NEW JERSEY TURNPIKE AUTHORITY

GARDEN STATE PARKWAY

NEW JERSEY TURNPIKE

Seventh Edition

2016

STANDARD SPECIFICATIONS

NEW JERSEY TURNPIKE AUTHORITY

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STANDARD SPECIFICATIONS

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First Printing

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SECTION 101 - GENERAL INFORMATION

101.01 Headings.

The headings of the Divisions, Sections and Subsections herein are intended for convenience of reference only and shall not be considered as having bearing on their interpretation. The sections are numbered, and the numbers are in two parts. The first part denotes the division and the section in which the provision or specification is found and the second part of the number is the Subsection. The Subsections may be further divided into paragraphs, subparagraphs and parts, i.e.:

DIVISION	100
Section	101
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Subpart	(i)

101.02 Definitions.

Pronouns and working titles having a masculine gender, such as "he", "him", "his", "flagmen", "materialmen", "watchman", and the like, are utilized in the specifications for the sake of brevity and are intended to refer to persons of either gender or to corporate or other legal entities, as appropriate. Whenever in the Specifications or other Contract Documents, the following abbreviations and terms, or pronouns in place of them are used, their intent and meaning shall be interpreted as follows:

(A) ABBREVIATIONS.

AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGC	Associated General Contractors of America
AIA	American Institute of Architects
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ANLA	American Nursery and Landscape Association
ANSI	American National Standards Institute
API	American Pipe Institute
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
BOCA	Building Officials and Code Administrators
CRSI	Concrete Reinforcing Steel Institute
EEI	Edison Electrical Institute
EPA	Environmental Protection Agency of the United States Government
FAA	Federal Aviation Agency
FHWA	Federal Highway Administration
FSS	Federal Specifications and Standards, General Services
HMA	Hot Mix Asphalt

IBC	Industrialized Building Commission
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronic Engineers
IMSA	International Municipal Signal Association
IPCEA	Insulated Power Cable Engineers Associations
ISA	International Society of Arboriculture
ITE	Institute of Transportation Engineers
MARTCP	Mid-Atlantic Region Technician Certification Program
MUTCD	Manual on Uniform Traffic Control Devices
NCHRP	National Cooperative Highway Research Program
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NJSA	New Jersey Statutes Annotated
NJSAT	New Jersey Society of Asphalt Technologists
NJSHPO	New Jersey State Historic Preservation Officer
NJSP	New Jersey State Police
NPCA	National Precast Concrete Association
NRCA	National Roofing Contractors Association
OSHA	Occupational Safety and Health Administration
PCI	Prestressed Concrete Institute
SAE	Society of Automotive Engineers
SPN	Standard Plant Names adopted by the American Joint Commission on Horticulture Nomenclature
SSPC	Steel Structures Painting Council
UCC	Uniform Construction Code
UL	Underwriters' Laboratories
USCG	United States Coast Guard

The publications, specifications, test methods and standards of the above organizations to which referral or of which mention is made, shall be the edition of such publication and any interim modifications in effect on the date Contract Documents are made available, unless otherwise noted.

(B) TERMS.

Acceptance	Formal written acknowledgment by the Authority that all Work, or a specific portion thereof, under the Contract has been satisfactorily completed.
Acceptance Testing	Testing conducted by the Engineer to measure the degree of compliance to the Contract Documents.
Addenda	Written interpretations or revisions of any of the Contract Documents transmitted to bidders via the Authority's Electronic Bidding website in advance of the opening of bids and in the manner required by law.

Advertisement For Proposals	The public announcement, as required by law, inviting bids for Work to be performed or materials to be furnished. Such announcement will indicate the location of the Project, character and estimated quantity of materials required, prequalification requirements, time of the opening of Proposals, and other relevant information to prospective bidders.
Authority	The New Jersey Turnpike Authority.
Authority Laboratory	The testing laboratory (or laboratories) or testing engineers that may be designated by the New Jersey Turnpike Authority.
Award	The decision of the Authority to accept the Proposal of the lowest responsible Bidder, subject to the Governor's veto period, and the execution and approval of a Contract, and receipt by the Authority of the Contract Bond, in accordance with the Specifications, and as may be required by law.
Bidder	An individual, firm, partnership, corporation, or joint venture, acting directly or through a duly authorized representative, submitting a Proposal.
Business Day	A weekday between the hours of 9:00 A.M. and 5:00 P.M.
By Others	The term "by others" refers to a person, firm or corporation, other than the Contractor or its surety or persons, firms or corporations in a contractual relationship with the Contractor or the surety, such as a subcontractor, supplier, fabricator or consultant at any tier. "By others" shall include the Authority or other public body.
Calendar Day Or Day	Every day shown on the calendar.
Change Order	A written order to the Contractor, signed by the Chief Engineer, ordering a change in the work from that shown by the original Plans and Specifications.
Chief Engineer	The Chief Engineer of the New Jersey Turnpike Authority.
Commissioners	The Commissioners of the New Jersey Turnpike Authority acting as a body, directly or through their duly authorized representatives; such representatives acting within the scope of the particular duties delegated to them.
Completion Date	The date upon which all of the following shall occur: (1) the Work has been satisfactorily completed in all respects in accordance with the Contract Documents; (2) the Project is ready for use by the Authority to the degree required by the terms of the Contract; (3) the Contractor has satisfactorily executed and delivered to the Chief Engineer all documents, certificates, and proofs of compliance required by the Contract Documents, it being understood that the satisfactory execution and delivery of said documents, certificates, and proofs of compliance is a requirement of the Contract.
Conditional Award	Award of the Contract subject to Veto of the Governor as required by law.
Construction Operations	Construction operations shall include site clearing, demolition, movement of utilities or other facilities and actual construction of any of the temporary or permanent structures, roadways or public improvements required by the Contract. The term shall not include mobilization, procurement and storage of materials and plant, providing engineering, Performance Bond and Payment Bond, surveys, working drawings, field offices, or other schedules, certificates, forms, or documents necessary prior to the performance of Work on Pay Items.
Construction Manual	A document with instructions for construction supervision staff in the performance of their duties associated with the administration and inspection of a Contract.

Contract	The Agreement between the Authority and the Contractor for the performance of a specific project, in accordance with the requirements and provisions of the Contract Documents, which include, without limitation, the Proposal, Proposal Guaranty, Contract Agreement, Contract Bond, Standard Specifications, Supplementary Specifications, Traffic Permit, Power of Execution, Plans, Addenda (if any) and Change Orders (if any), all of which are to be treated as one instrument, as if set forth at length in the Contract.
Contract Bond	The approved form of security furnished by the Contractor guaranteeing the faithful performance of the Contract by the Contractor
Contract Documents	The term "Contract Documents" includes, without limitation,: Advertisement for Proposal, Proposal Guaranty, Contract Agreement, Contract Bond, Power of Execution, Standard Specifications, Supplementary Specifications, Plans, Addenda, or other information mailed or otherwise transmitted to the prospective bidders prior to the receipt of bids, Change Orders, Field Orders, and Supplementary Agreements, all of which are to be treated as one instrument whether or not set forth at length in the written Contract Agreement.
Contract Price	The amount of the successful bidder's Proposal, accepted by the Authority at the time of the award.
Contractor	Party to the Contract who is solely liable for the acceptable performance of the Project and for the payment of all debts pertaining to the Project, except those specifically assumed by others.
Current Controlling Operation Or Operations	Any feature of the Work, which, if delayed at the time in question, will delay the overall time of completion of the Contract.
Days	Calendar days, unless otherwise designated.
Electronic Bidding	The means of producing a Proposal using the Authority's approved software that has been downloaded from the Authority's website.
Engineer	The Chief Engineer of the Authority, or his duly authorized representative acting within the scope of the particular authority vested in him.
Engineer of Record	The Professional Engineer licensed in NJ, responsible for the preparation of the Contract Documents.
Equipment	All machinery, equipment, tools and apparatus, together with the necessary supplies for upkeep and maintenance, necessary for the proper construction and acceptable completion of the Work.
Field Order	A written order, signed by the Resident Engineer, requiring specified performance by the Contractor. Such written order shall be in the sole judgment of the Resident Engineer, and is not subject to negotiation.
Highway, Street Or Road	A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.
Holidays	The following days shall be considered Holidays: ▪ New Year's Day ▪ Martin Luther King's Birthday - Observed ▪ Presidents' Day ▪ Good Friday ▪ Memorial Day - Observed ▪ Independence Day ▪ Labor Day ▪ Columbus Day - Observed ▪ Election Day ▪ Veterans Day ▪ Thanksgiving Day ▪ Day after Thanksgiving Day ▪ Christmas Day

Inspector	Authorized representative of the Engineer assigned to inspection of work and materials.
Invitation For Bids	The Advertisement for Proposals for all work or materials on which bids are required.
Laboratory	A firm or individual designated by the Chief Engineer for the inspection and testing of the materials to be used or integrated into the Project.
Lane	Area of roadway utilized for either permanent or temporary single line of vehicular traffic.
Letter Of Authorization	A letter issued by the Authority to prospective bidders, containing instructions for access to, and inspection of, work sites.
Letter Of Surety	The Proposal Guaranty submitted by the Bidder on the Authority issued form.
Lump Sum	When used for a Scheduled Item of Work, means complete payment for that Scheduled Item of Work described in the Contract.
Major Item	Any Scheduled item of Work whose price, based on the Proposal quantity multiplied by the Contract unit price bid, amounts to more than 15 per cent of the Total Price bid for the Contract.
Manufacturer	Any corporation, partnership, firm or individual who manufactures goods, materials, or equipment.
Materials	All raw or prepared materials and manufactured or fabricated products utilized in the Project.
Median	That portion of a divided highway separating the paved sections, said paved sections including both the shoulders and the traveled way.
NJDOT	The New Jersey Department of Transportation of the State of New Jersey, as created by law.
Notice Of Award	The written notice from the Authority to a successful Bidder advising of the Award of the Contract. The date of the Notice of Award is the beginning of the Contract Time.
Notice To Proceed	Written notice to the Contractor advising the Contractor to begin work on the Project.
Parkway	The facilities known as Garden State Parkway owned and operated by the Authority.
Pay Item	A specifically described item of Work for which the Bidder provides a per unit or lump sum price in the Proposal.
Plans	The standard drawings, the official approved drawings specially prepared for the Project, profiles, cross-sections, and any supplemental drawings, or exact reproductions thereof, and that are current on the date the bids are received, and were furnished by the Authority, that indicate the location, character, dimensions, and details of the Work to be done.
Preconstruction Conference	The initial project meeting conducted by the Engineer, and attended by the Contractor. A separate utility preconstruction conference may be scheduled.
Project	The entire Work to be performed under the Contract, including the furnishing and doing of all things necessary or proper therefor or incidental thereto for completion of the Work.
Proposal	The Authority issued Electronic Bidding form which has been completed, executed, and submitted by the Bidder as a bid for the performance of the Project.

Proposal Bond	The Proposal Guaranty submitted by the Bidder on the Authority issued form.
Proposal Guaranty	Security in the form of a Proposal Bond or Letter of Surety, accompanying a Proposal, guaranteeing that Bidder will execute the Contract and furnish the required Contract Bond, if Bidder's Proposal is accepted.
Resident Engineer	The field representative of the Engineer, having direct supervision of the administration of the Contract.
Qualified Products List ("QPL")	A list of products prequalified as meeting the Contract requirements for specified materials to be incorporated into the Work. The list is maintained and updated periodically and is available on the Authority's official website.
Scheduled Item Of Work	A specifically described unit of work for which a price is provided in the Contract.
Shall	Designates an obligation of the Contractor, unless otherwise indicated.
Shop (Working) Drawings	Stress sheets, working drawings, diagrams, illustrations, schedules, performance charts, brochures, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, reproductions of manufacturer's pre-printed information (catalog cuts), and any other supplementary plans or similar data that are prepared by the Contractor or any subcontractor, manufacturer, supplier or distributor, and that the Contractor is required to submit to the Engineer for approval.
Specialty Items	Such items that require highly specialized knowledge, craftsmanship or equipment not normally available among contractors qualified to bid on the Contract as a whole, and which are designated as "specialty items" in the Contract Documents.
Specifications	The Standard Specifications, the Supplementary Specifications and Addenda, if issued, pertaining to the method or manner of performing the Project and to the qualities of the materials to be furnished for the Project.
Specified Completion Date	The date on which the Contract Work is specified to be completed.
Standard Specifications	The Seventh edition, dated 2016, of the Standard Specifications of the New Jersey Turnpike Authority.
State	The State of New Jersey.
Subcontractor	Any corporation, partnership, firm or individual who contracts with the Contractor to perform work at or about the construction site, for or on behalf of the Contractor.
Substantial Completion	The point in time that the Chief Engineer determines the performance of the Work or portion thereof under the Contract is 98% complete, except final clean-up and repair of Work performed not acceptable to the Engineer, has been completed; provided however, that the Chief Engineer has determined, in his sole discretion, that (1) the project is safe and convenient for use by the public and Authority employees and visitors; and (2) failure to complete the Work and repairs excepted above will not result in deterioration of the other completed Work.
Superintendent	The Contractor's authorized representative in charge of the Work, who shall be authorized to receive all communications from the Authority.
Supplementary Agreement	A bilateral agreement between the Chief Engineer and the Contractor.
Supplementary Specifications	Additions to or amendments of the Standard Specifications pertaining to the Project.

Supplier	Any corporation, partnership, firm or individual who contracts with the Contractor to supply or sell goods, materials, or equipment for the Project for or on behalf of the Contractor.
Surety	A company licensed to do business in the State of New Jersey, and authorized to issues bonds in accordance with N.J.S.A. 2A:44-143..
Testing Agency	A privately owned facility capable of testing and evaluating component parts, or the whole, for certification of the composition or construction of the material or product.
Total Contract Price	The total contract price as adjusted through the issuance of Change Orders and Field Orders and the calculation of as-built quantities.
Total Price	The sum of the individual amounts for all Scheduled Items of Work listed in the Bidder's Proposal.
Traffic Manual	The Authority's "Manual for Traffic Control in Work Zones", a contract document available on the Authority's website.
Traffic Permit	An approved form, also referred to as a construction permit, issued to the Contractor by the Operations Department of the Authority through the Engineer. No operations will be performed by the Contractor, which requires occupation of or entry upon any Authority roadway or facility, until a Traffic Permit has been issued. The Permit does not alter the provisions of the Contract as may be amended by Change Order. The Traffic Permit is considered a part of the Contract Documents, and it shall be adhered to in all circumstances. In addition, if the completion date is extended, the Contractor shall submit a request for an extension of the Traffic Permit.
Turnpike	The facilities known as New Jersey Turnpike owned and operated by the Authority.
Uniform Construction Code	The State of New Jersey laws and regulations governing the construction of buildings and other specific facilities. This Code is administered by the Department of Community Affairs.
USD	When used for a Scheduled Item of Work, means a unit of measure in United States dollars.
Utility	A public, privately or cooperatively owned authority, agency or agencies operated by one or more persons or corporations for public service. For purposes of this Contract, railroads shall be considered utilities as well as all Authority owned services. Utilities include, but are not limited to, electric, telephone, communications, traffic surveillance, sewer, water, gas and similar services.
Vendor	A general term used for either Contractor, Subcontractor, Supplier, or Manufacturer.
Wage Act	The New Jersey Prevailing Wage Act, N.J.S.A. 34:11-56.25 et seq. as amended and supplemented.
Weekday	A calendar day exclusive of Saturdays, Sundays, Authority recognized holidays and other holidays as declared by the Authority.
Weekend	Saturdays and Sundays, exclusive of the Authority recognized holidays, and other holidays, as declared by the Authority
Will	Designates an action to be taken by the Authority, the Engineer or any authorized representative, unless otherwise indicated.

Words Of Like Import	When referring to the Project or its performance, "directed," "required," "permitted," "ordered," "designated," "prescribed," and words of like import, shall imply the direction, requirement, permission, order, designation or prescription of the Engineer; and "approved," "acceptable," "satisfactory," and words of like import, shall mean approved by or acceptable or satisfactory to the Engineer; and "necessary," "reasonable," "proper," "correct," or words of like import, shall mean necessary, reasonable, proper or correct in the judgment of the Engineer.
Work	The term "Work" means the furnishing of all labor, services, materials, equipment, tools, transportation, supplies, and other incidentals necessary or convenient for the successful completion by the Contractor of the construction described in the Contract Documents, and the carrying out of all duties and obligation imposed by the Contract Documents on the Contractor.
Working Day	Any calendar day, exclusive of: 1) Saturdays, Sundays and holidays, 2) days on which the Contractor is specifically required by the Supplementary Specifications to suspend construction operations, and 3) days on which the Contractor is prevented by inclement weather or conditions resulting immediately therefrom adverse to the current controlling operation or operations, as determined by the Engineer, from proceeding with at least 75 percent of the normal labor and equipment force engaged on such operation or operations for at least 60 percent of the total daily time being currently spent on the controlling operation or operations. Should the Contractor prepare to begin work at the regular starting time in the morning of any day on which inclement weather, or the conditions resulting from the weather, prevent the work from beginning at the usual starting time, and the crew is dismissed as a result thereof, and the Contractor does not proceed with at least 75 percent of the normal labor and equipment force engaged in the current controlling operation or operations for at least 60 percent of the total daily time being currently spent on the controlling operation or operations, the Contractor will not be charged for a working day whether or not conditions should change thereafter during said day and the major portion of the day could be considered to be suitable for such construction operations.

SECTION 102 - BIDDING REQUIREMENTS AND CONDITIONS

102.01 Prequalification of Prospective Bidders.

Proposals for Work in excess of $50,000 will be received only from Bidders that have been prequalified (prior to bidding) in accordance with the "Procedure for Prequalification and Award on New Jersey Turnpike Authority Construction Contracts." In order to "prequalify", Bidders must submit the "Contractor's Qualifying Statement" form furnished by the Authority. Bidders must have effective classification ratings, issued by the Authority, in an amount not less than the amount of their respective bids. The Authority reserves the right to accept bids that are not more than 10% in excess of the Bidder's maximum classification rating.

At the time of submission of a Proposal, Bidders must submit an executed "Prequalification Recapitulation" on the form furnished by the Authority, notifying the Authority of any change which has occurred in the Bidder's financial condition, status of contracts on hand and moral integrity since the submission of the Contractor's Qualifying Statement.

The Authority reserves the right, at any time, to require a Bidder to submit such additional evidence of its qualifications as the Authority may deem necessary. The Authority may consider, in its evaluation, any evidence available to the Authority of the Bidder's financial and technical abilities, and any other qualifications and abilities of a Bidder. Determinations as to the Bidder's prequalification are reserved to the sole discretion of the Authority. Contracts will be awarded to a Bidder who, in the Authority's sole determination, is fully qualified to undertake the Project.

The Authority reserves the right to waive any or all irregularities and technicalities in the submission of prequalification documents, in accordance with law.

102.02 Disqualification of Bidders.

The Authority reserves the right to (i) disqualify a prequalified prospective Bidder; (ii) refuse to receive a Proposal from a prequalified prospective Bidder; or (iii) reject a Proposal received from a prequalified prospective Bidder for any lawful reason, including but not limited to:

(A) Submittal of more than one Proposal for the same Work from an individual, firm, partnership, association or corporation under the same or different name;

(B) Evidence of collusion among Bidders. Warning: participation in collusion will result in Bidder(s) failing to receive recognition as a qualified Bidder for future Work of the Authority until such time as the participant has been reinstated as a qualified Bidder;

(C) Lack of competency or lack of adequate machinery, plant or other equipment;

(D) Uncompleted existing work which, in the judgment of the Authority, might hinder or prevent the prompt completion of additional work, if Awarded;

(E) Failure to pay, or satisfactorily settle, all bills due for material furnished, for labor supplied or performed, for rental of equipment used, and for services rendered by public utilities on a contract in force at the time of issuance of proposals;

(F) Failure to comply with any Authority prequalification regulations;

(G) Failure to cure under notice of default or declaration of default under a previous contract;

(H) Contractor currently debarred by any Federal, State or Local entity;

(I) Material or intentional failure to comply with any material term or condition of the contract, drawings or specifications on a previous contract;

(J) Unsatisfactory performance on previous or current contracts;

(K) Lack of moral integrity as determined by the Attorney General of New Jersey or any federal or state authority;

(L) Failure to reimburse the Authority for monies owed on any previously Awarded contracts, including those where the prospective Bidder is a party to a joint venture and the joint venture has failed to reimburse the Authority for monies owed.

(M) Default under any previous or current contract with the Authority, New Jersey Department of Transportation or with any other public agency, body or authority.

102.03 Proposals.

The Bidder shall submit a Proposal via Electronic Bidding.

Electronic Bidding information is available on the Authority's Electronic Bidding website. Registration and a subscription fee are required to access the Proposal documents. The Bidder shall download the bidding software. When installing the bid program, the Bidder enters its Bidder ID assigned by the Authority. The Bidder shall not alter or in any way change the software.

The Bidder shall download all Proposal documents, including any and all Addenda, from the Authority's Electronic Bidding website. The Authority assumes no responsibility for errors or omissions in the downloaded Proposal documents. The Bidder shall direct questions or problems with downloading or using the electronic files to the contacts identified on the website.

The Bidder shall specify a price in figures for each Pay Item. For lump sum items, the price shall appear solely in the box provided for the lump sum item under the column designated as "Amounts." For unit price items, the per unit price shall appear under the column designated "Unit Price" in the appropriate box, and the product of the respective unit price and the approximate quantity for that item shall appear under the column designated "Amounts." The Total Contract Price is the sum of all figures of the Scheduled Items of Work shown in the column designated "Amounts" and shall appear at the location provided therefor. Determination of the low bidder, for purposes of price comparison will be made on the basis of the correct total price.

The only entries permitted in the Proposal will be the unit or lump sum prices for items that must be bid. The Electronic Bidding software will perform all extensions of the unit or lump sum prices, and calculate the total bid amounts.

The Bidder shall check its bid prior to submission using the Electronic Bidding software. The Bidder shall select "Tools" and then select "Check Bid" and assure there are no errors prior to submitting the electronic bid. The Authority shall not be liable for any failure on its part to detect correct errors and no right shall inure to any Bidder as a result of any action taken be the Authority connection.

When the Proposal contains alternate items, the Bidder shall only provide the unit price and amount for the lowest priced alternate item. When alternate items in the Proposal have a lump sum pay quantity, the Bidder shall only provide the amount for the lowest priced alternate item. The alternate item for which a price has been provided shall be constructed by the Bidder. When the Proposal contains alternate groups of items, the Bidder shall only provide the unit price and amount for each item within the lowest priced alternate group. The alternate group of items for which a price has been provided shall be constructed by the Bidder. Proposals that have not been prepared as described herein shall be rejected.

The Bidder's Certification form of the proposal shall indicate the authorized representative of the firm who is submitting the proposal. Authorization is given through the Authority.

All Bidders, who are not residents of New Jersey, shall designate a proper agent in the State of New Jersey on whom service of process can be made in the event of litigation, which designation shall be shown by a statement accompanying the Proposal duly executed by the Bidder, or submitted prior to Award.

102.04 Familiarity with Work.

Bidders are encouraged to ascertain the conditions to be encountered at the location of the Project, including, but not limited to, means of access, and all physical characteristics above, on and below the surface of the ground.

Bidder is obligated to fully examine and become familiar with the Plans, Specifications, and other Contract Documents. The Bidder shall consider fully these and all other matters which can in any way affect the work under this Contract, make the necessary investigations relating thereto, to properly understand the nature and extent of the work involved. Plans, specifications and related information on previous construction performed by the Authority are available for inspection at the Authority's office. The Authority assumes no responsibility whatsoever with respect to ascertaining for the Bidder such facts.

All prospective Bidders desiring to inspect the construction site(s) must make specific arrangements, prior to such inspections. Contact information and instructions are available in the "Letter of Authorization" issued with the Contract Documents. The Letter of Authorization must be in the possession of the Bidders at all times during the inspection.

Bidders shall investigate and ascertain for themselves, during the bidding period, all specific requirements pertaining to railroad companies and utility companies affected by the Work other than that provided by the Authority such as verification of times and schedules for track occupancy. These requirements include, but are not limited to, de-energization of power lines, flagging, shop drawing submittals, re-submittals and review, escrows, permits, etc. Any costs incurred for compliance with such requirements shall be borne by the Contractor unless specifically provided for in the Contract Documents.

Bidders shall investigate subsurface conditions prior to submitting a Proposal. Borings, test excavations and other subsurface investigations, if any, made by the Engineer prior to the construction of the Project, the records of which may be available to Bidders, are not a part of the Contract, but are made available solely for use as a guide for design, and are not warranted to show the actual subsurface conditions. If in carrying out the Project, the Contractor finds that the actual conditions encountered do not conform to those indicated by said borings, test excavations and other subsurface investigations, Contractor agrees to immediately report findings to the Engineer. This information, while considered by the Authority to be sufficient for design purposes in both scope and content, is not necessarily sufficient for construction purposes and, accordingly, may require further investigation by the Bidder and Contractor.

Any estimate or estimates of quantities shown on the Plans or in the Proposal, based on said borings, test excavations and other subsurface investigations or otherwise, are in no way warranted to indicate the true quantities or distribution of quantities.

Bidders shall secure all necessary labor and equipment for completion of the Project. Bidders shall insure that the materials and equipment proposed will comply with the requirements as set forth in the Contract

Documents, and can be obtained by the Bidder in the quantities necessary, and at the time required. Bidders shall secure the required insurance with special endorsements, and the Contract Bond, and shall comply with all other requirements of the Contract.

The Contractor agrees that he will make no claim for, and has no right to, additional payment or extension of time for completion of the Work or any other concession including, but not limited to, (i) any misinterpretation or misunderstanding on its part of this Contract; (ii) any failure on Bidder's part to become fully acquainted with all conditions relating to the Work; (iii) if the actual conditions encountered do not conform to those indicated by borings, test excavations and other subsurface investigation; or (iv) if the actual quantity or quantities do not conform to the estimated quantity or quantities. The Contractor shall make no claims for additional compensation as a result of delays or necessary alterations in the procedure of the Work that may be caused by delays in the acquisition of right-of-way except as specified in Subsection 107.06.

The Authority may require all Bidders to attend a field demonstration or inspection prior to receipt of Proposals. The details of a field demonstration or inspection, if required, shall be set forth in the Advertisement for Proposal.

Plans shall indicate the locations of the various items of Work and, in general, show the extent of the modifications or removals necessary at these locations, provided however, the extent of the modifications or removals may vary from that shown, in which case, the actual limits of the Work will be determined by the Engineer as work progresses.

102.05 Examination of Contract Documents.

Prospective bidders must examine the Contract Documents carefully before bidding and must request, electronically, for any interpretation or correction of any apparent ambiguity, inconsistency or error therein. Instructions on submitting an electronic request for interpretation or correction may be found on the Authority's Electronic Bidding website. If necessary, an interpretation or correction shall be issued by the Chief Engineer as an Addendum. Such Addendum shall become a part of the Contract Documents. Requests for interpretations and/or corrections shall be considered only if received at least five (5) business days prior to the established submission deadline for Proposals.

Only written interpretations or corrections issued by the Chief Engineer, by Addendum, shall be binding.

The submission of a bid is conclusive evidence that the Bidder is fully aware of the conditions to be encountered in performing the Work and is fully aware of the requirements of the Contract Documents. If the Bidder, prior to the submission of his bid, fails to notify the Chief Engineer of the existence of an ambiguity, inconsistency or error in the Contract Documents, a bid will conclusively be presumed to have been based upon the interpretation of such ambiguity or inconsistency.

The Contractor shall not take advantage of an apparent error or omission in the Contract Documents. In the event the Contractor discovers any discrepancy, error, or omission in the Plans, Specifications, or other Contract Documents, or if there is any doubt or question as to the intent or meaning of the Plans, Specifications, or other Contract Documents, the Contractor shall immediately notify the Engineer in writing. The Engineer will promptly make, in writing, such corrections and interpretations as deemed necessary.

102.06 Approximate Quantities.

Quantities of Scheduled Items of Work, involved in the performance of a Project, and stated in the Proposal, are estimates only. The actual quantities may be greater or less, or items may be eliminated entirely. Payment will be made only for the actual quantity of authorized work performed under each Scheduled Item of Work.

The Proposal Form may request bids on one or more Pay Items to be incorporated into the Project "if and where directed" by the Engineer. Such items may not be located on the Plans. The estimated quantities set out in the Proposal for such items are presented solely for the purpose of obtaining a representative bid price, but are not intended to indicate the Authority's anticipation as to the quantities of such items, which will actually be incorporated into the Project. Depending on field conditions, such "if and where directed" items may or may not be incorporated into the Project and if incorporated, may be many times the estimated quantity or only a fraction thereof.

Incorporation of such items shall only be made upon written direction of the Engineer. In the absence of written directions, no such items shall be incorporated into the Project and if incorporated shall not be paid for. The Engineer may order incorporation of such items at any location within the Project, and at any time during the Contract Time except as provided in Subsection 104.04. Claims for additional compensation shall not be

made because of any increase, decrease or elimination of such items, nor because of an increase or decrease in the amount of Work due to the field conditions encountered in incorporating such items into the Project.

102.07 Proposal Guaranty.

Proposals shall be accompanied by a Proposal Guaranty which shall consist, at the Bidder's option, of a Proposal Bond or Letter of Surety utilizing the forms provided in the Authority's Electronic Bidding software.

The Proposal Bond shall be in the sum of not less than ten percent (10%) of the total price of the Proposal. Alternatively, the Letter of Surety shall provide the Authority with liquidated damages in an amount by which the Contract covering the Proposal, properly and lawfully executed by the Authority, exceeds the total price bid by the successful Bidder, if the successful Bidder should fail or refuse to execute the Contract within the stipulated time.

102.08 Power of Attorney and Consent of Surety.

The Proposal Bond or Letter of Surety shall be accompanied by a Power of Attorney and a Consent of Surety, each in a form acceptable to the Authority, which shall be executed by the surety company. The Power of Attorney shall set forth the authority of the attorney-in-fact who has signed the Proposal Bond or Letter of Surety on behalf of the surety company and shall further certify that such power is in full force and effect as of the date of the Proposal Bond or Letter of Surety. The Consent of Surety shall set forth the surety company's obligation to provide the Contract Bond upon award of the Contract to the Bidder.

102.09 Submitting Proposals.

The Bidder shall submit a Proposal via Electronic Bidding. An authorized representative of the Bidder is required to digitally sign the Proposal. The Authority may reject Proposals that are not digitally signed by the authorized representative of the Bidder with an approved digital signature. More information on digital signatures are found on the Authority's Electronic Bidding website.

The Bidder is solely responsible for any and all errors and for timely submission of the bid, all components thereof, and all attachments thereto, through the Electronic Bidding system; the Authority assumes no responsibility for any claim arising from the failure of any Bidder or of the electronic delivery system to cause any bid, bid component, or attachment to not be delivered to the Authority on or before the time set for the opening of bids.

The following documents shall be submitted with the Proposal:

(A) Scheduled Items of Work and associated bid prices.

(B) Bidder's Certification indicating the authorized representative of the firm who is submitting the Proposal.

(C) Acknowledgment of compliance of the Contractor's Business Registration as required pursuant to N.J.S.A. 52:32-44.

(D) Acknowledgment of compliance of the Public Works Certification as required pursuant to P.L.1999, C.238, N.J.S.A. 34:11-56:50.

(E) Disclosure Statement indicating firm ownership in compliance with N.J.S.A. 52:25-24.2.

(F) Non-Collusion Certification.

(G) Disclosure of Investment Activities in Iran form provided by the Authority, pursuant to N.J.S.A. 52:32-58.

(H) Prequalification Certification.

(I) The Proposal Guaranty, Consent of Surety, and Power of Attorney.

(J) Acknowledgment of Addenda, if issued.

(K) Filed copy of Public Records Filing for New Business Entity evidencing filing with the New Jersey Department of Treasury, Division of Revenue (if prequalification not required).

When the Proposal forms provide for the performance of the Work under two or more Contracts, or under one combined Contract for the entire Work, a Bidder may, unless otherwise stipulated in the Supplementary Specifications, submit Proposals for any of the Contracts for which Proposals are solicited, provided however, any Bidder submitting a Proposal for the combined Contract must also submit Proposals for each portion of the Work.

102.10 Withdrawing Proposal.

Bidders may withdraw bids, or withdraw and resubmit bids, via the Authority's Electronic Bidding software.

Any Bidder attempting to withdraw a Proposal after the opening of bids, for any reason, including an alleged unilateral mistake by the Bidder, shall be liable to the Authority for costs incurred there from, including costs incurred in re-advertising for Proposals, printing costs, staff time, consultants' time, costs incurred by the Authority in conducting a hearing on the application of the Bidder to withdraw the Proposal, costs of transcripts, and attorney's costs and fees. Additionally, such Bidder may be subject to disqualification from submitting bids on Projects for a period of six (6) months.

102.11 Causes for Rejection.

Proposals from Bidders not qualified to bid according to the provisions of Subsection 102.01 will be rejected.

Proposals may be rejected for any reason, including, but not limited to, (a) if conditions, restrictions or limitations are attached to a Proposal, (b) if the Proposal fails to conform to the essential requirements of the Contract Documents, (c) if the bid amount is in excess of Bidder's prequalification classification, (d) if the Proposal Guaranty is not verified on the internet by one of the Surety Registry Agencies listed in the Authority's Electronic Bidding software, (e) if the unit prices are unbalanced, (f) if competition has been suppressed, (g) if received from Bidders who have previously performed work for the State of New Jersey or the Authority in an unsatisfactory manner, (h) for nonconformance with "The New Jersey Prevailing Wage Act," N.J.S.A. 34:11-56.25 et seq. as amended and supplemented, (i) if more than one bid is submitted by the Bidder for the same contract, (j) if the bid is not submitted on the Authority's issued Proposal form , (k) for nonconformance with New Jersey Public Works affirmative action requirements, N.J.S.A. 10:5-31 et seq. as amended and supplemented, (l) for nonconformance with New Jersey ownership disclosure requirements, N.J.S.A. 52:25-24.2 as amended and supplemented, (m) if it is deemed advisable to do so in the best interests of the Authority, (n) if the Bidder is disqualified pursuant to Subsection 102.02, (o) failure to submit the complete form entitled "Disclosure of Investment Activities in Iran" pursuant to N.J.S.A. 52:32-55, (p) if the Proposal is unreasonable as to price, both as to Total Price and prices for individual line items as well, (q) for any reason set forth in 102.02, or (r) for any other reason allowed by law.

The Authority reserves the right to waive any or all irregularities and technicalities in the submission of bidding documents, in accordance with law.

The Authority reserves the right to reject all bids when it is deemed to be in the best interest of the Authority.

102.12 Return of Proposal Guaranty.

Proposal Guaranties of Bidders, whose bids are to be considered by the Authority, will be retained until such time as the Authority executes the Contract or when the matter has been disposed of by the Authority.

The Proposal Bond or Letter of Surety of Bidders, whose bids are not to be considered for Award by the Authority, will be void.

102.13 Prevailing Wage Rates.

Attention is directed to the Prevailing Wage Rate List and to the applicable provisions of "The New Jersey Prevailing Wage Act" N.J.S.A. 34:11-56.25 et seq., governing the prevailing rates of wages for workmen who are employed in this Project. All provisions of said Wage Act and Amendments thereto, shall be considered as part of this Contract and made a part hereof. The Contractor shall submit certified payrolls as proof of compliance.

The Bidder, by submitting the Proposal, represents to the Authority that he is aware of the provision of said Wage Act with relation to prevailing rates of wages for workmen to be employed on this Project.

The Bidder further represents that in the event of any re-determination of such prevailing rates at any time before the execution and delivery of the Contract between the Bidder and the Authority for the construction of the Project, or at any time thereafter, the new rates, if any, will become the applicable minimum rates for work performed thereafter under said Contract. No increase in the Contract Price shall be claimed by the Bidder and no such increase will be granted by the Authority as a result of such determination.

The applicable Prevailing Wage Rate List is available for examination at the office of the Chief Engineer.

Prospective Bidders are advised to contact the New Jersey Department of Labor and Industry with respect to questions relating to the Wage Rate Determinations.

State wage rates may be obtained from the New Jersey Department of Labor & Workforce Development (Telephone: 609-292-2259) or by accessing the Department of Labor & Workforce Development's website at:

http://lwd.dol.state.nj.us/labor/wagehour/wagehour_index.html

Pursuant to N.J.S.A. 34:11-56.27, (1) workers employed in the performance to the contract shall be paid not less than the prevailing wage rate; and (2) in the event it is found that any worker is not paid the prevailing wage rate required by the contract, the Authority may terminate the contractor's right to proceed with the work or such part of the work as to which there has been a failure to pay required wages and to prosecute the work to completion or otherwise.

102.14 Use of Authority Roadways and Facilities.

All prospective Bidders inspecting the construction sites must have in their possession a Letter of Authorization from the Authority. The letter will be issued with the Contract Documents, if inspection is applicable.

102.15 Public Works Contractor Registration Act.

Contractors shall comply with P.L. 1999, c.238, the Public Works Contractor Registration Act, as amended by P.L. 2003, c.91 (N.J.S.A. 34:11-56.48 et seq.), and shall have been issued a certificate of registration, by the New Jersey Department of Labor, Division of Wage and Hour Compliance indicating compliance with the Act's requirements. No contractor or subcontractor, including lower tier subcontractors, shall engage in the performance of any public work subject to the Contract, unless they are registered pursuant to this Act. The Authority requests that Bidders submit a copy of their certificate of registration with the New Jersey Department of Labor and Workforce Development prior to bid. Instructions on submitting the certificate may be found on the Authority's Electronic Bidding website. Failure to submit a valid copy of the certificate(s) may result in the rejection of the Bidder's Proposal. Copies of the certificates of registration for subcontractors not listed in the Proposal shall be submitted in accordance with 103.04. The certificate(s), or certified facsimile(s) of the certificate, shall be maintained at the worksite and shall be made readily available for inspection.

102.16 Business Registration Act.

Contractors shall comply with P.L. 2004, c.57 (N.J.S.A. 52:32-44) (the "Business Registration Act"). The Business Registration Act requires that all New Jersey business organizations and foreign business organizations doing business in the State of New Jersey obtain a Business Registration Certificate (BRC) from the State of New Jersey Department of Treasury, Division of Revenue prior to conducting business in the State of New Jersey. "Business organization" means an individual, partnership, association, joint stock company, trust, corporation, or other legal business entity or successor thereof. This requirement, under the Business Registration Act, is an entirely separate requirement from the certificate of registration that public contractors are required to obtain from the Department of Labor and Workforce Development pursuant to the Public Works Contractor Registration Act, N.J.S.A. 34:11-56.48 et seq.

Proof of valid business registration with the State of New Jersey Department of Treasury, Division of Revenue shall be submitted by the successful Bidder in the form of a valid BRC in compliance with N.J.S.A. 52:32-44. No contract shall be awarded without proof of business registration with the Division of Revenue. Any questions with regard to obtaining a BRC can be directed to the Division of Revenue at (609) 292-1730. Alternatively, further information is available on the internet at:
http://www.state.nj.us/treasury/revenue/gettingregistered.shtml

No subcontract shall be entered into by the Contractor unless the Subcontractor first provides proof of valid business registration.

The Authority requests that all Bidders submit a copy of the Bidder's BRC prior to bid. Instructions on submitting the certificate may be found on the Authority's Electronic Bidding website.

The Contractor shall submit to the Authority a copy of the Contractor's list of Subcontractors and their addresses and any updates that take place during the performance of the Contract. The Contractor shall submit a complete and accurate list of Subcontractors to the Authority before final payment is made for goods provided or services rendered or for construction of a construction project under the Contract.

102.17 Public Law 2005, Chapter 51 and (Executive Order 134) & Executive Order 117 Award of Contract.

In order to safeguard the integrity of State government procurement by imposing restrictions to insulate the award of State contracts from political contributions that pose the risk of improper influence, purchase of access, or the appearance thereof, Executive Order 134 was signed on September 22, 2004 ("EO 134"). The Order is applicable to all State agencies, the principal departments of the executive branch, any division, board, bureau, office, commission within or created by a principal executive branch department, and any independent State authority, board, commission, instrumentality or agency. Executive Order 134 was superseded by Public Law 2005, c.51, signed into law on March 22, 2005. In September 2008, Executive Order 117 was signed and became effective November 15, 2008. It applies to the same government contracting entities subject to Executive Order 134, but extends the political contribution restrictions by expanding the definition of "business entity" to include, for example, more corporate shareholders and sole proprietors. Executive Orders 134 and 117, and Public Law 2005, c.51 contain restrictions and reporting requirements that will necessitate a thorough review of the provisions. Pursuant to the requirements of Public Law 2005, Chapter 51, ("EO 134") the terms and conditions set forth in this subsection and in Appendix B are material terms of any contract resulting from this bid solicitation.

The required certification forms shall be submitted by the intended awardee only who will be notified in writing and sent the required forms by the Authority.

The required certification forms must be submitted to the Authority within 48 hours of Notice by the Authority.

Please note that more than one Certification and Disclosure may be required from your firm

See Appendix B in the Supplementary Specifications for Compliance Requirements.

102.18 Disclosure of Investment Activities in Iran.

Pursuant to N.J.S.A. 52:32-58, the bidder must certify that neither the bidder, nor one of its parents, subsidiaries, and/or affiliates (as defined in N.J.S.A. 52:32-56(e)(3)), is listed on the Department of Treasury's List of Persons or Entities Engaging in Prohibited Investment Activities in Iran and that neither is involved in any of the investment activities set forth in N.J.S.A. 52:32-56(f). If the bidder is unable to so certify, the bidder shall provide a detailed and precise description of such activities to the Authority. Each Bidder shall certify under penalty of perjury, date and return to the Authority the completed form entitled "Disclosure of Investment Activities in Iran" as set forth in the Proposal. Failure to include the completed form, certified and dated, shall be grounds for rejection of Bidder's Proposal.

102.19 Ethics Standards (Executive Order 189).

In the public interest, the Authority may debar a vendor for violation of any of the following prohibitions on vendor activities or for breach of any of the following affirmative obligations:

- No vendor shall pay, offer to pay, or agree to pay, either directly or indirectly, any fee, commission, compensation, gift, gratuity, or other thing of value of any kind to any State officer or employee or special State officer or employee, as defined by N.J.S.A. 52:13D-13b. and e., to any officer or employee of the Authority or any other agency with which such vendor transacts or offers or proposes to transact business, or to any member of the immediate family, as defined by N.J.S.A. 52:13D-13i., of any such officer or employee, or any partnership, firm, or corporation with which they are employed or associated, or in which such officer or employee has an interest within the meaning of N.J.S.A. 52:13D-13g.
- The solicitation of any fee, commission, compensation, gift, gratuity or other thing of value by any State officer or employee, special State officer or employee or Authority officer or employee from any vendor shall be reported in writing forthwith by the vendor to the Attorney General and the State Ethics Commission.
- Unless a waiver has been granted in accordance with (D) below, no vendor may, directly or indirectly, undertake any private business, commercial or entrepreneurial relationship with, whether or not pursuant to employment, contract or other agreement, express or implied, or sell any interest in such vendor to, any State officer or employee, special State officer or employee or Authority officer or employee having any duties or responsibilities in connection with the purchase, acquisition or sale of any property or services by or to any State agency or any instrumentality thereof, or with any person,

firm or entity with which he is employed or associated or in which he has an interest within the meaning of N.J.S.A. 52:13D-13g.

- Any relationship subject to the provisions of (C) above shall be reported in writing forthwith to the State Ethics Commission, which may grant a waiver of this restriction upon application of the State officer or employee, special State officer or employee or Authority officer or employee upon a finding that the present or proposed relationship does not present the potential, actuality or appearance of a conflict of interest.
- No vendor shall influence, or attempt to influence or cause to be influenced, any State officer or employee, special State officer or employee or Authority officer or employee in his official capacity in any manner which might tend to impair the objectivity or independence of judgment of said officer or employee.
- No vendor shall cause or influence, or attempt to cause or influence, any State officer or employee, special State officer or employee or Authority officer or employee to use, or attempt to use, his official position to secure unwarranted privileges or advantages for the vendor or any other person.
- The provisions cited in (A) through (F) above shall not be construed to prohibit a State officer or employee, special State officer or employee or Authority officer or employee from receiving gifts from or contracting with vendors under the same terms and conditions as are offered or made available to members of the general public subject to any guidelines the State Ethics Commission may promulgate under (C) above.

SECTION 103 - AWARD AND EXECUTION OF CONTRACT

103.01 Award of Contract.

The Authority shall Award a Contract or reject all Proposals within sixty (60) days from the date of receipt of Proposals unless such timeframe is extended by mutual agreement of the Authority and the Bidder. Otherwise, bids are deemed to be rejected.

The Authority reserves the right, should the Authority determine it is in the Authority's best interest, to accept a Proposal, or combination of Proposals when the Work is to be performed by two or more Contractors. The Award shall not be binding upon the Authority until the Contract has been executed by the Authority's Executive Director.

Before an Award is made to a Bidder, who is not a resident of the State of New Jersey, such Bidder shall appoint a proper agent in the State of New Jersey on whom service can be made in event of litigation arising under the Contract, or as a result of performance of the Contract. Said appointment shall remain in effect during the performance of the Contract and for 6 years following Acceptance.

103.02 Execution of Contract.

The Bidder to whom the Contract has been Awarded shall, within ten (10) calendar days of receipt of the Contract:

- Execute and deliver to the Authority three copies of the Contract, with the appropriate signatures and seals affixed;
- Furnish and deliver three copies of the Contract Bond on the standard form of the Authority contained in the bid Documents. The Contract Bond shall be furnished by only those Sureties with an "A" or better rating, as published in the most recent edition of Best's Insurance Key Rating Guide and authorized to do business in the State of New Jersey. The Bond shall be in a sum of not less than the total amount bid for the Project and shall be maintained by the Contractor until the final payment is made. In the event of insolvency of the Surety, the Contractor shall forthwith furnish and maintain another surety satisfactory to the Authority.
- Furnish proof satisfactory to the Authority, of the authority of the person or persons executing the Contract and Contract Bond on behalf of the Contractor;
- Furnish and deliver the Power of Execution on the standard form of the Authority bound in the Contract;
- Furnish certificate(s) for the required insurance with endorsements as specified in Subsection 106.20. The insurance policies shall be in effect when submitted to the Authority;

- If the Award is to a Joint Venture, furnish and deliver the Certificate of Secretary on the standard form issued by the Authority;
- Furnish location of proposed borrow pits and/or quarries.

All of the above shall be furnished, executed and delivered before the Contract will be executed and dated by the Authority.

103.03 Failure to Execute Contract.

Failure, upon the part of the Bidder to whom the Contract has been Awarded, to comply with the provisions of Subsection 103.02 shall be just cause for annulment of the Award and for the exclusion of the Bidder from bidding on subsequent Authority projects for such period as the Authority may deem appropriate. Bidders improperly failing to execute Contracts shall also be liable for all damages incurred, including, but not limited to:

(A) Increased Contract Price incurred in Awarding the contract to another Contractor;

(B) Amounts resulting from any delay caused by said failure at the liquidated per diem rate for delay damage set forth in the Contract;

(C) Increased administrative and/or consultant costs incurred as a result of said failure.

It is understood and agreed by Bidders that, upon notice of said failure, the Surety shall pay the Authority the amount provided for in the Proposal Guaranty in accordance with the provisions of such Proposal Guaranty, and/or the Authority shall be entitled to collect on any Proposal Guaranties posted as security for execution of the Contract.

103.04 Subletting and Assigning Contract.

The Contractor shall perform, with his own organization and with the assistance of workmen on his payroll and under his immediate superintendence, Work amounting to not less than fifty (50) percent of the total amount of the Contract, exclusive of specialty items, except that, in the case of a Joint Venture, each party to the Joint Venture shall perform, with his own organization, Work amounting to not less than thirty (30) percent of the total amount of the Contract. Specialty items, if any, shall be as set forth in the Supplementary Specifications, or as directed by the Chief Engineer.

The Contractor shall, within thirty (30) days after Award of the Contract, notify the Engineer in writing on the standard form "Notification of Intent to Subcontract" furnished by the Authority, of the names of all Subcontractors intended for the Work. The notification shall include a complete description and total value of each portion of the Work to be sublet. The notification shall also include a copy of a valid certificate of registration for the “Public Works Contractor Registration Act” for each subcontractor, including lower tier contractors. Subcontractors not in possession of a valid copy of the certificate will be disapproved for Work. Subsequent notifications shall be promptly made by the Contractor during the performance of the Contract, advising the Engineer of any changes including additional subcontract work sublet by the Contractor.

The Contractor shall have a representative at the site whenever a subcontractor is performing Work on the contract. The Contractor’s designated representative shall be responsible for making all decisions and coordinating all subcontractor activities with the Engineer.

The Contractor shall, at all times and in all respects, be the party primarily responsible to the Authority for the performance of the Contract, and for all subcontractors and suppliers. The Contractor shall not sell, transfer, assign, or otherwise dispose of Contractor’s obligations to the Authority.

The receipt of notification of the subletting of any part of the Work, or obtaining supplies, shall not be construed to be an approval of the said subcontract, or supply contract or any of its terms. The Contractor shall not use a subcontractor or supplier without the express written approval of the Authority. The Authority reserves the right to reject the use of a subcontractor or supplier, at any time, for any reason, including but not limited to:

- Lack of competency, of adequate machinery, plant, or of other equipment;
- Uncompleted existing work which, in the judgment of the Authority, might hinder or prevent the prompt completion of additional work, if Awarded.
- Failure to pay, or satisfactorily settle, all bills due for material furnished, for labor supplied or performed, for rental of equipment used, and for services rendered by public utilities on a contract in force at the time of issuance of proposals;
- Failure to comply with any Authority prequalification regulations;

- Failure to cure a notice of default or declaration of default under a prior contract:
- Subcontractor or supplier is currently debarred by any Federal or State entity.
- Failure to comply with any material term or condition of the contract, drawings, or specifications on a prior contract;
- Unsatisfactory performance on prior or current contracts;
- Lack of moral integrity as determined by the Attorney General of New Jersey or any federal or state Authority;
- Failure to reimburse the Authority for monies owed on any previously Awarded contracts, including those where the subcontractor or supplier is a party to a joint venture and the joint venture has failed to reimburse the Authority for monies owed.

If a subcontractor or supplier is rejected by the Authority, the Contractor agrees that it shall notify any subcontractor of, and the subcontractor agrees to be bound by, the following:

The subcontractor shall make no claim whatsoever against the Authority, its officers, agents, or employees for any work performed or material supplied by reason of said subcontract or for any cause whatsoever that may arise by reason of the relationships arising from this subcontract. Should the subcontractor institute legal action against the Authority, the subcontractor shall be liable and responsible for attorney fees, expert expenses, and costs incurred by the Authority in said litigation.

SECTION 104 - CONTROL OF WORK

104.01 Intent of Contract.

Where the Contract Documents describe portions of the Work in general terms, but not in complete detail, it is understood that only the best general construction practice is to prevail and that only materials and workmanship of the first quality are to be used.

104.02 Authority of the Engineer.

The performance of the Work shall at all times and in all respects be subject to the inspection and approval of the Engineer. The Engineer shall give instructions necessary to attain strict and entire conformity with the Plans and Specifications. The Engineer shall have the right to correct apparent errors or omissions in the Plans and Specifications, and to make such interpretations as the Engineer may deem necessary for the proper fulfillment of the intent of the Plans and Specifications.

The Engineer's inspection, approval, acceptance, instruction, or oversight, however, shall not relieve the Contractor of the Contractor's responsibility for the performance of the Work in accordance with the Plans and Specifications, and shall not commit the Authority to acceptance thereof if it is subsequently found that the materials, methods of construction, or workmanship were defective or otherwise did not conform with the requirements of the Plans and Specifications.

At the Contractor's request, any order or direction of the Engineer shall be stated in writing.

Unless otherwise directed, the Contractor shall forward all communications with the Authority to the Resident Engineer. Where communications are directed to persons other than the Resident Engineer, a written communication shall be sent to the Resident Engineer.

In the event of a difference of opinion between the Engineer and the Contractor, the Contractor shall submit the question in writing to the Chief Engineer for decision and, when such decision affects Project progress, shall indicate the date by which the decision of the Chief Engineer is required, which shall not be less than 30 days from the date of the letter. The Chief Engineer will ascertain the facts involved and will render his decision by the requested date in writing, which decision shall be final and conclusive on the Contractor and become a part of the Contract.

104.03 Plans and Specifications.

Plans bearing the general title designated in the Contract, showing the general outlines and details necessary for a comprehensive understanding of the Project, are a Contract Document, and are on file at the Authority's office.

Projects shall be performed in accordance with the requirements of the Plans and Specifications, subject to modifications as provided in Subsection 104.04. The Plans and Specifications are intended to complement and

supplement each other. Any work required by either shall be performed. In the event that necessary Work is not set forth in the Specifications or on the Plans, but which is nevertheless necessary for the proper performance of the Project, such Work shall be fully performed at the direction of the Authority notwithstanding that such work was not delineated and fully specified therein.

If there is a discrepancy found on the Plans between a figured dimension and a scaled dimension, the figured dimension shall govern.

In case of conflicting requirements, the following order of precedence shall be adhered to:

- Official approved drawings specially prepared for the Project
- Supplementary Specifications
- Traffic Manual
- Standard Drawings
- Standard Specifications

The Contractor shall not take any advantage of any apparent error or omission in the Contract Documents. In the event the Contractor discovers any discrepancy, error or omission in the Plans, Specifications or other Contract Documents, or if there is any doubt or question as to the intent or meaning of the Plans, Specifications or other Contract Documents, the Contractor shall immediately notify the Engineer in writing. The Engineer will promptly make, in writing, such corrections and interpretations as deemed necessary.

Plans, Standard Drawings, Standard Specifications, and Supplementary Specifications will be furnished upon request, by the Engineer, at a charge in accordance with Authority rates on file in the Engineering Department, except that the successful Bidder will receive four copies of Supplementary Specifications and plans, without charge, upon Award of the Contract.

One copy each of the Plans and the Supplementary Specifications shall be kept by the Contractor at the site of the Project at all times.

104.04 Change Orders.

It is understood and agreed that the Chief Engineer may make changes in the Plans and Specifications by a written Change Order at any time and without notice to the Contractor's Surety. Such Change Orders may increase or decrease the quantities of items scheduled in the Proposal, and may involve the addition of Work different in character from that prescribed under any of the Proposal items. Such Change Orders shall become a part of the Contract. If such changes cause an increase or decrease in the amount due under the Contract or in the time required for its performance in the opinion of the Chief Engineer, an equitable adjustment will be made and the Chief Engineer will issue Change Orders accordingly. The Chief Engineer may issue unilateral Change Orders in the event the terms of the Change Order are not agreed upon with the Contractor. The amount to be paid the Contractor for performing the work or furnishing the materials covered by a Change Order shall be as prescribed below. In the event that a method of payment cannot be agreed upon, compensation for such work will be determined on a cost- plus basis as provided in Subsection 108.04.

Change Orders will show in detail the kind and quantity of work to be performed or omitted, or of materials to be furnished or omitted, and the number of days, if any, that will be added to or deducted from the time for completion on account of the added or decreased work. The Contractor shall do no work and furnish no materials under a Change Order until he has received an executed copy of said Change Order or, at the option of the Authority, a written directive to proceed from the Chief Engineer.

Promptly upon receipt of a written order to proceed from the Chief Engineer, the Contractor shall incorporate the changed work into the progress schedule and proceed with the Work as required to minimize any adverse schedule impact. The Contractor shall proceed with the Work as directed during the negotiation and processing of the price and schedule aspects of the change and shall progress the Work without delay or postponement pending resolution of the Change Order.

When a change affects a critical work activity, as determined by the Progress Schedule, the Contractor shall notify the Authority in writing of the date by which the executed Change Order or, at the option of the Authority, the written notice to proceed, must be issued so as not to adversely impact the schedule.

Promptly upon receipt of a written order to proceed from the Chief Engineer, the Contractor shall incorporate the changed Work into the progress schedule and proceed with all of the work, whether changed or unchanged, as required to minimize any adverse schedule impact of any such change. The Contractor shall proceed with

the Work as directed during the negotiation and processing of the price and schedule aspects of the change and shall progress the Work without delay or postponement pending resolution of the Change Order.

When such changes result in increases or decreases to the quantities of items scheduled in the Proposal, payment for the revised quantities of Work actually done will be made solely at the established Contract unit prices for such items, except as follows:

(A) When such changes result in an increase or decrease amounting in cost that exceeds 25% of the total cost of the Project, as determined on the basis of the Proposal quantities and the bid prices for all the items scheduled in the Proposal, then only the Contract unit prices for these items whose quantities have been increased or decreased by more than 25% will be eligible for price negotiation. For each item whose quantity is increased by more than 25%, only the quantity in excess of 125% of the Proposal quantity will be subject to the negotiated price. For each item whose quantity is decreased by more than 25%, the entire revised quantity will be subject to the negotiated price.

(B) When the changes result in a decrease of more than 25% in the quantity of any Major Item, then the price bid for that Major Item will be eligible for price negotiation. When the changes in the quantity of a Major Item result in an increase of more than 25%, the quantity of that Major Item in excess of 125% of the Proposal quantity will be subject to negotiation.

(C) In the event the Authority and the Contractor cannot reach a mutual agreement on price changes by negotiation as provided in (A) and (B) above, a unilateral Change Order will be issued by the Authority. Payment for such work will, as directed by the Chief Engineer, be made on a cost plus basis, as prescribed in Subsection 108.04 or at the Contract's original unit prices, and it will be stated in the Change Order.

The elimination of any item not classified as a Major Item will not be considered as a basis for a claim for additional payment for loss of anticipated profits, except for such actual work as may have been done and materials actually purchased prior to notification of the elimination of the item. The omission of any Major Item will be subject to negotiation between the Authority and the Contractor.

The reduction or elimination of any item, whether major or not, will not be considered as a basis for a claim for payment for costs or expense associated with an unbalanced allocation of such costs or expense among the Scheduled Items of Work shown in the Proposal.

When changes involve the addition of work of a different character than that prescribed under any of the items scheduled in the Proposal, payment for such additional work will be made on the basis of a negotiated price or prices and the final terms for such work placed in a Change Order. In the event the Authority and the Contractor cannot reach a mutual agreement for a negotiated price, payment for such work will be made on a force account basis, as prescribed in Subsection 108.04 and the Change Order shall so state.

Change Orders may also include appropriate changes in the terms of the Contract, such as extensions of time and adjustment of quantities. Change Orders may also include specifications and drawings that may be necessary to cover the additional work. .

Work shall not proceed on any portion of the Project affected by a proposed change by the Authority until a Change Order or a written directive to proceed is issued by the Chief Engineer. The requirements of this paragraph may be waived if, in the opinion of the Chief Engineer, the circumstances are of an emergent nature, including circumstances affecting the safety of the traveling public, whereby it may be hazardous to delay action until formal approval of the Authority. In such event, the Engineer, or his duly authorized representative, may authorize the change in writing, subject to subsequent written confirmation by Change Order at a later date.

The Resident Engineer shall have the authority to order minor changes in the Work not involving an adjustment to the unit or lump sum prices, or quantities of Pay Items or an extension of time, and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by Field Order, shall be binding on the Authority and the Contractor, and shall not be the basis of additional compensation to the Contractor beyond that provided under the unit and lump sum prices bid.

It is understood and agreed that issuance of a Change Order does not constitute a waiver by the Authority of the right to enforce its Standard and/or Supplementary Specifications with regard to further Change Orders, claims, and/or other contracts.

Changes in the extent of work shall not operate as a waiver of any conditions of the Contract not specifically stated in the Change Order.

If, in the opinion of the Engineer, the proposed increase in or additions to the original scope of work are of such magnitude as to warrant an extension in the time or times of completion, such extension of time will be authorized by the Authority, in accordance with Subsection 107.06.

The foregoing provisions shall not apply in the case of changes in quantities specifically covered elsewhere in this Contract.

104.05 Inspection of Work.

The Authority shall have the right to inspect all Work done and all materials furnished, including the preparation, fabrication and manufacture in mill, plant, shop and field, of the materials to be used, and may assign an inspector or other authorized representative for this purpose. The Contractor shall provide all facilities necessary for such inspection and shall furnish or cause to be furnished to the said inspector or other authorized representative safe access at all times to the places where preparation, fabrication or manufacture of materials and construction of the work is in progress, as well as such information and assistance as may be required to make a complete and detailed inspection. When the said Inspector or other authorized representative is in or about the premises above referred to in the course of his employment, he shall be deemed conclusively to be a business invitee of the Contractor. If the Contractor is not the owner of the place where fabrication, preparation or manufacture is in progress, the owner thereof shall be deemed to be the agent of the Contractor with respect to the obligation assumed hereunder. The Contractor or his agent shall be responsible for the payment of claims for injuries to the Authority's authorized representative due to negligence on the part of the said Contractor or his agent. The cost of providing the necessary facilities, information, assistance and protection and of satisfying claims for injuries to the Authority's representative, as specified above, shall be included in the prices bid for the various items scheduled in the Proposal.

Inspectors or other authorized representatives may be stationed on the work site to report to the Engineer as to the progress thereof and the manner in which it is being performed, to inform him whenever it appears that the materials furnished and the work performed by the Contractor fail to comply with the requirements of the Plans and Specifications, and to direct the attention of the Contractor to such failure. The inspection, however, shall not relieve the Contractor from his obligations to furnish materials or perform work in conformity with the requirements of the Plans and Specifications. The Contractor shall provide safe transportation for Inspectors to dredges and boats used for procuring or delivering materials to the project.

The Inspector or other authorized representative is not authorized to revoke, alter, enlarge or release any requirements of the specifications or to issue instructions contrary to the Plans and Specifications. He shall not act as foreman or perform other duties for the Contractor, nor shall he interfere with the management of the Contractor's work. If a difference of opinion arises between him and the Contractor relating to the materials furnished or the performance of the work, he has the authority to reject the materials and suspend the work until such time as the question at issue can be referred to and decided by the Engineer.

104.06 Contractor's Organization.

At all times, the Contractor shall attend to the Work personally or through a competent, English-speaking superintendent at the site, authorized to receive and carry out instruction. The workers shall be competent and shall perform the Work in a neat and workmanlike manner. Any worker not properly qualified for the Work or performing in an unsatisfactory manner or contrary to the Specifications or the Engineer's instruction, or who is disorderly, or who shall work in an unsafe manner, shall be discharged from this Project, if so directed by the Engineer, and shall not be employed again on the Project except with the approval of the Engineer.

All contractor personnel shall wear photo identification at all times on Authority work sites. The photo identification shall have the individual’s name, company name and company telephone number.

When the Contractor is comprised of two or more persons, firms, partnerships, or corporations functioning on a joint venture basis, said Contractor shall designate in writing, before starting work, the name of one individual who shall have the authority to represent and act for the joint venture.

The superintendent, the number of workers, and the equipment employed, shall at all times be adequate and sufficient, in the opinion of the Engineer, to insure the completion of the Project within the time stipulated therefore. The measure of the capacity, adequacy and efficiency of machinery and equipment shall be based upon its ability to perform the work. The equipment shall be operated so as not to damage public or private property. All equipment shall be subject to the approval of the Engineer.

The Contractor shall deliver to the Engineer each week a memorandum of the numbers and classification of workers and equipment performing the Work each day of the previous week.

104.07 Cooperation by Contractor.

The Authority reserves the right to perform the Work with its own Employees or have the Work performed through other Contractors and to permit Public Utility Companies' and others to perform the Work during the progress of the Project, and within the limits of, or adjacent to, the Project. The Contractor shall conduct his work and cooperate with such Utility Companies' and others so as to cause as little interference as possible with the Utility Companies' work. It shall be the responsibility of the Contractor to take reasonable measures to acquaint itself with the ongoing status and progress of all Contracts in the vicinity of his work, including intended locations of other plants, traffic restrictions of others, access routes of others, etc., in order that his operations can be properly scheduled to secure completion of the Project in general harmony and in a satisfactory manner. The Contractor agrees to make no claims against the Authority for additional payment due to delays or other conditions created by the operations of such other parties. The Contractor shall notify the Engineer in writing within three (3) working days of any conflicts with the work of others. If there is a difference of opinion as to the respective rights of the Contractor and others doing work within the limits of or adjacent to the Project, the Engineer will decide as to the respective rights of the various parties involved in order to secure the completion of the Project in general harmony and in a satisfactory manner. The Engineer's decision shall be final and binding for purposes of completing the work.

The Contractor will not be held responsible for damage to Work performed on the Contract or on other Contracts within or adjacent to the site of the Project that may be caused by or on account of the work of other Contractors or Utility Companies'. The Contractor will be held responsible for any damage done or caused by or resulting from the Contractor's Work to work performed by other contractors or Utility Companies' within or adjacent to the site of the Project, and he shall repair or make good any such damage in a manner satisfactory to the Engineer and without cost to the Authority.

It shall be the responsibility of the Contractor for the Work covered by these Specifications to acquaint himself with the ongoing status and progress of all contracts in the vicinity of his work in order that his operations can be properly scheduled to secure completion of the project in general harmony and in a satisfactory manner. The Contractor shall coordinate his lane closing requirements with those of the other Authority contractors in the vicinity.

The Contractor is advised that the work may be performed over railroads, roadways and utilities and that during construction and rigging operations, they will be required to comply with the provisions of Subsections 106.16 and 106.18 and shall provide approved means for safely preventing any objects and debris resulting from his operations from falling to the ground or onto the roadway below. The Contractor shall be responsible for protection of railroad and utility properties. The Contractor shall submit to the Engineer for review, details of the means he proposes to catch and collect materials.

104.08 Shop and Working Drawings.

Shop and working drawings shall be provided by the Contractor. Catalog cuts shall be considered as part of the shop and working drawings.

Shop and working drawings and design calculations for catches and temporary flooring platforms shall be signed and sealed by a Professional Engineer licensed in the State of New Jersey and submitted for review and approval to the Engineer.

Prior to submitting any shop or working drawings, or other submittals required by the Contract, including those of his Subcontractors and suppliers, the Contractor shall review and check each submission for compliance with the Contract requirements and the coordination of the Work as it affects other trades. The Contractor will be responsible for checking dimensional accuracy and for verifying field measurements. Shop or working drawings and other submittals transmitted to the Engineer shall bear the stamp of the Contractor's approval. All shop drawings shall be complete in detail and form along with supporting calculations and be submitted promptly so as to allow for reviews and resubmittals as necessary, by the Engineer, to meet the Contract schedule specified herein. Re-submittals shall be thoroughly checked by the Contractor prior to resubmission to the Engineer for review, to insure that corrections and modifications have been incorporated. All calculations required for the shop and working drawings shall be signed by and bear an embossed seal of a Professional Engineer licensed to practice in the State of New Jersey.

In instances where erection drawings are required in addition to shop drawings, and where the review of certain shop drawings requires details of other trades affecting the Work, submittal of these items shall be made concurrently.

Unless directed otherwise by the Engineer, form work for all concrete structures shall be submitted as shop and working drawings to the Engineer for review. Shop and working drawings for steel and aluminum structures shall consist of shop, erection and other drawings, showing the details, dimensions, sizes and other information necessary for the complete fabrication and erection of the metalwork. Shop and working drawings for concrete structures shall consist of any additional detailed drawings, sketches and data sheets as may be required for the prosecution of the work, such as reinforcement bar lists, bending diagrams, drawings and computations for falsework, bracing, centering and form work, cofferdams, supports for deck slab finishing machines, and masonry layout diagrams.

The Contractor shall check completely the details for reinforcement steel shown on the Plans and shall submit complete shop and working drawings for the reinforcement steel to the Engineer for his review. In addition, shop and working drawings for prestressed concrete structures shall show the number, size, layout of the tendons and the post-tensioning or pretensioning system proposed to be used along with any other specific requirements prescribed in the Supplementary Specifications. The Contractor shall also prepare drawings showing screed elevations for bridge deck slabs, together with their computations.

Shop and working drawings for electrical equipment shall include complete wiring diagrams; installation drawings showing the location by dimensions, of all conduits, equipment and cable runs; section drawings of all cables with dimensions; outline drawings of major equipment with overall and other critical dimensions; and complete lists of all equipment and fixtures, accompanied by catalogs, catalog cuts, data sheets, or other matter describing the equipment proposed for use. Complete specifications, required test data, sizes and numbers of conductors, cables and conduits shall be given.

The Contractor shall submit shop and working drawings to the Engineer for his review. Shop drawings for permanent features designed by the Design Engineer will be examined and marked as follows:

- "No Exceptions Taken" - No further review of Submittal required. The Contractor may proceed with any fabrication, ordering of materials, or work related to said drawings.
- "Make Corrections Noted" – If the Contractor complies with noted corrections; fabrication, ordering of materials, or work related to said drawings may proceed prior to resubmission. If for any reason the Contractor cannot comply with the corrections as noted, revise to respond to exceptions and resubmit. Within 30 days of receipt of conditional approval, Contractor shall resubmit revised shop drawings which incorporate the corrections previously noted to the Engineer.
- "Amend and Resubmit" -The Contractor shall amend and resubmit for review. Fabrication, ordering of materials, or work related to said drawings may not proceed.
- "Rejected" – The submittal is not in compliance with the contract documents. Contractor is to prepare a new submittal complying with the requirements of the contract and resubmit. Fabrication, ordering of materials, or work related to said drawings may not proceed.

Shop drawings for permanent features designed by the Contractor will be examined and marked "Recommended for Approval" and returned to the Authority for approval by the Office of the Chief Engineer of the New Jersey Turnpike Authority. When the Office of the Chief Engineer deems the submitted shop drawings acceptable, they will be stamped "Approved" by an authorized representative of the Chief Engineer and returned to the Engineer for final distribution to the Contractor. Shop drawings which are not recommended for approval will be returned to the Contractor to amend and resubmit.

The carrying out of the work or the ordering of materials before the final review of the drawings may constitute a cause for rejection of such work or materials. No deviations from shop or working drawings marked "No Exception Taken," shall be made without the written consent of the Engineer. All shop and working drawings shall be submitted by the Contractor. Direct submittal by a subcontractor or a supplier will not be accepted.

The closing of lanes for construction will not be permitted before the Engineer's final review of all shop and working drawings for work to be performed. All shop drawings required for work to be performed in a specific lane(s) closing shall have the Engineer's final review prior to the placement of any traffic protection and the closing of the lane(s), with the exception of approved lane closings for measurements.

Each shop and working drawing shall have a title box, located in the lower right hand corner of the drawing. The title box shall display the following:

(1) Number and title of the drawing

(2) Date of drawing or revision

(3) Name of project and contract number

(4) Name of Contractor or subcontractor preparing drawing

(5) Clear identification of contents and location of the work

(6) Contractor's approval stamp

Each shop and working drawing shall have a blank area, five inches by five inches, located adjacent to the title box.

Shop drawings, working drawings, catalog cuts and other Supplemental information shall be transmitted to the Engineer accompanied with the following prescribed form:

SHOP DRAWING TRANSMITTAL FORM

TO: CONTRACT NO. _____ DATE _____

JOB LOCATION _____

We are sending you _____ herewith ( ) under separate cover ( ) by messenger ( ).

The Contractor will be provided information concerning the addressee for shop and working drawings at the pre-construction meeting.

It is expressly understood that the review by the Engineer of the Contractor's shop and working drawings relates solely to conformance with design Plans and Specifications. The fact that no exceptions are taken shall not relieve the Contractor from responsibility for errors in dimensions and elevations. Lack of exceptions taken by the Engineer does not constitute an order for a change in the Contract requirements.

Three (3) prints of each shop and working drawing, including data sheets, reinforcement bar lists, brochures, catalogs, etc., shall be submitted to the Engineer for review. If prints are returned for correction, three (3) prints shall again be submitted until no exceptions are taken by the Engineer. Three (3) prints of all shop and working drawings marked "No Exception Taken" and related data sheets shall be subsequently furnished to the Engineer for distribution.

The Contractor has the option of utilizing electronic transmission and review procedures for the processing of shop drawings. At the preconstruction meeting, the Contractor shall indicate if the electronic submission of shop drawing is desired. If the Contractor chooses to submit any shop drawings by electronic means, the Contractor shall submit to the Engineer in writing a detailed procedure describing the methods by which the electronic shop drawing review process will be conducted. The written procedure shall address the responsibilities for each of the participating review entities, including the Engineer, Design Engineer, Fabricator and Contractor. The written procedure shall describe the software to be used for the transmission and viewing, the means of annotating the drawings, and the method for transferring and transmitting comments. Electronic shop drawing files shall be submitted in either Tagged Image File (TIF) or Portable Document File (PDF) formats. The entire electronic shop drawing submission and review procedure must be approved by the Engineer prior to implementation and submission of electronic shop drawing submissions.

In order to employ full electronic transmission of shop drawings, a mutually agreeable access site must be available to all the participating review entities. If an agreeable site is not accessible to all the parties involved, file transfer by electronic mail may still be used, but the conventional shop drawing submission and review procedures described in Subsection 104.08 shall be abided by for those entities unable to access the electronic transfer of shop drawings. Regardless of the transfer or viewing methods used, the Contractor is responsible for the proper submission of shop drawings to the Engineer for distribution. Prior to the submission of electronic shop drawings, the Contractor shall obtain, in a format compatible with the shop drawing files, an electronic version of all shop drawing review stamps for insertion into the electronic drawings. Subject to the approval of the Engineer, a mutually agreed upon software may be utilized to annotate the electronic shop drawings; otherwise, the traditional means of shop drawing reviews shall be employed.

All shop drawing submissions, electronic or otherwise, require Contractor approval prior to forwarding to the Engineer. A transmittal form shall accompany each electronic submission. The submission of electronic shop drawings shall be sent to the Engineer and subject to the approval of the Engineer, group e-mail address may be used to allow for concurrent reviews. The Engineer will be responsible for returning all comments to the Contractor. Comments may be annotated on the drawings, described in detail in text format, or a combination of the two methods.

Upon completion of the Project, the Contractor shall deliver to the Authority one complete set of all shop and working drawings, as directed by the Engineer, on good quality drafting film with fully-legible and

reproducible lines, figures and letters, acceptable to the Authority, and as electronic CADD format. The process used in making reproductions shall be subject to the approval of the Engineer. Shop and working drawings on drafting film, whether original tracings or reproductions thereof, shall be suitable for use in making fully legible prints by the ozalid or other similar contact printing process. The shop and working drawings shall be 22" x 36" or as directed by the Engineer.

Hard copies of all the final approved shop drawings, with the appropriate approval stamps and original signatures, must be submitted to the Engineer, including shop drawings submitted electronically for review and approval. When utilizing electronic submission and review procedures it is acceptable for the final hard copy to be a print of a stamped and signed electronic file.

The cost of preparing and furnishing shop and working drawings as described in this Subsection shall be included in the prices bid for the various scheduled pay items in the Proposal which are pertinent to the particular work to which such drawings apply.

104.09 Construction Layout.

The Engineer will furnish all traverse control points and bench marks as shown on the Plans. The Contractor shall preserve such controls and bench marks throughout the duration of the Contract and shall lay out therefrom all of the lines and grades necessary for the complete construction of the Project. If such controls and bench marks are damaged, lost, displaced or removed, they shall be reset by the Contractor at his expense.

When an existing structure is to be modified in any way, the Contractor shall verify that the dimensions of the existing structure are as shown on the plans, and any discrepancy shall immediately be brought to the attention of the Engineer. Field verification of the dimensions of the existing structure shall be completed prior to the fabrication of the new structural steel.

The Contractor shall perform all work required in connection with the layout for construction of the Project using the traverse control points and data furnished by the Engineer, as specified above. This work shall be performed by qualified personnel under direct supervision of a licensed Professional Engineer or Land Surveyor.

The Contractor shall make all necessary computations to establish the exact position of all work from the traverse control points furnished by the Engineer. The Contractor shall establish the base lines, which are shown on the Plans, from the traverse control points, and he shall reestablish when necessary and maintain the base lines throughout the life of the Contract, so as to permit the Engineer to make the necessary preliminary, interim, and final measurements and to check the Contractor's layout if he so desires. All work shall be referenced by the Contractor to these base lines.

On all new work or major reconstruction work, the Contractor shall provide and maintain offset points from each main roadway base line, from each ramp or turnaround base line and from each local road base line, at each station, and outside the limits of grading and construction. Offset points shall be located at a maximum spacing of 50' intervals for all base lines over a 475' radius and on tangents, and at a maximum spacing of 25' intervals for all base lines under a 475' radius. Each offset point shall be identified and marked as to the base line station and offset distance from the base line, and the Contractor shall furnish grade sheets showing the cut or fill to the finished profile lines with reference to the offset points.

The Contractor shall be responsible for maintaining all points that he has established. He shall be responsible for the finished work conforming to the lines and grades shown on the Plans. Any error or apparent discrepancy found in the Plans or Specifications shall be called to the attention of the Engineer, for interpretation, prior to proceeding with the work.

(A) RESURFACING CONTRACTS.

The Engineer will provide the Contractor with Grade Sheets necessary for paving work. Grade Sheets shall indicate locations and elevations of bench marks, lines, stations, elevations, and the required thickness of each course noted at regularly spaced intervals (approximately 25 feet) along the station lines. The Contractor shall perform all operations necessary to insure that the proper thickness of courses is obtained, including providing sufficient guides for the operation of the sensor of the automatic screed control devices on the paving machines. The Engineer will, for resurfacing contracts only, provide regularly spaced guide markers along the lines to be striped.

(B) BRIDGE DECK REPAIR CONTRACTS.

The Engineer will provide the Contractor with the outlines of the limits of spalled areas, bridge deck surface removal, joint reconstruction limits, safety walk, parapet and curb repairs and other work areas to be repaired and reconstructed.

The use of pilot holes will be required to accurately determine the lateral limits of deck replacement. The Contractor shall provide the Engineer with a schedule of his test crews. He shall give written notice to the Engineer 48 hours in advance of commencement of such work, advising him of the times, number of test crews working and locations where he proposes to start work. The Contractor shall cooperate with the Engineer in providing whatever men and equipment that may be required to provide these pilot holes and the cost of this work shall be included in the unit prices bid for the Concrete Deck Replacement items.

The Contractors layout shall also include providing regularly spaced guide markers and continuous string line between markers on the finished pavement for the application of reflectorized striping.

For areas requiring resurfacing, the Contractor shall furnish the control for proper profile and cross slope and install all necessary materials and devices, such as screed rails on adjustable chairs or piano wire strung between drive pins at 25 foot centers, for spreading the asphalt surfacing. Such screed rails or piano wire shall be set to be able to provide required compacted pavement thickness. The vertical alignment of the screed rails or piano wire shall be adjusted to a smooth profile meeting the bridge armor joints within the tolerances specified in subsection 302.05(K) or as directed by the Engineer.

The cross slope of the screed for all lifts shall be set to provide a smooth transition as directed by the Engineer from the cross slope of the existing pavement surface and the armored joint or the abutment headblock cross slope.

Screed controls shall employ approved compensating devices to adjust the grade line so that minor changes in grade elevations will not be reflected immediately in the finished surface.

Nighttime operations shall be illuminated by a lighting system which shall provide the construction area with a minimum illumination intensity of 5 foot candles and shall be positioned and operated to preclude glare to approaching traffic. The lighting system shall not include incandescent lights.

The cost of the lighting system for nighttime operations will not be paid for separately but shall be included in the prices bid for the various scheduled pay items.

All equipment used for nighttime operations shall have a minimum of 72 square inches of high intensity reflective sheeting toward the extremities of each side of the equipment. A minimum of 144 square inches of the sheeting shall be visible from each direction. The color of the reflective sheeting shall be orange.

Within 24 hours of the beginning of the lane closing, the Contractor shall remove the headblock material at abutment locations or the overlay material at sealed deck joint locations to determine the extent of repair work required.

The amount of allowable "If and Where Directed by the Engineer" quantities and estimated quantities shown on the plans shall be performed within the stipulated lane closing time frames listed in Division 800.

Additional commensurate lane closing time may be allowed as determined by the Engineer in cases where the amount of "If and Where Directed by the Engineer" quantities exceed considerably the quantities stipulated in the Contract. For "If and Where Directed by the Engineer" work on bridges currently not scheduled in the Contract, commensurate, allowable lane closing hours will be established by the Engineer.

In stages where two lanes or similar are closed and inclement weather or other circumstances may impact the stipulated lane closing pick-up time, the Contractor shall concentrate his work effort on the lane adjacent to the active traffic lane. He shall be prepared to complete work in this lane ahead of the work in the remaining area in order to allow this lane to be opened to traffic, at the time requested by the Engineer. This approach may require a non-contiguous paving operation. The Contractor shall allow in his bid for any additional cost, which may result for the various items involved.

The Contractor shall allow in his bid for the above stipulated requirements and provisions.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CONSTRUCTION LAYOUT	LUMP SUM

Construction Layout shall include furnishing and setting the points, furnishing all engineering and surveying personnel, equipment, materials, and all else incidental thereto.

Monthly or other payments on account for this item will be made pro rata as the value of all contract work completed at the time of such payments bears to the total value of the Contract.

If no item for Construction Layout is provided in the Proposal, then the cost to the Contractor of laying out the work shall be included in the prices bid for the various items scheduled in the Proposal.

104.10 Mobilization.

The Contractor shall furnish all preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to the Project site and mobilize all required plant and equipment necessary for initiating and concluding the Contract and may include such portions of the following as are required at the beginning and end of the Project: Setting up at the Work site, the Contractor's general plant, offices, shops, storage areas, sanitary and other facilities as required by the Specifications, by local or state law, or by regulation, the subsequent demobilization and removal from the site of said equipment, appurtenances and the like upon completion of the Work.

Payment will be made under:

PAY ITEM	*PAY UNIT*
MOBILIZATION	LUMP SUM

Payment will be made in accordance with the following schedule:

When five percent of the Work is completed, 25 percent of the lump sum bid for mobilization or 2.5 percent of the Total Contract Price, whichever is less, will be paid.

When ten percent of the Work is completed, 50 percent of the lump sum bid for mobilization or five percent of the Total Contract Price, whichever is less, will be paid.

When 15 percent of the Work is completed, 75 percent of the lump sum bid for mobilization or 7.5 percent of the Total Contract Price, whichever is less, will be paid.

When 20 percent of the Work is completed, 100 percent of the lump sum bid for mobilization or ten percent of the Total Contract Price, whichever is less, will be paid.

When all Work on the Project is complete, payment for the lump sum bid for mobilization in excess of ten percent of the Total Contract Price will be made as per Subsection 108.05 provided that the demobilization of all the Contractors Plant and Equipment is completed to the satisfaction of the Engineer.

The percentage of Work completed shall be the total of payments earned compared to the Total Contract Price. The total of payments earned excludes the amount paid for this item and the amount of remaining unpaid partial payments for work and materials in accordance with Subsection 108.03.

Partial payments may be reduced by an amount determined by the Engineer if, in his determination, the plant equipment at the site (other than construction equipment for which payment is included in the various contract items) is insufficient or is not suitable for the performance of the work or, the plant and equipment brought on the Project Site and committed to the work are removed from the Project without permission of the Engineer. In the event of a reduction in partial payments, the remainder of the partial which are unpaid at the date of such reduction will be paid with subsequent progress payments as and when the conditions are rectified.

The lump sum price bid in the Proposal for mobilization shall not exceed the following:

Total Price, Including Mobilization		Maximum Lump Sum Bid for
More Than	Up To and Including	Mobilization Item*
0	$ 200,000	10% of total price
$ 200,000	$ 1,000,000	$20,000 plus 7.5% of amount in excess of $200,000.
More than $ 1,000,000		$80,000 plus 5% of amount in excess of $1,000,000.

*Note: In the event the Contractor's lump sum price bid for mobilization exceeds the above amounts, the excess will not be paid until the final payment.

No additional payment will be made for demobilization and remobilization due to shutdowns, suspensions of the work, or for other mobilization activities.

If no item for Mobilization is provided in the Proposal, then the cost of furnishing, mobilizing and demobilizing said plants and equipment shall be deemed included in the prices bid for the various items scheduled in the Proposal.

Included in the cost of mobilization will be the maintenance of the continuity of the project area fencing. This will be done in accordance with the requirements of Section 511 - Fencing. Temporary fencing shall be Temporary Orange Plastic Fence furnished and erected in accordance with Section 211. The Contractor will erect, relocate temporary fencing and maintain, at all times, complete perimeter closure of the project work areas. The fence installation operation shall be carried out as expeditiously as possible, and the right-of-way shall be temporarily secured when the work is unattended. At the completion of the project when all right-of-way has been secured by permanent fencing, the temporary fencing shall be removed as directed by the Engineer. The location of the temporary fencing shall be subject to the Engineer's review. If so ordered by the Engineer, the Contractor shall provide additional temporary fencing or relocate previously erected fencing in order to obtain satisfactory project perimeter security. Gates shall be provided at truck entrance points off local roads, if approved by the Engineer. No separate payment will be made for additional temporary fencing, gates, or the relocation of previously erected fencing as directed by the Engineer.

No separate payment will be made for railroad grade crossings. Unless there is a separate pay item in the proposal, all costs associated with any required railroad grade crossing necessary to gain access to the job site are the responsibility of the Contractor and shall be included under the lump sum bid price for Mobilization.

104.11 Noise Control.

The Contractor shall conduct all operations during the performance of the Work to provide protection for the general public, and those working within the construction site, from the harmful and disturbing effects of excessive noise.

(A) SOUND LEVELS.

Sound Levels measured at the closest point in normal use by the public adjacent to the source of construction noise shall not exceed the following:

Duration per Day for a Person (Hours)	Sound Level DB(A)
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

(B) IMPULSIVE AND IMPACT NOISE.

Sound Levels for impulsive or impact noise (noise of duration of less than 1 second) measured at the closest point in normal use by the public adjacent to the source of impulsive or impact noise shall not exceed 120 DB(A).

(C) NOISE LEVEL SCHEDULE.

Sound Levels consisting of existing ambient and construction noise measured at any and all structures adjacent to the area of the Contractor's operations shall not exceed the following:

Residential Structures (houses, apartments, schools, hospitals and churches):

Time Periods	Sound Level in DB(A)
Week Days	
Midnight - 7:00 A.M	60
7:00 A.M. - 7:00 P.M.	80
7:00 P.M. - 11:00 P.M.	70
11:00 P.M. - Midnight	60
Saturday	
Midnight - 8:30 A.M.	60

Time Periods	Sound Level in DB(A)
Week Days	
8:30 A.M. - 7:30 P.M.	80
7:30 P.M. - 11:00 P.M.	70
11:00 P.M. - Midnight	60
Sunday	
All Hours	60

Business-Commercial structures (offices and stores):

Daily including Saturday and Sunday, all hours at a maximum of 85 DB(A).

Factory-Commercial Structures (Manufacturing and Production Facilities):

Daily, including Saturday and Sunday, all hours at a maximum of 90 DB(A).

Sound level measurements will be made by the Engineer with an approved general purpose sound level meter, supplied by the Contractor, conforming to ANSI Standard S1.4, Specification for Sound Level Meters, Type 2. All measurements will be made on the A scale only, and except for impulsive or impact sound levels will be measured at fact response of the meter. Sound level measurements for compliance with the Specification shall be made at the locations specified under (A), (B) and (C) above.

No separate payment will be made for measures taken by the Contractor in compliance with the noise control requirements set forth under this Subsection or for any work in connection therewith and incidental thereto, but all cost therefore shall be included in the bid price for the item mobilization in the proposal.

104.12 Dust Control.

The Contractor shall conduct all operations during the performance of the work to provide protection for the general public, and those working within the construction site, from the harmful and disturbing effects of excessive dust. Protection shall include but not be limited to the provisions of Sections 208, 417 and 418.

No separate payment other than that specified in Subsections 417.11 and 418.09 will be made for measures taken, materials, labor, equipment and tools required by the Contractor for compliance with the dust control requirements set forth under this Section.

104.13 Sanitary, Health and Safety Provisions.

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees and for Authority field offices as may be necessary to comply with the requirements of the State and local health departments, or of other agencies having jurisdiction.

Attention is directed to Federal and State laws, rules and regulations concerning construction safety and health standards. The Contractor shall not require any worker to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his health or safety.

(A) TOILET FACILITIES.

The Contractor shall ensure privacy to all employees and Authority personnel assigned to the Project by providing on site separate toilet facilities for male and female employees. These facilities shall be portable toilets and clearly marked MEN and WOMEN. They are in addition to the facilities provided in the field office.

The total number of facilities shall be determined from the chart listed below. A facility is defined as one unit. A facility site is defined as a location that provides at least one facility for each sex. The maximum distance between the location of facility sites and workers shall be no more than one-half mile.

All toilet facilities shall be in compliance with OSHA Regulation 29 CFR 1926.51(c) with the exception that the Authority will require that separate toilet facilities be provided for males and females. The sewage disposal method shall not endanger the health of employees and shall be in compliance with all State and Federal regulations.

Toilet facilities shall be cleaned and sanitized a minimum of once per week except from May 15 through September 15 in which these facilities shall be cleaned and sanitized a minimum of twice per week.

Number of Male Employees	Minimum No. of Facilities for Male Use	Number of Female Employees	Minimum No. of Facilities for Female Use
1 – 15	1	1 – 15	1
16 – 35	2	16 – 35	2
36 – 55	3	36 – 55	3
56 – 80	4	56 – 80	4
81 – 100	5	81 – 100	5
111 – 150	6	111 – 150	6
Over 150	6 +(1)	Over 150	6 +(1)

(1) – One additional facility for each additional 40 employees of each sex.

(B) TEMPORARY FLOORS AND CATCH PLATFORMS.

Workers who are working on temporary floors or catch platforms on bridges and viaducts shall be instructed concerning the safe use of these systems. The contractor shall review the following items with their employees and subcontractors as part of a Pre-Construction Safety meeting prior to the installation of the system:

(1) **Design.**

(a) The elements of the system, including planks and plywood (or other material) top cover, and the purpose of each element.

(b) Identification of areas allowed for catching demolished concrete.

(c) A description of acceptable planking material.

(2) **Fall Protection.**

(a) Fall protection procedures that apply to installing or removing temporary floors and catch platforms.

(b) The necessity and methods of fall protection when planks are temporarily removed for any purpose.

(c) The necessity of fall protection when repairing damaged temporary floors or catch platforms.

(3) **Inspection and Maintenance.**

(a) Signs of damage to planks or covering and the need to replace damaged materials promptly.

(b) Instruction to immediately report signs of damage to the shield to any supervisor.

(c) Instruction that sheeting must be promptly replaced if shifted or moved.

(d) Instruction that planks that have been removed or shifted must be replaced in their proper positions.

104.14 Construction Safety.

The Contractor's personnel in any work area shall wear a vest at all times as specified in Subsection 920.03.

The Federal Occupational Safety and Health Standards, 29 C.F.R. 1910 and 1926 (and all future revisions or additions) are required by law to be followed on all work.

104.15 Protection Of Wetlands And Transition Areas During Construction.

Prior to the commencement of all work, the Contractor shall locate and clearly stake out the boundaries of all wetland areas and transition areas delineated on the Contract Plans, which are outside the limits of construction, with temporary orange plastic fence. "KEEP OUT" signs shall be placed at intervals of not less than 100 feet around perimeter of all staked out areas. Should the marking be damaged during construction, the Contractor shall repair it within one working day.

Entry into or physical disturbance of a designated wetland area and transition area is prohibited, unless it is in accordance with the Contract Plans and Specifications or prior approval has been obtained from the Engineer. Such approval shall not be unreasonably refused.

Temporary roads shall not be placed in designated wetlands or transition areas outside the limits of construction shown on Contract Plans. Where the entry of vehicles into designated wetland or transition area is required and permitted, the Contractor shall take measures to protect the wetland and transition area from gouging, cutting or other damage by the use of appropriate protective measures such as travel mats.

Precast piles extending to the deck level are permitted to be installed in wetland and transition areas provided that the area of soil cutting be limited to the location of the pile; that disturbance to surrounding areas and access routes be minimized; and that all equipment and materials used in the placing of piles be removed as soon as work is completed. The work area shall be restored to its original condition.

No fill shall be placed in wetland and transition areas either temporarily or permanently beyond the limits of construction shown in the Contract Plans.

Storage of materials or equipment or parking of vehicles on wetlands and transition areas is prohibited beyond the limits of construction shown in the Contract Plans.

No construction wastes, excess fill, petroleum products or cut vegetative materials shall be placed on any wetland or transition area beyond the limits of construction shown in the Contract Plans.

No buildings or sanitary facilities, whether temporary or permanent, shall be placed on any wetland or transition area.

Where construction is being carried out in adjoining areas or in portions of wetland or transition areas, silt fences shall be placed along the edge of the wetland or transition area so as to prevent silt running onto the wetland or transition area beyond the limits of construction shown in the Contract Plans.

No borrow material shall be taken from a designated wetland or transition area beyond the limits of construction shown in the Contract Plans.

104.16 Nighttime Operations.

(A) GENERAL.

All operations that are performed during the non-daylight hours shall be properly illuminated to allow for the complete performance and inspection of the work. This work shall consist of furnishing, installing, operating, maintaining, moving, and removing portable light towers and equipment-mounted fixtures for nighttime construction operations, for the duration of the nighttime work on the Contract. Nighttime operations consist of work specifically scheduled to occur after sunset and before sunrise. Before nighttime operations may begin, the Contractor shall demonstrate to the Engineer that its nighttime operation meets the light level requirements.

(B) LIGHT LEVELS AND ILLUMINATION REQUIREMENTS.

A minimum of 50 lux shall be maintained throughout the entire area of operation. Area of operation is a work area that is a minimum of 65 feet ahead and behind the employee, where an employee is on or near the roadway.

Specific tasks should meet the minimum illumination levels shown in the following table:

Minimum Illumination Level	Description of Tasks	Areas of Illumination
50 lux	Embankment, fill, and compaction Excavation regular, lateral ditch and channel Landscape, grassing and sodding Maintenance of earthwork embankment Mechanical sweeping and cleaning Reworking shoulders Subgrade stabilization and construction	General illumination throughout area of operation
50 lux	Bituminous concrete milling* Bituminous concrete paving operation*	General illumination throughout area of operation. Minimum of 200 feet ahead and 200 feet behind equipment.

Minimum Illumination Level	Description of Tasks	Areas of Illumination
50 lux	Bituminous concrete roller operation*	General illumination throughout area of operation. Minimum of 100 feet ahead and 100 feet behind equipment.
100 lux	Barrier walls and traffic separators Base course construction Bituminous concrete paving operation* Bituminous concrete roller operation* Bridge decks Bridge painting Concrete pavement Drainage structures, culverts, and storm sewers Guide rail and fencing Highway signs and permanent installation Removal of pavement Other concrete structures Painting stripes and pavement markers Pot hole filling Repair of concrete pavement Resetting guide rail and fencing Sidewalks Surface treatment Waterproofing and sealing Any other operation not listed in this table	General illumination of tasks and around equipment. Minimum of 25 feet ahead and 25 feet behind equipment. Illumination shall be provided on the sides of the equipment.
200 lux	Crack filling, sawcutting, and sealing joints Electrical work Highway street lighting Traffic signals Intelligent transportation systems	Illumination on task.

*Both requirements of 50 lux and 100 lux for these operations must be met.

Light meter readings shall be taken horizontally to the roadway surface facing the light source. If the Contractor fails to meet the minimum illuminate levels at any time, the Contractor shall cease its nighttime operations until such time that required light levels are attained. The uniformity of illuminance, defined as the ratio of the average illuminance to the minimum illuminance over the work area, shall not exceed 5:1. Construction operations shall be deemed to include all work operations by the Contractor's personnel, including layout and measurements ahead of the actual work.

(1) **Equipment.**

Materials and/or equipment shall be in good operating condition and in compliance with applicable OSHA, NEC, and NEMA codes.

The Contractor shall furnish, for use by the engineer, two light meters capable of measuring the level of illuminance in lux. These light meters shall be supplied to the Engineer for use as necessary to check the adequacy of illumination throughout the nighttime operations. The light meters will become the property of the Contractor after acceptance.

The Contractor shall provide suitable brackets and hardware to mount lighting fixtures and generators on machines and equipment. Mountings shall be designed so that lights can be aimed and positioned as necessary to reduce glare and to provide the required illuminance. Mounting brackets and fixtures shall not interfere with the equipment operator or any overhead structures and shall provide for secure connection of the fixtures with minimum vibration.

Portable and trailer-mounted light towers shall be sturdy and free-standing without the aid of guy wires or bracings. Towers shall be capable of being moved as necessary to keep pace with the construction operation. Portable towers and trailers shall be positioned to minimize the risk of being impacted by traffic on the roadway or by construction traffic or equipment.

Light towers mounted on paving and milling machines, rollers, and other paving equipment shall not exceed the height of vertical underclearances, such as trees, aerial utilities, or bridge underclearances.

Lights shall be aimed and adjusted to provide uniform illumination with a uniformity ratio 5:1. The hopper, auger, and screed areas of pavers shall be uniformly illuminated. The operator's controls on all machines shall be uniformly illuminated.

Conventional vehicle headlights shall not be permitted as the means of illumination while working. All moving equipment used for nighttime operations shall have a lighting system consisting of a minimum of two lights directed in each direction of travel of the equipment. The equipment shall also have a minimum of 0.5 square feet high intensity retroflective sheeting toward the extremities of each side of the equipment. A minimum of 1 square foot of the sheeting shall be visible from each direction. All workers shall, during the hours of darkness, wear reflectorized garments as specified for traffic directors.

Existing street and highway lighting shall not eliminate the need for the Contractor to provide lighting. Consideration may be given to the amount of illumination provided by existing lights in determining the wattage and/or quantity of lights to be provided.

The Contractor shall provide sufficient fuel, spare lamps, generators, and qualified personnel to ensure that all required lights operate continuously during nighttime operations. Each generator shall have a fuel tank of sufficient capacity to permit operation of the lighting system for a minimum of 12 hours. In the event of any failure to the lighting system, the operation shall be discontinued until the required level of illumination is restored. Hydraulic generator system shall be used in residential areas and areas designated to minimize noise pollution. If hydraulic generator systems are unavailable, other generator-powered systems may be used with the approval of the Engineer.

A supply of emergency flares shall be maintained by the Contractor for use in the event of emergency or unanticipated situations.

(2) **Glare Control.**

All lighting provided under this item shall be designed, installed, and operated to avoid glare that interferes with traffic on the roadway or that causes annoyance or discomfort for residences adjoining the roadway. The Contractor shall locate, aim, and adjust the lights to provide the required level of illuminance and uniformity in the work area without the creation of objectionable glare. The Engineer shall be the sole judge of when glare is unacceptable, either for traffic or for adjoining residences. The Contractor shall provide screening such as shields, visors, or louvers on lights as necessary to reduce objectionable levels of glare.

(C) PAYMENT.

Separate payment will not be made for lighting for nighttime operations, but all costs thereof shall be included in the prices bid for the various pay items as scheduled in the Proposal.

104.17 Diesel Equipment Operation.

The Contractor shall ensure that all diesel non-road construction equipment used during the construction of the Project use ultra-low sulfur fuel (<15 ppm sulfur) in accordance with the federal Nonroad Diesel Rule, 40 CFR Parts 9, 69, 80, 86, 89, 94, 1039, 1051, 1065, 1068.

The Contractor shall ensure that all vehicles, including non-road construction equipment operated at, or visiting, the Project site comply with the three (3) minute idling limit, pursuant to N.J.A.C. 7:27-14 and 15, and ensure that every equipment operator and site superintendent has received a copy of the policy and has been instructed on its implementation.

No separate payment will be made for complying with the requirements of this Subsection.

SECTION 105 - CONTROL OF MATERIALS

105.01 Materials.

Unless otherwise specifically provided, all materials (including manufactured equipment) forming a permanent part of the Project shall be new materials furnished by the Contractor and shall be subject to the approval of the Engineer. Approval by samples applies only as long as the material conforms to the samples approved, and it can be furnished at the time and in the quantity required by a producer equipped to furnish it in uniform quality and composition. Approval for a specific case or use does not imply approval for other cases or uses. Approved materials which appear defective when received, or which may have become damaged in any

manner, shall not be used until retested and reapproved. Orders for material shall include a detailed description and their intended use, manner of shipment, proposed delivery date, and the official designation of the Project on which the material is to be used. Duplicates of orders shall be furnished to the Engineer at the time the order is placed. When the use of more than one type of material or product is permitted, only one type shall be used throughout the Project.

The Authority will not accept shipment of any materials unless the materials are shipped to the Authority with a Bill of Lading clearly inscribed with the statement "All shipping costs have been prepaid by the consignor."

The Authority will not approve the use of any materials as fill material for the project exhibiting the following characteristics unless specifically provided for in the contract documents: any waste or combination of waste, including toxic, carcinogenic, corrosive, irritating, sensitizing, radioactive, biological infectious, explosive, or flammable waste or otherwise determined to be unsuitable by the Authority which poses a present or potential future threat to human health, living organisms, or the environment. Such un-approved materials also include all hazardous or toxic substances defined as such by the New Jersey Department of Environmental Protection (NJDEP) and/or the United States Environmental Protection Agency (USEPA).

The Authority will not approve the use of any materials that are contaminated as defined by N.J.A.C. 7:26E-1.8 and NJDEP's most recent version of the Solid and Hazardous Waste Management Program Guidance Document on Contaminated Soil.

Within ten (10) days after the date of execution by the Authority of the Contract, the Contractor shall inform the Engineer in writing from whom and where the Contractor proposes to obtain the materials required for the Project, and thereafter advise the Engineer of proposed changes provided, however, the location of proposed borrow pits and / or quarries shall be submitted within ten (10) days of receipt of Notice of Award, as specified in Subsection 103.02. The location of proposed borrow pits and / or quarries shall be approved by the Engineer prior to use for the Project. Said borrow pits and / or quarries shall be limited to borrow pits and / or quarries already in use. The source of supply of each of the materials to be incorporated into the Project shall be approved by the Engineer before delivery is started. The approval of the Engineer may be withdrawn at any time when it appears to the Engineer that the materials have deteriorated subsequent to the giving of such approval. Subsequent to the submission of the initial list of sources of supply the Contractor shall notify the Engineer of all new sources of supply at least thirty (30) calendar days in advance of the proposed shipment of materials from such new sources.

105.02 Local Material Sources.

Sources of materials for earthwork, aggregates and landscaping may either be designated and provided by the Authority, or designated and provided by the Contractor.

(A) SOURCES PROVIDED BY THE AUTHORITY.

The Authority may acquire and make available to the Contractor the right to take materials from the sources designated on the plans and described in the Supplementary Specifications together with the right to use such property as may be specified, for plant site, stockpiles and hauling roads. The quality of material in such deposits will be acceptable in general, but the Contractor shall be responsible for determining the amount of equipment and work required to produce a material, which meets the requirements of the Contract. It shall be understood that it is not feasible to ascertain from samples the limits for an entire deposit, and that variations shall be considered as usual and are to be expected. The Engineer may order procurement of material from any portion of a deposit and may reject portions of the deposit as unacceptable.

If the Contractor desires to use material from sources other than those designated, the Contractor shall first receive pre-approval from the Authority; and then acquire the necessary rights to take materials from the sources and shall pay all costs related thereto, including any which may result from an increase in length of haul. All costs of exploring and developing such other sources shall be borne by the Contractor. The use of material from other than designated sources will not be permitted until such preliminary samples as may be required by the Engineer have been obtained, tested and approved, and the Contractor receives approval of the source of such materials.

(B) SOURCES PROVIDED BY THE CONTRACTOR.

When material deposits are not designated or where those designated provide insufficient material, the Contractor shall provide sources of material acceptable to the Engineer.

When sources of material or material deposits are provided by the Contractor, securing such sources and testing material shall be in accordance with Subsection 203.03(F).

Prior to the commencement of operations at the Contractor's proposed borrow pit and/or quarry, the Contractor shall obtain the written approval of the New Jersey State Department of Environmental Protection (NJDEP). No material shall be brought on site from the proposed borrow pit or quarry without such written approval.

Unless otherwise permitted, borrow pits and quarries occupied by the Contractor or his subcontractor or suppliers shall be so excavated that water will not collect and stand therein. Sites from which materials have been removed shall, before completion of the Contract, be left in a neat and presentable condition adequately drained and treated as necessary to prevent erosion as required by the agency having jurisdiction. Where practicable, all pits and quarry sites shall be located so that they will not be visible from the highway.

105.03 Inspections, Tests and Samples.

All materials will be inspected, tested and approved by the Engineer before incorporation in the work and/or shall be furnished from an approved source. Any Work, in which untested materials are used without written permission of the Engineer, shall be performed at the Contractor's risk. Such unauthorized materials, when found to be unacceptable, will not be paid for, if directed by the Engineer, shall be removed at the Contractor's expense.

The Contractor shall, unless specified otherwise, provide the necessary facilities for taking samples, or shall furnish samples and shall deliver them to the Laboratory or elsewhere as the Engineer may direct. Samples shall be prepared by the Contractor for testing, if so required. Unless otherwise specifically provided, materials will be tested in accordance with the current methods of AASHTO, ASTM, ANSI, FSS or as otherwise specified or applicable. Unless otherwise specifically provided, the cost of testing materials which are approved will be borne by the Authority. The cost of testing materials by the Contractor's Quality Control System shall be borne by the Contractor and shall be included in the Contractor's bid prices for the applicable items being tested. The cost of testing materials which are rejected will be borne by the Contractor; said cost will be deducted by the Authority from monies which are due or will become due to the Contractor.

Mill certificates attesting to chemical analyses and mechanical tests performed on reinforcement steel and structural steel by the steel manufacturer shall be submitted to the Engineer, or to a testing agency designated by him, for review prior to fabrication and delivery of steel.

Nothing in this Subsection shall be construed to limit the right of the Engineer to order special inspections, tests or approvals.

Manufacturers supplying pipe under the Contract shall provide all facilities necessary to carry out the tests required by the Specifications, at their own expense.

Certain materials as specified will be accepted on the basis of Certifications of Compliance in accordance with Subsection 105.04.

The required number of samples and rate of sampling or Certifications of Compliance for the various materials shall be as specified in the respective methods of test or in the Subsections applicable to that particular material or Pay Item.

Additional samples shall be required, whenever in the opinion of the Engineer, additional tests are required to determine the quality and suitability of materials for their respective uses.

If soil materials are obtained by dredging, the Contractor shall provide safe and adequate water transportation for the Engineer to and from the dredges or other boats and shall cooperate with the Engineer in every reasonable way to expedite inspection and sampling of the materials.

Positive and negative pay adjustments for asphalt and concrete, as defined in Division 900, are Awarded to encourage high quality construction and, when necessary, to recoup the anticipated extra costs to the Authority resulting from poor quality materials used in construction. The manner in which positive and negative pay adjustments are to be shared by the prime Contractor and Subcontractors or Producers is to be negotiated by the affected parties. A letter signed by both parties, stating that an agreement has been reached between the parties, shall be provided by the Engineer before commencement of Work. Nothing contained herein shall create right of action either in law or equity against the Authority.

105.04 Certification of Compliance.

Materials or assemblies as specified will be accepted on the basis of Certificates of Compliance (Manufacturers' Certifications) stating that such materials or assemblies fully comply with the requirements of the Contract. The form of Certificates of Compliance shall be approved by the Engineer.

Materials or assemblies used on the basis of Certificates of Compliance may be sampled and tested at any time and, if found not to be in conformity with the Contract requirements, will be subject to rejection whether in place or not. The Contractor shall require the manufacturer or supplier to furnish the required copies of Certificates of Compliance with each delivery of materials, components and manufactured items that are acceptable by certification. Copies shall be furnished to the Engineer as required, and one copy shall be retained by the Contractor.

Certificates of Compliance shall contain the following information:

- Project to which the material is consigned.
- Name of the Contractor to which the material is supplied.
- Kind of material supplied.
- Product Trade Name (as listed on the Qualified Products List if applicable)
- Quantity of material represented by the certificate.
- Means of identifying the consignment, such as label marking, seal number, etc.
- Date and method of shipment.
- Statement that the material has been tested and found in conformity with the pertinent Contract requirements stated in the certificate.
- Signature of a person having legal authority to bind the supplier.
- Signature attested to by a Notary Public or other properly authorized person.
- Payments relative to materials specified to be accepted on the basis of Certificates of Compliance shall not be made until the Engineer has in his possession an acceptable Certificate of Compliance.

105.05 Plant Inspection.

The Engineer may inspect materials at the source. Manufacturing plants may be inspected for compliance with specified manufacturing methods. Material samples may be obtained for laboratory testing for compliance with materials quality requirements. This may be the basis for acceptance of manufactured lots as to quality.

In the event plant inspection is undertaken, the following conditions shall be met:

- The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he contracted for materials.
- The Engineer shall have full entry at all times to such parts of the plant involved in the manufacture or production of the materials being furnished.
- If required by the Engineer, the Contractor shall arrange for approved office space for the use of the inspector; such space to be located conveniently in or near the plant.
- Adequate safety measures shall be provided and maintained.

It is understood that the Authority reserves the right to retest all materials, which have been tested and accepted at the source of supply after the same have been delivered and to reject all materials which, when retested, do not meet the requirements of the Contract.

105.06 Foreign Materials.

The Contractor shall comply with N.J.S.A. 52:32-1 and N.J.S.A. 52:33-1, et seq., which prohibits the use by the Contractor or subcontractors of farm products or materials produced or manufactured outside of the United States on public work. The Authority may allow exceptions if its enforcement would be inconsistent with the public interest, where the cost of enforcing the prohibition would be unreasonable, or where the material in question is not of a class or kind mined, produced, or manufactured in the United States.

Where the use of foreign materials is allowed in the performance of this Contract, such materials shall be furnished in accordance with the following requirements:

- Materials manufactured, produced or mined outside the United States shall be delivered to approved locations within the State unless otherwise permitted, where they shall be retained until sampling and testing can be completed.
- Each lot of foreign material shall be accompanied by a Certificate of Compliance prepared in accordance with Subsection 105.04. In addition, certified mill test reports shall be attached to the Certificate of Compliance for those materials for which mill test reports are required and shall clearly identify the lot to which they apply.
- Structural materials requiring mill test reports will be accepted only from those foreign manufacturers who have previously established the adequacy of their in-plant quality control to assure delivery of uniform material in conformance with Contract requirements to the satisfaction of the Engineer.
- Adequacy of quality control shall be established, at the option of the Engineer, by either submission of detailed written proof of adequate control, or through an in-plant inspection by the Engineer or his representative. Travel and subsistence costs incurred by the Authority's representative for the performance of such in-plant inspection shall be reimbursed by the Contractor.
- Foreign materials will not be accepted which cannot be identified with mill test reports and Certificates of Compliance, as applicable.

105.07 Storage of Materials and Staging Areas.

Materials shall be stored to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the Work. Stored materials shall be located so as to facilitate their prompt inspection. With the approval of the Engineer, portions of the Authority's right-of-way may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space must be provided by the Contractor at his expense. Hazardous or flammable materials shall not be stored under structures. Private property shall not be used for storage purposes without written permission of the owner or lessee, and if requested by the Engineer, copies of such written permission shall be furnished by the Contractor. Storage sites shall be restored to their original condition by the Contractor at his expense.

Prior to occupying and any staging area on Authority right-of way, the Contractor shall submit to the Engineer a minimum of 10 photographs documenting the initial condition of the staging area.

Similarly, upon vacating any staging area on Authority right-of-way, the Contractor shall submit to the Engineer a minimum of 10 photographs documenting the final condition of the staging area.

At the conclusion of the contract and prior to the final inspection, the Contractor shall restore all storage and staging areas to their original condition as directed by and to the satisfaction of the Engineer. The restoration of storage and staging areas shall not be measured for payment; the cost for such work shall be considered compensation to the Authority for the Contractor's use of the area during the duration of the Contract. The Contractor shall completely vacate and restore all storage and staging areas within 10 days following the completion of the punch list items of work. In the event the Contractor fails to so vacate and restore all storage and staging areas within 10 working days, the Engineer has the authority to arrange for this work to be done by others, deducting the cost for such work to restore the areas from any monies due or which may be due the Contractor, in accordance with Subsection 106.23.

Materials or their containers shall be plainly marked with name of producer, net weight, grade, lot number of approved material from which the content is taken, and date of approval. Materials liable to damage by the elements shall be stored in proper structures or in such other manner as may be necessary to protect them from damage. Materials shall be kept clean and free from foreign matter of any kind before, while, and after being placed in the finished work, and provisions necessary therefore in the opinion of the Engineer shall be made by the Contractor.

Immediately upon receipt of any shipment of materials, and in no event more than twenty-four (24) hours after receiving a shipment of material, the Contractor shall notify the Engineer, in writing, that the materials have been received and are available for inspection. The Contractor shall furnish the Engineer with a copy of the delivery forms indicating the kind, size, quantity and location thereof.

The following requirements are mandated as part of the NJDEP Highway Agency Stormwater General Permit (Highway Agency Permit) for discharge to surface water and groundwater. Documents and forms listed herein and additional instructions are included in the Supplementary Specifications if necessary.

- The Contractor shall operate storage/staging areas within the Authority's right-of-way in accordance with Appendix I of the Supplementary Specifications.

- At least thirty (30) calendar days prior to occupying any staging area, the Contractor shall submit the form entitled "NEW JERSEY TURNPIKE AUTHORITY STAGING AREA INVENTORY/INSPECTION FORM" " contained in Appendix I to the Engineer for approval. The Contractor shall re-submit the form to the Engineer any time an update to the form is necessary (e.g. contact information) or at least every six (6) months.
- At least fourteen (14) calendar days prior to vacating the staging area, the Contractor shall re-submit the above-mentioned form to the Engineer.
- The Contractor shall provide two weeks written notice to the Authority's Engineering Department, Environmental Section prior to vacating the staging area. A copy of the notice should also be submitted to the Engineer.
- All above ground fuel storage tanks utilized for on-site vehicle or equipment fueling must be placed on an impervious surface other than asphalt. The material utilized must be resistant to gasoline and diesel fuel and the limits of the impervious material must encompass the area within which fueling operations are conducted. The surface of the impervious material shall be sloped such that any fuel spills are contained and do not migrate onto adjacent pervious surfaces.

105.08 Handling Materials.

Materials shall be handled to assure the preservation of their quality and fitness for the Work. Aggregates shall be transported from the storage site to the Project site in tight vehicles constructed to prevent loss or segregation of materials after loading and measuring in order that there may be no inconsistencies in the quantities of materials intended for incorporation in the work as loaded, and the quantities actually received at the place of operations.

Paints, pesticides, epoxies and other materials used in construction require special handling and precautions in their use. All such materials shall be handled and applied in strict accordance with the manufacturer's recommendations in a manner so as not to endanger the personnel of the Contractor, the Authority, its patrons, neighbors or their respective properties. Containers of such material shall be properly handled and disposed of after use. Where required, licensed personnel shall supervise the handling, application, and disposal of such materials and their containers. All reports and documentation required by law shall be promptly submitted to the agency having jurisdiction, with copy to the Engineer.

105.09 Unacceptable Materials.

All materials whether in place or not, not conforming to the requirements of the Contract Documents, as determined by the Engineer, shall be considered as unacceptable and such materials will be rejected and shall be removed immediately, upon the Engineer's directive, at the Contractor's expense from the site of the work unless otherwise instructed by the Engineer. Rejected material, the defects of which have been corrected, shall not be used until approval has been given. Contractor shall be responsible for all costs associated with the Contractor's failure to comply with the Engineer's directive to remove such rejected material.

105.10 Authority Furnished Material.

The Contractor shall furnish all materials required to complete the work, except those specified to be furnished by the Authority. Material furnished by the Authority will be delivered or made available at the points specified in the Supplementary Specifications.

The cost of handling and placing the materials after they are delivered or made available shall be considered as included in the work for the Pay Item in connection with which they are used.

The Contractor will be held responsible for all material delivered to him, and deductions will be made from any monies due him to make good any shortages and deficiencies from any cause whatsoever, for any damage which may occur after such delivery, and for any demurrage charges.

105.11 Approved Equals and Substitutions.

Whenever a product, defined as an item of material or equipment, is specified or described in the Contract Documents or QPL by using the name of a proprietary item or the name of a particular Vendor, the Contract Price has been based upon the Contractor furnishing such product as specified. The specification or description of such product is intended to establish the type, function, appearance, and quality required. Refer to the QPL Manual found on the Authority's website for more information on qualified products.

Where the term "approved equal" is given in the specifications in conjunction with a particular brand, make, material, device or equipment, substitution will be considered when such proposed substitution equals or exceeds that specified with respect to quality, workmanship, service, maintenance, economy, and reliability of operation.

Such requests shall only be considered during the course of construction. The Engineer will not accept requests to authorize other products from anyone other than the Contractor. Requests will be denied if the Engineer deems that evaluation will result in delay of construction schedule.

When the Contractor requests substitution of a brand, make of material, device or equipment, other than that or those specified as a basis of quality, workmanship, service and maintenance, he shall first thoroughly investigate his proposed substitution and certify to the Engineer, in writing, that said proposed substitution is equal to that specified. At the Contractor's expense, he shall include with said certification all required data, samples, reports and tests to substantiate his findings. Where color, color selections, sizes, space limitation, finished appearance, and other requirements may be a factor, these shall be considered. The Engineer will decide if such substitution is, in his judgment, equal to that specified; and if found to be so by him, may then be approved. The Engineer's decision will be final and binding to all parties.

105.12 Material and Product Samples.

In addition to the shop and working drawings specified in Subsection 104.08, when directed the Contractor shall furnish physical samples of materials and/or finishes proposed to be incorporated in the work to the Engineer for review and approval.

Samples shall be of sufficient size or number to be representative of quality, type, range of color, finish, and texture of the material. Each sample shall be labeled, bearing the name and quality of the material, Contractor's name, date submitted, contract number and project, and a notation of the item's intended use and placement. A form of transmittal, acceptable to the Engineer, must accompany all samples and all transportation charges shall be prepaid.

Samples and other required information shall be submitted in sufficient time to permit proper consideration and action without delaying any operation under the Project. Materials, equipment, and/or appliances should not be ordered until the Engineer has completed his review and the item is approved for use. When submitted samples are disapproved, other samples shall be submitted until satisfactory and approval granted.

The Engineer's review of any sample shall be completed as rapidly as possible and shall be only for the characteristics, color, texture, strength, or other features of the material named in such approval and no other. Use of materials will be permitted providing the quality remains equal to the approved sample and complies in every respect with the Specifications. Approval of a sample will not in itself change or modify any requirements of the Contract.

105.13 Additional Requirements.

Additional requirements supplementing the Control of Materials are given in the subsequent Divisions of these Specifications and other contract documents as they relate to specific materials.

All materials and products used in conjunction with this Project shall conform to the current New Jersey Department of Environmental Protection (NJDEP) Rules and Regulations; including Section 7:27-23, Volatile Organic Substances in Consumer Products, and other applicable sections. The Contractor shall furnish certificates of compliance with NJDEP rules and regulations, concerning consumer products for all products and materials used.

105.14 Timber Grading and Certification.

All timber used in the design and construction of catches, and/or temporary flooring platforms shall be graded timber and certified by Sawn Lumber Grading Agency certified by the "American Lumber Standard Committee."

The National Design Specifications (NDS) for Wood Construction and the Supplement shall be used for timber design of temporary floors or catch platforms.

Timber plank systems shall meet the following requirements:

(A) All timber planking systems will require an overlay. The overlay may be plywood or other approved material.

105.15 Payment for Material on Hand.

The Contractor may request payment for the cost of materials, including the storage cost, not yet incorporated into the work. If approved by the Engineer, the Authority will make payment for the cost of materials, including storage costs; however, the amount of payment shall not exceed 65% of the price bid for the associated Pay Item in the Proposal.

In accordance with Subsection 108.03, the Authority shall not make any partial payment for Material on Hand until the Engineer approves that the following requirements are met:

(A) The Contractor shall have provided the Engineer with the paid invoice or paid bill of sale for the material and a fully executed "Release of Liens for Materials Stored for Incorporation in New Jersey Turnpike Authority Contract" Form (available on the Authority website at http://www.state.nj.us/turnpike/construction.html) , including the transfer of ownership to the Authority.

(B) The items which are eligible for payment under the aforementioned provisions shall be handled case by case and are subject to the approval by the Engineer. In general, compensation for Material on Hand shall be those materials which are unique and specific to the Contract. Any questions in this regard shall be reviewed by the Engineer.

(C) Two (2) percent of the value of raw material as it pertains to the Structural Steel Pay Item(s) has been deducted and retained at all times.

(D) Ten (10) percent of the value of fabricated permanent materials and equipment furnished but not yet incorporated into the work has been deducted and retained at all times.

(E) The Contractor shall have properly stored and protected materials within the Contract Limits or at locations owned or leased by the Contractor or the Authority within the State, with the exception of structural steel provided that the Authority granted prior approval.

(F) When materials are stored in a leased area, the lease was made out to the Contractor and provided that it shall be canceled only with the written permission of the Authority. The Contractor shall have submitted a copy of the lease to the Engineer.

(G) The Contractor shall have provided bills of lading for the receipt of the raw material delivery to the approved storage facility.

(H) The Contractor shall have provided all required material certifications.

(I) The Contractor shall have provided proof of insurance for the materials stored at the approved storage facility.

(J) The Contractor shall have stored the material in a fenced-in area with access limited to the Authority and the Contractor.

(K) The Contractor shall have covered or otherwise protected the material from the elements to the satisfaction of the Engineer.

(L) The Contractor shall have posted a sign at the location clearly identifying that the materials are without encumbrances and are solely used for this Contract.

Upon Engineer approval of the above requirements, partial payments for Material on Hand will then be made as follows:

Payment up to a maximum of 25% of the Pay Item, less 10% retainage, will be made to the Contractor upon confirmed delivery of raw materials to the approved storage facilities, not to exceed the raw materials quantities shown on bills of materials in approved shop drawings.

Payment up to a maximum of 40% of the Pay Item will be made to the Contractor upon complete fabrication of items stored at approved storage facilities.

Payment up to a maximum of 35%, or the remaining value, of the Pay Item will be made to the Contractor upon final delivery, installation, and/or erection of the Pay Item as given in the Contract documents or as directed by the Engineer.

Payment for materials does not constitute Authority approval or acceptance of the materials or work. If materials paid for are damaged, stolen or prove to be unacceptable, the Authority retains the right to recover the costs from the Contractor.

No separate payment will be made for storage of the material at the approved storage facility.

No separate payment will be made for the insurance required for the storage of the material at the approved storage facility.

SECTION 106 - LEGAL RELATIONS AND RESPONSIBILITY

106.01 Personal Liability.

In carrying out the provisions of this Contract or in exercising any power or authority granted them by their position, neither the members of the Authority nor any officer, agent, or employee thereof shall be charged personally by the Contractor with any liability.

106.02 Laws and Ordinances.

The Contractor shall observe and comply with all Federal and State Laws and local ordinances that affect those engaged or employed on the Project, the materials or equipment used, or the conduct of the work.

The Contractor shall comply with all of the applicable provisions of the Williams-Steiger Occupational Safety and Health Act (OSHA) of 1970, 29 U.S.C Section 651 et seq., including Safety and Health Regulations for Construction. The Contractor must maintain up-to-date records of the required information as specified in the Recordkeeping Requirements pamphlet issued by the U.S. Department of Labor, Bureau of Labor Statistics or Occupational Safety and Health Administration. The Contractor shall comply with the applicable provisions and regulations of the New Jersey Worker and Community Right-To-Know Act, N.J.S.A. 34:5A-1 et seq. The Contractor shall maintain the appropriate records and information as specified in the Act and make available to the Authority a copy of these records and information.

Prior to the commencement of work to be performed adjacent to high voltage lines, the Contractor shall notify the Department of Labor and Industry, Bureau of Engineering and Safety to secure their approval, and shall prosecute such work in strict accordance with the provisions of "High Voltage Proximity Act", N.J.S.A. 34:6-47.1 et seq.

The parties to this Contract agree to incorporate into the Contract the mandatory language of N.J.A.C. 17:27-3.4(a) and N.J.A.C. 17:27-7.4(A) and (B) promulgated by the Treasurer pursuant to P.L. 1975, C 127, N.J.S.A. 10:5-31 et seq., and the Contractor or Subcontractor agrees to comply fully with these regulations, the provisions of N.J.A.C. 17:27-3.4(a) shall apply subject to the terms of N.J.A.C. 17:27-3.4(c).

(A) CONTAINER LABELING REQUIREMENTS FOR CONTRACTORS AND SUBCONTRACTORS.

Vendor/supplier/contractor shall ensure that each and every container delivered to an Authority facility is labeled in accordance with the New Jersey Worker and Community Right-to-Know Act (N.J.S.A. 34:5A-1 et seq.) and the regulations promulgated pursuant thereto (N.J.A.C. 8:59-5 et seq.).

Any subcontractor who delivers to, or stores hazardous or other substances at an Authority facility, shall ensure that the containers holding these substances are labeled in accordance with the New Jersey Worker and Community Right-to-Know Act (N.J.S.A. 34:5A-1 et seq.) and the regulations promulgated pursuant thereto (N.J.A.C. 8:59-5 et seq.).

Specifically, every container "shall bear a label indicating the chemical name and chemical abstracts service numbers of all hazardous substances in the container, and all other substances which are among the five most predominant substances in the container, or the trade secret registry number assigned to the substance. Common names specified in N.J.A.C. 8:59-5.7 may be substituted for the chemical name of the substance "(N.J.A.C. 8:59-5.1(c))."

These labeling requirements shall not apply to containers falling within N.J.A.C. 8:59-5.5, "exceptions to labeling requirements; Federal and State labeling laws" or N.J.A.C. 8:59-5.6, "Exclusions from the requirement to label."

Any vendor / supplier / contractor / subcontractor who delivers to, or stores hazardous or other substances at an Authority facility, shall provide material safety data sheets to the Authority for all products present at, purchased for, or brought on site to an Authority facility. [Pursuant to N.J.A.C. 8:59-2.2(I)].

(B) OVERHEAD WIRES.

The Contractor is directed to the need of working safely near overhead wires. The Contractor shall, at all times, observe the provisions of the New Jersey Statute known as Chapter 249 of the Laws of 1948, being codified as Sections 34:6-47.1, et. seq. of the New Jersey Statutes Annotated, and operate in accordance with the rules and regulations concerning precautions to be taken in the proximity of high voltage lines for the prevention of accidents promulgated by the Commissioner of the Department of Labor and Industry of the State of New Jersey, effective September 6, 1966 all as amended and supplemented; and in accordance with the provisions of the Federal Occupational Safety and Health Act of 1970 and of Subpart N paragraph 1926.550 of the Rules and Regulations issued under that act (see 29 CFR 1926.550).

(C) CATCH AND TEMPORARY FLOORING.

Catch and Temporary flooring used as working platforms must comply with OSHA 29CFR, Part 1926-Safety and Health Regulations for Construction, Subpart L – Scaffolds.

106.03 Annulment of Contract.

The Authority may, by written notice, with the approval of the Federal Highway Administration where applicable, annul the Contract or any portion thereof for any lawful reason, including but not limited to the following:

- The Contractor is prevented from proceeding with the construction of the Project as a direct result of a Presidential Executive Order with respect to the occurrence of war or in the interest of national defense;
- The Authority or the Contractor is prevented from proceeding with the construction contract as a direct result of an Order of a Court of competent jurisdiction;
- Funds necessary for the Project's completion become unavailable;
- For the Authority's convenience, the Authority has determined that such determination will be in its best interest; or
- All of the Work of any critical work activity, as determined by the Progress Schedule, is delayed for more than ninety (90) consecutive calendar days, for any cause beyond the responsibility of the Contractor. The Authority may enter into an Agreement with the Contractor or may annul the Contract by written notice to the Contractor. If an agreement is entered into, it will be executed by the Contractor and the Authority's Executive Director, approved by the Surety and the Commissioners or their designees.

When the Contract, or any portion is annulled before completion of all items of contract Work, payment will be made for each unit of Work fully completed at the Contract unit price, and payment for each partially completed unit of Work will be as mutually agreed, or at the percentage of the contract unit price that the cost of the partially completed unit is of a fully completed unit with a maximum allowable of 100%. No claim for lost profits or damages of any kind will be allowed for the annulment.

Acceptable material, obtained by the Contractor for the Work, will be purchased from the Contractor at actual cost, as shown by receipted bills and actual cost records, at such points of delivery as may be designated.

Annulment of any portion of the Contract does not relieve the Contractor of responsibilities for the completed Work, nor will it relieve the surety of its obligation for any claim arising out of the performance of the Work.

106.04 Default of Contract.

If the Contractor's for any reason including, but not limited to the following:

- fails to begin the Work under the Contract within the time specified in the Contract Documents, or
- fails to perform the Work with sufficient workers and equipment or with sufficient materials to ensure its completion within the Contract Time specified, or any extension thereof, or
- fails to complete the Contract within the Contract Time specified, as extended, or
- performs the Work unsuitably, or neglects or refuses to remove materials or to again perform such Work as may be rejected as unacceptable or unsuitable, or
- discontinues the prosecution of the Work, or
- fails to resume Work which has been discontinued within a reasonable time after notice to do so, or

- becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or
- allows any final judgment to stand against it unsatisfied for a period of ten (10) days, or
- makes an assignment for the benefit of creditors, or
- fails to acquire or maintain the required insurance, or
- fails to comply with Contract requirements regarding minimum wage payment, disadvantaged business enterprises, or equal employment opportunity requirements, or
- is a party to fraud, or
- for any other cause whatsoever, fails to carry out the Work in an acceptable manner,

the Engineer will give written notice to the Contractor and Surety of such delay, neglect, or default, demanding the elimination of such cause for default.

If the Contractor or Surety, within a period of ten (10) days after such notice, does not proceed in accordance therewith, the Chief Engineer has, upon written notification of the fact of such delay, neglect, or default and the Contractor's failure to comply with such notice, full power and authority without violating the Contract, to declare the Contractor in default and notify the Contractor to discontinue the Work. The declaration of default will be in writing and given to the Contractor and the Surety. The Authority may appropriate any or all materials and equipment on the site as may be suitable and acceptable and may direct the Surety to complete the Contract or may enter into an agreement for the completion of the Contract according to the terms and provisions thereof with another contractor or the Surety, or use such other methods required for the completion of the Contract, including completion of the Work by the Authority.

The Contractor and Surety are not relieved of the assessment of liquidated damages under Section 107.07 because of the Contractor's default.

All costs and charges including, but not limited to, consultants and counsel fees incurred by the Authority, together with the cost of completing the Work, will be deducted from any monies due or that may become due to the Contractor and Surety. If such expense exceeds the sum which would be available from such monies, then the contractor and Surety shall be liable and shall pay to the Authority the amount of such excess.

The rights and remedies of the Authority are in addition to any other rights and remedies provide by law or under the Contract and the Contract Bond.

If a notice of termination for default has been issued, and it is later determined for any reason that the Contractor was not in default, the rights and obligations of the parties shall be the same as if the notice of termination had been issued pursuant to Subsection 106.03 Annulment of Contract.

Where the Authority's default of the Contractor pursuant to the provisions of this Section is found by a court to be legally improper, the Contract will be treated as if the Contract had been annulled pursuant to Subsection 106.03, and such annulment is to be compensated for in accordance with provisions of Subsection 106.03.

106.05 Forfeiture.

If the Contractor or any of his agents, employees, or representatives shall give, offer to give, or promise to give or pay, either directly or indirectly, any money, property, entertainment, or other valuable thing to secure the Award or execution of this Contract to any employee of the Authority or to any agents of the State Government for any reason, purpose, cause, or as an inducement, bribe, or reward for doing or omitting to do any act, or for showing any favor or disfavor in relation to the Contract, the making of such gifts, offer to give, inducement, or promise, shall constitute a violation of the Contract. Upon proof to the Authority of such violation, the Authority shall (i) terminate the Contract; (ii) take all legal action, as appropriate; and (iii) take any other lawful action deemed appropriate. The Contractor shall forfeit all monies paid to or deposited with the Authority and all monies due under the Contract.

106.06 Unauthorized or Defective Work.

The Contractor shall use no materials in the Work before they have been approved as provided in Section 105; he shall perform no work before the lines, grades and benchmarks therefore have been established as provided in Subsection 104.09; and he shall perform no work not designated in the Contract, unless a written order therefore has been given as provided in Subsection 104.04. Work performed, which does not comply with the requirements therefore, will be rejected and shall be removed, replaced, or repaired as the Engineer may direct and in a manner satisfactory to him at the Contractor's expense, and the Authority shall not be liable or responsible for any damages due to delay.

Work performed which is out-of-tolerance in accordance with the contract documents will be rejected and shall be removed, replaced, or supplemented as the Engineer may direct and in a manner satisfactory to him at the Contractor's expense, all costs related to this review shall be at the Contractor's expense and the Authority's consideration will not be considered grounds for an extension of the contract time. The Authority shall not be liable or responsible for any damages due to delay. Should the Contractor request that out-of-tolerance work be reviewed for acceptance, all costs related to this review shall be at the Contractor's expense. All costs incurred by the Authority, including those of the Design Engineer, shall be reimbursed to the Authority in the form of a credit deducted from the Contractor's estimate. Rejection of the out-of-tolerance work subsequent to this additional review will not be means for a claim by the Contractor for monies or time.

106.07 Claims for Additional Compensation or Extension of Time.

When the Contractor deems that additional compensation or extension of time is due for Work to be performed or materials to be furnished, which were not required by the Contract and which have not been covered by a Change Order as herein specified, he must notify the Chief Engineer in writing of his intention to make claim for such additional compensation or extension of time or both. This notification must be received by the Chief Engineer within 10 days after the event or events giving rise to the claim first occurs, or the Contractor expends extra costs or deems that he will be required to expend extra costs, or the Contractor is or will be delayed, or before he will begin the work or furnish the materials in question, whichever of the foregoing shall occur first. If such notification is not given, and if the Chief Engineer is not afforded proper facilities for keeping account of the actual cost to the Contractor of such work and materials, then the Contractor shall agree, and hereby does agree, to waive the claim for such additional compensation or extension of time or both.

During the Authority's operations of snow removal from its roadways, it may sometimes be impracticable to avoid piling the accumulated snow onto the Contractor's working areas alongside. In such event, the Contractor shall clear such areas of the accumulated snow as necessary to proceed with his work. The Contractor agrees that he will make no claim for compensation for any such work which might be required, nor for extensions of time due to any delays occasioned thereby. However, the Contractor shall not be responsible for removal of ice or snow from sections of the roadways opened to traffic or for damage to the Project caused by the operation of snow plows or other snow removal or de-icing operations carried on by others, under the supervision or direction of the Authority or of the various Counties and Municipalities.

Claims shall be filed with the Chief Engineer in quintuplicate, and will be ruled on by the Authority. Claims shall be submitted only by registered mail addressed to the Chief Engineer. No claim will be granted unless the Authority deems such claim to be just. Claims shall be filed promptly after submitting notification of an intention to file a claim. No claim for whatever reason will be considered by the Authority, and the Contractor hereby waives all claims submitted more than sixty (60) days after the event or occurrence giving rise to such claim, or more than thirty (30) days after the Project has been substantially completed in the opinion of the Engineer, whichever shall first occur.

To facilitate the expeditious resolution of claims, the Contractor shall include the following documents and supporting data with each claim submitted:

(A) TIME RELATED DISPUTE SUBMISSIONS.

(1) A description of the operations that were delayed, the reasons for the delay, how they were delayed, including the report of all scheduling experts or other consultants, if any.
(2) An as-built chart, "Critical Path Method" scheme or other diagram or chart depicting in graphic form how the operations were or are presumed to be adversely affected.
(3) The date on which actions resulting in the dispute occurred or conditions resulting in the dispute became evident.
(4) A copy of the "Notice of Intention to Make a Claim," required as per Subsection 106.07 for the specific dispute by the Contractor.
(5) To the extent known, the name, function, and activity of each Authority official, or employee or agent, involved in or knowledgeable about the facts that gave rise to such dispute.
(6) The name, function, and activity of each Contractor or subcontractor official, or employee, involved in, or knowledgeable about the facts that gave rise to such dispute.
(7) The identification of any pertinent documents, and the substance of any material oral communication relating to such dispute.
(8) A statement as to whether the additional compensation or extension of time, if requested is based on the provisions of the Contract, or is an alleged breach of contract.

(9) The amount of additional compensation sought and a breakdown of that amount into the categories specified in the Contract Documents.
(10) If an extension of time is also requested, the specific days for which it is sought, and the basis for such request as determined by an analysis of the construction progress schedule.

(B) FOR OTHER DISPUTES INCLUDING ACCELERATION DISPUTES.

(1) A detailed factual statement of the dispute providing all necessary dates, locations and items of Work affected by the dispute.
(2) The date on which actions resulting in the dispute occurred or conditions resulting in the dispute became evident.
(3) A copy of the "Notice of Intention to Make a Claim" required for the specific dispute by the Contract pursuant to Subsection 106.07.
(4) The name, function, and activity of each Authority official or employee or agent involved in, or knowledgeable about the facts that gave rise to such dispute.
(5) The name, function, and activity of each Contractor or subcontractor official or employee or agent involved in, or knowledgeable about the facts that gave rise to such dispute.
(6) The specific provisions of the Contract which support the dispute and a statement of the reasons why such provisions support the dispute.
(7) The identification of any pertinent documents and the substance of any material oral communications relating to such dispute.
(8) A statement as to whether the additional compensation or extension of time, if requested is based on the provisions of the Contract, or is an alleged breach of contract.
(9) If an extension of time is also requested, the specific days for which it is sought and the basis for such request as determined by an analysis of the construction progress schedule.
(10) The amount of additional compensation sought and a breakdown of that amount into the categories specified in the Contract Documents.

(C) DISPUTES OVER $50,000 DOLLARS.

When submitting any dispute over $50,000, the Contractor must certify in writing, under oath and in accordance with the formalities required by the Contract, as to the following:

(1) That supportive data is accurate and complete to the Contractor's best knowledge and belief;
(2) That the amount of the dispute and the dispute itself accurately reflects what the Contractor in good faith believes to be the Authority's liability;
(3) If the Contractor is an individual, the certification shall be executed by the individual.
(4) If the Contractor is not an individual, the certification shall be executed by:
(5) The senior company official in charge at the Contractor's plant or location involved; or
(6) An officer or general partner of the Contractor having overall responsibility for the conduct of the Contractor's affairs.

The Contractor shall proceed with all Work, whether or not such Work is the subject of a pending claim, as directed and in accordance with the Contract Agreement, and shall not delay the Project progress in any way because of any pending, unresolved or denied claim.

The Contractor expressly agrees to take all reasonable actions to mitigate the cost and schedule impacts of all events or circumstances giving rise to claims for additional compensation or extensions of time.

If, within 30 days of receipt by the Contractor of the Authority's determination with respect to a claim, the Contractor fails to notify the Chief Engineer in writing that he disagrees with such determination, the Contractor shall be conclusively presumed to agree to and accept such determination.

The Authority shall have the right to require, and the Contractor hereby agrees as a condition to the Authority's consideration of his claim to permit an audit, or other inspection by the Authority or its representatives of all books, records, costs, and any and all records and documentation that the Authority deems relevant to a determination of the alleged costs, damages or other impact to the Contractor, resulting from the facts and circumstances giving rise to such claim.

The provisions of this Article shall not apply to claims arising out of the operations of Subsection 107.08. Attention is directed to the provisions of Subsection 104.04, regarding limitation of increase and reduction of quantities of scheduled items.

106.08 Subcontractors and Suppliers Claims.

Any claim by subcontractor or suppliers or any person, Firm or Corporation doing business with the Contractor shall be filed in accordance with the Provisions of the New Jersey Bond Act, N.J.S.A. 2A:44-143, et seq.

106.09 Responsibility for Work.

The Contractor assumes full responsibility for materials and equipment employed in the construction of the Project and agrees to make no claims against the Authority for damages to such materials and equipment from any cause whatsoever. Until final acceptance of the Project, the Contractor shall be responsible for damage to or destruction of the Project, or any part thereof, due to any cause whatsoever including damage or defacement by graffiti or other acts of vandalism. The Contractor shall make good all work damaged or destroyed, before the final acceptance except as specified herein.

The Chief Engineer reserves the right to order completed or partly completed sections of the project to be opened to traffic prior to the acceptance of the project and will notify the Contractor in advance when deemed necessary. This order shall prevail over any notifications shown in the Contract Documents. The Contractor agrees that he will make no claims for and shall have no right to additional payment or any other concession due to maintenance and protection of traffic or additional protection of work caused by such opening to traffic, either before or after the completion of the project. The Contractor shall replace or renew any work or materials lost or damaged, because of such opening to traffic. All repair of damage and replacement of lost materials, caused by opening to traffic prior to the acceptance of the project, for reasons beyond the control of the Contractor, will be paid for by the Authority at Contract unit prices, if applicable, or by supplementary agreement.

106.10 Permits, Licenses and Taxes.

The Contractor shall procure all permits, grants and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work. Where the Authority has procured permits, grants or licenses for temporary or permanent construction, the Contractor will be relieved of the above obligation to the extent provided by the terms of such permit, grant or license. However, he shall advise the issuing agency or party of his proposed operations and obtain their cooperation and such supplemental permission, as may be necessary. Before submitting his bid, the Contractor shall obtain from the Authority all available information on the permits, grants, and licenses that it has obtained. Charges for permits, grants, and licenses in connection with the work, and not obtained by the Authority, shall be paid by the Contractor, and shall be included in the unit prices bid for the various Pay Items scheduled in the Proposal.

The Contractor shall be responsible for conformance to all requirements of any permits, grants or licenses necessary during construction. Should the Contractor violate these requirements and cause the issuing agency to levy any fine against the Authority, the Authority will deduct an equal amount from the Contractor's final payment.

Before the Contractor performs dredging or channel excavation within tidal waterways for the procurement of materials, or performs therein other work of his own, when such work is not part of the permanent or temporary work provided for in the Contract, he shall advise the Engineer, the Corps of Engineers, US Army, US Coast Guard, and the New Jersey Department of Environmental Protection, Division of Marine Services and Division of Water Resources of his intended work. If the waterway is not navigable, he shall notify the Engineer and the Division of Water Resources only. The Contractor shall procure all necessary permits for such work from the above named agencies, having jurisdiction and interest and shall comply with their rules and regulations in the performance of the above mentioned work.

Prior to submitting a bid based on utilizing hydraulically procured soil aggregate materials, Bidders shall assure themselves that the State Department of Environmental Protection will issue a permit to dredge such materials.

Sales or services supplied to or purchased by the Authority are exempt under N.J.S.A. 54:32B-8 et seq., from the State of New Jersey Sales and Use Tax (Tax Exempt No. 22-6002951). Also, sales made to Contractors, subcontractors or repairmen of materials, supplies or services which are to be incorporated into the completed Work are exempt from the State of New Jersey Sales and Use Tax. The exemption provided under N.J.S.A. 54:32B-8 is conditioned on the person seeking such exemption to qualify therefore pursuant to the rules and regulations and upon the forms prescribed by the New Jersey Division of Taxation. The required form, "Contractor's Exemption Purchase Certificate: (Form No. ST-13), can be obtained by writing or calling the New

Jersey Division of Taxation, Tax Information Services (TIS), West State and Willow Streets, Trenton, New Jersey 08625.

All Contractors, subcontractors, or repairmen are required to abide by any amendment and/or revision to the State of New Jersey Sales and Use Tax, without any right of recourse against the Authority.

The Contractor's attention is called to the following two permits, recently established by the NJDEP that may also be required on this Contract:

(A) WELL DRILLING PERMIT.

The Contractor shall apply for and obtain a Well Drilling Permit from the NJ Department of Environmental Protection's (NJDEP) Division of Water Resources, Bureau of Water Allocation, when the drilling, boring, coring or excavation of any hole that is $\geq$ 25 feet in-depth or that enters the groundwater table at an elevation above 25 feet in depth is anticipated. No well drilling shall be permitted until such permit is obtained. Each permit covers all wells within a ¼ sq. mi. area.

(B) DEWATERING PERMIT.

The Contractor shall apply for and obtain a Dewatering Permit from the NJDEP's Division of Water Resources, Bureau of Water Allocation, when the pumping or lowering of any groundwater at an average rate of 100,000 gallons per day, over a 30-day period, within a 2 sq. mi. area is anticipated. No pumping of groundwater shall be permitted until such permit is obtained.

Pursuant to N.J.S.A. 54:49-19, and notwithstanding any provision of the law to the contrary, whenever any taxpayer, partnership, or S corporation under contract to provide goods or services or construction projects to the State of New Jersey or its agencies or instrumentalities, including the legislative and judicial branches of State government, is entitled to payment for those goods or services or construction projects and at the same time the taxpayer, or the partner or shareholder of that entity, is indebted for any State tax, the Director of the Division of Taxation shall seek to set-off that taxpayer's, partner's or shareholder's share of the payment due to the taxpayer, partnership, or S corporation. The amount of set-off shall not allow for the deduction of any expenses or other deductions which might be attributable to a partner or shareholder subject to set-off under this act. No payment shall be made to the taxpayer, the provider of goods or services or the contractor or subcontractor of construction projects pending resolution of the indebtedness.

The Director of the Division of Taxation shall give notice to the set-off to the taxpayer, the provider of goods or services, or the contractor or subcontractor of construction projects and provide an opportunity for a hearing with thirty (30) days such notice under the procedures for protests established under R.S. 54:49-18. No requests for conference, protest or subsequent appeal to the Tax Court from any protest under this section shall stay the collection of the indebtedness. Interest that may be payable by the State pursuant to P.L. 1987, c. 184 (c.582:32-32 et seq.) to the taxpayer, the provider of goods or services, or the contractor or subcontractor of construction projects shall be stayed.

106.11 Patented Devices, Materials and Processes.

If the Contractor employs any design, device, materials, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor shall assume all costs arising from the use of patented materials, equipment, devices, or processes used on or incorporated in the work. The Contractor and the surety shall defend, indemnify, and save harmless the Authority, and any affected third party or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material, process, or any trademark or copyright, and shall indemnify the Authority for any costs expenses and damages which it may be obliged to pay by reason of an infringement at any time during the prosecution or after the acceptance of the work.

106.12 Public Convenience and Safety.

At all times, the Contractor shall conduct the Work as to assure the least possible obstruction to traffic. The safety and convenience of the general public and the residents along Authority roadways and the protection of persons and property shall be provided for by the Contractor as specified under Division 800, Traffic Control.

Precaution shall be exercised at all times for the protection of persons and property. The safety provisions of all applicable laws, including but not limited to OSHA regulations, building and construction codes, and the rules and regulations of the New Jersey Department of Labor and Industry, shall be observed.

The Contractor shall conduct and schedule his hauling operations, so that local residents will not be inconvenienced and shall cooperate with local officials in this regard.

Trucks hauling materials shall have tight tailgates and shall be loaded with adequate freeboard of not less than 3 inches, without precarious cones or piles of material, and shall be properly covered in conformance with the applicable state laws, local codes, or Authority Regulations. All loads shall be trimmed and covered so as to prevent spillage.

The Contractor shall be responsible for the prompt and continuous satisfactory removal and cleaning of dirt spillages and other materials that have been spilled, washed, tracked or otherwise deposited on streets, drains, inlets, shoulders, curbs, gutters, and other areas in use by the public and the Authority for the duration of the Contract. The Contractor shall undertake all necessary precautionary measures, and shall employ mechanical sweepers or any other approved cleaning devices necessary to comply with these requirements.

The Contractor shall employ the necessary means to control the dust as provided under Subsection 104.12.

Fires will not be permitted on or adjacent to the Authority property.

At all times, the Contractor shall keep the construction site in a neat and orderly condition to the satisfaction of the Engineer. The Contractor shall make a daily cleanup of all trash including all papers, containers, wrappings, waste construction materials, etc., originating from the operations of the Contractor or his subcontractors.

106.13 Use of Explosives.

Explosives shall not be brought onto Authority property without prior written approval of the Engineer. The Contractor shall submit with his request for permission to use explosives, detailed methods and procedures Contractor proposes to use. Approval for use of explosives will greatly depend, along with other factors (safety, local codes, and ordinances, etc.), on the acceptance of the Engineer of such methods and procedures.

Explosives shall be stored safely under lock in an area and a manner approved by the Engineer. The storage places shall be marked conspicuously DANGEROUS EXPLOSIVES and be in the care of a competent watchman at all times. The storing and handling of explosives and highly inflammable materials shall conform to the State regulations relating thereto. Proper means shall be used to avoid damage by blasting to public and private property, flagmen shall be provided when necessary in order to warn and keep traffic from the danger area, and all persons within the danger area shall be warned and given time to withdraw.

106.14 Protection and Restoration of Property Markers and Land Monuments.

The Contractor shall be responsible for the preservation of all Authority, public and private property markers and shall protect carefully from disturbance or damage all land monuments and property markers, until the Engineer has witnessed or otherwise referenced their location. Monuments and markers shall not be moved until directed. Land monuments and property markers shall be reset by a licensed land surveyor.

106.15 Forest Protection.

In carrying out Work within or adjacent to State or National Forests or Parks, the Contractor shall comply with all executive orders, regulations of the State Fire Warden, State Division of Parks and Forestry, or other authority having jurisdiction, governing the protection of forests and the carrying out of Work within forests, and shall observe all sanitary laws and regulations with respect to the performance of Work in forest areas. The Contractor shall keep the areas in an orderly condition, dispose of all refuse, obtain permits for the construction and maintenance of all construction camps, stores, warehouses, residences, latrines, cesspools, septic tanks, and other structures in accordance with the requirements of the Division or such other authority.

The Contractor shall take all reasonable precautions to prevent forest fires and shall require his employees and subcontractors, both independently and at the request of Forestry officials, to do all reasonably within their power to prevent and assist in preventing forest fires and to make every possible effort to notify a Forestry official at the earliest possible moment of the location and extent of any fire seen by them.

106.16 Construction Over or Adjacent to Railroad Facilities.

Where the Project includes work across, over, under, or adjacent to railroad tracks or railroad right-of-way, the Contractor shall safeguard the traffic, tracks and appurtenances, and other property of the railroad affected by his work. Contractor shall comply with the regulations of the railroad company relating to the work, shall keep tracks clear of obstructions, shall provide barricades, warning signs, lights or other safety devices as required

and specified under Section 804. Any damage to railroad facilities due to Contractor's negligence shall be borne by the Contractor.

106.17 Construction Over or Adjacent to Navigable Waters.

All work over, on, or adjacent to navigable waters shall be so conducted that free navigation of the waterways will not be interfered with and that the existing navigable depths will not be impaired except as allowed by permit issued by the US Coast Guard and/or the US Army Corps of Engineers, as applicable, and as required and specified under Section 805.

106.18 Utilities.

Except as otherwise specifically provided, the Contractor shall be responsible for the safety, protection, maintenance and final restoration, to as useful, safe and durable a condition as existed prior to construction, of all surface and subsurface utilities (together with all parts and appurtenances thereof), facilities, streets, waterways, structures, and other properties at or near the site. Within the site of the Project there may be Authority, private and/or public utility facilities, and notwithstanding any other clause or clauses of the Contract, the Contractor shall not proceed with any ground intrusive activities until it has notified the State's One Call System and complied with the State's Underground Facility Protection Act. The One Call System can be reached by calling 1-800-272-1000.

Before the beginning of any ground intrusive activities, the Contractor shall provide the Engineer with the New Jersey One Call System confirmation number or a copy of the New Jersey One Call System markout ticket. The Contractor is responsible for confirming that all the utilities listed on the New Jersey One Call System markout ticket and the plans have been marked out prior to beginning ground intrusive operations. The Contractor shall carefully locate the marked out facilities, in accordance with the State's Underground Facility Protection Act, in the work area and conduct his operations so as to avoid any damage to them.

As directed by the Engineer, the Contractor shall mark and identify the perimeter of the proposed site of the ground intrusive activities with white paint, flags, stakes, or a combination thereof prior to notifying the New Jersey One Call System of the Contractor's intent to engage in excavation or demolition. The proposed site shall be the minimum size necessary to safely accommodate the planned excavation or demolition (e.g. small sites, non-linear excavations, spot excavations such as soil borings, sign posts, or guide rail) to avoid unnecessary marking and locating by the Authority in accordance with N.J.A.C. 14:2-3.2.

The Contractor shall notify the owners/operators of utilities or other properties well in advance of the time that he proposes to perform any work which would endanger their facilities or property, and shall cooperate with the owners/operators in protecting their facilities and property during construction operations.

The Contractor shall permit the operators of utilities and personnel engaged by them, access to the site of the work at all times in order to protect or relocate their facilities, and he shall cooperate with them in performing this work.

Unless otherwise specifically stated in the Contract Documents, the Contractor shall be responsible for the continuity of service of all overhead, surface and subsurface utilities affected by his operations and shall maintain them in a safe and satisfactory operating condition.

In the event a facility is damaged, the Contractor shall immediately notify the utility owner/operator in accordance with the State's Underground Facility Protection Act and at his own expense, he will make good any direct or ancillary damage that occurred in the course of construction to any utility facility or property or any other property through or by reason of the prosecution of this work. The affected utility owner/operator/property owner will solely determine the method of restoration to the damaged facility or property and the application of any reimbursement costs and/or ancillary damages. The liability of the Contractor under this covenant is absolute and is not dependent upon any questions of negligence on his part or on the part of his agents, servants, employees, subcontractors, or suppliers, and the neglect of the Engineer to direct the Contractor to take any particular precaution or to refrain from doing any particular thing shall not excuse the Contractor in any case of any such damage.

(A) Authority Owned Electrical and Communication Facilities.

Operations on the Turnpike and Parkway are controlled in part by changeable message signs, speed warning and speed limit signs. These signs, along with telephone and other operational devices, operate through underground communications cables on Authority right-of-way. Direct burial communications cables may exist within the Contract limits. The Contractor is responsible for confirming that all the

Authority Owned Facilities on the New Jersey One Call System markout ticket and the plans have been marked out prior to beginning ground intrusive operations. Contractor is responsible for verifying the cables have been marked out, the exact location of the cables and protecting all such cable from damage. Extreme care is to be exercised to avoid any damage to such cables, since they are necessary for the safe operation of Authority roadways. In the event a cable is damaged, the Contractor shall immediately notify the Authority, in accordance with the State's Underground Facility Protection Act, and the Engineer and shall then cooperate fully to take and/or construct all temporary measures as may be necessary to provide for the operations of any affected signs or other operations and shall expeditiously proceed with approved permanent repairs. (Splicing of communications cables may only be done under stringent controls, utilizing encapsulated splicing procedures. Information is available upon request from the Authority.)

Included in the Contract may be the removal of existing, abandoned above and below ground communication cable, located in the berm area behind the existing guide rail.

In the event that any utility or facility is damaged by the Contractor or forces engaged by him, the Authority reserves the right to immediately effect both temporary and permanent repairs, or to arrange for others to effect such repairs, at the expense of the Contractor, and the Contractor agrees that in such event the Authority may deduct such costs from any monies due the Contractor under the Contract.

The Contractor is responsible for verifying that all existing Authority owned underground electrical and communication facilities have been marked out, taking whatever steps are necessary so that they remain intact. The Contractor shall pay all costs, as determined by the Authority, for the repair of any cable, conduit or appurtenance damaged during the course of construction and other installation procedures required for the Project.

Where the Contract Drawings or pre-bid site conditions indicate that Authority electrical or communications facilities or their appurtenances interfere with permanent construction or reconstruction, the work involved in temporarily relocating or otherwise altering the facilities to maintain service shall be performed by the Contractor at no cost to the Authority.

All Electrical and Communication Division assets damaged or destroyed by contract operations shall be expeditiously repaired or replaced by the Contractor at no cost to the Authority.

(B) AUTHORITY OWNED FIBER OPTIC FACILITIES.

Buried conduits containing fiber optic cables used by the Authority and customers of the Authority exist within the Authority's Right-of-Way and may exist within the Contract limits. The Contractor is responsible for confirming that all the Authority Owned fiber optic facilities on the New Jersey One Call System markout ticket, and the plans have been marked out prior to beginning ground intrusive operations. The Contractor is also responsible for verifying the exact location of the facilities and protecting all such facilities from damage. Extreme care is to be exercised to avoid any damage to such facilities, since they are necessary for the safe operation of Authority roadways. The Contractor is advised that the fiber optic facilities are contained within flexible conduit and the Contractors operations may require hand excavation in excess of the 2 feet specified by the State's Underground Facility Protection Act, when work is in proximity to the marked out fiber conduit location. In the event a facility is damaged, the Contractor shall immediately notify the operator, in accordance with the State's Underground Facility Protection Act and the Engineer.

In the event that any fiber optic facility is damaged by the Contractor or forces engaged by him, the Authority reserves the right to arrange for others to immediately effect both temporary and permanent repairs at the expense of the Contractor, and the Contractor agrees that in such event the Contractor is responsible for such costs and any ancillary damage costs. The affected fiber optic customer(s) will solely determine the method of restoration to the damaged facility or property and the application of any restoration costs and/or ancillary damages.

The Contractor shall notify the utility owners not less than 60 days in advance of the time he proposes to perform relocation, restoration or shoring work that may endanger or affect their facilities.

No separate payment will be made for measures taken by the Contractor in complying with the requirements of the State's Underground Facility Protection Act and this specification for protecting, repairing, or replacing damaged utilities, facilities, communication cables, structures, or other Properties, or for cooperating with their owners, for any work in connection therewith and incidental thereto, but all costs thereof shall be included in the bid prices for the various items scheduled in the Proposal.

106.19 Risks Assumed By The Contractor.

The Contractor assumes the following distinct and several risks, whether they arise from acts or omissions, and whether or not resulting from the negligence of the Contractor, its subcontractors, suppliers, materialmen, employees, agents and all others working for the Contractor on the Project, or of the Authority, or of third persons, or from any other cause, and whether such risks are within or beyond the control of the Contractor, excepting only risks which arise from solely affirmative acts done by the Authority subsequent to the execution of the Contract with actual and willful intent to cause the loss, damage and injuries described in subparts (A) through (C) below:

(A) Risks of Loss or Damage to the Permanent Construction.

Until acceptance of the Project by the Authority, the Contractor shall have the charge and care of the Work and of the materials to be used therein, including materials for which he has received partial payment under Subsection 108.03, and shall take every precaution against injury or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before acceptance and shall bear the expense thereof. However, the Contractor shall not assume the risk for damage to the work due to acts of war. Where necessary to protect the work or materials from damage the Contractor shall, in furtherance of the above paragraph but not by way of limitation, at his expense provide suitable drainage for the Project and erect such temporary structures as are necessary to protect the work or materials from damage. The risks for failure to take such actions are assumed by the Contractor.

In case of suspension of Work from any cause whatever, the Contractor shall continue to be responsible for the Project as provided above and shall take such precautions as may be necessary to prevent damage to the Project, provide for drainage, and shall erect any necessary temporary structures, signs, or other facilities. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings, and soddings furnished under this Contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury. If ordered by the Engineer, the Contractor shall properly store during such suspension of work materials which have been partially paid for by the Authority or which have been furnished by the Authority, on behalf of the Authority. At all times, The Authority shall be entitled to the possession of such materials, and the Contractor shall promptly return the same to the site of the work when requested. The Contractor shall not dispose of any of the materials so stored, except on written authorization from the Engineer. The Contractor shall be solely responsible for the loss or damage to such materials.

(B) Risks of Claims on Account of Injury, Loss or Damage.

The risk of claims, just or unjust, by third persons made against the Contractor or the Authority on account of injuries including wrongful death, loss or damage of any kind whatsoever arising or alleged to arise out of or in connection with the performance of the work (whether or not actually caused by or resulting from the performance of the work), or out of or in connection with the Contractor's operations or presence at or in the vicinity of the construction site or Authority premises, whether such claims are made and whether such injuries, damages and loss are sustained before and after acceptance of the Project by the Authority.

The Contractor shall bear the risk of any action from or alleged to arise from the Contractor’s safety and health program or compliance to safety and health regulations for the Project.

(C) Risk of Loss to Property Used to Perform the Work.

The risk of loss or damage to any property of the Contractor, and of claims made against the Contractor or the Authority for loss or damage to any property of subcontractors, materialmen, workmen and others performing the work, and to lessors, occurring at any time prior to completion of removal of such property from the construction site or the Authority's premises, or the vicinity thereof.

(D) Risk of Environmental Claims.

The risk of environmental claims, just or unjust, by third persons made against the Contractor, the Authority, or the Authority's agents, on account of injuries including wrongful death, loss or damage of any kind whatsoever arising from any excavation, testing, transporting, stockpiling, disposal, or permitting, associated with work called for by the contract between the Contractor and the Authority.

The Contractor shall indemnify and save harmless the Authority, and the Authority's agents, against all claims described in Subparts (B), (C), and (D) above, and for all expenses incurred by the Authority in the defense, settlement or satisfaction thereof, including expenses of attorneys. If so directed, the Contractor shall at his own expense defend against such claims, in which event he shall not without obtaining express advance permission from the Authority raise any defense involving in any way jurisdiction of the tribunal, immunity of the Authority, governmental nature of the Authority, or the provisions of any statutes respecting suits against the Authority.

The provisions of this Subsection shall also be for the benefit of all officers, agents, and employees of the Authority so that they shall have all the rights which they would have under this Subsection if they were named at each place above at which the Authority is named, including a direct right of action against the Contractor to enforce the foregoing indemnity, except, however, that the Authority may at any time in its sole discretion and without liability on its part cancel the benefit conferred on any of them by this Subsection.

Neither the acceptance of the Project by the Authority nor the making of final payment shall constitute a release of the Contractor from any liabilities arising under this Subsection. Moreover, neither the enumeration in this Subsection nor the enumeration elsewhere in the Contract of particular risks assumed by the Contractor or of particular claims for which he is responsible shall be deemed: (a) to limit the effect of the provisions of this Subsection or of any other provision of the Contract relating to such risks or claims, (b) to imply that he assumes or is responsible for risks or claims only of the type enumerated in this Subsection or in any other provision of this Contract, or (c) to limit the risks which he would assume or the claims for which he would be responsible in the absence of such enumerations.

The Contractor expressly understands and agrees that any insurance protection required by the Contract, or otherwise provided by the Contractor, shall in no way limit the Contractor's responsibility to defend, indemnify, and save harmless the Authority as herein provided. Such insurance requirements are designed to provide greater assurance to the Authority that the Contractor will be financially able to discharge his obligations under this Subsection and as to the risks assumed elsewhere in the Contract and shall not in any way be construed as a limitation on the nature and extent of such obligations.

106.20 Insurance.

Prior to the commencement of any activity under this Contract, the Contractor shall procure and maintain at its own expense, throughout the term of the Contract and until acceptance by the Authority of the Project or for a duration as otherwise provided herein, and, with respect to products and completed operations insurance, for a period of not less than three (3) years following the termination of this Contract, from an insurance carrier acceptable to the Authority, the following insurance coverages:

(A) COMMERCIAL GENERAL LIABILITY INSURANCE.

Contractor shall maintain Commercial General liability insurance (CGL) with a coverage limit of not less than $2,000,000 each occurrence. CGL insurance shall be written on the latest ISO occurrence form without any added restrictions or diminution in coverage (or a substitute form providing at least equivalent coverage) and shall cover liability for bodily injury and property damage arising from premises, operations, independent contractors, products-completed operations and for liability arising from personal injury and advertising injury, and liability assumed under contract. This insurance shall also provide coverage for mental anguish or other mental injury arising from bodily injury. The insurance shall be endorsed to delete the coverage restriction related to work conducted within fifty (50) feet of a railroad, and the XCU exclusions. "The New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers" shall be included as additional insureds on the latest ISO forms providing such status for ongoing operations and products-completed operations without any added restrictions or diminution in coverage (or substitute forms providing at least equivalent coverage). This insurance shall be endorsed to apply as primary insurance and not contribute with any other insurance or self-insurance programs afforded to the Authority. This insurance shall be endorsed to waive the insurance carrier's right of subrogation against the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers. This insurance shall not contain any provision under which claims made by the Authority against the Contractor would not be covered due to the operation of an insured versus insured exclusion.

(B) COMMERCIAL AUTOMOBILE LIABILITY INSURANCE.

Contractor shall maintain Commercial Automobile liability insurance covering all vehicles owned or used by Contractor with a coverage limit of not less than $2,000,000 each occurrence. Auto insurance shall be written on the latest ISO form without any added restrictions or diminution in coverage (or a substitute form providing at least equivalent coverage) and shall cover liability for bodily injury and property damage. This insurance shall also provide coverage for mental anguish or other mental injury arising from bodily injury. "The New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers" shall be included as additional insureds. This insurance shall apply as primary insurance and not contribute with any other insurance or self-insurance programs afforded to the Authority. Such insurance shall be endorsed to waive the insurance carrier's right of subrogation against the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers. This insurance shall not contain any provision under which claims made by the Authority against the Contractor would not be covered due to the operation of an insured versus insured exclusion.

The Contractor and any Subcontractors who will be transporting any hazardous materials, hazardous substances, hazardous wastes and contaminated soils as part of the Work under this Contract, shall provide the Authority with evidence of levels of financial responsibility as required by the Motor Carrier Act of 1980 and 49 C.F.R., Part 387. The Contractor and/or Subcontractor, as the case may be, shall provide the Authority with an Endorsement for Motor Carrier Policies of Insurance for Liability under Sections 29 and 30 of the Motor Carrier Act of 1980 (Form MCS-90) issued by the insurer.

(C) WORKERS' COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE.

Contractor shall maintain workers' compensation and employer's liability insurance. Employers' liability coverage shall be with a limit not less than $1,000,000 Bodily Injury by Disease Each Employee, $1,000,000 Bodily Injury by Accident- Each Accident, $1,000,000 Bodily Injury by Disease – Policy Limit. Where permitted by law, such insurance shall be endorsed to waive the insurance carrier's right of subrogation against the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers. Workers' Compensation Insurance shall be provided in accordance with the requirements of the laws of the State of New Jersey and shall include all-states insurance to extend coverage to any state which may be interpreted to have legal jurisdiction. Such policies shall include endorsements to ensure coverage under the U.S. Longshore and Harborworkers' Compensation Act, and general maritime law, the Jones Act and the Death on the High Seas Act where required.

(D) CONTRACTORS POLLUTION LIABILITY INSURANCE.

Contractor shall maintain Contractors Pollution liability (CPL) insurance with a coverage limit of not less than $5,000,000 each occurrence, $10,000,000 aggregate.

The CPL insurance shall include, but not be limited to, coverage for on-site cleanup, bodily injury and property damage liability, contractual liability, personal injury liability and automobile liability for the transportation of materials (including hazardous materials and waste) to and from the project site, completed operations and independent contractors. This insurance shall also provide coverage for mental anguish or other mental injury arising from bodily injury. "The New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers" shall be included as additional insureds. This insurance shall be endorsed to apply as primary insurance and not contribute with any other insurance or self-insurance programs afforded to the Authority. This insurance shall be endorsed to waive the insurance carrier's right of subrogation against the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers. This insurance shall not contain any provision under which claims made by the Authority against the Contractor would not be covered due to the operation of an insured versus insured exclusion.

Upon selection of a disposal facility (if applicable), the Contractor shall also furnish evidence to the Authority that the disposal facility chosen has the minimum environmental liability insurance required by applicable law.

(E) UMBRELLA EXCESS LIABILITY INSURANCE.

Contractor shall maintain Umbrella Excess liability insurance with a coverage limit of not less than $3,000,000. This insurance shall be written on the latest ISO occurrence form without any added restrictions or diminution in coverage (or a substitute form providing at least equivalent coverage) and

shall provide excess coverage for CGL and Auto liability matters, providing no less coverage than the underlying policy. Such insurance shall be endorsed to waive the insurance carrier's right of subrogation against the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers. "The New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers" shall be included as additional insureds.

(F) MARINE LIABILITY INSURANCE.

As respects any watercraft (Boats, Barges, etc.) used during the performance of this contract, Contractor shall maintain Marine Protection and Indemnity Insurance covering all marine hazards arising from this contract; including injuries to crew members, if not provided through other insurance; Bodily Injury to third parties and Property Damage to wharves, piers and other structures and loss or damage to other vessels whether or not caused by collision. This insurance shall also provide coverage for mental anguish or other mental injury arising from bodily injury. The policy shall be subject to a limit of liability of not less than $5,000,000 per occurrence and $10,000,000 in the aggregate. If the policy is subject to an aggregate limit, replacement insurance will be required if it is likely such aggregate will be exceeded. "The New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers" shall be included as additional insureds. This insurance shall be endorsed to apply as primary insurance and not contribute with any other insurance or self-insurance programs afforded to the Authority. This insurance shall be endorsed to waive the insurance carrier's right of subrogation against the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers. This insurance shall not contain any provision under which claims made by the Authority against the Contractor would not be covered due to the operation of an insured versus insured exclusion.

(G) AIRCRAFT LIABILITY INSURANCE.

If the Contractor or subcontractor is engaged in any operations utilizing aircraft, it shall maintain aircraft liability insurance covering bodily injury and property damage liability in an amount not less than $10,000,000, written on an occurrence basis. This insurance shall also provide coverage for mental anguish or other mental injury arising from bodily injury. "The New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers" shall be included as additional insureds. This insurance shall be endorsed to apply as primary insurance and not contribute with any other insurance or self-insurance programs afforded to the Authority. This insurance shall be endorsed to waive the insurance carrier's right of subrogation against the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers. This insurance shall not contain any provision under which claims made by the Authority against the Contractor would not be covered due to the operation of an insured versus insured exclusion.

(H) OWNER'S PROTECTIVE LIABILITY INSURANCE.

The Contractor shall obtain and maintain a separate Owner's Protective Liability policy covering bodily injury and property damage liability arising from its operations in an amount not less than $5,000,000. Such insurance shall be written on the latest ISO form without any restrictions or diminution in coverage (or a substitute form providing at least equivalent coverage). This policy shall name the New Jersey Turnpike Authority, its members, commissioners, officers, agents, employees, guests, consultants and volunteers as named insureds.

(I) RAILROAD INSURANCE.

If the Contractor or Subcontractor is engaged in any Work on the Project which requires a permit from a railroad company, the Contractor will provide insurance in such amounts and such limits as required by the individual railroad company. At a minimum, insurance will be at least as broad as that provided by the latest ISO railroad protective liability insurance form without any restrictions or diminution in coverage (or a substitute form providing at least equivalent coverage.)

(J) OTHER INSURANCE.

Any additional insurance policies necessary to obtain required permits or otherwise comply with applicable law, ordinances or regulations regarding the performance of the Work shall be provided upon request of the Chief Engineer or his designee.

(K) INSURANCE, CERTIFICATE AND ENDORSEMENT REQUIREMENTS.

All insurance policies shall specify that the territorial limits shall be on a worldwide basis or as otherwise agreed with the Authority. All insurance policies shall provide that not less than 30 days advance written notice of cancellation or material change of any insurance referred to therein shall be given by registered mail to the General Counsel, New Jersey Turnpike Authority at P.O. Box 5042, Woodbridge, NJ 07095. All insurance companies providing coverage shall be authorized to do business in the State of New Jersey and maintain an A.M. Best rating of A-, VII, or better.

(1) Any other insurance carried by Contractor or Subcontractors shall be considered to be primary and any insurance carried by or self-insurance programs afforded to the Authority shall be considered excess and non-contributing with such primary insurance.

(2) Any other insurance carried by Contractor or Subcontractors shall also contain a waiver of subrogation clause in favor of the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers.

(3) Prior to commencing any work under this Contract and thereafter upon the Authority's request, Contractor shall furnish the Authority with a certificate(s) of insurance satisfactory to the Authority and, if requested by the Authority, applicable endorsements and/or a certified duplicate copy of the insurance policy(s) required, executed by a duly authorized representative of each insurer, showing compliance with the insurance requirements set forth herein. The Certificates of Insurance shall state that each of the above-required policies has been amended to include the following endorsements and shall be accompanied by copies of the endorsements:

   (a) "The New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers" shall be included as additional insureds." This statement is not required for the Contractor's workers' compensation and employer's liability insurance or builders risk insurance, if required.

   (b) Thirty (30) days' notice of cancellation or material change in coverage shall be given by registered mail to the New Jersey Turnpike Authority as specified above.

   (c) Where permitted by law, all policies shall contain a waiver of subrogation clause in favor of the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers.

   (d) With respect to all policies, the other insurance clause under each policy shall be amended to read as follows: "This policy will act as primary insurance and not contribute with policies issued to or self-insurance programs afforded to the New Jersey Turnpike Authority and its members, commissioners, officers, agents, employees, guests, consultants and volunteers".

   (e) All certificate(s) shall be mailed to: Law Department, New Jersey Turnpike Authority, P. O. Box 5042, Woodbridge, New Jersey 07095, Attention: Insurance.

(4) In the event that Contractor subcontracts any portion of its duties under this Contract, Contractor shall In the event that Contractor subcontracts any portion of its duties under this Contract, Contractor shall require each such Subcontractor to comply with all of the above insurance requirements as if the Subcontractor's name were substituted for any reference to Contractor, except with respect to the limits provided by each Subcontractor, which shall be as follows: CGL- $1,000,000; Automobile $1,000,000; and Umbrella Excess- $1,000,000. Except as specifically set forth above, all other requirements for Subcontractors shall remain the same as the requirements for the Contractor. If any Subcontractor cannot comply with this requirement, then such Subcontractor shall be added under the Contractor's policies as an additional insured. Upon request of the Authority, the Contractor shall submit evidence of insurance for each Subcontractor, indicating compliance with all requirements.

(5) It is agreed and understood by the parties that the obligation of the Contractor to obtain and maintain insurance policies required in accordance with this Contract is an essential term of the Contract and that the Authority relies on the Contractor to perform such obligation. The parties further acknowledge and agree that the failure of the Authority to require strict compliance with all the terms and conditions regarding insurance, as set forth in this Contract, and as evidenced by any Certificates of Insurance, Slips and/or Binders, copies of insurance policies, or otherwise, shall not constitute a waiver or amendment of any of the terms, conditions and requirements of this Contract regarding the provision of insurance coverage by the Contractor.

(6) The Contractor shall ensure that the activities to be performed under this Contract do not violate the terms and conditions of any insurance policy which is or may be provided by the Contractor

hereunder, and that it shall take all measures necessary to avoid any actions which may lead to cancellation or voidance of such insurance policies.

(7) In the event that the Contractor fails or refuses to maintain or renew any insurance policy required to be maintained herein, or if such policy is cancelled or modified so that the insurance does not meet the requirements contained herein, the Authority may refuse to make payment of monies due under this Contract. The Authority in its sole discretion may use such monies to purchase insurance on behalf of the Contractor or Subcontractor, or it may default the Contractor and direct the Surety to complete the Project. During any period when the required insurance is not in effect, the Chief Engineer may suspend performance of the Contract. If the Contract is so suspended, no additional compensation or extension of time shall be due on account of such suspension. The Authority may waive or modify any insurance requirement set forth herein.

(8) Due to future changes in economic, financial, risk and/or insurance market conditions the Authority at its discretion may modify the above insurance requirements.

(9) NOTWITHSTANDING THAT MINIMUM AMOUNTS OF INSURANCE COVERAGE CARRIED OR REQUIRED TO BE CARRIED BY THE CONTRACTOR ARE SPECIFIED HEREIN, THE LIABILITY OF THE CONTRACTOR SHALL NOT BE LIMITED TO THE AMOUNTS SO SPECIFIED AND SHALL EXTEND TO ANY AND ALL LIABILITY IN EXCESS OF THE INSURANCE COVERAGES SO PROVIDED NOR SHALL THESE MINIMUM LIMITS PRECLUDE THE AUTHORITY FROM TAKING ANY ACTION AVAILABLE TO IT UNDER THE PROVISIONS OF THE CONTRACT OR OTHERWISE IN LAW.

(10) Terms and Deductibles. The Contractor shall be responsible for any deductible or self-insured retention, exclusions or lack of coverage in the insurance policies described above. Any deductible or self-insured retention greater than $5,000 per occurrence must be disclosed to and approved by the Authority. The Authority reserves the right to require than any deductible or self-insured retention be no greater than $5,000 per occurrence.

106.21 Applicable Law.

Interpretation of this Contract shall be governed by the laws of the State of New Jersey. Any legal suit brought by any party against or involving the Authority involving any dispute related to the Contract shall be brought only in the Superior Court of New Jersey and shall be venued in Middlesex County.

106.22 Character of Workmen, Methods and Equipment.

At all times, the Contractor shall employ sufficient labor and equipment for prosecuting the several classes of Work to full completion in the manner and time required by the Contract Documents.

All workmen shall have sufficient skill and experience to perform properly the Work assigned to them. Workmen, engaged in special Work or skilled Work, shall have sufficient experience in such Work and in the operation of the equipment required to perform the Work satisfactorily.

Any person employed by the Contractor or by any Subcontractor who, in the opinion of the Engineer, does not perform his Work in a proper and skillful manner, or is intemperate or disorderly, shall at the written request of the Engineer, be removed promptly by the Contractor or Subcontractor employing such person, and shall not be again employed in any portion of the Work without approval.

Should the Contractor fail to remove such person or persons as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the Work, the Engineer may suspend the Work by written notice until compliance with such orders.

Except for regularly retired employees, the Contractor and his Subcontractors shall not, without the written consent of the Authority, engage on a full, part-time or other basis, during the period of the Contract any of the professional or technical personnel of the Authority, who are or have been at any time during the period of the Contract, or for 30 days prior to the Award of the Contract, in the employ of the Authority.

All equipment, which is proposed to be used on the Work, shall be of sufficient size and in such mechanical condition as to meet requirements of the Work and to produce a satisfactory quality of Work. Equipment used on any portion of the Project shall be such that no damage to the roadway, adjacent property, or other highways will result from its use.

Use of equipment will not be permitted that is owned and/or operated by firms and individuals suspended or debarred by the NJDOT or NJTA, or included in the Report of Suspensions, Debarments and Disqualifications of Firms and Individuals as maintained by the Department of the Treasury, Division of Building and Construction, Bureau of Contractor Prequalification.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed in the Contract, the Contractor is free to use any methods or equipment that will accomplish the Work in conformity with the Contract Documents.

If the Contractor desires to use a method or type of equipment other than that specified in the Contract, he may request approval from the Engineer to do so. The request shall be in writing and shall include a full description of the methods equipment proposed, and of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing Work in conformity with Contract requirements. If, after trial use of the substituted methods or equipment, the Engineer determines that the Work produced does not meet Contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining Work with the specified methods and equipment. The Contractor shall remove the deficient Work and replace it with Work of the specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the Pay Items involved or in Contract Time as a result of authorizing a change in methods or equipment under this Subsection.

106.23 Recovery of Monies by the Authority.

Whenever it is provided in the Contract Documents that the Authority or Engineer is to (i) withhold or deduct money from any monies due or that may become due the Contractor, (ii) that the Contractor is to pay or return monies for any reason, (iii) that the Authority or Engineer can charge against the Contractor certain costs, assessments, or fines, (iv) that the Authority or Engineer can recover any sum for any reason from the Contractor, it is understood that the Authority may draw against any monies due or that may become due the Contractor under the Contract and on other contracts between the Contractor and the Authority. Such other contracts shall include joint ventures in which the Contractor is a participant but only to the extent of its participation. The right to recover against the Contractor as herein provided is in addition to and does not affect the right of the Authority to seek recovery against the Contractor or surety under the Contract, bonds, or as otherwise allowed by law.

106.24 Small Business Enterprise Program.

In accordance with Executive Order No. 84 signed by Governor Jim Florio on March 5. 1993 and Executive Order No. 71 signed by Governor James E. McGreevey on October 2, 2003, it is the policy of the New Jersey Turnpike Authority (the "Authority" or "NJTA") that Small Business Enterprises ("SBE"), as determined and defined by the State of New Jersey, Department of Treasury, Division of Minority and Women Business Development ("Division") and the Department of the Treasury ("Treasury") in N.J.A.C. 17:13-1.1 et seq and N.J.A.C. 17:14-1.1 et seq., respectively, have the opportunity to compete for and participate in the performance of contracts for the purchase of goods and services and for construction services required by the Authority. The Authority further requires that its contractors shall agree to take all necessary and responsible steps, in accordance with the aforementioned regulations, to ensure that SBEs have these opportunities.

The goal of the SBE program is to award at least twenty five percent (25%) of the dollar value of public construction contracts expended in each calendar year to those firms registered as SBEs. The Authority will reach the minimum of 25% in two separate ways. First, and in accordance with the Small Business Enterprise Subcontractors Program, each contractor must agree to make a good faith effort to award at least 25% of any contract award to subcontractors registered by the Division as a SBE. Second, under the Small Business Enterprise Set Aside Program for construction contracts, the Authority may set aside certain contract awards for which only registered SBEs can participate. The minimum goal of twenty-five percent (25%) should be awarded as follows: at least ten percent (10%) shall be awarded to SBEs registered in the category of businesses whose annual gross revenues do not exceed $1 million (herein referred to as SBE Category 4); and at least an additional five percent (5%) shall be awarded to SBEs registered in the category of businesses whose gross revenues do not exceed the applicable annual revenue standards set forth in 13 CFR 121.201 (herein referred to as SBE Category 5); and the remaining ten percent (10%) shall be awarded where possible to firms registered in either of the two categories.

The Contractor agrees to make a good faith effort to award at least 25% of this contract to subcontractors registered by the Division as a SBE. Subcontracting goals are not applicable if the prime contractor is a registered Small Business Enterprise (SBE) firm.

Bidders are required to complete and submit within 7 days after Notice of Award, Authority Form entitled proposed "Proposed Schedule of Small Business Enterprise Participation", which is included in Appendix X. This Form must identify your compliance with the Authority's SBE goals for this Project.

In the event that the Bidder cannot meet the above mentioned SBE participation goals set for this contract, Authority Form entitled "SBE Unavailability Certification", which is included in the proposal and attached to Appendix X, must also be completed and submitted. The Bidder must demonstrate to the Authority's satisfaction that a genuine good faith effort has been made to meet this percentage.

For the aforementioned reasons, all contractors must meet all requirements as set forth in the Authority's SMALL BUSINESS ENTERPRISE SUBCONTRACTORS' AND SET ASIDE PROGRAM FOR CONSTRUCTION CONTRACTS bound hereinafter as Appendix X.

To allow the Authority to monitor and report SBE participation during the course of the Contract pursuant to N.J.A.C. 17:14-5.2, the Authority form entitled "SBE-Certificate of Participation" shall be completed by the Contractor and attached to each "Certificate for Payment to Contractor" that is submitted for payment in accordance with Section 108. Certificates for Payment submitted without the completed SBE Certificate of Participation Form will not be processed.

If the Contractor, for any reason, at any time during the course of the Contract, intends to make any additions, deletions or substitutions to the list of firms on the SBE Schedule of Participation form submitted to the Authority, the Contractor shall notify the Authority in writing of such proposed changes and shall submit a revised SBE Schedule of Participation form from Appendix X to the Authority for each such proposed change. Any such proposed changes must comply with the requirements and procedures set forth in Appendix X.

106.25 Warranties Made by Contractor.

The Contractor represents and warrants:

- That he is financially solvent, that he is experienced in and competent to perform the type of services contemplated by this Contract, that the facts stated or shown in any papers submitted or referred to in connection with his Proposal are true, and, if the Contractor be a corporation, that it is authorized to perform this Contract;
- That he has carefully examined and analyzed the provisions and requirements of this Contract and inspected the construction site, that from his own investigations he has satisfied himself as to the nature of all things needed for the performance of this Contract, the general and local conditions and all other matters which in any way affect this Contract or its performance, and that the time available to him for such examinations, analysis, inspection and investigation was adequate;
- That the Contract is feasible of performance in accordance with all its provisions and requirements and that he can and will perform in strict accordance with such provisions and requirements;
- That no Commissioner, officer, agent or employee of the Authority is personally interested directly or indirectly in this Contract for the compensation to be paid hereunder, and;
- That, except only for those representations, statements or promises expressly contained in this Contract, no representation, statement or promise, oral or in writing, of any kind whatsoever by the Authority, its Commissioners, officers, agents, employees or consultants has induced the Contractor to enter into this Contract or has been relied upon by the Contractor, including any with reference to: (1) the meaning, correctness, suitability, or completeness of any provisions or requirements of this Contract; (2) the nature, existence or location of materials, structures, obstructions, utilities or conditions, surface or subsurface, which may be encountered at the construction site; (3) the nature, quantity, quality or size of the materials, equipment, labor and other facilities needed for the performance of this Contract; (4) the general or local conditions which may in any way affect this Contract or its performance; (5) the price of the Contract; or (6) any other matters, whether similar to or different from those referred to in (1) through (5) immediately above, affecting or having any connection with this Contract, the bidding thereon, any discussions thereof, the performance thereof or those employed therein or connected or concerned therewith.

Nothing in the Contract Documents or any other part of the Contract is intended as or shall constitute a representation by the Authority as to the feasibility of performance of this Contract or any part thereof. Moreover, the Authority does not warrant or represent either by issuance of the Contract Documents or by any provisions of this Contract as time for performance or completion or otherwise that the Contract may be performed or completed by the times required herein or by any other times.

The Contractor further represents and warrants that he was given ample opportunity and time and by means of this subsection was requested by the Authority to review thoroughly all documents forming this Contract prior to opening of Proposals on this Contract in order that he might request inclusion in this Contract of any

statement, representation, promise or provision which he desired or on which he wished to place reliance; that he did so review said documents, that either every such statement, representation, promise or provision has been included in this Contract or else, if omitted, that he expressly relinquishes the benefit of any such omitted statement, representation, promise or provision and is willing to perform this Contract without claiming reliance thereon or making any other claim on account of such omission.

The Contractor further recognizes that the provisions of this Subsection, (though not only this Subsection) are essential to the Authority's consent to enter into this Contract and that without such provisions, the Authority would not have entered into this Contract.

106.26 Discrimination in Employment on Public Works.

All contractors and subcontractors must comply with the requirements of N.J.S.A. 10:2-1 Discrimination in Employment on Public Works as included in Appendix J.

SECTION 107 - PROSECUTION AND PROGRESS

107.01 Commencement and Procedure.

Following the approval of contract Award by the Authority, the Contractor will receive a Notice of Award from the Authority. The Contractor shall, upon receipt of Notice of Award, immediately begin all aspects of offsite mobilization and all other work which does not require access to the Work site or Authority property.

107.02 Pre-Construction Conference.

Prior to the issuance of the Notice to Proceed and/or commencement of work, a preliminary conference will be held in the offices of the Authority to discuss the Scope of the Work, drawings, cross-sections, standards, specifications, Supplementary Specifications, Insurance, partial payments construction layout, toll tickets, progress photos, maintenance bond security, existing conditions, methods for maintaining and protecting traffic during construction, materials to be ordered, testing of materials, equipment to be used, and all essential matters pertaining to the prosecution of and the satisfactory completion of the project as required.

The Contractor, his superintendent, or his authorized agent shall be present at the conference and shall present a list of proposed subcontractors, if any, a list of suppliers from whom materials are anticipated to be purchased, an executed application for a Traffic Permit to begin work at the site, and other data as required by the Authority. The information so presented shall be on forms submitted to the Contractor with the notice of this pre-construction conference. Separate utility and/or pre-concrete conferences may be scheduled when required by Supplementary Specifications.

107.03 Commencement of Work.

Upon execution of the contract by the Authority, a fully executed copy thereof together with a Notice to Proceed will be forwarded to the Contractor. Receipt of the executed Contract and Notice shall constitute the Contractor's authority to enter upon the site of the work, provided the Contractor has prior thereto submitted to the Engineer, and he has accepted, the insurance certificates required under Subsection 106.20 and applied for and received a Traffic Permit required under Section 801. Construction operations shall not begin until the Contractor has supplied, and the Engineer has accepted, the progress schedule and other certifications, forms, schedules, and any other documents required by the Contract Documents prior to the beginning of construction operations and established a field office as required by the Supplementary Specifications.

Construction operations shall begin promptly after execution of the Contract by the Authority and shall continue without interruption until the work is completed, unless otherwise specified or directed.

The Contractor shall employ all practicable measures to avoid wetlands within or adjacent to the proposed right-of-way. No storing of equipment or supplies shall be permitted in adjacent wetlands.

Should the Contractor begin work prior to the execution of the Contract by the Authority, such work shall be considered as having been done by him at his own risk and as a volunteer. In the event the Authority decides to reject the Contract, the Contractor shall at his expense do such work as necessary to leave the site occupied by him in a neat condition to the satisfaction of the Engineer.

The Contractor is notified that the Turnpike / Parkway shall be maintained in an as orderly condition as possible during the entire construction period. To this end, salvageable items to be reused in the Contract shall be removed and stored in obscure locations until the time for their use. Unsalvageable materials and debris resulting from the construction operations shall be promptly disposed of off Authority property in approved

areas in accordance with Subsection 202. At the end of each work shift, the Contractor shall neatly store all material and equipment, and clean existing work area and roadway surfaces within the limits of the project to the satisfaction of the Engineer so as to allow traffic and pedestrians safe passage.

A monthly estimate will not be processed while the Contractor is in non-conformance with the above requirements. Furthermore, before final inspection and acceptance of the Contract, borrow and local material sources and all areas occupied by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures and equipment, and all parts of the work shall be left in acceptable condition.

No separate payment will be made for the work of cleaning up, but all costs thereof shall be included in the prices bid for the associated pay items scheduled in the Proposal.

107.04 Progress Schedule.

The Contractor shall furnish for approval, within ten (10) calendar days after the date of execution of the contract by the Authority, an interim partial progress schedule containing detailed activities depicting the Contractor's proposed plan and schedule of work to be performed within the first sixty (60) days, indicating the dates on which he shall start the various work stages, the intended maintenance of traffic and pollution control measures, summary activities which are necessary to properly show the remaining work areas or phases of the entire project, and realistic delivery dates for all procurement. The interim progress schedule shall describe the activities to be accomplished and their interdependencies subject to all requirements specified, where appropriate. This interim progress schedule must be in the form of a network diagram. Construction operations shall not begin until the partial schedule has been approved.

The Contractor shall furnish for approval, within thirty (30) calendar days after the date of execution of the Contract by the Authority, a complete progress schedule showing the order in which the Contractor proposes to prosecute the work, the dates on which the Contractor shall start the various work stages, operations and principal items of work including procurement of materials and plant, the quantity and kinds of equipment and character of the labor force and the contemplated dates for completing the same. The progress schedule shall clearly outline the intended maintenance of traffic, pollution control measures and such other information as required by the Contract Documents, or as deemed appropriate for the Project.

The Engineer will not process a "Certificate for Payment to Contractor" until the complete progress schedule has been approved. Ten (10) working days will be required for review and comment on each progress schedule submission for projects having a duration of two (2) years or less with two (2) additional working days for each year or part thereof in excess of two (2) years. Once the progress schedule has been approved by the Engineer, the Contractor shall not deviate from the logic, interim milestones or contract completion date contained therein without the approval of the Engineer in writing.

(A) STAGING.

The Contractor shall schedule the Work using such procedures and staging as may be specified in the Contract Documents. Such procedures and staging depict a general sequence of the Work and are not intended to show each and every element of the Work. The Contractor is responsible for preparing a progress schedule which identifies all elements of the work. Work designated as part of separate stages may be performed simultaneously, where provided by the Contract Documents or where approved.

When the Contract Documents provide for staging or specific procedures, the Contractor may, prior to submitting a progress schedule, present for written approval of the Engineer, a detailed, written alternate staging plan or procedure which incorporates the requirements of the Authority. As a condition of the Engineer's reviewing the alternate staging plan or procedure, the Contractor agrees that Contractor is not entitled to additional contract time or compensation arising from possible delays to construction due to the time spent in reviewing the Contractor's alternative staging plan or procedure, regardless of whether the Authority accepts or rejects it. If such staging plan or procedure is approved in writing, the Contractor shall then prepare a progress schedule consistent with the approval.

(B) PROSECUTION OF THE WORK.

The Contractor shall provide sufficient materials, equipment and labor to guarantee the completion of the Project in accordance with the Contract Documents and within the time set forth in the Contract Agreement.

If the Contractor falls 15 or more work days behind the submitted schedule, the Contractor shall submit a revised schedule for approval.

Should the prosecution of the work be discontinued for any reason, the Contractor shall notify the Engineer, in writing, prior to discontinuing work and at least 24 hours in advance of resuming operations.

The Contractor shall arrange and prosecute the work, so that each successive construction operation at each location shall follow the preceding operation as closely as the requirements of the various types of construction permit.

Work which closes or alters the use of existing roadways; the construction of subsurface structures; structure excavation; demolition work; and other Contractor operations adjacent to traffic lanes shall not be undertaken until adequate provisions, conforming to the requirements of Division 800, have been made by the Contractor and approved.

The Engineer may revise construction staging and maintenance of traffic, if deemed necessary, due to unforeseen circumstances which may arise during construction.

Compensation for additional expense to the Contractor and allowance of additional time for completion of the work shall be as set forth in a Change Order or Supplementary Agreement or in accordance with Subsections 107.06 and 108.04.

(C) INTENT, RESPONSIBILITY AND TIME.

Scheduling of construction is the responsibility of the Contractor. Therefore, it is the Contractor's responsibility to determine the most feasible order of work commensurate with the Contractor's abilities and the Contract Documents. The requirement for the progress schedule is included to assure adequate planning and execution of the work, to assist the Engineer in appraising the Contractor's compliance with the Contract Documents and to evaluate progress of the work. The progress schedule will be used for determining extensions or reductions of Contract Time pursuant to Subsection 107.06.

It is not intended that the Engineer, by approving the progress schedule agrees that it is reasonable in all respects, or that following the progress schedule can result in timely completion of the Project. The parties shall agree that the progress schedule is not a part of the Contract.

If, in the preparation of the progress schedule, the Contractor reflects a completion date different than that specified in the Contract, this in no way voids the date set therein. The date or dates as specified in the Contract governs. Where the Contractor's progress schedule reflects a completion date earlier than that specified in the Contract, the Engineer may approve such schedule with the Contractor specifically understanding that no claim for additional time or compensation shall be brought against the Authority as the result of failure to complete the work by the earlier date shown on the progress schedule.

(D) ACCELERATION AND DEFAULT.

If, in the opinion of the Engineer, the Contractor falls behind his progress schedule and cannot complete the Work within the time prescribed in the Contract, as modified pursuant to Subsection 107.06, the Contractor shall take such steps as may be necessary to improve his progress. The Engineer shall have the right to require the Contractor to increase the number of shifts, begin overtime operations, work extra days including weekends and holidays, supplement his construction plan, or all of the foregoing, and to submit for approval such supplementary schedule or schedules, as may be deemed necessary to demonstrate the manner in which the agreed rate of progress shall be regained all at no additional cost to the Authority. Failure of the Contractor to comply with the requirements of the Engineer under this paragraph is grounds for the determination that the Contractor is not prosecuting the work with such diligence as to ensure completion within the times specified. Upon such determination, the Engineer may terminate the work or any separable part thereof in accordance with Subsection 106.04.

(E) TYPES OF PROGRESS SCHEDULES.

All progress schedules shall comply with the foregoing provisions of this Subsection. Regardless of the type of progress schedule used, the Contractor shall supply the Engineer with a weekly work schedule indicating the Contractor’s planned work, subcontractors' planned work, anticipated quantity of manpower to be utilized (by craft), anticipated quantity of equipment to be used (by type), the dates when materials are to be delivered and a forecast of lane closings.

Lane closing information shall be prepared and transmitted to the Engineer in the prescribed form, a sample of which is included in Division 800.

The progress schedule shall be one of the following dependent on whether the progress schedule is a Pay Item or not.

(1) **When the Progress Schedule is a Pay Item.**

The progress schedule shall be prepared by the Critical Path Method (CPM) utilizing Oracle's Primavera P6 Professional Project Management software, Version 7 or later, conforming with the requirements hereinafter prescribed.

The network shall include, as a minimum, one activity for each discrete component part of each Pay Item scheduled in the Proposal. The Engineer may allow grouping of similar Pay Items. The system shall consist of network diagrams and accompanying mathematical tabulations as described hereinafter.

(a) Logic Diagram.

The diagrams shall show the order and interdependence of activities and the sequence and quantities in which the work is to be accomplished. The basic concept of Precedence Diagramming Method (PDM) network scheduling shall be followed to show how the start of a given activity is dependent on the completion of preceding activities and how its completion may affect the start of following activities. No activity duration shall be longer than 20 working days without prior approval. The critical path shall be distinguished from other paths on the network. The logic diagrams shall be banded by major work areas (including one band for procurement). It shall include the following:

(1) Activity description
(2) Activity duration(work days)
(3) Critical path denoted
(4) Numerical event nodes
(5) Slack or float for each activity
(6) Work days calendar which extends for the length of the Contract plus 25 percent additional time

In addition to construction activities, network activities shall include the submittal and approval of samples of materials and shop and working drawings, and the fabrication of special materials. It shall include all documents and proofs of compliance required by the Contract Documents for Final Inspection and Acceptance of the work.

All activities of the Authority that affect progress and any special Contract required dates shall be shown.

The Contractor shall schedule his work in accordance with the Lane Closing restrictions specified in Division 800.

(b) Mathematical Tabulations.

The mathematical tabulation of the network diagram shall include a tabulation of each activity shown on the detailed network diagram.

The information tabulated below shall be furnished as a minimum for each activity. All submittals and updates shall consist of three hard copies and electronic delivery of the reports described below.

(1) Numerical even nodes
(2) Activity description
(3) Activity duration(work days)
(4) Earliest start date(calendar date)
(5) Earliest finish date(calendar date)
(6) Latest start date(calendar date)
(7) Latest finish date(calendar date) or float for each activity
(8) Quantities involved on each activity based on Contractor's intended start and completion dates

(9) Critical path activities denoted
(10) Work days calendar which extends for not less than the length of the contract plus two months
(11) Lead or lag type and duration (negative leads or lags are not permitted)

(c) Computer Generated Reports.

This mathematical tabulation shall be in the form of computer generated reports. Computer generated reports, in the following sorts, shall be provided by the Contractor:

(1) Activity Number from lowest to highest (with predecessors and successor, leads and lags)
(2) Total Float, from lowest to highest, then by Early Start
(3) Area code, then by Early Start
(4) Traffic Impact Code, then by Early Start
(5) 60 days look-ahead sorted by Area, then by activity number (with updated line)

(d) Holidays.

In preparing his mathematical tabulation, the Contractor shall use a single 5-day work week calendar including the following ten holidays:

- New Year's Day
- Martin Luther King's Birthday
- Presidents' Day
- Memorial Day
- Independence Day
- Labor Day
- Columbus Day
- Veterans' Day
- Thanksgiving Day
- Christmas Day

The Contractor is responsible for determining his actual schedule for the work, including actual days, holidays and extended non-work periods, if any, consistent with all requirements and conditions of the specification. Nothing herein shall be construed as advising or directing the Contractor which holiday(s) or extended non-work period(s) are to be taken in the performance of this contract.

An extended non-work period is any period longer than a weekend or single holiday in which the Contractor shall not work on certain activities, such as a winter shutdown. Extended non-work period(s) shall be clearly identified as such in the activity description, and explained in the narrative report. The purpose of the extended non-work period(s) shall be clearly defined and subject to the Engineer's approval. Extended non-work period(s) shall be indicated as required by the use of an activity(ies) to denote each extended non-work period(s). Work activities that shall not be performed during extended non-work periods shall be restrained to finish before, or start after, the extended non-work period activity(ies).

(e) Narrative Report.

In addition to the mathematical tabulations, the Contractor shall submit with the schedule network, a narrative report describing the Contractor's approach to performing the work and stating any assumptions made by the Contractor in preparing the schedule. The narrative report shall also include a description of the critical path through the network.

(f) Updating.

The Contractor shall update the mathematical tabulation on a monthly basis. On the day the monthly or semi-monthly Partial Payments are prepared, the Contractor shall provide the Engineer with three (3) updated hard copies and schedule data delivered electronically. Network diagrams shall be submitted with the tabulation if there are any proposed revisions to network logic, interim milestones or contract completion. The updated tabulations shall reflect the current status of activities as outlined on the baseline network diagram. If any delays have occurred,

these shall be noted for item consideration. The updated tabulation reports shall reflect all changes in dates, durations and float time.

During the month, utilizing the previous month's 60 days look-ahead report, the Contractor shall record the percent complete and start and/or completion dates of each scheduled work activity. On a day each month, at least one week prior to the monthly progress meeting, the Contractor shall meet with the Engineer to tour the site and review update information gathered by the Contractor during the month. After approval of the Contractor's update data by the Engineer, the Contractor shall use this information to update its mathematical tabulations. The updated mathematical tabulation shall include the following data for each activity:

(1) Actual start date(for started activities)
(2) Actual finish date(for completed activities)
(3) Percent complete
(4) Current early start date (for not started activities)
(5) Current early finish date (for uncompleted activities)
(6) Current total float
(7) Critical path activities noted

The updated schedule shall consist of the same reports specified under the section "Mathematical Tabulation." The Contractor's update shall include a narrative report which shall describe current status of the project, progress for the period, a description of the critical path, a discussion of current or potential delays, change orders (pending or approved), or other problems. If applicable, a discussion of proposed revision to network logic or activity durations shall be included in the narrative.

(g) Network Revisions.

Conditions may develop which require revisions to logic or durations of the original diagram. If, during the progress of the work, events develop which necessitate changes in the original plan, the Contractor shall make such changes so as to depict the current mode of operation, and shall provide the Engineer with a revised network diagram. Any revision to the original logic must be approved by the Engineer. After approval, logic revisions will be incorporated into the schedule and will be addressed in the monthly narrative report by means of both, a description of the revision, and a listing of those network elements affected by such change. This listing will include the following, when applicable:

(1) Addition and deletion of activities
(2) Addition and deletion of relationships
(3) Changes to activity descriptions and durations
(4) Changes to relationship types and lag codes
(5) Changes to contract milestone dates and approved constraint dates
(6) All other revisions to the network logic

(h) Change Orders, Delays, and Time Extensions.

When a change order(s) is (are) proposed by the Authority or the Contractor or delays are experienced, the Contractor shall submit a Time Impact Analysis (TIA) illustrating the influence of each change order or delay on any specified intermediate milestone date(s) and/or contract completion date. Each TIA shall include a sketch (fragnet), demonstrating how the Contractor proposes to incorporate the change or delay into the current Schedule. The fragnet will include all logic changes and additions required as a result of said change order(s) and/or delay. This fragnet will show all CPM logic revisions for the work in question and its relationship to other activities in the network plan. Additionally, the analysis shall demonstrate the time impact based on the date that the change was given to the Contractor, the status of construction at that point in time, and the activity duration of all affected activities. The activity duration used in this analysis shall be those included in the latest update of the Schedule, closest to the time of delay or as adjusted by mutual agreement.

Each Time Impact Analysis shall be submitted within twenty (20) calendar days after a delay occurs, or a notice of change or change order is given to the Contractor. In cases where the Contractor does not submit a Time Impact Analysis for a specific change or delay within the

specified period of time, the Contractor expressly waives its rights to make any claim for such change or delay, and it shall be mutually agreed that no time extension is required. No Time Impact Analysis need be submitted if the change or change order does not impact the completion or the completion date of the work, and it is agreed to by the Engineer.

Final evaluation of each Time Impact Analysis by the Engineer shall be made within fourteen (14) calendar days after receipt unless subsequent meetings and negotiations are necessary. Adjustments in the contract time for performance shall be made only by written change order approved by the Authority as specified in Subsection 107.06. Upon approval by the Authority, fragnets illustrating the influence of changes and delays shall be incorporated into the current schedule by the Contractor during the first update after agreement is reached.

The time difference between the Early Finish date and the Late Finish date is defined as "float." The "float" belongs to the Project and may be used by the Contractor or the Engineer to benefit the Project. Changes or delays that influence activities in the network with "float," and do not extend the Critical Path (the sequence of activities with zero days float), shall not be justification for an extension of Contract time for performance.

(i) Recovery Schedule.

In the event that the mathematical analysis indicates that the project has fallen 15 or more work days behind schedule, and there is no excusable delay or change to support a time extension, the Contractor shall prepare and submit a recovery schedule for approval by the Engineer. The Contractor shall revise logic and/or durations to cause the mathematical analysis to show the project on schedule. The Contractor shall provide additional manpower, equipment or materials; or work additional shifts, expedite procurement to complete activities within the approved intermediate or contract completion dates at no additional cost to the Authority. Upon approval of the recovery schedule by the Engineer, the Contractor shall incorporate the recovery schedule into the current schedule.

(j) Measurement.

Payment for the accepted progress schedule will be made on a lump sum basis for the schedule completed as specified, including all necessary updating. Twenty-five percent of the lump sum bid will be paid upon approval of the initial submission, with the balance paid upon approval of updates at a prorated sum based upon the number of anticipated updates to be submitted during the Contract Time.

(k) Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
PROGRESS SCHEDULE	LUMP SUM

If the progress schedule is not approved, regardless of type specified, the Contractor shall make revisions as required and resubmit such schedule until approved.

The Engineer will not process any partial payments as specified under Subsection 108.03 until a satisfactory progress schedule and/or monthly update is approved by the Engineer. No claims shall be made by the Contractor against the Authority as a result of a delay in partial payments due to the late submission of an approved progress schedule by the Contractor.

(2) **When the Progress Schedule is Not a Pay Item.**

The progress schedule may be of the bar chart or similar type acceptable to the Engineer as to form and substance. The schedule shall be in a suitable scale as to indicate the percentage of work scheduled for completion at any time. The progress schedule shall include, as a minimum, one activity for each major Pay Item and/or stages included in the Project provided, however, that the Engineer may require and the Contractor shall provide for certain Pay Items, a breakdown of each discrete component part to be included in the Progress Schedule. The Contractor shall include in the progress schedule, or in a separate submission, a schedule of shop and working drawings submissions. The Contractor shall update the progress schedule when conditions have changed such to invalidate the current schedule.

All costs for furnishing, revising as required and updating the progress schedule shall be included in the prices bid for the various pay items scheduled in the Proposal.

If the progress schedule is not approved, regardless of type specified, the Contractor shall make revisions as required and resubmit such schedule until approved.

The Engineer will not progress any partial payments as specified under Subsection 108.03 until a satisfactory progress schedule is submitted to and approved by the Engineer. No claims shall be made by the Contractor against the Authority, as a result of a delay in partial payments due to the late submission of an approved progress schedule by the Contractor.

107.05 Time of Completion.

The Contractor shall complete all or any portion of the Work within the time or times set forth in the Contract. When the Contract Time is on a calendar day basis, it shall consist of the number of calendar days stated, computed from the date of the Notice of Award. When the Contract Time is defined as a specified completion date, such completion date shall be the date on which all work on the Project shall be complete.

Written permission, provided by the Engineer to the Contractor as provided herein, permitting the Contractor to continue and finish the Work or any part of it after the time(s) established in the Contract Agreement for its completion, or after the date to which the time for completion may have been extended, shall not operate as a waiver by the Authority of any of its rights under the Contract and shall not relieve the Surety from its obligations.

107.06 Extension and Reduction of Contract Time.

Extensions or reductions to the Contract Time can only be provided by Change Order. Such extensions or reductions shall only be allowed to the extent that the increase or decrease in the Work or delays of the types indicated below affect the over-all completion of the Contract. Increases or decreases in work or such delays which do not affect the overall completion of the Contract shall not be the basis for reduction or extension of time. Extensions of time will not be granted where it is determined that the Contractor could have avoided the circumstances which give rise to his requesting such extension.

If, through the failure of the Authority to acquire right-of-way, the Contractor sustains losses that could not have been avoided by the judicious handling of forces, equipment, and plant, or performance of the Work is delayed, compensation for such loss and an extension of Contract Time may be granted if the Engineer orders the Contractor in writing to suspend, delay, or interrupt all or any part of the Work for such period of time as the Engineer may determine to be appropriate for the convenience of the Authority.

If the performance of all or any portion of the Work is suspended, delayed, or interrupted by the Engineer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry), and the Contractor believes that additional compensation or Contract Time or both are due as a result of such suspension, delay, or interruption, the Contractor shall submit to the Engineer in writing a request for adjustment within seven Calendar Days of receipt of the notice to resume Work. The request shall set forth the reasons and support for such adjustment.

Upon receipt, the Engineer will evaluate the Contractor's request. If the Engineer agrees that the cost or time or both required for the performance of the Contract have increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors, and not caused by weather, the Engineer will make an adjustment (excluding profit) and modify the Contract in writing accordingly. The Engineer will determine and notify the Contractor whether or not an adjustment of the Contract is warranted. Adjustments in Contract Time will be made pursuant to this Subsection. Adjustments in compensation will be made pursuant to Subsections 106.07, 107.04 and Section 108.

If the Contractor is delayed in completion of the Work by reason of changes made under Subsection 104.04 or by failure of the Authority or by any act of other contractors consistent with Subsection 104.07 or by any act of the Engineer or of the Authority not contemplated by the Contract, an extension of time commensurate with the delay in overall completion of the Contract thus caused will be granted, and the Contractor shall be relieved from any claim for liquidated damages, or engineering and inspection charges.

Additionally, the Contractor may be granted an extension of time for any portion of the delay in overall completion of the Contract work beyond the time provided in Subsection 107.04 caused by:

- Acts of civil or military authorities, war or riot, or declared national or state emergencies;
- Fire;

- Floods, tidal waves, earthquakes, cyclones, tornadoes, hurricanes, or other cataclysmic natural phenomenon;
- Extreme weather conditions (see paragraph below);
- Epidemics or quarantine restrictions.

When the Contractor deems that an extension of time is due him on account of delay beyond his control, he must notify the Chief Engineer in writing of his intention to make claim for such extension of time in accordance with the requirements of Subsection 106.07 and promptly file with the Authority proper evidence of the cause of the delay.

Extensions of time for delays caused by the non-completion of essential work of other contractors may be granted when such non-completion is the sole cause of the delay and where the Contractor has available the plant, materials, and labor necessary to proceed with the work. Where the Contractor has delays of his own making coincident with delays caused by others, no extension of time will be granted.

Delays caused by requests for substitution of materials and products under Subsection 105.11 shall be the sole responsibility of the Contractor and will not be cause for an extension of time.

The Contractor hereby waives any claim in which the Contractor has not complied with this requirement for written notice. The Engineer shall ascertain the facts and extent of the delay, and the Engineer's findings thereon shall be final and conclusive.

An average number of inclement days when Work cannot proceed is to be anticipated during the construction period and is not to be considered as warranting an extension of time. During the actual construction period, average weather conditions for the construction period for the past five years shall be considered normal expectancy. It shall be the duty of the Contractor to prove the average number of inclement days for the construction period.

The Contractor agrees that it shall make no claim for damages or additional compensation, including, but not limited to, overhead, extended field office overhead, extended home office overhead, etc., for any delay in or hindrance to the performance of this Contract occasioned by any act or omission to act by the Authority or any of its representatives, including failure of the Authority to acquire right-of-way or obtain right of entry, or for any of the reasons enumerated in this Subsection, and further agrees that any such claim shall be fully compensated for by an extension of time to complete performance of the Work.

No extensions of time will be granted due to delays caused by, or in any way related to, the financial condition of the Contractor, subcontractors, sub-subcontractors, materialmen, fabricators or suppliers. The Contractor and his Surety assume full responsibility for ensuring that the financial condition of any of the above will not delay completion of the Project.

The Contractor or Surety shall not be relieved of liability for damages for any period of delay in completion of the Work in excess of that for which an extension of time has been approved.

107.07 Failure to Complete on Time.

The Contractor and the Authority recognize that delay in completion of the Project will result in damage to the Authority in terms of the effect of the delay in the use of the Project upon the public convenience and the business reputation, economic status and loss of revenue of the Authority, and it will also result in additional cost to the Authority for engineering, inspection and administration of the Contract. Because some of this damage is difficult or impossible to calculate or estimate, the parties agree that if the Contractor fails to complete the Project and each and every part and appurtenance thereof fully, entirely, and in conformity with the provisions of the Contract within the time stated in the Contract, or within such further extension of time as may have been granted, the Contractor shall pay the Authority liquidated damages in the amounts set forth in the contract agreement in lieu of the above stated actual damage. Such liquidated damages shall be paid for each and every day that he is in default on time to complete the work.

107.08 Suspension of Work.

The Chief Engineer has the authority to suspend the Work wholly or in part, for such period as he may deem necessary. The Chief Engineer may notify the Contractor in writing to suspend work on all or any part of the Project, and the Contractor shall do no further Work, nor shall any further supplies or equipment be ordered, until he has received written notice from the Chief Engineer to resume Work. When Work is suspended, payments for the completed parts of the suspended Work will be made as provided in Subsection 108.03. No other compensation or allowance will be made on account of such suspension unless it shall be for more than

ten (10) days. Should the suspension be for more than ten (10) days and should the Contractor incur a delay or additional expense on account thereof, he shall have the right to file with the Authority a claim for additional compensation or extension of time as specified under Subsection 106.07. However, he shall have no claim for additional expense for said first ten (10) days of suspension, and any claim for allowance as stated above shall be filed with the Authority before the expiration of the ten (10) days of suspension. No payment will be made for work done by the Contractor when a suspension is in effect. If the suspension extends for one (1) year and the value of the suspended work, based on bid prices and estimated quantities, exceeds twenty-five (25) per cent of the Total Contract, the Authority will, at the Contractor's request annul the Contract as provided in Subsection 106.03. When said value is twenty-five (25) per cent or less, and the suspension extends for one (1) year, the Authority will at the Contractor's request omit the suspended work from the Contract by Change Order as provided in Subsection 104.04.

107.09 Termination of Contract.

By written order, the Authority may terminate the Contract or any portion thereof for convenience, after determining that for reasons beyond the Contractor's control, the Contractor is unable to proceed with or complete the Work as contracted for, or that termination is in the public interest.

Upon receipt of an order of Termination for convenience, the Contractor shall not proceed with any item of Work which is not specified in the Order of Termination. The Contractor shall complete all items of Work specified in the termination order. Such Work shall include punch list items and all Work necessary to ensure the safety of the public, to properly secure existing Work already constructed or partially constructed, and to secure the Project site. This Work so ordered shall be performed in accordance with the Contract Documents, and may include items of Work not in the original contract. The Contract shall be considered substantially complete upon completion and acceptance of all items of Work specified in the Order, except punch list items. After completion of the punch list items and all documents required by the Contract, the Contract shall terminate upon issuance of a Final Certificate and payment. The Authority reserves the right to declare in default a Contractor who fails to carry out the conditions set forth in an order of Termination for convenience.

When the Authority orders termination of the Contract for convenience, all completed items of Work as of that date will be paid for at the Contract bid price. Payment for partially completed Work will be paid for at agreed prices or by force account methods described in Subsection 108.04 provided. However, that such payment does not exceed the bid price of the Pay Item under which the Work was performed. Items which are eliminated in their entirety by such termination will be paid for only to the extent provided in Subsection 104.04. Payment for new items, if any, will be made either at agreed prices or paid for by force account methods described in Subsection 108.04.

Materials obtained by the Contractor for the Work, but which have not been incorporated therein, may be purchased at the option of the Engineer from the Contractor at actual cost delivered to a prescribed location, or otherwise disposed of as mutually agreed.

Within 60 days of the effective termination date, the Contractor shall submit claims for additional costs actually incurred not covered above or elsewhere in these Specifications. Such claims may include such cost items as reasonable mobilization efforts, overhead expenses attributable to the Project terminated, subcontractor costs not otherwise paid for, actual idle labor cost if Work is stopped in advance of the termination date, and guaranteed payments for private land usage as part of original Contract. Costs which are prohibited under Subsection 106.19 and anticipated profits on Work not performed are not allowed.

By written order, the Authority may also, terminate the Contract or any portion thereof for cause after determining that reasons for default as stated in Subsection 106.03 exist. The decision whether to terminate for cause or declare the Contractor in default will be made in the sole discretion of the Authority acting in the best interest of the Authority. Prior to the issuance of an Order of Termination for cause, the Engineer will give written notice to the Contractor and Surety of the causes for the proposed termination. The notice shall demand the elimination of such causes.

Within a period of 10 days after such notice, if the Contractor or surety does not proceed in accordance therewith, then the Authority may terminate the Contract for cause.

The Order of Termination for cause will terminate the Contractor's right to proceed with any items of Work except as specified in the termination order. Such Work will include punch list items and all Work necessary to ensure the safety of the public, to properly secure existing Work already constructed or partially constructed, and to secure the job site. This Work so ordered shall be performed in accordance with the Contract Documents and may include such items of Work not in the original Contract. Substantial Completion shall occur when all Work specified in the termination order, except for punch list items, is complete and accepted by the Engineer.

After the completion of all punch list items and all documents required by the Contract, the Contract shall terminate upon issuance of a Final Certificate and payment.

When the Authority orders termination of the Contract for cause, all completed items of Work as of that date will be paid for at the Contract bid price. Payment for partially completed Work will be made either at agreed prices or by force account methods described in Subsection 108.04 provided, however, that such payment does not exceed the bid price of the Pay Item under which the Work was performed. Items which are eliminated in their entirety by such termination will be paid for only to the extent provided in Subsection 104.04. Payment for new items, if any, will be made either at agreed prices or paid for by force account methods described in Subsection 108.04. No other costs will be allowed the Contractor. Profit and overhead not included in the bid price for Pay Items for Work completed or partially completed will not be allowed except that profit and overhead on force account work may be paid consistent with Subsection 108.04.

In terminating a Contract for cause, the Authority does not waive its right to sue the Contractor for any costs incurred by the Authority as a result of the termination, including the additional costs of completing the Project. The Authority reserves the right to declare in default a contractor who fails to carry out the conditions set forth in an Order of Termination for cause.

Where the Authority's termination of the Contract for cause pursuant to the provisions of this Subsection is found by a court to be legally improper, the termination of the Contract for cause will be treated as if it had been a termination for convenience and such termination is to be compensated for in accordance with the provisions of this Subsection governing terminations for convenience.

In terminating a Contract for convenience or cause pursuant to this Subsection:

(A) The Contractor shall make cost records available consistent with Subsection 108.04 to the extent necessary to determine the validity and amount of each item for which it seeks compensation;
(B) The Contractor shall not be relieved of contractual responsibilities for the Work completed, nor shall the surety be relieved of its obligations for and concerning any just claim arising out of the Work performed;
(C) The Contractor shall, if so directed by the Engineer, remove promptly any or all of his equipment and supplies from the site of the Project or other property of the Authority. If the Contractor fails to remove the equipment and supplies as directed, the Engineer may remove such equipment and supplies at the expense of the Contractor.

107.10 Progress Photographs.

Before construction operations have started at the site, the contractor shall take and provide color photographs in a number that is sufficient to depict the existing condition of the construction site. An average of ten (10) views shall be taken each month to show the progress of work and shall continue until completion of work. The Engineer will determine the actual number and location of views to be taken each month. Two (2) sets of color prints and a complete set of digital image electronic files shall be submitted to the Engineer, without charge to the Authority, promptly after taking the views each month.

Photographs shall be of standard commercial quality, 8" x 10" in size, on professional quality glossy paper utilizing linen backing of clear laminate mounting with a minimum thickness of 3 mils. Each photograph shall be enclosed in a double face plastic sleeve. Each photograph shall show an information box in the lower right hand corner approximately 1 ½" high and 3" wide having a white background and black letters. The information box shall be incorporated into the print by a photographic process and shall not be pasted to the finished print.

The following information shall be typed, not handwritten in the box:

NEW JERSEY TURNPIKE AUTHORITY - CONTRACT _____

_____(Engineer's Name)_____

_____(Contractor's Name)_____

No. _____ Date _____

(Information regarding view such as location, direction of sight and significant points of interest.)

Digital file to be JPEG file format. File to be digital image size of a minimum of 1600 x 2000 pixels @ 200 pixels/inch.

All CD's and prints shall become the property of the Authority.

The Contractor shall notify the Engineer 24 hours in advance of taking any photographs.

Any and all photographs taken of the construction area shall not be released to any source whatsoever without the prior written permission from the Authority. This provision shall prevail for the duration of the Contract and shall run indefinitely thereafter.

107.11 Lane and Roadway Occupancy Charges.

The Contractor is advised that severe impacts are experienced by the traveling public occasioned by having a lane or lanes closed beyond the allowable lane closure hours listed in the Authority's Manual for Traffic Control in Work Zones. In the event that the Contractor fails to open a lane or lanes or make the lane or lanes fully available for use by Authority Maintenance crews, according to the allowable lane closure hours, the Authority will have the right to collect a Lane Occupancy Charge for the use and occupancy of each such lane or lanes beyond the allowable lane closure hours until such time that the lane or lanes are reopened to traffic or made fully available for use by Authority Maintenance crews. Therefore, the contractor will be assessed a Lane Occupancy Charge for a delay in the reopening of the lane closing(s), premised upon road user costs and costs incurred by the Authority for engineering, inspection, and administration (including overhead). The Lane Occupancy Charges shall be collected by deducting the appropriate Charges, as determined in accordance with the Authority's Road User Cost Manual and Lane Occupancy Charge Worksheet, from the Contractor's partial payments.

The Authority's Road User Cost Manual and Lane Occupancy Charge Worksheet are available on the Authority's Web Site (www.state.nj.us/professional-services.html) under the Engineering Reference Material section.

THE CONTRACTOR IS ADVISED THAT ROADWAY CLOSURES MAY NOT BE AVAILABLE FOR WORK ON THIS PROJECT. However, the Contractor may be allowed to utilize any roadway closure installed/scheduled by others for work on other Contracts or for Authority Maintenance. The Contractor is advised that severe impacts are experienced by the traveling public occasioned by having a roadway closed beyond the hours specified by Contract documents or the Operations Department. In the event that the Contractor fails to remove their operations from a roadway or make the roadway fully available for use, the Authority will have the right to collect a Roadway Occupancy Charge for the use and occupancy of the roadway beyond the specified hours until such time that the roadway is reopened to traffic or made fully available for use. Therefore, the contractor will be assessed a Roadway Occupancy Charge for a delay in the reopening of the roadway closing, and costs incurred by the Authority for engineering, inspection, and administration (including overhead). The Roadway Occupancy Charge shall be collected by deducting the amount from the Contractor's partial payments.

Roadway Occupancy Charges for roadway closings will be assessed after the hours specified by the Engineer and will be in the amount of $20,000 per day, until the roadway is fully available for use by Authority patrons or Authority Maintenance crews as applicable.

SECTION 108 - MEASUREMENT AND PAYMENT

108.01 Measurement of Quantities.

All work completed under the Contract will be measured by the Engineer, according to United States standard measure.

A station when used as a definition or term of measurement will be 100 linear feet.

The method of measurement and computations, to be used in determination of quantities of material furnished and of work performed under the Contract, will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and deductions will not be made for individual fixtures having an area of 9 square feet or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the Plans or ordered in writing by the Engineer.

Structures will be measured according to neat lines shown on the Plans or as altered to fit field conditions.

All items which are measured by the length, such as pipe culverts, guide rail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise shown on the Plans.

In computing volumes of excavation, the average end area method or other acceptable methods will be used.

The thickness of plates and galvanized sheet, used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing, will be specified and measured in decimal fractions of inches.

All materials, which are measured or proportioned by weight, shall be weighed on accurate, approved scales by competent personnel at locations designated by the Engineer. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material be paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty daily at such times as the Engineer directs, and each truck shall bear a plainly legible identification mark.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to at least their water level capacity, and all loads shall be leveled when the vehicles arrive at the point of delivery.

When requested by the Contractor and approved by the Engineer in writing, material specified to be measured by the cubic yard may be weighed and such weights will be converted to cubic yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the Engineer.

Volumes of bituminous materials of the types and grades specified shall be as determined by applicable temperature - volume correction tables in accordance with ASTM D1250.

Timber will be measured by the thousand feet board measure actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

When a complete structure or structural unit (in effect, "Lump Sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

The term “Each” when used as a definition or term of measurement shall refer to one of two or more elements considered separately and will be measured by the number in place, replaced, or removed.

When standard manufactured items are specified such as a fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

Scales for the weighing of highway and bridge construction materials, which are required to be proportioned or measured and paid for by weight, shall be furnished, erected and maintained by the Contractor, or be certified permanently installed commercial scales.

Scales shall be accurate within one-half percent of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the inspector before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed one-tenth of one percent of the nominal rated capacity of the scale; but not less than one pound. The use of spring balances will not be permitted.

Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and inspector can safely and conveniently view them.

Scale installations shall have available ten standard 50 pound weights for testing the weighing equipment or suitable weights and devices for other approved equipment.

Scales must be tested for accuracy and serviced before use at a new site. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end.

Scales overweighing (indicating more than true weight) will not be permitted to operate, and all materials received subsequent to the last previous correct weighing accuracy test will be reduced by the percentage of error in excess of one-half of one percent.

In the event inspection reveals the scales have been underweighing, they shall be adjusted and no additional payment to the Contractor will be allowed for materials previously weighed and recorded.

All costs in connection with furnishing, installing, certifying or testing, and maintaining scales; for furnishing check weights and scale houses; and for all other items specified in this Subsection for the weighing of highway

and bridge construction materials for proportioning or payment, shall be included in the unit prices for the various Pay Items.

When the estimated quantities for a specific portion of the work are designated as the pay quantities in the Contract and if the work is actually performed as specified, they shall be the final quantities for which payment for such specific portion of the work will be made, unless the dimensions of said portions of the work shown on the plans are revised by the Engineer, or unless errors in the quantities are discovered. If revised dimensions result in an increase or decrease in the quantities of such work, the final quantities for payment will be revised in the amount represented by the authorized changes in the dimensions.

It is expressly understood that no measurement or payment will be made of work performed and/or materials incorporated in the completed work in excess of those shown on the Plans or specified, when such additional labor and materials are furnished for the Contractor's own convenience or to correct deficient or faulty work. Any material furnished and work performed in excess of the Contract requirements shall, unless such use is specifically ordered in writing by the Engineer, be deemed to be furnished by the Contractor for his own convenience. Lack of exceptions taken by the Engineer for excess materials and work proposed to be used by the Contractor during the review and examination of shop and working drawings shall not constitute an order for a change in the Contract requirements.

108.02 Payment.

Payment under the aggregate of the items listed in the Proposal, at the prices bid, for the quantities as determined herein, is to provide for the construction and completion in every detail of the work described in the Contract Documents. The Contractor shall furnish all labor, materials, equipment, tools, transportation, supplies, and all else necessary and incidental thereto to complete the work.

Payment for Work, which is not specifically covered by a pay item in the Proposal, but is required to complete work in an item for which payment is to be made, will be considered to be included in the price bid for that pay item in the Proposal. The cost of Work, which is not specifically covered by a pay item and is not directly related to any of the pay items in the Contract, will be considered to be included in the prices bid for the various pay items scheduled in the Proposal.

Payment for each pay item in the Proposal will be made for the quantity as determined in accordance with the Contract Documents at the price per unit bid in the Proposal.

Except for the items Construction Layout (Subsection 104.09), Mobilization (Subsection 104.10), Progress Schedule (Subsection 107.04) and items related to dust control (Subsection 208.05) when scheduled in the Proposal, no separate payment will be made for costs incurred by the Contractor in complying with the requirements specified under the various Subsections of Division 100, General Provisions, but the cost thereof shall be included in the bid prices for the various pay items scheduled in the Proposal.

Payment for Work shall be timely made to the Contractor in accordance with P.L. 2006, c. 96, amending P.L. 1991, c. 133 (N.J.S.A. 2A: 30A-1 and 2) (the “Prompt Payment Act”). Disputes regarding whether the Authority, or any other party subject to the Prompt Payment Act, has failed to make payments required under the Prompt Payment Act may be submitted to alternative dispute resolution.

108.03 Partial Payments.

(A) CONTRACTS UNDER $5 MILLION.

At monthly intervals, or semi-monthly when the work accomplished in a two-week period amounts to a minimum of $100,000 or 25 percent of the total price bid for the contract, the Engineer will prepare a "Certificate for Payment to Contractor," which shall be executed by the Contractor, showing the approximate quantities of work completed and all permanent materials and equipment furnished but not incorporated in the work, up to the date of such certificate, and the value of such materials and equipment as security for the fulfillment of this contract by the Contractor until the completion of the contract. The Authority will pay monthly or semi-monthly to the Contractor while carrying on the Work, the balance not retained after deducting there from all previous payments. In connection with the value of the approximate quantities of work completed, an amount equivalent to two (2) percent of the amount due will be deducted and retained from the partial payments pending substantial completion. The Engineer will notify the contractor in writing of the substantial completion date of the contract. In the first estimate following substantial completion, the Authority will reduce the amount retained to one (1) percent of the total value of the contract. No additional retainage will be withheld provided that the work is proceeding satisfactorily and timely on the basis of approved construction schedules. Ten (10) percent of the value of

permanent materials and equipment furnished but not incorporated in the work will be deducted and retained at all times. This will be in addition to any amount retained in connection with the total value of the approximate quantities of work completed. The total value of the contract will be considered to mean the original total Awarded value of the Contract, adjusted by the total value of all approved Change Orders.

If it becomes evident on the basis of the approved progress schedule or otherwise that the completion date for the Contract will not be met, the Authority reserves the right to retain four (4) percent of the total value of the approximate quantities of work completed throughout the entire Contract period and to make additional retention in the amount of the liquidated damages as specified in the contract.

(B) CONTRACTS OVER $5 MILLION.

At monthly intervals, or semi-monthly when the work accomplished in a two-week period amounts to a minimum of $250,000, the Engineer will prepare a "Certificate for Payment to Contractor," which shall be executed by the Contractor, showing the approximate quantities of work completed and all permanent materials and equipment furnished but not incorporated in the work, up to the date of such certificate, and the value of such materials and equipment as security for the fulfillment of this contract by the Contractor until the completion of the contract. The Authority will pay monthly or semi-monthly to the Contractor while carrying on the Work, the balance not retained after deducting there from all previous payments. In connection with the value of the approximate quantities of work completed, an amount equivalent to two (2) percent of the amount due will be deducted and retained from the partial payments pending substantial completion. The Engineer will notify the contractor in writing of the substantial completion date of the contract. In the first estimate following substantial completion, the Authority will reduce the amount retained to one (1) percent of the total value of the contract. No additional retainage will be withheld provided that the work is proceeding satisfactorily and timely on the basis of approved construction schedules. Ten (10) percent of the value of permanent materials and equipment furnished but not incorporated in the work will be deducted and retained at all times. This will be in addition to any amount retained in connection with the total value of the approximate quantities of work completed. The total value of the contract will be considered to mean the original total Awarded value of the Contract, adjusted by the total value of all approved Change Orders.

If it becomes evident on the basis of the approved progress schedule or otherwise that the completion date for the Contract will not be met, the Authority reserves the right to retain four (4) percent of the total value of the approximate quantities of work completed throughout the entire Contract period and to make additional retention in the amount of the liquidated damages as specified in the contract.

(C) ALL CONTRACTS.

Prior to the issuance of each partial payment by the Authority to the Contractor, the Contractor shall certify in writing to the Authority either that:

(1) each and every subcontractor and/or supplier has been paid from any previous partial payment any amount due and owing by the Contractor and shall be paid any amount due and owing by the Contractor from the current partial payment; or
(2) a valid basis exists under the terms of the subcontractor's or supplier's contract to withhold payment from the subcontractor or supplier and therefore, payment is being withheld.

Any future partial payment to the Contractor will be withheld by the Authority until the required certification is submitted by and received from the Contractor.

In accordance with N.J.S.A. 2A:30 A-2 – the Prompt Payment Act, regarding the prompt payment of construction contracts, the required 30-day payment period shall begin when the "Certificate for Payment to Contractor" has been approved in the Authority's contract management system (CapEx Manager) by the Deputy Chief Engineer of Construction.

When the Work of the Contract is being satisfactorily carried to completion within the Contract time, and is substantially completed, the Authority may reduce the retainage below the amounts set forth above.

The Authority shall have the right to retain out of monies due any amounts claimed by the Authority to be due it from the Contractor, which retainage shall be in addition to any retainage set forth elsewhere.

In the event of any conflicting claim about the right to receive payments which may be or become due from the Authority under the terms of the Contract, the Authority may withhold any or all disputed payment amounts until such dispute is resolved by a court of competent jurisdiction. The Authority shall not be

joined as a party to any lawsuit between the Contractor and its Subcontractors and/or suppliers by reason of holding said fund and any party suing the Authority in contravention of this provision shall be responsible and liable for attorney's fees and legal costs incurred by the Authority in defending said claim.

The Authority shall have the right to withhold from monies due the Contractor an amount sufficient to completely indemnify the Authority against liability resulting from any claim against the Contractor.

108.04 Payments for Cost-Plus Work.

Where the Contractor and the Engineer cannot negotiate an agreement for extra work or for work designated as cost-plus work elsewhere in the Contract Documents, the Chief Engineer may direct and require the Contractor to do such work on a cost-plus basis to be compensated as provided in this Subsection.

The total costs for labor, materials, equipment, bonds, insurance and tax as provided in the following Subparts, together with applicable markups shall constitute full compensation for all direct and indirect costs, including overhead, and profit, and shall be deemed to include all items of expense not specifically designated.

(A) LABOR.

Labor shall mean:

(1) Actual hourly wages, as set forth and substantiated by the Contractor's Certified Payroll Records, paid to and received by foremen, shop stewards, surveyors, laborers, mechanics and other employees below the rank of superintendent, exclusive of timekeepers, as dictated by union contract and directly employed at the construction site, whether employed by the Contractor or by the subcontractor, subject to the Engineer's authority to determine what employees of any category are "required for Extra Work" and as to the portion of their time allotted to Extra Work.

(2) A pro rata portion of:

(a) Vacation allowances and union dues and assessments which the employer actually pays, as set forth and substantiated by the Contractor's Certified Payroll Records, pursuant to contractual obligation upon the basis of such wages, and

(b) Taxes actually paid by the employer (such as Social Security Tax, Federal and State Unemployment Compensation Contributions and State Temporary Disability Benefits Contributions), as set forth and substantiated by the Contractor's Certified Payroll Records, pursuant to law upon the basis of such wages and as shown in the "Notice of Employer Contribution Rates" issued by the New Jersey Department of Labor

(c) Holiday pay actually paid by the employer during the performance of the work.

"Employees" as used herein shall mean only the employees of one employer.

(B) MATERIALS.

Actual cost of all material used and incorporated into the permanent construction, including freight and delivery charges as shown on original receipted bills. For all materials not incorporated into the permanent construction but necessarily involved in the performance of the work, the Contractor shall receive an amount equal to the actual cost of such materials, less a reasonable allowance for the salvage value of such materials when they are no longer required for the performance of the work except as follows: (Fuels and lubricants consumed by equipment shall be included in the Equipment and Plant described below.)

The Authority is exempt from the Sales and Use Tax pursuant to Subsection 106.10. The Contractor will not be reimbursed for taxes for which the Authority is exempt.

(C) INSURANCE.

Actual additional cost of Workman's Compensation, Contractor's Commercial General Liability Insurance, Owner's Protective Liability Insurance, Contractor's Pollution Liability (CPL) Insurance, Umbrella Liability Insurance, and other types of Insurance which may be required for the performance of the work, provided the cost of such insurance is increased due to an increase in the cost of the work. Calculations for these additional costs shall be submitted to the Engineer prior to the completion of the cost plus work.

Cost of bonds, property damage, liability, and workers compensation insurance premiums; unemployment insurance contributions; and social security taxes shall be supplied to the Engineer prior to the start of cost plus work.

(D) OVERHEAD.

Ten (10) percent of the cost of Labor (A), Materials (B) and Insurance (C), and five (5) percent of the cost of Equipment and Plant (E) and Sublet Work (I) shall be added as full compensation for all general superintendents (other than Foremen), administration and overhead, bonding expenses, general safety items and equipment including personal protection equipment (PPE) and the use of small tools.

(E) EQUIPMENT AND PLANT.

(1) **Contractor Owned Equipment and Plant.**

An hourly rate determined as set forth below of all equipment, other than small tools, actually owned by the Contractor and used in the performance of the work, limited to the periods that such equipment is actually required and engaged in the performance of the work.

The Rates shall be derived from the monthly rate, as set forth in the recommendations of the "Rental Rate Blue Book " published by EquipmentWatch®, (a unit of Penton Media, Inc.) 6151 Powers Ferry Rd. Suite 200, Atlanta, Georgia 30339.

(a) The ownership hourly rate will be determined by dividing the monthly rate by 176. The weekly, hourly, and daily rates will not be used.

(b) The number of hours to be paid will be the number of hours that the equipment or plant is actually used on a specific cost-plus activity.

(c) The current revisions will be used in establishing rates. The current revision applicable to specific cost-plus work is as of the first day of work performed on that cost-plus work and that rate applies throughout the period the cost- plus work is being performed.

(d) Area adjustment and equipment life adjustment will not be made.

(e) Overtime shall be charged at one-half the rate indicated in Part (a) above.

(f) The estimated operating costs per hour will be used for each hour that the equipment or plant is in operation on the work. Such costs do not apply to idle time, regardless of the cause of the idleness.

(g) Idle time for equipment will not be paid for, except where the equipment has been held on the project site on a standby basis at the direction of the Engineer and, but for this direction, should have left the project site. Such payment will be made at one-half the rate established in Subparagraph (1) above.

(h) The rates established above include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs, overhaul and maintenance of any kind, depreciation, storage, profit, insurance, all costs (including labor and equipment) of moving equipment or plant to, on, and away from the site. The only exception shall be the cost to move such equipment if the use of such equipment was not required as part of the contract scope at the time the contractor is directed to proceed with cost plus work.

Operator costs will be paid only as provided in (A) Labor above. There will be no payment for operator cost when the equipment is idle. All equipment shall, in the opinion of the Engineer, be in good operating condition. Equipment used by the Contractor shall be specifically described and be of suitable size and suitable capacity required for the work to be performed. In the event the Contractor elects to use equipment of a higher rental value than that suitable for the work, payment will be made at the rate applicable to the suitable equipment. The equipment actually used and the suitable equipment paid for will be made a part of the record for cost-plus work. The Engineer will determine the suitability of the equipment. If there is a differential in the rate of pay of the operator of oversize or higher rate equipment, the rate paid for the operator will be that for the suitable equipment.

If a rate is not established in the Rental Rate Blue Book for a particular piece of equipment or plant, the Contractor shall obtain a rate from Equipment Watch for the Engineer's review and approval.

The above provisions apply to the equipment and plant owned directly by the Contractor or by entities which are divisions, affiliates, subsidiaries, or in any other way related to the Contractor or its parent company.

(2) **Rented Equipment and Plant.**

Rented Equipment and Plant. In the event that the Contractor does not own a specific type of equipment or plant and must obtain it by rental, the Contractor shall inform the Resident Engineer of the need to rent the equipment and of the rental rate for that equipment prior to using it on the Work. The Contractor will be paid the actual rental for the equipment for the time that the equipment is actually used to accomplish the work, provided that rate is reasonable as determined by the Engineer. The Contractor shall provide a copy of the paid receipts and canceled checks for the rental expense incurred.

(F) PROFIT.

Ten (10) percent of the cost of Labor and Materials as described above, as full compensation for profit and for all other items of cost and expense to the Contractor not specifically provided for herein.

(G) TOLLS.

Tolls for Authority roadways or any other roadways will not be reimbursed.

(H) SUBLET WORK.

In the event any portion of the work ordered on a cost-plus basis is sublet, the Contractor will be paid for the actual cost of the work performed in accordance with the provisions as specified above.

(I) RECORDS.

The Contractor shall maintain its records in such a manner as to provide a clear distinction between the direct costs of work paid for on a cost-plus basis and the costs of other operations.

From the above records, the Contractor shall furnish to the Engineer the completed Daily Schedule of Labor, Equipment and Material charges reports using the forms provided herein the appendix of the supplementary specifications for each day's work. Said daily cost-plus work reports shall be signed by the Contractor and submitted daily for the Engineer's review and approval.

The Contractor's final cost plus work reports shall be submitted using the schedule of forms provided in Appendix Z of the Standard Supplementary Specifications and shall be listed as follows:

Standardized Schedules for Cost-Plus Work

Schedule A: Summary of Charges

Schedule B: Daily Schedule of Labor Charges

Schedule B-1: Calculation of Hourly Labor Rates

Schedule C: Daily Schedule of Equipment Charges

Schedule C-1: Calculation of Hourly Equipment Rates

Schedule C-2: Calculation of Rented Equipment

Schedule D: Daily Schedule of Material Charges

Schedule E: Daily Schedule of Subcontractor Charges

Schedule F: Inspector Report

Material charges shall be substantiated by valid copies of vendor's invoices. Such invoices shall be submitted with the daily cost-plus work reports, or if not available, they shall be submitted with subsequent daily cost-plus work reports. Should said vendor's invoices not be submitted within 60 days after the date of delivery of the material, or within 15 days after the completion, whichever occurs first, the Authority reserves the right to establish the cost of such materials at the lowest current wholesale prices at which said materials are available, in the quantities concerned, delivered to the location of work.

The Contractor will not be paid until all of the above records are provided to the Authority as outlined above, and reviewed and approved by the Engineer and Authority.

The Chief Engineer may direct a Contractor to perform work which would require the paying of premium time wages not anticipated in the original scope of the project. The premium portion of all wages will not receive a mark-up for profit; however, a 10% overhead allowance will be paid on the premium portion of wages.

The Contractor's cost records pertaining to work paid for on a cost-plus basis shall be open to inspection or audit by representatives of the Authority, during the life of the contract and for a period of not less than three years after acceptance thereof, and the Contractor shall retain such records for that period. Where payment for materials or labor is based on the cost thereof to forces other than the Contractor, the Contractor shall ensure that the cost records of such other forces are open to inspection and audit by representatives of the Authority on the same terms and conditions as the cost records of the Contractor. In case all or a part of such records are not made so available, the Contractor understands and agrees that any items not supported by reason of such unavailability of the records will not be allowed, or if payment therefore has already been made, the Contractor shall refund to the Authority amount so disallowed.

Should the Contractor refuse or fail to prosecute the work as directed, the Chief Engineer may withhold the payment of all current estimates until the Contractor's refusal or failure is eliminated.

108.05 Final Payment.

When the Project is, in the sole opinion of the Engineer, ready for final acceptance by the Authority, a "Final Certificate For Payment To Contractor" will be made by the Engineer based on the actual quantities of authorized work done under each Scheduled Item of Work, and under Change Orders, if any, at the unit price or prices stipulated therein. When this final certificate is approved by the Authority, the balance due to the Contractor for the performance of the Project will be paid the Contractor, less any amounts of liquidated damages that may be imposed by the Authority, provided however, that before final payment is made the following shall be satisfied:

- The Contractor shall provide a Maintenance Bond as required and specified in the Contract and/or Subsection 109.03.
- The Contractor and Subcontractors shall file affidavits certifying the amounts due and identity of any and all workmen owed wages due on account of the project work.
- The Contractor shall execute and deliver the Final Certificate For Payment To Contractor on the required form, which includes a full release of the Authority and its agents from any claims or actions on this contract and a certification by the Contractor that there are no outstanding liens or claims for work performed or materials supplied under this Contract.

In the event a claim is filed against the Contractor or the Contractor intends to file a claim against the Authority, the Authority may issue, pursuant to the recommendation of the Chief Engineer, a semifinal payment releasing all monies due the Contractor, except the amounts in dispute, provided other provisions hereinabove are fulfilled with the exception of the release to the Authority, in respect to the amounts in dispute.

108.06 As-Built Quantities.

The Engineer will prepare as-built quantities for all Scheduled Items of Work and Cost-Plus work which has been authorized and incorporated into the Project. When such as-built quantities are completed, they will be incorporated into a proposed "Final Certificate for Payment To Contractor". The Contractor assumes the positive obligation of assisting the Engineer wherever possible in the preparation of such as-built quantities.

From time to time, the Engineer may prepare adjusted quantities and incorporate these quantities into monthly estimate certificates through an appropriate change order. Such adjusted quantities shall be subject to re-calculation. However, nothing contained in these specifications shall be construed to place on the Engineer the obligation of providing the Contractor with as-built quantities for the work performed prior to the issuance of the proposed Final Certificate For Payment To Contractor nor to provide more than rough approximate quantities of the work done for use in the preparation of monthly estimates.

Where the Final Certificate For Payment To Contractor reveals that an overpayment has been made, the Contractor shall immediately return the amount of the overpayment. If the Contractor fails to remit the overpayment, the Authority shall avail itself of other funds held on other projects with the same Contractor, and then shall be entitled to proceed against the Contractor or his Surety.

108.07 Release.

The acceptance by the Contractor of payment of the final certificate shall release the Authority and its agents from all claims of or liability to the Contractor for anything done or furnished or omitted to be done or furnished for or relating to the Project, or any act or neglect of the Authority to the Contractor or any Corporation or person arising from the Contract.

108.08 Unforeseen Work.

The Engineer may direct the Contractor to perform unforeseen work not identified in the contract documents. The Engineer will notify the Contractor in writing for an initial assessment of the unforeseen work order.

The Contractor shall prepare and submit a detailed scope of work to be performed which shall include labor, materials and equipment necessary to complete the unforeseen work order. The scope shall include a construction schedule and completion date including a cost breakdown as outlined under Subsection 108.04 "Payments for Cost-Plus for Work."

The Engineer may approve, disapprove or modify any of the items submitted by the Contractor.

The Contractor shall only start the work order after approval by the Engineer.

Materials and methods of construction shall conform to the appropriate Subsections of the Standard or Supplementary Specifications.

Measurement for payment will be made on a Cost-Plus basis for the labor, materials and equipment used in accordance with Subsection 108.04.

Payment will be made under:

PAY ITEM ..... ***PAY UNIT***

ALLOWANCE FOR UNFORESEEN WORK (NO-BID) ..... COST-PLUS

No additional payment will be made for the preparation of work orders and submittals for unforeseen work. These costs shall be included in the pay unit of unforeseen work. Work Orders and submittals for unapproved unforeseen work will be at the Contractor's own expense.

108.09 Audit.

All claims filed, requests for equitable adjustments, and cost-plus work is subject to audit at any time following the filing, whether or not part of a suit pending in the courts of this State pursuant to the New Jersey Contractual Liability Act, N.J.S.A. 59:13-1 et seq. The audit may be performed by employees of the Authority or by an auditor under contract with the Authority. The audit may begin on 10 days' notice to the Contractor, Subcontractor, or Supplier. The Contractor, Subcontractor, or Supplier shall provide adequate facilities, which are acceptable for such audit during normal business hours. The Contractor, Subcontractor, or Supplier shall make a good faith effort to cooperate with the auditors. Failure of the Contractor, Subcontractor, or Supplier to maintain and retain sufficient records to allow the Authority's auditor to verify all or a portion of such claim, request for equitable adjustments, or cost-plus work to the books and records of the Contractor, Subcontractor, or Supplier shall constitute a waiver from payment of such claim, request for equitable adjustments, or cost-plus work and shall bar any recovery thereunder.

At a minimum, provide the auditors the following documents:

1. Daily time sheets and foreman's daily reports.
2. Union agreements.
3. Insurance, welfare, and benefits records.
4. Certified payroll records.
5. Earnings records.
6. Payroll tax forms.
7. Material invoices and requisitions.
8. Material cost distribution worksheet.
9. Equipment records (list of company equipment and rates).
10. Vendors', rental agencies', and subcontractors' invoices.
11. Subcontractors' payment certificates.
12. Canceled checks (payroll and vendors).
13. Job cost report.

14. Job payroll ledger.
15. General ledger.
16. Cash disbursements journal.
17. Financial statements for all years reflecting the operations on the Project.
18. Income tax returns for all years reflecting the operations on the Project.
19. Depreciation records on company equipment whether such records are maintained by the company involved, or its accountant, or others.
20. If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the cost of owning and operating equipment, all such other source documents.
21. All documents that reflect the Contractor's actual profit and overhead during the years the Project was being performed and for each of the 5 years before the date of award of the Project.
22. All documents related to the preparation of the Contractor's bid, including the final calculations on which the bid was based.
23. All documents that relate to each and every request or claim together with all documents that support the amount of damages as to each claim.
24. Worksheets used to prepare the request or claim establishing the cost components for items of each including, but not limited to, labor, benefits and insurance, materials, equipment, subcontractors, and all documents that establish the time periods, individuals involved, and the hours and rates for these individuals.

Where payment for materials or labor is based on the cost thereof to forces other than the Contractor, the Contractor shall ensure that the cost records of such other forces are open to inspection and audit by the Authority or its representatives on the same terms and conditions as the records of the Contractor.

Pursuant to N.J.S.A. 52:15C-14(d), relevant records of private vendors or other persons entering into contracts with the Authority are subject to audit or review by the New Jersey Office of the State Comptroller. The Contractor shall maintain all documentation related to products, transactions or services under the Contract for a period of five years from the date of final payment. Such records shall be made available to the New Jersey Office of the State Comptroller upon request.

SECTION 109 - ACCEPTANCE AND GUARANTY

109.01 Final Cleaning Up.

Before the final acceptance of the Project, the Contractor shall remove all equipment, temporary work, unused and useless materials, rubbish and temporary buildings, shall repair or replace in an acceptable manner fences or other private or public property which may have been damaged or destroyed on account of the prosecution of the work, shall fill all depressions and water pockets on public and private property caused by his operations, shall remove all obstructions from waterways caused by his work, shall clean all drains and ditches within and adjacent to the site of the project which have been obstructed by his operations, and shall leave the site of the project and adjacent public and private property in a neat and presentable condition wherever his operations have disturbed conditions existing at the time of starting work. Payment for final cleaning up and restoration of property as above provided will not be made under any specific item but the cost of this work shall be included in the prices bid for the various items scheduled in the Proposal.

109.02 Final Inspection and Acceptance of Work.

When in the opinion of the Contractor the Project has been completed, the Contractor shall so notify the Engineer in writing, and the Engineer will arrange for inspection. If the project is not acceptable to the Engineer, the Engineer shall advise the Contractor as to the particular defects to be remedied before final acceptance will be made. Payments made to the Contractor before the final acceptance shall not be deemed as committing the Authority to acceptance of the Project. The final inspection will be made by the Engineer, and the final acceptance will be made by the Authority when the Project has been completed.

All defects discovered and indicated by the Engineer during the Final Inspection shall be corrected by the Contractor within 30 days after written notice by the Engineer. Failure to correct all such defects within such 30

day period, or within the specified date for final completion of the Contract, whichever is later, will be considered as a default in carrying out the terms of the Contract, and it is agreed that such default will entitle the Authority to collect from the Contractor (or withhold from monies due) liquidated damages as provided in the Contract.

The term "defects," shall be construed as applying only to completed work requiring repairs, adjustments, etc.

The Authority shall not be precluded or estopped by any measurement, estimate, certificate or approval of work performed or materials furnished, made either before or after the completion and acceptance of the Project and payment therefore, if such measurements, estimate or certificate be found to be in error or untrue, from showing the true amount and character of the work performed and materials furnished by the Contractor, or from showing that any such measurement, estimate, certificate or approval is incorrectly made or untrue, or that the work or materials do not conform in fact to the requirements of the Contract, or that said work was performed in a defective or unworkmanlike manner. The Authority shall not be precluded or estopped, notwithstanding any such measurement, estimate or certificate and payment made in accordance therewith, from recovering from the Contractor and his surety such damages as it may sustain by reasons of the Contractor's failure to comply or to have complied with the terms of the Contract.

Neither the final acceptance by the Authority or any acceptance by any representative of the Authority, nor any payment made for the whole or any part of the Project, nor any extension of time granted the Contractor, nor any possession taken by the Authority, shall operate as a waiver of any portion of the Contract or of any power herein reserved, or any right to damages herein provided. A waiver of any breach of the Contract shall not be held to be a waiver of any other or subsequent breach.

109.03 Maintenance Bond.

Before final payment is made as provided in Subsection 108.05, the Contractor shall furnish a Surety Bond to the Authority in a sum equal to five (5) percent of the Total Adjusted Contract Price, rounded to one hundred dollars. The Bond shall be on the form furnished by the Authority and with surety satisfactory to the Authority. The Bond shall remain in full force and effect for a period of one (1) year from the date when all defects and punchlist items have been corrected for final acceptance of the Project by the Authority.

The Bond shall provide that the Contractor guaranties to replace for said period of one (1) year all work performed and materials furnished that were not performed or furnished according to the terms of the Contract, and make good defects thereof, regardless of cause which have become apparent before the expiration of said period of one (1) year, and that if any part of the Project, in the judgment of the Chief Engineer for the reasons above stated, needs to be replaced, repaired, or made good during that time, he will so notify the Contractor in writing. If the Contractor fails to do such work within five (5) days from the date of service of such notice, the Chief Engineer may have the work done by others and the cost thereof shall be paid by the Contractor or his Surety.

Before the Surety is released from its bond, the Chief Engineer shall certify in writing that the foregoing obligations have been duly performed.

The obligations of the Contractor and Surety under the Bond specified hereinabove shall not be construed as limiting, diminishing, or in any way affecting the liability and obligations of the Contractor and Surety under the terms of the Contract Bond, it being understood that the Bond prescribed in this article is intended to cover patent defective work and does not include latent defective workmanship and/or materials or such other defects not known to the Authority.

In an emergency as determined by the Chief Engineer, the Authority reserves the right to immediately effect both temporary and permanent repairs, or arrange for others to effect such repairs, at the expense of the Contractor, and the Contractor agrees that in such event the Authority will be reimbursed for such costs by the Contractor or by the Surety.

The Contractor shall obtain and assign to the Authority any manufacturers' warranties or guaranties on electrical or mechanical equipment or any other product or material installed in the Project which are given as customary trade practice.

109.04 Termination of Responsibility.

When all work included in this Contract has been finally accepted by the Authority, the Project shall be considered as completed, and the Contractor shall be released from all further obligations and requirements except as set forth and provided in Subsections 109.02 and 109.03 and in the Contract.

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DIVISION 200 - EARTHWORK

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SECTION 201 - CLEARING AND GRUBBING

201.01 Description.

Clearing and Grubbing shall consist of clearing, grubbing, removing and disposing of trees, logs, stumps, and other vegetation, fences, rubbish and other work as herein described. This work shall also include preservation from injury or defacement of all vegetation and objects to remain. The removal of bridges, structures, and other such obstructions is not included.

Removal of existing fences and associated appurtenances is included under clearing and grubbing.

Removal of existing guide rail and associated appurtenances is included under clearing and grubbing.

201.02 Materials.

Materials shall conform to the following Sections:

TREE PAINT 919.01

201.03 Methods of Construction.

All clearing and grubbing shall be done a satisfactory distance ahead of the grading operations.

Fences of any kind, within the limits of the Project and designated for removal on the Plans, shall be removed and disposed of by the Contractor.

All timber, logs, trees, stumps, brush, rubbish and other objectionable materials accumulated by clearing and grubbing shall be completely removed, so as to leave the areas disturbed by the Contractor with a neat and finished appearance, free from debris.

Once a tree has been cut, it shall be removed from the Project Site within ten (10) working days.

Burning will not be permitted. No materials shall be buried within the right-of-way. All wood materials shall be chipped and either stockpiled for disposal by the contractor or spread in areas to be reforested, if determined to be acceptable by the Engineer. Tree stumps shall be disposed of off Authority property in accordance with the requirements of the New Jersey Department of Environmental Protection. All other materials shall be disposed of by the Contractor at sites to be provided by the Contractor outside and out of sight of the Authority right-of-way in a manner satisfactory to the Engineer and to the owner or agency having jurisdiction over the disposal site.

Topsoil stripped during clearing and grubbing operations shall not be stored either within or at the edge of native woodlands, as equipment working in and around trees could seriously damage tree roots. Topsoil shall be stockpiled in areas designated especially for that purpose, satisfactory to the Engineer.

(A) CLEARING.

Clearing shall consist of the cutting, removing, and cleaning up of all timber, brush, grain, grass, weeds and other annual plants, stumps and rubbish, except such trees and shrubs as may be designated by the Engineer for preservation. Trees, shrubs and other landscape features which do not interfere with the work, or which are designated to be left in place, shall be carefully trimmed and all cuts on trees painted as directed by the Engineer. All such trees and brush shall be protected from scarring; debarking or other injuries during construction operations in a manner approved by the Engineer; if any such trees, shrubbery or plants are damaged, they shall be replaced in kind and size or repaired (if possible) by a competent tree surgeon, all at the Contractor's expense. Outside of the areas where grubbing is to be done, all trees to be removed, roots and existing stumps shall be cut off flush with the original ground surface.

Clearing shall, unless otherwise shown on the Plans or permitted in writing by the Engineer, extend the full length and width of the embankments and excavation work only. Clearing for the purpose of setting up the Contractor's shop, storage, staging area, or such other facilities will not be permitted.

Branches of trees overhanging any roadway of the Project shall be properly trimmed to maintain a clearance height of 20 feet unless ordered otherwise by the Engineer.

All dead trees and those which die during the life of the Contract, along the edge of wooded areas remaining after clearing the site, shall be removed. Individual free-standing trees within the

right-of-way but outside the limits of construction which are dead or which shall have died during the life the Contract, shall also be removed. Such removals shall be considered incidental to and included as part of the work under the item Clearing and Grubbing.

The removal and disposal of elm trees are subject to provisions of State Laws and to regulations of the New Jersey State Department of Agriculture. Before removing any elm trees within the site of the Project the Contractor shall consult the Plant Pathologist of said department and shall comply with his instructions relating to the removal of elm trees and the marking, segregation, and disposal of elm wood.

(B) GRUBBING.

Grubbing shall include the excavation and removal of all roots, stumps, submerged logs and similar objectionable matter. Grubbing shall be performed within the limits of grading operations, including the areas to be topsoiled.

Grubbing shall extend for the full length of all roadway cut sections for the width between the slope stake lines to a depth of 12 inches below neat excavation lines for the roadbed, the ditches, and the slopes, and slightly below the depth to which any areas under the roadbed are disturbed.

Under all roadway embankment sections, grubbing shall extend for the width between slope stake lines and to a depth of 12 inches below original ground surface and slightly below the depth to which any area is disturbed. Where areas are required to be undergraded, stumps shall be cut off at the surface of the undergrading.

No other areas require grubbing, unless otherwise provided for on the Plans.

201.04 Measurement.

Clearing and Grubbing will be paid for on either a lump sum or unit price basis. When payment is to be made on a unit price basis, the quantity of Clearing and Grubbing will be the area cleared and grubbed.

Removal of existing fence and appurtenances will not be measured, but the cost thereof shall be considered incidental to all other items.

201.05 Payment.

Payment will be made under:

PAY ITEM ..... *PAY UNIT*

CLEARING AND GRUBBING ..... ACRE

CLEARING AND GRUBBING ..... LUMP SUM

When paid for as lump sum, payment for clearing the site area, in excess of the amount shown in the following table, will not be made until completion of all contract work:

TOTAL CONTRACT PRICE		
For More Than	**Up To and Including**	**Amount**
$0	$100,000	$4,000
100,000	500,000	18,000
500,000	1,000,000	35,000
1,000,000	2,000,000	70,000
2,000,000	3,000,000	105,000
3,000,000	4,000,000	140,000
4,000,000	5,000,000	175,000
5,000,000	6,000,000	205,000
6,000,000	7,000,000	235,000
7,000,000	8,000,000	265,000
8,000,000	9,000,000	295,000

TOTAL CONTRACT PRICE		
For More Than	Up To and Including	Amount
9,000,000	10,000,000	325,000
10,000,000	-----	(see Note)

Note: Amount will be determined by increasing $325,000 by $25,000 for each $1,000,000, or fraction thereof, in excess of $10,000,000.

SECTION 202 - ROADWAY EXCAVATION

202.01 Description.

Roadway Excavation shall consist of the removal of all materials from within the right-of-way necessary for the preparation and construction of the roadway and all appurtenances including the grading of side ditches. It shall also include saw cutting existing pavements, breaking up and satisfactorily removing gravel, macadam, bituminous or concrete pavements, driveways, curbs and sidewalks, the removal of inlets, culverts, manholes, pipes, headwalls, flared end sections, concrete aprons and other miscellaneous drainage items, the removal of light standard bases, conduits, foundations and other obstructions of whatever nature encountered within the limits of the Roadway Excavation, which are not specified to remain in place or are not specified to be removed under other pay items scheduled in the Proposal. Roadway Excavation shall also include the removal and satisfactory disposal of muck and other unsuitable materials.

Roadway excavation operations shall be classified as follows:

- Roadway Excavation, Earth
- Roadway Excavation, Rock
- Roadway Excavation and Embankment
- Roadway Excavation, Muck
- Removal of Concrete Pavement
- Stripping Topsoil

and as such shall include all authorized excavation within the right-of-way not included under Clearing and Grubbing, Channel Excavation, Foundation Excavation, and Trench Excavation.

Roadway Excavation, Earth, shall include the excavation of all materials not hereinafter classified as Roadway Excavation, Rock; Roadway Excavation, Muck; Removal of Concrete Pavement; or Stripping Topsoil.

Roadway Excavation, Rock, shall include excavation of all boulders more than 1/2 cubic yard in volume and all rock in mass formation and other materials which is determined by the Engineer to be so hard that it is not practicable to loosen and handle it with a 1-1/2 yard power shovel in good condition without continuous drilling and blasting. The classification of Roadway Excavation, Rock, shall not apply to old plain or bituminous bound bases or surface courses of macadam, gravel or broken stone, or Portland cement concrete pavement.

Roadway Excavation and Embankment shall include the excavation of all earth and rock materials as defined under the classification Roadway Excavation, Earth and Roadway Excavation, Rock and shall also include the construction of common embankment using suitable materials obtained from such excavations.

When the Contract does not include the item Roadway Excavation and Embankment in the Proposal, all common embankment construction will be measured and paid for as provided in Section 203.

Roadway Excavation, Muck, shall include excavation of material of large organic content and excessively high moisture which is so unstable and compressible as to be unsuitable for an embankment foundation, and which is specifically designated as "Muck Excavation" on the Plans. The excavation of soft unstable material deemed unsuitable for embankment foundations by the Engineer in areas other than those designated as "Muck Excavation" on the Plans shall be classified as "Roadway Excavation, Earth."

Removal of Concrete Pavement shall include demolition and satisfactory disposal of existing reinforced and unreinforced Portland cement concrete pavement in accordance with the Plans and Specifications. The

removal and disposal of any base and subbase material underlying the existing concrete pavement will be classified as Roadway Excavation, Earth. The removal of Portland cement concrete pavement from areas other than those designated on the Plans for payment under the item Removal of Concrete Pavement shall be classified as "Roadway Excavation, Earth".

Stripping Topsoil shall include excavation of materials encountered at the site in areas of proposed cut and embankment, which material conforms to the requirements prescribed therefore in Subsection 919.07.

202.02 Materials.

No materials are involved.

202.03 Methods of Construction.

Prior to grading, clearing and grubbing shall be performed as required for the Project. The ground surface within excavation and embankment areas shall then be stripped of all sod and vegetable matter and of all material which is suitable, as determined by the Engineer, for top-soiling. All topsoil material shall be stripped and stored for use on the Project. Stripped topsoil, in excess of the quantity required for the Project, shall be disposed of outside the Authority right-of-way by the Contractor. Topsoil shall not be stored in areas where it will interfere with surface drainage or with the conservation of trees, shrubs, fences or any other vegetation or objects that are to remain. Grading operations may then proceed.

"Template grade," as used in these Specifications, shall mean the bottom surface of the required Embankment, Grade A provided for in Subsections 203.02 and 203.03.

The Contractor shall provide a person, familiar with OSHA requirements, to perform daily inspections of excavations, adjacent areas and protective systems. Inspections shall be performed by the competent person prior to the start of work and as-needed throughout the shift.

All abandoned pipes, electrical conduits and boxes encountered during excavation shall be completely removed within the limits of the required excavation and the ends of the pipes which remain shall be plugged in accordance with the requirements of Subsection 502.03(E). Any pipes or conduits, which may be partially exposed during roadway excavation, and which are scheduled for removal or abandonment, shall be removed and the trench backfilled to the level of the bottom of excavation as provided under Subsection 206.03(C). Manholes and inlet walls shall be broken down to 2 feet below the proposed template grade; the bottom slab or paved invert of such structure shall be broken up in such a manner so as to prevent the entrapment of water and the structure then backfilled with embankment material.

When soft unstable material, organic or inorganic, deemed by the Engineer to be unsuitable for foundation for the roadbed is encountered within the embankment areas or below the template grade in cuts and such material is not specifically designated on the Plans as "Muck Excavation," the Material shall be removed within the lateral limits and to the depths specified by the Engineer as part of Roadway Excavation, Earth. The Engineer will specify such lateral limits and depths station by station; any material removed beyond the specific limits and depths will not be measured for payment and the Contractor will be required to provide at his own expense suitable material, properly compacted, necessary to replace the excess material which has been excavated.

The areas in cut from inslope to inslope of ditches shall be compacted for a depth of not less than 1 foot, to the percentage of maximum dry density specified in Paragraph 203.03(E). Such compaction shall not be started until all material unsuitable for foundation for the roadbed has been removed as provided in the preceding paragraph or under Muck Excavation. Methods of compaction shall be as specified in Subsection 203.03.

If during excavation, material appearing to conform to the classification for Roadway Excavation, Rock, is encountered, the Contractor shall notify the Engineer and shall suspend his operations in that area and allow the Engineer sufficient time to investigate and make such measurements as are necessary to determine the volume of the material in question.

All rock shall be excavated to the cross section and elevations shown on the Plans with no rock projections above the template grade or inside the neat slope lines of the required cross section. The operation shall be so conducted as to provide drainage and not leave undrained pockets in the surface of the rock. Care shall be taken to avoid overshooting when blasting. Any loose shattered rock, loosened boulders, or overhanging ledges, either on or outside the required cross section, shall be removed. All rock slopes shall have reasonably uniform faces.

Materials removed from stone fences, masonry walls, concrete or masonry structures, and concrete and bituminous concrete pavements shall be excavated to the lines shown on the Plans, or as directed by the Engineer. Material acceptable for use in Embankment shall be broken up so that the largest dimension of any piece is 2 feet. Other material shall be removed and disposed of, away from the Authority right-of-way, by the Contractor.

When portions of existing concrete pavement are to be left in place, demolition along the peripheral limit shall be done by saw cutting. The Contractor shall exercise extreme care in the removal of concrete pavement to insure that no damage occurs to the concrete to remain and, in the case of reinforced Portland cement concrete pavement, that the bond between reinforcement and the concrete is not broken.

Ditches, where necessary, in all stages of construction shall be provided and maintained. Cuts shall be crowned to permit ready run-off of rain water.

Sufficient work shall be performed on the top surface and side slopes of the cuts, so that the top surface and slopes will be left in a neat and workmanlike condition and true to the lines and grades shown on the Plans. In shovel cuts the ridges which a shovel ordinarily leaves along the banks shall be removed. Wherever shown on the Plans, the Contractor shall perform the designated rounding at the tops and bottoms of slopes and elsewhere as shown. Any slides shall be removed and the material disposed of as directed by the Engineer. The cuts shall be maintained in completed condition until final acceptance.

The Contractor shall not widen roadway cuts beyond the limits shown on the Plans.

The construction of common embankment under the item Roadway Excavation and Embankment shall be as specified in Subsection 203.03.

Earth and rock materials for embankment construction, in excess of that required for embankment construction under the Contract, shall be disposed of outside the Authority right-of-way by the Contractor.

Material not suitable for embankment shall be disposed of outside the Authority right-of-way to the satisfaction of the Engineer. The Contractor shall comply with all laws (Federal, State and local) in disposing of unsuitable materials and shall use appropriate means required to prevent pollution and sedimentation of streams.

If the Contractor discovers potential environmental contamination during construction activities (Area of Concern (AOC) defined in accordance with N.J.A.C. 7:26E-1.8), which was not previously identified (unexpected discovery) in the contract documents, the Contractor shall notify the Engineer immediately.

The Contractor shall not perform any sampling of the materials associated with the AOC without prior approval of the Engineer. If the Engineer determines that it is necessary for the Contractor to undertake material sampling, the Contractor shall provide a sampling plan to the Engineer for review and shall not initiate sampling until said plan is approved. All sampling must be performed in accordance with N.J.A.C. 7:26E.

If construction activities caused the AOC (i.e. discharge), the Contractor will take corrective measures immediately to contain the AOC and notify the Engineer immediately. The Contractor shall advise the Engineer prior to reporting any unexpected discovery or discharges to the NJDEP Hotline (1-877-WARNDEP (927-6337)).

(A) MUCK EXCAVATION.

The excavation of material in areas designated on the Plans as "Muck Excavation" shall be carried down to good bearing soil referred to as "Firm Bottom". The lower limit of excavation shown on the Plans referred to herein as "Approximate Firm Bottom", is an approximate elevation only and is based on information obtained from subsurface investigations. The actual required bottom limit may be above, at, or below the elevation shown on the Plans, but in each case, "Firm Bottom" elevation will be determined by the Engineer during the course of excavation operations and inspection of the materials as they are being removed.

The Contractor shall take samples or otherwise test the bottom of the excavation area as the excavation progresses to determine for himself that all muck has been removed and that "Firm Bottom" has been reached throughout the muck excavation areas. If the tests shown that muck is present below the "Approximate Firm Bottom" elevation shown on the Plans, the Contractor shall notify the Engineer who shall make a field determination of the "Firm Bottom" elevation to which the excavation shall be carried. The Contractor shall not excavate below the "Approximate Firm Bottom" elevation shown on the Plans, unless such excavation is approved in writing by the Engineer.

The Plans show approximate lateral limits and side slopes of the excavation based on the "Approximate Firm Bottom" elevation shown on the Plans and slope criteria shown in the Typical Section(s). The lateral limits and the slope criteria are subject to change with changes in the actual elevation of "Firm Bottom". The Engineer will designate the actual limits and other criteria governing the lateral limits of the excavation as the work progresses. Unless otherwise designated by him, the slopes shall be carried to the maximum limit shown.

Unless otherwise permitted in writing by the Engineer, no materials will be removed beyond the designated lateral limits. In no case will materials removed below a depth of 1 foot below "Firm Bottom" as determined by the Engineer, or beyond the designated lateral limits, be measured for payment. The Contractor shall furnish and place at his own expense Embankment, Grade B, in accordance with the provisions of Section 203 necessary to replace material excavated beyond the approval limits of excavation.

The excavation shall be performed by methods and equipment which will ensure the removal of all materials down to "Firm Bottom" within the required lateral limits and provide generally plane surfaces along the bottom of the excavation. Muck excavation shall be performed in a manner which will minimize movement or sloughing of soil beyond the lateral limits shown on the Plans or designated by the Engineer, and to ensure against damage to existing or new construction in the area. Any material that enters the excavation by sloughage, slides, heavy rain, or from any other cause or action whatever shall be classified as excess excavation and shall be removed, at the Contractor's own expense, prior to proceeding with the backfilling operations in that area. No measurement will be made for the removal of any excess excavation. The Engineer reserves the right to require the Contractor to change his methods and equipment if the coverage and results being obtained are, in the opinion of the Engineer, unsatisfactory.

The excavated material shall not be deposited nor shall heavy equipment be placed at locations which may cause a slide of the sides of the excavation or damage to any installations at the site. In no case shall materials be placed within 50 feet of the edge of the excavation. The Contractor shall be responsible for repairing at his expense any damage caused as a result of depositing and placing excavated materials or equipment at such locations.

When the Contractor has completed to his satisfaction the excavation in any area, he shall notify the Engineer that such locations are in proper condition to receive the backfill and are ready for checking and measurement. The Contractor shall allow the Engineer sufficient time to check the bottom and to measure the excavation area before backfilling begins. The Contractor shall remove any muck found by the Engineer to be still present within the limits of the excavation. Backfilling shall not begin until permitted by the Engineer.

The Contractor shall provide for the exclusive use of the Engineer at each location where muck excavation is in progress, one row-boat at least 10 feet in length, equipped with oar locks, oars, life jackets, and seats, and shall also furnish docking facilities for such boat(s). All boats and equipment shall be in good condition and satisfactory to the Engineer.

(B) DISPOSAL OF MUCK, UNSUITABLE AND EXCESS MATERIALS.

All excavated muck and other unsuitable materials shall be disposed of within disposal sites to be provided by the Contractor. These sites shall not be located within 50 feet of the present or proposed Authority right-of-way, except with the approval of the Engineer and provided that the material shall be graded to a reasonably even surface not higher than the adjacent roadway and that the disposed material and surrounding area is properly drained. The Contractor shall make his own arrangements with the respective property owners regarding permission to dispose of excavated material on their property and/or temporarily place pumping or dredging lines on their property for the purpose of transporting the material to the disposal area (if such a method is used).

The Contractor shall obtain from the property owners on whose property excavated materials are deposited and/or pumping lines placed, written releases protecting the Authority against claims or actions by the owner with respect to the presence of such materials or lines. Where permits are required for placing materials in areas under the jurisdiction of a Federal, State, or local agency, or the placing of pumping or dredging lines across any particular area, the Contractor shall secure such permits at his expense. Copies of all releases and permits shall be presented to the Engineer prior to the commencement of operations.

For disposal of materials by the pumping method, the Contractor shall provide settlement basins or other approved methods to prevent pollution and sedimentation of adjacent streams and shall further provide suitable methods to avoid obnoxious odors. If in the opinion of the Engineer these requirements are not being observed, he will suspend all operations until the above conditions have been complied with.

The Contractor shall conduct his operations within all disposal areas so as not to create conditions dangerous to persons who may be in or adjacent to the area, whether authorized or unauthorized. If such operations are not being conducted properly, the Engineer may require the Contractor to construct temporary fences enclosing unsafe areas and to maintain them until the unsafe conditions have been rectified, all at the Contractor's expense.

Vehicles used to transport muck and unsuitable materials to disposal sites shall, when traveling on paved areas, be watertight and of such construction as to prevent spillage. All methods of transportation and disposal shall be subject to the approval of the Engineer.

Environmental testing for off-site disposal of onsite materials may be required by the applicable regulatory agencies or by the disposal facility. In such circumstances, prior to the start of any sampling activity, the Contractor must obtain the disposal facility's specific disposal analytical/procedural requirements in writing. At a minimum, such information shall include:

(1) Site-specific in-situ and/or stockpile sampling requirements

(2) Analytical parameters (i.e. VOCs, SVOCs, Metals, PCBs, etc.) to be tested and specific laboratory "list" requirements

(3) Number of grab/composite samples required for collection within a specific grid area designated by the disposal facility

(4) Size of area to be sampled (i.e. 500 cubic yards, 1,000 cubic yards, etc.)

(5) Sample depths and sampling methodology

(6) Sampling equipment requirements

(7) Possible alternate sampling criteria and analysis based upon on-site material (frequent analysis of a specific analytical parameter or selection of an unusual analytical parameter)

The above described documentation shall be provided to the Authority upon the Contractor's receipt of the documentation from the disposal facility. The Contractor shall then prepare a site specific sampling plan (Plan) to satisfy the sampling requirements outlined by the disposal facility. Said Plan shall be provided to the Authority for review prior to the Plan being provided to the disposal facility or any other outside entity for their review. A two week period shall be anticipated by the Contractor for the Authority's review. After the Authority has accepted the Plan the Contractor shall schedule the implementation of the Plan, giving the Authority a minimum of a 5 working day notice prior to the initiation of any sampling. The Contractor shall not undertake any material sampling until the Authority has completed its review of the subject documentation and the Authority has authorized the contractor to proceed, in writing.

Material sampling shall be conducted in strict accordance with the most recent versions of the Technical Requirements for Site Remediation (N.J.A.C. 7:26E), NJDEP Field Sampling Procedures Manual, NJDEP Guidance Document for the Remediation of Contaminated Soil, and NJDEP Guidance Document for Waste Classification, and other local, State and federal requirements.

Should the disposal facility reject transported on-site material, and said material is returned to the project site, the material shall be separately stockpiled in an area that does not "cross contaminate" other materials, compromise construction activities or violate existing permits and approvals. The Contractor, in consultation with the Authority, shall assess said stockpiled material for disposal options.

202.04 Measurement.

Roadway Excavation, Earth will be the volume measured in its original position, and computed by the average end area method from cross sections taken after the removal of the topsoil and before the removal of the material and the neat excavation lines as shown on the Plans or established by the Engineer. The measurement will include the undergrading of cuts and embankment foundations for the removal of unsuitable material, but not the authorized stripping of topsoil from cut and embankment foundation areas.

Roadway Excavation, Rock will be measured as follows: for rock in mass formation, the volume in its original position, computed by the average end area method from cross sections taken before removal of the material and payment planes one foot below template grade and one foot outside of the neat slope lines as shown on the Plans, thus providing an allowance for overbreakage; for boulders more than 1/2 cubic yard each in volume, the volume measured in place by methods determined by the Engineer to suit the individual case.

Roadway Excavation and Embankment will be the volume of material excavated and measured in accordance with the requirements prescribed above for Roadway Excavation, Earth and Roadway Excavation, Rock, as applicable.

Roadway Excavation, Muck will be the volume measured in its original position, and computed by the average end areas method. The end area will be determined as follows: the upper limit will be the existing ground determined from cross sections taken before the removal of the material; the lateral limits will be the neat excavation lines as shown on the Plans, or as established by the Engineer during excavation operations; the lower limit will be the actual bottom of the excavation determined from cross-sections at which suitable materials are encountered and approved by the Engineer ("Firm Bottom") during excavation operations, plus material removed as a result of over-cutting for a maximum depth of 1 ft. below the approved "Firm Bottom" elevation.

Removal of Concrete Pavement will be measured by the total surface area of concrete pavement removed as designated on the Plans for removal under this item.

Stripping Topsoil will be measured by the cubic yard of topsoil stripped in accordance with the Plans and as directed by the Engineer. Stripping done beyond the lateral limits shown on the Plans or as established by the Engineer will not be measured for payment.

Overload Removal will be measured by the cubic yard of embankment removed in accordance with the Plans, and as directed by the Engineer.

Environmental Testing for Unsuitable and Excess Materials (No-Bid) provides a value for reimbursement to the Contractor for direct costs associated with environmental testing. The only reimbursable costs permitted will be those charges for testing approved by the Engineer.

202.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
ROADWAY EXCAVATION, EARTH	LUMP SUM
ROADWAY EXCAVATION, EARTH	CUBIC YARD
ROADWAY EXCAVATION, ROCK	CUBIC YARD
ROADWAY EXCAVATION AND EMBANKMENT	CUBIC YARD
ROADWAY EXCAVATION, MUCK	CUBIC YARD
REMOVAL OF CONCRETE PAVEMENT	SQUARE YARD
STRIPPING TOPSOIL	CUBIC YARD
OVERLOAD REMOVAL.	CUBIC YARD
ENVIRONMENTAL TESTING FOR UNSUITABLE AND EXCESS MATERIALS (NO-BID)	USD

The cost of replacing site excavated material used in other than common embankment shall be included in the unit price bid for the item roadway excavation and embankment.

No payment will be made under the items Roadway Excavation, Earth or Roadway Excavation, Rock when payment is made under the item Roadway Excavation and Embankment.

No payment will be made for the removal of materials entering the excavated areas due to sloughage or other reasons.

No payment will be made for required inspections made by Contractor furnished competent personnel.

SECTION 203 - EMBANKMENT

203.01 Description.

Embankment shall include furnishing, delivery, placing, and compacting suitable materials obtained from borrow sources, Roadway Excavation, and other excavations at the work site, in embankments at the prescribed locations and conforming to the prescribed lines, grades, cross-sections, and dimensions shown on the Plans, or as directed by the Engineer.

Embankment shall ***not*** include furnishing, placing and compacting topsoil.

203.02 Materials.

Material used for embankment shall be free from ashes, muck, wood, brush, roots, sod, rubbish, garbage, and any other matter that may decay. Material classified as A6 or A7 material by AASHTO Designation M145 may be used only outside vertical planes through the tops of the embankment slopes.

Asphalt millings generated from on-site activities may be used as embankment material. If utilized, asphalt millings cannot be placed less than 2 feet above the highest seasonal ground water table or within 2 feet of any underground utility. In addition, asphalt millings cannot be placed within 2 feet of the final subgrade.

In embankment and in cuts above template grade, within the limits shown on the Plans, the material shall be Embankment, Grade A. Adjacent to abutments and other structures, where shown on the Plans and within the limits there specified, the material shall be Porous Fill.

All backfill placed underwater shall be special Embankment, Grade B.

(A) COMMON EMBANKMENT.

Common embankment material may be any stable material which can be properly compacted to the densities hereinafter specified.

The greatest dimension of any piece placed in embankment, through which piles are to be driven, shall be 3 inches and such pieces shall be well distributed.

The greatest dimension of any piece placed in the top 5 feet of common embankment shall be 6 inches.

The greatest dimension of any piece placed elsewhere in the common embankment shall be 24 inches; such large pieces (6 to 24 inches in greatest dimension) shall be well distributed throughout the embankment.

(B) OTHER EMBANKMENT.

Materials shall conform to the following Subsections:

EMBANKMENT, GRADE A 901.01

EMBANKMENT, GRADE B 901.02

(C) SOURCE.

Embankment, Grade A and Grade B, is to be furnished by the Contractor from borrow sources outside Authority property. However, in the event that material conforming to these requirements is found within the limits of roadway excavation, it may be used as Embankment, Grade A or B, provided the following conditions are satisfied:

(1) The Contractor shall notify the Engineer in writing of the presence and location of the material and of his intention to use it at certain specified location. He shall allow the Engineer sufficient time to verify the material's conformance to the Specifications before the material is placed in the embankment.

(2) The Contractor shall replace the total volume of material so used with common embankment material, if needed for embankment construction or such lesser volume as required for completing the embankment.

(D) POROUS FILL.

Porous Fill material shall meet all of the requirements specified above for Embankment, Grade A. Broken stone at weep holes shall be of a quality and size approved by the Engineer.

203.03 Methods of Construction.

In general, embankments shall be constructed by placing the material in successive layers distributed uniformly over the full width of the cross section and rolling each layer to the required degree of compaction, with such intermediate operations as are necessary to control the consistency of the material and its moisture content. Embankments shall be made of sufficient height and width, so that after full shrinkage, sloughing of slopes, or subsidence of the foundation area, the elevation and width shall conform to the cross sections shown on the Plans.

It shall be the Contractor's responsibility to maintain stability of all embankment slopes until the final paving and drainage system has been completed and slopes are stabilized with vegetation. All proposed curb construction shall be completed, as soon as possible in conjunction with the final drainage system in order to keep slopes stable.

It is probable that the land will subside under portions of certain embankments, but the Authority does not undertake to estimate the amount of such subsidence, if any, nor the amount of additional material, if any, required to be placed in embankments, on account of such subsidence. Bidders shall examine the ground where embankments are to be constructed and shall make such investigations as they may consider necessary and shall base their bids upon their examinations.

(A) Optimum Moisture and Maximum Dry Density.

Wherever the terms "optimum moisture" and "maximum dry density" are used herein they shall be construed to mean the optimum moisture content and maximum density as determined by AASHTO T180.

(B) California Bearing Ratio (CBR).

The California Bearing Ratio (CBR) as referred to herein shall be determined in accordance with the procedures and requirements of AASHTO Designation T193, except that the weight of the rammer, the height of the drop, the optimum moisture, and the maximum dry density shall be obtained in accordance with the requirements of AASHTO T180.

(C) Preparation of Foundation Areas for Embankment.

After the stripping of sod, vegetable matter and topsoiling materials, and the removal of unsuitable material, as provided in Subsection 202.03, the construction of the embankment shall proceed as follows:

(1) For embankment having a height of 5 feet or more from the top of proposed pavement to original ground, or to a lower surface which results from undergrading, as provided for in Subsection 202.03, the placing and compaction of embankment may begin except when the embankment area has been cultivated, or the natural condition of the soil has been disturbed, so that the soil is of low density. Such areas shall first be compacted until the material, for a depth of not less than 1 foot, reaches the density hereinafter prescribed in Paragraph (E).

(2) For embankments having a height less than 5 feet from the top of proposed pavement to original ground, the original ground or the surface exposed by undergrading, as provided for in Subsection 202.03, shall be compacted until the underlying material for a depth of 1 foot, reaches the density hereinafter prescribed in Paragraph (E).

Whenever embankment is to be constructed against existing slopes steeper than 1 vertical on 3 horizontal, steps or benches shall be cut into the existing slope for the full height of embankment. The steps or benches shall be of such size that the horizontal dimension is at least 6 feet in width and the minimum width of any working area, combining existing and new embankments, shall not be less than one and one half the width of the compacting equipment. The benching shall not be done as a separate preliminary excavation, but shall be bladed in as each lift of new material is being placed and spread.

(D) Backfilling Excavations Under Water.

Backfilling excavated areas where standing water is present, shall not proceed until the Engineer has examined and approved the condition of the bottom of the excavation and has taken cross sections.

The Engineer will take representative soil samples from backfill material as it is delivered to the site. If any such sample indicates that the material does not conform to Specification requirements, the Engineer will test additional samples taken from materials in place in the construction and will

delineate any areas containing the unsatisfactory materials. The Contractor shall remove this unsatisfactory material to the depths and within the areas designated by the Engineer, and replace it with material conforming to the requirements of the Specifications. Removing and replacing unsatisfactory material shall be entirely at the Contractor's expense.

Backfilling under water shall be accomplished by end dumping the backfill material in a wedge-like formation with the apex at the center of the advancing face, so that any remaining soft underlying materials will be forced to the sides and not entrapped under the backfill. End dumping shall be employed only up to such elevation that will permit the use of normal compacting equipment. Materials shall not be end dumped directly into the water from the trucks, but shall be dumped on the backfill previously placed above water and then pushed into the water by bulldozers. Backfill shall not be placed by a hydraulic fill method.

All accumulations of muck and/or unstable material (mud waves), in front of and at the sides of the advancing backfill, shall be removed at intervals to prevent it from being entrapped within or under the backfill. The Contractor shall constantly check the area ahead of the backfill to determine when such removal is required. If muck and/or unstable material is entrapped within or under the backfill and the quantity and location or distribution thereof, in the opinion of the Engineer, is such as to be detrimental to the stability of the embankment, or to the proposed or future roadway or structures, the entrapped muck and/or unstable material and the overlying fill shall be removed. All such excavated areas shall be backfilled with materials of the same quality and to the same elevations as the fill materials surrounding the excavated area. No additional compensation will be made for such excavation and backfilling.

When underwater backfilling operations are interrupted for a period of more than 24 hours, backfilling shall not be resumed, until the Engineer has again examined and approved the condition of the bottom of the excavation.

If any muck and/or unstable material is spilled or otherwise deposited on the top or sides of the embankment during this operation, it shall be entirely removed by the Contractor at no additional cost to the Authority.

Underwater fill need not be consolidated, except for the incidental compaction, resulting from the passage of the bulldozer and dump trucks.

(E) EMBANKMENT CONSTRUCTION.

Materials shall be placed above water by the following dry fill method.

The Engineer will take representative soil samples from the embankment material, as it is delivered to the site. If any such sample indicates that the material does not conform to requirements specified, the Engineer will test additional samples taken from materials in place in the construction and will delineate any areas containing the unsatisfactory materials. The Contractor shall remove this unsatisfactory material to the depth, and within the areas designated by the Engineer, and replace it with material conforming to the requirements of these Specifications. Removing and replacing unsatisfactory material shall be entirely at the contractor's expense.

Materials shall not be placed while frozen nor shall they be placed on a frozen surface.

The material shall be deposited in uniform layers not to exceed 8 inches in thickness, loose measurement, and compacted to the percentage of maximum dry density specified below. The loose thickness of the embankment layers may be modified by the Engineer, if the Contractor can demonstrate to the satisfaction of the Engineer, as prescribed below, that the compacting equipment he proposes to use can compact embankment to the specified minimum, or greater compaction, when placed in layers thicker than the specified 8 inches maximum.

The Contractor shall, to demonstrate the capacity of such compacting equipment, construct a test strip within the embankment limits, consisting of 3 layers, each of the thickness that the Contractor proposed to use, to a width of 24 feet and a length of 200 feet minimum. Each layer shall be compacted by the Contractor, using the compacting equipment proposed for use on the Project. The Engineer will test each layer of the compacted material for conformance to the requirements of the Specifications. Each layer shall meet the compaction requirements before the next layer is placed.

Based on the results of the test strip, the Engineer will determine the acceptable maximum loose measured thickness to which each layer may be placed. Test strip construction shall be repeated whenever the source or quality of material is changed, or whenever the compaction equipment

changes. If at any time the specified compaction is not obtained, the Contractor shall modify or change his procedures to obtain the required compaction.

If the Engineer approves the test strip, then it shall remain as part of the finished construction. If the test strip fails to meet the required compaction values after modification of the Contractor's procedures, then the material in the test strip shall be entirely removed by the Contractor and replaced in accordance with the requirements of the Specifications. Removing, replacing and compacting such unsatisfactorily compacted material shall be entirely at the Contractor's expense.

Each layer of material shall be spread over the entire width of the embankment and leveled by a bulldozer blade or other approved equipment. Each layer shall be pulverized by dicing or otherwise manipulating to its full depth to obtain the required consistency and to assure uniform compaction. If the moisture content of the material when placed is not such as to permit compaction to the required density, the layer shall be moistened or dried as may be required before compacting is commenced. While embankment is being placed, the Engineer will determine the standard compaction for the materials and the proper moisture content at which each material may be compacted.

If the material is too moist to permit suitable compaction, it shall be allowed to dry and, if necessary, to assure the moisture content being uniform throughout the depth of the layer, it shall be diced, harrowed, bladed and aerated until reduced to the moisture content, which will permit acceptable compaction. If the material as placed is too dry, water shall be added and uniformly mixed by dicing the layer to its full depth. The moisture content of the material immediately before compaction shall not vary more than two percentage points plus or minus from the optimum moisture.

As soon as proper consistency and moisture content are obtained, the layer shall be thoroughly compacted before the condition of the material has changed appreciably by either rain or evaporation. The embankment shall be crowned at all stages of construction to permit ready runoff of rain water.

The density of the compacted materials, when tested in the field, shall not be less than the percentage of maximum dry density given in the following table:

Minimum Compaction Required - Percent of Maximum Dry Density

Maximum Dry Density (AASHTO T180) Pounds/Cubic Foot	Above Plane 5 Feet Below Profile Grade In Roadway Embankments	All Other Embankment Construction
120 and over	95	90
110 - 119.9	98	95
100 - 109.9	100	98
95 - 99.9	*	100

* Materials having a maximum dry density of less than 100 pounds per cubic foot shall not be placed above a plane 5 feet below the pavement surface.

The Contractor shall be solely responsible for providing equipment and performing the work so as to meet the above required minimum compaction. The Engineer will perform in-place tests on each layer to determine its actual density.

Compaction shall be accomplished by rolling with a sheepsfoot tamping roller and/or pneumatic tire supercompactors and/or vibratory compaction equipment, or other approved compacting equipment as best suited to the general character of the material being compacted, and to the space limitations of the area being compacted, or as otherwise approved by the Engineer.

The type and weight of the compacting equipment used shall be such that uniform density is obtained throughout the depth of the layer of material being compacted. The equipment that the Contractor proposes to use shall, at all times, be subject to the approval of the Engineer.

Trucks, carryalls, scrapers, tractors, tractor wagons, or other hauling equipment shall not be considered as compacting equipment as specified above.

Material placed adjacent to structures in areas inaccessible to the usual compaction equipment shall be compacted with mechanical tampers and/or vibratory equipment of a type approved by the Engineer.

At all times during the construction of embankment, the Contractor shall provide and maintain ditches, temporary pipes and other temporary or permanent construction, at his own expense, to permit ready runoff of water and insure proper drainage for the entire area.

Where embankments are to be formed wholly or partially with rock, limitations on size and location as specified in Subsection 203.02 shall govern. The material shall be carefully placed, so that all large rocks will be well distributed and the interstices completely filled with smaller rocks or stones, earth, sand or gravel, so as to form a solid embankment. Any rock or fragmented material of such size as would prohibit it from being placed in layers of the desired depth shall be placed in embankment only where and as directed by the Engineer. Rock shall be placed in layers preferably not more than 9 inches in thickness, and in no event shall the depth of the layer exceed 2 feet. For a depth of 5 feet below the template grade, the embankment shall be of earth or earth and rock, thoroughly compacted and placed in such a manner that all voids are filled, and the upper part of the rock fill below shall be chinked, so as to make it earth tight, provided that the topmost materials in all cases shall be earth to a depth of not less than 1 foot below template grade, and compacted to the percentage of maximum dry density specified above.

Porous Fill material shall be placed adjacent to bridge abutments and other structures within the limits shown on the Plans. All material shall be compacted to the percentage of maximum dry density specified. Broken stone shall be placed at weepholes as shown on the Plans.

Sufficient work shall be performed on the top surface and side slopes of the embankments that they will be left in a neat and workmanlike condition and true to the lines and grades shown on the Plans. Wherever shown on the Plans, the Contractor shall perform the designated rounding at the top and bottom of slopes and elsewhere as shown. The embankment shall be maintained in a completed condition until final acceptance.

(F) BORROW.

The Contractor shall secure at his own expense all rights, leases, or permits for obtaining the material for embankment, except that permits from the Division of Marine Services of the Department of Environmental Protection, to obtain borrow from underwater sources under jurisdiction of the State of New Jersey, will be obtained by the Authority.

No material shall be placed in the embankment until tested and approved by the Engineer. The Contractor shall furnish the Engineer, not less than 7 days prior to opening any borrow pits, with representative 30 pound samples of each proposed embankment material. The Engineer will test the materials for their quality and conformance to the requirements of Subsection 203.02. The Engineer will thereafter test the materials furnished as he deems necessary.

The Contactor shall provide documentation of testing to support the requirement for use of clean fill or certified clean fill for borrow material, as required, under Subsection 203.03. The Contractor shall be responsible for environmental testing of borrow material.

The contractor shall provide all necessary access roads and other facilities which may be required for hauling Borrow Excavation to and over the right-of-way, and upon completion of the hauling shall restore the entire right-of-way and all property of the Authority, which may have been disturbed by such operations to a satisfactory condition, as directed or approved by the Engineer.

Unless otherwise approved by the Engineer, borrow pits shall be located a minimum of 300 feet outside the present or proposed Authority right-of-way.

All materials obtained by the Contractor shall be his responsibility and in strict compliance with all applicable State and/or local laws, ordinances and regulations.

Material composition, quality, and structural characteristics will be approved by the Authority's Engineer prior to acceptance of any borrow material. The Contractor shall utilize clean fill as defined in N.J.A.C. 7:26-1.4.

(1) Certified Borrow Material.

If the Contractor obtains clean fill from a certified supplier of borrow material, appropriate documentation, consisting of a statement that to the best of the affiant's knowledge and belief, the fill being provided is not contaminated and a description of the steps taken to confirm such, must be obtained and submitted to the Engineer. If the Contractor obtains borrow material from a non-certified supplier, the Contractor must satisfy the following "Non-Certified Borrow Material" requirements.

(2) Non-Certified Borrow Material.

To minimize the potential of introducing contaminated borrow material onto a project site, the Contractor shall verify that the material meets the requirements outlined herein by performing due diligence inquiries and/or having the borrow material analyzed for potential contaminants based on the location and history of the source area.

Undesirable sources of borrow material include former and/or existing commercial and/or industrial sites where hazardous materials were used, handled or stored as part of the business operations, or unpaved parking areas where petroleum hydrocarbons could have been spilled or leaked into the soil. Agricultural areas with former waste processes and/or historical pesticide/herbicide use are also considered an undesirable source.

The Contractor must be aware that borrow material proposed from undesirable source areas will require testing to demonstrate that the material is clean material as defined by the NJDEP. If the use of material from undesirable sources is proposed by the contractor, documentation requirements will be more stringent than would be necessary for material from other sources.

Documentation required to be provided relative to all off-site non-certified borrow material shall include information obtained by the Contractor based on due diligence investigations. Due diligence may include, but not limited to, interviews with past and present owners, operators and occupants, reviews of historical sources of information, reviews of federal, state, tribal and local government records, visual inspections of the facility and adjoining properties, commonly known or reasonably ascertainable information, and degree of obviousness of the presence or likely presence of contamination at the property and the ability to detect the contamination. A due diligent inquiry shall be performed by the Contractor consisting of the following:

(a) Conducting a diligent search of all documents which are reasonably likely to contain information related to the object of the inquiry, which documents are in such person's possession, custody, or control, or in the possession, custody, or control of any other person from whom the person conducting the search has a legal right to obtain such documents; and

(b) Making reasonable inquiry of current and former employees and agents whose duties include or included any responsibility for hazardous substances, hazardous wastes, or pollutants, and any other current and former employees or agents who may have knowledge or documents relevant to the inquiry.

Documentation to be provided relative to off-site non-certified borrow material shall include detailed information on the previous use of the land from where the borrow material is proposed to be taken; a statement as to whether an environmental site assessment was performed and its findings; and the results of any testing performed. If such documentation is not available or is determined to be inadequate by the Authority, analytical testing protocols in accordance with applicable NJDEP Guidance documents shall be utilized by the Contractor to confirm the suitability of the borrow material. The level of analysis of the borrow material required by the Authority shall be based on the source of the borrow material and knowledge of the prior land use.

If determined to be necessary by the Authority, the Contractor shall provide documentation and/or a site-specific sampling plan for the analytical testing of borrow material for Authority review and acceptance before sampling. All borrow material sample collection and analysis shall be performed in accordance with the most recent versions of the N.J.A.C. 7:26E Technical Requirements for Site Remediation, NJDEP's Field Sampling Procedures Manual, NJDEP Guidance Document on Contaminated Soil, NJDEP Guidance Document for Waste Classification, and any other local, State and federal requirements.

203.04 Measurement.

Embankment items will be measured by the total volume of each embankment item, excluding topsoil, constructed as prescribed, whether from borrow materials or site-excavated materials. Embankment will be measured in place and computed by the average end area method from cross-sections taken after the completion of clearing and grubbing, stripping topsoil, or in the case of Muck Excavation the "Firm Bottom" elevation established in Paragraph 202.03(A), and from the neat embankment lines shown on the Plans or as established by the Engineer.

No deductions will be made in the quantities of the various Embankment items for the volume of embankment excavated for the construction of structures.

Inasmuch as benching slopes of existing embankments being widened is an integral operation of spreading adjacent lifts of new embankment, cross-sections of the existing slopes used in computing the pay quantities of the various Embankment items will be made before and without regard to benching.

The quantity of Porous Fill for which payment will be made, will be the total volume measured in place in the finished structure within the required limits, which is actually placed in accordance with the Plans or as directed by the Engineer. No deduction will be made for the volume of broken stone placed within the limits of the porous fill at weepholes.

203.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
EMBANKMENT, COMMON	CUBIC YARD
EMBANKMENT, GRADE A	CUBIC YARD
EMBANKMENT, GRADE B	CUBIC YARD
POROUS FILL	CUBIC YARD

No payment will be made under the item Embankment, Common when the item Roadway Excavation and Embankment, Section 202, is included in the Proposal.

If the Authority has a permit to obtain borrow materials from an underwater source under the jurisdiction of the State of New Jersey, and has indicated the availability of this source in the Supplementary Specifications for this Project, and the Contractor elects to utilize this source, then payment for such operations will be subject to the following conditions:

The Contractor shall include in his bid prices the royalty fee to the State of New Jersey, as specified in the Supplementary Specifications, for material dredged and placed in Authority Construction.

Payments to the Contractor for embankment materials will be at a rate equal to the unit price stated in his Proposal less the royalty fee, which will be paid by the Authority on behalf of the Contractor directly to the State of New Jersey.

Permits required by other agencies shall be obtained by the Contractor at his own expense.

If the area for obtaining embankment materials from underwater sources is outside the jurisdiction of the State of New Jersey, or is from upland sources, the Contractor shall obtain and pay for all required permits and all else necessary, and the price bid in the Proposal shall be interpreted as including all such costs. In this latter case, payment to the Contractor for embankment materials will be at the unit price bid in his Proposal without deduction.

There will be no separate payment for the testing and/or due diligence efforts associated with borrow material.

SECTION 204 - CHANNEL EXCAVATION

204.01 Description.

Channel Excavation shall include the excavation required for deepening, widening and relocating water channels, and the construction of ditches other than those having one side as part of a roadway embankment or cut.

204.02 Materials.

No materials are involved.

204.03 Methods of Construction.

The excavation shall be neatly finished as directed and approved by the Engineer. Excavated material suitable for embankment may be so used when needed for this purpose. Excess suitable material shall be disposed of outside the Authority right-of-way by the Contractor. Unsuitable material shall be disposed of outside the Authority right-of-way to the satisfaction of the Engineer. When the Contractor is permitted to dispose of excess material near the banks of the channel or ditch, provision shall be made to insure proper

flow of water from adjacent land to the waterway, and the site shall be restored to a condition satisfactory to the owner of the land and to the Engineer.

204.04 Measurement.

Channel Excavation will be measured by the volume, in its original position, and computed by the method of average end areas, removed within the neat lines of Channel Excavation shown on the Plans or as directed by the Engineer. No classification will be made of the materials encountered.

204.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CHANNEL EXCAVATION	CUBIC YARD

No separate payment will be made for stockpiling excess suitable material, disposal of unsuitable material or shaping and dressing slopes and other surfaces.

SECTION 205 - FOUNDATION EXCAVATION

205.01 Description.

Foundation Excavation shall include the excavation and backfill required for the construction of abutments, piers, walls and other structures. It shall include such excavation in whatever material may be encountered, and it shall include all work necessary to construct foundations to the required depths, including the removal of all timbers, piles, logs, boulders, or other obstacles which may be encountered, and the disposal of all excavated materials.

Porous fill and broken stone shall be placed behind walls as shown on the Plans and specified in Section 203.

205.02 Materials.

Material used as fill under foundations shall be Embankment, Grade A, conforming to the requirements of Subsection 901.01.

Backfill shall be suitable embankment material, free from large or frozen lumps, wood, and other foreign materials, and shall be acceptable to the Engineer.

Coarse aggregate layer shall be broken stone or washed gravel conforming to Subsection 902.07.

205.03 Methods of Construction.

Foundation excavation shall not begin in areas where Roadway Excavation or other excavation operations are required, until such other excavations are completed.

Excavations for foundations shall be made in such a manner that the permanent structures may be properly constructed without reduction of the dimensions of the concrete shown on the Plans, without rounded or undercut corners and edges of footings, and to the depths which may be required. Excavations deeper than 5 feet shall have the sides sheeted or shored, or shall have the sides sloped back to the angle of repose of the materials in accordance with the applicable OSHA requirements. Slopes surrounding masonry shall be stepped to prevent wedge action. The design and types of bracing, shoring, sheet piling, cribs, cofferdams or similar temporary construction shall be the responsibility of the contractor; they shall comply with OSHA requirements and shall be suitable to the conditions encountered, and insure proper construction of the permanent structures. Temporary sheeting shall conform to Section 415. If temporary sheeting is deemed to be required, it will be shown on the plans. If temporary sheeting is not deemed to be required, then the Contractor may sheet, shore or slope back at their option at no additional cost to the Authority.

Cofferdams or cribs of whatever type shall be carried sufficiently below the level to which the excavation is to be carried to insure a structurally sound, watertight earth support system, and shall be inspected frequently and adequately maintained by the Contractor. The Contractor may construct cofferdams or cribs of whatever size that he elects, but they shall be so built and braced that they will not interfere with the driving of foundation piles in the positions indicated on the Plans. Waling and bracing members shall be adequate to provide for all loads and to maintain cofferdams or cribs in correct form and position. Interior dimensions of cofferdams or cribs shall be ample to permit inspection and pumping as may be necessary, so

that all concrete above the sealing course shown on the Plans (or above the bottom of footing if no sealing course is shown) can be placed in the open.

The Contractor shall submit to the Engineer complete design calculations and detail drawings for review, in accordance with the requirements of Subsection 104.08, showing the character and sufficiency of cofferdams, cribs, sheeting or similar temporary construction that he proposes to use. He shall not begin construction until the Engineer's review has been completed. The Contractor shall be fully and solely responsible for the structural, dimensional and other required adequacy of cofferdams, cribs, sheeting, and similar temporary construction. The review and comments by the Engineer of the Contractor's design and detail drawings shall not be considered as relieving the Contractor of such responsibility.

Excavation adjacent to existing roadways or underground utilities shall be properly sheeted and braced. The Contractor shall protect and support, in a suitable manner, all utilities encountered in his excavation operations. Any damage to existing installations due to the Contractor's operations shall be repaired or replaced by him at his own expense to the satisfaction of the Engineer and the owners. Should any damage occur to any of the existing installations due to the Contractor's operations, the Contractor shall immediately notify the owners, and the repairing or replacing of such utilities, whether done by the Contractor or the utility owners, shall be at the Contractor's own expense. Temporary sheeting shall conform to Section 415.

It is hereby understood and agreed that failure on the part of the Engineer to order sheeting or bracing does not relieve the contractor of his responsibility for the safety of the work and for any damages, suits, claims, or other liability resulting from the Contractor's failure to properly sheet and brace the excavations. Where noted on the Plans and at such other locations as the utility owners or the Engineer may direct, such sheeting shall not be pulled as the excavation is backfilled, but shall remain in place permanently. Such sheeting shall be cut off 2 feet below final ground or 3 feet below paved surfaces.

When an excavation has been carried to the required depth, the material below shall not be disturbed, and in soft soil the last part of the excavation shall not be made until immediately before placing the masonry. If the structure is to be founded on rock or other hard material, loose and soft material shall be removed there from, and the hard surface shall be cleaned and cut either level, stepped, or serrated as the Engineer may direct. Seams in the rock shall be cleaned out and filled with concrete, mortar or grout as may be directed.

The Contractor shall notify the Engineer when an excavation is completed, and masonry shall not be placed therein until the Engineer has approved the suitability of the underlying material. The Engineer may issue written orders for changes in elevations and dimensions of footings, as he may deem necessary to secure satisfactory foundation support, and the Contractor shall comply therewith.

Where the bottom of a foundation excavation for a pile supported footing is soft, mud or material shall be excavated before placing any concrete to an additional depth of one foot, or as ordered by the Engineer, and the area so excavated backfilled with Embankment, Grade A, up to the elevation of the bottom of the concrete base. Such excavated material shall be disposed of outside the Authority right-of-way to the satisfaction of the Engineer.

Before foundation, construction within the cofferdam is started, the cofferdam shall be dewatered and maintained in that condition. When shown on the Plans, the excavation shall be carried below the established elevation of the bottom of the foundation, and the concrete seal shall be constructed below said elevation in accordance with the requirements of Section 401.

If the Contractor should desire to increase the depth of sealing courses shown on the Plans, or should desire to provide sealing courses where none are shown on the Plans, such additional depths of sealing courses, or such added sealing courses shall be below the bottom elevations of concrete foundations shown on the Plans. The additional depth of excavation will not be measured for payment and no separate or additional payment, will be made for such additional concrete seal.

Cofferdams shall be constructed and maintained, so that concrete placed therein is protected against damage from erosion and rising water. No lumber shall be left extending into the masonry without the approval of the Engineer. Pumping in an excavation shall be done so as to preclude materials placed therein being carried away. Pumping shall not be done while concrete is being placed and for a period of at least 24 hours thereafter, except from a suitable sump, separated from the masonry by a watertight wall or by other approved method. Dewatering of a sealed cofferdam shall not commence until the concrete seal has attained sufficient strength.

When the masonry has been placed, cofferdams and other temporary supports shall be removed, and excavated spaces not occupied by a permanent structure shall be backfilled to the surface of the surrounding ground with sufficient allowance for settlement of the fill. Backfill shall not be placed against concrete

masonry, until the latter has achieved sufficient strength to retain the backfill. Porous fill and broken stone shall be placed as shown on the Plans.

Backfill shall be placed in successive horizontal layers, and each layer shall be compacted by mechanical tamping or other approved methods before the succeeding layer is placed or, if required by the Engineer, it shall be compacted by puddling. Backfill supporting roadways and paved surfaces shall be compacted to the required densities specified in Subsection 203.03, Paragraph (E). Backfill around culverts shall be placed in layers not more than 4 inches thick and around other structures in layers not more than 12 inches thick. Backfill around culverts, arches, and piers shall be placed simultaneously on both sides thereof to the same elevation. The provisions of this paragraph do not apply to river piers.

Excavation material not required for backfill and suitable for the use in embankment may be used in embankment construction. If suitable materials obtained from Foundation Excavation is in excess of that required for the embankment construction under the Contract, or if the work on the Project does not include construction of embankments, such suitable material shall be disposed of outside the Authority right-of-way by the Contractor. Unsuitable material shall be disposed of outside the Authority right-of-way to the satisfaction of the Engineer.

In stream channels and other waterways, no excavation shall be made and the bed of the waterway shall not be disturbed outside the areas occupied by caissons, cofferdams, sheet piling or sheeting, unless otherwise approved by the Engineer. Surplus material shall not be dumped into the stream.

When the Project is within or adjacent to navigable waterways, the carrying out of the Project and removal of excess material shall be subject to the approval of the governmental agencies having jurisdiction, including the Coast Guard and/or Corps of Engineers, as well as the Engineer.

When directed, coarse aggregate layer material shall be placed following the completion of the excavation. The material on which the coarse aggregate layer is to be placed shall be shaped to an even surface. The aggregate shall then be placed in 6-inch lifts and compacted according to Subsection 301.03.

205.04 Measurement.

Foundation Excavation will be measured by the volume in place within vertical planes, 6 inches outside of the neat lines of the footings, from the surface of the ground, as determined by the Engineer as it exists at the time when the foundation excavation is started, to the elevations of the bottom of the footings shown on the Plans or as modified by the Engineer. When a concrete seal is constructed, as shown on the Plans or ordered by the Engineer, then the quantity of Foundation Excavation for which payment will be made will be the volume in place within vertical planes along the neat outline of the base of seal (lowest elevation) as shown on the Plans, from the surface of the ground as determined by the Engineer as it exists at the time when the foundation excavation is started, to the elevation of the bottom of the seal shown on the Plans or as modified by the Engineer. Where Foundation Excavation underlies excavation for which payment is made under other scheduled items, the quantity for which payment will be made under this item will include only material below the payment lines of such other items.

When it is necessary, in the opinion of the Engineer, to carry the footing below the elevations shown on the Plans, the volume of excavation for the first 3 feet of additional depth will be included in the quantity for which payment will be made under the item Foundation Excavation. Excavation below this 3 foot additional depth will be paid for, as provided in Subsection 104.04.

When it is necessary, in the opinion of the Engineer, to carry the excavation below the elevations shown on the Plans to remove unsuitable materials underlying the footings and replace it with Embankment, Grade A, the volume of excavation for the additional depth will be included in the quantity for which payment will be made under the item Foundation Excavation.

Excavation made below elevations shown on the Plans or modified by the Engineer will not be measured for payment. Material forced up between piles and re-excavated, or additional material excavated to compensate for swelling, due to driving of piles or on account of swelling, slips, slides or cave-in, will not be measured for payment.

Where structures or portions of structures do not have footings, the vertical planes of measurement will be 6 inches outside the neat outline of the bottom of such structures, and the lower limit of measurement will be the bottom surface of such structures.

Along faces where footings abut existing masonry, the vertical planes of measurement will follow the neat outline of the footing along such abutting faces only.

Coarse aggregate layer will be measured by the cubic yard.

205.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
FOUNDATION EXCAVATION	CUBIC YARD
COARSE AGGREGATE LAYER	CUBIC YARD

Embankment, Grade A, placed as backfill to replace unsuitable material underlying footings or placed as fill underneath soil bearing footings, will be measured and paid for under the item Embankment, Grade A.

Porous fill for backfilling behind structures will be measured and paid for under the item Porous Fill.

SECTION 206 - TRENCH EXCAVATION

206.01 Description.

Trench Excavation shall include excavation and backfill for underdrains, drain pipes, pipe culverts and their headwalls or flared end sections, sewers, water pipe, gas pipe, conduits, manholes, drop inlets, catch basins, and similar structures.

206.02 Materials.

Granular material for backfilling trenches and for pipe bedding shall be material composed predominantly of sand, gravel or crushed stone, and shall be free from clay, organic material or aggregate larger than 2 inches. Granular material must be acceptable to the Engineer.

Backfill placed beneath the roadway surface and above a plane, which is 5 feet below Profile Grade, shall conform to materials specified for and shall be placed in accordance with the requirements for embankment, Section 203.

Other backfill shall be suitable material, free from large or frozen lumps, wood and other foreign material and shall be acceptable to the Engineer. Backfill material placed within two feet of the pipe shall not contain aggregates larger than 2 inches in its greatest dimension.

Underdrain backfill shall be as specified in Section 501.

206.03 Methods of Construction.

Excavation into existing ground shall not be started until the exact locations of any existing utility structures or other installations have been determined in the field by the Contractor.

(A) EXCAVATION.

The excavation shall be made by open cut unless otherwise directed, and shall be wide and deep enough to permit the installation of the subsurface structure in a workmanlike manner. Trenches and openings for subsurface structures located within proposed pavement, shoulder and sidewalk areas, shall be excavated with vertical sides. Trenches for pipes shall be not less than 1 foot wider at the bottom than the outside diameter of the pipe, but not wider than necessary to permit installation of the pipe and proper compaction of backfill around the pipe, and where conditions permit, shall be opened for a distance of not more than 300 feet in advance of the laying of the pipe.

Excavations deeper than 5 feet shall have the sides sheeted or shored, or shall have the sides sloped back to the angle of repose of the material, all in accordance with applicable OSHA requirements. If close to existing pavement, sidewalks, curbs, pipes or structures of any kind, the excavation shall be secured by sheet piling or otherwise, so that such facilities and structures will be adequately protected. The design and type of sheeting, bracing and shoring shall conform to the applicable OSHA requirements.

For subsurface structure excavation in the area of active roadways, excavated material to be used for backfill shall be hauled and stockpiled at locations designated by the Engineer, except that when permitted in writing by the Engineer, such excavated material may be stockpiled in windrows adjacent

to the trench, provided that the windrows are not a safety hazard or interfere with the flow of vehicular or pedestrian traffic.

Excavated material not required for backfill and suitable for use in embankment may be used in embankment construction. All excess suitable material shall be disposed of outside the Authority right-of-way by the Contractor.

The Contractor shall provide for the temporary flow of water during all stages of construction.

At all storm drains to be constructed where new embankment is to be placed, the embankment shall be constructed and consolidated, as specified for roadway embankment to a height of not less than 3 feet above the future location of the top of the drain, or to the finished level of the embankment for a minimum distance of 10 feet each side of the drain, and the trench shall then be excavated for the placing of the drain.

Trenching for underdrains beneath new pavements shall not begin until embankment construction has been completed to template grade.

Where Embankment, Grade A or Grade B, is in place or required to be in place before the excavation for subsurface structures is made, the excavation shall be so made that the Grade A or Grade B material and the ordinary materials below will be kept segregated, and the backfill material shall be carefully placed, so that after compaction, all material will be at the locations and to the depths shown on the Plans.

Whenever the excavation made is beyond the limits of the slope lines, any topsoil in place shall be kept separate when removed, and replaced, as nearly as feasible, in its original position, and the entire area involved in the construction operations shall be restored to a presentable condition.

For the purpose of defining the lower limit of excavation for pipe trenches, the term "plan bottom of trench" shall mean the horizontal plane at the intersection of the vertical centerline of pipe and the bottom exterior surface of the pipe. This elevation shall be obtained at any point by deducting the wall thickness of the pipe from the invert elevation as determined from the Plans.

When the material at the bottom of a trench is soft or otherwise unsuitable, as determined by the Engineer, it shall be removed to such depth as the Engineer may require and the space backfilled with granular material. Unsuitable material shall be properly disposed of as provided in Subsection 202.03(B).

The Contractor shall provide a person, familiar with OSHA requirements, to perform daily inspections of excavations, adjacent areas and protective systems. Inspections shall be performed by the competent person prior to the start of work and as-needed throughout the shift.

When the material at the bottom of a trench is soft or otherwise unsuitable, it shall be removed to such depth as the Engineer may require and the space backfilled with granular material. The granular material shall be placed in layers not more than 6 inches thick and each layer thoroughly compacted, to the satisfaction of the Engineer, with mechanical tampers or vibratory soil compactors, so that it is uniformly dense and firm.

In trenches for underdrains, the granular material shall be backfilled up to the bottom of the underdrain backfill material specified. In trenches for pipes, the granular material shall be backfilled to the plan bottom of trench; and under the pipe, the granular material shall be placed to create a pipe bed shaped to conform to the shape of the pipe and recessed for pipe bells. In excavations for manholes, inlets, headwalls and similar structures, the granular materials shall be backfilled to the elevations shown on the Plans as the bottom of structure.

Rocks and boulders encountered in the excavation for all pipes, and all earth, rock and other materials in excavations for concrete pipes, shall be removed from within 6 inches of the outside surface of the barrel of the pipes at the bottom and sides. Backfilling below the pipe shall conform to Pipe Bedding specified below.

(B) PIPE BEDDING.

Where unsuitable material is encountered at the bottom of trenches, excavation shall be carried to an additional depth, as shown on the Plans or as directed by the Engineer for the purpose of creating a pipe bed. The additional excavation shall be backfilled with granular material and compacted with

mechanical or vibratory tampers. When completed, the bedding of granular material shall conform to the shape of the pipes.

(C) BACKFILLING.

When backfill material, including granular material, is required (in addition to that obtained from trench excavation), it may be supplied from excess suitable material obtained from other excavations within the Project, or from borrow excavation outside the Project.

Backfill shall be placed in layers not more than 6 inches thick (loose measurement) and shall be compacted as specified below.

(1) Backfilling Pipes (Except Underdrains).

Except where special backfill material is encountered in an existing installation, (Embankment, Grade A or Grade B), backfill to a height of 2 feet above the top of pipes shall be made with earth, which shall be free from stones or rock fragments of a size larger than 2 inches, and free from lumps, clods, frozen material, vegetation, or other objectionable materials. Such backfill shall be compacted with approved flat-faced mechanical or vibrator tampers. Where special material is encountered, the backfill shall be of equal quality.

The backfill shall be brought up uniformly on both sides of the pipe. When backfilling below centerline of pipe, special care shall be taken to thoroughly compact the material below the haunches of the pipe, without disturbing the alignment or invert grade of the pipe.

All backfill in trenches more than 2 feet above the top of the pipes and culverts shall be compacted as follows:

(a) by approved vibratory soil compactors, if the backfill material is predominantly sand or sand gravel; approved flat-faced mechanical tampers may be substituted for the vibratory soil compactors where the shoring and bracing of trenches or other special conditions make the use of vibratory compactors impracticable;

(b) by approved flat-faced mechanical tampers, if the backfill material is not predominantly sand or sand and gravel.

(2) Backfilling Underdrains.

Underdrain backfill in trenches shall be compacted by approved vibratory soil compactors or flat-faced mechanical tampers.

(3) Backfilling Structures Other Than Pipes.

Structures shall have acquired sufficient strength to permit backfilling without damaging the work. The backfill shall be brought up uniformly on all sides of the structure. If the material is dry, it shall be uniformly moistened to the optimum moisture content. The moistening and the compacting shall be such as to obtain the same degree of compaction as that specified for adjoining embankment material.

(4) Backfilling Flared End Sections, Headwalls, Etc.

Backfill around flared end sections, headwalls and similar structures shall be compacted by approved flat-faced mechanical tampers.

206.04 Measurement.

Trench Excavation, Extra Depth will be measured by the volume of all material excavated between vertical planes one foot outside of the barrel of pipes, and the outside neat lines of other structures, and between horizontal planes, one foot below the plan bottom of trench, or bottom neat lines of structures shown on the Plans, and the bottom of the excavation as determined by the Engineer.

Trench Excavation, Rock will be measured as follows: for boulders, more than 1/2 cubic yard each in volume, the measurement will be of the actual volume excavated within the limits prescribed hereinafter for rock in mass formation; for rock in mass formation, the measurement will be of the volume of rock in place between vertical planes, one foot outside of the outside of the barrel of pipes, and the outside neat lines of other structures, and above a surface 6 inches below the plan bottom of trench and the bottom neat lines of other structures shown on the Plans.

Trench Excavation, Earth will be measured by the volume, exclusive of any material classified as rock excavation above, of all material in place between vertical planes one foot outside of the outside of the barrel of pipes, and the outside neat lines of other structures, from the surface of the ground as determined by the Engineer, as it exists at the time when the excavation is started, to the plan bottom of trench and to the bottom neat lines of other structures as shown on the Plans, or to such other depth as the Engineer may require.

Trench Excavation, Electrical will be measured by the total length of trenching required along the conduit bank or duct run centerline through all boxes, foundations, and bases between the centers of terminal units, risers, connecting or branching points. No adjustment will be made for added width or depth for precast units, foundations, or precast units (including drainage pits), such as bases adjacent to conduit banks or duct run. Plowing, if used for duct installation, will be measured as Trench Excavation, Electrical.

When required by Contract Documents, Trench Excavation, if and where directed, will be measured by either the volume or the length as shown on the Plans, and by the various classifications as specified for Trench Excavation, as the Engineer may require.

206.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TRENCH EXCAVATION, EXTRA DEPTH	CUBIC YARD
TRENCH EXCAVATION, ROCK	CUBIC YARD
TRENCH EXCAVATION, EARTH	CUBIC YARD
TRENCH EXCAVATION, ELECTRICAL	LINEAR FOOT

Unless otherwise required by the Contract Documents, disposal of excavated material, and the replacement thereof with granular backfill material as provided for in Paragraph 206.03(A), shall be included in the installation costs for the various items of drainage pipes, utility pipes, inlets, manholes and underdrains.

No separate payment will be made for the removal and replacement of any asphalt pavement during trenching operations for the installation of electrical facilities, the cost for which shall be included in the price bid for Trench Excavation, Electrical.

No payment will be made for required inspections made by Contractor-furnished competent personnel.

Payment for Trench Excavation, Extra Depth shall include backfilling the extra depth excavation with pipe bedding material.

The removal of buried crib work, heavy timbers, and similar materials requiring special work for their removal will not be considered as part of Trench Excavation for purposes of payment. When such removal is required, payment will be made as provided in Subsection 104.04. Any such payment will not include any payment for backfilling.

If Trench Excavation, Rock is not a scheduled item in the Proposal, payment for removal of boulders, more than 1/2 cubic yard each in volume, and rock encountered, which cannot be removed in a practical manner by means of a trenching machine or ordinary hand methods without blasting, will be made as provided in Subsection 104.04. Any such payment will not include any payment for backfilling.

The disposal of muck material shall be paid for as specified in Subsection 202.05. Temporary sheeting, needed to remove muck material during trenching operations, shall be paid for as specified in Subsection 415.06.

SECTION 207 - STONE FOR EROSION CONTROL

207.01 Description.

Stone for Erosion Control shall include furnishing and placing stone on slopes and surfaces subject to erosion.

Where shown on the drawings, stone aprons, stone-lined ditches and filter fabric shall be furnished and constructed to dimensions shown, or as directed by the Engineer.

207.02 Materials.

Stone shall be sound, durable, angular rock, free from spoil, shale, and organic material and shall meet the following gradation requirements for the grade specified:

STONE, GRADE A 902.06

FILTER BLANKET ..... 902.05(D)

STONE, GRADE C 902.06

STONE, GRADE D 902.06

STONE, GRADE E 902.06

FILTER FABRIC 923.21

207.03 Methods of Construction.

The Contractor shall not impede or impound the flow of existing water courses.

(A) RIPRAP SLOPE PROTECTION.

In areas normally above mean low water, the slope on which the riprap slope protection is to be placed shall be shaped to an even surface, upon which the filter blanket shall be placed in a uniform layer of the specified thickness. Stone, Grades A, C, D, E or any approved combination conforming to the designated median stone (d_{50}) size shall be placed individually in close contact, and firmly bedded in the filter blanket. Open spaces between stones shall be filled with spalls firmly rammed in place. The finished surface shall be even and to the required lines.

In areas normally below mean low water, the filter blanket and stone may be dumped or otherwise placed to approximate the required lines.

The filter fabric shall be positioned over the entire surface upon which the riprap is to be placed and extend a minimum of 1 foot out on each side. The extended edges of the filter fabric shall be buried under a minimum of 6 inches of soil. When sections of fabric need to be joined, the sections shall be overlapped a minimum of 1 foot-6 inches in the direction of flow.

The filter blanket aggregate shall be laid on the filter fabric in a manner that does not cause damage to or dislodge the fabric.

The riprap stones shall be firmly bedded into the filter blanket also without damage to the fabric. Open spaces between the placed riprap shall be filled with smaller stones of the same type and quality as the riprap stones. These smaller stones shall be firmly rammed into place. The larger of these stones shall be used in the lower courses.

The finished surfaces of the riprap stone slope or ditch protection shall be even.

(B) RIPRAP STONE EROSION CONTROL.

Stone riprap aprons and ditch lining shall be constructed at the locations shown, or as directed by the Engineer, in accordance with the details shown on the Plans.

The area upon which the stone is to be placed shall be shaped and compacted to an even surface. All unsuitable material shall be removed and replaced with acceptable material, which shall then be compacted and properly shaped. A filter fabric of the prescribed unit weight shall be placed on the prepared surface and pinned in place at sufficient intervals to be able to resist movement or displacement by the riprap stone being placed on it. Stone of the designated median stone (d_{50}) size shall then be placed and spread on the filter fabric material to the specified thickness, and in such a manner as not to cause damage to the filter fabric. The finished stone surface shall be even and to the required lines and grades.

207.04 Measurement.

Riprap consisting of Stone Grades A, C, D or E, or any combination thereof will be measured by weight of stone actually furnished and placed.

Filter Blanket will be measured by the weight of the filter blanket material furnished and placed.

207.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
RIPRAP STONE SLOPE PROTECTION, ___ " THICK (D_{50}=___")	TON
RIPRAP STONE APRONS, ___ " THICK (D_{50}=___")	TON
RIPRAP STONE DITCH PROTECTION, ___ " THICK (D_{50}=___")	TON
FILTER BLANKET	TON

No separate payment will be made for any required excavation and replacement of unsuitable material or filter fabric placed under stone of the various grades.

SECTION 208 - TEMPORARY SOIL EROSION AND DUST CONTROL

208.01 Description.

Temporary Soil Erosion and Dust Control shall consist of the implementation of temporary measures, as shown on the Plans or ordered by the Engineer, to control soil erosion through the use of jute mesh, cutback asphalt, grass seeding, mulching, hay bale dams, and other approved methods. Other devices consisting of manipulations of earthwork, such as berms, temporary slope drains, dikes, dams, sediment, and basins may also be used to control erosion. Dust control shall consist of the application of calcium chloride and/or water as ordered by the Engineer. Work under this Section shall also include the removal of all dirt and materials deposited on existing pavements as a result of the Contractor's operations.

The Contractor shall, prior to the start of the necessary construction, submit to the Engineer for review his schedules for accomplishment of temporary erosion control work applicable for all phases and types of construction. The Contractor shall incorporate into the schedule topsoiling, seeding, and sodding operations as specified in the applicable Sections of Division 700 to the extent that said operations afford soil erosion protection during the various construction phases. The Contractor shall also submit for review his proposed method of erosion control on haul roads and his plan for disposal of waste materials. No work shall be started until the erosion control schedules and methods of operations have been approved by the Engineer.

Silt fence shall be constructed at locations shown on the Plans, or at locations directed by the Engineer, for temporary soil erosion control.

The silt fence shall consist of a two-component barrier system composed of a support fence and an attached filter fabric. The support fence is composed of minimum 14-gage woven wire attached to metal or wooden posts. The filter fabric shall be stapled or wired securely to the support fence.

Temporary erosion control devices, constructed and left in place at the completion of construction, shall be maintained as long as needed for temporary erosion control. They shall be removed when no longer needed, as determined by the Engineer.

208.02 Materials.

Materials shall conform to the following Section:

SEED	919.10
MULCH	919.13
JUTE MESH	919.35(A)
LIQUID ASPHALT.	904.04
CALCIUM CHLORIDE	923.03
TEMPORARY STONE, GRADE A	902.06
TEMPORARY STONE, GRADE B	902.06
SILT FENCE	923.30

COURSE AGGREGATE 902.05

GEOTEXTILES 923.37

Calcium chloride for dust control shall be in the form of loose dry lumps or flakes and fine enough to feed readily through the common forms of spreaders used in road work.

Temporary slope drains may be constructed for pipe, fiber mats, rubble, Portland cement concrete, bituminous concrete, plastic sheets, or other material acceptable to the Engineer that will adequately control erosion.

Hay Bales shall be free from weeds and other foreign material and shall be furnished in standard size bales.

The Contractor may, if permitted by authorities having jurisdiction, obtain water from streams or rivers. The Contractor may also obtain water from hydrants, if permitted to do so by the local authorities having jurisdiction. Approval of the Engineer will be required, if water is to be obtained from Authority facilities.

Welded steel wire mesh fabric shall conform to Subsection 908.01.

Pipe for temporary slope drains shall be a minimum size of 8 inches and shall conform to Subsection 917.05. End sections and elbows shall be of the same material as the pipe to which they are to be joined.

208.03 Methods of Construction.

As the construction progresses, the Contractor shall incorporate all permanent and temporary erosion control features (as outlined in his accepted schedule) into the Project at the earliest practicable time.

As ordered by the Engineer, temporary soil erosion measures will be used to correct conditions that develop during construction that were not foreseen during the design stage.

Temporary measures shall be coordinated with the construction of permanent drainage facilities and other permanent erosion control work to the extent practicable to assure economical, effective, and continuous erosion and siltation control.

The Contractor shall schedule his work and conduct his construction operations in a manner, so as to minimize the work area subject to erosion. As the work proceeds, cut and fill slopes and graded areas shall be topsoiled and seeded, and other permanent construction completed as soon as practicable, as determined by the Engineer. Should seasonal or other limitations make such completion of portions of the work unrealistic, additional temporary erosion control measures shall be taken immediately, as directed by the Engineer.

In the event of conflict between these requirements and pollution control laws, rules, or regulations of Federal, State, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor.

In case of failure on the part of the Contractor to control erosion, pollution, and/or siltation, the Authority reserves the right to employ outside assistance or to use its own forces to provide the necessary control measures. The cost of such work will be deducted from payments due the Contractor.

(A) SEEDING.

The grass seed shall be sown on the slopes where, in the opinion of the Engineer, there is the danger of soil erosion and/or the pollution of a water course. It shall be sown, using standard seeding equipment at the rate of 25 pounds per acre.

The Contractor shall maintain and repair by reseeding as necessary all seeded areas to prevent soil erosion and/or pollution of waterways.

(B) JUTE MESH.

Jute mesh shall be placed at locations designated by the Engineer.

(C) LIQUID ASPHALT.

The Engineer may order the Contractor to spray liquid asphalt on the newly constructed embankment or excavation sections, which have not been topsoiled as a preventative measure for soil erosion. Liquid asphalt shall be applied at the rate of 0.2 to 0.5 of a gallon per square yard; the exact amount will be determined by the Engineer in the field. Temperature of the liquid asphalt and method of application shall be as specified in Subsection 904.04.

Prior to the permanent topsoiling and seeding operation, the Contractor shall remove and dispose of all asphalt contaminated soil to the satisfaction of the Engineer.

(D) DUST CONTROL.

Whenever the work under the Contract causes dusty conditions, whether created by the Contractor's operations, by traffic, or by wind, the Contractor shall take immediate steps to relieve and prevent such conditions by the application of water, cutback asphalt or calcium chloride. Calcium chloride shall be spread by equipment acceptable to the Engineer. The control of dust is required 24 hours a day, 7 days a week throughout the entire period of the Contract, whether actual work is in progress or not.

(E) TEMPORARY EARTH BERM.

The Contractor shall shape the top of the earthwork in such a manner as to permit the channeling of rainwater and shall construct earth berms along the top edges of embankments to intercept runoff water. Temporary slope drains shall be provided to carry runoff from cuts and embankments. The slope drains may be of flexible or rigid construction, but they shall be capable of being readily shortened or extended as the cut or fill advances. A portable flume shall be provided at the entrance to the temporary slope drains.

(F) SEDIMENTATION BASINS.

Sedimentation basins shall be constructed in areas designated on the Plans, or as ordered by the Engineer. All basins shall be located on Authority property and shall in no way impede or impound the flow of existing water courses.

Basins requiring dikes or dams shall not be located on existing water courses. All dikes or dams built as impoundments for sedimentation basins shall be constructed of stone conforming to the requirements of Temporary Stone, Grade A, unless otherwise ordered by the Engineer.

(G) STONE FOR TEMPORARY EROSION CONTROL.

Stone, either Grade A or B, shall be placed, as ordered by the Engineer, in areas subject to erosion to afford temporary soil protection until such time that permanent erosion control features are constructed. Such areas shall include, but not be limited to, swales, storm drain outfalls, ditches, and cut or embankment slopes.

Stone, Grade A, shall be removed when no longer needed and reused at other locations or disposed of away from the Authority right-of-way. Stone, Grade B need not be removed.

(H) HAY BALES FOR TEMPORARY EROSION CONTROL.

Hay bales shall be used, as shown on the Plans or ordered by the Engineer, to construct hay bale dams as a measure to control minor erosion problems. A blanket of hay bales or Stone, Grade B, shall be placed immediately downstream of the hay bale dam, as shown on the Plans or ordered by the Engineer, to prevent erosion due to spillage. Hay bales shall not be incorporated in the earthwork but shall, when no longer needed, be removed and disposed of in a manner satisfactory to the Engineer.

(I) SILT FENCE.

The Contractor shall install the silt fence prior to any major soil disturbance in accordance with the details, and at the locations shown on the Plans, or as directed by the Engineer.

Heavy-duty silt fence shall include a welded wire mesh backing for the geotextile fabric. This welded steel wire mesh shall be galvanized and contain 6-inch openings. The geotextile fabric shall be secured to the welded wire mesh. Install heavy duty silt fence with geotextile securely buried in the existing soil. Join sections of the geotextile so that they work effectively as a continuous fence. Install fence posts at a slight angle toward the anticipated runoff source. Install heavy duty silt fence in locations as shown in the Plans.

The Contractor shall inspect and maintain the fences for the duration of their use until the area has been permanently stabilized with fertilizing, seeding and mulching or stone slope protection. The Contractor shall clean and reinstall the existing silt fence or install new silt fence as directed by the Engineer. Where the silt fence is no longer needed, the Contractor shall dispose of same in a manner satisfactory to the Engineer.

(J) HAYBALE CHECK DAMS WITH TEMPORARY STONE OUTLETS.

Haybales shall be embedded 4 inches into the ground and anchored in place with two stakes per bale. The temporary stone outlets, consisting of riprap stones conforming to the requirements for Type C Stone, shall be placed in the center of each flow line. Type B Stones shall be placed immediately upgrade of each stone outlet.

The Type C Stones shall be placed on geotextile fabric that shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot - 6 inches in the direction of flow.

(K) TEMPORARY STONE CHECK DAMS.

Temporary stone check dams shall be constructed in ditches to reduce flow velocity.

The check dams shall consist of riprap stones conforming to the requirements for Type C Stone. Type B Stones shall be placed immediately upgrade of each check dam.

The Type C Stones shall be placed on geotextile fabric that shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot - 6 inches in the direction of flow.

(L) TEMPORARY SLOPE DRAINS.

Temporary slope drains shall be installed on embankment slopes to intercept surface runoff where concentrated runoff will cause excessive erosion of the slope.

The drainpipe shall be staked to the slope or secured with riprap stones to prevent movement or displacement. A flared end section shall be attached at each end of the pipe, and elbows shall be installed as required to conform with the existing changes in slopes.

A temporary earth berm and haybales shall be constructed at the top of slope in the vicinity of the slope drain to intercept runoff and channel the runoff to the slope drain. The haybales shall be embedded 4 inches into the ground and anchored in place with two stakes per bale.

Riprap stones, conforming to the requirements for Type C Stone, shall be placed loosely at both ends of the pipe to prevent scour. The riprap stones shall be placed on geotextile fabric that, at the top of slope, shall be draped over the earth berm. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot - 6 inches in the direction of flow.

(M) DEWATERING BASIN.

Dewatering basins shall be constructed within the right-of-way of the Project and outside of any undisturbed wetland area, and areas not affected by roadway construction, as a dewatering containment measure to control sediment and provide filtration of water.

The Contractor shall size the dewatering basins to entirely contain the expected discharge of water and sediment based on the flow rate of the pump to be used and the volume of area to be dewatered. The material to be used to form the basin is at the discretion of the Contractor. The outfall of the basin shall be such that the water exiting the basin does not cause erosion to or scour the area onto which the water is being discharged.

(N) FLOATING TURBIDITY BARRIERS.

Floating turbidity barriers, consisting of ten (10) mil thick polyethylene plastic sheets suspended from floats, shall be installed in streams or other watercourses to intercept silt outletting from drainage pipes or caused by construction operations within the waterways.

Barriers shall be located 50 feet from the point of discharge of drainage pipes or from construction operations affecting the waterways. The barriers shall extend across the entire waterway or radially from the shore line.

(O) TEMPORARY STONE OUTLET SEDIMENT TRAPS.

Temporary stone outlet sediment traps, consisting of temporary basins and riprap spillways, shall be constructed within existing, proposed, and temporary ditches.

The spillways shall consist of riprap stones conforming to the requirements for Type C Stone. Type B Stone shall be placed immediately upgrade of the spillways.

The riprap stones and coarse aggregate shall be placed on geotextile fabric which shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 18 inches in the direction of flow.

(P) INLET FILTERS.

Provide Type 1 and Type 2 Inlet Filters as follows:

(1) Type 1.

For new inlet structures, mold welded steel wire fabric around the inlet frames and grates, or inlet structures, and extend a minimum of 6 inches down each side of the new structures. Secure geotextile to the welded wire fabric. Place Coarse Aggregate, Size No. 2 against the inlet structures to hold the inlet filter in place.

For existing inlet structures, place geotextile under the grates, over the curb pieces, and extend a minimum of 6 inches beyond. Place Coarse Aggregate, Size No. 2 behind each curb piece and on the geotextile to secure the fabric in place.

For existing or new inlets with curb pieces, wrap the geotextile around a piece of lumber. Place the lumber against the vertical opening to allow for flood overflow.

Remove inlet filters within 12 hours of a paving operation.

(2) Type 2.

Remove the inlet grate and place the inlet filter in the opening, holding out approximately 6 inches of the filter outside the frame. Replace the inlet grate to hold the filter in place. Empty the filter according to the manufacturer's recommendations. When removing the filter, ensure that sediment does not enter into the drainage system. Clean out the filter, dispose of the sediment, rinse and return the filter to its original shape, and replace the filter inside the inlet.

(Q) INLET SEDIMENT TRAPS.

Inlet Sediment Traps, consisting of silt fence and temporary stone inlets, shall be constructed to control sedimentation at existing and new inlet drainage structures.

The silt fence shall consist of geotextile fabric whose width shall be at least 3 feet to provide for a 2-feet high fence after 1 foot of fabric is buried in the existing soil. Sections of fabric shall be overlapped a minimum of 1 foot - 6 inches then joined in such a manner that, when in operation, the sections work effectively as a continuous fence. The silt fence shall be installed around the drainage structure and meet into the stone inlets. Fence posts shall be installed at a slight angle toward the anticipated flow.

The temporary stone inlets, consisting of temporary stone, Grade 'B', shall be placed in each flow line upgrade of the inlet structure. The coarse aggregate shall be placed on geotextile fabric that shall be buried in the soil. When sections of geotextile fabric need to be joined, the sections shall be overlapped a minimum of 1 foot - 6 inches in the direction of flow.

(R) CONSTRUCTION DRIVEWAY.

To minimize tracking of dirt and other materials onto existing roadways, provide a construction driveway at each location where vehicles exit the work site as approved by the Engineer. Construct driveways using temporary stone, Grade 'B' placed on geotextile. Ensure that the driveway is at least 15 feet wide. The Contractor may make driveways wider if approved by the Engineer. Maintain the driveway by top dressing or by excavating and top dressing, as directed by the Engineer, with additional temporary stone, Grade 'B'. When the driveway is no longer required, remove the driveway, backfill to the adjacent ground elevation, and restore the disturbed area to the original condition.

208.04 Measurement.

Temporary erosion and pollution control measures required to correct conditions created due to the Contractor's negligence, carelessness, or failure to install permanent controls in accordance with the approved schedule for performance of such work, will not be measured for payment. Temporary erosion and pollution control work required to correct conditions not created by the Contractor's negligence or carelessness shall be performed as ordered by the Engineer, and measurement therefore will be made as follows:

(A) Temporary Seeding will be measured by the surface area seeded.

(B) Cutback Asphalt will be measured by the volume of cutback asphalt material used to prevent soil erosion and dust clouds. The volume of the cutback asphalt will be measured at a temperature of 60ºF. as determined by the temperature-volume corrections specified in ASTM D1250, using the applicable table for the type and grade of material used.

(C) Calcium Chloride will be measured by the weight of calcium chloride used as directed by the Engineer.

(D) Temporary Stone, Grade A or Temporary Stone, Grade B, will be measured by the weight of stone furnished and placed.

(E) Hay Bales will be measured by the volume of hay bales used. Hay used for mulching permanent seeded areas will not be measured for payment under the item Hay Bales.

(F) Silt Fence will be measured by linear foot.

(G) Haybale check dams with temporary stone outlets will be measured by the linear foot.

(H) Temporary Stone Check Dams will be measured by the cubic yard.

(I) Temporary Slope Drains will be measured by the linear foot.

(J) Dewatering Basins will be measured by the number of each.

(K) Floating Turbidity Barriers will be measured by the linear foot.

(L) Temporary Stone Outlet Sediment Traps of the various sizes will be measured by the number of each.

(M) Heavy Duty Silt Fence will be measured by the linear foot.

(N) Inlet Filters, Type 1 will be measured by the square foot and paid for upon removal.

(O) Inlet Filters, Type 2 will be measured by the number of each and paid for upon removal.

(P) Inlet Sediment Traps will be measured by the number of each.

(Q) Construction Driveway will be measured by the weight of the stone furnished and placed.

208.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TEMPORARY SEEDING	SQUARE YARD
CUTBACK ASPHALT	GALLON
CALCIUM CHLORIDE	TON
TEMPORARY STONE, GRADE A	TON
TEMPORARY STONE, GRADE B	TON
HAY BALES	CUBIC YARD
SILT FENCE.	LINEAR FOOT
HEAVY DUTY SILT FENCE	LINEAR FOOT
HAYBALE CHECK DAM WITH TEMPORARY STONE OUTLET	LINEAR FOOT
TEMPORARY STONE CHECK DAM	CUBIC YARD
TEMPORARY SLOPE DRAIN	LINEAR FOOT
DEWATERING BASINS	EACH
FLOATING TURBIDITY BARRIERS	LINEAR FOOT
TEMPORARY STONE OUTLET SEDIMENT TRAPS, ____' X _____'	EACH
INLET FILTER, TYPE 1	SQUARE FOOT
INLET FILTER, TYPE 2	EACH
INLET SEDIMENT TRAPS	EACH

CONSTRUCTION DRIVEWAY..... TON

No separate payment will be made for maintenance or repair of seeding or stone covered areas; stripping and satisfactory disposal of asphalt contaminated earth; removal and disposal of stone; manipulations of earthwork, or permits and water charges.

Maintenance and removal of soil erosion control devices shall not be subject to separate payment, and the cost for this work shall be included in the unit costs of the various soil erosion control items.

Jute mesh for erosion control will be paid for under the item Soil Stabilization Matting as provided in Subsection 706.05.

Excavation for construction of Sedimentation Basins will be paid for under the appropriate Roadway Excavation item as provided for in Section 202.

No separate payment will be made for replacement of temporary riprap for the maintenance of the various soil erosion and sediment controls, but the cost thereof shall be included in the cost of the items.

No separate payment will be made for the application of water for the purpose of dust control. Watering for the purpose of dust control shall take place as necessary and as directed by the Engineer.

SECTION 209 - SUBGRADE

209.01 Description.

Subgrade shall consist of preparing previously constructed subgrade surfaces to receive shoulder and roadway pavement construction and appurtenances. The Contractor shall remove and dispose of foreign or unsuitable material, reshape the cross section, move suitable material along the Project, remove and dispose of excess material, furnish additional material from borrow, compact all areas and finish all of the surfaces.

209.02 Materials.

Embankment, Grade A, shall conform to the requirements of Subsection 901.01 and Paragraph 203.02(C).

209.03 Methods of Construction.

Except for the removal of foreign, unsuitable or excess material, Subgrade preparation shall not be commenced until after all underlying drains, utilities and other subsurface structures have been placed, the backfill thereof has been consolidated, and such work has been approved by the Engineer.

After the removal of foreign or unsuitable material from the area over the full width of the roadbed, the existing surface shall be shaped approximately to the section shown on the Plans. Embankment, Grade A, shall be compacted in areas where pavements and shoulders are to be placed in accordance with the requirements of Subsection 203.03, and to not less than the percentage of maximum dry density specified therein under Paragraph (E) for a depth of not less than 6 inches to form surfaces, which at all points are within 1/2 inch of the theoretical section shown on the Plans.

If soft, spongy, or other material which in the opinion of the Engineer does not meet the requirements for Embankment, Grade A or for Porous Fill, where the latter is required, is encountered in the shoulder or pavement areas, such material shall be removed to the lateral limits and depths specified by the Engineer and shall be replaced with Embankment, Grade A, or with Porous Fill, if so designated by the Plans or by the Engineer, which shall be compacted, as required in this Section.

Foreign or unsuitable material removed, as required above, shall be disposed of by the Contractor outside the Authority right-of-way to the satisfaction of the Engineer. Excess suitable material shall be disposed of outside the Authority right-of-way by the Contractor.

In all of the operations described in this Section, a deficiency in quantity of Embankment, Grade A, shall be made up by (a) bringing material from locations, within the Project limits at which a surplus of it is present or, (b) if the Engineer so directs, it shall be obtained by the Contractor from borrow pits. Any excess material remaining after the correction of such deficiencies shall be stockpiled by the Contractor at locations designated by the Engineer.

If, in the opinion of the Engineer, it is necessary to correct deficiencies of Embankment, Grade A, or Porous Fill by obtaining such materials from borrow, the provisions and requirements of Paragraph 203.03(F) shall cover all operations in connection therewith.

Construction of the first course of roadway pavement or shoulder pavement shall commence not later than 48 hours after the completion of the subgrade compactions in such areas. Immediately before the placing of pavement material on the subgrade, the surface of the subgrade to be so covered shall be rolled with not less than 4 passes, producing at least 2 complete coverages, of pneumatic tire super-compactors having wheel loads of not less than 25,000 pounds each with tire pressures of not less than 150 pounds per square inch, as a means of pretesting the subgrade. Prior to and during the pretesting and the finish dressing and rolling, the subgrade shall be kept watered, or shall be dried, as necessary to keep the subgrade within 2 percentage points plus or minus of optimum moisture content to a depth of 1 foot.

Any soft or spongy spots disclosed by this pretesting shall be excavated and reconstructed and retested as described above. The subgrade shall then be dressed to the proper grade and rolled with a three-wheel roller. The resulting surface at all points shall be within 1/2 inch of the theoretical section shown on the Plans. Areas failing to meet this tolerance shall be reconstructed and retested until satisfactory. If such rejected areas are extensive, modifications shall be made in the compaction procedure of embankment material to achieve proper densities and firmness.

In all areas, the compacted surface shall be free from water pockets and shall be approved by the Engineer before the placing of the next layer of material thereon.

During the preparation of the Subgrade, the Contractor shall not damage the areas outside of the limits of construction under the Contract, nor allow debris to accumulate thereon, or if such damage or accumulation does occur, it shall be repaired or removed to the satisfaction of the Engineer at the expense of the Contractor. All finished surfaces of the Subgrade shall be maintained by the Contractor to the satisfaction of the Engineer until base, subbase, or shoulders are constructed thereon or until final acceptance of the work under the Contract.

209.04 Measurement.

Except as otherwise herein provided, there will be no measurement for Subgrade.

Subgrade will be measured for payment only when the Contractor is required to construct roadway and shoulder pavement on Embankment, Grade A, material placed, compacted, and finished under another contract. In such case, the quantity of Subgrade for which payment will be made will be the area of Subgrade actually prepared to receive roadway and shoulder pavement.

209.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SUBGRADE	SQUARE YARD

SECTION 210 - DEMOLITION OF EXISTING STRUCTURES

210.01 Description.

Demolition of existing structures shall include the removal of superstructure, abutments, piers, retaining walls, foundations and footings, and all other above ground portions of the structures prescribed herein below, or as ordered by the Engineer.

210.02 Methods of Construction.

The Contractor shall demolish and remove items by whatever means that will satisfactorily execute the work while maintaining traffic. He shall provide all protective measures necessary to insure that none of the demolished materials will drop on or roll on to active shoulders or roadways at any time.

The work shall consist of complete demolition or removal of the structure, including removal of metal work, concrete, masonry and timber, and other miscellaneous structures appurtenant to the structure shown to be demolished; disconnecting and terminating utility facilities, if any; breaking concrete and masonry foundations and footings; backfilling of excavated areas within the limits of work; the removal and disposal of materials and debris and final cleaning up of the site.

It shall be the responsibility of bidders to ascertain, by their own inspection and investigation, the condition of the structure and barrier curb, the type of construction, data concerning equipment and fixtures in, or

part of, the structure, whether or not such information be shown or given in the Plans, Specifications or other Contract documents, and to make such other investigations that may be necessary for a complete understanding of the work to be performed. Bids shall be based on the bidder's own findings as to the work involved under this Section.

The removal of the structure shall be performed with extreme care, so as to avoid damage to the facilities of the Authority and to prevent any needless interference with, or delays to, traffic. Damage to the area surrounding the structure, or to adjacent structures or roadways due to violation of the foregoing provisions, or otherwise caused by the Contractor's negligence, shall be repaired and made good to the satisfaction of the Engineer.

Wherever necessary for the protection of the traveling public, or where required by State law or local ordinance or regulations, the Contractor shall construct and maintain adequate and substantial barricades, false-work and debris catches around and below the affected structure(s) while demolition work is in progress. Catches shall conform to the requirements of Subparagraph 417.04(A)(1). After the superstructure concrete is removed, the steel stringer removal over operating roadways will be done with traffic slowdowns. The use of a wrecking ball will not be permitted.

Prior to any demolition operations, the Contractor shall submit working drawings, approved and signed by a Professional Engineer licensed in the State of New Jersey, to the Engineer for approval in accordance with Subsection 104.08. These drawings shall include, but not be limited to, the following information:

- Methods of demolition
- Sequence of demolition
- Schedule of demolition
- Maintenance and protection of traffic layout and schemes

In areas where new roadways are to be constructed, existing structure foundations and footings shall be removed to a depth of not less than three (3) feet below proposed "template grade." Where such portions of existing structures lie wholly or in part within the limits of a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure. In other areas, the existing structures shall be removed to a depth of not less than two (2) feet below the finished ground surface.

All areas excavated in the course of removal of existing structures shall be backfilled with suitable approved materials obtained from roadway excavation, which material shall be thoroughly compacted in accordance with the requirements of Section 205.

The Contractor shall salvage all existing bridge fencing and handrail, and deliver to a location directed by the Engineer. Care shall be used to maintain the bridge fencing and handrail in good condition.

Removal and salvaging of bridge mounted electronic sign systems shall be as specified in Division 600.

210.03 Disposal of Debris.

Materials accumulated by demolition shall be disposed of at sites provided by the Contractor, away from the Authority right-of-way, to the satisfaction of the Engineer.

Written permission shall be obtained from the property owner on whose property the materials are to be placed. Copy of the Agreements is to be furnished to the Engineer.

All clearing and grubbing demolition operations shall be in accordance with Section 201.

210.04 Measurement.

Demolition of Existing Structures shall be paid for as a lump sum.

210.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
DEMOLITION OF EXISTING STRUCTURES	LUMP SUM

Removal and salvaging of bridge mounted electronic sign systems shall be paid for separately under Division 600.

SECTION 211 – TEMPORARY FENCING

211.01 Description.

This work shall consist of furnishing and installing temporary orange plastic fence to delineate the limits of disturbance in wetlands, or as required in other areas prior to placement of, or in addition to, the project steel fencing.

211.02 Materials.

Temporary orange plastic fence shall be in accordance with Subsection 923.25.

211.03 Methods of Construction.

The Contractor shall install the temporary orange plastic fence prior to initiating any construction in the vicinity of existing wetlands. The fence shall be held in place by 2" x 2" x 6' metal or hardwood posts spaced at 8 feet, and driven approximately 2 feet into the ground. The plastic fence shall be secured to the posts with wire or plastic ties. Plastic laminated "Keep Out" signs are to be secured to the plastic fence. "Keep Out" signs' size, location and method of attachment to plastic fence shall be approved by the Engineer. The Contractor shall inspect and maintain the temporary orange plastic fence for the duration of work adjacent to the delineated wetlands to the satisfaction of the Engineer. When no longer necessary, the fence shall be removed and disposed of off Authority property unless salvage of the fence materials and/or signs is required by the Engineer, in which case, fence materials and signs shall be stored at an Engineer approved location to remain the property of the Authority.

211.04 Measurement.

Temporary Orange Plastic Fence will be measured by the linear foot.

211.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TEMPORARY ORANGE PLASTIC FENCE	LINEAR FOOT

No separate payment will be made for "Keep Out" signs or costs of any salvage and storage, if required.

No extra payment will be made for restoration, maintenance or removal of temporary plastic fence.

SECTION 212 - SUBBASE

212.01 Description.

This work shall consist of the construction of one or more courses of the subbase and the preparation of the subgrade.

212.02 Materials.

Materials shall conform to the soil aggregate designations in Subsection 902.08 or as specified.

212.03 Methods of Construction.

Equipment shall include spreading equipment that can spread aggregate, without segregation, and one or more motor graders. The compaction equipment shall conform to Paragraph 203.03(E).

Before the placing of any subbase, the subgrade shall be shaped and compacted to within a tolerance of plus or minus ½ inch of grade and contour, with no areas consistently high, according to Section 203 and shall be free from water pockets. Subbase material shall not be placed on soft, muddy, or frozen areas, or until all irregularities in the prepared areas, including soft areas in the subgrade, have been corrected.

The subbase material shall be deposited on the prepared areas as uniformly as possible to avoid segregation.

Subbase shall be constructed in layers not exceeding a compacted thickness of 8 inches and according to the surface tolerances specified in Subsection 209. If the required compacted depth of the subbase exceeds 8 inches, the subbase shall be constructed in two or more layers of approximately equal thickness.

Subbase shall be completed at least 500 feet in advance of construction of the next course.

Except for the subbase layer directly under concrete surface or concrete base course, compaction shall be by the control fill method according to Paragraph 203.03(E) except that a single layer control strip shall be used. The subbase layer directly under the concrete surface and concrete base courses shall be compacted according to Subsection 301.03. Compaction shall progress gradually from the sides to the center with each succeeding pass uniformly overlapping the previous pass and shall continue until the entire area is shaped and compacted.

Unstable subbase conditions, including soft subgrade areas which develop before or ahead of the base course or paving operations, shall be corrected by scarifying, reshaping, and recompacting, or by replacement as required. Work may be suspended to permit such areas to stabilize.

If damage is caused to any utility, pipe, facility, building, structure, or to its contents, the method of operation shall be changed so as to avoid such damage. At such locations the subbase and subgrade shall be compacted by the density control method specified in Paragraph 203.03(E).

Correct damage to the subbase caused by construction activities, and maintain the corrected subbase until the subsequent course is placed. Do not allow traffic on the subbase. Remove all standing storm water and obtain the Engineer's approval before constructing subsequent courses.

Completed subbase that has been subjected to construction traffic or exposed to the elements for periods in excess of 120 calendar days will be retested for reapproval before construction of the base and surface courses.

Retesting of subbase before 120 calendar days may be required if there is reason to believe it no longer meets specified requirements. In all cases, subbase failing to meet requirements shall be corrected or replaced.

212.04 Measurement.

Subbase will not be measured, and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 108.01.

212.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SUBBASE	CUBIC YARD

SECTION 213 – REGULATED MATERIAL

213.01 Description.

Excavation, reuse or disposal of Acid Producing Soil (APS) and Regulated Material, shall consist of the excavation and either reuse or off-site disposal of materials that have been determined to contain APS or Regulated Material. If the earthwork summary for the Contract allows for the on-site embankment of excavated material, APS or Regulated Material may be used for backfilling, provided that the material meets the requirements of Embankment, Common.

Excavation and disposal of Regulated, Hazardous Material shall consist of excavation and off-site disposal of all materials that have been determined to be hazardous.

213.02 Materials.

Materials shall conform to the following Sections:

PULVERIZED LIMESTONE	919.08
SOIL STABILIZATION MATTING	919.35
SILT FENCE	923.30

HAYBALES 208.02

OIL-WATER SEPARATOR 923.42

Polyethylene sheeting shall be at least 10 millimeters in thickness.

213.03 Methods of Construction.

(A) EXCAVATING REGULATED MATERIAL.

The Authority, as the generator, is solely responsible for the designation of excavated material. Regulated material excavation consists of the excavation and management of material of whatever nature encountered, that is classified as regulated or hazardous in the NJDEP Solid Waste Regulations, N.J.A.C 7:26-1 *et seq.* or N.J.A.C 7:26-8.

The areas of known regulated material are identified on the Plans. The Contractor shall handle regulated material according to applicable Federal, State, and local laws, rules, and regulations; and as specified herein. Dispose of regulated material as specified in Paragraph 213.03(D).

(1) Pre-Excavation Plans.

The Contractor shall submit 4 copies of the following plans to the Engineer for approval 30 days before beginning construction operations. The Contractor shall update and resubmit the plans to identify changes in the condition or operation of the construction activities. If the Contractor fails to follow the pre-excavation plans, the Engineer will suspend the construction activities.

(a) Site-Specific Health and Safety Program (HASP).

The Contractor shall perform a hazard assessment of each proposed construction activity, and the Contractor shall make independent evaluations regarding the appropriate level of health and safety requirements.

The Contractor shall employ a Certified Industrial Hygienist (CIH) or Certified Safety Professional (CSP) to develop and oversee the Site-Specific HASP. The CIH/CSP shall prepare the Site-Specific HASP to protect the Contractor's employees, any subcontractor's employees, the Authority's employees and consultants, and the public from contamination present in the areas requiring excavation, as shown on the Plans. The Contractor shall ensure that the Site-Specific HASP complies with Federal, State, and local laws, rules, and regulations, including the health and safety requirements of OSHA 29 CFR 1910 and 29 CFR 1926. The Contractor shall implement the Site-Specific HASP, as approved by the Engineer, at the beginning of construction operations.

The Contractor shall ensure that the CIH/CSP review the site-specific data and address the proposed activities to the level of detail needed to ensure that the site-specific data, appropriate regulations, and a description of the site conditions are incorporated into the Site-Specific HASP.

The Site-Specific HASP shall describe the workplace and emergency procedures, so that the Contract is constructed in a safe manner. The Site-Specific HASP shall govern all facets of the Contract and encompass the activities of all persons who enter or work on the Contract. The Site-Specific HASP shall incorporate the procedures that conform to Federal, State, and local laws, rules, and regulations pertaining to employee working conditions where appropriate, National Institute for Occupational Safety and Health, OSHA, USCG, EPA, and NJDEP.

The Site- Specific HASP shall include the requirements for a health and safety coordinator to monitor the working conditions during excavation procedures and during the handling of regulated material to ensure conformance with the approved Site-Specific HASP. The CIH/CSP shall evaluate the need for air monitoring during excavation and loading operations of regulated material. If deemed necessary, the CIH/CSP or an assigned coordinator suitably trained and approved by the CIH/CSP for the work required, shall implement the air monitoring program. The CIH/CSP shall include in the Site-Specific HASP the applicable training and qualifications documentation for each health and safety coordinator.

The Contractor shall provide the initial and annual training and medical monitoring for all Contractor employees scheduled to work in or with regulated material and, per the Engineer's request, and up to 10 Authority employees, or their authorized representatives as specified in

OSHA 29 CFR 1910. The Contractor shall provide the initial training for Authority employees or their authorized representatives 30 days before excavating begins.

(b) Materials Handling Plan.

Once potentially regulated material has been tested and positively identified, the Contractor shall develop a Materials Handling Plan (MHP) for the regulated material encountered, moved, and disposed of or recycled during construction. The Contractor shall ensure the MHP includes the following:

(1) Techniques to be used in managing regulated material to protect adjoining properties and workers and visitors to the project limits against exposure to regulated material, and to prevent the release of regulated material into the environment.

(2) Standard operating procedures for excavation, stockpiling, transporting, measurement, and disposal of regulated material.

(3) Current receiving facility certification and permits.

(4) Qualifications of the licensed hauler.

(5) Proposed routes to receiving facilities and weighing facilities.

(6) Waste characterization forms.

(7) A sampling and analysis protocol for characterizing the regulated material for on-site reuse and off-site disposal. Include the name, address, and telephone number of the contact for the proposed environmental laboratory and the name and experience of the proposed environmental sampling technician. The proposed environmental laboratory and proposed environmental sampling technician are subject to the Engineer's review and approval.

(8) Requirements of the receiving facility to accept the regulated material.

The Contractor shall submit the MHP to the Engineer for review and approval 30 days before the scheduled date that excavation is to begin. The Contractor shall not begin any excavation activities until the MHP has been approved by the Engineer. The Contractor shall implement the MHP, as approved by the Engineer, at the beginning of the excavation. The Contractor shall perform planning, administrative, and control functions required to implement the MHP.

(c) Pollution Prevention and Control Plan.

The Contractor shall develop a Pollution Prevention and Control (PPC) Plan describing the methods of preventing discharge of regulated stormwater, ground water, sediments, and free product during stormwater control, excavation, and dewatering operations. The Contractor shall prepare the PPC Plan according to Federal, State, and local laws, rules, and regulations relative to regulated discharges. The Contractor shall submit the PPC to the Engineer for review and approval 30 days before the scheduled date that excavation is to begin. The Contractor shall not begin any excavation activities until the PPC has been approved by the Engineer. The Contractor shall implement the Engineer’s approved PPC Plan before beginning excavation.

The Contractor shall detail the methods, personnel, equipment, and reporting requirements on how to discharge regulated stormwater, groundwater, sediments, and free product during stormwater control, excavation, and dewatering operations into a dewatering basin, storm/sewer system, or other approved system. The PPC Plan shall specify the methods and equipment for collecting, pumping, treating, monitoring, and disposing of liquids generated by stormwater control. The PPC Plan shall specify the measures to prevent stormwater run-on and runoff and measures for dewatering of excavations, dewatering of sediments, decontaminating personnel and equipment, and storing fuels and chemicals. The PPC Plan shall include detailed water collection, treatment, monitoring, discharge activities, and reporting requirements. The PPC Plan shall provide daily construction reports to identify water collection, treatment, monitoring, and discharge activities; personnel and equipment; and relevant quantities. When dewatering in areas of petroleum contamination, provide an oil-water separator with the dewatering basin or sediment control tank. At least 10 days before beginning the work, the Contractor shall submit to the Engineer for approval a plan detailing the size, location, anticipated discharge flow and manufacturer’s catalog cuts of the oil-water

separator before installation. The Contractor shall dispose of oils and sediments collected in the oil-water separators as specified in Paragraph 213.03(E).

(2) Excavating.

The Contractor shall excavate the regulated material as specified in Subsection 202.03, and as shown on the Plans.

(3) Temporarily Storing.

The Contractor shall temporarily store the regulated or hazardous material in stockpiles within the project limits, and as shown on the Plans. The Contractor shall construct stockpiles on polyethylene sheeting. The Contractor shall contain stockpiles with haybales or silt fence placed continuously at the perimeter of the stockpiles. For hazardous material, if a stockpile area is not available within the project limits, the Contractor shall sample and analyze the materials in-situ for disposal. The Contractor shall excavate and place the hazardous material directly into trucks, and haul it directly to the approved disposal facility.

The Contractor shall cover the stockpiles with polyethylene sheeting. Secure the cover in place at all times. Overlap the joints in the polyethylene sheeting a minimum of 12 inches, and place securing materials along the joints. The Contractor shall maintain the cover, and replace damaged polyethylene sheeting as directed by the Engineer.

The Contractor shall clean the equipment used for the movement of excavated material at the end of each working day, or before removing it from the Contract limits. The Contractor shall install non-vegetative erosion control features to limit the movement of the excavated material from equipment cleaning areas. The Contractor shall temporarily store the excavated material from the equipment cleaning in stockpiles.

If regulated material is not designated for reuse on-site, the Contractor shall dispose of the regulated material within 180 days of being stockpiled, as specified in Paragraph 213.03(D).

The Contractor shall not reuse hazardous material. The Contractor shall dispose of hazardous material as specified in Paragraph 213.03(E) within 90 days of being stored in stockpiles.

(4) Sampling and Analysis.

The Contractor shall collect, transport, and analyze environmental samples required for facility acceptance of the material. The Contractor shall perform sampling, testing, and inspections conducted in areas containing regulated material according to the Site-Specific HASP.

The Contractor shall perform the sampling, testing, and data management procedures according to NJDEP Field Sampling Procedures Manual, NJDEP Technical Requirements for Site Remediation, NJDEP Management of Excavated Soils Guidelines, Appendix 1 of the NJDEP Waste Classification Form, and EPA requirements.

The Contractor shall not sample or analyze any part of the project limits for purposes of re-delineating designations of excavation.

(5) Document Control.

The Contractor shall provide the following items:

(a) Soil/Sediment Usage Tracking Log.

Complete a tracking log for each working day involving excavation, stockpile, transport, and disposal of regulated material. Monitor and record the following information on the tracking log:

(1) Date.

(2) Location maps showing excavation and placement, including depth, of material.

(3) Type, volume, and characteristics of regulated material removed.

(4) Names and signatures of personnel responsible for preparing and executing the tracking log.

The Contractor shall submit copies of daily tracking logs to the Engineer on a weekly basis.

(b) Materials and Handling Reports.

The Contractor shall submit weekly reports to the Engineer documenting the excavation, stockpiling, sampling, off-site management, and on-site placement of regulated material. The reports shall indicate the location and dates of excavation, stockpiling, sampling, off-site management, and on-site placement of regulated material. The report shall explain changes to or variations from the MHP. Additionally, the report shall include the dates of planned excavation, sampling, and off-site management of regulated material for the coming months.

The Contractor shall provide a final report documenting the management of regulated material, including the location and dates of excavation, stockpiling, sampling, off-site management, and on-site placement of regulated material. The final report shall include plans depicting placement of regulated material. The Contractor shall submit 4 copies of the final report to the Engineer within 30 days of completing excavations of regulated material, off-site management of regulated material, and embankment/backfill operations reusing regulated material.

(c) Sampling Logs and Analytical Reports.

The Contractor shall submit to the Engineer 2 copies of the sampling logs, chain of custody, and analytical reports after each soil analysis is performed within 10 days of analysis.

(d) Pollution Prevention and Control (PPC) Logs.

The Contractor shall maintain a PPC log for water collection, monitoring, and handling activities, and make the log available to the Engineer upon request. In the PPC log, note the daily water removal, treatment and discharge volumes, effluent sampling activities and results, discharge or spill incidents, and sampling and reporting activities.

(B) EXCAVATING ACID PRODUCING SOIL (APS).

The Authority, as the generator, is solely responsible for the designation of excavated material. Acid producing soil (APS) excavation consists of excavation and management of high acid producing soil, with a pH below 4.0 or soil containing iron sulfides. Areas of known APS are shown on the Plans. The Contractor shall dispose of APS as specified in 213.03(C).

(1) Pre-Excavation Plans.

The Contractor shall submit a Materials Handling Plan as specified in Paragraph 213.03(A).

(2) Excavating.

The Contractor shall excavate APS material as specified in Subsection 202.03, and as shown on the Plans.

(3) Temporarily Storing.

The Contractor shall temporarily store APS in separate stockpiles as specified in Paragraph 213.03(A) within the Contract limits, and as shown on the Plans. The Contractor shall construct stockpiles on polyethylene sheeting. The Contractor shall contain the stockpiles using silt fence, haybales, or other non-vegetative erosion control features to limit movement of soil and possible acidic runoff. Cover stockpiles with polyethylene sheeting. Secure and maintain the cover in place. Overlap joints in the polyethylene sheeting a minimum of 12 inches, and place securing materials along the joints. Maintain the cover, and replace damaged polyethylene sheeting as needed. Ensure that no stockpile is left uncovered and exposed to the air or precipitation for more than 8 hours to minimize oxidation.

The Contractor shall clean the equipment used for the movement of APS at the end of each working day and before removing it from the Contract limits to prevent the spreading of APS to other areas within the project limits, and to prevent tracking APS off-site. Install non-vegetative erosion control features around the equipment cleaning area to limit the movement of the APS and possible acidic runoff. Temporarily store the APS from equipment cleaning in the APS stockpile.

(4) Sampling and Analysis.

The Contractor shall test the stockpiled soil at a NJDEP certified laboratory for APS according to the *NJDEP Technical Manual for Stream Encroachment*. Within 10 days of stockpiling, The Contractor shall submit 3 copies of the test results to the Engineer.

The soil testing shall be performed at a NJDEP certified laboratory. The Contractor may set up a field laboratory, and if the results of the field testing are identical to the test result of the certified laboratory testing, field testing shall be a suitable substitute for certified laboratory testing.

(5) Acid Soil Remediation.

When reusing excavated APS as backfill or embankment in areas to be vegetated, the Contractor shall place the APS at the bottom. Remediate the soil by covering the APS with a layer of pulverized limestone applied at a rate of 6 tons per acre (or 275 pounds per 1,000 square feet) of surface area, and as follows:

(a) Where establishing turf, cover the limestone layer with a minimum of 12 inches of compacted soil with a pH of 5 or more.

(b) Where planting trees or shrubs, cover the limestone layer with a minimum of 24 inches of compacted soil with a pH of 5 or more.

(c) Do not place APS within 24 inches of a slope or bank surface (such as berms, stream banks, ditches, etc.) or structure to prevent the potential lateral leaching.

Immediately following remediation, the Contractor shall place topsoil, fertilizer, seed, and mulch over APS not under pavement for permanent erosion control. Dispose of excess APS as specified in 213.03(C).

(6) Document Control.

The Contractor shall perform document control as specified in 213.03(A), except that the PPC logs are not required.

(C) REUSE OR DISPOSAL OF EXCESS MATERIAL.

(1) Reuse.

The Contractor may use excavated APS or regulated material for backfilling, provided that the requirements specified in Subsection 902.01 are met for the construction of Embankment, Common. However, APS and regulated material shall not be used in lieu of clean excess excavated material from within the Contract limits. The Contractor shall submit written notification to the Engineer at least 15 days before reuse.

With approval, the Contractor may reuse excavated soil to widen or flatten slopes of embankment, to fade embankments into cuts, or as approved at other locations.

The Contractor may reuse broken concrete, HMA pieces, and millings in the lower portion of Embankment, Common in accordance with Subsection 203.03. Spread out pieces in layers, with the pieces lying flat and not arching, with spaces between the pieces filled with soil. Do not place the broken concrete, HMA pieces and milling within 2 feet of the final subgrade, less than 2 feet above the highest seasonal high ground water table or within 2 feet of any underground utility. Compact the material using the directed method as specified in Subsection 203.03.

Dispose of excavated APS or regulated material that will not be reused as specified in Paragraph 213.03(C).

(2) Disposal.

The Contractor shall dispose of excess regulated material as specified in Paragraph 213.03(D). Dispose of excess APS at approved landfills according to applicable Federal, State, and local laws, rules, and regulations. For excavation not designated as regulated material or APS, provide the following before removing the excess excavation from the Contract limits.

(a) At least 10 days before disposing, the Contractor shall submit the disposal procedure and location to the Engineer for approval. The Contractor shall not dispose of excavation on property proposed to be or used for parks, playgrounds, and other recreational purposes; educational facilities; environmentally sensitive areas such as wetlands; historic sites; or within sight of a State highway during all seasons.

(b) The Contractor shall obtain the property owner's notarized authorization of the acceptance of the excess material and where it is being placed.

Once material leaves the project limits, the Contractor is responsible for ensuring that the handling procedures, placement method, and disposal location are according to applicable Federal, State,

and local laws, rules, and requirements, including permits that may be issued for the Contract. If the disposal of excess material results in a violation notice from any governmental authority, the Contractor shall immediately correct the violation. The Contractor shall indemnify and defend the Authority for any violation incurred, penalty assessed, or any claims, suits, losses, demands or damages of whatever kind or nature arising out of, or claimed to arise out of, the improper disposal of excess materials.

If the Contractor does not correct the violation to the satisfaction of the governmental authority that issued the violation notice, the Contractor is responsible for assessed penalties including costs incurred by the Authority to remedy the violations.

The Contractor shall dispose of other material or debris in accordance with the Solid Waste Management Act (N.J.S.A. 13:1E-1) and N.J.A.C. 7:26 et seq., and according to the solid waste management plan developed by the solid waste management district of origin. The Contractor shall submit the proper documentation from the disposal facility to the Engineer, and the county of origin within 15 days of acceptance at the disposal facility.

(D) DISPOSAL OF REGULATED MATERIAL.

The contractor shall load, transport, and dispose of regulated material that the Engineer determines to be excess, unusable, or unsuitable for the Contract according to Federal, State, and local laws, rules, and regulations and as specified in 213.03(C). The Contractor shall pay all fees associated with removal and disposal of regulated materials.

The Contractor shall submit the results of material sampling and analysis, waste facility applications and acceptance documentation, and fee payment requirements to the Engineer at least 15 days before the planned removal of regulated material. The Contractor shall submit to the Engineer a bill of lading for each truckload of regulated material removed from the project limits. Ensure that the bill of lading and waste manifest include the following information:

(1) Transport subcontractor name, address, permit number, and telephone number.

(2) Type and quantity of material removed.

(3) Weight of vehicle with weigh slip.

(4) Recycling or disposal facility names, address, permit number, and telephone number.

(5) Date removed from the Contract limits.

(6) Signature of transport vehicle operator.

The Engineer will sign the bills of lading for the Authority as the generator of the Contract limits. The Contractor shall submit 1 copy of the bill of lading to the Engineer by the end of each working day that the transport vehicle leaves the site.

The licensed hauler shall transport the regulated material to the disposal/recycling facility with no unauthorized stops in between, except as required by the regulatory authority. The hauler shall use the appropriate vehicles and operating practices to prevent spillage or leakage from occurring during the transport. The Contractor shall remove excess soil adhering to the wheels or under carriage of the vehicles before leaving the Contract limits. If soil or water escapes to the public roads, the Contractor shall immediately clean the road to restore it to the original condition, and the Contractor shall immediately notify the Engineer. The Contractor shall not transport regulated material over public roads if they contain free liquid or are sufficiently wet to be potentially flowable during transport.

The Contractor shall submit 1 copy of the documentation of the disposal facility's acceptance of the regulated material, including the weight ticket slips, to the Engineer and the county of origin within 15 days of acceptance at the disposal facility.

The Contractor shall immediately submit written notification to the Engineer if problems arise, regarding the facility chosen to accept the regulated material for off-site management, that would require the return of waste, or if the chosen facility has violated any environmental regulation that may result in regulatory enforcement action. The Contractor shall propose an alternate disposal facility, and obtain the Engineer's written approval of off-site management at such facility.

(E) DISPOSAL OF REGULATED MATERIAL, HAZARDOUS.

The Contractor shall load, transport, and dispose of the hazardous regulated material for the Contract according to Federal, State, and local laws, rules, and regulations and as specified in 213.03(C). The Contractor shall pay all fees associated with removal and disposal of hazardous materials.

The Contractor shall submit the results of material sampling and analysis, waste facility applications and acceptance documentation, and fee payment requirements to the Engineer at least 15 days before planned removal of hazardous material. For each truckload of hazardous material removed from the Contract limits, the Contractor shall submit to the Engineer a bill of lading and waste manifest that include the following information:

(1) Transport subcontractor name, address, EPA ID number, and telephone number.

(2) Type and quantity of material removed.

(3) Weight of vehicle with weigh slip.

(4) Recycling or disposal facility name, address, permit number, and telephone number.

(5) Date removed from the Project Limits.

(6) Signature of transport vehicle operator.

(7) Waste manifest tracking number.

The Engineer will sign the manifest as the generator, and he will forward questions or concerns to the Bureau of Environmental Program Resources for resolution. The manifest will verify the type and quantity of hazardous material being transported off-site.

The Uniform Hazardous Waste Manifests are required by the Federal Resource Conservation and Recovery Act (RCRA) (40 CFR Subpart B Parts 262.20 to 262.23) and N.J.A.C 7:26G for all off-site shipments of hazardous materials. The Authority is the generator of the waste. The Authority will obtain an EPA Identification Number (EPA ID#) and supply this information to the Engineer for inclusion on the Uniform Hazardous Waste Manifest. The Engineer will provide the Contractor with an EPA ID# if the Project contains hazardous material.

The Contractor shall complete the manifest form in accordance with all applicable regulations and mail it to the Bureau of Environmental Program Resources at 951 Parkway Avenue, PO Box 600, Trenton, NJ 08625-0600 to ensure that the "final disposition" (TSD to Generator) copy of the manifest is mailed back to the office responsible for the record keeping requirements.

The Engineer will keep a copy of the original manifest for the Contract files. The Bureau of Environmental Program Resources will distribute the original manifests in accordance with the regulations and also for retention of the manifests per regulatory requirements.

The Contractor is responsible for all manifest discrepancies. The Contractor shall immediately report discrepancies to the Engineer and resolve the discrepancy to the satisfaction of the Engineer. The Engineer will forward a copy of manifest discrepancy letters to the Bureau of Environmental Program Resources.

The licensed hauler shall transport the hazardous material to the disposal/recycling facility with no unauthorized stops in between, except as required by the regulatory authorities. The hauler shall use the appropriate vehicles and operating practices to prevent spillage or leakage from occurring during transport. The Contractor shall remove excess soil adhering to the wheels or under carriage of the vehicles before leaving the Contract limits. If soil or water escapes to the public roads, the Contract shall immediately clean the road to restore it to the original condition, and the Contractor shall immediately notify the Engineer. The Contractor shall not transport hazardous regulated material over public roads if they contain free liquid or are sufficiently wet to be potentially flowable during transport.

The Contractor shall submit 1 copy of the documentation of the disposal facility's acceptance of the hazardous regulated material, including the weight ticket slips, to the Engineer and the county of origin within 15 days of acceptance at the disposal facility.

The Contractor shall immediately submit written notification to the Engineer if problems arise, regarding the facility chosen to accept the hazardous regulated material for off-site management, that would require the return of waste, or if the chosen facility has violated any environmental regulation

that may result in regulatory enforcement action. The Contractor shall propose an alternate disposal facility, and obtain the Engineer's written approval of off-site management at such facility.

213.04 Measurement.

Disposal of Acid Producing Soil, Disposal of Regulated Material and Disposal of Regulated Material, Hazardous will each be measured by the ton.

213.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
DISPOSAL OF ACID PRODUCING SOIL	TON
DISPOSAL OF REGULATED MATERIAL	TON
DISPOSAL OF REGULATED MATERIAL, HAZARDOUS	TON

No Separate payment will be made for pulverized limestone, but the cost thereof shall be included in the cost for the disposal of APS.

No separate payment will be made for polyethylene sheeting, but the cost thereof shall be included in the cost of the various disposal of regulated material pay items.

No separate payment will be made for the oil-water separator, but the cost thereof shall be included in the cost of the various disposal of regulated material pay items.

No separate payment will be made for the preparation of the Site-Specific HASP, MHP, PPC Plan or any other miscellaneous paperwork, but the cost thereof shall be included in the cost of the various disposal of regulated material pay items.

Payment for the various items related to soil erosion and sediment control will be made in accordance with Section 208.

Payment for soil stabilization matting will be made in accordance with Section 706.

SECTION 214– VIBRATION AND DISPLACEMENT MONITORING

214.01 Description.

This work shall include furnishing of labor, transportation, equipment, and materials required to perform monitoring of vibration and displacement of existing or proposed structures, pavements, railroads, earth slopes, utilities, phased construction elements, etc., or any other potential vulnerabilities within the project limits (henceforth referred to as "Features") within the Project as designated in the Plans, as identified by the Contractor's Vibration Specialist or as directed by the Engineer. This work shall include installing, protecting, and maintaining monitoring instrumentation throughout the duration of the Contract. This work shall also include the preparation of Preconstruction Inspection, Daily and Post Construction Inspection report(s).

214.02 Materials.

All vibration monitoring instruments shall be powered with rechargeable batteries or be connected to a permanent power supply. Where outside temperatures drop below 32 degrees Fahrenheit, the Contractor shall supply extension geophone and microphone cables such that the instruments can be placed within insulated enclosures.

(A) PHOTOGRAPHIC EQUIPMENT.

Photographic equipment shall be digital media based and capable of superimposing the date and time on all images or video recordings.

(B) SEISMOGRAPHS.

Seismograph(s) shall be as specified in Subsection 924.01 and shall be provided in the number and locations as indicated on the Plans. Seismographs shall include a built in tri-axial transducer, containing three high output, low distortion geophones located along orthogonal axes (vertical, longitudinal and

transverse) and must be capable of measuring and recording the peak particle velocities at the three axes of ground vibration. All seismographs proposed for use shall include a certificate of calibration, dated within the previous twelve (12) months of its anticipated use on the project. Certificate of calibration shall be directly traceable to the US Bureau of Standards. The seismographs shall have both a visual and paper (or electronic) readout. Where features of the project are to be monitored for greater than one year, the seismographs shall be recalibrated by the manufacturer(s) on an annual basis until the monitoring work is complete. Solid state devices may be calibrated on a less frequent basis where permitted by manufacturer recommendations and upon approval of the Engineer.

Micro-electromechanical System (MEMS) Accelerometer based vibration monitoring may also be utilized upon review and approval of the Engineer.

(C) DISPLACEMENT MONITORING EQUIPMENT.

The Contractor shall provide optical survey points, crack gages, biaxial tiltmeters, and inclinometers to monitor displacement or relative motion of Features as indicated on the Plans or as directed by the Engineer.

214.03 Methods Of Construction.

(A) QUALIFICATIONS.

The Contractor shall engage the services of a licensed Professional Engineer in the State of New Jersey to perform the vibration and displacement monitoring work (Vibration Specialist). Surveys shall be conducted by a Land Surveyor licensed in the State of New Jersey. The Vibration Specialist shall have a minimum demonstrated experience conducting similar work for three (3) projects of similar size and complexity in the previous five (5) years. All work shall be performed under the direct supervision of the Vibration Specialist.

(B) SHOP DRAWINGS.

The Contractor shall submit for approval the following as shop drawings in accordance with Subsection 104.08 of the Specifications. All submittals shall be submitted to the Engineer for review at least twenty (20) calendar days prior to commencement of any of the work described herein this specification.

(1) Qualifications.

Including the name and qualifications of the Vibration Specialist proposed to perform all vibration and displacement monitoring, inspections, and report work.

(2) Vibration and Displacement Monitoring Plan.

Including a list of all Features to be inspected and monitored within the project limits. The Contractor shall submit five (5) copies of the Vibration and Displacement Monitoring Plan to the Engineer for review, at least twenty (20) days prior to commencement of proposed construction activities. The Vibration and Displacement Monitoring Plan will include, at a minimum:

(a) Written assessment of the vibration susceptibility of all Features within a 100 foot zone or the monitoring limits as indicated on the Plans or recommended by the Vibration Specialist, whichever is greater. The Vibration Specialist shall also identify any Features which in his/her opinion, may be damaged by vibrations from the Contractor's construction activities

(b) Predicted construction vibrations at any locations identified either on the Plans or by the Vibration Specialist, including estimated damage threshold particle velocities.

(c) Location sketches depicting the location of the monitoring points and the proposed equipment to be used at each monitored Feature. The sketches shall be submitted on 11″x17″ plan sheets prepared on the Authority's standard drawing border and bearing the Vibration Specialist's name, address, registration number, and seal.

(d) Inspection schedule of all Features to be monitored with anticipated submission dates for the pre-construction inspection report, vibration and displacement monitoring and construction control report(s), and Post Construction Inspection Report.

(e) Proposed list of equipment to be used on the project including the number and type of seismographs and optical survey points per construction stage at the specified locations within the monitoring limits as defined in the Plans.

(f) Description of modifications to construction equipment or methods to prevent structural damage, as necessary.

(3) Pre-Construction Inspection Report.

Pre-Construction Inspection Report shall be in 8.5 inch x 11 inch format and shall include an index, the names and responsibilities of the inspection party, and 4 inch x 6 inch color prints of photographs with date, location and defect captions. Five (5) copies of the report shall be submitted to the Engineer for review at least twenty (20) calendar days prior to the commencement of any proposed construction activities in the project. This report shall at a minimum include the following:

(a) General description of the Features to be monitored, including the type of construction, and materials used.

(b) Photographs of the elements with close-ups of existing damage, if any.

(c) Detailed Written Notes indicating existing cracks, crack widths, crack lengths, displacements, and other evidence of existing damage or structural deficiencies.

(4) Daily reports.

Daily reports shall be furnished to the Engineer for review at the end of each day of the monitored construction activity. The report shall include the displacement data and equipment recording including the date and times. The daily report shall also include a summary of peak recorded daily values at each Feature monitored. A sample daily report shall be submitted to Engineer for approval prior to start of monitoring.

(5) Post Construction Inspection Report.

Post Construction Inspection Report shall include photographs, visual inspection report, and record of all measurements required to assess the post construction position and condition of the monitored Features. The Contractor shall submit for review, five copies of the report no later than twenty (20) calendar days after completion of each construction activity which generates vibration in the vicinity of the monitored Features. The post construction report shall be in the same format as the pre-construction report with the following additions:

(a) Summary of monitored features noting any changes or damage or the absence of change or damage to the monitored Features.

(b) Photographs taken at the same location and from the same distance and vantage point as those taken for the pre-construction report.

(c) Remedial Action proposed by the Contractor to be taken in the case of change or damage to the monitored Features with a discussion as to the cause of the change or damage.

(C) MONITORING REQUIREMENTS.

(1) Pre-Construction Inspection.

The Vibration Specialist shall inspect all Features within the monitoring limits of the vibration inducing construction activities set in the contract documents and shall tour the project limits and identify any additional Features which may be vulnerable to vibration damage. The Vibration Specialist shall take into consideration the energy imparted by anticipated vibration source(s), the soil conditions, and the condition of the existing and proposed Features when determining the radius of influence of the Contractor's activities. Minimum monitoring limit from a source of vibration shall be 100 feet. The Vibration Specialist shall take photographs, perform a visual inspection, note any existing damages, and take all measurements necessary to assess vibration susceptibility and to meet the minimum requirements of the Pre-Construction Inspection Report defined in Subparagraph 214.03(B)(3).

(2) Vibration and Displacement Monitoring.

The Vibration Specialist shall prepare a vibration and displacement monitoring and control program to assess the vibration susceptibility of Features in relation to predicted construction vibration levels, and determine which structures or utilities may be susceptible to vibration damage. The vibration monitoring program shall assess Features for suitability of velocity based monitoring criteria. If Features are more appropriately assessed by force based criteria, peak

accelerations shall be utilized in addition to peak particle velocity. Equipment capable of automated real time notification shall be utilized where indicated on the Plans.

The Vibration Specialist shall propose the displacement monitoring methods and instrumentation as a part of the Vibration and Displacement Monitoring Plan described in Subparagraph 214.03(B)(2). At a minimum, the use of optical survey points to monitor vertical and lateral displacements of identified Features supplemented by biaxial tiltmeters to measure rotation, crack gauges to monitor existing structural damage or deficiencies, or inclinometers to monitor soil prone to movement (i.e. mobilization of soil slopes) shall be utilized. Inclinometers and inclinometer casings shall be installed in accordance with the latest edition of ASTM D6230. Use of automated total station survey equipment with real time notification shall be utilized where indicated on the Plans.

The Contractor shall perform construction operations and vibration and displacement monitoring in accordance with the approved Vibration and Displacement Monitoring Plan. Changes to the plan must be approved by the Engineer prior to implementation. Displacement monitoring points including but not limited to optical survey points shall be monitored prior to and during the construction activities.

The Vibration Specialist shall interpret the collected data, which shall include making correlations between instrumentation data and specific construction activities. For specific instrumentation used for the protection of existing or proposed Features, the instrumentation data shall be evaluated to determine whether the response to construction activities is accurately captured or if additional monitoring instrumentation is required.

Threshold and limiting values for the approved instruments shall be proposed by the Vibration Specialist. These values shall be defined collectively as Response Values. Response Values are subject to adjustment by the Engineer as indicated by prevailing conditions or circumstances, however, the generally accepted safe limit for particle velocities on structures is as specified in Figure A. This value shall be reduced for existing structures noted in the Plans to be in 'satisfactory' or 'poor' condition. These limits are frequency dependent, and may vary by material and/or age of a structure.

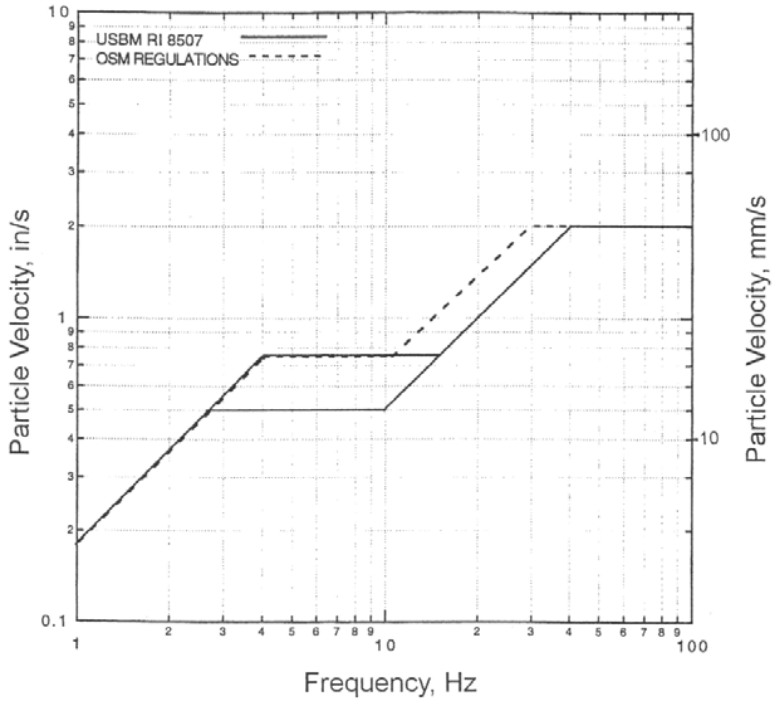

Figure A – USBM Vibration Criteria (after Siskind et al., 1980)

The figure provides a "threshold damage" limit, defined as cosmetic damage (e.g., cracking) within the structure, categorized by both frequency ranges and particle velocity

Threshold Values and Limiting Values for peak acceleration at Features shall be as indicated on the Plans. Threshold Values and Limiting Values for the deformation monitoring points shall be as indicated on the Plans for settlement and lateral movement.

If the Threshold Value is reached, the Contractor shall immediately stop work and contact the Engineer to discuss appropriate response actions required, if any, so that the Limiting Value is not exceeded. No work shall be performed within the project limits until such time as the Engineer has reviewed and approved the Contractor's proposed response action. The Vibration Specialist shall install additional instrumentation, as directed by the Engineer.

Damage due to vibrations created by the Contractor's construction activities is the sole responsibility of the Contractor and shall be repaired to the satisfaction of the Engineer or property owner. Any and all damage shall be repaired by the Contractor at no cost to the Authority.

214.04 Measurement.

Vibration and Displacement Monitoring will be measured for payment on a lump sum basis.

214.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
VIBRATION AND DISPLACEMENT MONITORING	LUMP SUM

Payment for Vibration and Displacement Monitoring will be made upon submission and acceptance of the Post-construction Inspection Report.

No separate payment will be made for furnishing of labor, materials, equipment, and incidentals necessary to fabricate, calibrate, test, furnish, install, maintain, and monitor the instrumentation, to remove instruments when no longer required, or for development and publication of any of the required submissions.

No separate payment will be made for any work required to repair existing facilities or structures damaged during the vibration inducing construction activities.

No separate payment will be made for additional work to prevent damage to Features or furnishing/installation/removal of additional monitoring equipment as directed by the Engineer where Threshold Values have been reached as described in Subparagraph 214.03(C)(2).

No separate payment will be made for any delays or stoppages of work where Threshold Values have been reached and the Engineer has directed the work be stopped. All costs resulting from delays or stoppages of work resulting from reaching or exceeding Threshold Values shall be at the sole expense of the Contractor.

SECTION 215 – GEOTECHNICAL INSTRUMENTATION AND MONITORING

215.01 Description.

This work shall include furnishing labor, transportation, equipment, materials, and incidentals necessary for installing and maintaining instrumentation required to observe ground movements and pore pressure levels during embankment, placement, preload and/or surcharge operations.

215.02 Responsibilities.

The responsibilities of the Contractor shall include, but not be limited to, the following:

(A) Furnish components of instrumentation that are to be installed during construction.

(B) Furnish portable readout units.

(C) Install and monitor all installed instrumentation. All initial readings shall be taken jointly with the Engineer.

(D) Perform and report the results of pre-installation and post installation measurements.

(E) Protect instruments from damage and maintain instruments installed, both by Contractor and existing instruments installed by others. Repair or replace damaged or inoperative instruments at no cost to the Authority.

(F) Coordinate with the Engineer to verify consistency of collected data.

215.03 Instruments.

No instrumentation installation shall take place before review by the Engineer of instrumentation submittals. The Contractor shall protect and maintain all instrumentation throughout the Contract, or until directed otherwise by the Engineer.

(A) Settlement platforms are surface displacement reference platforms placed on the prepared ground surface as shown on the Plans after grubbing and before placement of the sand blanket, common embankment, Embankment, Grade A, with or without any high strength geotextile/geogrid (if shown on plans) and before placement of the preload fill. A settlement platform consists of a square steel platform to which risers are attached. The riser(s) will be extended as the embankment, preload, and/or surcharge is placed to maintain the top of the settlement platform between 2 and 4 ft. above the average surrounding ground. Settlement platforms will be monitored by optical survey methods to determine vertical displacements occurring during and after embankment, preload and surcharge fill placement.

(B) Inclinometers consist of an inclinometer casing installed and grouted within vertical boreholes or horizontally in the in-situ soil materials. A probe inserted within the casing is used to monitor horizontal or vertical soil displacements occurring during construction. The inclinometer casings are extended as the fill is placed to maintain the top of the inclinometer casing between 2 and 4 ft. above the average surrounding ground.

(C) Vibrating wire piezometers consist of one or more vibrating wire pore pressure transducers placed in a borehole at designated depths to monitor changes in pore pressures within compressible soils during construction. A signal cable is extended to a readout terminal beyond the limits of all fill placement to facilitate readings.

(D) Control stakes consist of alignment and displacement reference stakes placed at the toe of fills where shown on plans, before placement of the fill. A control stake consists of a wood cross-marked with graduated vertical and lateral reference scales. Control stakes are monitored by optical survey methods to determine vertical and lateral displacements occurring during and after fill placement.

(E) Open standpipe piezometers consist of PVC riser pipes with slotted bottom sections embedded in a zone of granular (sand) filter medium. Open standpipe piezometers are installed within a vertical borehole to measure groundwater levels. The open standpipe piezometer riser pipe is extended as the fill is placed, to maintain the top of the open standpipe piezometer casing between 2 and 4 ft. above the average surrounding ground.

(F) Survey monitoring points shall be ¼-inch diameter expansion anchors installed in existing structures or objects and which are suitable for survey operation.

215.04 Instrument Monitoring.

Instrument monitoring is the reading and/or measuring of installed instruments at defined time intervals; calculating elevations, changes from initial elevations, lateral displacements, vertical displacements, and changes in pore pressure; and recording and plotting all instrument readings. Survey control consists of precise field measurements as specified herein, taken by qualified personnel using approved methods and equipment for accurately determining elevations, coordinates, and distances essential for the prosecution of this Section's work. The purpose of instrument monitoring is to accomplish some or all of the following:

(A) To provide baseline data for the Engineer prior to the commencement of Embankment construction,

(B) To provide reliable information for the Engineer to assess the fill performance and embankment stability, ground movements, and pore pressures resulting from Embankment construction.

(C) To permit timely implementation of proper remedial measures when and as required to prevent slope stability failures and/or damage to existing structures, roadways, equipment and utilities.

(D) To provide reliable information for the Engineer to determine the rate(s) of settlement and pore pressure dissipation and evaluate the performance of the Embankment construction.

(E) To permit the Engineer to evaluate the actual time period for which any surcharge, as indicated on the Plans, is required to achieve the desired degree of consolidation of the underlying compressible soil.

(F) To document ground movements and preload performance.

215.05 Quality Assurance.

(A) Reference Standards:

American Society for Testing Materials (ASTM)

ASTM A36	Carbon Structural Steel.
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
ASTM C109	Compressive Strength of Hydraulic Cement Mortars Using 50 millimeter Cube Specimens.
ASTM C827	Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
ASTM D1557	Laboratory Compaction Characteristics of Soil Using Modified Effort.
ASTM D1556	Density and Unit Weight of Soil in Place by the Sand Cone Method.
ASTM D1586	Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.
ASTM D1785	Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
ASTM D6230	Monitoring Ground Movement using Probe-Type Inclinometers.
ASTM D6598	Installing and Operating Settlement Platforms for Monitoring Vertical Deformations.

ASTM. Suggested Methods of Test for Identification of Soils. Submitted by D.M. Burmister. 1958 (Burmister Soil Classification System)

(B) Control of Materials:

(1) The Engineer reserves the right to approve each of the materials to be used in fulfilling the requirements of instrumentation work. Approval of the materials to be used for instrumentation shall not relieve the Contractor of the responsibility to provide instrumentation in accordance with these Specifications.

(2) The Engineer reserves the right to inspect, test and approve the workmanship of the instrumentation equipment and materials.

(3) A final quality assurance inspection shall be made by the manufacturer before shipment. During the inspection, a checklist shall be completed to indicate each inspection and test detail. A completed copy of the checklist shall be supplied with each instrument.

(C) Field Monitoring:

(1) The Engineer reserves the right to approve, disapprove, modify or change the method of installation and maintenance of monitoring devices. Approval of the method of installation and maintenance of monitoring devices shall not relieve the Contractor of the responsibility to install and maintain the instruments in conformance with the Specifications.

(2) The Engineer shall be notified of monitoring devices that become damaged or inoperable within 12 hours of the time the Contractor becomes aware of such conditions.

(3) Installation and monitoring of all settlement monitoring devices will be under the full time, on-site supervision of a geotechnical engineering consulting firm which has previous experience in supervising installation and monitoring of similar instrumentation devices. The firm and/or the individual who will actually be performing the field supervision for both installation and monitoring will be retained by the Contractor. The instrumentation personnel shall include a Supervising Engineer, who shall be a Professional Engineer registered in the State of New Jersey, with at least two years of direct field experience in the installation and monitoring of the types of instruments specified herein to supervise and be responsible for instrumentation installation. Responsibilities of the geotechnical engineering consulting firm shall include, but not be limited to the following:

(a) Prepare detailed step-by-step procedures and installation schedule for all instruments specified herein.

(b) Review and approve all data submittals.

(c) Be on-site and supervise the installation of each geotechnical monitoring instrument.

(d) Conduct each of the following tasks as applicable for each instrument specified herein: pre-installation acceptance tests, post-installation acceptance tests, field calibration, initial reading and data collection, and data reduction, processing, plotting, and reporting.

(4) The geotechnical engineering consulting firm shall assign a Supervising Engineer who will be in full-time, responsible charge on-site during all instrument installations, pre-installation acceptance tests, post-installation acceptance tests, field calibrations, and initial readings The Supervising Engineer shall have at least two years of direct field experience in the supervision of installation and monitoring of the types of instrumentation specified herein, and they shall have supervised instrumentation programs of similar magnitude in similar subsurface conditions. Up to one junior geotechnical engineer with a minimum of 2 years of instrumentation installation supervision and/or geotechnical boring inspection shall be allowed to monitor a second instrumentation installation crew, provided the geotechnical engineering firm's Supervising Engineer maintains sufficient oversight of the second installation crew via proxy. The Supervising Engineer shall be on-site to conduct the baseline readings and the first two readings of each instrument following the start of fill placement and, following a training period acceptable to the Engineer, the junior geotechnical engineer may continue to obtain such readings. All data reduction, processing, plotting, and reporting shall be performed by the Supervising Engineer.

(5) The person in responsible charge of the surveyors shall be a qualified land surveyor registered in the State of New Jersey, with a minimum of four years of experience in deformation measurements of the types and accuracies specified herein. The field survey party chief shall have a minimum of two years of experience in deformation survey measurements of the types and accuracies specified herein.

(6) The driller responsible for drilling instrumentation boreholes shall be licensed in the State of New Jersey, be on-site full-time during the drilling program, and have at least four years of direct field experience in drilling boreholes for the types of instruments specified herein.

(7) The Contractor's instrumentation personnel and surveyors, including the geotechnical instrumentation engineer, the superintendent, the driller, the field survey party chief and all other field and office personnel shall be subject to the approval of the Engineer. Resumes for all such personnel associated with the review, approval, calibration, installation, monitoring and/or remediation of any geotechnical monitoring instrument shall be supplied prior to their start of work on the project. No substitutions are allowed without prior notice to the Engineer including submission and subsequent approval of the replacement's resume.

(8) All survey monitoring points shall be monitored by optical survey method to determine vertical displacements, if any, occurring during construction.

(D) CALIBRATION:

A factory calibration shall be conducted on all instruments at the manufacturer's facility before shipment. Each factory calibration shall include a calibration curve with data points clearly indicated, and a tabulation of the data. Calibration sheets for each instrument shall be provided to the Engineer prior to installation. Each instrument shall be marked with a unique identification number.

(1) Factory calibrations of vibrating wire piezometers shall be made against a pressure gauge traceable to the National Institute of Standards and Technology. The accuracy of the pressure gauge shall not be less than twice the specified accuracy of the piezometers. Calibrations shall be made to full scale in two complete cycles, recording the reading in 10 equal increments during two loading and unloading cycles. The thermal factor of each piezometer shall be determined in a precision test chamber, at 32, 50, 68, and 86 degrees F. The calibration record shall include gauge factor, thermal factor, and zero reading with corresponding temperature and barometric pressure.

(2) Factory calibrations of inclinometers shall include comprehensive calibrations of the force balance accelerometers before assembly in the probe. A final calibration shall include measurements made at 18 degree intervals from minus 22 degrees to plus 86 degrees with respect to vertical, and a comprehensive repeatability check over a smaller zone near vertical.

215.06 Submittals.

(A) INSTRUMENTATION.

No instrumentation shall be delivered or installed on the site before review and approval by the Engineer of the materials, products and installation procedures. At least 30 calendar days before proceeding with the work, the Contractor shall submit to the Engineer for review the following:

(1) Schedule and Procedures: Proposed schedule and procedures for instrumentation installation and performance of initial reading monitoring for the instruments. Detailed step-by-step procedure for installation, together with a sample installation record sheet. The procedures shall be bound and indexed. The installation procedures shall include, but not be limited to:

(a) Drill casing type and size.

(b) Sample depths.

(c) The method to be used for cleaning the inside of casing.

(d) Depth increments for backfilling boreholes with sand and bentonite pellets.

(e) Method for overcoming buoyancy of instrumentation components during grouting.

(f) Method for sealing of joints in pipes and inclinometer casing to prevent ingress of grout.

(g) Detailed step-by-step procedures for conducting all optical survey measurements to obtain initial readings to the specified accuracy's, including types of surveying equipment, all as specified herein.

(h) Method and equipment for mixing and placing the grout.

(2) Product Data: Manufacturer's catalog cuts, shop drawings, material specifications, installation and maintenance instructions, and other data pertinent to the work of this Section.

(3) Within two workdays of receipt of each instrument at the site, the Contractor shall submit to the Engineer, copy of factory calibration, manufacturer's test equipment certification, and completed copy of quality assurance checklist.

(4) Grout Mix: Material specifications and mix design for grout required for inclinometer, piezometer and/or settlement indicator installations, as indicated on plans, along with verification from a certified testing laboratory that this mix is in accordance with the requirements specified. The information shall include specifications for proposed grout mixes, including commercial names, proportions of admixtures and water, mixing sequence, mixing methods and duration, pumping methods and tremie pipe type, size and quantity.

(5) Qualifications: Resumes for all supervisory personnel, technicians and drillers performing the instrumentation work.

(B) SHOP DRAWING.

(1) Survey Control Layout: Show survey bench marks and baselines. Show proposed location of benchmarks to permit surveying with sight distances less than 200 feet.

(2) Instrumentation Layout and Installation Details: Within two days of installing each instrument, the Contractor shall submit an installation record sheet, including the appropriate items from the following list.

(a) Project name.

(b) Contract name and number.

(c) Instrument type and number including readout unit.

(d) Planned location in horizontal position and elevation.

(e) Planned orientation.

(f) Planned lengths and volumes of backfill.

(g) Personnel responsible for installation.

(h) Plant and equipment used including diameter and depth of any drill casing or augers used.

(i) Date and time of start and completion of installation.

(j) Spaces on record sheet for necessary measurements or readings required at hold-points during installation to ensure that all previous steps have been followed correctly including instrument readings made during installation.

(k) A log of subsurface data indicating the elevations of strata changes encountered in the borehole. Soil strata nomenclature shall conform to the Burmister Classification System.

(l) Type(s) and depth(s) of backfill used to fill instrumentation boreholes.

(m) As-built location in horizontal position, adjacent ground elevation, top of instrument elevation for settlement platform risers, center of instrument elevation for piezometers, and bottom of borehole elevation.

(n) As-built orientation.

(o) Result of post-installation acceptance test.

(p) Weather conditions at the time of installation.

(q) Notes of importance on the installation including problems encountered, delays, unusual features of the installation, and details of any events that may have a bearing on instrument behavior.

215.07 Job Conditions.

(A) PROTECTION.

Protect from damage due to construction operations, weather, traffic, and vandalism, survey reference and control points, instruments and appurtenant fixtures, instrument leads, connections, and other components of the instrumentation systems. Replace any monitoring probes, cables, or readout units that may be damaged or, in the opinion of the Engineer, are not functioning properly or consistently.

(B) SCHEDULING.

Except where otherwise specified, maintain access to instruments. Temporary stoppage or interruption of certain portions of the work may be required to enable the geotechnical engineering consulting firm to monitor, take readings and or remediate instrumentation. The geotechnical engineering consulting firm will perform such monitoring and measurement in a manner not to delay the work unnecessarily. The Contractor's schedule shall include time for such monitoring and measuring, and shall allow for remediation/reinstallation of replacement instruments in the event of damage or inoperability, due to any cause whatsoever.

(C) ENGINEER'S JUDGMENT.

When in the Engineer's judgment, the instrumentation data indicate potentially damaging ground displacements the Contractor shall modify the construction rate and sequence as directed by the Engineer, at no additional cost to the Authority, and take other action as approved by the Engineer to reduce further excess ground displacements to an amount acceptable to the Engineer.

215.08 Materials.

(A) The Contractor shall provide products, materials, and equipment in conformance with the Plans and Specifications so as to fulfill the requirements of this Section.

(B) Whenever any product is specified by brand name and model number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the product desired. The term "or approved equal" shall be understood to indicate that the "approved equal" product is the same or better than the product named in the Specifications in function, performance, reliability, durability, quality, accuracy, and general configuration. This procedure is not to be construed as eliminating from use other suitable products of equal quality by other manufacturers. In such cases, the Contractor may submit complete comparative data to the Engineer for consideration of another product. Substitute products shall not be used in the work unless accepted in writing by the Engineer. The Engineer will be the sole judge of the suitability and equivalency of the proposed substitute product.

(C) Any request from the Contractor for consideration of a substitution shall clearly state the nature and amount of any deviation(s) from the product specified.

(D) For each instrument type, provide an instruction manual which shall include the following:

(1) A description of the purpose of the instrument.

(2) Theory of operation.

(3) Step-by-step procedures for:

(a) Pre-installation acceptance test when instruments are received on site, to ensure the instruments are functioning correctly before installation.

(b) Calibration of readout units.

(4) A list of calibration equipment required, and recommended frequency of calibration, for inclinometers only.

(5) Step-by-step instrument installation procedure including materials, tools, spare parts and any borehole requirements, and post-installation acceptance tests.

(6) Maintenance procedures.

(7) Step-by-step data collection procedures.

(8) Data reduction, processing, and plotting procedures.

(E) All graduations shall be in English Units

(1) Settlement Platforms

(a) The telltale pipe shall be standard weight (Schedule 40) carbon steel meeting ASTM A53, Grade B standards.

(b) Base plate shall be steel conforming to the requirements of ASTM A-36.

(c) Sand base and sand fill shall be Embankment, Grade A conforming to Section 901 of Standard Specifications.

(2) Inclinometers

(a) Provide inclinometer casing, probe, control cable, readout unit, and accessories.

(b) Inclinometer Casing: ABS plastic in 10 feet lengths and with adequate wall thickness to withstand external ground pressures but with flexibility enough to reflect horizontal ground movement. The casings shall have four broached internal keyways equally spaced 90 degrees apart, with twist-tolerance better than one degree per 10 feet of length, and shall be compatible with other components of the inclinometer.

(c) Bottom Caps: ABS semi-rigid plastic to form a watertight seal and to prevent dirt from entering the casing.

(d) Special Sealing Grout: Portland cement, bentonite, and water as specified in Subsection 6 below.

(e) Inclinometer Probe: Probe shall be suited for vertical inclinometers and or horizontal inclinometers as required. Probe shall be supplied in a carrying case. Probe shall be biaxial consisting of two force balance accelerometers mounted at 90 degrees, with a 20 inches wheelbase.

(f) Control Cable: The control cable shall be compatible with sensor and readout unit, 150 feet long (or less as approved by Engineer).

(g) Inclinometer Readout Unit: Readout unit shall be capable of stabilizing to within plus or minus one unit of display within eight seconds between recordings 2 feet apart.

(h) Pulley Assembly: The pulley assembly shall be directly mountable to the inclinometer casing and shall have a control cable hold.

(i) Pull Cable: A stainless steel pull cable shall be installed at each horizontal inclinometer to pull the probe to the far end of the casing.

(j) Dead-End Pulley: When the far end of the casing is closed in a horizontal inclinometer, a dead-end pulley and cable return pile shall be installed to operate the pull cable. Dead-end pulley is optional when both ends are open.

(3) Vibrating Wire Piezometers

(a) Vibrating Wire Pressure Transducer: Vibrating wire piezometers shall be new and obtained from an approved manufacturer as specified in Subsection 924.02.

(b) Vibrating wire piezometers shall have a pressure range of 50 psi, an over-range rating of twice the rated pressure, plus or minus 0.2 percent full scale accuracy, 0.025 percent full scale resolution, and be fitted with a low air entry filter.

(c) Electrical Cable and Splice Kit: Electrical cable for individual piezometers. Each cable shall be attached to the appropriate piezometer and permanently marked with the number of the instrument to which it is attached. Cable shall be attached to the piezometer through an integral bulk head seal consisting of an interior waterstop seal and a cable entry seal. Seals shall be either o-rings or hermetic seals.

(d) Protective conduit: Conduit for protection of buried electrical cables shall be 4 inches diameter corrugated polyethylene pipe, as specified in Subsection 924.03

(e) Special Sealing Grout: Portland cement, bentonite, and water as specified in Subsection 6 below.

(f) Readout Station: Each readout station shall consist of a lockable readout terminal box raised above ground on a pedestal, pole or other suitable rigid support. The readout terminal box shall be aluminum or other approved non-corroding material and shall contain a switch type panel for selecting the output of up to twelve (12) vibrating wire piezometers plus one "dummy" piezometer. A surge protector board shall be provided for each vibrating wire piezometer and shall be installed in the terminal box. Terminal boxes shall have sufficient opening at the bottom to allow for entry of all instrument cables and ground wire. A ground cable shall be attached to the top of a 10 feet long 0.55 inch diameter copper clad ground installation rod installed near the base support for the terminal box.

(g) Surge protector: The surge protector board shall be adequately sized for the accepted system.

(h) Filter Sand: Filter sand shall be Standard Ottawa sand, as defined by ASTM D 1556.

(i) Bentonite Pellet Seal: Pelletized bentonite shall have an approved water-soluble coating for forming a seal above the piezometer filter sand and canvas bag. The Contractor shall demonstrate that the bentonite pellets are compatible with the in situ groundwater for hydrating, and shall be subject to approval by the Engineer.

(4) Control Stakes

(a) The vertical post of the control stake shall be sound untreated Number 2 southern pine, and shall be painted at the bottom. The horizontal and vertical cross members shall be sound untreated Number 2 southern pine, dressed at least on one face. The dressed face shall be painted white. The face painted white shall also have black markings as shown on the Plans. The members shall be spiked together as shown on the Plans.

(5) Open standpipe piezometers

(a) Riser Pipe: Riser pipe shall consist of 2.0 inch inside diameter Schedule 40 rigid PVC pipe conforming to ASTM D 1785. Riser pipe shall be clean, straight, and free of obstructions. Pipe sections shall be joined by watertight, flush threaded couplings to ensure straight, water tight and unobstructed inside diameter.

(b) Slotted PVC Well Screen Pipe: Slotted PVC well screens shall consist of 2 inch inside diameter Schedule 40 PVC pipe conforming to ASTM D 1785 fitted with machine cut slot openings of 0.01 inch. The slots shall be arranged in three rows and the spacing between the individual slots measured along the pipe shall not exceed 6 millimeter. The well screen shall be joined to the riser pipe with watertight, flush threaded couplings. Alternate screens shall be allowed provided they have a minimum 2 inch inside diameter.

(c) Filter Sand: Filter sand shall be clean, unweathered, durable, natural (non-crushed), uniform sand. The sand shall be washed and graded such that 90 percent or more will be retained by the slotted well screen. Filter sand that is contaminated with soil, organic debris, or other deleterious materials shall not be used. The Contractor shall provide the Engineer with a grain size analysis from the manufacturer or other testing laboratory of the proposed material for approval before use.

(d) Bentonite Pellet Seal: Use pelletized bentonite with an approved water soluble coating for forming a seal above the well screen

(e) Special Grout: Portland cement, bentonite, and water as specified in Subsection 6 below.

(f) Water Level Meter: Water level meter shall be model No. 101 as manufactured by Solinst Canada Ltd., or approved equal.

(g) Protective standpipe shall be 4 or 6 inch diameter (as required) Schedule 40 steel pipe. The exposed casing shall be painted day-glo orange. Locking covers shall be provided. All locks shall be keyed alike.

(6) Cementations Materials

(a) Special Grout Mix: The special grout required for installation of instrumentation shall be a cement-bentonite material that is non-shrink and non-metallic. The special grout shall not contain calcium chloride or other salts, or aluminum or other harmful metals. When tested in accordance with ASTM C827, the material shall show no shrinkage in the plastic state. For soft soils (SPT N≤4), when tested in accordance with ASTM C109, the special grout mix shall have a 7 day strength of no less than 2 psi and a 28 day strength of approx. 4 psi as measured on 2 inches cubes. For harder soils (SPT N>4) and/or rock, the special grout mix shall have a 7 day strength of no less than 70 psi and a 28 day strength of approx. 100 psi.

(b) Lean Concrete: The concrete required for installation of protective terminal boxes shall have a minimum compressive strength of 500 psi.

(7) Terminal Boxes and Covers

(a) For all instruments except vibrating wire piezometers and inclinometers, surface protection shall consist of a roadway box with matching lock-lid cover as specified in Subsection 924.04. Roadway boxes for inclinometers shall either have a diameter adequate to allow attachment of cable support assembly or shall allow for attachment of an inclinometer casing extension while readings are being taken.

(8) Survey monitoring point

(a) Points shall be a ¼-inch diameter expansion anchor, consisting of an outer lead alloy sleeve, an inner lead alloy wedge nut, and a one-inch long, ¼-inch, 20 stainless steel hexagonal head bolt positioned to receive survey level rod on edge of head or a similar configuration approved by the Engineer. A detail of the proposed survey monitoring point shall be submitted for approval.

215.09 Methods of Construction.

Embankment, Grade A placement, vertical wick drain installation, embankment fill placement, retaining wall construction, and any other modification to the existing ground shall not take place until geotechnical instrumentation installation has been completed and approved by the Engineer and baseline readings taken for each instrument.

(A) PRE-INSTALLATION ACCEPTANCE TESTS.

(1) When instruments are received at the site, the Contractor's instrumentation personnel and geotechnical engineering consulting firm shall perform pre-installation acceptance tests to ensure that the instruments and readout units are functioning correctly before installation. Pre-installation acceptance tests shall include relevant items from the following list.

(a) Check that the model, dimensions, materials, etc. are correct.

(b) Check that quantities received correspond to quantities ordered.

(c) Check all components for signs of damage in transit.

(d) Examine factory calibration curve and tabulated data to verify conformance with this Section and completeness.

(e) Examine manufacturer's final quality assurance inspection checklist to verify completeness.

(f) Check cable length.

(g) Check that tag numbers match on instrument/cable sets

(h) At point of connection to instrument, bend cable back and forth while reading the instrument to verify connection integrity.

(i) Perform resistance and insulation testing in accordance with manufacturer's recommendations using a gauge insulation or circuit tester that applies no more than two volts.

(j) Verify that all components fit together in the correct configuration.

(k) During pre-installation acceptance testing of each instrument, the Contractor's instrumentation personnel shall complete a pre-installation acceptance test record form.

(l) Any instrument that fails the specified pre-installation acceptance test shall be repaired such that it passes a subsequent pre-installation acceptance test, or it shall be replaced by a new instrument at no additional cost to the Authority.

(B) GENERAL.

(1) All instrumentation shall be furnished and installed at the locations and in accordance with the details shown on the Plans, and in accordance with the requirements of these Specifications, or as directed by the Engineer.

(2) The Contractor shall notify the Engineer at least 10 working days prior to installing each instrument.

(3) Instrumentation shall include maintaining instrumentation throughout the Contract, or until directed by the Engineer that readings may cease. This shall include, but shall not be limited to the raising and lowering of settlement platform risers, inclinometers and open standpipe piezometer risers, as required, to enable access to and measurement of monitoring instruments from the top of the fill. Locations where instrumentation protrudes through the fill or extends out beyond the toe of the fill shall be barricaded and clearly flagged with brightly colored flagging. Barricading shall consist of nominal 2 in. x 4 in. lumber risers and horizontals, extending a minimum of 4 feet above ground, or other methods approved by the Engineer. The barricades shall be placed at least 2 feet in all directions from monitoring devices. Each barricade shall be flagged so it's highly visible to equipment operators and others. The Contractor shall maintain barricades and flagging throughout the period of the Contract, or until the Engineer determines the instrumentation may be abandoned and removed.

(4) Installation procedures for instruments in boreholes shall be such that all steps in the procedure can be verified and recorded during installation and reviewed by the Engineer. Volumes of each increment of backfilling with sand and bentonite shall be small enough such that no bridging occurs, and the depth to the top of each increment shall be checked and recorded after placement.

(5) Specifications and Plans refer to depth of boreholes for inclinometers. Minimum depths are specified and estimated bottom elevations are shown on the Plans. Boreholes shall be drilled to the specified minimum depths into dense sand or bedrock, or to the specified bottom elevations, whichever are deeper.

(6) Whenever withdrawing drill casing during instrument installation in a borehole, care should be taken to minimize the length of unsupported borehole and the rate of drill casing withdrawal. Collapse of the borehole shall not be allowed to occur. Backfill material shall not be allowed to build up inside the drill casing, such that the instrument is lifted as the casing is withdrawn. The drill casing shall be withdrawn without rotation.

(7) Specimens of grout shall be obtained from each batch of grout mix prepared for instrument installation for testing by a certified laboratory to verify that the 28 day compressive strength of the batch is as specified. Specimens shall either be 2 inches cubes or cylindrical specimens with a diameter of 3 inches and a length of 6 inches, or as approved by the Engineer. One specimen shall be taken immediately before initial placement of each batch of grout in the ground (the "initial"

specimen) and another specimen (the "final" specimen) shall be recovered after at least two-thirds of the batch has been placed or at the completion of grouting if less than two-thirds of the batch has been used. The Engineer may order additional ("intermediate") specimens be prepared following delays or stoppage of the work, or at other times as deemed necessary. Each specimen shall be labeled with the time and date at which it was prepared and whether it is an initial, final, or intermediate specimen.

(8) An instrument that fails the specified post-installation acceptance test shall be replaced by an identical instrument at no additional cost to the Authority.

(9) Initial readings shall be taken daily at approximately the same time for 3 successive days following installation to establish baseline readings.

(10) All readings of geotechnical instrumentation monitoring devices shall be transmitted to the Engineer by noon of the following day for each reading to allow for review on a daily basis.

(11) Damaged instrumentation that has not already been abandoned and is still needed shall be repaired or replaced with identical instrumentation, to the satisfaction of the Engineer and at no expense to the Authority. All earthwork operations within a specified distance shall cease until the damaged instrumentation is repaired or replaced. The Engineer shall make the sole determination as to the specified distance to which earthwork will cease. The repair or replacement shall occur within one week of notification of damage by the Engineer, unless otherwise specified.

(C) SETTLEMENT PLATFORMS.

(1) Settlement platforms shall be fabricated and installed as shown on the Plans and Details.

(2) Settlement platforms shall be placed on a sand base. After filling in any depressions and grading the platform subgrade. The sand base shall be tamped using a vibratory smooth-plate tamper to provide a firm, unyielding and level bearing surface for the settlement platform. The compacted surface shall not be more than 1/8 inch per foot from level in all directions. For settlement platforms placed on or near original ground, all vegetation shall be stripped and a minimum of 6 in. of Embankment, Grade A shall be constructed to provide a level base for the settlement platform. For settlement platforms placed atop a sand blanket, install the settlement platform after installing the vertical wick drains by leveling the sand blanket. The vertical pipes shall have a maximum length of 4 feet for each section. Centralizers shall be provided between the riser pipe and casing pipes at maximum intervals of 4 feet to ensure verticality. A container, as shown on the plans, shall be placed around the initial length of casing pipe to the edges of the platform. This container shall be backfilled with tamped clean sand or gravel to support the pipe in a vertical position during fill placement until the fill is carried above the platform as shown on the plans.

(3) The fill surrounding the settlement platform riser shall be placed in a controlled manner so as to prevent damaging or moving the riser pipe. The outer protective casing shall not be more than 1/8 inch per foot from vertical in all directions at all times while placing the surrounding fill. The verticality of the outer casing shall be checked periodically while placing the fill to assure this result.

(4) As the height of fill above the settlement platform changes, the casing and riser shall be increased or decreased in maximum 4 feet increments to maintain the top of the pipe and casing above the embankment. As each additional length of pipe is added or removed, the pipe cap on the casing shall be immediately transferred to the top section on the settlement platform to prevent fill material from entering the casing.

(5) If rock is used as embankment material, all rock backfill shall be kept at least 5 feet away from the settlement platform, with sufficient soil backfill placed evenly around the settlement platform in advance of placing rock backfill, to prevent disturbance or damage to the platform.

(6) Each settlement platform shall be marked with barricades as described above. Additionally, the casing pipe shall be painted Day-Glo orange or yellow. The Contractor shall maintain the paint during the Contract.

(7) The Contractor and/or the Engineer shall jointly take the initial settlement platform readings immediately after the settlement platform is installed, and before any fill is placed. The Contractor will survey the position and elevation of the settlement platform risers at least twice per week until one month after completion of placement of the embankment fill or surcharge, whichever is later, and then at least once every week until the surcharge is removed.

(8) The settlement platform risers shall at no time rise above 4 feet over the surrounding ground surface elevation. Sections shall be added or removed as necessary during filling or removal of fill to maintain the tops of the pipes at least 2 feet above the surface of the fill.

(9) The settlement platform risers shall be surveyed by the Contractor immediately before and after additional extensions are added or removed. The Contractor shall notify the Engineer at least two working days before extension or removal of the settlement platform risers.

(10) Upon completion of final readings, and once the Engineer has determined a settlement platform may be abandoned, the platform shall be cut off at an elevation determined by the Engineer and disposed of, and the remaining settlement platform shall be left in place.

(D) INCLINOMETERS.

(1) Install inclinometer casing as shown on the Plans, as approved by the Engineer, and according to the manufacturer's recommendations. Inclinometer(s) shall be installed within a cased borehole having a minimum diameter of 6 in. Inclinometers shall be installed before any earthwork begins. The Engineer reserves the right to modify the locations, number, and depth of the instrument(s) based on the materials encountered in the boreholes during installation. The bottom 10 feet of the inclinometer shall be installed within a stratum that will provide fixity, such as dense sand.

(2) Three split spoon samples shall be taken of the material assumed to provide base fixity, one at the bottom of the borehole, others at 5 feet and 10 feet above the bottom of the borehole, and submitted to the Engineer before installation of the instrument.

(3) Install vertical inclinometer casing to the depths specified, or as directed by the Engineer, in a minimum 6 inch diameter borehole. The boring shall be advanced and cleaned by rotary wash boring methods. Stabilize the borehole with temporary drilling casing as the borehole is advanced. The inclinometer casing shall be installed within one degree of proposed orientation for the entire length. After installation, the casing groove spiral shall not exceed one degree per 10 feet of length and the orientation of the grooves at the top of the casing shall be within ten degrees of the planned orientation.

(4) Assemble additional sections of inclinometer casing using appropriate watertight couplings, and lower them into the hole. Fully extend telescoping casing sections and ensure that seals are watertight.

(5) Add clean water to inside of inclinometer casing to facilitate lowering inclinometer through water or drilling mud in the borehole and minimize floatation of casing

(6) Position vertical inclinometer casing so that the orthogonal grooves are parallel and perpendicular to the centerline of the embankment, or as directed by the Engineer. Position the horizontal inclinometer casing with one pair of grooves oriented vertically. If the grooves are not aligned correctly, remove and reinstall the casing to re-align. Do not rotate the casing to re-align, as this may result in spiraling of the casing.

(7) Grout annulus between inclinometer casing and borehole with special grout mix proportioned to match the strength of the formation, and as approved by the Engineer. Place grout with a detachable, flexible tremie pipe or grout pipe attached to the bottom of the inclinometer casing. Ensure an intimate soil/grout contact. Recover grout specimens for testing, as required, from the return flow of clean grout with proper consistency.

(8) Immediately after grouting, jet and flush inclinometer casing with clean water.

(9) Install horizontal inclinometer casing to the depths specified or as directed by the Engineer, on a minimum 18 inches wide and 6 inches thick layer of Embankment, Grade A material.

(10) For horizontal inclinometer installation, install dead-end pulley and cable return pipe, if required, at the "inaccessible" end of the inclinometer pipe.

(11) Place, without solvent cement, protective cap on the "accessible" end of the horizontal inclinometer casing.

(12) Casing groove orientation shall be maintained throughout installation.

(13) After completion of installation, but before the grout, if used, has set, a post-installation acceptance (probe passage) test shall be performed to verify there is no grout in the inclinometer casing, that

groove orientation is correct, and that the inclinometer probe tracks correctly in all four orientations. After the grout has set, a check shall again be made to verify that the inclinometer probe tracks correctly in all four orientations.

(14) Install protective terminal box with locking cover over the top or "accessible" end of the inclinometer casing. Lock the cover.

(15) Each inclinometer installation shall be marked with barricades as described above.

(16) The Contractor's geotechnical engineering consultant and/or the Engineer shall jointly take the initial inclinometer readings immediately after the inclinometer is installed, and before any fill is placed. The Contractor's geotechnical engineering consultant will take readings at least once a week thereafter for the duration of the Contract.

(17) The Contractor is responsible for protecting and maintaining the inclinometers in working order during the period of this Contract. This includes adding or removing inclinometer casing sections, as necessary, to maintain the top of the inclinometer casing between 1 ft and 4 feet above the surface of the surrounding ground.

(18) Upon completion of final readings, and once the Engineer has determined an inclinometer may be abandoned, the inclinometer casing shall be filled with special sealing grout, installed from the bottom up using a tremie pipe. The casing shall then be cut off at an elevation or location determined by the Engineer and disposed of, and the remaining inclinometer shall be left in place.

(E) VIBRATING WIRE PIEZOMETERS.

(1) The Contractor shall furnish and install vibrating wire piezometers as specified herein and as shown on the Plans. The piezometers shall be installed at the locations and sensor elevations indicated on the Plans. The piezometers shall be installed, and piezometer readings shall stabilize, before any earthwork commences. The Engineer reserves the right to modify the locations and sensor elevations based on the materials encountered in the boreholes during installation. The piezometer sensor shall be located within the compressible stratum, as determined by the Engineer.

(2) The piezometer shall be installed within a cased borehole having a minimum diameter of 4 in., or as recommended by the manufacturer, whichever is greater. The borehole shall be advanced using rotary drilling methods with temporary casing and using water as the drilling fluid. The use of drilling mud will not be permitted. The casing shall be installed to a depth of 5 feet above the sensor elevation shown on the Plans, or as directed by the Engineer. The casing shall be advanced 6 feet by driving while kept full of water.

(3) Continuous split spoon samples shall then be obtained for the final 6 feet (to the bottom of the casing). Each soil sample shall be field identified according to D.M. Burmister, and representative samples stored and labeled in minimum 8 ounce glass jars and submitted to the Engineer or the Contractor's geotechnical engineering consulting firm before installation of the instrument to confirm that the sensor will be installed within the compressible soil stratum. The soil within the casing shall then be washed out using clean water and a side discharge bit. Drilling below the casing shall not be allowed.

(4) Before placing the piezometers in the hole, a 1 foot layer of filter sand shall be placed in the bottom of the hole, the casing raised 1 foot, and additional filter sand added to maintain the 1 foot thickness. Provide a measuring device approved by the Engineer to check that the required filter sand level is achieved.

(5) Take zero pressure transducer and temperature sensor readings in a controlled temperature environment prior to taking instrument into the field. Once in field, allow calibration instrument to thermally stabilize for at least 10 minutes prior to taking reading. Take barometric pressure reading and compare to reading of piezometer when held in air. Record all readings.

(6) Piezometers shall be saturated before placement in the hole and saturation shall be maintained throughout installation.

(7) Lower the piezometer sensor and cable assembly to top of filter sand in the borehole. Alternatively, the piezometer may be placed in a cloth bag then the cloth bag filled with sand filter material and tied. The piezometer in cloth bag is then lowered into the borehole. As the piezometer is lowered into the hole, readings shall be taken to confirm the equipment accuracy.

After insertion of the piezometer on top of the sand layer, check to ensure that the piezometer reading agrees with the water head. Record the elevation of the diaphragm.

(8) Fill the borehole with filter sand to 1 foot above the top of the sensor. Measure the depth to the top of the sand in the borehole for verification. The casing shall then be raised to a level of 1 foot above the final elevation of the top of the piezometer sensor. Refill the annulus between the piezometer assembly and the wall of the hole with filter sand to maintain a height of 1 foot above the top of the piezometer sensor.

(9) Place coated bentonite pellets in the hole and tamp in place with the cylindrical sounding hammer to produce a bentonite seal a minimum of 3 feet thick above the top of the filter sand. The pellets shall be placed in layers, taking care not to form a plug within the casing bottom. The length of the seal shall be checked with a cylindrical sounding hammer.

(10) Partially withdraw the casing in increments after placing each layer of coated bentonite pellets to avoid lifting the bentonite seal.

(11) Fill the remainder of the hole with special grout from the bottom up.

(12) Remove remainder of casing, keeping the grout level within 5 feet of the ground surface at all times.

(13) No vertical movement of the piezometer is allowed as the casing is withdrawn. A lockable, steel protective standpipe shall be installed upon completion of piezometer installation.

(14) Record the volume of grout and collect samples of grout for testing, as specified.

(15) Take initial piezometer readings following installation.

(16) Take and record subsequent piezometer readings following installation until readings stabilize.

(17) Cables from the piezometers shall be routed to the toe of the embankment or outside the limits of retained fill, or as directed by the Engineer.

(18) The cable shall be installed in the conduits leaving sufficient slack within the conduit to prevent the cable from tensioning as a result of settlement

(19) After the cable has been installed in the conduit, and the Contractor's geotechnical consulting engineer and the Engineer have verified that the instrument is functioning properly, the trench shall be backfilled using the excavated material.

(20) A readout station consisting of a readout terminal box supported a minimum of 3 feet above grade, shall be provided at the location of each vibrating wire piezometer array, or group of nearby arrays. The station shall be located so as not to interfere with construction activities and shall be barricaded as described above under General.

(21) The support for the readout terminal box shall be rigid. Both the exterior of the terminal box and the support shall he painted Day-Glo orange or yellow.

(22) The ends of the piezometer cables shall be routed into the readout terminal box and attached as per the manufacturer's recommendations. Label all cables of vibrating wire piezometers. Instrument designation number shall appear on each instrument sensor and at the manual readout terminal to which each cable is connected.

(23) Grounding shall be provided by installing a grounding rod into the ground next to the readout station, and connecting to the rod with a grounding wire.

(24) After completion of installation, a post-installation acceptance test shall be performed to verify that all piezometers function correctly.

(25) The Contractor's geotechnical engineering consultant and/or the Engineer shall jointly take the initial piezometer readings immediately after the piezometer is installed, and before any fill is placed. The Contractor’s geotechnical engineering consultant will then take the remainder of the baseline readings and additional readings at least once a week thereafter for the duration of the Contract.

(26) The Contractor is responsible for protecting and maintaining the piezometer(s) in working order during the period of this Contract.

(27) Upon completion of final readings, and once the Engineer has determined a vibrating wire piezometer may be abandoned, the cable shall be cut off at an elevation or location determined by the Engineer and disposed of, and the remaining piezometer shall be left in place.

(F) CONTROL STAKES.

(1) Control stakes shall be furnished and installed as specified herein and as shown on the Plans. Control stakes shall be installed before placement of the fill begins.

(2) The Contractor shall maintain and keep in good order control stakes and shall take whatever precautions are necessary to prevent any alterations, movement, or disturbance of them. Control stakes shall be reset or replaced by the Contractor at the Contractor's expense when and as directed by the Engineer. If, in the opinion of the Engineer, damage has been done to any control stake, the Contractor shall stop work at and near its location until the stake is reset or replaced, to the satisfaction of the Engineer. Toe stakes shall be resurveyed upon reinstallation at no expense to the Authority.

(3) Each line of stakes shall be installed along a survey line established by at least two fixed reference points. The exact location for each line of control stakes will be determined jointly by the Engineer and the Contractor in order to use the most convenient reference points while providing the required project control. Reference points shall be located at least 200 feet beyond the work limits so they are not affected by embankment construction. Control stakes shall be installed such that the center of each stake is not more than 0.1 inches on either side of the line established by the two reference points. The Contractor shall notify the Engineer when each line has been installed. The Contractor and/or the Engineer shall then take the initial readings along each line of control stakes. The Engineer will review the alignment before approval and acceptance of the control stake installation.

(4) The Contractor will survey the position and elevation of the control stakes at least once per week until one month after completion of placement of any embankment fill, surcharge and/or preload, and then once every week until any surcharge is removed. Any and all movement indicated by the control stakes shall be assumed to have been caused only by movement in the ground around the control stake, and not due to any other source or cause, including, but not limited to, impact by any object, vehicle or person, ground vibrations from pile installation or any other source, and vandalism.

(5) The Engineer shall make the sole determination as to when excessive ground movement is indicated by the control stakes. When so determined, all earthwork shall cease within a specified distance of the indicating control stake(s). The Engineer shall make the sole determination as to the specified distance to which earthwork will cease, and will determine when and how earthwork operations should resume to minimize future movement.

(G) OPEN STANDPIPE PIEZOMETERS.

(1) Open standpipe piezometers shall be installed from existing ground to the elevations shown on the plans, with such elevations indicating the middle of the slotted/screen length. Open standpipe piezometers shall be installed in a drill hole using water as a drilling fluid and using temporary casing to maintain the hole. The minimum diameter of the borehole shall be 6 in. The Contractor's geotechnical consulting engineer shall keep a log of soils encountered during drilling and submit it to the Engineer as part of the piezometer installation record.

(2) Full length steel casing shall be used to maintain boreholes for piezometer installation. Casing may be advanced by any means to an elevation 5 feet above the piezometer elevation. Any drilling mud used shall then be removed from the casing and the casing shall be advanced 6 feet by driving while kept full of water. Continuous split spoon samples shall then be obtained for the final 6 feet. Each soil sample shall be field identified according to D.M. Burmister, and representative sample(s) stored and labeled in 8 ounce glass jars.

(3) The soil within the casing shall then be washed out using water and a side discharge bit. Drilling below the casing shall not be allowed. Sand filter material shall then be poured into the casing to fill the bottom 1 foot below the piezometer.

(4) The piezometer shall be fitted with centralizers located as follows: one at the bottom of the piezometer, the second no more than 2 ft. above the slotted length, then as needed at maximum 20

foot intervals to the ground surface. The fully assembled piezometer shall then be lowered into the open hole.

(5) Fill the annulus between the well assembly and the wall of the hole with filter sand to 2 feet above the top of the well screen. Using the cylindrical sounding hammer, check that the required level of filter sand to be placed in the hole has been achieved. The temporary casing shall be carefully withdrawn to the top of the filter sand as the filter sand is being placed to prevent caving of the borehole around the filter sand or riser pipe.

(6) The Contractor shall then grout the rest of the hole from the bottom up.

(7) The casing shall then be removed, keeping the grout level within 5 feet of the ground surface at all times. No vertical movement of the piezometer is allowed as the casing is withdrawn. A lockable, steel protective standpipe shall be installed upon completion of piezometer installation.

(8) When installation is completed, develop the well by bailing or pumping out the riser pipe until the water runs clear.

(9) Survey the open standpipe piezometer to establish its horizontal location, top of protective steel collar elevation, top of PVC riser pipe elevation, and surrounding ground elevation. Prepare and submit a well installation log for the completed open standpipe piezometer.

(10) Each open standpipe piezometer shall be marked with barricades as described above. Additionally, the steel standpipe shall be painted Day-Glo orange or yellow. The Contractor shall maintain the paint during the Contract.

(11) The Contractor's geotechnical engineering consultant and/or the Engineer shall jointly take the initial piezometer readings immediately after the piezometer is installed, and before any fill is placed. Determine that each piezometer is functioning properly by adding or removing water, measuring rates at which water level rises and falls, and comparing the final water level with pre-test level. The Contractor's geotechnical engineering consultant will then take the remainder of the baseline readings and additional readings at least once a week thereafter for the duration of the Contract. The Contractor's geotechnical engineering consultant shall also periodically demonstrate continued proper functioning of each piezometer by performing rising and falling head tests on a schedule as approved or directed by the Engineer.

(12) The Contractor is responsible for protecting and maintaining the piezometer(s) in working order during the period of this Contract. This includes adding or removing riser pipe sections and resetting the steel standpipe, as necessary, to maintain the top of the piezometer between 1 ft. and 4 ft. above the surface of the surrounding ground.

(13) Upon completion of final readings, and once the Engineer has determined an open standpipe piezometer may be abandoned, the standpipe shall be removed and disposed of. The piezometer pipe shall then be abandoned in conformance with NJDEP regulations and requirements. Generally, the piezometer pipe shall be grouted from the bottom up using a tremie pipe, the pipe shall then be cut off at an elevation or location determined by the Engineer and disposed of, and the remaining pipe shall be left in place.

(H) SURVEY MONITORING POINTS.

(1) Survey monitoring points shall be installed as per the plans. The exact locations of the survey monitoring points shall be determined by the Engineer in conjunction with the Contractor to accommodate survey operations. A minimum of two survey monitoring points shall be established.

(2) The Contractor is responsible for maintaining the survey monitoring points in working order during the Contract. Survey monitoring points damaged by the Contractor's construction operation shall be repaired or replaced by the Contractor, at the Contractor's expense, within three calendar days after being damaged.

(3) Initial readings of the survey monitoring points shall be performed by the Contractor after the points have been set, by conducting at least three separate and complete set of readings and yielding consistent results. Subsequent readings shall be performed by the Contractor on a daily basis during the construction.

(I) INSTRUMENTATION MONITORING.

(1) All initial readings shall be taken jointly with the Engineer. The Contractor's geotechnical engineering consultant will take the remaining baseline readings, and all subsequent readings.

(2) Baseline Readings:

(a) Obtain baseline readings for all instruments before any embankment, surcharge and/or preload material is placed.

(b) Determine baseline readings by conducting at least three separate and complete sets of readings on each instrument, at similar time over a minimum 3 day period, which yield consistent results.

(c) The Contractor's geotechnical engineering consultant shall forward the baseline reading results to the Engineer for approval prior to the start of fill placement.

(J) TOLERANCES.

(1) Establish the elevation of benchmarks to 0.04 inch.

(2) Establish the initial elevation of settlement platform (top of riser), vibrating wire piezometers (pressure sensor), open standpipe piezometers (top of PVC riser pipe), and inclinometers (top of inclinometer casing) to 0.1 inch.

(3) Establish the initial coordinates of each instrument installation to 0.1 feet.

(4) Install inclinometer casing within one degree of orientation for the entire length. After installation, the casing groove spiral shall not exceed one degree per 10 feet of length and the orientation of the grooves at the top of the casing shall be within ten degrees of the planned orientation.

(5) Establish the initial position of control stake points to 0.1 inch.

(K) SURVEY CONTROL.

(1) Before the start of construction, establish bench marks for use by monitoring instruments using bench marks installed as part of this Contract, to the tolerances specified herein.

(2) Establish the elevation of bench marks by running level circuits started and closed at the specified existing benchmarks.

(a) Establish turning points during leveling so that foresight and back-sight distances are approximately equal.

(b) Use well-defined surface points of solid objects or masonry nails driven into pavement for turning points.

(c) Do not exceed sight distances of 200 feet.

(d) Establish an error of closure less than 0.1 inch for level circuit closures. If an error of closure greater than 0.1 inch is achieved for any level circuit, resurvey the circuit.

(e) Prove the established elevations of benchmarks by obtaining consistent results on at least three separate and complete level circuits. If an inconsistent elevation for any bench mark results, resurvey the level circuit until correct and repeatable elevations are obtained.

(3) Check elevation of benchmarks every month or when directed by the Engineer.

(L) PROTECTION AND MAINTENANCE.

(1) Protect and maintain instrument systems throughout the entire Contract. Maintenance shall include draining or flushing protective terminal boxes, repairs to damaged or missing components of systems, and raising and lowering instrumentation, as required, during general excavation and fill placement and removal. Damaged or missing instrumentation shall be repaired or replaced by the Contractor within seven days, unless otherwise specified, at no expense to the Authority.

(2) The Contractor shall furnish and install protective steel standpipes as specified and as shown on the Plans, or an approved equal. Such standpipes shall be installed at the locations indicated on the Plans. The standpipes shall be installed outside and concentrically with the instrument casings, and as approved by the Engineer. The standpipes shall extend to a maximum of 4 feet above the

final grade and shall penetrate at least 2 feet below the ground surface, and as approved by the Engineer. Ensure intimate soil-to-standpipe and standpipe-to- instrument casing contact using lean concrete as specified.

(M) DISPOSITION OF INSTRUMENTS.

(1) All instruments shall remain in place except those that may be removed or abandoned, as directed by the Engineer, because of interference with planned or possible future construction. When directed by the Engineer, remove and dispose of those portions of all instruments, including standpipes and covers that are readily accessible. Grout all remaining open portions of boreholes, open standpipe piezometers and inclinometer casings, backfill the area and/or patch asphalt and concrete surfaces in like kind, and restore to the Engineer's satisfaction. Grout shall be cement grout consisting of Type III Portland cement and water. No instrumentation shall be demolished, abandoned, removed, or disposed of without prior approval of the Engineer.

(2) All surfaces affected by installation of instruments shall be restored to the original condition prior to completion of the work.

215.10 Measurement.

Settlement platforms, open standpipe piezometers, control stakes, inclinometers and vibrating wire piezometers will be measured by the unit installed, maintained and read throughout the length of the Contract, or until readings are discontinued by the Engineer. No separate measurement will be made for periodic extension and/or shortening of the instruments.

Drilling of holes, permits for setting open standpipe piezometers, standpipes and other covers, and all other incidental items, labor, equipment and supplies necessary for the installation of the instruments and removal of instruments no longer required, disposition of instruments, will not be measured separately for payment, but all costs therefore will be considered incidental to these items of work.

215.11 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SETTLEMENT PLATFORMS	EACH
OPEN STANDPIPE PIEZOMETERS	EACH
VIBRATING WIRE PIEZOMETERS	EACH
CONTROL STAKES	EACH
INCLINOMETERS	EACH

Payment for the items specified above will be made at the Contract prices for the quantities as determined above. Prices shall include the cost of furnishing all permits, labor, materials, equipment, and incidentals necessary to satisfactorily fabricate, calibrate, test, furnish, install, protect, maintain, and monitor the instrumentation and to remove instruments no longer required as shown on the Plans and specified herein, including labor for assistance to the Engineer in monitoring instruments.

Vibrating wire piezometers shall also include the cost of all necessary excavation and backfill of trenches to install leads. The use of any switching device(s)/terminal box(es) shall be allowed and will be paid for under the item vibrating wire piezometer. No separate payment will be made for furnishing, installing, or operating any switching device(s)/terminal box(es) and all associated wiring, conduit, fittings and appurtenances, but all costs thereof will be considered incidental to the cost of the vibrating wire piezometer item.

Any instrumentation that becomes damaged or inoperable shall be repaired or replaced by the Contractor at no cost the Authority.

Seventy five percent of the unit price of settlement platforms, open standpipe piezometers and vibrating wire piezometers shall be paid upon acceptable installation of the device, with the remainder paid upon completion of monitoring.

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SECTION 301 - AGGREGATE BASE COURSE

301.01 Description.

Aggregate Base Course shall include furnishing, placing and compacting suitable materials in the areas prepared therefore, as required in Section 209 at the locations and to the depths, lines and grades shown on the Plans.

301.02 Materials.

Materials shall conform to the following Subsection:

AGGREGATE BASE 902.07

301.03 Methods of Construction.

Where Special Subgrade Material is required adjacent to the edges of the aggregate base course, the placing and compaction of the subgrade material shall be scheduled so as to form a lateral support for the aggregate base course during compaction.

Placing of the loose materials on the finished subgrade shall not proceed until the subgrade has been approved by the Engineer for a distance of not less than 500 feet in advance of the laying of the aggregate base course material. No material shall be placed when the subgrade is frozen or when it is unstable because of excessive moisture.

Should the subgrade be dry to the point of being dusty, it shall be moistened by sprinkling as directed by the Engineer.

Aggregate base course 8 inches or less in compacted thickness shall be placed and compacted in one course unless otherwise specified.

Aggregate base course of more than 8 inches compacted thickness shall be placed and compacted in two or more courses of approximately equal thickness, no course to be more than 8 inches compacted thickness. All points on the aggregate base course surface after final compaction shall be within the following tolerance of the plan profile grade and cross slope.

	High	Low
Under Portland Cement Concrete Pavement	0 in	3/8 in.
Under Base Course for Asphalt Concrete Pavement	1/4 in.	1/4 in.

Variations in excess of these tolerances shall be corrected by scarifying and reconstructing the areas requiring corrections as established and delineated by the Engineer at no extra cost to the Authority.

Corrected areas shall be compacted in accordance with the requirements for compaction of the aggregate base course. At the option of the Contractor, low areas on the finished aggregate base course under Portland Cement Concrete Pavement may be brought up to grade by filling the low areas with course sand provided the compacted thickness does not exceed 3/4 inches. Such areas need not be scarified. The sand shall conform to the requirements of fine aggregate in Subsection 902.04. The sand cover shall be compacted using flat wheel rollers in accordance with the requirements for compaction of aggregate base course.

(A) SPREADING.

Spreading of the aggregate base course material on the finished subgrade may be accomplished by the use of spreading machines, or it may be dumped directly on the subgrade and spread with motor graders.

If spreading machines are used, the aggregate base course material shall be uniformly spread in a manner which will prevent segregation and to a loose thickness such that after the specified compaction, the required thickness will be obtained.

If motor graders are used for spreading, the material shall be dumped on the subgrade in the amounts necessary to complete the course to the lines and grades shown on the Plans. It shall then be formed into a windrow or windrows. In all manipulations, care shall be used to prevent segregation of the

materials. After the windrow or windrows have been uniformly made, and the required amount of material is combined therein, the material shall be uniformly spread over the entire surface of the subgrade. During the spreading operation, the material shall be so manipulated that the entire windrow or windrows will be moved from its original position. Care shall be exercised to prevent the equipment from disturbing the subgrade and mixing it into the aggregate base course material, and to prevent segregation of the different size materials. During the operation of handling, placing, windrowing, and spreading the aggregate base course material, it shall be maintained by the addition of water necessary to prevent segregation and assure proper moisture content for compaction after spreading is completed. Immediately upon completion of the spreading operations, the course shall be compacted, for its full depth, to not less than the minimum percent of maximum dry density specified in Subsection 203.03(E) for materials above a plane 5 feet below profile grade.

The Engineer will determine the optimum moisture content at which the material shall be compacted. The moisture content of the material immediately before compacting is started shall not vary more than two percentage points plus or minus from the optimum.

If the material spread is too dry, it shall be uniformly moistened by sprinkling and mixing the material in a manner, approved by the Engineer, such that the moisture will be evenly distributed throughout the depth of the material. If the material is too moist, it shall be allowed to dry and, if necessary to achieve uniform distribution of moisture throughout its depth, it shall be mixed in a manner approved by the Engineer.

(B) COMPACTION.

Compaction of the aggregate base course material shall be accomplished with vibratory compaction equipment with the vibrational force transmitted to the material through a roller, sled, pan, or shoe so designed for that purpose. The vibrational frequency of the compactor shall be at least 1,400 vibrations per minute, and the centrifugal force produced by the equipment shall be at least 150 pounds per inch of width of the tamping face. The number of pieces of vibratory compaction equipment shall be subject to the approval of the Engineer, and shall be such as to achieve desired compaction at a rate consistent with the rate of placement of the material.

Compacting shall start at the edges and progress towards the center, and it shall continue with sufficient passes and coverage the required density has been obtained, and the material does not move under the compactor. When the proper cross-section has been obtained and compaction to the required density is completed, the surface shall be rolled with a steel wheel roller to seal the surface. The surface may be moistened by sprinkling, if necessary and approved by the Engineer before final rolling.

Immediately prior to the placement of concrete or asphalt pavement, the finished aggregate base course will be inspected by the Engineer and if found loosened, damaged, rutted, or littered with foreign materials, it shall be cleaned, reshaped, and recompacted as specified above. If there should be a delay of more than 48 hours between the final rolling of the aggregate base course and construction of the pavement or base, the surface of the aggregate base course shall be rechecked just prior to constructing the pavement or base with an additional pass of the steel wheel roller to make certain there is no visible movement under the roller.

301.04 Measurement.

Aggregate Base Course will be measured by the total area of each specified thickness constructed without deductions of areas occupied by manholes and similar structures within the pavement area.

301.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
AGGREGATE BASE COURSE, ___" THICK	SQUARE YARD

SECTION 302 – HOT MIX ASPHALT (HMA) PAVEMENTS

302.01 Description.

This work shall include the construction of one or more courses of HMA on surfaces prepared therefore in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown on the Plans or established by the Engineer.

The work shall also include the construction of a membrane waterproofing on bridge decks, joint sealing, joint repairs and reflective crack prevention.

302.02 Materials.

Materials shall conform to the following Sections and Subsections:

ASPHALT ADDITIVES 904.05

HOT MIX ASPHALT. 903

AGGREGATES 902

BITUMINOUS MATERIALS 904

MEMBRANE WATERPROOFING 923.06

CRACK SEALANT 904.03

SEALING MATERIALS..... 904.06

CRACK SPANNING MEMBRANE/PAVEPREP..... 923.24

HIGH PERFORMANCE PERMANENT COLD PATCH 923.34

TACK COAT 904.02

The requirements for specific HMA mixtures are identified by the abbreviated fields in the Pay Item description as defined in the following example:

HOT MIX ASPHALT 12.5M64 SURFACE COURSE

"HOT MIX ASPHALT" – the term "Hot mix asphalt" is located in the first field in the Pay Item description for the purpose of identifying the mixture requirements.

"12.5" – the second field in the Pay Item description designates the nominal maximum size aggregate (in millimeters) for the job mix formula (other sizes may be 9.5, 19, 25, and 37.5mm).

"M" – the third field in the Pay Item description designates the medium design compaction level as for the job mix formula based on traffic forecasts as listed in Table 903-2 (other levels may be L=low, and H=high).

"64" – the fourth field in the Pay Item description designates the high temperature (in ^{o}C) of the performance-graded binder (other options may be 70, and 76 ^{o}C). All binders shall have a low temperature of –22 ^{o}C, unless otherwise specified.

"SURFACE COURSE" – The last field in the Pay Item description designates the intended use and location within the pavement structure (other options may be intermediate, or base course).

302.03 Contractor's Quality Control.

Prior to the commencement of any paving operations, the Engineer shall conduct a job meeting with the Contractor and Subcontractor, if one is used for paving, in order to review intended methods of grade control proposed by the Contractor, to highlight job requirements and criteria; to insure adequate plant production and number of trucks for material delivery in order to permit continuous placement; and to review specific requirements of any special asphalt or additive.

Quality control of each HMA mixture shall be the responsibility of the Contractor. The Contractor shall maintain equipment and qualified personnel, acceptable to and approved by the Engineer, including at least one HMA technician, who shall perform all field sampling and testing of the produced mixture for conformance to the requirements of the Specifications.

The Contractor shall provide and maintain a quality control system. Under this system, the Contractor shall perform or have performed the inspection and tests required by the Contract. The Contractor's quality control procedures, inspections, and tests shall be documented and shall be submitted, as soon as the tests are made, to the Engineer for review and approval.

(A) LABORATORY AND TESTING EQUIPMENT.

A plant laboratory shall be provided and maintained at each plant site for use of the Engineer for sampling and acceptance testing, and for use of the producer for quality control testing during periods of production. The plant laboratory shall also include an office area for use by the Engineer. The costs of the plant laboratory, and all the facilities and equipment therein shall be included in the other items in the proposal, and no separate payment will be made for the plant laboratory.

The plant laboratory shall be located to provide an unobstructed view of the trucks as they are loaded.

The laboratory shall have inside dimensions which provide a working area of not less than 160 square feet, with adequate ventilation, heat, light, water, sink and drainage, electrical and/or gas outlets, work table, shelves, and supply cabinets. Telephone service shall be provided by the Contractor.

The plant laboratory for HMA shall meet the above requirements, except that an office area shall be provided with a floor area that is not less than 100 square feet for the exclusive use of the Engineer. HMA gyratory compactor conforming to AASHTO T 312 shall be provided instead of the Marshall Method equipment required by AASHTO T 245. HMA plants producing more than 3,000 tons of mixture per day may be required to increase the laboratory facilities and equipment.

The laboratory shall have all necessary equipment and supplies to determine the asphalt content of the mixture, the gradation of the aggregates, and the volumetric properties of the mixture for verification of the design formula. The equipment and apparatus for performing the required tests shall be in accordance with the specified AASHTO, ASTM and Asphalt Institute Standards. The Contractor shall also furnish the following items: 10-digit electric calculator capable of adding, subtracting, multiplying and dividing; mason's trowels (approximate dimensions 4 and 8 inches); square point shovel; small and large sugar scoops; heavy galvanized pail approximate 14-quart capacity); aggregate sample pans; asbestos gloves; brushes; flashlights; glassware; and such other items and supplies as are necessary for performance of the tests.

The Authority reserves the right to conduct periodic inspections of the measuring and testing devices to confirm their calibration and condition of operation. The Authority, at no cost to the Contractor, will arrange for quality assurance testing of materials and samples of the HMA mixes as produced for conformity with the established job-mix formula. The plant laboratory for the Contractor's quality control system shall be made available for the Authority's use.

(B) PERSONNEL.

The Contractor's quality control personnel shall be properly trained and instructed to perform all tests, make calculations, and provide documentation. Personnel shall be competent to control the processes, so that all requirements are met.

A producer’s laboratory technician shall be present during periods of mix production.

The Contractor's or Subcontractor's quality control technician(s) shall be certified by the Society of Asphalt Technologists of New Jersey, Inc. as an Asphalt Paving Construction Technologist, Level II and/or Asphalt Plant Technician Level II.

The Contractor's or Subcontractor's foreman in charge of paving operations shall be certified by the Society of Asphalt Technologists of New Jersey, Inc. as an Asphalt Paving Construction Technician.

Individuals responsible for the Contractor's quality control operations shall be either directly employed by the Contractor or employees or officers of a quality control organization employed by the Contractor. Such quality control organization shall be considered a Subcontractor and shall therefore comply with all the requirements for Subcontractors and subcontracted work in Division 100 of these Specifications.

The Contractor shall submit all personnel certifications to the Engineer prior to submittal of HMA mix designs or start of plant production of HMA for the project. HMA mix design submittals will not be reviewed, or HMA will not be accepted until these requirements have been met.

(C) DOCUMENTATION.

The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the nature of corrective action taken, as appropriate. The Contractor's documentation procedures will be subject to review and approval of the Engineer each day prior to start of the work. The procedures shall also be subject to compliance checks by the Engineer during the progress of the work. All charts, records, and daily report forms, documenting the Contractor's quality control inspections and tests, shall become the property of the Authority and turned over to the Authority at the end of each day's operation.

All conforming and non-conforming inspections and test results shall be recorded on standard forms and charts similar to those of the New Jersey DOT or those in the most current edition of the Asphalt Institute's Manual Series No. 2 (MS-2). Forms and charts shall be kept up to date, complete, and available at all times to the Engineer during the performance of the work. Test properties for the various materials and mixtures shall be charted.

(D) PROCESS CONTROL.

For facilities not approved by the NJDOT, the Contractor's quality control system shall document the process control activities shown on the following table. Facilities approved by the NJDOT shall follow their approved NJDOT Quality Control Plan. A copy of the approved plan and the annual approval shall be submitted to the Engineer:

Process Control Requirement	*Frequency Per Plant (Minimum)*
Gradation	
Determine Gate Settings Of Each Cold Bin To Assure Compliance With Job-Mix Formula	Daily
Determine Aggregate	
Gradation Of Each Hot Bin	2 Per Day
HMA Mixture	
Ross Count	1 per Day
Extraction Test to Determine Aggregate Gradation and Percent of Bitumen	2 per Day
Temperature	1 per Each 50 Tons
Theoretical Maximum Density and Voids	2 per Day
Weigh Scales and Asphalt Pumps	
Calibrate Scales and Pumps	Prior to Start of Job
Check Calibration of Scales and Pumps	Yearly

Frequency for process control will, as directed by the Engineer, vary with the size and type of aggregate or mixture and the batch-to-batch variability of the mixture.

302.04 Asphalt Plant and Equipment.

All plants and equipment necessary for the work shall be available and approved before the work will be permitted to start. Plants and equipment shall meet or exceed the following requirements.

(A) BATCH PLANT.

Plants used for the preparation of HMA mixtures may be of the fully automated batch type or drum mixing type. All plants shall be designed, equipped, calibrated, and operated to deliver well-coated, homogeneous mixtures complying with the job mix formula.

Any defects which adversely affect the functioning of a plant or plant unit or the quality of the mixture shall be corrected immediately.

HMA mixtures may be produced from one or more such plants, provided that aggregates from the same source are used in each plant for any one mixture.

The size of plant shall be subject to the approval of the Engineer, and shall be adequate to perform the

work required for the Project within the stipulated time of completion.

At all times, the Engineer or his authorized quality assurance representative shall have access to any part of the batch plant or the laboratory for checking the adequacy of the Contractor's Quality Control System and the equipment in use, inspecting the conditions and operation of the plant, for the verification of weights or proportions and character of materials, and for the determination and checking of temperatures being maintained in the preparation of the mixtures.

(1) Aggregate Storage.

The plant site shall have adequate storage facilities. Sufficient storage space shall be provided for separate stock piles, bins or stalls for each size of aggregate, and the different aggregate sizes shall be kept separated until they have been delivered, without segregation, by the feeder or feeders to the boot of the cold elevator or elevators in their proper proportions. Stockpiles shall meet the requirements of Section 902. Where cold feed storage bins are used, partitions between bins shall be of sufficient height to insure against mixing of different sized aggregates. The storage yard shall be maintained neat and orderly, and the separate stock piles shall be readily accessible for sampling.

(2) Storage Tanks.

Tanks for storage of asphalt binder shall be equipped for heating the material, under effective and positive control at all times, to the temperature required in the HMA mixture specifications. Heating shall be by steam or oil coils, electricity, or other means such that no flame shall contact the heating tank.

Storage tank capacity shall be sufficient to insure continuous operation of the plant and uniform temperature of the asphalt binder when it is introduced into the pugmill. Storage tanks shall be accurately calibrated in 100 gallon intervals and shall be accessible for measuring the volume of asphalt binder at any time.

The circulating system for the asphalt binder shall be of adequate capacity to provide, during the entire operating period, proper and continuous circulation between the storage tank and proportioning units. The discharge end of the asphalt binder circulating pipe shall be kept below the surface of the asphalt binder in the storage tank to prevent discharging the hot asphalt binder into the open air. All pipe lines and fittings shall be steam or oil-jacketed or otherwise properly insulated to prevent heat loss.

Provisions shall be made for a sampling valve shall be located in the lowest third of the storage tank. The outlet shall consist of a valve installed in such a manner that samples may be withdrawn from the line slowly at any time during the plant operation. A drainage receptacle shall be provided for flushing the outlet prior to sampling.

(3) Feeder for Dryer.

Separate feeders shall be provided for each size and source of aggregate. Each size shall be fed onto the belt going to the dryer by mechanical feeders with separate adjustable gates. The feeders shall be capable of delivering the separate aggregates onto the belt in proper proportions. The feeders shall provide for adjustment of total feed and proportional feed.

Means shall be provided to ensure a constant and uniform flow of material from each bin.

The aggregate shall be fed into the dryer, so that uniform production and uniform temperature may be obtained.

(4) Bins.

The plant shall have a hot bin storage capacity sufficient to insure uniform and continuous operation. Bins shall be divided into at least three compartments arranged to insure separate and adequate storage of appropriate fractions of the aggregate.

The plant shall have cold-feed aggregate storage bins of sufficient number and capacity to store the amount of aggregate required to keep the plant in continuous operation. The bins shall be designed to prevent overflow of material from one bin compartment to another. There shall be at least one cold-feed aggregate bin for each stockpile of material to be used. An indicator shall be provided on each cold-feed bin to show the gate opening.

Each compartment shall be provided with an overflow pipe of such size and at such location to prevent any backing up of material into other bins or into contact with the screens.

Adequate additional dry storage shall be provided for mineral filler, and provisions made for its proper proportion for each batch of the mixture. Gates on the bins shall be constructed, so as to prevent leakage when they are closed.

Bins shall be equipped with "tell-tale" devices to indicate the position of the aggregate in the bins at the lower quarter points. An automatic plant shutoff shall be provided to operate when any aggregate bin becomes empty.

Adequate and convenient facilities shall be provided for obtaining aggregate samples from each bin.

(5) Asphalt Control Unit.

Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of asphalt binder. Metering devices shall be accurate to within $\pm$ 1.0 per cent when tested for accuracy.

The time required to add the asphalt binder shall not exceed 15 sec. for pugmills of 4,000 lb. or less rated capacity and 25 sec. for pugmills of larger capacity. Where the quantity of asphalt binder is metered, provision shall be made to check the delivery of the meter by actual weight.

Steam or oil-jacketing, or other insulation, shall be provided for maintaining the specified temperatures of the asphalt binder in the pipe lines, meters, weigh buckets, spray bars, and other containers or flow lines.

(6) Thermometric Equipment.

An armored recording thermometer of suitable range shall be fixed in the asphalt binder feed line at a suitable location near the discharge at the mixer unit.

The plant shall be further equipped with approved recording thermometers, pyrometers, or other approved recording thermometric instruments, at the discharge chute of the drier and in the hot fines bin, to register and record automatically the temperature of the heated aggregates.

(7) Dust Collectors.

The plant shall be equipped with a dust collector capable of wasting or uniformly returning to the plant all or any part of the material collected as directed. Dust collecting systems shall be installed and operated in compliance with NJAC 7:27-6.1 et seq.

(8) Surge and Storage Bins.

Bins used for either surge or storage shall be such that mix drawn from the bin shall have substantially the same characteristics as mix loaded directly into trucks from the pugmill.

A plant may be permitted to store prepared mixtures in surge or storage bins provided the bins have received prior evaluation and approval by the Authority. Use of the bins shall be in conformance with the limitations on retention time, type of mixture, heater operation, bin atmosphere, bin level, or other characteristics set forth in the Engineer's letter of approval.

Each bin shall be equipped with a device that visually or audibly signals automatically when the material in the bin reaches the 25 Ton level. The signal device shall be visible or audible from within the plant laboratory, and shall remain in operation until the bin level exceeds the specified minimum.

An evaluation of a surge or storage bin will be made by the Authority upon written request by the supplier. The supplier shall submit with its request two copies of plans for its surge or storage system showing bin capacity, heating, and splitter arrangements. The evaluation determines the degree of composition uniformity and the temperature characteristics.

For bin evaluation, the method of sampling, rate of sampling and testing, and analysis procedures, will be performed in accordance with the requirements of Storage of Hot Bituminous Concrete Mixes, New Jersey Department of Transportation Research Report No. 74-007-7733 (October 1973).

In the event that the surge or storage system is changed or altered, the Authority shall be notified of the modification. Any radical departure will necessitate re-evaluation. The Authority may re-evaluate any surge or storage system whose performance becomes suspect due to deficiencies in mixture quality.

(9) Weigh Box or Hopper.

The equipment shall include means for weighing each bin size of aggregate into a weigh box or hopper, suspended on scales, and shall be ample in size so as to hold a full batch without hand raking or running over.

The weigh box or hopper shall be supported on fulcrums and knife edges that will not easily be thrown out of alignment or adjustment.

Gates, both on the bins and the hopper, shall be constructed to prevent leakage when closed.

(10) Aggregate Scales.

Scales for any weigh box or hopper may be either beam or springless dial type and shall be of standard make and design having tolerances on over-registration and under-registration not exceeding 0.5 percent of the indicated weight when tested for accuracy.

The change in load required to noticeably alter the position of rest of the indicating element (or elements) of a non-automatic indicating scale shall not be greater than 0.1 percent of the nominal scale capacity.

Beam type scales shall be equipped with a device to indicate that the required load is being approached. This device shall indicate at least the last 200 lb. of the load. Graduation intervals for either beam or dial scales shall not be greater than 0.1 per cent of the nominal scale capacity. Scale graduations and marking shall be plainly visible. On dial scales, parallax effects shall be reduced to the practical minimum with clearance between the indicator index and scale graduations not exceeding 0.01 in. Scales shall be equipped with adjustable pointers for marking the weight of each material to be weighed into the batch.

Not less than 10 test weights, each of 50-lb. nominal weight and each stamped with its actual weight to within $\pm$ 0.05 percent, shall be provided for the purpose of testing and calibrating the scales. For each scale, a suitable cradle or platform shall be provided for applying test loads. The test weights shall be kept clean and conveniently located for calibration of the scale.

(11) Asphalt Buckets.

If a bucket is used, it shall be large enough to handle a batch in a single weighing. The filling system and bucket shall be of such design, size and shape that the asphalt binder will not overflow, splash, or spill outside the bucket during filling and weighing. The bucket shall be steam or oil-jacketed or equipped with properly insulated electric heating units. It shall be arranged to deliver the asphalt binder in a thin uniform sheet or in multiple sprays over the full length of the mixer.

(12) Asphalt Scales.

Scales for weighing the asphalt binder shall conform to the requirements for aggregate scales, except a device to indicate at least the last 20 lbs. of the approaching total load shall be provided. Beam type scales shall be equipped with a tare beam or adequate counter-balance for balancing the bucket and compensating periodically for the accumulation of asphalt binder on the bucket.

(13) Mixer Unit.

The plant shall include a batch mixer of an approved twin pugmill type capable of producing a uniform mixture within the permissible job-mix tolerances. The mixer shall be designed to provide means of adjusting the clearance between the mixer blades and liner plates to insure proper and efficient mixing. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust by dispersion. The mixer shall be constructed to prevent leakage of the contents. Mixer discharge shall not cause appreciable segregation.

(14) Control of Mixing Timer.

The mixer shall have an accurate time lock to control the operation of a complete mixing cycle by locking the weigh box gate after the charging of the mixer until the closing of the mixer gates at the completion of the cycle; it shall lock the asphalt binder bucket throughout the dry-mixing period and shall lock the mixer gate throughout the dry and wet-mixing periods.

The dry-mixing period is defined as the interval of time between the opening of the weigh box gate and the application of asphalt binder. The wet-mixing period is interval of time between the start of the application of bituminous material and the opening of the mixer gate.

The timing control shall be flexible and capable of being set at intervals of not more than 5 seconds throughout cycles up to 3 minutes.

(15) Truck Scales.

Each batch plant shall be equipped with a truck scale which has a platform of sufficient size to accommodate the entire length of any vehicle used. The balancing mechanism shall be enclosed in a suitable weathertight and heated house with sufficient tables, chairs, and storage drawers as needed.

The truck scales shall be certified and approved by the State Office of Weights and Measures, Consumer Affairs Division.

Platform truck scales shall be a direct-reading, cabinet dial type or an electronic load cell type with a visual indicating device capable of automatically printing gross, tare and net weights; and time and date on the weigh ticket. The time and date may be printed automatically by a time clock each time the truck passes over the scale. The scales shall be equipped with a motion detection device or a time delay relay which prevents printing the weight on the weigh ticket until the scale is fully at rest. Tare beams must be removed or permanently locked in place.

The scale shall have a manufacturer's rating equal to or greater than the maximum gross load being weighed, and the accuracy and certification requirements shall be as specified herein for plant scales. The approaches to the scale at both ends shall have a level grade at the same elevation as the platform. The scale cabinet and dial and the mechanical weight recorder shall be housed in a suitable shelter, furnished with adequate heat and light.

(16) Weigh Tickets.

The quantity of HMA mixture will be the net weight of the mixture delivered in each truck load. The weight of mixture in each truck load shall be determined by one of the following methods:

(a) A weigh ticket printed by an automatic scale, showing both the tare and gross weights of the truck as determined for each trip.

(b) A weigh ticket showing the gross, tare and net weight of each truck as certified by a weigh master. To each weigh ticket, the weigh master shall affix his signature and official seal or approved commissioned stamp, attesting that he is a duly constituted weigh master.

A weigh ticket shall be furnished to the Engineer's representative on the project. No material will be accepted unless accompanied by such a weigh ticket, which shall be completely legible and clearly indicate the type of mixture specified for the intended use. The Contractor shall furnish all weigh tickets.

(17) Safety.

Adequate and safe stairways to the mixer platform and sampling points shall be provided, and guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Overhead protection shall be provided at locations deemed necessary. A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment, and other similar equipment from the ground to the mixer platform and return. All gears, pulleys, chains, sprockets, and other hazardous moving parts shall be guarded and protected. Ample and unobstructed space shall be provided on the mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free from drippings from the mixing platform.

Accessibility to the top of truck bodies shall be provided by two platforms located away from the mixing plant to enable samples and temperature data to be obtained from each side of loaded trucks. One platform is acceptable, if the truck has room to turn around and return to the platform.

In addition to the above, the plant shall conform to all State and local safety requirements. When plant production occurs during nighttime hours, lighting shall be provided throughout the plant operations, plant laboratory, and truck scale areas to ensure a clear view of the operations.

(18) Special Requirements for Fully Automated Batch Type Plants.

Daily checks shall be made to ensure that hoppers are discharging completely and that the balance returns to zero tare whenever the hoppers are emptied. When directed, checks shall be made to verify the accuracy of the batch scales within the normal weighing range, and to ensure that the interlocking devices and automatic recordation equipment are functioning properly. When the accuracy of the batch scales is not within the normal weighing tolerances, the Authority reserves the right to require that all trucks be weighed on an approved truck scale.

For mixes containing reclaimed asphalt pavement, the batch plants shall have a means for adding the reclaimed asphalt pavement to the heated new aggregate at a point in the system beyond the hot bins, and in a manner that does not damage the asphalt in the reclaimed material and provides control for proportioning the reclaimed asphalt pavement into the mixture. If the reclaimed asphalt pavement is introduced into the system prior to the hot bins, the proportioning controls shall include weigh belts or belt scales which electronically interlock the new aggregate feed with the reclaimed asphalt pavement feed and vary the feed rates, as required, to maintain the required ratio of new aggregate to reclaimed asphalt pavement.

The recycled bituminous mixtures shall be prepared by the heat transfer method of recycling which means that the reclaimed asphalt pavement shall not come in direct contact with the flame in the dryer. When preparing mixtures by the heat transfer method, the batch plant shall be operated as a conventional plant except that a higher temperature of new aggregate leaving the dryer and the time interval of the dry and wet mixing cycles may need to be adjusted, and provisions must be made for the proportioning of the recycled asphalt pavement into the mixture.

Prior to being combined with the heated new aggregate, the reclaimed asphalt pavement shall pass through a 2-1/2 inch vibrating scalping screen.

Fully automated batch type plants shall include the following:

(a) Dryer.

Plants shall include a dryer or dryers which continuously agitate the aggregate during the heating and drying process. The dryer shall be capable of drying and heating the aggregate to the specified moisture and temperature requirements without leaving any visible unburned oil or carbon residue on the aggregate when discharged from the dryer.

(b) Screens.

Plant screens shall be capable of screening aggregates to the specified sizes and proportions, and shall have capacities in excess of the capacity of the mixer.

(c) Aggregate Hot Bins.

The plant shall include at least four aggregate storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to ensure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for mineral filler or hydrated lime when used, and the plant shall be equipped to feed such material into the mixer accurately and uniformly. Each bin shall be provided with overflow pipes of such size and at such locations as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with an individual outlet gate, constructed so that when closed there shall be no leakage. The gates shall cut off quickly and completely. Bins shall be provided with means to obtain representative samples. Bins shall be equipped with a device that visually or audibly signals automatically when the level of aggregate reaches the lowest quarter point. The signal device shall be visible or audible from within the plant laboratory and shall remain in operation until the bin level exceeds the minimum.

(d) Plant Scales.

All plant scales shall be of the springless dial type or electronic load cell type, with a readout, and shall be accurate within the tolerances permitted by the New Jersey Department of Law and Public Safety, Office of Weights and Measures, and shall conform to the requirements of the National Institute of Standards and Technology Handbook 44. Scales shall be tested semiannually and certified by the Office of Weights and Measures, New Jersey Department of Law and Public Safety, or a municipal weights and measures agency. This semiannual inspection shall be performed by an approved private scale company if the Office of Weights and Measures, New Jersey Department of Law and Public Safety, or a municipal weights and measures agency cannot perform the work.

Scales or slave systems shall be so located that they are plainly visible to the plant operator at all times.

The graduation of scales used in weighing amounts of aggregates less than 2.5 Tons shall not be greater than 5 lbs; for amounts of aggregates from 2.5 Tons to 5 Tons, not greater than 10 lbs; and for amounts of aggregates in excess of 5 Tons, not greater than 0.1 percent of the capacity of the scales.

Scales for weighing bituminous material shall conform to the requirements for aggregate scales, except that they shall read to the nearest pound, and shall have a capacity of not more than 250 percent of the normal amount of asphalt required.

All plants shall be capable of continuously weighing, within the tolerances specified, the various components of the mixture for the full range of batch sizes. All of the following tolerances are based on the total batch weight of the bituminous mix.

Weighing Tolerances	*Percent*
Each Aggregate Component	± 1.5
Mineral Filler	± 0.5
Bituminous Material	± 0.1
Zero Return (Aggregates)	+ 0.5
Zero Return (Bituminous Material)	+ 0.1

If mineral filler is used in a batch cycle, the allowable tolerance for the aggregate component weighed just prior to the filler in a cumulative weighing system shall be plus or minus 0.5 percent.

(e) Weigh Box or Hopper.

The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales, and of ample size to prevent overflow to the pugmill.

The discharge gate shall close so that no material is allowed to leak into the mixer while a batch is being weighed. The weigh box or hopper shall be supported on fulcrums and knife edges so constructed that they are not easily thrown out of alignment or adjustment.

(f) Asphalt Binder Control.

When an asphalt binder material bucket is used, it shall be a type recommended by the plant manufacturer. The length of the discharge opening or spray bar shall be not less than three-fourths the length of the mixer, and it shall discharge directly into the mixer. The asphalt binder material bucket discharge valve and spray bar shall be adequately heated. The plant shall have an adequately heated, quick-acting, nondrip charging valve located directly over the asphalt binder material bucket.

When a volumetric meter is used, it shall automatically meter the asphalt into each batch. The dial to indicate the amount of asphalt binder shall have a capacity of at least ten percent in excess of the asphalt binder materials required in one batch. The meter shall be constructed, so that it may be locked at any dial setting and automatically resets to this reading after the addition of asphalt binder to each batch. The dial shall be in full view of the mixer operator.

For all asphalt binder control units, the flow of asphalt binder shall be automatically controlled to begin when the dry mixing period is over. All of the asphalt binder required for one batch shall be discharged within 15 seconds after the flow has started. The size and spacing of the

spray bar openings shall provide a uniform application of asphalt binder for the full length of the mixer.

(g) Mixer.

The batch mixer shall be capable of producing a uniform mixture within the job mix tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

The clearance of paddles shall not exceed 1-1/2 inches from all fixed and moving parts.

(h) Control of Mixing Time.

The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh box gate after charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the asphalt binder discharge throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the start of introduction of asphalt binder. The wet mixing period is the interval of time between the start of introduction of asphalt binder and the opening of the mixer gate.

The control of the timing shall be adjustable and capable of being set at intervals of five seconds or less. A mechanical batch counter shall be installed as a part of the timing device and shall be so designed as to register only completely mixed batches.

(i) Automated Batching and Mixing Control.

Fully automated plants shall include an automatic batching and mixing control system, including an automatic printer system conforming to the following:

(1) The recording equipment and batch scales shall be interlocked and the panels providing access to interlocking devices shall be maintained under sealed conditions.

(2) The system shall contain auxiliary interlocking cut-off circuits to interrupt and stop the automatic cycling of the batching operations any time the weighing tolerances are exceeded, or when any aggregate bin becomes empty, or when there is a malfunctioning of any portion of the control system. A platform truck scale is not required. If, however, the automatic proportioning or recording devices become inoperative or inaccurate, the plant shall be operated manually in conformance with all the requirements for manual batch plants, including a platform truck scale.

(3) The Authority will make independent checks on batch weights by weighing trucks before and after loading, and may request an inspection of the plant scales by the Office of Weights and Measures, New Jersey Department of Law and Public Safety for verification of the automatic printout tickets.

(j) Modifications.

Modifications to batch plants required for the use of 26 to 50 percent of reclaimed asphalt pavement are as follows:

(1) The dryer may have to be operated at higher temperatures. Modifications to the dryer and the dust collection system may be necessary to prevent damage.

(2) At the beginning of production of a reclaimed bituminous mixture in a batch plant, a dry mixing period of 25 seconds shall be used for combining materials in the pugmill. The wet mixing period shall be established initially as 25 seconds. Modifications may be required to these periods if they do not prove effective for breakdown of lumps of the reclaimed material, melting of the old asphalt, and coating of aggregate.

(3) The new aggregate shall be heated to a temperature high enough to produce an acceptable mixture temperature after being combined with the cold reclaimed asphalt pavement material, mineral filler, if needed, and new asphalt. It is anticipated that an aggregate temperature in excess of 500 degrees F may be necessary.

(4) The preheating of the reclaimed asphalt pavement material may facilitate lowering heating requirements for the new or virgin aggregate. Any such preheating method shall be approved prior to its use.

(B) DRUM-MIXING PLANT.

The Contractor may, at his option, elect to use drum-mix process in the production of HMA pavement. If the Contractor elects to use this alternate process, the heating, coating, and mixing of the asphalt mixture shall be accomplished in an approved parallel flow or counter flow dryer-mixer. The plant shall be designed, equipped, calibrated, and operated to deliver a well-coated homogeneous asphalt mixture meeting the applicable requirements of the Specifications.

The Specifications dealing with materials shall be supplemented by the addition of the clauses cited below. No other clauses or requirements applicable to these mixtures are waived, relaxed, or otherwise changed hereby.

Prior to the start of production, the Contractor shall assure that cold feed aggregates are of known and uniform gradations so that they may be metered in the prescribed proportions and consistently produce a mixture within Specification limits. Control of the individual stockpile gradations and proportioning from those stockpiles shall be the Contractor's responsibility.

The moisture content of finished asphalt mixtures shall not exceed 1.0 percent. Moisture content determination shall be based on the weight loss on heating for one hour at 280 degrees plus or minus 5 degrees of an approximately 1,500 gram sample of finished asphalt mixture.

The drum-mixing plant shall consist of the following items of equipment:

(1) Aggregate Bin System.

The plant shall have cold feed aggregate storage bins of sufficient number and capacity to store the amount of aggregate required to keep the plant in continuous operation and proper design to prevent overflow of material from one bin compartment to that of another compartment. The number of cold feed aggregate bins shall be equal to or greater than the number of stockpiles of individual materials to be used.

The fine aggregate bin compartment(s) shall be equipped with an appropriate type and size vibrator or similar anti-bridging device which is automatically actuated when "bridging" of the material occurs, and which shuts off automatically with the onset of continuous material flow.

Each bin compartment shall be equipped with a device that visually and/or audibly signals when a no flow state occurs. Indicators shall also be provided on each bin to show the respective gate opening.

(2) Mineral Filler System.

Mineral filler shall be added from a bin and feeder separate from the aggregate cold bins. The system shall have a device to feed the mineral filler at adjustable rates accurately and uniformly. The mineral filler feed rate in tons per hour shall be accurate within 3.0 percent of the indicated rate throughout the full range of the plant's production capacity.

The feeder shall be interlocked in such a manner that production is interrupted if the bin becomes empty or the flow is obstructed.

(3) Aggregate Feed System.

The plant shall be provided with a mechanical system for uniformly and continuously feeding each aggregate in its proper proportion onto a collecting belt and then into the drum mixer. Prior to entering the mixer, the aggregate on the collector belt shall pass through a two-inch scalping screen or other device that will remove oversize aggregate or debris. The control of the quantity of aggregate fed to the drum-mixer shall be by variable speed system which provides for total and proportional control. One feeder shall be provided for each bin compartment. Each aggregate feeder shall be interlocked in such a manner that production is interrupted if one or more of the bins become empty or obstructed.

The individual bin feeder belts or the intermediate collecting belt that delivers the aggregate to the main feed for the drum-mixer shall be equipped with belt type scales (load cells) capable of continuously displaying, at the operator's station, the weight of aggregate flow in tons per hour or the corresponding percentage of total mix from each individual bin and the accumulated total from each bin in tons. The aggregate feed rate in tons per hour from each bin shall be accurate within 1.0 percent of the indicated rate throughout the full range of the plant's production capacity.

For mixes containing reclaimed asphalt pavement, the drum mix plant shall have a means for adding the reclaimed asphalt pavement to the dryer-mixer in a manner that does not damage the asphalt in the reclaimed material. Control shall be provided for proportioning the reclaimed asphalt pavement into the mixture.

Means shall be provided for compensating for the moisture in the reclaimed asphalt pavement.

Prior to being combined with the heated new aggregate, the reclaimed asphalt pavement shall pass through a 2-1/2 inch vibrating scalping screen.

(4) Asphalt Binder Metering System.

An approved system shall be provided to introduce the proper amount of asphalt binder into the mix.

The asphalt binder pump shall be a positive displacement type pump with a circulating asphalt system. The asphalt binder pump shall be equipped with a revolution counter or flow meter and a pyrometer or thermometer probe of suitable range and accuracy to record the asphalt binder temperature, with the data being transmitted to the operator's station. A flow switch designed to interrupt production, if the asphalt binder is discontinued, shall be installed in the delivery line between the meter and the mixer.

A temperature compensating device shall be provided in conjunction with the asphalt binder meter to correct the quantity of asphalt binder introduced into the mix to 60°F. The flow of asphalt to the drum-mixer shall be continuously displayed in the operator's station in units, corrected to 60°F., of tons per hour or as the corresponding percentage of the total mix. The asphalt binder feed rate in tons per hour shall be accurate within 1.0 percent of the indicated rate throughout the full range of the plant's production capacity. The accumulated weight of the asphalt binder feed to the mixer shall be totalized.

Convenient means shall be provided for diverting the asphalt binder into distributor trucks or other suitable large containers for checking the accuracy of the asphalt binder delivery system.

(5) Proportioning Control System.

The combined aggregates shall pass over a weigh belt or belt scale that is electronically interlocked with the asphalt binder metering system in such a manner as to automatically vary the asphalt binder feed rate to maintain the required asphalt binder content in the mixture, as required.

Provisions shall be made for introducing the moisture content of the cold-feed aggregates into the composite aggregate weigh belt signal and correcting wet aggregate weight to dry aggregate weight. The dry weight of the composite aggregate flow shall be continuously displayed by electronic readout at the operator's station in units of tons per hour and shall be totaled. The composite aggregate feed rate shall be accurate within one percent of the indicated rate. Belt conveyors shall be equipped with scrapers or other suitable devices to prevent adherence or other loss of the weighed cold-feed aggregate.

Before the start of production of Authority mixes, plant controls shall be calibrated. Any changes in or modifications to the equipment or operation occurring subsequent to the initial calibration shall be reported to the Engineer. Depending on the nature and extent of the modifications made, calibration checks or a new plant calibration may be directed. Recalibrating the plant also may be directed if the finished mixture displays composition deficiencies. For each drum mix plant placed in operation, two complete sets of plant drawings, a plant operator's manual, and a plan detailing the method of plant calibration shall be submitted. The Engineer will witness the calibration of the individual cold-feeders at several production rates throughout the range of plant's capacity. A copy of the computations for the combined rate of flow and a plot of calibration charts shall be submitted. Such charts shall indicate the rate of aggregate delivery in tons per hour from each cold-feeder for particular dial settings and gate openings. Calibration points shall be determined by independently diverting each cold-feed into trucks (or running each feed through the plant) and determining the proper console dial setting corresponding to the measured rate of delivery. Such calibration points shall be determined in increments of approximately 100 tons per hour of total aggregate flow.

Unless previously calibrated and approved by the NJDOT, the Engineer will witness a check on the mineral filler and asphalt binder feeds at several production rate increments throughout the range

of the plant's capacity. Calibration of the asphalt binder metering system and subsequent checks shall be accomplished by diverting the asphalt binder into trucks or other containers for weight or volumetric measurements. The method used to calibrate the mineral filler feeder system is subject to approval. The procedures shall be sufficient to ensure that the controls are marked to correspond with the calibration of the asphalt binder and mineral filler feeds.

(6) Drum Mixer.

A drum mixer of satisfactory design shall be provided. The drum-mixer shall be of the type that continually agitates the mixture of aggregate and asphalt during heating and in which the temperature can be so controlled that the aggregate or asphalt will not be injured in the necessary drying and heating operations, required to obtain a mixture of the specified temperature. A continuous recording pyrometer or thermometer shall be provided which will indicate the temperature of the mixture as it leaves the drum-mixer.

An approved method and facilities shall be provided for safely and conveniently obtaining representative mixture samples at the discharge end of the drum-mixer.

(7) Surge or Storage Bin System.

The plant shall be provided with a surge or storage bin system of adequate capacity to minimize production interruptions during the normal day's operation. The surge or storage bin shall be designed and operated to deliver the asphalt mixture meeting all the quality requirements of the Specifications.

(8) Truck Scale System.

An approved weighing system, conforming to the requirements delineated elsewhere herein, shall be furnished at a location approved by the Engineer.

(9) Emission Control System.

The plant shall be equipped as to meet all applicable limitations on emissions.

(10) Control Console.

The following items will be part of a control console furnished in the operator's station:

(a) Cold aggregate feed controls capable of both total and proportional control of the aggregates.

(b) Dryer burner controls that automatically control the temperature of the mix and record the mix temperature at the dryer discharge.

(c) Aggregate weigh belt readouts displaying the weight of material being proportioned from each aggregate bin in tons per hour or the corresponding percentage of total mix weight and the total flow over the main feeder to the drum-mixer in tons per hour. The accumulated weights in tons from each bin and the total feed to the mixer shall be separately totalized and recorded.

(d) Mineral filler readouts, displaying the weight of material being proportioned from the mineral filler bins in tons per hour, or the corresponding percentage of total mix weight together with an accumulative total in tons.

(e) Asphalt binder pump revolution counter or meter readouts indicating the quantity of asphalt binder, corrected at 60ºF., being proportioned into the mix together with an accumulative total in tons and a recording pyrometer or thermometer that records the temperature of the asphalt binder at the pump.

(f) Proportioning control dials that set the asphalt content as well as the aggregate moisture adjustment. The dials shall be capable of being key locked.

(11) Incidental Equipment.

The Contractor shall furnish power units, conveyors, aggregate handling equipment and all else necessary for the proper and continuous operation of the plant.

The plant equipment shall also include an appropriate means of proportioning, weighing, calibrating, controlling and introducing an asphalt binder additive into the mixture, as may be required.

(C) HMA PAVERS.

HMA pavers shall be self-contained, power-propelled units with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of HMA mixture in lane widths applicable to the specified typical section and thicknesses shown on the Plans. Pavers capable of constructing widths equal to two lanes (25 or 26 feet wide pavers) shall be furnished and used as specified in Subsection 302.05. Two lane pavers shall be capable of forming a crown section where required and shall be capable of transitioning from specified crown section, to straight slope across both lanes. Pavers, used for placing HMA pavement over membrane waterproofing on bridge decks, shall be equipped with rubber tires or rubber lined tractor treads.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture.

Pavers shall be equipped with automatic screed controls with sensors on either one or both sides of the paver, capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing the automatic signals which operate the screed to maintain the desired grade and transverse slope. The sensor shall be so constructed that it will operate from a reference line.

The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. The paver shall be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

The Contractor shall use a suitable small paver in all areas requiring bridge deck surfacing, except spall area repairs, as specified in Subsection 417.04. A paver, with a width between 6 and 8 feet suitable for use in areas of pavement width of less than a normal 12 foot lane width, shall be provided by the Contractor as may be required.

The Contractor shall furnish an additional paving machine, similar to the one in use, on a standby basis in case of breakdown. The additional paving machine shall be moved to each immediate area of work and placed in an area designated by the Engineer.

The Contractor shall furnish ten (10) foot, sixteen (16) foot aluminum straightedges and a ten (10) foot rolling aluminum straight edge with dye at the site for every paving machine he uses.

(D) MATERIAL TRANSFER VEHICLE.

A Material Transfer Vehicle (MTV) shall be used for the placement of all HMA on continuous wedge for leveling base, intermediate, and surface courses to be placed on the traveled way, unless otherwise approved by the Engineer. The MTV shall independently deliver a uniform mixture from the hauling equipment to the paver and shall not be used as a haul unit between the plant and paver. A paver hopper insert shall be installed in the hopper of conventional paving equipment when an MTV is used.

At a minimum, the MTV shall have a high capacity truck unloading system which will receive mixtures from the hauling equipment. It shall have a storage bin with an auger system to continuously blend the mixture prior to discharging to a conveyor system

The MTV shall be specifically designed to transfer mixture from haul units to the paver without depositing the mixture on the roadway. The placement of mixture shall be discontinued in the event of failure of the MTV, except placement will be permitted of mixture already produced at the time of the failure, if approved by the Engineer. Use of the MTV will not be considered cause to violate load limits on structures or the roadway.

(E) VEHICLES FOR TRANSPORTING HMA MIXTURES.

The trucks for hauling HMA mixtures shall have tight, clean, and smooth metal beds. Petroleum base products or diluents harmful to HMA material shall not be applied to the surface of the truck beds. A detergent or lime solution may be used to prevent the mixture from adhering to the beds. A sample of this solution shall be submitted to the Engineer for approval. Each truck shall be covered with a canvas or other suitable material of such size as to protect the mixture from the weather. Such canvas shall not be removed until the mixture is ready to be placed into the hopper of the paver. Any truck causing excessive segregation of material by its spring suspension or other contributing factors, or that shows oil leaks of any magnitude, or that causes undue delays, shall upon direction of the Engineer be discharged from the work until such conditions are corrected. When the length of haul tends to produce excessive loss of heat of mixture, or when directed by the Engineer, the vehicles shall be insulated to maintain specified placement temperature of the mixture, and all covers shall be held securely in place.

All material haul trucks delivering hot mix asphalt to the jobsite or millings from the jobsite shall be equipped with proper flashing yellow (amber) lights in accordance with Subsection 920.13 or as otherwise directed by the Engineer. Flashing lights shall be maintained in good working condition and activated whenever the vehicle enters or exits the work area.

(F) ROLLERS.

Rollers shall be of the steel wheel and pneumatic tire type and shall be in good condition, capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the HMA. Steel wheel rollers shall be equipped with adjustable scrapers to keep the wheels clean and with means of keeping the wheels moist to prevent HMA from sticking to the wheels. Wheels shall be free of flat areas, openings, or projections which would mar the surface. The number of rollers shall be sufficient to compact the mixture to the required density, while it is still in a workable condition. Other compaction equipment may be used if approved by the Engineer. The use of equipment, which results in excessive crushing of the aggregates, will not be permitted.

(1) Three-Wheel Breakdown Steel Wheel Power-Driven Rollers.

Three-Wheel Breakdown steel wheel power-driven rollers shall have a load of not less than 330 pounds per linear inch of tread of rear wheels and shall have a manufacturer's certified metal weight of not less than 10 tons. The Contractor, with approval from the Engineer, may substitute a two-axle tandem roller for use as the breakdown roller.

(2) Two-Axle Tandem.

Two-axle Tandem steel wheel power-driven rollers shall have a ballasted load of not less than 330 pounds per linear inch of tread of drive roll and shall have a manufacturer's certified metal weight of not less than 10 tons.

(3) Pneumatic-Tired Rollers.

Pneumatic-tired rollers shall be of the self-propelled type; shall have not less than 7 wheels mounting smooth tread pneumatic tires, not less than 7.50 x 15 in size; each tire shall be capable of exerting an average pressure of 90 psi $\pm$ 5 psi. Wheels shall be equally spaced along both axles and shall be so arranged that those on one axle track midway between those of the other. The wheels on one or both axles shall be arranged to oscillate in pairs or they may be individually sprung.

The roller shall be equipped with power steering and fluid drive or torque converter; be capable of turning or reversing on the hot material without scuffing or displacement of the surface; and be provided with means of wetting and cleaning the tires during operation to prevent adhesion of the HMA to the tires.

Provision shall be made for checking tire pressures at any time during operation. The tires shall be kept uniformly inflated at the pressure designated by the manufacturer to obtain the specified contact pressure and the difference in pressure between any 2 tires shall not exceed 5 psi.

The roller shall be equipped with means of adjusting the wheel load by ballasting, and the ply-rating of the tires shall be such that they will support the maximum operating wheel load at the specified maximum contact pressure.

The Contractor shall furnish to the Engineer copies of the roller manufacturer's charts or tabulations showing the contact areas and average contact pressures for the full range of tire inflation pressures and for the full range of tire loadings for each type and size of compactor tire furnished, together with copies of the calibration table or chart for the ballast box, showing the volume of the box in cubic feet for at least 3 inch increments of depth, and also showing the empty or tare weight of the roller.

(4) Vibratory Steel Wheel Rollers.

Vibratory Steel Wheel rollers shall be of the self-propelled type and shall be capable of accomplishing compaction and consolidation at least equivalent to that required of the type specified above. The use of equipment which results in excessive crushing of the aggregate will not be permitted. Vibratory rollers shall have a static weight of not less than 6 ½ tons, and shall be capable of maintaining the frequency of vibration and the amplitude specified by the manufacturer. Vibratory rollers having rubber tires on any axle shall not be used on HMA paving.

Vibratory equipment shall have dual drum, counter weight which rotates in the same direction as to the roller drum, and vibratory action capable of being shut off.

(G) LIQUID ASPHALT DISTRIBUTOR.

Liquid asphalt materials shall be applied by means of motor driven, pneumatic tired, pressure distributors of modern design, in good mechanical condition, and of not less than 1,000 gallon capacity, capable of producing sufficient pressure to apply the asphalt material in the amount and between the limits of temperature specified, calibrated as approved by the Engineer and equipped with spraying manifolds of various lengths as may be approved by the Engineer.

The liquid asphalt distributor shall be of such design that the material shall be heated indirectly. Suitable means for accurately indicating the temperature of the liquid asphalt shall be provided. The thermometer well shall be so placed as not to be in contact with a heating tube.

The materials shall be applied directly from the manifolds, except where the conditions are unsuitable for their use. Spray bars shall have a minimum length of 9 feet and shall be of the full circulating type. If a spray bar extension is used to cover a greater width, it shall be of the full circulating type. The header bar shall be adjustable to permit varying the height above the surface to be treated. The nozzles attached to the bar shall be either of the conical or flat slotted type. The center to center distance of the nozzles shall not exceed 6 inches. The valves shall be operated by levers, so that one or all valves may be quickly opened or closed in one operation. The valves which control the flow from the nozzles shall be of a positive acting design, so as to provide a uniform unbroken spread of asphalt on the surface.

The distributor shall be equipped with devices and charts to provide for accurate and rapid determination and control of the amount of material being applied, and with a tachometer of the auxiliary wheel type reading speed in feet per minute and so located as to be visible to the truck driver to enable him to maintain the constant speed required for application at the specified rate. The pump for the pressure distribution of asphalt materials shall be operated by a separate power unit, or by the truck power unit; it shall be equipped with a tachometer registering gallons per minute passing through the nozzles and readily visible to the operator. The spreading equipment shall be so designed and articulated that uniform application, in controlled amounts, may range from 0.05 to 2.0 gallons per square yard of surface, and at a uniform pressure ranging from 25 to 75 pounds per square inch.

The distributor shall be equipped with a hose and nozzle attachment to be used for spraying skipped areas inaccessible to the distributor. The distributor shall also be equipped with pressure gauges. Distributors and booster tanks shall be so maintained at all times as to prevent dripping of free asphalt material from any part of the equipment.

Each distributor and delivery vehicle shall be provided with a sampling valve inserted in the distributor line. The valve shall be clearly labeled "Sampling Valve." The distributors are subject to the approval of the Engineer. Safe and convenient access shall be provided to all sampling valves and measuring devices.

Each distributor shall be equipped with the following:

(1) A gauge sheet, available for the convenience of the Engineer, showing the number and capacity of the truck and an outage table for not less than each inch out, approved by the Engineer.

(2) A metal rod, the length of which is not less than the vertical depth of the truck tank plus one foot, with accurate 1/4 inch divisions, showing inch marks more prominently and starting with the first inch at the bottom.

(3) A device to indicate the bottom volume to within 0.5 percent of tank capacity. The device shall be at the low point of the tank and shall be visible through an observation hatch at least 8" in diameter.

(4) An accurate thermometer for determining the temperature of the liquid asphalt material being applied.

Duplicate delivery slips shall accompany each load delivered and shall contain such information as hauler certification that the tank is in suitable condition to be loaded with the specified product; a log with the truck or distributor showing the material hauled in the previous load and whether or not the tank was cleaned or drained after the last load; and producer certification to the Authority of the source, product and quantity of liquid asphalt being shipped.

(H) Small Tools.

All necessary small tools, including hand compactors, and suitable means for keeping them clean and free from accumulation of bituminous material, shall be supplied. For pavement repair, pneumatic or hand tools shall be used.

(1) Sawing equipment for sawing joints shall conform to the requirements of Subsection 304.03, except that dry diamond-edge blades or abrasive wheels shall be permitted providing that the saw cut does not result in excessive spalling at the sawed edges. Dry saws shall be equipped with an approved dust collection system to prevent airborne residue from escaping into the atmosphere. The wet sawing operation shall provide a means for removing the wet slurry from the pavement and joint wall. The blades shall be of such size and configuration that the desired dimensions of the saw cut are achieved in one pass.

(2) Pneumatic hammers, used to remove existing pavement, shall not exceed 31 pounds.

(3) The compressor for air blowing shall filter moisture and oil from the air, and shall deliver air at a minimum of 4.6 cubic yards per minute and develop a nozzle pressure of at least 87 psi.

(4) Sealing equipment for sealing joints or cracks shall consist of a kettle or melter and applicator wand. The melter shall be constructed as a double boiler, with the space between the inner and outer shells filled with oil or other heat transfer medium. The melter shall include positive temperature control, mechanical agitation, recirculation pumps, and thermometers for continuous reading of the temperature of both the sealing compound and the heat transfer medium. The applicator wand shall be heated or insulated to maintain the pouring temperature of the sealant during the placing operation. Pouring pots or similar devices shall not be used to fill sawed joints or cracks.

(5) Vibratory drum compactors shall be the self-propelled type, having one or two smooth steel drums having a minimum centrifugal force of 177 pounds per inch of width of tread of drive roll. Vibratory drum compactors shall be capable of maintaining the frequency of vibration and amplitude specified by the manufacturers. Instruction sheets indicating operational instructions, recommended amplitude, vibrations per minute, and speed settings shall be provided on each project.

302.05 Methods of Construction.

The following requirements shall apply to all HMA pavement construction:

(A) Preparation of Existing Surface.

Surfaces, upon which the asphalt paving mixtures are to be placed shall be clean, dry, and free from frost when the paving operations are about to start, and they shall be maintained in that condition. Surfaces shall be completely cleaned of all dirt, turf, weeds, debris, and other foreign materials prior to paving with HMA materials. Cleaning shall be by means of a self-propelled, pick-up type power broom, supplemented by hand-brooming and shovels. Power-broom shall be utilized with as many passes as necessary to eliminate all foreign materials.

When newly constructed base or intermediate courses have become dirty prior to placing the following

course, the surfaces to be overlayed shall be cleaned of all dirt and loose materials by means of power brooming supplemented by hand-brooming if necessary. Tack coat material shall then be applied for the full width of the area to be surfaced by means of a pressure distributor.. Tack coat shall also be applied to the vertical face of transverse joints by means of hand held pressure distributors. Tack coat applied to transverse joints shall be asphalt binder of the same grade used in the HMA mix. When HMA is laid on Portland cement concrete, the existing surface shall also be tack coated in accordance with the above.

Care shall be exercised to prevent spraying tack coat materials upon adjacent pavement, structures, guide rail, trees and shrubbery that are not to be removed, adjacent property and improvements, and any other improvements and facilities not specifically mentioned. Any of the above mentioned facilities so damaged shall be cleaned or replaced to the satisfaction of the Engineer at the expense of the Contractor. Wasting tack coat materials within the Authority right-of-way, or within sight of any part of Authority property, will not be permitted.

Pavement removal (except on bridge decks) in areas of distorted pavement, areas adjacent to existing concrete slabs, areas indicated on the Plans or on grade sheets, and other areas where directed by the Engineer, shall be by means of cold milling in accordance with Section 305. Pavement removal on bridge decks shall be in accordance with Section 417.

Disposal of dirt, debris, and all other products of cleaning surfaces in the preparation of resurfacing shall be the responsibility of the Contractor. Unless otherwise specified, all such matter shall be disposed of off Authority property.

All holes, minor depressions, and large cracks over one inch in width in the existing pavement surface shall be cleaned, tack coated, filled, and compacted with HMA mix material.

Cracks 3/8 inch to one inch wide shall be cleaned to the entire depth of the crack by use of portable blower or air compressor. Existing wedged-in non-compressible material not removed by air shall be removed by hand tools. Cracks less than 3/8 inches wide shall be routed 1/2 inch wide and to a depth of 3/4 inches to one inch, and cleaned only to the routed depth. Cracks shall be free of all dust, dirt, moisture, or foreign material before being sealed. Cracks shall be sealed in a manner to prevent voids in the sealant material. Crack Sealant material shall be applied to completely fill the void depth flush to the adjacent surfaces.

The Contractor shall seal all existing longitudinal bridge pavement joints existing within the lane detour zone during lane closings provided for striping changes and prior to implementation of traffic shift. Cost for sealing longitudinal pavement joints shall be included with the bid price for HMA bridge surfacing item.

Surfaces upon which "crack spanning membrane" or "Paveprep" material is to be placed shall be clean, free of dirt, water or other deleterious materials for a minimum of 12 inches on each side of the crack. A properly milled surface resulting in a diamond grid will be acceptable. A grooved surface and/or ridges resulting from milling or over-cutting are not acceptable. The final surface, prior to tack and membrane application, shall be absolutely clean and free from oil, dust, or deleterious materials.

A properly milled surface is considered suitable to accept the "Paveprep" material provided the surface is absolutely clean, and the tack coat is properly applied.

The existing crack between pavement and the approach slab shall be air blasted to clean out debris and then filled with hot-poured joint sealer prior to placement of the tack coat and membrane mat.

Resurfacing shall not take place until all of the above work is completed in each work area.

(1) Tack Coat Application.

Tack coat material shall be applied to the cleaned surfaces for the full width of the areas to be resurfaced at the rate and in the manner prescribed below. Exposed vertical cut faces of existing asphalt or concrete pavement shall also be coated with the tack coat material. Tack coat shall be applied just prior to placement of the HMA surface course. Tack coat shall not be applied over membrane waterproofing surfaces.

Contact surfaces of curbings, gutters, manholes, and other structures shall be painted with a thin uniform coating of tack coat material just before the HMA mixture is placed against them. The tack coat shall be carefully applied and in such a manner that the tack coat shall not show above the surface of the finished pavement.

Tack coat materials shall not be applied when, in the opinion of the Engineer, conditions are unsuitable or when the atmospheric temperature is below 40 degrees F. Tack coat materials shall only be applied with the ambient temperature is a minimum of 40 degrees F and the ambient temperature has not been below 32 degrees F for 12 hours immediately prior to application, unless approved otherwise by the Engineer.

The tack coat shall be applied by means of a pressurized sprayer in good working condition capable of spraying at a rate of 0.02 to 0.15 gallons per square yard. In no case shall the tack coat application exceed 0.15 gallons per square yard.

Tack coat application rates and materials shall be in accordance with the following:

Minimum Tack Coat Application Rates (gallons per square yard)		
	HMA	*OGFC*
Over New HMA	0.03 to 0.05	0.05 to 0.08
Over Existing HMA and PCC Pavement	0.05 to 0.07	0.06 to 0.12
Over Milled Pavement	0.06 to 0.12	0.08 to 0.12

Material	*Spraying Temperature*	*Season*
Cut-Back Asphalt		
RC-70	120° - 190°F	Oct. 15 – Apr. 15
Emulsified Asphalt		
RS-1	70° - 140°F	All Year
SS-1	70° - 140°F	All Year

(2) Crack Spanning Membrane Placement.

The edges of the crack spanning membrane material shall be well bonded to the prepared surface of the milled asphalt. The width of the asphalt tack application shall be at least 3 inches wider than the width of the membrane material and shall be applied no further in advance of the material placement than can be accomplished without losing adhesion abilities of the tack coat.

The crack spanning membrane or "Paveprep" material shall be placed into the tack coat prior to its cooling and loss of tackiness. The material shall be unrolled so that the corners naturally turn down.

Where adjacent segments of the mat meet, the material shall be butted or overlapped, as recommended by the manufacturer, so as to provide complete waterproofing protection. Additional tack coat shall be as required to bond the two membrane areas together.

Material damaged after placement and prior to resurfacing shall be removed and replaced by the Contractor at his expense.

The placement of asphalt surfacing can follow at any time after placement of the material.

Immediately after the placement of HMA bridge surfacing in areas of deck slab replacement and deck resurfacing, the horizontal joint between the new and existing surfacing shall be sealed with asphalt binder, applied with a brush or roller to a width not to exceed 1 inch each side of the joint.

HMA shall not be placed over the tack coat until the emulsion has broken.

(B) Installation of Membrane Waterproofing on Bridge Decks.

Prior to applying the primer, the entire surface of bridge decks and the sides of the curb for a height of 1 inch above the top of its surface course shall be thoroughly cleaned and shall be free of all foreign material such as dirt, grease, clay, dust, salt deposits, etc. All loose and/or adhering foreign material shall be removed from the deck using air jets, sandblasting, mechanical sweepers, hand broom or other approved methods. Any unusually sharp concrete edges on the deck surface, which would puncture

the membrane, shall be corrected in a manner satisfactory to the Engineer, prior to application of the membrane waterproofing.

The primer shall not be applied nor membrane waterproofing installed during wet weather conditions or when the deck and ambient temperatures are below the prescribed minimum temperature for the application of the HMA surface course. The deck, shoulder and walk area surfaces shall be thoroughly clean and visibly dry prior to and during application of the primer.

The primer shall be applied uniformly with a squeegee, brush, or roller and worked thoroughly into the concrete surface at a rate prescribed or, if not prescribed, as recommended by the manufacturer. The membrane shall be applied as recommended by the manufacturer provided that the primed surface does not become contaminated with foreign matter or moisture.

After the primer has dried, one layer of membrane shall be applied. The release paper, protecting the tacky surface of the membrane, shall be removed from the membrane, and the membrane shall be rolled with the tacky side face down so as to bond to the primed deck surface. The membrane may be applied by hand methods or mechanical applicators. Overlaps shall be a minimum of 4 inches at the edges and ends of each strip and shall be made in a manner to provide a shingling effect toward the low side of the deck. Overlaps shall be sealed in accordance with the manufacturer's recommended procedure. Hand rollers or other satisfactory pressure apparatus shall be used on the applied membrane to assure firm and uniform contact with the primed surface. Special care shall be used at the curb, parapet, or barrier face to insure that the membrane is uniformly adhered to the concrete. The entire membrane shall be free of wrinkles, air bubbles, and other placement defects.

Membrane waterproofing at drop inlets, vertical concrete surfaces and roadway joints shall be placed in accordance with the details shown on the Plans. At concrete curbs, barriers and other vertical concrete faces adjacent to areas of bridge deck surfacing, a membrane flashing strip shall be installed in the manner detailed on the Plans and in accordance with the membrane manufacturer's recommendations.

Any torn or cut areas or narrow overlaps shall be patched by coating the area with primer and then placing sections of the membrane over the defective area in such a manner that the patch extends at least 6 inches beyond the defect in all directions. The patch shall be rolled or firmly pressed onto the surface.

Membrane waterproofing shall be placed in continuous sheets. Cutting membrane waterproofing, thereby leaving temporary openings around spall and deck repairs, will not be permitted.

After the membrane waterproofing has been completed, the membrane at all deck drain pipes shall be cut with 2 right angle cuts. The cuts shall be made to the inside diameter of the drain pipe, and the corners made by the cutting shall be turned down into the drains and laid in a coating of primer.

Rubber tired vehicles, including paving equipment, may be allowed on the bare membrane only at such time and in such manner as approved by the Engineer.

(C) Preparation of Asphalt Binder.

The asphalt binder shall be heated at the plant and shall be brought to a temperature as recommended by the asphalt binder manufacturer and/or the mix design. The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt binder to the mixer at a uniform temperature at all times. The specified temperature viscosity information shall be furnished by the refinery with each shipment of asphalt binder.

(D) Preparation of Aggregates.

The aggregates for the mixture shall be dried and heated to the temperature required to produce the specified lay down temperature of the mixture. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid soot on the aggregate.

Immediately after heating and drying, the aggregates shall be screened into three or more fractions as determined by the job-mix formula and conveyed into separate compartments ready for batching and mixing with asphalt binder.

(E) Mixing.

The size of the weighted batches shall be based on the manufacturer's capacity rating of the mixer.

The dried aggregates shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The asphalt binder shall be measured by weight or metered and introduced into the mixer in the amount specified by the job-mix formula.

After the required amounts of aggregate and asphalt binder have been introduced into the mixer, the materials shall be mixed for a period of not less than 25 seconds, until a complete and uniform coating of the particles and a thorough distribution of the asphalt binder throughout the aggregate, is secured.

The total mineral aggregate and asphalt shall be so combined and mixed that at least 95 percent of the coarse aggregate particles are entirely coated with asphalt binder, as determined by AASHTO Designation T 195. At the option of the Engineer, random samples will be taken from each of 5 trucks and the adequacy of the mixing will be based on the average of particle counts made on these 5 test portions. If the above requirements are not fully met, mixing time shall be increased as necessary to obtain the required degree of coating.

The finished mixture shall be such that it may be handled, placed, and compacted without stripping the asphalt binder from the aggregate.

(F) STORING OR HOLDING THE MIXTURE.

A mixture may be stored or held in surge or storage bins for a period not to exceed 12 hours, provided that the characteristics of the mixture after storing or holding are substantially the same as those of the mixture when discharged from the pugmill.

(G) TRANSPORTATION AND DELIVERY.

No loads shall be sent out so late in the day as to prevent completion of the spreading and compaction of the mixture during daylight, unless otherwise permitted by the Engineer; in such event the Contractor shall provide artificial lighting satisfactory to the Engineer. In case of unexpected rain, material previously loaded may be placed at the Contractor's risk.

(H) PLACING LIMITATIONS.

Asphalt paving mixtures shall not be placed when weather or surface conditions are such that the material cannot be properly handled, finished, or compacted. The surface upon which HMA mixtures are to be placed shall be free of moisture at the time such materials are spread.

Intermediate and/or surface courses must be completed in its entirety for the full-length of the paving section attempted that work day. Where the construction of new HMA pavement will result in a vertical drop-off the drop off shall be 2 inches or less.

All paving equipment including rollers, pavers, water trucks and tack coat trucks to be utilized for resurfacing during non-daylight hours shall be equipped with a minimum of two (2) lights directed in each direction of travel of the equipment and powered with portable generators. Lights shall not interfere with an active lane or roadway and must be adequate to allow for complete inspection of the paved roadway by the Engineer both before and after compaction.

Open joints and inlets shall be effectively covered prior to placement of HMA surfacing.

The temperature of the base upon which the asphalt paving mixture is to be placed, the corresponding minimum lay down temperature of the mixture (in the paver), and the minimum rolling time shall conform to the following requirements unless otherwise recommended by the mix design and control strip operations:

Minimum Laydown Temperature						
Course Thickness						
Base Temp. °F	*1/2"*	*3/4"*	*1"*	*1-1/2"*	*2"*	*3" and Greater*
20-32	---	---	---	---	---	285 (see Note)
32-40	---	---	---	305	295	280
40-50	---	---	310	300	285	275
50-60	---	310	300	295	280	270
60-70	310	300	290	285	275	265

Minimum Laydown Temperature						
Course Thickness						
Base Temp. °F	*1/2"*	*3/4"*	*1"*	*1-1/2"*	*2"*	*3" and Greater*
70-80	300	290	285	280	270	265
80-90	290	280	275	270	265	260
90	280	275	270	265	260	255
Rolling Time Minutes	4	6	8	12	15	15

Note: *Increase by 15 degrees when placement is on base or sub-base containing frozen moisture.*

The minimum lay down temperature of the HMA bridge surfacing mixture (in the paver), when the temperature of the bridge deck surface is between 40 and 50°F, shall be 325°F and shall be 300°F when the temperature of the bridge deck surface is 51°F and over.

HMA paving or bridge surfacing mixture shall not be placed at a temperature lower than the minimum temperature specified above, nor shall any mixture be used whose temperature has at any time exceeded 365°F.

Should the Contractor be unable to complete the rolling within the time specified, the placing of the HMA mixture shall cease until sufficient rollers are available, or other corrective action is taken, to permit the completion of the rolling within the specified time.

(I) SPREADING AND FINISHING.

The mixture shall be laid upon an approved surface, spread and struck off to the required grade elevation. When paving widths of one or two traffic lanes, the entire width shall be placed by one paver in one pass; longitudinal joints will not be permitted. When paving widths of more than two traffic lanes, two pavers shall operate in echelon, so that the entire width of the roadway is covered in one pass. The second paver shall follow as closely as possible behind the first paver so that the temperature of the mixture in the advance lane will not fall below 150°F. At all times, each paver shall be fully manned when paving operations are in progress.

Plant production, the number of trucks, and the speed of the asphalt paver(s) shall be such as to insure delivery of the mixture to the project in sufficient quantities and at such intervals as to permit the continuous placement of the mixture with minimal stopping and starting of the paving operation. Failure to maintain such delivery shall be cause for the Engineer to suspend the work.

When delivery of material is delayed, so that a paver remains idle for more than 30 minutes, the paver shall be moved away from the end of the lane and the material in place fully compacted. When adequate material is at hand to insure against further delay, the material at the end of the partially completed lane shall be cut back and a transverse joint constructed.

Automatic control of the screed will be required for the construction of all courses in the main lanes of each roadway and any adjacent deceleration and acceleration lanes. The Contractor may employ automatic screed control for shoulders, if practicable. The Contractor shall furnish and install all necessary materials and devices, such as screed rails on adjustable chairs or piano wire strung between driven pins, to serve as a guide for the sensor in surfacing to the proper grades.

The Contractor shall provide reference lines for vertical and horizontal control for the first lane of pavement on a roadway. The grade and slope for adjacent lanes shall be controlled automatically by means of a ski, not less than 20 feet long, and a slope control device. Shoes for grade control shall not be used unless approved by the Engineer. The Contractor shall furnish and install all pins, brackets, tensioning devices, wire and accessories necessary for satisfactory operation of the automatic control equipment.

Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually to permit the placement of the asphalt mixture previously loaded. Further paving will be discontinued until the automatic controls are satisfactorily repaired.

On minor areas and in areas where irregularities or unavoidable obstacles make the use of mechanical

spreading and finishing equipment impracticable, the mixture shall be spread, raked, luted and compacted by hand tools. For such areas, the mixture shall be placed, spread, and screeded to give the required compacted thickness. When such irregular areas are located adjacent to a machine-laid surface, hand placing shall be delayed until the machine laying of the adjacent surface is completed.

Whenever work areas commence or terminate, the surface courses shall be featheredged following the irregular limits shown on the Plans. The featheredging shall be accomplished by decreasing the full thickness of course in order to maintain the required profile, using the screed controls until the course thickness is approximately 1/2 inch. The remainder of the course shall be constructed by broadcasting the mix for the purpose of segregating the large aggregate which shall be promptly removed. This shall be immediately followed by the rolling operations. All featheredging work shall be under the direction of the Engineer.

If a void should appear on the asphalt mat after it has been screeded, the contractor shall place asphalt mixture by hand in the void and rake out all large aggregate. Broadcasting will not be permitted.

For work areas where detailed plans and/or grade sheets are not provided by the Authority:

(1) The Contractor shall furnish and install all necessary materials and devices, such as screed rails on adjustable chairs or piano wire strung between drive pins at 25 foot centers, for spreading the left lane leveling course. Such screed rails or piano wire shall be set to provide a compacted intermediate course thickness of five-eighths inches. The vertical alignment of the screed rails or piano wire shall be adjusted to a smooth profile at the direction of the Engineer. A minimum length of 1,000 feet of such sensor control shall be approved by the Engineer prior to spreading any asphalt material.

(2) The cross slope of the screed for all lifts shall be set to duplicate the cross slope of the existing pavement surface or as directed by the Engineer. The existing pavement cross slope shall be determined and recorded by the Contractor prior to applying tack coat material.

(3) Screed controls for all other lifts shall employ approved compensating devices to adjust the grade line, so that minor changes in grade elevations will not be reflected immediately in the finished surface.

(J) JOINTS.

Longitudinal and transverse joints in base and intermediate courses shall be offset from the joint in the underlying course by not less than six (6) inches, stepping progressively as shown on the Plans or as directed by the Engineer. The longitudinal joint in the surface course shall be offset 1'-0" from the lane lines.

(1) Transverse joints shall be carefully constructed and thoroughly compacted to provide a smooth riding surface. Joints shall be straight-edged to check smoothness. If the line of joint is formed with a bulkhead, it shall form a straight line and vertical face. If a bulkhead is not used to form the joint, the joint shall be made by sawing the compacted mixture a sufficient distance back of the end of the placement to assure full thickness of the pavement at the joint; the material ahead of the sawed joint shall be removed. In either case, the joint face shall be painted with a thin coat of hot asphalt binder before the fresh material is placed against it. Cross rolling, unless prohibited by field conditions, is required to obtain thorough compaction of these joints.

All transverse joints constructed against new and existing pavement to remain in place shall be surface scaled with asphalt cement viscosity Grade AC-20 in accordance with the Plans, these Specifications or as directed by the Engineer.

Bridge deck resurfacing at deck joints shall be in accordance with the applicable requirements of Subsection 417.07.

(2) Where longitudinal joints are constructed, and due to the required maintenance of traffic or to unforeseeable conditions, the temperature of the mixture at the longitudinal edge of the strip first laid becomes less than 150°F., the edge shall, prior to paving the adjacent strip, be painted with a thin coat of hot asphalt binder of the same grade used in the HMA mix. If the edge of the joint is not vertical, it shall be saw cut to a vertical face.

For all longitudinal pavement joints constructed against cold pavement or existing pavement to remain in place the Contractor shall thoroughly clean the joints to ensure they are free of dust and debris and apply polymerized joint adhesive over the entire joint. The Contractor shall uniformly apply a 1/8" thick coating of polymerized joint adhesive over the entire joint face. The material shall be applied slowly to ensure an even coating thickness. Polymerized joint adhesive material shall conform to the requirements set forth in Section 904 of these Specifications.

(3) When bridge joint material removal is required, the Contractor shall carefully remove the existing preformed joint filler in a manner so as not to damage existing flashing, clean the openings, repair spalled areas in accordance with Subsection 417.06 and install new preformed joint filler, crack spanning membrane and membrane waterproofing prior to resurfacing. The HMA bridge surfacing shall then be placed across the deck joint to the specified limits.

After completion of bridge deck resurfacing, the Contractor shall make a saw cut over the

preformed joint filler, being careful not damage the membrane waterproofing material and clean and seal the void with hot poured joint sealer , in accordance with details shown or as directed by the Engineer.

The Contractor shall temporarily plug open joints prior to the removal of existing surfacing. The joints shall be thoroughly cleaned out and free of all debris prior to opening the lane(s) to traffic.

(K) COMPACTION.

Compaction requirements are as follows:

(1) Compacted Thickness.

All HMA mixes shall be constructed in layers not less than 3 nor more than 5 times the nominal maximum aggregate size of the mixture being constructed.

Base Courses greater than 5 inches in thickness shall be placed in two equal compacted layers.

HMA mixtures placed for bridge surfacing or for approach roadway surfacing shall be placed in one layer to the compacted thickness prescribed above or shown on the Plans, which will achieve a smooth profile using the bridge armor joints and/or the bridge profile for control, or as directed by the Engineer. The details shown on the plans shall be followed for transitioning the new pavement to existing pavement.

The Contractor shall take elevations by survey along the toe of the new bridge barrier parapet and along the top of the existing pavement edge prior to placement of HMA bridge surfacing. The elevations shall be taken at no longer than 25 foot intervals and at all deck joint locations, and they shall be submitted to the Engineer as shop drawings for review a minimum of 14 days before resurfacing. Adjustments may be made to the cross slopes, if shown on the plans, depending on the vertical deflection of the bridge deck and parapet construction.

The Contractor shall pave so that in the final compacted state, the asphalt surfacing meets the top of armoring or if there is no armor joint the surfacing meets joint headers or abutment headblocks with an allowable tolerance of +1/8" to +1/4". In order to achieve the desired grades, a smooth profile and a smooth riding pavement surface, the Contractor shall employ string lining or take elevations to establish pavement lift control points at the appropriate spacing, as necessary, to develop a profile that meets the aforementioned requirements.

(2) Rolling.

Immediately after the asphalt paving mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.

The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving.

Rolling shall begin at the sides and progress gradually to the center, except that on superelevated curves, rolling shall progress from the lower to the upper edge parallel to the centerline, and uniformly lapping each preceding track until the entire surface has been rolled at least once by the rear wheels.

When compacting the longitudinal edge of the first lanes placed using the wedge joint, the breakdown roller shall not extend more than 2 inches over the top of the sloped face of the wedge joint.

Alternate passes of the roller shall be terminated in stops approximately 2 feet from the preceding stop. When paving in echelon, rollers shall not compact within 6 inches of an edge where an adjacent lane is to be placed.

The drive wheels of the rollers shall be toward the paver during compaction operation.

Rollers shall move at a slow but uniform speed. Maximum roller speed shall be 3 miles per hour except for vibratory rollers used on the surface course where the maximum speed shall be 2 ½ miles per hour. Rolling shall be continued until all roller marks are eliminated, and the air voids conform to the specified requirements.

Any displacement occurring as a result of reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of lutes and addition of fresh mixture when required. Care shall be exercised in rolling not to displace the line and grade of the edges of the HMA mixture.

If necessary to prevent adhesion of the mixture to the rollers, the wheels shall be kept moistened with water mixed with very small quantities of detergent or other similar material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls, and other places not accessible to the rollers, the mixture shall be compacted by a vibratory drum compactor, according to Subsection 302.04.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of asphalt binder material shall be removed and replaced.

When the average lay down rate does not exceed 2,000 square yards per hour, initial or breakdown rolling shall be accomplished by at least one three-wheel roller, and final rolling shall be accomplished by at least one tandem roller except, if permitted, one vibratory roller, meeting the requirements specified elsewhere herein, may be substituted for both the three-wheel roller and the tandem roller. However, if the vibratory roller does not produce a surface free of roller marks and ridges, a tandem roller shall be used for final rolling.

When the average lay down rate exceeds 2,000 square yards per hour, but is less than 4,000 square yards per hour, initial or breakdown rolling shall be accomplished by at least two three-wheel rollers and final rolling shall be accomplished by at least one tandem roller except, if permitted, one vibratory roller, meeting the requirements specified elsewhere herein, may be substituted for one three-wheel roller and the tandem roller. However, if the vibratory roller does not produce a surface free of roller marks and ridges, a tandem roller shall be used for final rolling.

When the average lay down rate exceeds 4,000 square yards per hour, initial or breakdown rolling shall be accomplished by at least three, three-wheel rollers and final rolling shall be accomplished by at least two tandem rollers except, if permitted, one vibratory roller, meeting the requirements specified elsewhere herein may be substituted for one three-wheel roller and one tandem roller, or two such vibratory rollers may be substituted for two three-wheel rollers and the two tandem rollers. However, if the vibratory roller does not produce a surface free of roller marks and ridges, a tandem roller shall be used for final rolling.

Demonstrate compaction capability for a particular vibratory roller as directed. During compaction with the vibratory roller, if there is excessive aggregate fracture or crushing, lateral displacement or compaction waves, the vibratory roller will not be approved.

(3) Test Strip.

One or more test strips shall be constructed for each course (base, intermediate and surface) for the purpose of determining project density and rolling pattern requirements. The test strip shall be constructed for the first 700 to 1,200 square yards placed for each job mix formula. Prior to paving, a detailed plan of the test strip shall be submitted to the Engineer for review and approval. During paving of the test strip, the Contractor shall record and submit the following information to the Engineer:

(a) Ambient temperature.

(b) Base temperature.

(c) Nuclear density readings

(d) Core density readings.

When the temperature of the bituminous pavement permits, five cores, 6 inches in nominal diameter, shall be removed and tested according to Subsection 302.08, in order to correlate the nuclear density gauge testing with the core results. The core and nuclear density gauge testing results shall be submitted to the Engineer prior to the next day's paving. Failure to submit the reports will result in suspended paving operations. The core results shall include the bulk specific gravity and maximum specific gravity determined from testing, and the calculated percent air

voids. The nuclear density gauge testing results shall include the bulk density as measured by the gauge, the maximum density based on the maximum specific gravity determined at the plant, and the calculated percent air voids.

Upon completion of the test strip, the Contractor shall determine the appropriate method to proceed. If the Contractor elects to continue production, the day's production including the test strip will be subject to the regular acceptance procedure. If the Contractor elects to discontinue production, the Contractor shall notify the Engineer indicating that a second test strip is necessary due to unsatisfactory results. The paving placed up to that point will be treated as a separate lot, and will not be subject to the lot size requirements stated herein. The test strip lot will be evaluated in accordance with the acceptance plan and pay adjustment provisions of these specifications. If more than two test strips are required, the Contractor shall obtain written approval from the Engineer.

A quality control plan outlining the use of the nuclear density gauge, cores, and the control of the compaction process shall be submitted for approval by the Engineer. Paving operations shall not begin prior to approval of the quality control plan. The Contractor shall perform quality control testing of compaction by use of a thin lift nuclear density gauge in accordance with ASTM D 2950. Cores shall be taken for correlation with the nuclear gauge at a frequency of not less than one core per week and not more than two cores per 1,100 tons. A higher frequency of coring may be approved by the Engineer with valid cause presented by the Contractor. Cores for correlation with the nuclear density gauge shall be tested by the Contractor. Results of both the nuclear density and core testing shall be furnished on a weekly basis to the Engineer. Core and nuclear density results shall include the bulk specific gravity, the maximum specific gravity in accordance with AASHTO T 209, and the calculated air voids. Failure to submit the core and nuclear density test results from the previous weeks paving, will result in suspended paving operations.

(L) SAMPLING AND TESTING.

(1) Batch and Drum Mix Plants.

Five random samples will be taken from each lot of approximately 3000 tons of each type of mix. When a lot of asphalt concrete is necessarily less than 3000 tons, samples will be taken at random for each type of mix at the rate of one sample for each 600 tons or fraction thereof.

At the manual batch plants and drum mix plants, the bituminous mixture will be sampled and tested for compliance.

To determine the quantity of asphalt binder and gradation of the aggregate in the asphalt concrete mixtures for acceptance testing purposes, extractions at the sampling rate specified will be performed each day for each type mixture in accordance with Test B-4 in Section 990.

(2) General Sampling and Testing Requirements.

Acceptance testing of asphalt concrete will be performed in a timely manner.

The Authority will not perform the composition control testing or other routine test functions in the absence of or in lieu of the plant laboratory technician.

Acceptance testing does not preclude the Engineer from requiring disposal of any batch or shipment without further testing which is rendered unfit for its intended use due to contamination, segregation, improper temperature or incomplete coating of the aggregate. For other than improper temperature, visual inspection of the material by the Engineer is considered sufficient ground for such rejection.

When materials are rejected for any of the above reasons, except for improper temperature, samples will be taken for testing. Should such testing indicate that the material was erroneously rejected, payment will be made for the rejected material.

HMA mixtures processed through a surge or storage system will be inspected visually to assure that they are essentially free of lumps of cold material. A batch or shipment of material found to be so contaminated will be rejected and shall be disposed of.

(3) Conformance to Job Mix Formula.

Conformance to the job mix formula will be determined on the basis of extraction or burnoff oven samples taken and tested at the mixing plant for both batch and drum oven mix plants.

The average of test results for the five samples or less for a lot shall conform to the job mix formula within the applicable tolerances of Section 903.

(4) Conformance to Volumetric Requirements.

Provisions of Section 903 and the following shall apply for control only.

Volumetric properties will be determined on the basis of samples taken, compacted and tested at the mixing plant. A gyratory compactor meeting the requirements of AASHTO TP24 must be provided for the compaction of specimens at the mixing plant. The material for the volumetric properties will be obtained in accordance with Test B-3 in Section 990 at the mixing plant at the same time that the random samples are taken for composition analysis. The material will be compacted in accordance with AASHTO TP4. Volumetric properties must conform to the density, VMA, and VFA requirements listed in the above tables. If two samples in a lot do not conform to the volumetric requirements, corrective action shall be initiated immediately.

The Bulk Specific Gravity of the compacted sample will be determined in accordance with Test B-9 of Section 990.

(5) Pavement Samples.

The Authority will, at no cost to the Contractor, arrange with a laboratory to cut core samples from the completed course which will be used for determining the thickness, composition, density and air voids of the mixtures. The Authority's laboratory will also patch and compact the cored holes.

(M) Cleaning of Shoulders.

The Contractor shall utilize equipment that can remove debris deposits from the edges of shoulders or closed lanes without restricting the use of active adjacent lanes. The debris removal equipment shall only travel in the direction of traffic and shall be equipped with dust control.

The Contractor shall clean the right shoulders no more than two days prior to shifting traffic on to the shoulder for construction. During the following stages the Contractor shall perform cleaning of traffic lanes (during lane closing) as directed by the Engineer.

All closings for the cleaning of shoulders or lanes shall be performed by the Contractor's forces.

The Contractor shall submit his plan for cleaning of shoulders or lanes to the Engineer for review and approval 30 days after Contract is awarded. The plan shall detail the Contractor's methods for removal of debris deposits, including the work force and number and type of equipment to be used.

Disposal of dirt, debris, and all other products collected during the cleaning of shoulders shall be the responsibility of the Contractor and shall be legally disposed of off Authority property.

302.06 Surface Requirements.

(A) General.

Tests for conformity with the specified crown and grade shall be made by the Contractor under supervision of the Engineer immediately after the course is screeded and again immediately after initial rolling; variations shall be corrected by removing or adding materials as may be necessary. Rolling shall then be continued as specified.

After rolling the surface of each finished course shall be free from waves or irregularities so that when a straightedge 10 feet long is laid on the surface parallel to the centerline, the surface shall in no place vary from the lower edge of the straightedge more than the following amounts:

For Base Courses ..... 1/2 inch

For Intermediate Courses ..... 3/16 inch

For Surface Courses ..... 1/8 inch

Additional compensation, extension of time, or other concession will not be granted because of revised methods or equipment necessary to produce an asphalt concrete surface in conformity with the specified surface requirements.

(B) SURFACE ACCEPTANCE REQUIREMENTS - NEW CONSTRUCTION OR RECONSTRUCTION PROJECTS.

(1) Permissible Surface Variations.

The asphalt concrete surface course will be tested with a rolling Straightedge that automatically marks, in colored dye, the length of surface variations which exceed a tolerance of 1/8 inch in 10 feet, in accordance with the following:

(a) The asphalt concrete surface course, placed in the traveled way of mainline pavement or at other locations indicated on the plans or in the Supplementary Specifications, shall be constructed, so that when tested in accordance with the requirements specified below, the measured length of lot exceeding 1/8 inch tolerance shall not exceed 1.3 percent.

(b) The measured length of such areas exceeding the 1/8 inch tolerance shall not exceed 3.5 percent for asphalt concrete surface course placed in areas other than those specified above, when tested for acceptance in accordance with the requirements specified in Subsection 302.06(B)(3). The number, length, and location of Straightedge tests undertaken to determine conformity in such areas will be at the sole discretion of the Engineer.

(2) Surface Acceptance Plan.

Any required sweeping of the surface prior to acceptance testing shall be performed.

Conformance to the surface tolerance for HMA, placed at the locations specified in Subsection 302.06(B)(1), will be determined in lots, each lot being equal to the total number of Tons of mixture accepted and placed each production day, less the weight of such mixture placed in areas other than those specified in Subsection 302.06(B)(1). When the weight of the surface course placed in areas other than those specified in Subsection 302.06(B)(1) cannot be readily determined from weigh tickets and other records, it shall be calculated based on the square yards of such areas paved on the given day, the specified thickness, and the average mix weight per 1/8 inch thick per square yard.

The acceptance of a lot will be based on the percentage of the total length of the lot having surface variation exceeding 1/8 inch in 10 feet, this percent noncompliance being defined as the lot percent defective length. Lot percent defective length will be computed by adding the lengths, to the nearest foot, of individual surface defects exceeding the specified tolerance, dividing this sum by the total length tested, and multiplying by 100 to convert to percent.

The full extent of the lot will be tested in the longitudinal direction. The transverse location of the test will be in the wheelpaths of vehicle travel, defined as the two imaginary lines located approximately 3 feet on each side of the centerline of the lane and extending for the full length of the lane. The wheelpath of the test will be determined randomly and varied every 100 to 130 yards.

The minimum number of full-length tests required to determine the lot percent defective length is shown in Table 302-1. The 25 percent sampling plan, wherein the number of tests is at least equal to one-fourth of the number of wheelpaths in a day's production, will be used initially. The bituminous concrete surface course will be accepted when the lot percent defective length is equal to or less than 1.0 based on the 25 percent sampling plan. If a lot percent defective length of 1.1 to 3.4 is indicated by the tests of the 25 percent sampling plan, additional tests will be performed such that the total number of tests performed equals that shown for the 50 percent sampling plan. If the lot percent defective length in the 25 to 50 percent sampling plan exceeds 3.4, the full length of each wheelpath will be tested.

Table 302-1 Surface Acceptance Testing Schedule						
Corresponding Number of Wheelpaths to be Tested						
				Lot Percent Defective		*Reduction*
Sampling Plan	*One Lane*	*Two Lanes*	*Three Lanes*	*Four Lanes*	*Length Measured*	*Or Retest Requirement*
25%	See 50% Sampling Plan	1	2	2	0 to 1.0	None
					1.1 to 3.4	Perform 50% Testing
					3.5 or more	Test each wheelpath
50%	1	2	3	4	0 to 3.4	As per Table 302-2
					3.5 or more	Test each wheelpath
100%	2	4	6	8	All values	As per Table 302-2

When more than one test is specified in Table 302-1, the initial and intermediate transverse locations of each test will be determined randomly. In no case will exact duplicate tests be performed. When testing of all wheelpaths is specified, intermediate transverse variation of the individual tests will not be made. The results of preceding tests will no be included in the computation of lot percent defective length when application of the 100 percent sampling plan is indicated.

Tests may be performed beyond the minimums specified in Table 302-1. In addition to the tests run on randomly selected sites, any area which appears defective may be tested including a previous day's production which is damaged by construction.

If the lot percent defective length is 1.4 to 3.4 inclusive, and if the Contractor elects not to remove and replace the HMA surface course, the lot will be accepted upon written request provided that payment for the lot is reduced in accordance with Table 302-2.

Table 302-2 Reduction per Lot Due to Nonconformance to Surface Requirements	
Lot Percent Defective Length	*Reduction Per Lot, Percent*
0 - 1.3	None
1.4 - 2.3	12
2.4 - 3.4	30

If the lot percent defective length exceeds 3.4, any or all of the material in the lot may be directed to be removed, replaced, and retested for acceptance. If the material is permitted to remain in place, payment will not be made for that quantity of material.

(3) Surface Acceptance Plan - Other Areas.

The paving operation for areas other than the traveled way of mainline pavement is acceptable if the percent defective length of the HMA surface course does not exceed 3.5. If the percent defective length exceeds 3.5, the Engineer may direct that paving operations be discontinued until mutually acceptable paving methods and/or equipment are used.

(C) Surface Acceptance Requirements - Resurfacing or Widening Projects.

(1) Permissible Surface Variations.

The HMA surface course will be tested with a rolling Straightedge that automatically marks, in colored dye, the length of surface variations which exceed a tolerance of 1/8 inch in 10 yards, in accordance with the following:

(a) The HMA surface course, placed in the traveled way of mainline pavement or at other locations indicated on the Plans or in the Supplementary Specifications, shall be constructed so that when tested in accordance with Subsection 302.06(C)(2) below. The measured length of lot exceeding the 1/8 inch tolerance shall not exceed 3.5 percent.

(b) The HMA surface course placed in areas other than those specified above will be tested for acceptance in accordance with Subsection 302.06(B)(3). The measured length of such areas exceeding the 1/8 inch tolerance shall not exceed 3.5 percent. The number, length, and location of Straightedge tests, undertaken to determine conformity in such areas, will be at the sole discretion of the Engineer.

(2) Surface Acceptance Plan.

Any required sweeping of the surface prior to acceptance testing shall be performed.

Conformance to the surface tolerance for HMA will be determined in lots. Each lot will generally be 400 yards long and one lane wide, the latter dimension being determined from the Plans.

The specific limits of each lot will be established by starting at one end of the Project and progressing towards the other in 400-yard increments in the direction of the traffic.

When this procedure results in a remaining pavement length of 300 yards or less, that length of pavement shall be included in and become part of the immediately preceding lot. If the pavement remainder is greater than 300 yards, it shall be considered a separated lot.

The acceptance of a lot will be based on the percentage of the total length of the lot having surface variation exceeding 1/8 inch in 10 feet, this percent noncompliance being defined as the lot percent defective length. Lot percent defective length will be computed by adding the lengths, to the nearest foot, of individual surface defects exceeding the specified tolerance. Dividing this sum by the total length tested, and multiplying by 100 to convert to percent.

The full extent of the lot will be tested in the longitudinal direction. The transverse location of the test will be in the wheelpaths of vehicle travel, defined as the two imaginary lines located approximately 1 yard on each side of the centerline of the lane and extending for the full length of the lane. In addition to the scheduled lot acceptance tests, any previously tested lot which is damaged by construction operations may be retested.

The rolling Straightedge will not be used immediately adjacent to or over manholes, utility openings, or similar structures which, in the opinion of the Engineer, have a significant and unavoidable adverse impact on achievable smoothness.

If the lot percent defective length is 3.5 or more, the HMA surface course shall be removed and replaced or may be accepted upon written request provided that payment for the lot is reduced by 20 percent.

The Engineer may test the bituminous concrete surface course with a response type ride meter prior to performing lot acceptance testing with the rolling Straightedge. If, in the opinion of the Engineer, such ride meter tests indicate, to a substantial certainty, that the lot percent defective length does not exceed the acceptable value of 3.5, the lot will be deemed in compliance with surface requirements. If the Engineer judges the ride meter tests to be inconclusive, the specified schedule of rolling Straightedge tests will be performed and the lot acceptance decision grounded on those results.

The decision to undertake any optional testing with the ride meter, the specific conduct of the ride meter testing and the interpretation of the results, shall exclusively be the province of the Engineer.

If the lot percent defective length exceeds 3.5, the Engineer may direct that paving operations be discontinued until mutually acceptable paving methods and/or equipment are used.

302.07 Air Voids Acceptance Plan.

(A) Lot Definition.

Acceptance of HMA for air voids content will be on the basis of a day's production. If such a subdivision would leave a small portion or an isolated area unaccounted for, the Engineer may combine such areas into an existing lot as practical. To the extent possible, surface and subsurface layers shall

have the same lot boundaries.

(B) ACCEPTANCE PLAN.

Each mixture in a completed lot shall be compacted so that the combined percentage of material below 2.0 percent voids or above 8.0 percent voids shall be no more than ten percent. Air voids will be determined from Nuclear Gauge readings during construction in accordance with the following:

If the percent voids outside the specified range of 2 to 8% when testing by nuclear gauges exceeds 10%, payment factors will be based on cores taken from the roadway. Air voids content will then be determined from five drilled cores (6" in diameter), taken at random locations from each lot, and tested according to Subsection 903.03 (G) for HMA or Subsection 924.03(G) for HMA.

Acceptance will be based on the percentage of the lot estimated to fall outside specification limits according to the following steps as follows:

(1) Compute the sample mean (X) and the standard deviation (S).

N Test Results (X1, X2, ...XN)

$$\underline{X} = (X1+X2+...+Xn)/N$$

$$S = [(X1 - \underline{\mathbf{X}})^2 + (X2 - \mathbf{X})^2 + ... + (XN - \underline{\mathbf{X}})^2/(N-1)]^{1/2}$$

Note: Raising to the 1/2 power is the same as taking the square root.

(2) Compute QL.

Compute QL = (X - 3.0)/S and QU = (9.0 - X)/S, where "Q" is the quality index for the lower and upper values.

(3) Compute Percent Defective.

Using Table per Subsection 923.36 for Lot Percent Defective for the appropriate sample size, determine the percentage of material (PD) falling outside specification limits associated with QL (lower limit) and QU (upper limit). Add these two values to obtain the total percent defective (PD).

If for any reason the number of available test results is different from N = 5 for initial testing and N = 10 for retesting, tables for the appropriate sample size are to be used for Step 3.

(4) Compute the Pay Factor.

Compute the Pay Factor (PF) for ALL paving (including ramps).

Surface, Intermediate and Base:

Quality	*Pay Factor (Percent)*	
PD < 10	PF_V = 100	(Eq. 1)
10 ≤ PD < 30	PF_V = 101 - (0.1 PD)	(Eq. 2)
PD ≥ 30	PF_V = 140 - (1.4 PD)	(Eq. 3)

(5) Retest.

If the initial series of N=5 tests produces a percent defective value of PD>30, the Contractor may elect to take an additional set of N=5 drilled cores to be taken at new random locations as designated by the Engineer. The additional cores shall be taken within 10 Working Days of receipt of the initial core results. If the additional cores are not taken within the 10 Working Days, the initial core results (N = 5) will be used to determine the percent pay adjustment. When the additional cores are taken, Steps 1-3 will be repeated using the combined data set of N=10 test values to obtain the total PD estimate using the table in Subsection 923.35, and Step 4 will be repeated to obtain the final lot pay factor using Equations 1 through 3 in Step 4, as appropriate.

(6) Removal and Replacement.

If the lot percent defective based on the combined set of N=10 tests is equal to or greater than PD=75, the Authority will require removal and replacement of the lot at the Contractor's expense. In lieu thereof, the Contractor and the Engineer may agree in writing that the deficient lot shall not be removed, and Contract compensation will be adjusted per the calculated pay factor.

(7) Outlier Provision.

All cores will be examined for obvious physical damage at the Laboratory. Any core found to be damaged shall be replaced by taking an additional core within a two foot radius of the original location.

All acceptance cores will be screened for outliers using a statistically valid procedure. If an outlier is detected, that core shall be replaced by taking an additional core within a 2-foot radius of the original location. The following procedure applies only for a sample size of 5.

Step 1:

Arrange the 5 core results in ascending order as follows, in which X1 represents the smallest value and X5 represents the largest value:

X1, X2, X3, X4, X5

Step 2:

If X5 is the value suspected of being an outlier, compute:

R = (X5 - X4) / (X5 – X1)

If X1 is suspected of being an outlier, compute:

R = (X2 – X1) / (X5 – X1)

Step 3:

If R > 0.642, the value is judged to be statistically significant and the core is excluded

(8) Pay Adjustment.

The quantity of HMA for payment for each item will be adjusted according to the percent pay adjustment calculated for each lot.

Surface, Intermediate and Base:

The lot percent pay adjustment for air voids is the value computed under Subsection 302.07, 4.

PPALOT = PFV

302.08 Core Samples.

Upon completion of a lot of HMA paving, the Contractor shall obtain acceptance cores from the finished pavement at random locations as directed, according to this Section and Sections 903 and 990. For all lots containing a test strip, and the first mainline pavement lot, cores shall be taken no sooner than 12 hours after paving and delivered no later than 48 hours after completion of the lot. All other acceptance cores shall be taken no sooner than twelve hours after completion of the lot and delivered no later than six working days after completion of the lot. All cores shall be taken in the presence of the Engineer at random locations as directed by the Engineer.

The cores shall be 6 inches in nominal diameter and shall contain the full depth of the lift to be tested. Cores to be submitted for air voids acceptance of the surface course and for total pavement thickness shall be full depth of the entire thickness of the pavement and shall be taken after all lifts have been placed. The drilling equipment shall be of sufficient size and power to drill through the entire thickness of the pavement. The drill bit shall consist of a water-cooled diamond-tipped masonry type capable of obtaining a valid test sample through the entire pavement thickness.

The core shall be removed from the pavement without damage to the core. Damaged cores shall not be submitted for testing. After the core has been removed from the pavement, the excess cooling all water shall be pumped from the hole, and the hole shall be filled and compacted with HMA or cold patching material according as approved by the Engineer. The finished patch shall be at least ¼ inch above the surrounding pavement surface to allow for additional compaction by traffic. Cores received at the Laboratory in a damaged condition will not be accepted for testing and shall be re-drilled within 1 foot of the original core location, and delivered to the laboratory within 48 hours after the notification by the Authority. Each core shall be identified by number, painted on the side of the sample and accompanied by the appropriate laboratory form, supplied and signed by the Engineer. The cores shall be placed in a ventilated box with a

lid capable of being locked and sealed by the Engineer. The boxes shall provide adequate protection to prevent damage during transit. The Engineer will record the seal number on the laboratory form. The sealed boxes shall be transported by the Contractor to the Authority.

302.09 Measurement.

HMA Base Course, HMA Intermediate Course, HMA Surface Course, and HMA Bridge Surfacing will be measured by the total weight of the mixtures required for the course or courses in the respective items, placed as prescribed, as determined from certified scale weights.

The weight of all material lost, wasted for any reason, damaged, rejected, or used to correct deficiencies will be deducted from such measurements. Similarly, whenever the compacted total thickness of the pavement (total thickness of all courses of the HMA) exceeds the specified compacted thickness by more than 1/4 inch, then the weight of the extra thickness in excess of the specified thickness + 1/4 inch will not be measured for payment.

Due to possible variations in the specific gravity of the aggregates, the tonnage used may vary from the Proposal quantities, and no adjustment in the unit price bid in the Proposal will be allowed due to such variation.

Asphalt price adjustment for asphalt binder will be determined on a monthly basis by the following formula:

$$A = (MA - BA) \times T$$

where:

A =	Asphalt Price Adjustment
MA =	Monthly Asphalt Price Index
BA =	Basic Asphalt Price Index
T =	Tons of New Asphalt Binder (see Note)
Note:	The weight of asphalt binder eligible for price adjustment will be determined by multiplying the percentage of new asphalt binder in the approved job mix formula by the weight of HMA.

Asphalt price adjustment for tack coat will be determined on a monthly basis by the following formula:

$$A = (B) \times (I) \times (C) \times (M) \times (G)$$

where:

A =	Asphalt Price Adjustment
B =	Bid Price for Tack Coat
I =	Asphalt Price Adjustment Factor (see Note)
C =	Petroleum Content of the Tack Coat and Prime Coat in Percent by Volume: Use 100% for cutbacks 90% for inverted emulsions 60% for RS or similar type emulsions
M =	Percentage of Bid Price Applicable to Materials
G =	Gallons of Tack Coat and Prime Coat Furnished and Applied
Note:	Asphalt price adjustment factor for a given month will be a percentage increase or decrease determined by comparing that month's monthly asphalt price index with the basic asphalt price index.

The monthly asphalt price index will be the average of quotations from suppliers serving the area in which

the Project is located, and will be determined by the Department each month. For that part of the State north of and including Route 195, the asphalt price index will be based on quotations from Chevron, Citgo, and, Valero Refining Company New Jersey. For that part of the State south of Route 195, the index will be based on quotations from Coastal, Chevron, Citgo, and Valero Refining Company, New Jersey.

The basic asphalt price index is the asphalt price index for the month before the opening of bids. The Authority will use the asphalt price index for the month before the regular monthly estimate cut-off date as the monthly asphalt price index.

Should a monthly asphalt price index increase 50 percent or more over the basic asphalt price index, no additional MA shall be furnished for the Project without written approval from the Director of Construction Services and Materials.

Should a monthly asphalt price index decrease from the basic asphalt price index, payments will be decreased accordingly.

Asphalt price adjustment for work performed after the time of completion, as specified in Subsection 107.05, will be based on the asphalt price index for the month in which the work was to be completed, except if the monthly asphalt price index decreases after the completion date, the asphalt price adjustment will be decreased accordingly.

Asphalt price adjustment provides a value for reimbursement to the Contractor for costs as calculated according to this Subsection, and an estimated amount to cover the asphalt price adjustment will be included in the Proposal. Payments for increases will be made from this amount.

Asphalt price adjustments will not be made for Contracts which propose less than 2000 tons of hot mix asphalt.

Asphalt price adjustments will not be made in those months for which the monthly asphalt price index has changed by less than five percent from the basic asphalt price index.

Tack Coat will be measured by the volume of tack coat material furnished and applied, as prescribed for the construction of HMA surface and intermediate courses measured in its undiluted form in gallons at 60 degrees F.

Membrane Waterproofing will be measured by the surface area of bridge deck covered by membrane, measured in place without deduction of areas occupied by drainage structures, or joints within the bridge deck area.

Cleaning Inside Shoulders and Cleaning Outside Shoulders will be measured by the length of each shoulder cleaned, measured separately, regardless of width as directed by the Engineer. Preparation of shoulder cleaning plan, and removal and disposal of debris, will not be measured for payment.

Sealing Cracks in Bituminous Surface will be measured by the linear foot. Preparation and cleaning of cracks will not be measured separately for payment.

The sealing of longitudinal joints and transverse joints in all work areas using asphalt binder viscosity grade AC-20, will not be measured for separate payment, but the cost shall be incidental to the asphalt surface course item.

The application of Polymerized Joint Adhesive to all cold pavement joints will be measured for payment by the linear foot of joint adhesive applied.

No separate payment will be made for the material transfer vehicle and paver hopper insert. The cost for this vehicle and paver hopper insert shall be included in the price bid for the HMA pay items.

The construction of "disable ramps" will not be measured for separate payment, but the cost thereof shall be incidental to the Asphalt Surface Course item.

High Performance Permanent Cold Patch will be measured by the ton furnished and delivered to the designated stockpile location.

Crack Spanning Membrane will be measured by the length.

Reflective Crack Repair using "Crack Spanning Membrane" or "Paveprep" will be measured by the straight line length of crack or joint repaired as prescribed.

Bituminous Core Samples will be measured by the number of each.

302.10 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
HOT MIX ASPHALT _____ SURFACE COURSE….	TON
HOT MIX ASPHALT _____ INTERMEDIATE COURSE	TON
HOT MIX ASPHALT _____ BASE COURSE	TON
HOT MIX ASPHALT BRIDGE SURFACING	TON
MEMBRANE WATERPROOFING	SQUARE YARD
ASPHALT PRICE ADJUSTMENT	USD
TACK COAT	GALLON
CLEANING INSIDE SHOULDERS.	LINEAR FOOT
CLEANING OUTSIDE SHOULDERS	LINEAR FOOT
SEALING CRACKS.	LUMP SUM
HIGH PERFORMANCE COLD PATCH	TON
REFLECTIVE CRACK REPAIR	LINEAR FOOT
CRACK SPANNING MEMBRANE	LINEAR FOOT
POLYMERIZED JOINT ADHESIVE	LINEAR FOOT
BITUMINOUS CORE SAMPLES…….	EACH

Payment reductions due to non-conformance to air voids, thickness and rideability requirements will be made according to Subsections 302.06 and 302.07.

Payment for HMA placed in the pavement removal or deck replacement areas will be made as specified under the items HMA Surface and HMA Intermediate Course and HMA Bridge Surfacing, respectively.

No separate payment will be made for the preparation of shoulder cleaning plan, and removal and disposal of debris, but the costs thereof will be included in the unit price bid for the pay items "Cleaning Inside Shoulders" and "Cleaning Outside Shoulders". Payment for all closings required for the cleaning of shoulders shall be in accordance with Section 801.

No separate payment will be made for sealing transverse joints between the new pavement and existing pavement using asphalt cement viscosity Grade AC-20 (or other approved material), but the costs thereof will be included in the unit prices bid for the various affected construction items scheduled in the Contract.

Payment for sawcutting and sealing of transverse joints at bridge abutments using hot poured joint sealant will be made in accordance with Section 312.

SECTION 303 - SHOULDER AND BERM SURFACING

303.01 Description.

Shoulder and Berm Surfacing shall include the furnishing, placing, and compacting of suitable materials in the areas prepared therefore at the locations and to the lines, grades, dimensions, and mixes shown on the Plans, in accordance with the requirements of the Specifications.

303.02 Materials.

Materials shall conform to those of the base or surface course to be constructed in accordance with Sections 301 and 302.

303.03 Methods of Construction.

Construction of the individual courses for shoulder and berm surfacing shall comply with all requirements of Sections 301 and 302, except as modified herein.

All equipment shall meet the approval of the Engineer. The use of any equipment which will mar or damage the surface or edges of completed pavement or shoulder construction will not be permitted. Graders with metal wheels or tractors, equipped with lugs of angle iron, V-shaped cleats, or metal street plates, will not be permitted. Heavy equipment such as power shovels, etc., shall not be operated on the surface of the roadway pavement. None of the wheels of the rolling equipment shall operate on the completed pavement, unless specifically authorized in writing by the Engineer. If so ordered by the Engineer, pavement shall be covered with a cushion of earth where equipment, including pavers, graders, or rollers are turned.

No material shall be placed when the subgrade is frozen, or when it is unstable because of excessive moisture. Should the subgrade be dry to the point of being dusty, it shall be moistened by sprinkling as directed by the Engineer.

Shoulder construction shall not begin until the adjacent roadway pavement is completed, and the subgrade has been prepared and compacted in accordance with the requirements of Section 209.

The surface of the shoulder when finished shall be flush with the surface of the adjoining pavement, shall not have any depressions in which water can collect, shall be sloped to drain as required by the Plans, and at no point shall be more than 1/4 inch from the elevation required by the Plans.

Berm surfacing construction shall not begin until the adjacent shoulder is completed and the subgrade has been prepared and compacted to the grades, which will provide the specified thickness of the finished berm surfacing, in accordance with the requirements of Section 209.

The HMA berm surfacing shall be constructed in one course. Rolling shall be longitudinal only.

303.04 Measurement.

Berm surfacing will be measured by the total area of berm surfacing placed without deductions of areas occupied by guide rail posts, manholes, lighting standard bases and similar structural elements.

Berm surfacing work shall be included for asphalt price adjustment as specified in Subsection 302.09.

303.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
BERM SURFACING, ____ INCHES THICK	SQUARE YARD

SECTION 304 - PORTLAND CEMENT CONCRETE PAVEMENT

304.01 Description.

Portland Cement Concrete Pavement shall include the construction of reinforced Portland cement concrete pavement for roadways, bridge approach slabs and toll plaza slabs on the sub-base prepared, the construction of joint ties in the new or existing concrete roadway; cleaning and sealing of exposed joints and cracks in concrete surface course; the taking of core samples for testing; and the construction of transverse concrete grooving and/or texturing of concrete pavement course at the required locations, to the prescribed grade, lines, and dimensions in accordance with the requirements of the Plans and Specifications and as directed by the Engineer.

This work shall also consist of widening existing bridge approach slabs.

304.02 Materials.

Materials shall conform to the following Sections and Subsections:

CONCRETE, MORTAR AND GROUT	905
REINFORCEMENT STEEL.	908.04
CURING MATERIALS	906.05
PREFORMED EXPANSION JOINT FILLER.	907.01
JOINT SEALERS	907

304.03 Plant and Equipment.

(A) Batching Plant.

Portland cement concrete shall be supplied by a batching plant which meets all requirements of the Specifications and has the facilities necessary to ascertain and control the quality of the concrete. The plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be sealed and vented to preclude dusting during operation. The batching plant shall be equipped with a non-resettable batch counter, which indicates the number of batches proportioned. Batching equipment shall conform to the requirements of Subsection 401.03(B).

The batching plant shall consist of the following:

(1) Bins and Hoppers.

Bins with separate compartments for fine aggregate and for each size of coarse aggregate shall be provided at the batching plant.

(2) Scales.

The scales for weighing aggregates and cement shall be either the beam type, the springless dial type, or the electronic load cell type with a readout. They shall be accurate within 0.5 percent for cement and one percent for aggregate throughout the range of use. When beam type scales are used, a telltale dial shall be provided for indicating to the operator the required load in the weighing beams and for indicating critical position clearly. Poises shall be designed to be locked in any position and to prevent unauthorized change. The weigh beam and telltale device shall be in full view of the operator who shall have convenient access to all controls while charging the hopper.

Accuracy and certification requirements for plant scales shall be as specified in Subsection 302.04(A)(18).

(3) Water Measuring Equipment.

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over one percent. Unless the water is to be weighed, the water measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with outside taps and valves or other means to permit accurate calibration and to provide for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

(4) Admixture Dispenser.

An automatic displacement dispenser with plant operation shall be used for adding each admixture.

(5) Automatic Batching System.

Batching plants equipped to proportion aggregates and bulk cement, by means of automatic weighing and recordation devices, shall consist of a combination of automatic batching controls meeting the following requirements:

(a) All batching equipment in the system for batching by weight must be actuated by a single starting mechanism. A separate starting mechanism is permitted for volumetric batching of water or admixtures not batched at the time of initial weighing.

(b) Each automatic batcher must return to zero balance and each volumetric device must reset to start or signal empty before it may be charged.

(c) The discharge of any ingredient in the system shall not start unless all batching controls have been cleared of the previous batch with scale returning to zero balance and volumetric devices resetting to start or signaling empty. The discharge of any weighed ingredient shall not start until all weighed ingredients have been batched.

(d) For cumulative batchers, interlocked sequential controls shall be provided.

(e) Automatic batching controls shall start the weighing operation of each material and stop automatically when the designated weight of each material has been reached, interlocked in such a way that:

(1) The charging device cannot be actuated, until the scale has returned to zero balance within plus or minus 0.3 percent of the scale capacity.

(2) The discharge device cannot be actuated, until the required material is within the applicable tolerances.

(3) The discharge device cannot be actuated, if the charging device or the discharge device is open.

(6) Recordation.

Each automatic batching plant shall be equipped with an accurate recorder or recorders, which provide a permanent and continuous record of batching operations. A maximum of two recording units in lockable enclosures shall be provided with each plant. A batching record shall be removed as directed, and it shall become the property of the Authority. Each recorder shall produce a digital record on tickets and shall provide the following information:

(a) The quantity or batched weights of each aggregate, portland cement, water, and admixture.

(b) The zero balance condition of each scale after batchers have been discharged, or prior to the start of the batching operation.

(c) A means of identifying each admixture batched.

(d) The time, date, and batch number of each batch delivered.

(e) Mix formula or concrete classification identification.

(7) Plant Laboratory.

A plant laboratory shall be provided and maintained at each plant site for use of the Engineer for sampling and acceptance testing, and for use of the producer for quality control testing during periods of production. The plant laboratory shall also include an office area for use by the Engineer. The costs of the plant laboratory and all the facilities and equipment therein shall be included in the various items in the proposal, and no separate payment will be made for the plant laboratory.

The plant laboratory shall be located to provide an unobstructed view of the trucks as they are loaded.

(8) Safety.

Adequate and safe stairways shall be provided at points where accessibility to plant operations is required. Overhead protection shall be provided at locations where deemed necessary.

All gears, pulleys, chains, sprockets, and other hazardous moving parts shall be guarded and protected.

The plant shall conform to all State and local safety requirements. When plant production occurs during nighttime hours, additional lighting shall be provided throughout the stockpile, plant, and laboratory areas to ensure a clear view of the operations.

(B) PROJECT SITE EQUIPMENT.

The following equipment shall be available and used on the Project Site to ensure the quality of the finished work, unless approved otherwise by the Engineer or specified otherwise in Supplementary Specifications:

(1) Scratch Template.

An accurately constructed template shall be used to check the elevation of the sub-base. See Subsection 304.04 for forms requirements.

(2) Forms.

Forms for concrete pavements shall be made of wood or steel. The depth of the forms shall be equal to the depth of the pavement. The forms shall have no variation of more than 1/8 inch in 10 feet from the true plane of face or top. This variation shall not be exceeded for shorter length forms used for curves.

When used, steel form sections shall have a minimum length of 10 feet; except that on curves having a radius of 200 feet and less the length shall be not more than 6 feet. The width of the bases of steel forms shall be not less than 9 inches. The forms shall be of an approved section without horizontal joints and with flange braces extending outward on the base not less than 2/3 the height of the form. There shall be at least 3 stake pockets per length of form. Each stake pocket shall be equipped with a positive non-detachable wedge. Forms shall be staked in place with at least 3 steel pins, and they shall be equipped with positive locking devices that will permit neat tight joints, which will not deform under impact, vibration, or thrust.

Wood forms shall be made of two-1 inch, well seasoned, surfaced planks fastened together and shall be attached securely to a wooden base 8 inches in width. All wood forms shall be braced at least every 2 feet with steel pins not less than 7/8 inch in diameter and 30 inches long.

(3) Steel Placing Equipment.

Power equipment for placing reinforcement shall accurately position the steel to line and grade.

(4) Spreading and Finishing Equipment.

Equipment shall include a mechanical power-driven concrete spreader capable of striking off the concrete to the required cross-section and elevation.

The mechanical finishing machine shall be power driven; shall be designed and operated to strike off, screed, consolidate, and float; shall be of ample weight and strength to furnish the necessary pressure; shall be capable of being adjusted to produce the cross-section and finish required; shall have sufficient power and be geared to operate consistently and smoothly; and shall be equipped with at least two oscillating-type transverse screeds and a scraping device to keep the tops of the forms clean.

Vibrators shall be the spud type and may be hand operated and/or attached to the spreader or mounted on a separate carriage. The vibrators shall have a minimum frequency of 5000 impulses per minute.

Except for hand-held vibrators, all vibration shall be controlled by the forward movement of the spreading and finishing equipment, so that vibration automatically ceases when the forward movement of the spreader is stopped.

Tube finishers shall be equipped with a smoothing float or floats suspended from and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on and constantly in contact with side forms.

Individual traveling bridges shall be furnished as directed.

At least two straightedges, each not less than 10 feet long, with handles at least 3 feet longer than one-half the width of the slab, shall be constructed of light metal or wood and shall be maintained clean and straight.

At least two straightedge templates shall be provided for testing the completed surface. They may be made of wood or metal, shall be not less than 12 feet long, and shall be maintained clean, straight, and free from warp.

(5) Concrete Saw.

When sawing joints is specified, sawing equipment shall be provided, adequate in number of units and power to complete the sawing to the required dimensions and at the rate necessary to prevent uncontrolled cracking, in accordance with Subsection 304.04(D). The saws shall be equipped with water-cooled diamond-edge blades or abrasive wheels and alignment guides.

When saw cutting of grooves is specified, the saws shall be of a multi-bladed type, adequate in number of units and power, and equipped with water-cooled, circular, diamond-edge blades and alignment wheels. A system of slurry collection shall be provided.

At least one standby saw in working order and an ample supply of saw blades shall be provided at the work site at all times during sawing operations.

(6) Tines.

The metal tines shall be tempered spring steel, arranged in a single line and securely mounted in a suitable head (rake) and shall be 1/32 inch thick, 1/8 inch wide, 6 to 8 inches long, and spaced at 1 inch centers. The tines shall be capable of producing a groove of the specified dimensions in the plastic concrete without slumping of the edge or tearing of the surface. Tines shall be maintained, so as to remain straight, clean, and free of any concrete buildup. The metal comb (rake) shall be attached to a mechanical device capable of traversing the entire paving width in a single pass at a uniform speed.

(7) Spraying Equipment.

When liquid membrane compound is used for curing concrete, the mechanical spraying equipment shall be mounted on a movable bridge. The equipment shall be the fully atomizing type equipped with a tank agitator. The spraying equipment shall be capable of continuously agitating the liquid membrane during application. Small hand-held spray equipment capable of maintaining the liquid membrane in a mixed condition will be permitted, if used in accordance with Subsection 304.03(E).

(8) Small Tools and Other Equipment.

Small tools shall include such items as edgers, trowels, hand floats, and brushes, necessary to produce the results required.

Water supply equipment shall include pumps or tanks mounted on trucks, of adequate capacity to furnish sufficient water to accommodate this construction and at the required pressure. A pipeline appropriate to the requirements of the construction may be used.

Equipment and tools, as necessary for the construction of special features, shall also be on the Project site.

304.04 Methods of Construction.

The following requirements shall apply to all Portland Cement Concrete Pavements.

(A) Preparation of Grade.

The base course shall be prepared, as specified in Section 301, for at least 12 inches beyond the edge of the concrete surface course.

The sub-base shall be uniformly moist when the concrete is placed. If it subsequently becomes too dry, the sub-base shall be sprinkled, but the sprinkling shall not form mud or pools of water.

During concrete paving operations, a roller weighing not less than 5 tons shall be maintained in readiness to recompact the sub-base, if for any reason, the surface has become uneven or defective. Soft spots in the sub-base shall be corrected to the satisfaction of the Engineer.

Unless otherwise permitted by the Engineer, all vehicular equipment used for mixing, transporting, and placing the concrete shall be operated outside the forms. In the case that operation of such equipment is permitted within the forms, suitable planks or platforms shall be provided and used for the equipment to run on, so that the sub-base will be maintained in an approved condition.

(B) Setting Forms.

The material under the forms shall be compacted and shall be at grade, so as to be in firm contact with the form for its entire length. Sub-base at the form line which is below grade shall be brought to grade with clean granular material in lifts of 1/2 inch or less for a distance of 18 inches on each side of the base of the form and shall be thoroughly compacted. Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary. Pedestals of sub-base or other materials, upon which

to reset the forms to bring them to grade, will not be permitted.

Forms shall be set in advance of the point where concrete is being placed for at least the distance required for the next day's paving. This distance may be reduced, as approved, when a shorter distance is justified by prevailing conditions. Forms shall be staked into place with not less than three pins for each 10 foot section. All form sections shall be locked tightly and free from play or movement in any direction.

The alignment and grade elevations of the forms shall be checked and corrections made before placing the concrete. The form shall not deviate from the required alignment by more than 1/4 inch at any point. Forms that settle or deflect under the spreading and finishing equipment shall be reset or removed. The top and face of forms shall be cleaned, and the face oiled prior to the placing of concrete. When any form has been disturbed or any grade has become unstable, the unstable condition shall be corrected, and the form shall be reset and rechecked.

(C) HANDLING, MEASURING, AND BATCHING MATERIALS.

The batch plant site, layout, equipment, and provisions for transporting material shall be such as to ensure a continuous supply of concrete to the work.

The fine aggregate and each size of coarse aggregate shall be weighed separately into hoppers in the amounts in the job mix design.

Cement shall be measured by weight. Each bag of cement shall weigh 94 pounds, and 94 pounds of bulk cement shall be considered one bag. Batches involving fractional bags are not allowed, except when bulk cement is used. When bulk cement is used, separate scales and hoppers shall be used for the cement with a device to indicate the complete discharge of the batch of cement into the batch box or container. The weighing hopper and scale shall be of adequate size, completely encased, with provisions for locking. The hopper discharge mechanism shall be interlocked against opening until the full batch is in the hopper and the scale balanced, against opening while the hopper is being filled, against closing until the hopper is entirely discharged and the scale back in balance, and against opening if the batch in the hopper is either overweight or underweight by more than one percent of the amount specified. The weighing hopper discharge gate shall operate in such a manner, so as not to affect the scale balance. The discharge chute, boot, or other such device shall be suspended from the encasement and not from the weighing hopper and shall be so constructed that cement does not lodge therein and there is no loss of cement by air currents or otherwise. There shall be means to ensure the presence in each batch of the entire cement content required.

Where bulk cement is to be used, there shall be provided separate storage for tested and mixed approved cement, which shall be held in such storage for the particular Project or Projects for which it was consigned. Different brands of cement, or the same brand of cement from different mills, shall not be nor shall they be used alternately unless approved.

For individual batches, the following tolerances shall apply based on the required scale reading:

(1) Cement.

Cement: plus or minus one percent of the required weight of material being weighed or plus or minus 0.3 percent of scale capacity, whichever is greater.

(2) Aggregates 1 ½ Inches or Smaller.

Aggregates 1 ½ inches or smaller: plus or minus two percent of the required weight of material being weighed or plus or minus 0.3 percent of the scale capacity, whichever is greater.

(3) Aggregates Larger Than 1 ½ Inches.

Aggregates larger than 1 ½ inches: plus or minus three percent of the required weight of material being weighed or plus or minus 0.3 percent of scale capacity, whichever is greater.

The water measuring system shall be capable of incorporating in the batch, the predetermined quantity of water, to an accuracy of plus or minus one percent. The measuring device shall automatically register and stop the flow of the water when the designated quantity has been delivered into the mixing drum.

Plants shall be equipped with a separate dispensing system with a visual sight gauge for each admixture incorporated into the concrete. Admixtures shall be added to the mixing water or sand. Each system shall be capable of dispensing the total amount required to within plus or minus 3.0 percent or 1 ounce, whichever is greater. Convenient means shall be provided to calibrate each system. Such admixture devices shall also be provided with each truck mixer approved for dispensing admixtures at the Project or placement site.

When approved by the Engineer, a water reducing retarder admixture, conforming to the requirements of Section 906, may be added to the concrete mix.

Fly ash shall be stored at the batching plant in a separate storage facility. The scales and batching tolerances shall be equivalent to those specified for portland cement. When fly ash is weighed cumulatively with the cement, the fly ash shall be last in the batching sequence. A split silo containing fly ash and cement will not be permitted.

A representative of the fly ash producer shall be available for technical assistance.

(D) MIXING CONCRETE.

Concrete may be mixed at the job site or in a central-mix plant or may be mixed in transit-mix trucks. Mixing time shall be measured from the time all materials are in the drum. Mixers of a type capable of mixing not less than a one-bag batch, of the class of concrete or mortar required, may be used where only small quantities of concrete or mortar can be placed at a time.

Concreting in hot weather (when the ambient temperature is 85ºF or more) shall be performed in accordance with the recommended practice of ACI Standard 305. Concreting in cold weather (when the ambient temperature is 50ºF or less) shall be performed in accordance with the recommended practice of ACI Standard 306.

The following mixing methods are permissible:

(1) Mixing on the Project in Truck Mixers.

Mixing on the Project in truck mixers shall not be used for concrete surface course or structural concrete items.

Truck-mixed concrete shall be materials proportioned at a batching plant and mixed in a revolving-drum truck mixer at the point of delivery following the addition of the proper amount of mixing water.

Each truck mixer shall have attached a metal plate or plates on which is plainly marked the manufacturer's capacity rating in terms of the gross drum volume, the capacity of the drum in terms of the volume of mixed concrete, and the manufacturer's designated drum speed of rotation for both mixing and agitation. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum may be readily verified.

The counter unit shall be positioned on the truck, so as to be plainly visible if the driver's door is open.

The mixer shall be capable of producing a thoroughly mixed and uniform mass and discharging the concrete with satisfactory uniformity within the ranges of slump and air entrainment specified for the class and type of concrete being furnished.

Each truck mixer shall be equipped to carry sufficient water to mix a full capacity load of concrete within the required range of slump and shall also carry wash water as necessary.

The mixing water tank, pump, and the piping shall be kept clean and free of leaks. An in-line multi-jet or positive displacement meter shall be provided which indicates the amount of mixing water added to the batch. Either meter shall be provided, as a minimum, on one truck mixer for each concrete pay-adjustment item per day. The device shall have an accuracy of plus or minus 1.5 percent, by volume, of the indicated amount dispensed. The meter shall have a non-resettable register with a capacity of 100,000 gallons. A remote, readily visible, resettable three or four-digit counter, shall be mounted in the truck cab. The counter shall measure water added to the nearest gallon and shall be provided with a unique mechanical or electrical device for resetting. This device shall remain in the possession of the Engineer during production. The distribution system

shall be equipped with three-way valves and bypasses or other suitable means for calibration of the water-measuring device.

The water-measuring device shall be calibrated prior to use and recalibrated whenever any repairs or modifications are made that may affect the calibration. Documentation showing the date and results of calibration of the water-measuring device shall be carried on each truck mixer and copies shall be furnished upon request. Near the measuring device, on the mixing water tank, there shall be stenciled the word calibrated and the date of the last calibration.

The mixing water-measuring device shall be located, so as to be plainly visible to the truck operator when operating the mixing water and the drum controls, and to the Engineer while standing on the ground. All measuring indicators shall be kept clean and in good condition. Truck mixers are subject to inspection by the Engineer, including the mechanical condition of the truck mixer, verifying the mixing and agitation rates, the accuracy of the water-measuring device, the size of discharge opening and chutes, and the general condition and wear of the blades. The truck mixer will not be approved for use if any part or section of the pickup and throw-over blades is broken, missing, or excessively worn. Truck mixers shall be examined daily for cleanliness of the drum and blades, leaks in the mixing water system, and the condition of the water-measuring device and the revolution counter.

The concrete supplier shall maintain, at a convenient location, a copy of the manufacturer's design for each size and type of truck showing the dimensions and arrangements of the blades, the dimensions of the drum, the gross volume of the drum, the recommended rates of rotation for all types of operations, and any other pertinent information.

Prior to the time mixing water is added at the job site, no water or other fluids will be permitted in the drum of the truck mixer, except concrete admixtures which are measured and dispersed with the dry ingredients. Truck mixers may be required to pull under the batch plant with the drums revolving in discharge rotation as an indication that the drum is empty.

The truck mixer, when loaded for mixing concrete, shall not contain more than 63 percent of the gross drum volume.

The maximum elapsed time from the loading of the portland cement into the drum to the discharge of all the concrete from the mixer shall be 90 minutes except that, under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 85 ^{o}F or above, such time limit shall be changed to 60 minutes. However, if retarders are used, the time limit may be increased to a maximum of 90 minutes, if approved. Under very severe conditions, further reductions of the time limits or the size of the loads may be required.

Immediately following the addition of all the mixing water, the mixing revolution counter shall be reset to zero, with the drum revolving at the rate of speed designated by the manufacturer for mixing.

Each batch shall be mixed not less than 50 and not more than 100 revolutions at the rate of rotation designated as mixing speed. The concrete shall be mixed into a plastic, uniform mass complying with the specified range of slump and air entrainment. The number of revolutions within the limits specified above, and the control of the consistency shall be as directed.

If the concrete cannot be entirely discharged within ten minutes after the mixing has been completed, the concrete remaining in the drum shall be kept plastic and workable by revolving the truck drum, at the manufacturer's designated speed for agitation, for a period of two minutes in each ten minutes. In no case shall the total revolutions exceed 200.

Prior to the completion of 100 mixing revolutions, the operator may add water or air entraining agent or both incrementally, in order to produce concrete within the required slump or air content range in conformance with Subsection 905.05.

During discharge, drum gates and cover shall be fully opened and the rate of discharge shall be governed by drum speed.

Discharge chutes shall be ample in size, without struts, and capable of handling the concrete within the specified slump range. Use of extension chutes shall be restricted as much as is practical.

Wash water shall be provided in addition to the water required for mixing. If the wash water runs through the measuring device for the mixing water, it shall not be used during any of the periods

when mixing water is being measured into the drum. Under no circumstances shall the washdown hose be used to temper the concrete or to aid the flow of concrete in the chute except for pre-wetting the chute. Any concrete that has been wetted with wash water shall be discarded.

Immediately after the discharge of each load, the drum shall be washed out and the wash water and any residue from the previous batch shall be completely discharged before reloading the drum at the batch plant.

(2) Mixing at a Central-Mixing Plant.

Central-mix concrete shall be materials proportioned and mixed at a central plant and transported to the point of use in an agitator or non-agitator truck of approved design.

Central-mixing plant mixers shall be of the type and capacity capable of combining the cement, aggregates, and water into a thoroughly mixed and uniform mass within the specified mixing time and of discharging the mixture with a satisfactory degree of uniformity, and it shall be operated in compliance with the NJAC 7:27-6.1 et seq.

Stationary mixers shall be equipped with a timing device that does not permit the batch to be discharged until the specified mixing time has elapsed. Mixing time at the central-mix plant shall be not less than one minute. Mixing time shall be measured from the time all cement and aggregates are in the drum. The batch shall be so charged into the mixer that sufficient water enters in advance of cement and aggregates to prevent caking, and all water shall be in the drum by the end of the first quarter of the specified mixing time.

When the temperature of the mixing water exceeds 100°F, the loading sequence shall be modified by mixing all the water and the aggregates and then the cement. Mixing shall begin immediately following the complete charging of the drum and continue for not less than one minute.

Truck mixers for the delivery of central-mix concrete shall have a revolving, watertight drum capable of transporting and discharging the mixed concrete with a satisfactory degree of uniformity. The speed of the drum shall be that stated by the manufacturer to be the agitating speed. Each truck shall have attached thereto, in a prominent place, a metal plate on which is stated the gross volume of the drum, the manufacturer's rating in terms of mixed concrete for agitation, and the speed of rotation for agitation. The volume of mixed concrete in the drum shall not exceed the manufacturer's rating, nor shall it exceed 80 percent of the gross drum volume.

The use of open body trucks with agitating mechanism may be permitted provided that the elapsed time, from addition of water to the mix until the concrete starts to be deposited in place at the site of work, does not exceed 30 minutes.

Non-agitating trucks may be used if the slump of the concrete to be transported is 2 ± 1 inches, the haul road surfaces are maintained in a smooth riding condition, and the elapsed time from addition of water to the mix until the concrete starts to be deposited in place at the site of work, does not exceed 30 minutes. Bodies of non-agitating hauling equipment shall be smooth, mortar-tight metal containers and shall be capable of discharging the concrete mix at a controlled rate without segregation. If the concrete is determined to have segregated, the load will be rejected and removed from the site.

Covers over trucks shall be provided when needed for protection.

Except for non-agitating trucks, the maximum length of time, from loading at the plant to discharge at the Project, shall not exceed 90 minutes, except under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 85 °F or above, such time limit shall be changed to 60 minutes. However, if the use of retarders is permitted, the time limit may be increased to a maximum of 75 minutes. Under very severe conditions, further reduction of the time limits, or the size of the batches may be required. During these intervals, the concrete shall be agitated continuously.

If a truck mixer is used, the provisions for adding water at the Project site are as specified below under the transit mixing method.

Two-way telephone or radiotelephone communication between the site of the placement of concrete and the mixing plant shall be provided.

(3) Transit Mixing.

Transit mix concrete shall be materials, including water, proportioned and introduced into a truck mixer from a one-stop or two-stop batching plant, and mixed while the truck is at the plant or a combination of mixing at the plant and on the job site.

A one-stop batching plant shall be a plant where all dry ingredients for each batch of concrete are loaded into the mixer truck simultaneously, while water is being introduced.

A two-stop batching plant shall be a plant where the ingredients for each batch of concrete are loaded into the mixer truck at two separate locations.

Each transit mixer shall comply with the requirements for truck mixers, except that the mixing water tank and measuring device shall be used only for providing tempering water if necessary.

In addition, all truck mixers used for transit mix concrete shall be equipped with an electrically operated counter unit, which shall be non-resettable, except by use of a 110-volt device utilizing a nonstandard plug located at the batching plant. The counter unit shall contain two counters. One counter shall record only those revolutions at speeds recommended by the manufacturer of the truck mixer as mixing speed and shall record the total of all such mixing revolutions from the time the truck is loaded. The other counter shall record revolutions of the drum at all speeds and shall record the total revolutions from the time the truck is loaded. The unit shall include an indicator on the front panel, which shows if the instrument has been turned off or tampered with in any manner after being reset at the time of loading. The counter unit and the resetting device shall conform to the NEC.

The counter unit shall be positioned on the truck so as to be plainly visible if the driver's door is open.

In lieu of the time clock, the counter unit may contain a third counter, an electrically-operated timer, which shall be non-resettable except by use of the 110-volt device.

Mixing and delivery for transit mix concrete shall comply with the requirements for truck mix concrete except as follows:

(a) All ingredients, including water, shall be introduced into the transit mixer at the batch plant.

(b) At a one-stop batching plant, at least one-third of the mixing water shall be introduced into the mixer prior to the dry ingredients, and sufficient mix water to wash down the chute shall be introduced after all the dry ingredients have been added.

(c) At a two-stop batching plant, the loading sequence shall be one-half to three-quarters of the mixing water, aggregates, cement, and remaining water.

(d) As an alternative, at either a one-stop or two-stop batching plant, when the mixing water is less than 100 ^{o}F, slurry mixing can be used. When this method is used, all mixing water is added first, followed by the cement, and mixed at mixing speed for one minute. The remaining ingredients shall then be added.

(e) At either a one-stop or two-stop batching plant, when the temperature of the mixing water exceeds 100 ^{o}F, the loading sequence shall be the mixing water, then the aggregates, and then the cement.

(f) Sufficient mix water to wash down the chute shall be introduced after all the dry ingredients have been added. However, not less than 80 percent of the mixing water, as established by the mix design, shall be added at the plant.

Mixing shall begin immediately following the complete charging of the drum and continue for not less than 50 nor more than 100 revolutions of the drum at the mixing speed recommended by the manufacturer of the truck mixer. Upon completion of at least the minimum number of mixing revolutions at the plant, the speed of the drum shall be reduced to the agitation speed recommended by the manufacturer. Concrete delivered to the job with less than 100 mixing revolutions may be mixed to not more than 100 revolutions at mixing speed.

Prior to acceptance testing, mixing water or air entraining agent or both may be added incrementally, at the Project site, in order to achieve the proper slump or air content range in conformance with Subsection 905.05.

If the concrete cannot be entirely discharged within ten minutes after the mixing has been completed, the concrete remaining in the drum shall be kept plastic and workable by revolving the truck drum at the manufacturer's designated speed for agitation for a period of two minutes in each ten minutes.

The maximum elapsed time from loading at the plant to the discharge of all the concrete from the mixer under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 ^{o}F or above, shall be 90 minutes with the use of retarders. Concrete not discharged within this time frame will be rejected.

(4) Transit mix concrete will be rejected for any of the following reasons:

(a) If the concrete is not discharged within the specified time limit after loading all ingredients into the drum;

(b) If the indicator on the counter shows that the instrument has been turned off or tampered with;

(c) If the non-resettable total revolution counter shows more than 300 revolutions;

(d) If water has been added while the truck mixer is en route to the Project. Two-way telephone or radio communication between the site of the placement of concrete and the batching plant shall be provided.

(5) Mixing on the Project in Continuous-Mixing-Type Truck Mixers.

Mixing on the Project in continuous-mixing-type truck mixers shall be used for headwalls, utility encasements, manhole and inlet foundations and top slabs, gutters, curbs, headers, barrier curbs and bases, sidewalks, islands, driveways, fence post footings, sign foundations, foundations for electrical items, guide rail end treatment footings, junction boxes, and other miscellaneous items, as approved.

If concrete additives are to be used in the mix, means shall provide for storing the additives on the truck and incorporating them into the mix. A way to check the rate of flow on the additive into the mix and meter to register the total volume of additive incorporated into the mix during each mixing operation shall be included. Truck not having functional meters will not be permitted on the project site.

The concrete shall be mixed in a mixing unit, which is part of the truck carrying the dry ingredients. The mixing unit shall be an auger type incorporated in the truck's discharge chute or other approved mixing mechanism. The mixer shall produce concrete of uniform consistency and shall discharge the mix without segregation.

The truck mixer shall have permanently attached thereto, in a prominent place, a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, operating speed, and the cement constant of the machine in terms of an indicator revolution count required to deliver 94 pounds of cement, all as rated by the manufacturer.

The truck mixer shall be equipped with a cement bin of sufficient capacity to store and supply the quantity of dry cement required to produce the maximum volume concrete capacity of the truck mixer as rated by the manufacturer. The cement bin shall be free of moisture and contamination at all times.

The truck mixer shall be equipped with aggregate bins of sufficient capacity to store separately the quantities of fine and coarse aggregates required to produce the maximum volume concrete capacity of the truck mixer as rated by the manufacturer. Means shall be provided to prevent contamination or intermixing of the fine and coarse aggregates during loading and transporting. Aggregate bins shall be covered when there exists a possibility of moisture entering the bins.

The truck mixer shall be equipped with a means of readily determining the level of aggregates in the aggregate bins without the need for climbing up on the truck. The aggregates shall be maintained at the proper level to cause the correct volume to enter the mix.

The aggregate bins shall be equipped with vibrators or other means of maintaining a smooth, even, and continuous flow of aggregate from the bins.

The truck mixer shall be equipped with water tanks of sufficient capacity to store the quantity of water required to produce the maximum volume concrete capacity of the truck mixer, as rated by the manufacturer and at the slump specified for each concrete item. If concrete additives are to be used in the mix, means shall be provided for storing the additives on the truck and incorporating them in the mix, including a way to check the rate of flow of the additive into the mix.

The truck mixer shall include a feeder unit mounted under the compartment bins to deliver the ingredients to the mixing unit.

Each bin on the truck shall have an accurately controlled individual gate or feeding mechanism to form an orifice for volumetrically measuring the material drawn from each bin compartment. The cement bin feeding mechanism shall be set to discharge continuously and at a uniform rate, a given volumetric weight equivalent of cement during the concrete mixing operation. The gates of the aggregate bins shall be calibrated at the various openings to discharge the volumetric weight equivalent of aggregates required for various concrete mixes. The mixer truck shall be equipped with a material flow indicator attached to the metering gates to monitor continuous flow of material. The indicator shall sound an alarm when a continuous flow of material does not pass through the metering gates.

The truck mixer shall be so constructed as to permit checking the calibration of the gate openings and meters by means of weight test samples.

The calibration of the gate openings and meters shall be checked and certified for each concrete mix design at least once a year by a testing agency. When approved, a representative of the Contractor may perform the calibration if it can be shown that the representative is knowledgeable in the proper techniques of calibration. The Authority shall be notified, at least one week prior to the date of the annual calibration, in order that the Authority may approve the calibration.

A calibration check or a yield test may be required at any time. The accuracy of the mixer to proportion the specified mix is acceptable if the calibration check shows that the equivalent weights of each component are within the following tolerances:

Cement	0 to + 4 percent
Fine Aggregate	± 2 percent
Coarse Aggregate	± 3 percent
Admixtures	± 3 percent
Water	± 1 percent

Each truck mixer shall be equipped with a revolution counter indicator permitting the reading of the volumetric weight equivalent of cement discharged during the concrete mixing operation.

Each truck mixer shall be equipped with fine and coarse aggregate dials to permit adjustment of the gates of the aggregate bins for volumetric proportioning of aggregates.

Each truck mixer shall be equipped with a water meter or gauge to register the discharge rate of water by volume entering the mix.

Each truck mixer shall be equipped with an automatic means of maintaining the operating speed of the proportioning and mixing operations. The truck mixer shall be operated within plus or minus eight percent of the revolutions per minute established by the manufacturer, noted on the aforementioned plate, and the value used during calibration. This tolerance shall be met when the mixer is moving or standing still. A tachometer shall be mounted on the unit to indicate the operating speed.

All indicators, dials, meters, tachometer, and controls shall be in full view and near enough to be read or adjusted by the operator while mixing concrete.

Handling, measuring, and batching of materials shall conform to Subsection 304.04(C) except as follows:

(a) Cement and aggregates shall be proportioned, measured, and batched by a volumetric weight equivalent method. Separate batching equipment and storage bins are not required, and the materials shall be batched in the continuous-mixing-type truck mixer.

(b) Each truckload of ingredients shall be accompanied by a sufficient number of delivery tickets such that the operator may supply one copy of the delivery ticket for each Project and for each class of concrete delivered. The delivery tickets shall show the brand name and type of cement, the calibrated cement constant of the machine in terms of the indicator revolution count, the source of aggregates, and the size of the coarse aggregate. The delivery tickets shall be signed by a responsible officer or employee of the concrete supplier.

At each project, for each class of concrete and for each separate mixing operation, the mixer operator shall enter on the tickets the name of the project, the name of the Contractor, the revolution counter indicator readings indicating the volumetric weight equivalent of cement discharged during that mixing operation, the concrete additive meter reading indicating the total volume of additive discharged into the mix during that mixing operation, the aggregate dial settings, the water and concrete additive flow rate, and the class of concrete delivered. The operator shall sign each completed ticket and furnish one copy.

The following shall apply only to mixing on the Project in truck mixers, mixing at a central mixing plant, and transit mixing above:

(6) Delivery Ticket.

A delivery ticket, completely filled out, shall be furnished for each load. The tickets shall be serially numbered and shall bear the printed heading of the supplier and the location of the batch plant. Each ticket shall show the name of the Project, the name of the Contractor and subcontractor, if pertinent, the number of cubic yards of concrete and the class and type, the name of each admixture and the quantity shown in liquid measure or weight, the time when loading into the drum was completed as imprinted on the ticket by an automatic clock, the time when the concrete was completely discharged, the amount of mixing water and the amount of tempering water, if used, both in gallons, the total number of revolutions on the counter at the time of complete discharge for truck-mix concrete plus the total number of mixing revolutions for transit mix, the date, and the truck number. In addition, for the first ticket of each day, for the first ticket of each pour, and when changes occur in the information, the number of pounds of portland cement with the brand name and type, the number of pounds and the source of the fine aggregate, and the number of pounds and the sizes and sources of the coarse aggregates shall be indicated. The ticket shall be authenticated by an authorized representative of the supplier.

(7) Concrete Rejection.

(a) the mixer fails to maintain the manufacturer's stated speed of rotation for both mixing and agitation, or is not able to promptly discharge the concrete;

(b) there is any indication of improper batching, lack of uniform distribution of constituents throughout the load, or balling of the cement and aggregates;

(c) the concrete is not discharged within the specified time limit, or if the revolution counter shows a total of more than the permitted number of revolutions. However, if the load has been partially discharged and if the concrete yet to be discharged complies with the specified ranges for slump and entrained air without further addition of water, the discharge and use of the concrete may be permitted.

(E) LIMITATIONS OF PLACING.

The limitations shall be as prescribed in Subsection 401.11(G), except that the placing of concrete shall be discontinued in time to allow finishing to be completed in daylight hours. If approved, to complete finishing after daylight hours, an artificial lighting system shall be in place and operable.

Concrete placed in cold weather shall be protected from freezing by covering it with a layer of hay or straw not less than 8 inches thick, over which canvas shall be spread to insure that the concrete will be maintained at a temperature of not less than 50 ^{o}F. for 5 days. The layer of hay or straw shall be placed on top of curing materials. The canvas shall be not less than 4 feet longer than the width of the pavement and shall be laid across it with edges overlapping and ends firmly fastened. In severe weather, another layer of hay or straw shall be placed above the canvas to insure that the concrete will be maintained at the proper temperature. Concrete which has frozen shall be replaced at the Contractor's expense.

(F) PLACING CONCRETE.

The concrete shall be unloaded into a concrete spreader, except that concrete mixed at a central-mix plant may be deposited on the base course and mechanically spread in such a manner as to prevent segregation of the materials. As deposited, the mixture shall be placed where it requires as little rehandling as possible.

The concrete shall be well distributed by the discharge chute across the formed area. In no case shall the concrete be discharged in windrows or piles.

Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels or other appropriate tools. Workers shall not be allowed to walk on previously placed and consolidated concrete.

Where concrete is to be placed adjoining a previously constructed lane and mechanical equipment is to be operated upon the existing lane, that lane shall meet the requirements for opening to traffic in Subsection 304.04(N).

If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after four days. Precautions shall be employed to prevent damage to the previously constructed concrete. In the event of such damage, all damaged areas shall be repaired at no cost to the Authority.

To prevent bowing or misalignment of the transverse expansion joints during paving operations, concrete shall be deposited simultaneously on both sides of transverse joints in a uniform fashion without disturbing the joints.

Should any material fall on or be worked into the surface of a completed slab, the material shall be removed immediately and the surface repaired immediately. The finished condition of the surface is subject to approval.

Where two or more lanes of concrete are to be constructed, two adjacent lanes may be constructed as a single operation.

Where two adjacent lanes of concrete are constructed as a single operation, the longitudinal joint between the lanes shall be the sawed type. The saw cut shall conform to Subsection 304.04(K).

Three or more lanes may be constructed as a single operation, provided that it can be demonstrated that the equipment being used can properly place, strike off, consolidate, finish, and cure the concrete.

(G) INITIAL STRIKE OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT.

Reinforcement steel to be embedded into an existing approach slab shall have a hole core-drilled to the size and depth indicated on the drawings and filled with non-shrink grout.

The placing of the concrete between transverse joints shall be carried out as a continuous operation. If, due to a breakdown in the plant or a delay of more than 30 minutes or other emergency, it is not possible to carry out a continuous paving operation, an intermediate Type A transverse expansion joint shall be constructed and so located that the short slab has a minimum length of 15 feet or of one normal reinforcement mat, whichever is the lesser.

The mixing and placing of the concrete shall progress only at such a rate as to permit proper finishing, protecting, and curing.

A single layer of concrete mixture shall be placed first and then spread and struck off with a mechanical spreader equipped with a screed board, so that the entire area between side forms and for a distance sufficient for placing a reinforcement mat is covered to the full depth of the side forms. Mechanical depressors shall be used to secure the steel in place at its proper elevation.

As an alternate, the concrete mixture may be placed in two layers with the first layer placed to such a depth that the surface of the layer is at the proper elevation to receive the reinforcement steel. The next layer of the concrete mixture shall be placed and spread immediately after placing reinforcement steel and in a manner to prevent segregation, and so that the surface is at the proper grade when the consolidation and finishing are completed. Concrete of the lower layer, which has developed initial set or has been in place more than 30 minutes before being covered with the next layer, shall be removed and replaced.

When concrete is constructed without reinforcement, the foregoing requirements for placing the

concrete in one layer shall apply.

After the concrete is placed, the portions thereof within 12 inches of transverse, longitudinal, and other joints and within 12 inches of all side forms shall be compacted with suitable tools and by vibrating. The method of vibrating and number of vibrating units shall be such as to ensure the proper density of the concrete adjacent to the ends and sides of the slab and within the areas of the transverse joint structures.

Vibrators shall not be permitted to come in contact with a joint assembly, the base course, or a side form. In no case shall the vibrator be operated longer than five seconds in any one location.

(H) FINAL STRIKE OFF, CONSOLIDATION, AND FINISHING.

(1) Sequence.

The sequence of operations shall be strike off and consolidation, floating and removal of laitance, straight edging, and surface texturing.

The addition of water to the surface of the concrete to assist in finishing operations will not be permitted.

(2) Machine Finishing.

As soon as the concrete has been placed, it shall be struck off and screeded with a finishing machine.

The machine shall go over each area as many times and at such intervals as necessary to give the proper compaction and leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The machine and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation which could affect the finish.

During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length. The moving of rolls of concrete in excess of 6 inches with the finishing machine will not be permitted.

If thorough consolidation of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the concrete, then other equipment and methods shall be furnished and employed which produce thorough consolidation.

(3) Finishing at Joints.

The concrete adjacent to joints shall be placed and consolidated against the joint material, under and around all load transfer devices, joint assembly units, and other features which extend into the concrete.

After the concrete has been placed and vibrated, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If continuous operation of the finishing machine up to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 8 inches from the joint. Segregated concrete shall be removed in front of and off the joint; the front screed shall be lifted and set directly on top of the joint, and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

(4) Hand Finishing.

Hand finishing methods will not be permitted except under the following conditions:

(a) In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade or in transit to the job when the breakdown occurs.

(b) Variable-width areas or other special conditions which make the use of finishing machines impractical may be finished by hand methods.

When hand finishing is permitted, the concrete shall be struck off and screeded as soon as placed. The major part of the concrete above the required grade shall be removed by a hand-operated vibratory screed, moved forward with a combined longitudinal and transverse motion, and so manipulated that it remains in contact with the side forms. The vibrating screed shall be at least 24 inches longer than the maximum width of the slab. It shall be sufficiently rigid to retain its shape and constructed of metal or other suitable material shod with steel.

Screeding shall be repeated until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

Immediately following the longitudinal screeding operation, further finishing with straightedges or lutes, final surface finishing with metal tines, rounding of joint edges, checking of the concrete surface with a straightedge, and the correction of excessive surface irregularities shall be performed as specified for machine finishing except that a mechanical tining machine need not be used. A spud type vibrator shall be used to consolidate the concrete around joints and along forms.

(I) STRAIGHTEDGE CONTROL TESTING AND SURFACE CORRECTION.

Systematic checking of the work during placement shall be performed in order to correct surface irregularities while the concrete is in a workable condition. This checking operation shall be performed after the concrete has been consolidated, and the excess water has been removed but while the concrete is still plastic.

Such systematic checking shall be performed as follows:

(1) After the intended final pass with the finishing machine, the concrete surface shall be checked with a straightedge parallel to the centerline of the traveled way. Surface variations from the testing face of the Straightedge shall be corrected before the concrete sets. Major deviations shall be corrected by the finishing machine, while minor deviations may be corrected by the straightedge or float. The addition of water to the surface of the concrete, to assist in finishing operations, will not be permitted.

(2) It is suggested that the checking operation progress in successive 5-foot longitudinal increments, with special attention being given to the concrete surface in the vicinity of joints.

(J) SURFACE TEXTURE.

Final surface texturing shall be via saw cut grooving. Sawing equipment specifically designed and equipped for the grooving of pavements shall be utilized. The sawing equipment shall be of a multi-bladed type, adequate in number of units and power to complete the saw cut grooving operation, and equipped with water cooled, circular, diamond-edge blades and alignment wheels. A system of slurry collection shall be utilized. An ample supply of replacement saw blades shall be maintained at all times during the saw cut grooving operations.

Grooves for new or completely resurfaced bridge decks shall be rectangular in shape and shall conform to the following dimensions:

WIDTH ..... 1/8 INCH ± 1/32 INCH

DEPTH ..... 3/16 INCH ± 1/16 INCH

SPACING ..... INCH ± 1/16 INCH

Where partial deck replacement or repair is performed, final pavement texture saw cut grooving shall be of the same cut direction, depth, width, and spacing as the existing pavement texturing, as much as is practicable.

Grooves shall not be cut over an area which has been already grooved. No cutting blade shall be introduced into a groove that has already been established. A maximum un-grooved gap of no more than 3" shall be permitted between passes of the grooving machine.

Residue from the grooving operation shall not be permitted to flow across shoulders or lanes occupied by traffic or into gutters or other drainage facilities.

Before traffic is permitted in the grooved area, the area shall be cleaned so that the grooves and surfaces between the grooves are free of debris, residue, and dust to the satisfaction of the Engineer.

Where the deck surface is to carry vehicular traffic prior to final pavement texturing, the temporary riding surface shall be given a skid resistant texture by brooming. Brooming shall only be done after floating. The broom finish shall be applied when the concrete has hardened to the point where strokes of the broom do not produce corrugations of greater than 1/8" in depth, but not less than 1/16". Strokes shall be square across the slab, from edge to edge with adjacent strokes slightly overlapped, and shall be made by drawing the broom and without tearing the concrete. The broom shall be of an approved type.

As an alternative to achieve the above surface texture, artificial turf of an approved type may be affixed to a broom or float paddle and used in the same fashion as directed above. Substitution of a broom for artificial turf shall be at the permission or direction of the Engineer.

All temporary riding surfaces shall be micro-milled in accordance with Section 535 prior to final pavement surface texturing.

(K) JOINTS.

Longitudinal and transverse joints shall be provided, as shown in the Plans, or as directed by the Engineer.

All joints requiring sealer shall be sealed with hot-poured rubber asphalt in accordance with Subsection 907.02 before any traffic is permitted. The joint opening shall be cleaned of all extraneous matter. The contact faces of the joint shall be dry at the time of sealing. Compressed-air jets, power-driven wire brushes, and any such additional equipment necessary to clean the joint and dry the contact faces shall be provided

Where the longitudinal joint between two adjacent lanes was constructed by saw cut, the sawed groove may be filled with a cold-applied type of sealer.

Pouring of this compound for sealing the joints shall be done by the use of hand pots, mechanical methods, or any other method which gives satisfactory results. Pouring shall be done in such a manner that the compound is not spilled on the exposed surface of the concrete. Any excess compound on the surface of the concrete shall be removed immediately.

Joints shall be filled so that upon completion, the compound shall be 1/8 to 1/4 inch below the adjacent surface. When more than one pouring is required to fill the joints, the succeeding pouring shall be made immediately after shrinkage of the compound in the previous pouring has taken place. Traffic will not be permitted over the poured joints until the compound has hardened sufficiently to resist pickup.

(1) Longitudinal Joints.

Longitudinal joints between adjoining strips or lanes of new concrete shall be of the keyway type. The keyway type longitudinal joint shall also be constructed between strips of existing and new concrete widening where the side of the existing is recessed, but where there is no such recess, the longitudinal joint shall be constructed with vertical plane faces and filled with 1/4 inch preformed expansion joint filler. The side of the concrete abutting shoulders and curbs shall be constructed with a recessed face as in the keyway type joint. The joint between the concrete and the curb shall be filled with 1/2 inch preformed expansion joint filler.

Where adjacent lanes of concrete are constructed one lane at a time, tie-bolts shall be installed in the longitudinal joint between the adjacent lanes.

Where two adjacent lanes of concrete are constructed in a single operation, tie bars shall be installed between the lanes.

Longitudinal sawed joints shall be cut with concrete saws not later than 72 hours after placing concrete and before any equipment or vehicles are allowed on the concrete. The saw cut shall have a depth of 2 1/8 inches in 8 inch concrete, and a depth of 2 3/4 inches in 9 inch concrete. The width of the saw cut shall be not less than 1/8 inch or more than 1/4 inch. If longitudinal cracking of the concrete occurs, sawing of the concrete shall be started just as soon as the concrete has hardened sufficiently to permit sawing without excessive tearing or raveling of the concrete. The method of repair of concrete, in which longitudinal cracking has occurred, is subject to approval. If the cracking cannot be satisfactorily repaired, the concrete shall be removed and replaced at no cost to the Authority.

(2) Transverse Expansion Joint Assemblies.

Transverse expansion joint assemblies shall be rigid metal devices capable of holding dowels and filler firmly in position during the entire construction operation and shall remain in place. The top of the filler shall be set below the surface of the proposed slab to accommodate the sealant specified. When in position, the filler shall be perpendicular to the surface of the slab. The top edge of the filler shall be protected by a metal channel cap while the concrete is being placed. Dowels shall be placed across transverse expansion joints, parallel to and level with the surface course.

Each day's paving shall be terminated at an expansion joint. Any concrete back to that preceding transverse joint shall be removed.

(3) Longitudinal and Transverse Joint Ties.

For placement of the joint tie, holes shall be drilled 9 inches deep into the side of the existing slab, half-way between the top and bottom. The holes shall be spaced as indicated. Joint ties shall not be placed within 24 inches of a transverse expansion or contraction joint. Joint ties shall be omitted when adjacent to bridge approach and bridge approach transition slabs. When the distance from a visible crack extending through the full depth of the exposed edge of the existing concrete roadway is less than 12 inches to the nearest joint tie, said tie shall be omitted.

After drilling, the holes shall be cleaned thoroughly and filled with the epoxy grout. The joint ties shall then be inserted in holes and securely supported in position until the grout has set.

(L) EDGING AND MARKING.

After the final finish, but before the concrete has taken its initial set, the outside edges of the concrete shall be rounded with an edging tool.

All joints shall be tested with a straightedge before the concrete has set and corrections made to comply with surface requirements.

The slabs, including bridge approach and bridge approach transition slabs shall be numbered consecutively as the work progresses and the last slab placed each day shall be marked with the date laid. The marking shall be made on a corner of the slab at the end completed last.

The figures shall be of uniform type, 1 1/2 inches high, and plainly and neatly stamped after the final finish.

(M)CURING.

Curing shall be in conformance with the methods specified for bridge slabs in Subsection 401.18.

(N) SURFACE REQUIREMENTS.

(1) Permissible Surface Variations.

The surface of the concrete will be tested with a rolling Straightedge that automatically marks, in colored dye, the length of surface variations which exceeds a tolerance of 1/8 inch in 10 feet.

Concrete placed on a new mainline shall be so constructed that, when tested in accordance with part (2) below, the measured length of lot exceeding the specified 1/8 inch tolerance shall not exceed five percent.

Concrete placed in non-mainline areas of the Project or constructed adjacent to an existing roadway, for the purpose of widening, will be tested in accordance with part (3) below.

(2) Surface Compliance Plan.

Prior to acceptance testing and notching of the expansion joint filler paper necessary to permit passage of the Straightedge, any required sweeping of the surface shall be performed as part of the work.

Conformance to the surface tolerance will be determined in lots, each lot being equal to the number of square yards of concrete surface placed in each production day.

The compliance of a lot will be determined from the percentage of the total length of the lot having surface variation exceeding 1/8 inch in 10 feet, this percent noncompliance being defined as the lot percent defective length. Lot percent defective length is computed by adding the lengths of individual surface defects exceeding the specified tolerance, dividing this sum by the total length tested, and multiplying by 100 to convert to percent.

The full extent of the lot will be tested in the longitudinal direction along the wheelpaths, defined as the two imaginary lines located approximately 3 feet on each side of the center of the lane and extending for the full length of the lane. The wheelpath of the test will be determined randomly and varied every 90 to 120 yards.

The minimum number of full-length tests required to determine the lot percent defective length is given in Table 304-1 below. The 25 percent sample plan, wherein the number of tests is at least equal to one-fourth of the number of wheelpaths in a day's production, will be used initially. Final compliance may be based on the results of the 25 percent sampling, except that if the lot percent defective length exceeds 13.9, each wheelpath will be tested.

When more than one test is specified in Table 304-1 below, the initial and intermediate transverse locations of each test will be determined randomly. Exact duplicate tests will not be performed. When testing of all wheelpaths is specified, no intermediate transverse variation of the individual tests will be made. The results of preceding tests are not to be included in the computation of lot percent defective length when application of the 100 percent sample plan is indicated.

In addition to the minimum number of tests specified in Table 304-1 below and run on randomly selected sites, any area which appears defective may be tested, including a previous day's production which is damaged by construction operations.

If the lot percent defective length is 5.1 to 13.9 inclusive, the lot shall be removed and replaced or the lot may be accepted upon written request, provided that the lot is reduced in accordance with Table 304-2 below.

Table 304-1 Surface Acceptance Testing Schedule

	Corresponding Number Tests				*Lot Percent Defective*	*Reduction*
Sampling Plan	*One Lane*	*Two Lanes*	*Three Lanes*	*Four Lanes*	*Length Measured*	*or Retest Requirement*
25%	1	1	2	2	0 to 13.9	As per Table 304-2
					14.0 or more	Test each wheelpath
100%	2	4	6	8	All values	As per Table 304-3

Table 304-2 Reduction Per Lot Due to Nonconformance to Surface Requirements

Lot Percent Defective Length	*Reduction per Lot, Percent*
0 - 5.0	None
5.1 - 11.0	2
11.1 - 13.9	5

If the lot percent defective length exceeds 13.9, any or all of the concrete in the lot may be directed to be removed, replaced, and retested for acceptance. If the concrete is allowed to remain in place, the lot quantity will be reduced by 16 percent.

(3) Other Testing.

The riding surface of non-mainline surface, bridge approach and transition slabs, and lanes constructed for the purpose of widening are not subject to the foregoing surface acceptance requirements.

However, the riding surface of any or all portions of the traveled way of the Project (including, but not limited to, such areas as ramps, acceleration or deceleration lanes, and lanes added to widen an existing roadway) may be tested to determine the adequacy of the paving methods and equipment. The paving operation is acceptable if the riding surface is in substantial conformity with a 1/8 inch in 10 feet surface tolerance. If the paving operation is unacceptable, the particular placement operation involved shall be discontinued until mutually acceptable methods or equipment are used.

Additional compensation, extension of Contract Time, or other concession will not be allowed, because of revised methods or equipment necessary to produce substantial conformity with a 1/8 inch in 10 feet surface tolerance.

(4) Surface Remedial Measures.

Correction of surface by grinding and resubmission for testing may be permitted provided that correction does not require removal of more than 1/4 inch of concrete from the surface. Grinding shall be performed with equipment specifically designed for the purpose and shall employ either a diamond-studded drum or stacked-blade-type cutting head. The texture depth in the ground areas shall be similar to that of the adjacent surface. All ground areas shall be neat areas of uniform appearance. When use of such remedial grinding procedures is requested, a plan shall be submitted in writing setting forth the intended limits of the surface restoration and a complete description of the methods and equipment proposed for use.

(O) Removing Forms.

The side forms shall not be removed until the concrete within them has been in place for at least 12 hours. The forms shall be removed carefully, so as to avoid damage to the concrete. After the forms have been removed, the sides of the slab shall be cured in accordance with Subsection 401.18. Honeycombed areas shall be repaired as directed and operations shall be modified to minimize further honeycombing.

Precautions shall be exercised with respect to form removal and load applications for Portland cement concrete containing fly ash since the rate of strength development may be slower.

(P) Protection from Traffic.

The concrete surface course and its appurtenances shall be protected from traffic, in accordance with Subsections 106.09 and 106.12. This shall include watch persons to direct traffic and the erection and maintenance of warning signs, lights, bridges, or crossovers, etc. Such protection devices and personnel shall be provided without additional compensation.

Warning signs shall be erected and maintained during the entire curing period. The warning signs shall be erected at each end of the section being cured and at intervals of approximately 6 inches along such section. In residential and business areas, the signs shall be erected at intervals of 100 feet. Wood bridging for pedestrian crossovers shall be placed at street intersections and at other established pedestrian crosswalks. The words KEEP OFF shall appear conspicuously on each warning sign and shall be stenciled on each waterproof paper blanket and each sheet of polyethylene sheeting.

In order that the concrete be protected against the effects of rain before the concrete is sufficiently hardened, materials for the protection of the edges and surface of the unhardened concrete shall be available at all times. Such protective materials shall consist of covering material such as burlap, curing paper, or plastic sheeting material. When rain is imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

Any damage occurring prior to acceptance shall be repaired or replaced at no cost to the Authority.

(Q) Defective Work.

The Engineer will from time to time make an examination of the pavement laid and as a part of such examination, he may cut cores or otherwise remove sections there from. The cores shall be approximately 6 inches in diameter and of the full depth of the pavement. Cores will be tested for strength, when not less than 28 days old, in accordance with AASHTO T 24. If such examination discloses the pavement to be of less than the required thickness, or to contain cracks or other defects,

the Engineer will require the Contractor to remove such defective work and replace it with pavement meeting the requirements of the Plans and Specifications, without cost to the Authority, in accordance with Subsection 905.23(F).

(R) OPENING TO TRAFFIC.

The pavement shall not be opened to traffic or construction equipment until the number of days after finishing shown below shall have lapsed, all joints have been filled and sealed, all concrete spilled on the surface has been removed, and all curing and other extraneous materials have been removed upon completion of the curing period:

MAY 16 - OCTOBER 15 ..... 9 DAYS

OCTOBER 16 - MAY 15 ..... 12 DAYS

Opening to traffic, as provided above, shall in no manner relieve the Contractor from his responsibility for the work in accordance with Subsection 106.09.

(S) THICKNESS REQUIREMENTS.

The concrete surface course shall be so constructed that its average thickness is equal to or in excess of the thickness specified. The thickness of the pavement will be measured, and where any pavement is found deficient in thickness, deductions in unit price for or removal of thin pavement will be made as specified herein.

For the purpose of determining the constructed thickness of the pavement, 4" diameter cores will be taken at random intervals in each traffic lane at the rate of 1 core per 1,000 feet or increment thereof. In addition, cores shall be taken at all locations where thickness measurements taken during construction indicate a thickness deficiency sufficient to justify a deduction from the contract unit price or at any other locations as may be determined by the Engineer. If the measurement of any core is deficient in excess of 2/10 inch from the plan thickness, additional cores will be taken at 50-foot intervals parallel to center line ahead and back of the affected location, until the extent of the deficiency has been determined.

It will be assumed that each core is representative of the pavement thickness for a distance extending one-half the distance to the next core, measured along the center line, or in the case of a beginning or ending core, the distance will extend to the end of the pavement section.

The drilling of cores in irregular areas, or on projects involving less than 2500 square yards of concrete pavement, may be waived by the Engineer.

If any core measurement of thickness is deficient, the contractor shall have the option of removing and replacing the pavement at the contractor's expense or of leaving the pavement in place and receiving the following deductions in payment.

Deductions Deficiency in Thickness	*Percent of Contract Unit Price*
0 inch to 2/10 inch	none
Over 2/10 inch and not over 4/10 inch	15
Over 4/10 inch and not over 6/10 inch	60
Over 6/10 inch	100

The above deductions will be applied to a section of pavement 50 feet long and extending from the edge of the pavement to a longitudinal joint, or between longitudinal joints in that section of pavement in which the deficient measurement was found.

If pavement which is deficient in thickness in excess of 6/10 inch may, in the judgment of the Engineer, seriously impair the traffic service of the pavement, the contractor will be required to remove the pavement and replace it with one of a satisfactory quality and thickness which, when accepted, will be included in the pay quantity. No payment will be made for any costs incurred in the removal of the pavement of deficient thickness. If, in the judgment of the Engineer, there is no probability of immediate failure, the Engineer may allow the contractor the choice of leaving the deficient pavement

in place and receiving no payment or of removing and replacing the pavement as provided herein.

In removing pavement, it shall be removed from the edge to a longitudinal joint, or between joints, and on each side of the deficient measurement until no portion of the exposed cross section is more than 2/10 inch deficient, except that there shall not be less than 25 linear feet of pavement removed. If there remains less than 15 feet of acceptable pavement between the section that has been removed and a transverse contraction, expansion or construction joint, the contractor shall remove the pavement to the joint.

304.05 Measurement.

Portland Cement Concrete Pavement will be measured by the surface area paved within the limits shown on the Plans or as directed by the Engineer without deduction of the areas occupied by transverse joints, interior longitudinal joints between pavement slabs, or by manholes, catch basins and similar structures within the pavement area.

Bridge Approach Slabs , Bridge Approach Transition Slabs and Toll Plaza Slabs will be measured by the area constructed in accordance with the Plans or as directed by the Engineer.

Core drilling and grouting for reinforcement steel to widen an existing approach slabs or toll plaza slabs will not be measured for payment, but the cost thereof shall be included in the items, Bridge Approach Slab and/or Toll Plaza Slab.

304.06 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
PORTLAND CEMENT CONCRETE PAVEMENT.	SQUARE YARD
BRIDGE APPROACH SLAB.	SQUARE YARD
BRIDGE APPROACH TRANSITION SLABS, ___" AVERAGE THICKNESS	SQUARE YARD
TOLL PLAZA SLAB	SQUARE YARD

Payment adjustments due to nonconformance with surface requirements will be made in accordance with Subsection 304.04(N), Table 304-2 and will be applied to the lot quantity as determined according to Subsection 304.04(N)(2).

Payment adjustments due to the average thickness being less than the specified thickness will be made in accordance with Subsection 304.04(T).

Payment adjustments for strength and durability for the various portland cement concrete items, listed above, will be made in accordance with Subsection 905.23.

All payment adjustments made according to the above are cumulative.

No separate payment will be made for finishing, joint work, grouting, reinforcement steel as specified above in the construction of Portland Cement Concrete Pavement, Bridge Approach Slabs or Toll Plaza Slabs.

SECTION 305 - PAVEMENT REMOVAL AND SURFACE MILLING

305.01 Description.

Pavement Removal shall consist of milling, shaping, and removing of distorted pavement and other areas of existing pavement surfaces by a cold milling process, within the areas indicated on the Plans or as directed by the Engineer. No materials are involved.

Pavement surface removal on bridge decks will be as specified in Section 417.

Work shall also include pavement texturing in accordance with the plans or as directed by the Engineer.

Surface Milling shall consist of removing the high areas of pavement by means of a milling machine on either asphalt surfaced roadways or bridge decks.

Pavement Texturing shall consist of milling a uniform diamond grid pattern, 1/4 inch deep into the existing

asphalt concrete pavement surface within the area indicated on the plans or as directed by the Engineer.

305.02 Equipment.

The milling machine shall be especially designed and built for milling bituminous pavements without heating. It shall be a self-propelled, self-loading type of machine, capable of picking up and discharging the milled material into a truck in one operation. The machine shall be equipped with automatic grade and cross slope controls with independent sensors, and shall include a cutting drum with carbide tip cutting teeth, that will produce a striated milled surface with the striations generally no deeper than 3/8 of an inch. The width of the cutting drum shall be a minimum of 108 inches and a maximum of 144 inches.

The automatic grade and cross slope controls shall be capable of producing a finished profile and cross slope within $\pm$ 0.02 feet of a referenced elevation. The referenced elevation shall be determined through the use of taut reference lines positioned at or near the edge of the milling machine, or through the use of a moving reference line such as a "floating beam or ski" of at least twenty (20) feet in length that is attached to the machine. A short ski or shoe may be used as a moving reference line, with the approval of the Engineer, provided a satisfactory fixed reference plane is available at or near the milling machine.

A mechanical vacuum type sweeper approved by the Engineer shall be furnished and used to clean the milled surface of any loose material.

305.03 Methods of Construction.

(A) Roadway Pavement.

The cold milling of the existing pavement is to be performed, as directed by the Engineer, and in conjunction with the maintenance of traffic requirements indicated for the Project.

The depth of milling shall be as indicated on the Plans or directed by the Engineer.

Milling operations shall be carefully planned so that the milled surface will be paved by the end of the work period. When milling adjacent to the longitudinal joint of a newly paved lane, the milling shall be extended two (2) inches into the mew mat of the lane. Longitudinal joints shall be milled parallel to the roadway centerlines within a tolerance of ±3 inches per 100 linear feet. If this tolerance is not met, trim or mill the edge of the HMA mat as necessary.

Areas not accessible to the milling machine, such as around and adjacent to toll islands, inlets, manholes, curbs and transverse joints on structures, may be removed and shaped by handwork or other methods approved by the Engineer. In general, except for the areas adjacent to curbs, this removal is to be performed immediately prior to the placement of the new asphalt riding surface.

For all roadways to be paved with Open Graded Friction Course (OGFC and AR-OGFC) the Contractor shall furnish pavement removal equipment with a fine milling drum having a tooth spacing of 5/16 inch (8mm) capable of producing a milled surface texture with a ridge-to-valley depth (RVD) of 1.6mm accuracy. Maximum RVD shall not exceed 3.2 mm.

The milled material including that removed by other means shall be immediately removed from the roadway surface. The material shall become the property of the Contractor and disposed of by him off Authority property.

When working adjacent to traffic, extreme care shall be exercised to avoid spillage of milled material onto the traveled way. In the event that such a condition should occur, the Contractor shall take immediate steps to correct the condition.

No sharply defined drop-offs will be permitted within or between travel lanes carrying traffic which are created by the milling. A smooth diamond plate pattern texture will be required on lanes to be opened to traffic.

The milling operation shall be performed in such a manner that at the end of each work day, the milled area shall be cleaned thoroughly of all loose material, utilizing approved vacuum and mechanical type sweepers, prior to opening to traffic.

Cleaning shall again be performed, when directed by the Engineer, prior to the placement of the new asphalt concrete wearing course.

Milling shall not be performed when there will be insufficient time for the placement of a new wearing course, in accordance with the limitations as indicated in Section 302 for asphalt paving.

(B) BRIDGE DECK SURFACE PAVEMENT.

When bridge deck surfacing is required by the Contract, the removal of high areas of "shoved", "bumpy" or otherwise distorted pavement shall be by methods and equipment approved by the Engineer, which will not damage headblocks, joint headers, membrane and joint armor to remain or adjacent concrete curbing and inlets.

The limit of surface milling shall be as delineated by the Engineer or as shown in the Plans.

The depth setting of the milling head shall be constantly monitored on both sides and adjusted if necessary, in order to achieve the desired results. In low areas, the machine shall cut to "daylight".

The milled surface shall be free from gouges, continuous grooves, and ridges with no more than a 1/8 inch differential between "high" and "low" areas.

Any grooving in excess of 1/8 inch shall be repaired by the Contractor to the satisfaction of the Engineer and at no cost to the Authority. When grooves appear, the milling operation shall be stopped and the equipment repaired or replaced. Overcutting in excess of 1/4 inch of the depth specified shall be repaired to the satisfaction of the Engineer at no expense to the Authority.

The final surface shall be of a smooth diamond plate texture.

If the removal of the existing pavement exposes any existing deck reinforcement, the Contractor shall clean the exposed reinforcement and the surrounding concrete surface, and apply epoxy mortar to provide a minimum of 3/4 inch cover over the reinforcement. The cost for cleaning and applying epoxy mortar cover will be considered incidental to removal of existing surfacing and surface milling.

Open joints and inlets shall be effectively covered prior to any surface milling.

The removed asphalt material and membrane shall become the property of the Contractor and shall be properly disposed of off Authority property.

305.04 Measurement.

Pavement Removal will be measured by the surface area of pavement removed within the prescribed limits, measured in place.

Pavement texturing will be measured by the surface area of pavement textured within the prescribed limits, measured in place.

Surface Milling will be measured by the surface area milled within the prescribed limits, measured in place. The Engineer will, when deemed necessary, direct the Contractor to surface mill areas in conjunction with scheduled removal of large areas of pavement removal.

305.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
PAVEMENT REMOVAL, ___" DEPTH	SQUARE YARD
PAVEMENT REMOVAL, VARIABLE DEPTH.	SQUARE YARD
PAVEMENT TEXTURING, 1/4 INCH DEPTH.	SQUARE YARD
SURFACE MILLING, ____" DEPTH	SQUARE YARD
PAVEMENT REMOVAL, FINE, ____" DEPTH	SQUARE YARD

SECTION 306 - MILLED RUMBLE STRIP

306.01 Description.

The work shall consist of milling a 7" x 16" x 1/2" groove, 1 foot on center in the shoulder pavement by a Cold Milling Process within the limits indicated on the plans, or as directed by the Engineer.

306.02 Equipment.

The milling machine shall be specifically designed and built for milling rumble strips in bituminous pavements without heating. It shall be self-propelled and equipped with automatic cutting controls that will produce a uniform groove in the pavement, as shown on the plans.

The mechanical vacuum-type sweeper approved by the Engineer shall be furnished and used to clean the milled surface of any loose material.

306.03 Methods of Construction.

The cold milling of the shoulder pavement is to be performed as directed by the Engineer and in conjunction with the maintenance of traffic requirements indicated for this project.

The depth and dimensions of the milled rumble strip shall be as indicated on the plans.

The milled material shall be immediately removed from the roadway surface. The material shall become the property of the Contractor and disposed of by him off Authority Property.

When working adjacent to traffic, extreme care shall be exercised to avoid spillage of milled material onto the traveled roadway. In the event that such a condition should occur, the Contractor shall take immediate steps to correct the condition.

The milling operation shall be performed in such a manner that at the end of each work-day, the milled area shall be cleaned thoroughly of all loose material, utilizing approved vacuum and mechanical type sweepers, prior to opening the work area to traffic.

306.04 Measurement.

Milled rumble strip will be measured by the length milled along the centerline of the rumble strip.

306.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
MILLED RUMBLE STRIP	LINEAR FOOT

SECTION 307 - LONGITUDINAL JOINT REPAIR

307.01 Description.

The work under this section involves repairing longitudinal pavement joints, furnishing and placing asphalt concrete surface course mix I-4 in the joints where required by the plans or directed by the Engineer.

307.02 Materials.

Materials shall conform to Subsection 302.02.

307.03 Methods of Construction.

Existing longitudinal joints shall be repaired by removing asphalt concrete pavement along the joint to a minimum depth of 2 inches and a width of 1 foot, also any loose or deteriorated pavement shall be removed to sound pavement. The joints shall then be cleaned by compressed air, so that they are free of all dust, dirt, moisture or foreign material prior to placing tack coat, asphalt concrete and immediately compacting by using a three wheel roller.

The exact locations of longitudinal joint repair will be delineated by the Resident Engineer in the field.

307.04 Measurement.

Longitudinal joint repair will be measured by the length of joint repaired as prescribed.

307.05 Payment.

Payment will be made under:

PAY ITEM ..... *PAY UNIT*

LONGITUDINAL JOINT REPAIR, WORK AREA _____ .... LINEAR FOOT

SECTION 308 – CONCRETE PAVEMENT SPALL REPAIR

308.01 Description.

The work under this section involves removing existing concrete pavement and patching with asphalt concrete pavement within the work areas, as shown on the plans or as directed by the Engineer.

308.02 Materials.

Asphalt materials shall be furnished and applied in accordance with Section 302. Tack coat shall be furnished and applied in accordance with Section 302.

308.03 Methods of Construction.

Concrete pavement areas to be reconstructed will be delineated by the Engineer and suitably marked.

The outline of each such area shall first be cut to a depth of one (1) inch into the existing concrete with a power saw.

All loose and deteriorated concrete shall be removed.

Only pneumatic or hand tools shall be used in the removal of the deteriorated concrete and in preparing and shaping the areas to be repaired.

Extreme care shall be taken where reinforcement steel is uncovered to prevent damage to the steel or its bond in the surrounding concrete. Pneumatic tools shall not be placed in direct contact with reinforcement steel. All debris shall be promptly swept up and removed from the site.

(A) CONCRETE REPAIRS.

After the removal of deteriorated and unsound concrete, surfaces of the remaining concrete pavement shall be cleaned of all loose concrete, dust, and other foreign materials.

An air jet shall be used to remove all other particles just prior to applying tack coat and patching the hole with asphalt concrete surface course Mix I-4.

308.04 Measurement.

The repair of concrete pavement spalls will be measured by the surface area repaired as prescribed.

308.05 Payment.

Payment will be made under:

PAY ITEM ..... *PAY UNIT*

CONCRETE PAVEMENT SPALL REPAIR ..... SQUARE FOOT

Payment for tack coat and asphalt concrete surface course used for spall repairs shall be included under the Pay Item, Concrete Pavement Spall Repair.

SECTION 309 – HOT MIX ASPHALT FRICTION COURSE

309.01 Description.

This work shall consist of the construction of open-graded friction courses.

309.02 Materials.

The materials and their use shall conform to Subsection 302.02 except as follows:

Coarse aggregate for open-graded friction course shall be broken stone of gneiss, granite, quartzite, or trap rock conforming to Subsection 902.02 or shall be crushed gravel conforming to Subsection 902.03, except that it need not be washed and shall not contain more than 50 percent of total carbonates (30 percent on

Federally-funded Projects) as determined according to Section 990, A-4.

309.03 Composition and Preparation of Mixtures.

The mixture for open-graded friction course shall conform to Section 903 and to the following:

Sieve Size	*Total Percent Passing by Weight*
½ "	100
⅜"	80-100
No. 4	30-50
No. 8	5 - 15
No. 200	2-5
Asphalt Cement, percent by weight of dry aggregate	5.7 - 7.0 (see Note)

Note: The specific asphalt content for the job mix formula shall be determined. A minimum of three 1,000-gram trial batches having different asphalt cement contents within the specified range shall be mixed in the producer's laboratory at 250 ± 10 ºF and placed on an 8 to 9 inch diameter heat resistant transparent Pyrex dish. The mixture shall be spread on the dish with a minimum of manipulation. The dish shall be placed immediately in an oven at 255 ± 5 ºF for a period of one hour. After one hour, the bottom of the dish shall be examined. The mixture with a slight puddle at points of contact between the aggregate and the glass dish shall be selected. Photographs of a desirable drainage condition are on file in the Department Laboratory and can be obtained upon request.

The formula selected and samples of all materials used in the final mixture design shall be submitted by the producer to the Engineer at least three weeks before the initial production date.

Sampling requirements are as follows:

COARSE AGGREGATE ..... 35 POUNDS

FINE AGGREGATE ..... 35 POUNDS

MINERAL FILLER ..... 5 POUNDS

ASPHALT CEMENT ..... 2 QUARTS

The submitted materials will be tested for verification of the producer's mix design and for resistance to effects of water according to AASHTO T 167 and ASTM D 1075-96.

Samples are to be molded at 255 ^{o}F using a pressure of 2,000 pounds per square inch. After four days of immersion at 120 ^{o}F, the index of retained strength must not be less than 50 percent. Should laboratory tests establish the need for a heat-stable, anti-stripping additive, the amount added shall be as directed.

The mixture shall have a minimum void content of 15 percent. Verification of the minimum void content will be made according to Section 990, B-6.

During production operations, five random samples will be taken from each lot of approximately 1,000 tons to verify mixture compliance with composition requirements. When a lot is necessarily less than 1,000 tons, samples will be taken at random at the rate of one sample for each 200 tons or fraction thereof.

Sampling and testing for mixture composition will be performed according to Section 990, B-2 and B-3.

309.04 Equipment.

The equipment shall be as provided in Section 302, except the open-graded mix shall be transported in clean vehicles with smooth dump beds that have been sprayed with a non-petroleum release agent. Mineral fillers, fine aggregates, slag dust, etc. shall not be used to dust truck beds. The mix shall be covered during transportation to prevent cooling and the formation of lumps. Long hauls, particularly those in excess of 30 miles, may result in separation of the mix and its rejection.

309.05 Construction Requirements.

The construction requirements shall be as specified in Section 302 except as follows for open-graded mix:

(A) Hand placing shall be avoided except where necessary.

(B) Laying temperature of the mix shall not be less than 225 °F.

(C) Ambient temperature shall be 60 °F minimum.

(D) Thickness shall be ¾ ± ¼ inch.

(E) Temperature at discharge from the plant shall be maintained from 240 to 270 °F.

Immediately after spreading and strike-off, the open-graded friction course shall be compacted by a minimum of one pass of a two-axle or three-axle tandem roller conforming to Subsection 302.04. Additional rolling shall be done if and as directed to firmly set the aggregate in the surface.

309.06 Measurement.

Friction course will be measured as specified for HMA in Section 302 except reductions due to nonconformance to job mix formula, air voids, and thickness requirements do not apply for open-graded friction course.

309.07 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
OPEN-GRADED FRICTION COURSE	TON

Payment for tack coat will be made according to Section 302.

SECTION 310 - REPAIR EXISTING SURFACE COURSE

310.01 Description.

This work shall consist of the cleaning and patching of existing holes in the bituminous concrete on an if and where directed basis, as directed by the Engineer.

310.02 Materials.

Bituminous concrete shall conform to Section 903 for Mix I-5. Tack coat shall conform to Subsection 904.02.

310.03 Method of Construction.

All loose bituminous concrete shall be removed from the perimeter of the hole. Removal may require jack hammering.

The surface of the hole and edges shall be cleaned of all dirt and given an application of tack coat at a rate of 0.02 to 0.04 gallons per square yard. Sufficient time shall be allowed to permit the tack coat to cure to a condition where it is tacky to the touch. Bituminous concrete shall be placed into the holes and compacted with a mechanical tamper. All loose material shall be swept up and disposed of off the site.

Holes within the limits of the pavement overlay shall be patched at least one (1) day in advance of the resurfacing.

310.04 Measurement.

Repair Existing Surface Course will be measured by the square yard.

310.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
REPAIR EXISTING SURFACE COURSE	SQUARE YARD

Tack coat will be paid in accordance with Section 303.

SECTION 311 - SOIL AGGREGATE BASE COURSE

311.01 Description

This work shall consist of the construction of base courses of soil aggregate and the reconstruction of soil aggregate base course.

311.02 Materials

Material shall conform to the following Subsection:

SOIL AGGREGATE 902.08

311.03 Methods of Construction

Spreading equipment shall include an aggregate spreader that can be adjusted to spread to the specified depth, without segregation, and one or more motor graders. The compaction equipment shall be pneumatic-tired rollers or dynamic compactors complying with Subsection 203.03(E).

(A) NEW BASE COURSE.

(1) Preparation of Subgrade or Subbase.

Before placing base course material on the subgrade, the surfaces shall conform to Subsection 209.03. Before placing base course material on subbase, the surfaces shall conform to Subsection 212.03.

(2) Placing and Spreading.

Material shall not be placed when the subgrade or subbase is frozen or when it is unstable because of excessive moisture. The base course material shall be spread with mechanical spreaders except in limited or restricted areas. If approved, the material may be dumped in windrows or end dumped. Material dumped in windrows or end dumped shall be spread so as to eliminate segregation and all ruts and ridges caused by dumping or hauling over the material.

Compaction of each layer shall continue until the material complies with the compaction acceptance testing requirements of Subheading 2 of the fifth paragraph below. The in-place dry density of each compacted layer will be determined according to AASHTO T 191 or AASHTO T310, except that only one method will be used throughout the Project.

The base course shall be constructed in layers not exceeding a compacted thickness of 8 inches, and according to the surface tolerances specified in Subsection 209.03.

If the required compacted depth of the base course exceeds 8 inches, the base course shall be constructed in two or more layers of approximately equal thickness. Each layer shall be compacted as specified above.

Water shall be applied uniformly over the materials during compaction in the amount necessary to obtain the required density.

Compaction of the base course shall conform to the following:

(3) Control Strips.

One or more control strips shall be constructed for the purpose of determining compaction requirements. One control strip shall be constructed at the beginning of work. Additional control strips shall be constructed whenever a change is made in the type or source of material and whenever a significant change occurs in the composition of the material from the same source. Each control strip shall consist of an area of at least 400 square yards. The thickness shall be the same as for completed courses in the pavement section. Each control strip shall remain in place and become a portion of the completed base course.

The material used in each control strip shall be furnished from the same source and shall be of the same type as the material used in the base course whose compaction requirements are established by that control strip. Moisture content of the test strip material shall be within two percent of its optimum moisture content as determined from AASHTO T 99, Method C including replacement

option. Compaction of control strips shall be accomplished using the same type and weight of equipment that is to be used for compaction of the remainder of the base course.

The material upon which a control strip is to be constructed must be approved before the construction of the control strip.

The control strip shall be compacted by a minimum of two complete passes with the compaction equipment. A pass is defined as one passage of any one tire, compacting wheel or vibrating unit over the entire surface of the layer. Compaction shall continue until no appreciable increase in density is obtained by additional passes. For this purpose, between successive passes, three density determinations will be made using the same apparatus as is to be used for acceptance testing.

Upon completion of compaction, a minimum of ten tests will be made at random locations to determine the average in-place dry density of the control strip. If the average density of the material in the control strip is equal to or greater than 95 percent of its maximum density, as determined from AASHTO T 99, Method C, including replacement option, then the value of this average shall be the reference maximum density for courses of the same materials and thicknesses. A control strip satisfying the 95 percent of AASHTO T 99, Method C, density requirement shall be established before construction of the additional base courses. If this density level in the control strip is not achieved, the compaction equipment and/or its method of use will be rejected.

(4) Compaction Acceptance Testing.

For the purpose of checking conformance to the compaction requirements, the base course will be divided into lots consisting of approximately 5,000 square yards or 1,000 cubic yards. Each lot of completed base course will be tested for compliance.

To be acceptable, as determined by the formula below, a lot must have not more than 20 percent of the lot area with a dry density of less than 95 percent of the reference maximum density. If a lot fails to meet this requirement, it shall be reworked and recompacted and shall be resubmitted for acceptance testing.

The percent of lot area with a dry density less than 95 percent of the reference maximum density shall be determined from the calculated value of the term Q. Q shall be equal to or greater than 0.36.

The term Q is defined as:

$$Q = \frac{\text{Average Lot Density - 0.95 of the Reference Maximum Density}}{\text{Range of Lot Density}}$$

where average lot density is the average dry density of five randomly selected locations in the lot and the range of lot density is the absolute difference between the lowest and highest dry density values recorded at these same five locations. The five locations for density tests will be determined by the use of a table of random numbers. One density determination will be made at each of the selected locations using AASHTO T 191 or AASHTO T310, except that only one method will be used throughout the Project. The specified density of all completed lots shall be maintained.

(5) Waiving Standard Compaction Requirements.

When the Special Provisions waive the requirements of Subheadings 1 and 2 above and no alternative method is specified, the base course shall be placed and compacted according to Subsection 203.03(E).

The thickness will be measured at a frequency not exceeding 500 feet or as established by means of test holes or other methods. Test holes shall be refilled with base course material and the material recompacted. Any deficiency in total thickness of the base course, in excess of 1 inch, shall be corrected by reconstructing the base course as specified in Subsection 311.03.

(B) Reconstructed Soil Aggregate Base Course.

The existing soil aggregate base course shall be scarified thoroughly to a depth of 3 to 4 inches. Scarified material containing an excess of clay or other unsatisfactory materials shall be removed and replaced with new soil aggregate. If necessary, new soil aggregate shall be added to obtain the required grade. The new soil aggregate shall be added while the existing surface is in a loose, scarified condition

and shall be mixed with the existing soil aggregate.

When it is provided on the Plans that traffic is permitted to ride on the completed base course, the base course shall be maintained smooth and uniform until covered by the following stage of construction.

311.04 Measurement.

Soil aggregate base course, of the various thicknesses, will not be measured and payment will be made for the quantity in the Proposal adjusted for Change Orders except as provided for in Subsection 108.01.

Reconstructed soil aggregate base course will be measured by the square yard.

New soil aggregate required for reconstruction of soil aggregate base course will be measured by the cubic yard based on the volume in the hauling vehicle according to Subsection 108.01.

311.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SOIL AGGREGATE BASE COURSE, VARIABLE THICKNESS	CUBIC YARD
RECONSTRUCTION SOIL AGGREGATE BASE COURSE	SQUARE YARD

SECTION 312 - SAWING AND SEALING JOINTS

312.01 Description.

The work under this section involves sawing and sealing joints in asphalt concrete overlays over existing Portland cement concrete pavement as indicated on the plans or as directed by the Engineer.

312.02 Materials.

Materials shall conform to the following subsections:

SEALING MATERIALS	904.06

312.03 Methods of Construction.

An accurate system for locating and referencing proposed saw cuts shall be established by the contractor and maintained throughout the duration of the work. The location of the saw cuts shall be directly over the existing concrete pavement joints and cracks and shall be accurately established by a method employing pins and stringline or other positive referencing system. The saw cut locations shall be established prior to paving. Details of the method for establishing the location of the saw cuts shall be submitted for approval at least two weeks prior to the start of paving. Overlays shall be saw cut over transverse cracks that are reasonably straight, at least 1/4" wide, and extend one full lane width.

Saw cuts shall be made in a straight line. When a saw cut is to be made over a crack in the existing concrete pavement, the saw cut shall be made over the approximate centerline of the crack.

Saw cutting, cleaning, and sealing shall be a continuous operation. If traffic is permitted on the overlay prior to sealing of the saw cuts, the saw cuts shall be blown clean prior to sealing. Any unsealed saw cuts damaged by traffic shall be resawed when sealing operations resume at no additional cost to the Authority.

Saw cuts shall be made no earlier than one day following placement of the overlay and no later than five days after placement of the overlay.

The transverse saw cut joints shall extend the full width of the traveled way and shall extend into the shoulder to the edge of the pavement or curbing.

If cracks appear in a base course prior to placement of the surface course, such cracks shall be referenced and the surface course saw cut shall be made directly over the crack, rather than directly over the joint.

Saw cuts shall be thoroughly cleaned with a water blast (50 P.S.I. minimum) immediately after sawing to remove any sawing slurry, dirt, or deleterious matter remaining in the saw cut cavity. Saw cuts shall be blown with air to provide dry surfaces prior to sealing. All sawing slurry from the wet sawing process shall be immediately flushed from the pavement surface. Saw cuts shall be sealed immediately after cleaning.

The joints shall be sealed with hot-poured sealant. A copy of the sealant manufacturer's recommendations pertaining to the heating and application of the joint seal shall be submitted prior to the start of work. The manufacturer's recommendations shall be adhered to. The temperature of the sealant in the field application equipment shall not exceed the recommended safe heating temperature. Sealant material shall not be heated at the pouring temperature for more than six hours and shall not be reheated.

The sealant shall fill the saw cuts such that after cooling, the level of the sealer shall be flush with the pavement. Care shall be taken in sealing so that saw cuts are not overfilled and their final appearance shall present a neat line. Sealant shall be tack free prior to opening to traffic. Sand, cement, or other fine material shall not be spread on the sealed joints to allow early opening to traffic.

312.04 Measurement.

Sawing and sealing joints in asphalt concrete overlay will be measured by the length of joint sawed and sealed.

312.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SAWING AND SEALING JOINTS IN ASPHALT CONCRETE OVERLAY	LINEAR FOOT

SECTION 313 - ROAD MIXED STABILIZATION

313.01 Description.

This work shall consist of the construction of base course of existing soil aggregate mixed in place with a stabilizing agent.

313.02 Materials.

Materials shall conform to the following Subsections:

COARSE AGGREGATE 902.05

SOIL AGGREGATE 902.08

WATER 919.42

STABILIZING AGENTS:

- BITUMINOUS MATERIALS:
  - CUT BACK ASPHALT, GRADE MC 250 OR MC 800 ..... 904.04
  - EMULSIFIED ASPHALT, GRADE SS 1, SS 1H, CSS 1, OR CSS 1H 919.15
  - INVERTED EMULSIFIED ASPHALT, GRADE IEMC 250 OR IEMC-800 ..... 904.10
- CALCIUM CHLORIDE 923.03
- FLY ASH 923.37
- HYDRATED LIME 923.38
- PORTLAND CEMENT 905.01

CURING MATERIALS:

- EMULSIFIED ASPHALT, GRADE SS 1, SS 1H, CSS 1, OR CSS 1H 919.15
- POLYETHYLENE SHEETING 906.07
- WATERPROOF PAPER 906.07
- WATER 919.42

(A) SAMPLING.

The following quantities of samples shall be submitted for testing and for determination of a design mix at least 45 days before construction of road mixed stabilized base course:

AGGREGATES	200 LB
BITUMINOUS MATERIALS	1 GAL
FLY ASH	50 LB
HYDRATED LIME	25 LB
PORTLAND CEMENT	25 LB

313.03 Methods of Construction.

(A) EQUIPMENT.

Equipment shall include a traveling plant with a rotary mixer capable of mixing the components to a uniform consistency and thickness and proper grade control, motor graders, pneumatic tired or steel wheeled vibratory rollers, 10-ton, three-wheel or tandem rollers, and such other equipment and small tools as may be required. The rollers shall conform to Subsection 203.03(E).

The traveling plant shall be self-propelled or tractor drawn and be capable of maintaining a uniform rate of travel while mixing. It shall be mounted on wheels or tracks of such type that, when loaded to capacity, it does not rut or damage the subgrade or subbase. For bituminous stabilization, the mixer shall be capable of mixing so as to ensure that all particles are completely coated.

Other machines capable of accomplishing the required results in one pass, in regard to both uniformity and depth, are acceptable.

(B) LIMITATIONS.

Stabilization will not be permitted when the materials to be stabilized are frozen or excessively wet. Emulsions shall be used only when the air temperature is above 50 °F. Other types of stabilization shall not be started until the surface temperature is at least 40 °F.

Lime fly ash stabilization will not be allowed from September 30 to April 1. Portland cement stabilization will not be allowed from October 30 to April 1. No form of stabilization will be allowed in rainy or snowy weather.

(C) ADDITION OF AGGREGATES.

When new soil aggregate or coarse aggregate is used for blending or to obtain grade, it shall be added to and placed uniformly on the existing soil aggregate before placement of the stabilizing agent.

(D) APPLICATION OF STABILIZING AGENT.

(1) Rate of Application.

Calcium chloride shall be applied at the rate of ½ pound per square yard per inch of compacted depth. Lime fly ash, portland cement, and bituminous materials shall be applied at the rate specified in the design mix.

(2) Spreading.

Stabilizing agents shall not be spread or distributed more than two hours before they are to be mixed with the materials to be stabilized. Calcium chloride, portland cement, or lime fly ash shall not be applied when the moisture content of the windrowed or blanket material exceeds the optimum moisture content of the design mix by more than two percent. For bituminous stabilizing agents, the range of moisture content of the soil aggregate shall be as prescribed in the design mix. The optimum moisture content shall be determined according to AASHTO T 99, Method C, including replacement option.

Windrow type operations will be allowed only when a traveling plant specifically designed for this purpose is used.

The soil aggregate shall be spread to a uniform thickness to the width required. The specified quantity of portland cement, lime fly ash, or calcium chloride shall be applied uniformly in a trench

on top of the windrow or spread uniformly over the aggregate. Stabilizing agent that is lost shall be replaced, without additional compensation, before mixing is started

(E) MIXING.

The soil aggregate and stabilizing agent shall be mixed thoroughly to the required depth by means of a traveling plant with a rotary mixer. Water, as required, shall be added from the traveling plant or a metered water truck and shall be mixed with soil aggregate and the stabilizing agent. Mixing shall be continued until the mixture is uniform in appearance. If more than one pass of the mixer is required, at least one pass shall be made before water or bituminous material is added.

The moisture content of the portland cement, lime fly ash, or chloride soil aggregate mixture, at the time of a final mixing, shall not vary from the optimum moisture content by more than two percent. Where the application of lime fly ash creates an unacceptable dust condition, the lime fly ash may be moistened or the specified quantities of fly ash and lime may be preblended (with or without a portion of the aggregate) with water before application to the soil aggregate or addition to the mixer.

The maximum thickness of a compacted layer shall be 8 inches. When the compacted base course thickness is required to be greater than 8 inches, it shall be constructed in approximately equal depth lifts.

The time between placement of subsequent lifts of lime-fly ash stabilization should be kept as short as possible to ensure that the lower layer has not set up and to ensure bonding with the upper layer. The lower layer shall be kept free of loose material, dirt, or sand. Otherwise, the lower layer shall be lightly scarified to a depth of 1 inch before placement of subsequent layers. Placement of the subsequent lift shall be within four hours.

Subsequent layers of bituminous stabilization containing emulsions shall not be placed for three days. When MC grade cut back asphalts are used, subsequent layers shall not be placed for five days.

Portland cement stabilization shall not be used for multiple lifts.

If the stabilized material is placed in multiple lanes, the maximum time for placement of an adjacent lane shall be the same as the time permitted between multiple lifts. Adjacent lanes of bituminous material may be laid without delay. For adjacent lanes of portland cement stabilization, the second lane shall be mixed within two hours after the water is added to the first lane.

(F) COMPACTION, SHAPING, AND FINISHING.

(1) Compaction.

Pneumatic-tired rollers or vibratory rollers shall be used to provide initial compaction of the mixture.

The in place dry density of each compacted course will be determined according to AASHTO T 191 or AASHTO T310, except that only one method will be used throughout the Project.

When portland cement is used as the stabilization agent, the base course shall be compacted at the specified moisture content and with the same equipment and number of passes used to achieve the reference maximum density in the control strip. In inaccessible areas, portland cement stabilized base course shall be compacted to 95 percent of the reference maximum density obtained in the control strip.

For all other stabilizing agents the base course shall be compacted at the specified moisture content to 95 percent of the reference maximum density determined in the control strip.

(2) Shaping and Finishing.

After the mixture has been compacted, but before the initial set, the surface shall be shaped to the required grade and cross-section. When necessary, the surface shall be lightly scarified with a drag harrow or similar equipment to produce a smooth and uniform surface. The final surface shall be rolled with a tandem roller. The moisture content of the surface material shall be maintained within plus or minus two percent of the specified optimum during finishing operations. Compacting and finishing operations shall be completed within the specified times and shall produce a smooth, dense surface. During the final finishing of the portland cement stabilization, or lime fly ash stabilization, accumulated material shall be removed.

The number of compaction and finishing units shall be sufficient to ensure completion of the initial compaction within two hours for portland cement and four hours for lime fly ash, from the time the water is added at the mixer. The final finishing and compaction shall be completed within four hours for portland cement and within eight hours for other stabilizers from the time of mixing.

(G) Construction Joints.

At the beginning of each day's construction, a straight transverse construction joint shall be formed by cutting back into the previously completed work to form a true vertical face free of loose or shattered material. For multiple lane and multiple layer sections, the construction joints shall be offset by at least 5 feet.

(H) Surface and Thickness.

The surface will be tested using a Straightedge at random locations. The variation of the surface from the testing edge of the Straightedge between any two contacts with the surface shall at no point exceed ¾ inch. All depressions exceeding ¾ inch shall be corrected by removing the entire layer and replacing it with new material. High spots may be removed by methods that provide an acceptable surface.

The thickness of the base course will be determined from the test holes dug at random locations at intervals not to exceed 500 feet. If the measured thickness deviates by plus ¾ inch or minus ½ inch from that specified, the base course shall be reconstructed or replaced. Test holes shall be filled with base course material and recompacted.

(I) Curing and Protection.

(1) Bituminous Stabilization.

No curing material shall be applied. The length of curing time before surface treatment or other surfacing shall be as specified in Subsection 312.03.

(2) Calcium Chloride Stabilization.

No curing material is required.

(3) Portland Cement or Lime Fly Ash Stabilization.

If the next layer is to be placed within 72 hours, curing material is not required. If the next layer is not to be placed within 72 hours, the curing material shall be applied as soon as possible but not later than 24 hours after completion of the finish operation. The finished base course shall be kept moist continuously until the curing material or next layer is placed. Placement of the next layer shall not occur within 12 hours after the application of the curing material. The curing material shall be maintained for a seven-day period so that all of the base course is covered during the period, unless the subsequent layer is constructed within the seven-day period.

The emulsified asphalt curing material shall be diluted with an equal volume of water by the manufacturer. Each shipment of the material shall include a certified statement specifying the rate of dilution. The rate of application of the diluted emulsions shall be 0.10 to 0.25 gallons per square yard.

If it is necessary for construction equipment or other traffic to use the surface before the bituminous material has dried sufficiently to prevent pickup, a cover, consisting of clean sand passing a ⅜-inch sieve or other material, shall be applied. All material placed for this purpose shall be removed before placement of the next lift.

Portland cement and lime fly ash base courses shall be protected from freezing for seven days after construction.

(J) Maintenance Under Traffic.

Maintenance shall be according to Section 801.

313.04 Measurement.

New coarse aggregate will be measured by the cubic yard based on the volume in the hauling vehicle according to Subsection 108.01.

313.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
COARSE AGGREGATE, SIZE NO. _____	CUBIC YARD

Payment for new soil aggregate will be made according to Section 311

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SECTION 401 - CONCRETE STRUCTURES

401.01 Description.

This work shall consist of the construction of reinforced or unreinforced cast-in-place Portland cement concrete for bridge substructures and superstructures, grade separations, viaducts, box culverts, retaining walls, and all other similar types of concrete construction not included in other Sections of these Specifications, at the designated locations, to the prescribed lines, grades, and dimensions and in accordance with the design and details.

Concrete bumper blocks at toll islands, box culvert sections, and other similar items may be either cast-in-place or precast at the Contractor's option. However, the Contractor shall submit drawings of all precast alternates to the Engineer for approval in accordance with Subsection 104.08.

401.02 Materials.

Materials shall conform to the following Sections and Subsections:

AGGREGATES....902

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CONCRETE, MORTAR AND GROUT....905

EPOXY BONDING COMPOUND....923.08

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STRIP SEAL EXPANSION JOINT *....907.07

SUPPORT BARS FOR REINFORCEMENT STEEL....908.01

WATER REPELLENT TREATMENT....923.06(F)

WATERSTOPS....923.17

* Only strip seal expansion joint systems having the preformed elastomeric joint sealer gland locked within lugs of embedded steel extrusions will be acceptable. No surface mounted strip seal expansion joint system shall be used.

The Contractor may, with the Engineer's approval, use a high range water reducer (superplasticizer) in all types and classes of concrete.

Corrosion inhibitor admixtures, when required by the Contract documents, shall be used in fabricating selected structural concrete members or in bridge deck or overlay concrete. Such fabrication shall be in accordance with applicable provisions of Sections 401 and 402. The use of chemical admixtures, in conjunction with the corrosion inhibitor admixture, subject to the provisions of Subsection 906.06, is permitted with the Engineer's approval.

401.03 Equipment.

All equipment and tools used in handling, loading, transporting, and unloading materials and in performing all phases of the work shall comply with the requirements given herein, and those not mentioned shall be suitable for the purpose intended and approved by the Engineer.

(A) UNLOADING AND HAULING EQUIPMENT.

Vehicles and equipment for transporting, unloading, and handling materials for batching shall be of standard design and of a capacity in excess of that needed to maintain the operation of the mixing plant which they serve and shall be in accordance with Subsection 304.03.

(B) BATCHING EQUIPMENT.

Cement and aggregates for concrete shall be measured and batched by weight in accordance with Subsection 304.03 and the following:

Aggregates shall be kept clean and free from foreign matter until used. Aggregates shall be placed in stockpiles for batching purposes on a platform to prevent contamination from underlying material. Different types and sizes of aggregates and similar types of aggregates from different sources shall not be mixed in the stockpiles. Aggregates shall be stored separately, using durable partitions of sufficient height to prevent mixing. The platforms shall be constructed of 2-inch planks or other suitable approved material laid on firm well-drained ground and shall be properly sized so that materials will not be spilled on the ground. Aggregates that have become mixed with earth or foreign material shall not be used. Aggregates that require washing shall not be used sooner than 24 hours after washing or until the surplus water has drained out.

Aggregates shall be handled and transported from stockpiles and other sources to the batching plant in a manner that will prevent segregation and secure a typical grading and uniformity of moisture content for the material.

The fine aggregate and each required separated size of coarse aggregate shall be weighed separately into the hopper in the respective amounts set by the Engineer for the particular proportions desired. The batching plant for aggregates shall include storage bins with adequate separate compartments of not less than 35 ton capacity for the fine aggregate and also for each required separated size of coarse aggregate, with partitions between the compartments extending not less than 3 feet above the top of the bins. Each compartment shall be designed to discharge efficiently and freely into the weighing hopper or hoppers. Means of control shall be provided in each case so that when the quantity desired in the weighing hopper is being approached, the material may be added slowly in small quantities and shut off with precision. Means of removing any over-load of any one of the several materials in the weighing hopper shall be provided. Weighing hoppers shall be constructed with sufficient clearance and operated so as to eliminate accumulations of tare materials and to fully discharge without affecting the scale balance. The discharge gates shall open parallel to the partitions of the receiving truck.

Cement shall be measured by weight. Each bag of cement shall weigh 94 pounds and 94 pounds of bulk cement shall be considered one bag. Batches involving fractional bags will not be allowed except when bulk cement is used. When bulk cement is used, separate scales and hoppers shall be used for the cement, with a device to indicate positively the complete discharge of the batch of cement into the batch box or container.

The weighing hopper and scale shall be of adequate size, completely encased, with provisions for locking. The hopper discharge mechanism shall be interlocked against opening until the full batch is in the hopper and the scale balanced; against opening while the hopper is being filled; against closing until the hopper is completely discharged and the scale back in balance; and against opening if the batch in the hopper is either overweight or underweight by more than 0.5 percent of the amount specified. The weighing hopper discharge gate shall be suspended from the encasement and not from the weighing hopper and shall be so constructed that cement will not lodge therein and there will be no loss of cement by air currents or otherwise. There shall be positive assurance of the actual presence in each hatch of the entire cement content required.

When bulk cement is used, the cement shall be transported to the mixer in waterproof compartments carrying the full amount of cement required for the batch. Cement in original shipping packages may be transported on the top of the aggregates, each batch containing the number of bags required by the job mix. Where bulk cement is to be used, there shall be provided suitable, adequate and separate storage for tested and approved cement, which shall be held in such storage for the particular project or projects for which it was consigned.

Different brands of cement, or the same brand of cement from different mills, shall not be mixed during use. They shall not be used alternately unless approval has been granted by the Engineer.

(C) MIXING AND TRANSPORTING EQUIPMENT.

Mixing on the Project in transit mixers, at a central mixing plant, or in self-contained mobile continuous mixers are the permissible methods of mixing concrete, except that with the Engineer's approval mixers of a suitable type and capable of properly mixing not less than a one-bag batch of the class of concrete or mortar may be used where only small quantities can be placed at a time. Trucks carrying concrete shall be subject to inspection by the Engineer to determine their suitability and adequacy. Any truck rejected by the Engineer shall not be used until such time that the Contractor has corrected all deficiencies.

(1) Mixing on the Project in Transit Mixers.

Transit mix concrete shall be materials proportioned at a central batching plant and hydrated and mixed at the site of the work in truck mixers.

The concrete shall be mixed in an approved water-tight revolving drum truck mixer so constructed as to produce concrete with a uniform distribution of the materials throughout the mass and shall be equipped with a discharge mechanism which will discharge the concrete with a satisfactory degree of uniformity.

Each truck mixer shall have permanently attached in a prominent place, a metal plate on which is stated the manufacturer's rating of capacity in terms of gross volume of the mixing drum, the volume of mixed concrete based on the use of the truck as a mixer, and speed of rotation for both mixing and agitation. The volume of concrete mixed per batch shall not exceed the number of cubic yards which the manufacturer has stated to be the mixing capacity of the truck, nor shall it be greater than 57.5 percent of the gross volume of the drum. Drums and auxiliary parts of the mixer shall be kept free from accumulated materials.

Each truck mixer shall be equipped with a counter permitting reading of the revolution count at the start and termination of the mixing.

The mixing water tank, pump, and the piping shall be kept clean and free of leaks. An in-line multi-jet or positive displacement meter shall be provided which indicates the amount of mixing water added to the batch. Either meter shall be provided, as a minimum, on one truck mixer for each concrete pay-adjustment item per day. The device shall have an accuracy of plus or minus 1.5 percent, by volume, of the indicated amount dispensed. The meter shall have a nonresettable register with a capacity of 100,000 gallons. A remote, readily visible, resettable three or four-digit counter shall be mounted in the truck cab. The counter shall measure water added to the nearest gallon and shall be provided with a unique mechanical or electrical device for resetting. This device shall remain in the possession of the Engineer during production. The distribution system shall be equipped with three-way valves and bypasses or other suitable means for calibration of the water-measuring device. The water-measuring device shall be calibrated before use and recalibrated whenever any repairs or modifications are made that may affect the calibration. Documentation showing the date and results of calibration of the water-measuring device shall be carried on each truck mixer and copies shall be furnished upon request. Near the measuring device, on the mixing water tank, there shall be stenciled the word "calibrated" and the date of the last calibration.

The mixing water-measuring device shall be located so as to be plainly visible to the truck operator when operating the mixing water and the drum controls, and to the Engineer while standing on the ground. All measuring indicators shall be kept clean and in good condition.

Truck mixers are subject to inspection by the Engineer, including the mechanical condition of the truck mixer, verifying the mixing and agitation rates, the accuracy of the water-measuring device, the size of discharge opening and chutes, and the general condition and wear of the blades. The truck mixer will not be approved for use if any part or section of the pickup and throw-over blades is broken, missing, or excessively worn. Truck mixers will be examined daily if deemed necessary by the Engineer for cleanliness of the drum and blades, leaks in the mixing water system, and the condition of the water-measuring device and the revolution counter.

The water shall be added to the mix immediately prior to the start of the mixing operation and the mixing shall be continuous from the time of admitting water into the drum until the concrete is discharged. After all ingredients are in the drum, each batch shall be mixed not less than 70 nor more than 100 revolutions and at the rate of rotation designated by the manufacturer of the equipment at the mixing speed. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. The volume of water, the time of mixing within the revolution limits specified above, and the control of the mixture shall be subject to regulation by the Engineer. Mixers shall be thoroughly cleansed and drained after each batch is discharged. The mixer shall not be used

when any of the devices specified previously are not functioning properly or when the blades of the mixer have worn down to 90 percent of their original width.

Handling, measuring and batching materials shall conform to the requirements previously specified and shall be subject to inspection by and approval of the Engineer at all times while transit mix concrete is being furnished. The concrete will be rejected if there is any evidence of setting up, improper batching or mixing, excessive segregation, use of excessive mixing water, or if the amount of entrained air is other than that specified.

The concrete shall be discharged from the truck mixer within 90 minutes (60 minutes for concrete for bridge deck slabs) after the cement has been loaded into the drum. Under conditions contributing to quick stiffening of the concrete or when the ambient temperature is 85°F or above, such time shall be reduced to 60 and 45 minutes respectively. However, if the use of water reducing admixtures is approved, the time limits shall be increased to a maximum of 90 minutes and 60 minutes respectively.

Each truck load of transit mix concrete shall be accompanied by a delivery ticket which shows the name of the Project, the name of the Contractor, the quantity of each ingredient, the brand name and type of cement, the source of the aggregates, the size or sizes of the coarse aggregate, and the time when the cement was loaded into the drum. The delivery tickets shall be signed by a responsible officer or employee of the concrete supplier. On delivery, one copy of each delivery ticket shall be furnished to the Engineer.

The equipment used to place the concrete may measure water either by volume or weight. The accuracy of measuring the water shall be within a range of error of not over one percent. Unless the water is to be weighed, the water measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with outside taps and valves or other means to permit accurate calibration and to provide for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank. The following shall also be required for this work:

(2) Bonding Grout Mixer.

The mixer shall be the type designed for mixing mortar. It shall have a minimum capacity of 0.1 cubic yard. The mixer shall be approved by the Engineer prior to use.

At least 2 (two) batching boxes of 0.1 cubic yard capacity each shall be approved at the site for the proportioning of sand and cement.

The equipment used to place overlay concrete shall comply with the requirements specified herein and the following:

They should be self-propelled and be capable of carrying sufficient unmixed dry, bulk cement, sand, coarse aggregate, and water to produce on the site not less than 6 cubic yards of concrete.

Mixers should be calibrated to accurately proportion the specific mix. Where placements involve more than 100 cubic yards, calibration of cement should be checked at 100 cubic yard intervals. The yield will be required to be within a tolerance of 1.0 percent according to the following test:

With the cement mixer set to zero and all controls set for the desired mix, activate the mixer, discharging mixed material into a 0.25 cubic yard container that is 3 feet x 3 feet x 9 inches in size. When the container is level-struck full, and provision for setting the material into all corners is made, the cement meter must show a discharge of 7 bags/cubic yard of cement.

(3) Mixing at a Central Mixing Plant.

Central mix concrete shall be materials proportioned and mixed at a central plant and transported to the point of use in an agitator truck of approved design.

Mixers shall be of approved type and capacity capable of combining the cement, aggregates, and water into a thoroughly mixed and uniform mass within the specified mixing time and of discharging the mixture with a satisfactory degree of uniformity.

Mixers shall be equipped with an acceptable timing device that will not permit the batch to be discharged until the proper mixing time has elapsed. The device for the measurement of the water, either by volume or weight, shall be readily adjustable and under all operation conditions shall be accurate within a tolerance of not more than 0.5 percent of its maximum capacity.

Handling, measuring and batching materials shall be as previously specified and shall be subject to

inspection by, and approval of the Engineer at all times while central mix concrete is being furnished. The consistency and air content of the concrete at the central plant and when placed in the work shall be subject to the approval of the Engineer. The concrete will be rejected if there is any evidence of setting up, improper batching or mixing, use of excessive mixing water, excessive segregation or if the amount of entrained air is more than that specified.

Agitator trucks for the delivery of central mix concrete shall be of a type approved by the Engineer, and shall have a revolving, water-tight drum capable of transporting and discharging the mixed concrete with a satisfactory degree of uniformity. The speed of the drum shall be that stated by the manufacturer to be the agitating speed. Each agitator truck shall have attached thereto, in a prominent place, a metal plate on which is stated the gross volume of the drum, the manufacturer's rating in terms of mixed concrete for agitation, and the speed of rotation for agitation. The volume of mixed concrete in the drum shall not exceed the manufacturer's rating, nor shall it exceed 80 percent of the gross drum volume.

All truck mixers used for central mix concrete shall be equipped with an approved, electrically operated counter unit which shall be nonresettable except by use of a 110 volt device utilizing a nonstandard plug located at the batching plant. The counter unit shall contain two counters. One counter shall record only those revolutions at speeds recommended by the manufacturer of the truck mixer as agitating speed and shall record the total of all such revolutions from the time the truck is loaded. The other counter shall record revolutions of the drum at all speeds and shall record the total revolutions from the time the truck is loaded. The unit shall be so designed that it will show a positive indication on the front panel if the instrument has been turned off or tampered with in any manner after being reset at the time of loading. The counter unit and the resetting device shall conform with the requirements of the National Electric Code. The counter unit shall be positioned on the truck so as to be plainly visible.

Each truck load of central mix concrete shall be accompanied by a delivery ticket which shows the name of the Project, the name of the Contractor, the quantity of each ingredient, the brand name, and type of cement, the source of the aggregates, the size or sizes of the coarse aggregate, and the time when the completely mixed concrete was loaded into the truck drum. The loading time shall be imprinted by an automatic time clock. In lieu of the automatic time clock, the counter unit specified above may contain a third counter, an electrically operated timer, which shall be nonresettable except by use of the 110 volt device. The delivery tickets shall be signed by a responsible officer or employee of the concrete supplier and on delivery, one copy shall be delivered to the Engineer.

The concrete shall be completely discharged within 90 minutes (60 minutes for concrete for bridge deck slabs) after the agitator truck is loaded with completely mixed concrete. Under conditions contributing to quick stiffening of the concrete or when the ambient temperature is 85ºF or above, such time shall be reduced to 60 and 45 minutes respectively. During the time that the concrete is in the agitator truck, it shall be agitated for two minutes of each period of ten minutes.

The Contractor shall provide the Engineer with two-way radio telephone or radio telephone communication between the job site and the central mixing plant.

(4) Self-Contained Mobile Continuous Mixers.

Equipment shall be of a self-contained, mobile, continuous-mixing type subject to approval of the Engineer.

The mixer shall be self-propelled and shall be capable of carrying sufficient unmixed, dry bulk cement, sand coarse aggregate, and water to produce on the site not less than 6 cubic yards of concrete.

The mixer shall be capable of positive measurement of cement being introduced into the mix. A recording meter, visible at all times and equipped with a ticket printout, shall indicate this quantity.

The mixer shall provide positive control of the flow of water into the mixing chamber. Water flow shall be indicated by flow meter and shall be readily adjustable to provide for minor variations in aggregate moisture. The device for proportioning water shall be accurate within one percent.

The mixer shall be capable of being calibrated to automatically and accurately proportion and blend all components of indicated composition on a continuous or intermittent basis, as required by the finishing operation, and shall discharge mixed material through a conventional chute directly in front of the finishing machine.

Proportioning equipment for each material shall be calibrated in the presence of the inspector, or the Engineer may accept a previous calibration and require satisfactory verification checks only at the

settings indicated by the previous calibration. The proportioning equipment shall be operated at the speed recommended by the manufacturer during calibration, checks, or normal operation. Continuous mixers shall be recharged at the site. The Contractor may make yield checks or other checks as he sees fit, and the inspector will cooperate in such checking.

Materials shall be thoroughly mixed in an approved mixer at the site of placement in accordance with the specified requirements for the equipment used. The mixture, as discharged from the mixer, shall be uniform in composition and consistency.

(5) Portable Mixer.

For small quantities, and when approved by the Engineer, the mixer may be portable of the rotating-paddle type. A continuous mixer used in conjunction with volumetric proportioning may be used. The device for proportioning water shall be accurate within one percent. Sufficient mixing capacity or mixers shall be provided for either type to permit the intended pour to be placed without interruption.

(D) SLIP-FORMING EQUIPMENT.

Equipment used for slip-forming concrete parapets other than bridge parapets may be subject to license fees under United States Patents Nos. 3957405 and 4014633, held by A.C. Aukerman Company. Should the Contractor provide for such use of this equipment, it shall execute a legal agreement in accordance with applicable contract documents and Subsection 106.11.

The slip-forming (extrusion) machine shall have the ability to place the approved concrete mix design through a mold of proper cross-section to produce concrete of the specified shape, surface texture, and density.

The slip-forming machine shall consolidate the freshly placed concrete in one complete pass of the machine. Sufficient internal vibrators shall be provided for consolidating the concrete along the faces of forms and adjacent to joints in such a manner that a dense and homogenous parapet, free from voids and honeycombs, is produced.

The equipment, methods, and processes proposed to be used in the construction of the slip-formed concrete parapet shall be submitted to the Engineer for approval prior to use. The Contractor shall furnish evidence of successful history and operation of the slip-form (extrusion) machine or other equipment. A test section at the job site for all proposed slip-forming shall be constructed, having a minimum length of 100 feet to verify that the proposed equipment, material, and methods are capable of producing concrete parapets that meet the plans and specifications. Accepted test sections may be incorporated into the project.

401.04 Contractor's Quality Control.

To insure that materials furnished and mixtures produced and placed in the work will be as specified, the Contractor shall make tests on materials and mixtures, check the accuracy of weighing, batching and recording equipment at the batching plant, and make corrections and adjustments relative to the materials, proportioning the mixture, air content, slump, and the accuracy and operating conditions of all equipment at the plant.

Tests			
	Test Method (ASTM Designation)	**Frequency (Minimum)**	**Acceptance**
Fine Aggregate			
Grading	C136	Once per day	Within range specified in ASTM Designation C13
Fineness Modulus (F.M.)	C136	On per day Mix $\pm$ 0.2	F.M. Design
Moisture Content	C566	Four per day (test at least 1 hour apart)	* (Moisture meters shall be used)
Coarse Aggregate			
Grading	C136	Once per day for each size	Within range for size specified in ASTM C33
Moisture Content	C566	One per day	* (Moisture meters for each size shall be used)

Tests			
	Test Method (ASTM Designation)	**Frequency (Minimum)**	**Acceptance**
Alkali-Silica Reactivity	C1260	Once per mix	< 0.10 percent expansion after 14 days in solution **

Tests			
	Test Method (ASTM Designation)	**Frequency (Minimum)**	**Acceptance**
Concrete			
Air Content	C173 or C231	One per 100 c.y. for each class but not less than one per day	As specified in Section 905
Slump	C143	One per day for each class	As specified in Section 905

* Based on the results of the moisture content tests, the plant shall make adjustments to compensate for the varying moisture contents of the aggregate by changing the weights of the materials being batched.

** If acceptance parameters are not met for alkali-silica reactivity, mitigation measures involving fly ash, slag, or low-alkali cement shall be performed in accordance with Paragraph 905.05(B).

401.05 Plant and Mixing Controls.

Batching plant scales, batching equipment, material controls, and recording devices shall conform to Section 304 except as may be approved otherwise by the Engineer and shall be periodically checked for accuracy as follows:

(A) Weighing Accuracy.

The accuracy of the scales shall be checked by test weights at least once a month for conformance with the applicable requirements of National Institute of Standards and Technology Handbook 44. Such checks shall also be made whenever fresh concrete shows visible variations in color, consistency, etc., which could be the result of batching or weighing errors.

(B) Batching And Recording Accuracy.

Once a week, the accuracy of each batching and recording device shall be checked by means of a normal weighing operation. A record shall be made of the results; the record shall include the required design mix weight, the weight recorded by the plant equipment, and the weight of the batch quantity as determined on a separate weigh scale.

(C) Batch-Plant Control.

When concrete is being mixed, the measurement of all materials, including cement, each size of aggregate, and admixture shall be continuously controlled. The aggregate weight and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air entraining agent shall be adjusted to control the air content within the specified limits. A ticket shall be issued by the Contractor's quality control representative for each batch of concrete produced by the batching plant; each ticket shall note the type, source, and amount of cement used; type, amount, and source of admixtures used; geological classification and source of aggregate used, and the required design mix weights of aggregate and water, amount of water as free moisture in each size of aggregate, and the weights of batched aggregate per cubic yard of concrete.

401.06 Testing by the Engineer.

The Engineer will perform all testing deemed necessary to insure the conformance of the concrete to the requirements of these Specifications. Final quality of the concrete will be determined from the tests performed by the Engineer in accordance with Subsection 905.22.

If it is the opinion of the Engineer that the mix properties are such that concrete of unacceptable quality is likely to be produced, the work may be ordered stopped until the cause has been determined and the necessary corrective action has been taken. The corrective action may range from a minor adjustment of proportions to the establishment of a new mix design. Corrective actions taken shall be at no cost to the Authority.

If the concrete producer has satisfactorily met applicable design, control, and acceptance testing requirements at the batch plant and has provided automatic recordation of the various batched weights which comply with specified design criteria, slump, and air content, the concrete will be presumed to be in compliance with Authority standards at the time of delivery. This presumption shall not waive or alter any other requirements or otherwise affect the Engineer's ability to impose pay adjustments or reject the mixed concrete completely.

Slump and air-entrainment tests are at the rate specified for strength tests in Section 905 and will be performed on the same samples of material from which the compressive tests cylinders have been molded. While these tests are being performed, discharge from the truck is to be halted. Discharge from other trucks not scheduled for test may proceed. Each truck load of concrete containing fly ash shall be tested for slump and air entrainment.

For slump or air entrainment or both, if the measured value is outside the ranges specified in Section 905, a second test will be performed on a different portion of material from the same load. If the average of the two test results for either slump or air entrainment exceeds the upper limit, the load of concrete will be rejected and removed from the project site. If the average of the two test results for either slump or air-entrainment falls below the lower specification limit, a single addition of mix water (or the approved Type F admixture for those mixes containing a water-reducing, high range admixture) and/or air-entraining agent will be permitted provided that this additional step can be accomplished without exceeding the time or revolution limits specified.

When an air-entraining agent is added, it shall be diluted with water prior to addition to the drum.

Following any permitted additions, the drum shall be rotated at the recommended mixing speed for a minimum of 30 revolutions in accordance with ASTM C 94. The original test results shall be disregarded, and a single test for both slump and air-entrainment shall be performed. Further additions of mix water or admixtures will not be permitted. If the measured values for slump and air-content are not within the ranges specified in Section 905, the load of concrete will be rejected and shall be removed from the project.

A maximum total of 300 revolutions shall be made for all mixing.

All testing for concrete strength shall be done in accordance with Subsection 401.16, Section 905 and applicable Supplemental Specifications.

401.07 Falsework.

Working drawings and design calculations of falsework and centering shall be sealed and signed by a Licensed Engineer in the State of New Jersey and submitted for the Engineer’s review when so required, but the lack of exceptions taken by the Engineer during his review or his acquiescence in the work constructed according to them shall not relieve the Contractor of full responsibility for the structural adequacy and safety of all such temporary construction. If necessary, to secure unyielding support, the falsework shall be supported on piles. Screw jacks, hardwood wedges, or other suitable means shall be used to correct slight settlements. Falsework shall be set to give the camber indicated and to allow for shrinkage and settlement. Centers for arches shall be gradually and uniformly lowered when struck so as to avoid injurious stresses in any part of the structure. In arch structures of 2 or more spans, the sequence of striking centers shall be as specified or approved.

401.08 Forms.

Detail drawings of forms shall be submitted to the Engineer for his review in accordance with the requirements of Subsection 104.08, but lack of exceptions taken by the Engineer during his review, or his acquiescence in the work constructed, shall not relieve the Contractor of full responsibility for the accurate and safe performance of the work.

(A) GENERAL.

Forms shall be constructed to conform to the lines, grades, and to the exact dimensions of the structure as shown on the plans. Where necessary, the forms shall be constructed to compensate for variations in camber of supporting members and to allow for deflections. They shall be substantially constructed, strong, rigid, mortar-tight, and properly braced and tied. The forms shall be designed so that they can be removed without causing damage to the concrete.

Forms may be of wood or metal except that approved fiber tubes may be used for column forms.

Metal forms shall be of substantial thickness and have a smooth true surface free from rust. Bolts and rivets shall be counter-sunk on the inside surface.

Wood forms for exposed surfaces shall be lined with plywood or fiber board or constructed of plywood

except where other types of surface finishes are specified. Plywood for lining forms shall not be less than 3/8 inch thick, of a grade suitable for concrete forms, and shall have a smooth finish. Fiber board for lining forms shall have a thickness of not less than 1/4 inch and shall have a hard, smooth surface on one side. The form lining shall be adequately fastened to the formwork to avoid buckling and deflection, and shall be sufficiently tight to avoid formation of fins.

Forms for concrete surfaces not exposed to view may be, at the option of the Contractor, rough or dressed lumber, or metal forms.

Forms for bridge parapets shall be metal or a plastic-lined material of sufficient imperviousness to produce a smooth and dense surface finish. New bridge parapets may be slip-formed only when the bridge is closed to all traffic. Conventional forming of bridge parapets shall be used for all other traffic conditions. Where white cement is required for concrete used in construction barriers, slip-forming methods will not be permitted unless the contractor can demonstrate satisfactory performance through test sections or other means.

Column forms of fiber tube, if used, shall be erected promptly after delivery. If storage is necessary, the tubes shall be supported their entire length and not less than four feet above the ground. Minimum protection shall consist of a tarpaulin which will cover ends of tubes at all times.

Column forms shall be erected and held in a vertical position in a manner which will prevent distortion of the circular section during placement of concrete.

All forms shall be constructed, braced, and aligned so as to produce smooth concrete surfaces without bulges and warps. When the forms appear unsatisfactory, either before or during concreting, the concrete placement shall be deferred until the forms have been erected to the satisfaction of the Engineer. Reused forms shall be in good condition in all respects.

Grooves and chamfers shall be formed with finished lumber or approved plastic strips. All exposed edges and corners of concrete not otherwise specified, shall be formed with a triangular 45° chamfer strip having a hypotenuse of not more than 3/4 inch nor with sides less than 1/2 inch wide. Where details stipulate 45° corners of dimensions not exceeding 4 inches on the sides, they shall be similar 45° chamfer strips. All strips shall be made in a planing mill, surfaced on all sides, and shall be of uniform dimensions throughout the job. Larger size chamfered or beveled corners stipulated shall be formed and finished as required for other parts of the adjacent forms.

Before placing concrete in the forms, they shall be thoroughly cleaned of all loose and foreign material and coated with an approved oil to prevent adherence of concrete. For concrete exposed to sea water, the forms shall be heavily coated with approved shellac or oil. Form oil shall be of a type that will not stain the concrete surface.

Form ties and anchorages within the forms shall be arranged so that they can be removed to a depth of not less than 2 inches from the surface of the concrete without damage to the surface. Ordinary wire ties shall not be used. The cavities left in the concrete when the ties are removed shall be filled with mortar similar to that of which the concrete is prepared, and the surface of the concrete shall be left sound, smooth, even, and uniform in color and texture.

Form ties of any character shall not be used through concrete parapets, curbs, or other thin low walls.

For bridge deck slabs supported directly on longitudinal members (stringers, girders), removable forms shall be used under cantilevered slabs outside the fascia stringers or girders and in bays where longitudinal joints are to be provided. Permanent metal bridge deck forms shall be used in interior bays on bridges constructed over roadways open to traffic. Either removable or permanent metal forms may be used, at the Contractor's option, in interior bays on all other bridges.

Forms and form supports for slabs which cantilever over stringers adjacent to longitudinal open bridge deck joints shall be supported only on the steelwork which supports the slab.

Forms for bridge deck slabs shall be constructed so that under full dead load, the slabs will be of the required thickness and the surface of the roadway will accurately conform to the profile grades, cross sections, and alignment shown. Allowance shall be made for the camber of the stringers, girders, and floorbeams as erected and for the additional dead load deflections of the stringers, girders, and floorbeams.

The depth of haunches between the top of the stringers and girders and the theoretical bottom of the slab as shown are theoretical. The depth of haunches to be constructed may vary considerably from the theoretical due to superelevation, variations in obtainable camber in the stringers, girders and floorbeams, and to usual variations of fabrication and erection of steelwork. The formwork shall be constructed so as to

provide for any and all necessary variations in actual depths of haunches required.

Removable forms for bridge deck slabs shall be of dressed lumber, metal, plywood, or lined with plywood or other approved lining, with joints sufficiently tight to avoid formation of objectionable fins and to prevent loss of mortar. No particular pattern of removable form boards will be required for underside of slabs, but the arrangements of boards or units the Contractor proposes to use shall meet with the approval of the Engineer.

Forms (removable or permanent) shall be so erected as to insure mortar tightness. Where form leakage occurs, the Contractor shall take immediate steps to seal the joint and to clean mortar from exposed surfaces of structural steel.

Fascia Deck Support Systems shall be provided in accordance with Subsection 417.09.

(B) PERMANENT METAL BRIDGE DECK FORMS.

Permanent metal form sheets shall not rest directly on the top of stringer or floor beam flanges but shall rest on form supports placed in direct contact with the stringer flange. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 1 inch at each end. All attachments shall be made by welds, bolts, clips, or other approved means; however, form supports shall not be welded to those portions of flanges subject to tensile stresses. Welding and welds shall be in accordance with the ANSI/AASHTO/AWS D1.5 Bridge Welding Code pertaining to fillet welds, except that 1/8 inch fillet welds will be permitted.

All attachments and supports shall be either galvanized in accordance with Subsection 909.11 or epoxy coated in accordance with Subsection 908.01.

No intermediate support between stringers will be permitted.

In areas where the transverse reinforcement is perpendicular to stringers, the pitch of the form corrugation shall coincide with the normal reinforcement spacing and the mid-depth of the corrugation shall be positioned vertically with respect to the top of concrete slab as shown.

Where the transverse reinforcement is skewed to the stringers, form sheets shall be cut and placed so that corrugations are aligned across all bays of the deck. At acute angle corners of skewed slabs where the transverse reinforcement is splayed, forms shall be lowered to furnish a minimum concrete cover of one inch under all reinforcement.

Metal form sheets, supports, and accessory items shall be handled with care during shipping and storage. During loading, hoisting, and unloading operations extra precaution and care shall be taken to prevent damage to ends, corners, and edges of the form sheets. If the form units and accessories are to be stored prior to installation, they shall not be placed in contact with the ground. If, during storage, they are to be exposed to the elements for long periods of time or under severe weather conditions, the material shall be adequately covered and/or protected to keep it dry. No loose sheets shall be left on the bridge deck at the end of the working day, nor at any time during windy weather.

During hot weather, metal forms in place shall be protected, in a manner satisfactory to the Engineer, from the direct rays of the sun to avoid placing concrete on hot metal.

Screed and runway supports shall not be located directly on the form sheets or form supports.

Any exposed form metal where the galvanized coating has been damaged shall be thoroughly cleaned, wire brushed, and repaired in accordance with the requirements of Subsection 403.16, to the satisfaction of the Engineer. Damage caused by welding shall also be repaired as above.

Field cutting of form sheets shall be done with a steel saw. Supports, closures and cutouts shall be cut with an electric arc, shears, or saw. Oxygen cutting will not be permitted.

Transverse joints in the forms shall be lap type; the lap shall be located at the bottom of a flute and 1/4 inch weep holes shall be provided in the field at not less than 12 inches on center along the line of the joint.

(C) SLIP-FORMED PARAPETS.

When roadway or bridge parapets are constructed using a slip-form (extrusion) method of construction, the concrete shall be fed to the slip-form machine at a uniform rate. The machine shall be operated at the proper speed to produce a well compacted mass of concrete, conforming to the following fabrication tolerances: Free from surface pits larger than 1/2 inch in diameter and 1/4 inch in depth, and requiring no further finishing other than an ordinary surface finish per Subsection 401.17. The rate of production shall be no greater than 10 feet per minute. Slip-form method of construction shall not be permitted for bridge

parapets during staged construction with live load present.

The grade for the top of the concrete parapet shall be indicated by an offset guide line, set by the Contractor, from survey marks established by the Contractor. The forming portion of the slip-form machine shall be readily adjustable vertically, during the forward motion of the machine, to conform to the predetermined grade line. A grade line gage or pointer shall be attached to the machine in such a manner that a continual comparison can be made between the barrier being placed and established grade line as indicated by the offset guide line.

Parapet joints shall be saw-cut to the width and height as shown on the construction plans and shall be saw-cut within four hours of the slip-forming operation.

All parapet joint locations shall be accurately located and reinforcement steel placed, so that after the joint is saw-cut, the reinforcement steel will have the minimum concrete clear cover, as shown on the plans, with applicable tolerances conforming to these specifications.

A support system shall be designed and constructed by the Contractor capable of restraining the reinforcement cage during slip-forming, so that detectable concrete cracks due to displacements will not occur. The detailing of the parapet reinforcement cage, as shown on the construction plans, shall not be modified by the Contractor, unless approved by the Engineer.

401.09 Reinforcement Steel.

When placed in the work, reinforcement steel shall be clean and free from loose mill or rust scale, paint, oil, and other foreign matter. Reinforcement material shall be protected at all times from damage. The materials shall be stored at the site in such a manner that it will not rest on or come in contact with the ground. Whenever the time of storage is lengthy or if inclement weather is imminent, the material shall be stored under cover.

All reinforcement shall be fabricated by cold bending, using motive power machines in an approved fabricating shop. Hooks and bends shall be dimensioned in accordance with either "Details and Detailing of Concrete Reinforcement (ACI 315-99)" or "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures (ACI 315R-04)".

Bending of new reinforcement steel in the field will not be permitted on bars larger than size No. 8, or when the temperature is less than 30ºF.

Reinforcement steel shall be placed and firmly secured in accordance with the details shown on the plans or as otherwise directed by the Engineer. A minimum of 50 percent ties are required and 100 percent perimeter ties. All rebar intersections shall be tied when the rebar spacing is more than 12 inches.

Welding of bar reinforcement, where shown or directed, shall be in accordance with the requirements of the most current AWS D1.4. Suitable ventilation shall be provided when welding epoxy coated reinforcement bars.

Reinforcement bars partially embedded in concrete shall be field bent only at locations shown on the plans or as may be permitted by the Engineer. When allowed, cold field bending of partially embedded or existing bars, No. 8 size or smaller, shall be done only at times when the temperature is above 30ºF. Bar sizes No. 9 and larger shall be bent only after the bend area has been uniformly preheated to a temperature between 1,100ºF - 1,200ºF. Bending shall be performed smoothly and in a gradual arc using an approved bending tool with adequate radius. Heat shall be applied in a fashion which will not result in damage to adjacent concrete. Concrete surfaces within 9 inches of the bend area shall be covered or wrapped with protective insulation.

The reinforcement steel shall be accurately placed and fastened in an approved manner and in accordance with the applicable ACI Codes and tolerances below, and as may be specified in the Supplementary Specifications. Distances from the forms shall be maintained by means of metal stays, chairs, ties, hangers or other approved supports. The placement of reinforcement steel shall be inspected and accepted by the Engineer before the concrete is placed. Otherwise, the concrete will be rejected and shall be removed.

Reinforcement Steel Placement Tolerances	
Location	**Tolerance**
Clear concrete protection and for depth "d" (see Note) in flexural members, walls and compression members:	
Where "d" is greater than 8 inches and less than 24 inches.	± 3/8 inch but cover shall not be reduced by more than 10 percent of the specified cover.
Where "d" is greater than or equal to 24 inches.	± 1/2 inch but cover shall not be reduced by more than 10 percent of the specified cover.

Reinforcement Steel Placement Tolerances	
Location	**Tolerance**
Longitudinal location of bends and ends of bars.	± 2 inches except at discontinuous ends of members, the tolerance shall be ± 1/2 inch.
Bar spacing, except where inserts etc. might require some shifting of bars, where spacing is:	
Equal to or less than 12 inches.	± 3/8 inch
Greater than 12 inches.	± 1/2 inch
Deck slabs, cover for reinforcement.	+ 1/4 inch, - 1/8 inch

Note: "d" equals specified effective design depth.

Parts of metal supports that are left in place within 2 inches of an exposed surface of the concrete or are in contact with permanent metal bridge deck forms shall be of non-rusting metal, galvanized metal, or provided with plastic coated feet subject to the approval of the Engineer. Galvanizing shall conform to the requirements of ASTM Designation A123.

For deck slabs, plain steel bars or angle iron sections shall be welded 3 feet on center to the stringer flanges and plain longitudinal bars shall be welded to them to properly position the top and bottom transverse reinforcement bars. Extreme care shall be exercised in positioning these longitudinal plain bars. Additional supports resting on the forms shall be provided along the centerline between stringers. These chairs shall support both layers of reinforcement steel, and in addition other means shall be provided to secure the steel to the forms to prevent floating. In situations with staged construction where live load is present on the structure, the top and bottom reinforcement steel mats shall be tied together at a longitudinal spacing not to exceed 3 feet. Such supports and tie-down methods shall be approved by the Engineer. Bars shall be tied at all intersections except where the spacing is less than 12 inches in each direction in which case alternate intersections shall be tied.

Splicing of reinforcement steel, except where shown or approved, will not be permitted. Splices shall have a length sufficient to develop the full strength in bond of the bar, and shall be well distributed and located at points of low tensile stress. Splices shall not be made at points where the section is insufficient to provide at least 2 inches between the splices and the nearest adjacent bar or the surface of the concrete. At splices the bars shall be rigidly clamped or wired together in an acceptable manner.

Repairs shall be made to all damaged epoxy coating on reinforcement steel in accordance with Paragraph 908.01(B).

Reinforcement under masonry plates shall be positioned to clear anchor bolts and/or bolt holes or sleeves.

Sheets of metal fabric shall overlap so as to maintain uniform strength and shall be securely fastened together.

(A) DRILLING AND GROUTING REINFORCEMENT BARS.

Prior to coring/drilling holes for embedment of reinforcement in existing concrete, the Contractor shall use a pachometer, or other method approved by the Engineer, to determine the location of the existing reinforcement.

Drilled hole diameter shall be in accordance with grout manufacturer's instructions. A copy of the manufacturer's instructions shall be submitted to the Engineer for approval in accordance with Subsection 104.08.

Equipment used for coring holes shall be approved by the Engineer prior to use.

Coring with a lubricant will not be permitted. Water is not considered a lubricant. Holes shall be surface dry and all foreign and loose material shall be removed from the holes immediately prior to grout placement.

Grout shall be first thoroughly brushed into all surfaces of the hole and then shall be placed to a depth sufficient to insure complete filling of the hole after insertion of the reinforcing bar.

Reinforcing bars shall be clean and dry prior to insertion into the grouted hole. Bars shall be inserted full depth into the holes and shall be manipulated to insure complete coverage by the grout. After the insertion of the reinforcing bar, all excess grout shall be struck off flush with the concrete face. If the grout fails to fill the hole after reinforcing bar insertion, additional grout shall be added to the hole to allow a flush strike-off.

If the reinforcing bar is inserted in a hole which has an axis predominantly horizontal to the ground surface, care shall be taken to prevent the reinforcing bar from changing position prior to the setting of the grout, and to prevent the grout from running down the face of the concrete.

The above methods shall provide adequate connection between the reinforcing bars, develop the full strength of the reinforcing bars and prevent the displacement of reinforcing bars during concrete placement.

401.10 Placing Embedded Metalwork, Pipe and Conduits.

Prior to placing concrete, the Contractor shall properly set end dams, intermediate bulkheads, other metal work, pipe, and conduit which are to be embedded. All items shall be carefully cleaned, placed, and firmly secured to insure that they will not be displaced during operations. Anchor bolts shall be placed by means of templates supplied by the Contractor. Prior to concreting, all threads shall be carefully greased after the bolts are firmly in position. The positioning of all embedded items shall be carefully observed during and at the completion of concreting operations to insure that they are in the proper position in the finished work.

401.11 Placing Concrete.

Placing the concrete mixture shall be conducted so as to produce a dense, compact, impervious structure of uniform texture and with smooth exposed surfaces. The temperature of the concrete when placed shall be not less than 50°F, nor more than 85°F. Concrete placement outside this temperature range will be subject to rejection and if rejected, shall require removal and replacement at the Contractor's expense. The concrete mixture shall be placed immediately after being mixed in such a manner that segregation does not occur and the reinforcement steel and embedded items are not displaced. Concrete shall be transported to and placed as near its final position as possible. A concrete mixture not placed within the times specified in Paragraph 401.03(C) above will not be accepted. Concreting in hot weather (when the ambient temperature is 85°F or more) shall be performed in accordance with the recommended practice of ACI Standard 305. Concreting in cold weather (when the ambient temperature is 40°F or less) shall be performed in accordance with the recommended practice of ACI Standard 306.

(A) Surface Preparation.

Prior to placing concrete, the areas to receive the concrete mixture shall be cleaned of all debris and foreign substances and otherwise treated as follows:

(1) Concrete on Grade.

All debris remaining from forming and other materials foreign to the subgrade shall be removed. The subgrade condition shall be prepared in accordance with Subsection 203.03 and shall be satisfactory to the Engineer for the placement of concrete.

(2) Concrete on Forms or on Construction Joints.

All debris from the Contractor's operations including material removed from previously set concrete shall be removed from within the forms by sweeping, vacuuming, air jet, or other means to the satisfaction of the Engineer prior to grouting in accordance with Paragraph 401.13(A).

(3) Concrete for Bridge Deck Overlays.

Bridge deck overlays are intended as bonded overlays.

On new concrete decks or newly patched deck areas, the surface shall be given a very rough texture while still plastic by use of a wire comb or other approved texturing device which will produce a bondable surface acceptable to the Engineer.

On old existing concrete, the surface shall be uniformly scarified to an approximate depth of 1/4 inch. Excessive tearing of the surface shall require adjustment of the scarifier drum or replacement of the machine. Over areas of deck repair, the 1/4 inch removal may be coincidental with operations for repair removal.

Scarifying equipment shall be a power operated, mechanical scarifier capable of uniformly scarifying or removing 1/4 inch of existing concrete surface or depths as required. The scarifier shall not produce a polished or slick surface.

In areas which cannot be machine scarified, concrete shall be scarified approximately 1/4 inch deep by chipping and by use of hand tools. Any epoxy patches encountered shall be completely removed to sound, natural concrete. Surfaces of concrete patches placed in the deck after machine scarifying shall

remain rough or be bush-hammered before placing the overlay.

A maximum of 24 hours prior to the placement of the, Low Slump High Density Concrete overlay, the surface shall be sandblasted followed by an air blast. The cleaned area shall subsequently be covered with plastic sheeting to prevent contamination. The sand blast shall be of such an extent as to remove all dirt, oil, and other foreign material, as well as any unsound concrete or laitance from the surface and edges against which new concrete is to be placed. Metal joint plates, floor drains, and areas of the curb or railing above the proposed surface shall be protected from the sand blast. It is desired that the surface be roughened and cleared of loose materials by the sand blast to provide satisfactory bond with the surfacing or overlay concrete. When approved by the Engineer, a water blast may be utilized in lieu of a sand blast. The Contractor shall also use other means if necessary to remove contaminates from the structural slab to achieve a fully bonded overlay. Additional sand blasting or other cleaning may be required on the day the overlay is placed if the surface upon which the overlay is to be placed has been contaminated.

Concrete surfaces upon which Class B concrete overlay is to be placed shall be thoroughly saturated with water immediately prior to placing the concrete overlay. However, no free water will be permitted to remain in the formed area during placement of concrete.

For low slump high density concrete, the structural slab shall be allowed to dry. Grout, in accordance with Subsection 401.13, shall be applied to the dry structural slab and adjacent concrete prior to the placement of the overlay and the overlay shall be placed before the grout coating has attained its initial set. If central mix facilities are used, the plant must be within 10 minutes travel time of the construction site.

The steel surfaces in contact with fresh concrete shall be cleaned by sand blasting or other approved method. Where Class B Concrete or low slump high density concrete overlays are to be applied, epoxy bonding compound shall be mixed neat and placed as follows:

The mixed components of the epoxy bonding compound shall be applied with a stiff-bristled brush. The compound shall be applied over steel surfaces so as to uniformly coat all contact surfaces to a thickness of not less than 20 mils and not more than 40 mils. All steel surfaces shall be coated to the satisfaction of the Engineer.

Concrete shall be placed immediately against the bonding compound while the compound is still tacky. If the bonding compound dries before the new concrete overlay is placed, another coating of epoxy bonding compound shall be applied as herein described at no additional cost.

(B) GENERAL.

The concrete mixture shall not be dropped for a distance of more than 5 feet and shall not be deposited in quantity at one point and subsequently run or worked along the forms. Long chutes shall not be used except when approved by the Engineer and if subsequently found unsatisfactory by the Engineer their use shall be discontinued. Long chutes will not be approved for work exposed to the effects of salt or brackish water. Troughs, pipes, or short chutes of ferrous metal or lined with ferrous metal may be used. Where the slope of the chute is steep, baffle boards or other approved arrangements shall be used. Troughs, pipes, and chutes shall be kept clean and free from coatings of hardened concrete by flushing them with water after each run; the water shall be discharged outside the forms at a point clear of the concrete in place. Troughs and chutes shall extend as near as possible to the place of deposit. Pipes shall be kept full of concrete mixture during the placing, and their lower ends shall be kept in contact with the newly placed concrete. If the concrete is placed intermittently, a hopper or other device shall be used for regulating the discharge.

Placing shall be so regulated that the pressure of the concrete mixture will not cause damage to the forms. Care shall be taken to fill each part of the forms, to work the coarse aggregate back from the face, and to distribute the concrete under and around the reinforcement steel without displacing the steel. The concrete shall be consolidated by continuous working with suitable tools and by vibrating, unless otherwise directed or approved. The method of vibrating and the type and number of vibrating units used shall be as directed or approved. The vibrating implement shall have a vibrating frequency of not less than 5,000 impulses per minute. The internal vibrators and their vibrating frequency shall conform to the requirements of ACI Standard 309.

The concrete mixture shall be placed in continuous horizontal layers not exceeding 12 inches in thickness, unless otherwise specified. If, on account of an emergency, a layer cannot be completed in one operation it shall be terminated at a vertical bulkhead. The batches shall follow each other so closely that a layer is placed and consolidated before the preceding one has taken initial set. The surface of each layer shall be

sufficiently rough to secure proper bonding with the subsequent layer, and this shall be consolidated so as to avoid the formation of a construction joint between the layers. Layers placed at the end of a day's work or when the operations are otherwise temporarily discontinued shall be cleaned as soon as the surface has become firm enough to do so. Visible joints on exposed faces shall be avoided as far as possible by smoothing the top surface of each layer adjacent to the forms with a plaster mason's trowel. Feather edges shall be avoided by insets in the forms so that no layer will end in a thickness of less than 6 inches. When the work has progressed to within 18 inches of the top, the remainder shall be placed monolithically.

Concrete may be conveyed by positive displacement pump when approved in writing by the Engineer. When pumping is permitted, a stand-by pump shall be present at the site of the work. The pumping equipment shall be piston or squeeze pressure type; no parts that come in contact with the fresh concrete shall be made of aluminum. The distance to be pumped shall not exceed the limits recommended by the pump manufacturer. The design mix of the concrete shall not be altered to accommodate the pumps. The concrete shall be supplied to the concrete pump continuously and the position of the discharge end of the line shall be as near as possible, but in no case more than five feet from the final position of the concrete. The pipe line shall be rigid steel pipe or heavy duty flexible hose. The diameter of the pipe shall be at least three times the nominal maximum size coarse aggregate in the concrete mixture to be pumped. When pumping is completed, concrete remaining in the pipe line shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms at a point clear of the concrete in place.

Concrete mixtures for slabs, girders, arch ribs, and other thin sections shall be placed carefully and thoroughly worked and consolidated. The faces shall be well spaded to flush the mortar to the surface of the forms. When buggies are used to distribute concrete they shall be operated on movable platforms or bridges supported directly on structure members or adequately supported forms.

(C) BRIDGE DECKS.

At least 10 days prior to the proposed start of placing bridge deck concrete, the Contractor shall submit a written plan of operation for approval by the Engineer. This plan shall include a screed and rail installation plan, deck grades, the sequence and proposed rate of placing concrete, the number and type of personnel who will be engaged in the work, and a complete description of the equipment to be used in handling, placing, and finishing the concrete. Acceptance of this plan by the Engineer shall not relieve the Contractor of the responsibility for the satisfactory performance of his methods and equipment.

Computation for setting forms and screed supports shall be based on an accurate set of elevations run by the Contractor at points no farther than 10 feet apart on each beam or stringer.

Concrete shall not be placed until the Engineer is satisfied that the proposed placement and finishing operation will be completed within the scheduled time, that experienced concrete finishers are available to finish the deck, that any required weather protective materials are in place, and that all necessary finishing tools and equipment are on hand at the site of the work and are in satisfactory condition for use.

Any change in the number, location, or configuration of construction joints from that shown must be approved.

The concrete shall be delivered, distributed, and consolidated at a uniform rate to insure a continuous operation. For structural deck slabs, the Contractor shall maintain a minimum rate of placement of 30 cubic yards per hour for daily pours of 180 cubic yards or less. When the daily pour is in excess of 180 cubic yards of concrete, the minimum rate of placement shall be 40 cubic yards per hour. For overlays, the minimum rate of placement shall be 1.5 cubic yards per hour, and the elapsed time between depositing the concrete on the prepared surface and final screeding shall not exceed ten minutes. The working face of fresh concrete shall at all times be maintained approximately parallel to the finishing machine or other strike-off.

Concrete placement shall be scheduled so that finishing operations can be completed during daylight hours unless adequate lighting facilities are present on the site and approval is given. Unless otherwise specified, the concrete shall be placed as a monolithic unit in a continuous operation between joints. Failure to produce a monolithic pour where required may result in rejection of the concrete if deemed necessary by the Engineer and required removal and replacement shall be made at Contractor expense without damage to the existing concrete.

Unless otherwise shown, sidewalks, parapets, median barriers, and curbs within any one complete unit shall not be placed until all the structural deck slabs within that complete unit have been placed and cured. These elements shall then be placed and cured prior to the construction of any overlay.

(1) Deck Repairs.

When a concrete overlay protective system type is used for deck repairs, the repair areas shall be brushed with a thin layer of the overlay material that is to be used to complete the overlay. The material shall then be placed, spud vibrated, and compacted by hand methods to fill the repair areas. Upon completing the repairs, the areas shall be cured in accordance with the provisions of Subsection 401.18 for a period of 72 hours. An air cure period will not be required. The provisions of Subsection 401.11 and 401.12 shall be followed for the installation of the overlay.

When an existing concrete overlay protective system is to be repaired, the type of overlay used to complete the repair shall be as per the plans or as determined by the Engineer. Adequate measures, to the satisfaction of the Engineer, shall be used to remove the deteriorated overlay areas. The repair areas shall be brushed with a thin layer of the overlay material. The material shall then be placed, spud vibrated, and compacted by hand methods to fill the repair areas. The repaired areas shall be cured in accordance with the provisions of 401.18 for a 72 hour period. An air cure period will not be required.

(D) GENERAL.

The parapets shall be constructed so that the top of the completed parapet will be parallel to the required grade of the roadway along the gutter line. Inaccuracies in the cambers of the stringers or any failure of these cambers to be entirely balanced by dead load deflections shall be compensated for by variations in the height of the parapet, but the heights of the parapet above the adjacent gutter line shall not be less than the height shown.

Care shall be taken to minimize concrete dripping or spattering on steelwork and other parts of the structure. Any such drippings or spatterings shall be cleaned off.

When permanent metal forms are used, the following additional requirements shall be met:

(1) Concrete shall be placed carefully so as not to damage the forms.

(2) The concrete shall be vibrated at construction joints, ends of form sheets and valleys to prevent honeycombing and voids.

(3) After the deck concrete has been in place for a minimum period of two days, the concrete will be tested for soundness and bonding of the forms by sounding at least 50 percent of the area of a form panel with a hammer. At least 25 percent of the individual form panels will be tested as selected by the Engineer on a random basis. If areas of doubtful soundness are disclosed by this procedure, the Contractor shall remove the forms from such areas for visual inspection after the concrete has attained the specified strength.

(4) After a substantial amount of slab has been constructed, and inspected as outlined above, and the inspection indicate that sound concrete is being obtained throughout the slabs, the amount of sounding may be moderated at the Engineer's discretion.

(5) At locations where forms are removed, the Contractor will not be required to replace the forms but the adjacent portions of forms remaining in place and supports thereof shall be repaired to present a neat appearance and assure their satisfactory retention. As soon as the form is removed, the concrete surfaces will be examined for cavities, honeycombing and other defects. If irregularities are found, and in the opinion of the Engineer these irregularities do not justify rejection of the work, the concrete shall be repaired as the Engineer may direct and given an ordinary surface finish. If the concrete where the form is removed is unsatisfactory, additional forms as ordered by the Engineer shall be removed to inspect and repair the slab, and the Contractor's methods of construction shall be modified as required to obtain satisfactory concrete in the slabs.

(E) PLACING CONCRETE UNDERWATER.

Concrete shall not be deposited in running water and, except with the written approval or direction of the Engineer, shall not be deposited in or exposed to water before setting. When deposited in water, the concrete shall be placed carefully in a compact mass in its final position by means of a tremie, a closed bottom dump bucket, or other approved method in such a manner as not to become segregated or mixed with water and, after being placed, it shall not be disturbed.

A tremie shall consist of a receiving hopper connected to a sectional, watertight tube not less than 10 inches in diameter and fitted with flanged and gasketed couplings capable of being readily and quickly assembled and disassembled. The tremie shall be marked to allow determination of depth to the mouth of the tremie.

Couplings in tremie pipes shall be watertight screwed joints or flanged couplings fitted with gaskets. A hopper or funnel of at least 0.5 C.Y. capacity shall be provided on top of the tremie pipe to facilitate transfer of concrete to the tremie. A supply of extra end plates and gaskets shall be maintained to allow resealing of tremies. The tremie shall be supported so as to permit free movement of the discharge end over the entire surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. Should water accidentally enter the tube during placing operations, the tube shall be withdrawn, resealed at the discharge end, and re-inserted into the concrete mass before resuming the placement. Concrete shall be supplied in a rapid and continuous flow and placement shall proceed without interruption until the concrete has been brought to the required height. The resultant concrete mass shall be monolithic and homogeneous.

The concrete placement rate shall be sufficient to produce a minimum vertical rise of concrete of 0.5 ft./hr., calculated by dividing the entire placement area (ft^2) by the concrete production rate (ft^3/hr.).

Tremie pipes shall be spaced to give a maximum concrete flow distance of 50 ft.

The placement shall begin with the tremie pipe sealed with a watertight plate. The empty tremie pipe shall be sufficiently heavy to be negatively buoyant when empty. "Rabbits" or "go-devils" shall not be used to start the tremie. The tremie shall be sealed, lowered to the bottom, and filled with concrete. The tremie shall then be lifted 6 in. to initiate concrete flow. Concrete supply shall be continuous until soundings indicate the required embedment is developed.

The mouth of the tremie shall remain embedded in the fresh concrete at all times unless the tremie is being completely removed from the water. At no time shall concrete be allowed to fall through water. Embedment shall be from 3 to 5 ft. at all times.

A tremie shall not be moved horizontally while concrete is flowing through it. To relocate a tremie, it shall be lifted from the water, flushed clean, resealed, relocated, and restarted in accordance with the above prescribed starting procedure.

All vertical movements of the tremie shall be carefully controlled to prevent loss of seal. If loss of seal occurs, placement through that tremie shall be halted immediately. The tremie shall be removed, flushed clean, resealed, replaced, and restarted.

Tremies shall be relocated during the placement in accordance with the approved placement plan and as indicated by soundings.

For small pours, and subject to the Engineer's approval, a bottom dump bucket may be utilized for placing concrete underwater. The bottom dump bucket for placing concrete under water shall be of not less than 1/2 cubic yard capacity. The bucket shall be lowered carefully and slowly, and it shall not be emptied until it rests on the surface on which the concrete is to be placed. It shall then be raised slowly while being emptied, so as to maintain still water at the point of discharge and avoid agitating the concrete mixture.

Concrete seals of cofferdams shall be placed in a continuous operation in horizontal layers, and each succeeding layer shall be placed before the preceding layer has taken its initial set. Cofferdams shall not be dewatered until 7 days after the concrete seal has been placed. Laitance or other foreign matter shall be removed before concrete is placed upon the seal in the dry.

(F) CONCRETE EXPOSED TO SALT WATER.

The concrete shall be mixed for a period of not less than 2 minutes and the water content of the mixture shall be carefully controlled and regulated so as to produce concrete of maximum impermeability. The concrete shall be thoroughly compacted and stone pockets shall be avoided. No construction joints shall be formed between levels of extreme low water and extreme high water, as established by the Engineer. Between these levels salt water shall not come in direct contact with the concrete, which may be accomplished by pumping or by not removing the forms, for a period of at least 30 days after being placed.

(G) CONCRETING IN HOT OR COLD WEATHER.

Concreting in hot weather (when the ambient temperature is 85°F or more) shall be performed in accordance with the recommended practice of ACI Standard 305.

At least 30 calendar days prior to the concrete placement, a plan of action for hot weather concreting shall be submitted if it is possible that the ambient temperature could rise above 85°F at any time during the concrete placement or wet cure period.

The Contractor shall provide the Engineer with instruments required to measure relative humidity (hygrometer), concrete temperature (bi-metal thermometer, calibrated using glass thermometer), and wind

speed (wind meter). No separate payment will be made. Wind breaks and fogging may be used as approved and directed by the Engineer.

Night work will be permitted, and when daytime temperatures exceed 85 °F or when dry and windy conditions occur, the Engineer may direct that concrete placement to be made at night or in the early morning hours if, in his opinion, a satisfactory surface is not being achieved. In either case, adequate lighting for nighttime work shall be furnished, subject to the direction of the Engineer.

When the weather forecast predicts temperatures of 85°F, or higher, the Contractor shall schedule placing and finishing overlay concrete during hours in which the ambient temperature will be lower than 85°F. The mixed concrete when placed shall have a temperature no higher than 85°F.

Concreting in cold weather (when the ambient temperature is 40°F or less) shall be performed in accordance with the recommended practice of ACI Standard 306.

At least 30 calendar days prior to the overlay placement, a plan of action for cold weather concreting shall be submitted if it is possible that the air temperature could fall below 50°F at any time during the overlay placement or wet cure period.

Overlay concrete shall be maintained at a temperature of 50°F or above for a minimum of 72 hours. It shall also be protected from freezing for a minimum of 7 days in accordance with the ACI Standard 306. At temperatures below 50°F, a longer curing time for the overlay concrete will be required.

Any concrete damaged by freezing shall be removed and replaced at the Contractor's expense.

No vehicle traffic shall be permitted on the a concrete surface overlay for 7 days and in no case until 3,000 psi compressive strength is attained. At temperatures below 55°F, a longer curing period may be necessary to attain this strength.

(H) THERMAL CURING OF MASSIVE POURS.

For massive pours of concrete, the Contractor shall thermal cure the concrete so as to maintain a temperature differential between the internal (hottest - located as close as possible to the center of the pour but not less than 12" from the surface) and external (coolest) temperature of the concrete to a 35°F maximum. In addition, the internal temperature of the concrete (measured at the hottest point located at the center of the pour) shall at no time exceed 160°F.

A massive concrete pour is defined as any pour in which the concrete dimensions in three directions is greater than four feet (4'-0").

At least twenty (20) days prior to any massive concrete pour, the Contractor shall furnish the Engineer with a heat flow analysis for the concrete mixture, proposed methods for observing, detecting, and controlling the thermal differential between the external and internal temperatures and the hottest point temperature, and proposed corrective measures. No massive pour shall be placed until the Contractor's thermal curing plan is approved.

(1) Corrective measures to control the heat may be accomplished through a combination of the following:

- (a) Selection of concrete ingredients to minimize the heat generated by hydration of the cement.
- (b) Cooling component materials to reduce the temperature of the concrete while in its plastic state.
- (c) Use of shaved ice to replace part or all of the mixing water.
- (d) Use of an approved nitrogen gas cooling system to lower the concrete temperature before placement.
- (e) Controlling the rate of placing the concrete.
- (f) Insulating the formed side and/or unformed top surfaces of the concrete to prevent heat loss.
- (g) Providing supplemental heat at the surfaces of the concrete to prevent heat loss.
- (h) Other acceptable methods which may be developed by the Contractor.

(2) The Contractor shall as a minimum requirement provide the following:

- (a) The Contractor shall install within the concrete placed in each massive pour, temperature sensing devices of a type approved by and at locations as designated by the Engineer. These devices shall be accurate to within ±2°F. The temperatures shall be recorded automatically by an approved strip-chart recorder furnished by the Contractor.

The sensing system shall contain as a minimum two (2) independent sets of sensing devices in order to assure readings if one of the systems fail.

The Engineer may approve manual observation and recording temperatures at 6 hour intervals where conditions warrant.

(b) Maintain records of temperature differential.

(c) Immediately apply corrective measures approved by the Engineer, when the temperature differential nears 35ºF so as to maintain it at 35ºF maximum.

(I) BRIDGE SIDEWALKS AND CURBS.

The removal of deteriorated concrete on existing bridge parapets and safety-walks shall conform to Paragraphs 417.04(A) and 418.04(A).

During removal of deteriorated concrete on safety-walks, the Contractor shall exercise care so as not to damage any existing steel conduit(s) embedded in concrete. Should any conduits be damaged during the removal of concrete, the damaged portion of the conduit(s) shall be replaced in accordance with Paragraph 601.05(B) Rigid Metallic Conduit.

Exposed reinforcement steel shall be cleaned of all adhering concrete and of any rust and scale. Any exposed existing steel reinforcement to remain which becomes damaged, shall be replaced or repaired by welding as directed by the Engineer at no cost to the Authority. All exposed existing steel reinforcement to remain in the new construction shall be field epoxy coated. Existing reinforcement to remain, projecting from remaining existing concrete section which exhibit section loss due to rusting, shall be replaced, as determined by the Engineer, with new epoxy coated reinforcement drilled and grouted in accordance with Paragraph 401.09(A) above.

Contraction and construction joints in bridge parapets shall be consistent with the corresponding joints in that portion of existing bridge parapet to remain.

401.12 Machine Finishing of Bridge Decks.

Finishing of bridge deck slabs and concrete overlays shall be performed using a finishing machine except where manual finishing is specifically permitted by the Engineer or as may be necessary in the event of breakdown of the mechanical equipment. The Contractor shall employ only workmen skilled in the use of the finishing equipment.

(A) MACHINE FINISHING OF STRUCTURAL SLAB.

An approved self-propelled finishing machine will be required for striking off and finishing the surface of all bridge decks. The finishing machine shall be the rotating cylinder type or the oscillating type. Longitudinal or transverse type finishing machines may be employed for spans up to 75 feet, while finishing machines for spans exceeding 75 feet shall be of the transverse type. The finishing machine shall be capable of being propelled both forward and backward to enable repeat passes to be made in order to correct surface irregularities and to produce a surface which conforms to the required profile grade, cross-section and surface smoothness. Longitudinal finishing machines shall be the full length of the span. Transverse finishing machines shall preferably be of sufficient size to finish the full width of deck between curbs, but not less than the width of the approach pavement or the distance between longitudinal construction joints. In areas outside the width of traffic lanes or in areas inaccessible by machine, vibratory screeds or other approved manually operated strike offs may be used.

The weight of the finishing machine shall not cause undue deflection of the bridge members or falsework. The machine shall travel on steel rails, pipe, or other approved grade control which shall be adequately supported by vertical supports securely fastened in place at spacing sufficiently close to prevent any appreciable deflection between rail supports. The supports for the rails shall be set above the finish grade of the concrete. If not practical to set the supports above the finish grade of the concrete, they may with the approval of the Engineer be located in the concrete deck. When the supports are located in the deck concrete, they shall be of the type which can be removed without disturbing the concrete or partially removable so that no part remains above 2-1/2 inches below the finished concrete surface. If such supports are removed before initial set has taken place, the resulting holes shall be filled with deck concrete. If the supports are removed after the concrete has hardened, the resulting holes shall be filled with epoxy resin mortar.

Prior to placing the concrete, rails or other guides for the finishing machine shall be accurately set in place in order to achieve the deck elevations shown on the plans, and shall be secured for the full length of the

concrete placing plus such additional distance that the machine will clear all finishing operations.

The finishing machine shall be operated over the full length of the bridge segment to be finished prior to beginning concreting operations. This test run shall be made with the screed adjusted to its finishing position. During the test run, checks shall be made of the deflection and adjustment of guide rails and of the cover over slab reinforcement and forms. All necessary corrections shall be made before concreting is begun. If the finishing machine is of the longitudinal type, the test run may be omitted when reinforcement clearances preclude movement of the machine across the deck.

Concrete placement and initial strike-off by a transverse finishing machine shall be coordinated so that initial strike-off is never more than 10 feet behind the concrete placement.

Strike-off by a longitudinal finishing machine shall not be initiated until concrete has been placed a minimum of two bays wide for the entire slab length. In this context, a bay is defined as the horizontal distance between adjacent girders. The final pass by the longitudinal finishing machine shall subsequently uniformly lag the placement by the minimum two bay width. Sufficient depth checks shall be made behind the machine and along the full length of the span to insure achievement of the required section and reinforcement cover.

The concrete shall be given as few passes of the machine as are necessary to obtain a smooth dense surface of the required contour. A small uniform quantity of mortar shall be maintained ahead of the screed on each pass. At no time shall the quantity of concrete carried ahead of the screed be so great as to cause slipping or lifting of the finishing machine on the rails.

Improper adjustment or operation of the finishing machine which results in unsatisfactory consolidation, reinforcement cover, or smoothness shall be corrected immediately. Unsatisfactory performance, particularly with respect to the surface smoothness attained, may be cause for rejection of the equipment.

A construction dam or bulkhead shall be installed in case of a major delay in the placement operation. During minor delays of one hour or less, the end of the placement may be protected from drying by several layers of wet burlap.

Adequate protection shall be taken to protect freshly placed concrete from sudden or unexpected rain. Concrete damaged by rainfall may be ordered by the Engineer to be removed.

A work bridge or other positive means of permitting access to the surface of the deck shall be provided by the Contractor for the purpose of finishing, straight-edging, making corrections, and for other operations requiring access to the surface of the deck after the passing of the screed. Before concrete placing operations begin, substantial bulkheads or headers shall be set and shaped to the required deck surface cross-section.

After the concrete of finished surfaces has begun to set, it shall not be walked upon or otherwise disturbed for a period of not less than 48 hours unless otherwise permitted.

(B) LOW SLUMP HIGH DENSITY AND CLASS B CONCRETE OVERLAYS.

The finishing machine and procedures shall meet the requirements of (A) above and the following additional requirements:

(1) The machine shall have a mechanical strike-off to provide a uniform thickness of concrete in front of the oscillating screed. The finishing machine shall be inspected and approved before work is started on the project. At least one oscillating screed shall be designed to consolidate the concrete by vibration to 100 percent of the unit weight, determined in accordance with ASTM C138. A sufficient number of identical vibrators shall be effectively installed such that at least one vibrator is provided for each 5 feet of screed length. The bottom face of this screed shall be at least 5 inches wide with a turned up or rounded leading edge to minimize tearing of the surface of the plastic concrete. Each screed shall have an effective weight of at least seventy-five pounds for each square foot of bottom face area. Each screed shall be provided with positive control of the vertical position, the angle of tilt, and the shape of the deck cross section.

(2) Design of the finishing machine together with appurtenant equipment shall be such that positive machine screeding of the plastic concrete will be obtained within one inch of the face of a curb and within six (6) inches $\pm$ of a barrier parapet. The length of the screed shall be sufficient to extend at least 6 inches beyond the line where a saw cut is intended to form the edge of a subsequent placement section and shall overlap the sawn edge of a previously placed course at least 6 inches. The finishing machine shall be capable of forward and reverse motion under positive control. Provision shall be made for raising the screeds to clear the screed surface for traveling in reverse.

(3) Supporting rails upon which the finishing machine travels will be required. The support for these rails shall be fully adjustable (not shimmed) to obtain the correct profile. The rails shall not deflect under the weight of the machine and shall be removed without damage to the edge of the new surface that is to remain in place.

(4) The thickness of all new concrete above the prepared surface shall be as specified on the plans. The clearance shall be checked in the following manner before concrete is placed.

A filler block having a thickness 1/4 inch less than the designated surface thickness shall be attached to the bottom of the screed. With screed guides in place, the screed shall be passed over the area to be concreted. As an alternate to passage of the finishing machine, an approved template, supported by the screed guides, may be passed over the area to be concreted. If the filler block or template does not clear the area to be concreted, the obstructing areas of the existing surface shall be removed.

(5) Adequate hand tools for placement of stiff plastic concrete and for working down to approximately the correct level for striking off with the screed shall also be used.

(6) When placing concrete overlay abutting a previously completed section of concrete overlay that side of the finishing machine adjacent to the completed section shall be equipped to travel on the completed surface.

(7) Placing, compacting, and finishing of the concrete overlay in areas not accessible for machine finishing adjacent to existing curbs or barrier parapet shall be done by hand using methods and equipment acceptable to the Engineer which will obtain the required density and finished surface as specified.

(8) Hand finishing with a wood float in areas mechanically finished may be required for producing a tight, uniform surface.

(C) HAND FINISHING.

When hand finishing is permitted, the concrete shall be struck off and brought to the required grade and finish by use of a vibrating screed. The screed shall be supported on longitudinal rails which are set above the grade of the finished surface and arranged so that they may be removed with a minimum disturbance to the concrete. The proper amount of concrete shall be maintained in front of the screed in order to avoid low spots. After removal of the screed support the concrete in that area shall be leveled by hand floats. The surface shall not be sprinkled with water to facilitate finishing.

After the surface has been finished to the required grade and contour, all other operations such as testing the smoothness, correction of irregularities, texturing, and curing specified above under (A) for machine finishing shall be followed.

(D) DECK SURFACE REQUIREMENTS.

Bridge deck slabs and approach slabs must meet a 1/8 inch in 10 feet straightedge check made longitudinally and transversely. After the final strike-off of the concrete and as close behind the final strike-off as possible, the Engineer will check the surface with a 10 foot straightedge.

The deck slab shall be struck and finished with a self-propelled finishing machine, as specified in Paragraph 401.12 (A), and shall be so constructed that, when tested as specified herein, the tolerances specified herein are not exceeded.

Regardless of the overall surface conformity of the bridge deck and approach slab concrete, if surface deviations have a detrimental effect on deck drainage or reinforcement steel cover, appropriate remedial measures to restore any or all of the deck slab surface to the required grades and surface tolerance will be ordered at no additional cost to the Authority. When such remedial procedures are ordered, a plan shall be submitted, setting forth the intended limits of the surface restoration and a complete description of the methods, equipment and materials proposed for use.

Following satisfactory completion of the surface restoration measures to the bridge deck slab and/or the approach slab, the affected area shall be retested.

Additional compensation, extension of contract time or other concessions will not be granted for any surface restorations ordered by the Engineer for compliance with the specification.

After the bridge decks and approach slabs are completed, a qualified Deck Rideability QC Contractor shall perform a ride quality test using an approved lightweight road profiler as specified in Subsection 924.44.

Ensure the Contractor's designee for Deck Rideability QC has a minimum of five years highway and/or bridge construction experience with a minimum of three years of relevant experience performing ride

quality tests using the lightweight road profiler. Do not begin deck or approach slab ride quality tests until the qualifications of the Contractor's designee have been approved by the Engineer. The ride quality tests shall be performed under the on-site supervision of the Contractor's designee, or an individual that meets the experience qualifications stated herein. If an individual other than the Contractor's designee will supervise the ride quality tests, the qualifications of that person shall be submitted to the Engineer for approval.

(E) CONTROL TESTING.

Deck slab and applicable overlay surfaces shall be systematically checked during placement to correct surface irregularities while the concrete is in a workable condition.

Such systematic control testing shall be performed as follows:

(1) After the intended final pass with the finishing machine or other strike-off, the deck surface shall be checked with a metal straightedge operated parallel to the centerline of the bridge. Surface variations from the testing face of the straightedge shall be corrected before the concrete sets. Major deviations shall be corrected by the finishing machine or other strike-off, while minor deviations may be corrected by the use of a straightedge or float. The addition of water to the surface of the concrete to assist in finishing operations will not be permitted.

(2) The specific conduct of the control testing, including the number and location of Straightedge checks, shall be entirely the province of the Contractor. However, it is suggested that the checking operation progress in successive 5 foot longitudinal increments, with at least one full-slab length straightedge check being made within the transverse limits of each of the designated lanes of traffic.

(F) CESSATION OF DECK CONCRETING.

The Engineer reserves the right to reject bridge deck construction methods or equipment which do not result in surfaces which are in substantial conformity with the 1/8 inch in 10 feet surface tolerance.

The continued use of methods and equipment which result in a lot percent defective length of 20 or more on any machine finished deck slab or 35 or more on any manually struck and finished deck will not be permitted. If these limitations are exceeded, deck placement and finishing shall be discontinued until other methods or equipment are proposed for trial and submitted in writing for approval. Approval of this revised plan of operations does not relieve responsibility for the satisfactory performance of the revised method or equipment.

Additional compensation, extension of Contract Time or other concession will not be granted because of revised methods or equipment necessary to produce deck slabs in substantial conformity with the 1/8 inch in 10 feet surface tolerance.

401.13 Joints.

Joints of the following types shall be constructed in accordance with details shown and as specified herein.

(A) CONTRACTION AND CONSTRUCTION JOINTS.

Contraction and construction joints shall be placed only where shown or authorized. When a concrete mixture is to be placed against set concrete, all loose concrete and foreign material shall be removed from the surface of the concrete and the surface shall be cleaned with wire brooms and saturated with water. To insure an excess of mortar at the joint, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall first be thoroughly covered with a coating of grout against which the new concrete shall be placed before the coating has attained its initial set. Immediately before placing the new concrete, the forms shall be drawn tight. Approved bond-breakers shall be used in joints where indicated.

Grout for bonding new concrete to existing or previously placed concrete shall consist of equal parts of Portland cement and sand by weight, mixed with sufficient water to form a stiff slurry. The consistency of this slurry shall be such that it can be applied with a stiff brush or broom to the previously placed concrete in a thin, even coating that will not run or puddle in low spots.

For sealing vertical joints at the curbs, this grout shall be thinned to paint consistency.

(B) CONCRETE OVERLAY JOINTS.

For bonded deck overlay concrete, transverse bulkheads, equal in depth to the thickness of the surface overlay, shall be installed to the required grade and profile where called for prior to placing the concrete.

The locations of longitudinal joints shall be as shown. Subject to the Engineer's approval, the position of

any optional joints shown may be altered, however, the repositioned joint location shall avoid wheel paths as much as possible.

In order to insure a junction with properly consolidated concrete, the surface course previously placed shall be saw-cut to a straight and vertical edge at longitudinal and transverse joints before the adjacent concrete is placed. The extent of such removal will be determined by the Engineer.

Screed rails and/or construction dams shall be separated from newly placed concrete by passing a pointing trowel along their inside face. Care shall be exercised to insure that this trowel cut is made for the entire depth and length of rails or dams after the mixture has stiffened sufficiently and that it does not flow back into the cut.

(C) EXPANSION JOINTS .

Expansion joints shall be provided where shown and shall be of the type specified.

Methods shall be employed in placing the joints to keep them in correct position during the placing of the concrete. The opening at expansion joints shall be adjusted to ambient temperatures.

The top of the expansion dam materials shall not be closer than 1/8 inch or more than 1/4 inch from the top of the finished bridge deck or overlay.

(D) WATERSTOPS.

Extreme care shall be taken to insure the correct positioning of the waterstops during installation. The centerline of the waterstop shall coincide with the joint opening and the concrete in the vicinity of the joint shall be carefully worked to insure maximum density and imperviousness. Any splices and connections of nonmetallic waterstops required shall be made by fusion in accordance with the manufacturer's recommendation. Metallic waterstop shall be spliced by an approved method as necessary to form continuous watertight joints.

Provisions shall be made to support the waterstops during the progress of work and insure their proper embedment in the concrete.

(E) STRIP SEAL EXPANSION JOINTS .

The strip seal expansion joint shall conform to the finished grade of the bridge deck when installed. The gland component shall be recessed sufficiently below finished grade of the bridge deck so that under all combinations of motion, there will be no projection above the deck surface.

The joint system shall be watertight.

The gland shall be mechanically locked into place within the steel locking lugs, and shall be installed using a lubricant adhesive.

The strip seal expansion joint system shall be installed at an ambient temperature no greater than 85°F.

The Contractor shall determine the width of the working joint at time of installation, taking into consideration, the ambient temperature at time of installation.

The strip seal expansion joint system shall be installed in strict accordance with the manufacturer's written instructions. Joint systems installed in place not accepted by the Engineer shall be removed and replaced in their entirety to the satisfaction of the Engineer at the Contractor's expense.

The Contractor shall not begin to install the first expansion joint system on the project until a trained factory representative of the manufacturer is on the job site to provide direction and assistance throughout the installation work.

401.14 Removal of Forms.

When the placing of the concrete has been completed, under good weather conditions and subject to approval, forms and their supports may be removed from under arches, beams and floor slabs after the expiration of 7 days, unless a longer period of time is required by ACI Standard 347. Column forms, wall forms, side forms for beams or surfaces carrying no loads may be removed after 24 hours; provided, however, that for portions (between levels of extreme low water and extreme high water) of structures to be exposed to salt water, the time for removal shall be as herein before specified in Paragraph 401.11(E).

401.15 Construction Tolerances.

Variation in alignment, grade and dimensions of the structures from the established alignment, grade and

dimensions shown shall be within the following tolerances unless otherwise indicated:

Departure from established alignment (plan)	1/2 inch
Departure from established grade (elevation)*	Bridge deck slab ± 1/4 inch, others ± 1/2 inch
Variation from plumb or specified batter in lines and surfaces of columns, piers, wall and in arrises	± 1/2 inch in 10 feet, 2 inch maximum offset
Variation from level or indicated grade or slope in slabs, beams, horizontal grooves, and railing offsets	± 1/8 inch in 10 feet
Variation in cross sectional dimensions of columns, piers, slabs, walls, beams, and similar elements	- 1/4 inch, + 1/2 inch
Variation in slab thickness	- 1/8 inch, + 1/4 inch
Footings: Plan dimensions misplacement or eccentricity not exceeding 2 inches	2 percent of footing width in the direction of misplacement,
Reduction in thickness, 2 inch maximum	- 5 percent of specified

* Requirements for concrete bearing pads shall be as specified in Paragraph 401.17(E).

Subsequent to placement of concrete, the Engineer shall verify that the position of the placed concrete, is correct within tolerances shown above. If the allowable tolerances are exceeded, the Engineer will stop the work and so advise the Contractor, in writing, stating the deficiencies upon which the rejection is based. The Engineer will review the nature and extent of the deficiencies and at his discretion, allow the Contractor to submit one or more corrective actions for the Engineer's approval or designate one or more of the following alternatives:

(A) The affected concrete placement shall be removed and replaced in whole or in part.

(B) The Contractor shall provide special corrective measures as directed by the Engineer.

(C) The concrete placement shall be accepted without corrective action.

The removal of the concrete placement and its subsequent replacement, or other corrective work which the Contractor is directed to perform, shall be accomplished at no additional cost to the Authority.

401.16 Test Specimens.

This Subsection specifies the requirements for the preparation, testing and evaluation of Portland Cement Concrete specimens. Final quality acceptance testing shall be in accordance with Section 905. In order that the Engineer can maintain a record of the strength gain of all concrete placed, the Engineer will make standard test specimens: 6" x 12" concrete test cylinders for compressive strength, 4″ x 8″ cylinders for AASHTO T277 and AASHTO TP95 and 6″ x 6″ x 3″ molds for AASHTO T259/T260 permeability testing, and beams for flexural strength testing. The Contractor shall provide the concrete and molds for the test specimens, shall be responsible for the handling and protection of the specimens on the job site and shall arrange for delivery of the specimens to the designated Testing Laboratory between 24 and 48 hours after casting.

(A) Test Specimen Preparation.

A sufficient number of curing facilities for the storage and curing of concrete test specimens on the project site for the time required by ASTM C 31 shall be provided as approved by the Engineer at the expense of the Contractor and for the sole use of the Authority. The curing facilities shall be provided with a minimum-maximum thermometer and shall be securable with lock and key. If curing facilities are not provided as required, the Engineer will instruct the Contractor to provide such facilities. During the initial 24 hours, the Contractor is solely responsible for ensuring that the test specimens are undisturbed and maintained within the specified temperature range. The test facilities shall be provided when requested by the Engineer. The Contractor shall not be allowed to place any concrete until all needed test facilities are provided.

The cost of the concrete cylinder molds, care of the specimens on the site, and transporting the specimens to the Laboratory shall be borne by the Contractor and shall be included in the price bid for the concrete item or items scheduled in the Proposal. The Authority will pay the costs of performing the tests at the Laboratory.

(B) STANDARDS AND FREQUENCY OF TESTING PRIOR TO FINAL ACCEPTANCE TESTING.

Some or all of the following procedures will be used by the Engineer to evaluate in-place concrete prior to final quality acceptance testing in accordance with Section 905.

(1) Compressive Strength.

In accordance with ASTM C31 and ACI 318-99 - Part 3, Chapter 5, Item 5.6, entitled "Evaluation and Acceptance of Concrete", except that samples will be done on a random basis with a minimum of two cylinders prepared for each Sublot, as defined in Subsection 905.22. If 3 day and 7 day testing is requested by the Engineer for Portland cement concrete, four test cylinders will be prepared for each Sublot. The Engineer will calculate the average of two test specimens at the design compressive strength time requirement for the material. The average of the two test specimen result values for each Sublot at the design compressive strength time requirement shall be considered the Sublot compressive strength value. The specimens will be made and cured in accordance with the requirements of ASTM C31except submersion in water storage containers shall be used in lieu of moist room curing if required by the Engineer for hot weather concreting of Portland cement concrete.

(2) Coulomb Test (AASHTO T277), Surface Resistivity Test (AASHTO TP95) and Ponding Test (AASHTO T259/T260).

The Coulomb Test (AASHTO T277), Surface Resistivity Test (AASHTO TP95) and Ponding Test (AASHTO T259/T260) are used to evaluate the permeability of concrete. Two-inch thick samples will be cut from the center of each cylinder for AASHTO T277 testing, with a maximum of two slices per cylinder utilized. Samples shall be wet cured in water storage containers per ASTM C31 for 2 days, and air cured at the site for 3 days, prior to pickup for testing Additionally, the two (2) 6" x 6"x 3" molds will be tested for permeability in accordance with AASHTO T259/T260.

If the strength test results of a seven day compressive strength test indicate that the concrete may not develop the minimum 28 day compressive strength specified, the Engineer reserves the right to order the Contractor to immediately core the portion of the concrete structure represented by that cylinder for testing purposes. The coring shall be made of the size and at the locations ordered. If the results of the core tests indicate that, in the sole opinion of the Engineer, the expected rate of increase in strength is not sufficient to produce a satisfactory compressive strength at 28 days, the portion of the concrete structure represented by the core shall be removed and disposed of, and replaced with new construction.

If the results of the core tests indicate, in the sole opinion of the Engineer, that a satisfactory 28 day compressive strength may yet be realized, possible rejection or pay adjustment of the concrete in question will be deferred until the 28 day cylinders are tested in accordance with Subsection 905.22.

All coring and filling core holes with concrete, as outlined in the two preceding paragraphs, shall be entirely at the Contractor's expense; core testing will be done at the Authority's expense in accordance with Subsection 105.03.

Removal and replacement of deficient concrete, as previously outlined, shall be entirely at the Contractor's expense.

Refer to Subsections 905.21, 905.22 and 905.23, including modifications made in the supplementary specifications, for requirements of Quality Acceptance limit, testing, sampling and pay adjustment.

401.17 Surface Finish.

The surfaces of concrete shall be finished immediately after the forms are removed and, unless otherwise specified or shown on the plans, shall be given an ordinary surface finish.

The final surfaces of High Performance Concrete (HPC) shall be finished in accordance with Subparagraph 401.17 (F) (3) unless specified otherwise in the contract documents.

For overlay finish on rehabilitation and widening contracts use either Subparagraphs 401.17(F) (2) or 401.17(F)(3) as required in the contract documents unless approved otherwise by the Engineer. For new construction with no staging, surface finish in accordance with Subparagraph 401.17(F)(3).

(A) ORDINARY SURFACE FINISH.

Immediately following the removal of forms, all fins and irregular projections shall be removed from all

surfaces except from those which are not to be exposed to view unless such non-exposed surfaces are to be waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges, and other defects shall be thoroughly cleaned, and after having been kept saturated with water for a period of not less than 3 hours shall be carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the class of the concrete being finished to insure a uniform appearance. Mortar used in pointing shall be not more than one hour old. The mortar patches shall be cured as specified under curing. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint shall be left exposed for its full length with clean and true edges.

The resulting surfaces shall be true and shall have a uniform appearance. All surfaces which cannot be repaired to the satisfaction of the Engineer shall be finished as specified for rubbed finish.

(B) RUBBED FINISH.

Concrete surfaces shall have a rubbed finish only when shown or specified and as provided above. Surfaces shall first be pointed and repaired in accordance with the requirements specified in Paragraph (A) above.

Immediately before starting rubbing operations, the concrete shall be kept thoroughly saturated with water for a minimum period of 3 hours. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of rod holes and defects to thoroughly set. The surfaces shall be rubbed with Carborundum No. 16 blocks, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the proportions used in the class of the concrete being finished. Rubbing shall be continued until all form marks, projections, and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this time and allowed to reset.

The final finish shall then be obtained by rubbing with Carborundum No. 30 blocks until the entire surface is smooth and of uniform color. After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap and shall be left free from all unsound patches, paste, powder, and objectionable marks.

(C) FINISH FOR TOPS OF PARAPETS, BRIDGE SEATS AND CURBS.

Tops of parapets and curbs, bridge seats and other similar horizontal surfaces not subject to wear shall be formed by placing an excess of material in the forms and striking it off with a wood template, forcing the coarse aggregate below the surface; mortar topping shall not be used. The surface shall then be thoroughly worked with a wood, canvas, or cork float and before this finish has set, the surface shall be lightly striped with a fine brush to remove surface film, leaving a smooth, fine-grained texture. Vertical surfaces of curbs shall have the forms removed as soon as possible and shall be finished with a wood float.

(D) FINISH FOR WALKING SURFACES ON BRIDGES.

After being placed, the concrete shall be screeded and finished to true grade and surface. The surface shall be finished with a wood float, followed by brushing to a neat workmanlike surface. Vertical surfaces shall have the forms removed as soon as possible and shall be finished with a wood float.

(E) FINISH UNDER SUPERSTRUCTURE SHOES.

Unless otherwise shown, the surfaces of concrete on bridge seats, piers and pedestals, which are to support steel shoes or bearing plates, and elastomeric pads of the superstructure metalwork, shall be finished 1/8 to 1/4 inch higher than the required elevations over areas extending 3 inches outside of the shoes, bearing plates or pads. After the concrete has been cured and has thoroughly hardened, these areas shall be dressed down by tooling, rubbing, grinding, or as otherwise may be approved, so as to provide true level surfaces at the required elevations.

(F) FINISH FOR BRIDGE SLABS.

Bridge slabs are to be finished in accordance with the following:

(1) Slabs to be Overlaid.

There shall be no texturing of the surface of the deck slab construction other than that obtained by the floating equipment. Where machine floating does not produce a sealed and slightly roughened surface, additional floating by hand methods will be required to produce said surface.

(2) Final Surface.

The final surface of the bridge slab shall be in accordance with Paragraph 304.04(J).

(3) Saw Cut Finish.

The hardened surface of concrete bridge deck slabs shall be grooved except as shown in the table below.

Saw Cut Grooved Area Limits		
Location	**Closest Allowable Distance**	**Farthest Allowable Distance**
Drainage Structure	12"	15"
Vertical Face (curb or parapet), or Face of Railing (no curb)	12"	15"
Joint System	6"	(see Note)

Note: This distance is a variable which is dependent upon equipment size. This dimension shall be measured from the tip of the longitudinal groove marks to the edge of the joint system and, in no case except as noted below, shall it be greater than 2'-0". The depth of saw cut adjacent to joints may vary over a distance equal to ½ the diameter of the groove cutting machine saw blade(s), but shall not exceed 2'-0".

At least seven days prior to saw cutting, a plan of action shall be submitted for approval detailing the layout of the grooving procedure to be followed. Spacing dimensions at the starting and ending point of each pass shall be noted. A description of the saw cutting equipment shall be included.

Grooves shall be cut longitudinal or parallel to the centerline of the traveled way. Concentric grooving for horizontally curved roadways shall be conducted in full-length passes where practicable. Adjustment shall be made as required to ensure that a uniformly grooved surface finish is accomplished in accordance with the specified limits. Groove width, depth, and spacing shall be as specified in Paragraph 304.04(J).

Grooves shall terminate within the limits prescribed in the above table.

Grooves shall be constructed using multi-bladed saw cutting equipment, fitted with diamond-tipped circular saw blades except when the use of single blade circular saw equipment is permitted where such equipment is necessary to complete the work, as required.

Prior to grooving operations, two approved gauges to verify groove depth shall be supplied. The gauges shall be accompanied by the manufacturer's instructions for their use.

During grooving operations, the groove dimensions will be checked at random. If the minimum groove depth has not been achieved, grooving operations shall stop and the necessary adjustments shall be made.

Slurry or debris from the grooving operations shall not accumulate in the grooves. Slurry or debris shall not be disposed of in the structure or highway drainage system or on roadway slopes. Slurry shall be collected promptly and removed for off-site disposal.

401.18 Curing.

Portland cement concrete bridge deck surfaces consisting of the structural slab, Class B overlay, and low slump high density overlays shall receive a wet burlap cure for at least 72 hours. For the first 24 hours, the burlap shall be kept continuously wet by means of an automatic sprinkling or wetting system. After 24 hours, the Contractor may cover the wet burlap with a layer of 4-mil polyethylene film for the remaining period in lieu of using a sprinkling or wetting system. The wet burlap shall be applied within 30 minutes after the concrete has been deposited on the deck, except when the surface will be excessively marred by so doing, as directed by the Engineer. If low slump high density concrete is revibrated because of failure to meet density requirements with initial vibration, this time will be extended 15 minutes. Failure to apply wet burlap within the required time shall be cause for rejecting the work so affected. Surface concrete in the rejected area shall be removed and replaced at no additional cost.

(A) HOT AND COLD WEATHER CURING.

Concrete Curing in hot weather (when the ambient temperature is 85ºF or more) shall be performed in accordance with the recommended practice of the most current ACI Standard 305 except wet curing only shall be used. No membrane curing shall be used unless authorized by the Engineer. Concrete curing in cold weather (when the ambient temperature is 40 ºF or less) shall be performed in accordance with the recommended practice of the most current ACI Standard 306. Curing requirements specified herein conflicting with ACI requirements for hot and cold weather curing shall not be used except as approved by the Engineer.

Do not apply deicing chemicals within 30 days of placement if the mean curing temperature is expected to be below 45 ºF during that time.

(B) GENERAL.

All new bridge deck and overlay concrete shall be wet cured. No curing compound will be permitted. All other exposed concrete shall be cured for a period of not less than 72 hours. Additional curing will not be required for concrete surfaces on which forms have remained for 72 hours.

The entire surface of the concrete slabs shall be protected from rapid loss of moisture during the screeding and finishing operations by an approved method until the curing operations begin.

All other exposed concrete surfaces shall be similarly protected when there are any delays between finishing operations and the commencement of curing operations.

Wet burlap or salt hay curing shall not be used when the temperature is 40°F and falling; insulated blankets shall be used. Salt Hay shall not be used for curing bridge decks.

If there is any probability, in the opinion of the Engineer, of hair-checking developing during finishing operations before a curing compound can be applied or placed, wet burlap shall be provided until the curing compound is applied or placed.

Equipment and methods of application to be used for the various curing methods shall be as hereinafter specified.

(C) LIQUID CURING COMPOUND.

Liquid Curing Compound shall not be used on any surfaces which are to receive additional concrete construction and shall not be used for hot weather concrete curing unless approved by the Engineer. Application of the liquid curing compound shall be made immediately following final finishing, before any marked dehydration of the concrete or surface checking occurs. The compound shall be applied in two applications; the second shall follow the first within 30 minutes.

Liquid curing compound shall be applied in accordance with the manufacturer's recommendations.

In the event the Contractor is permitted and elects to use liquid curing compound, the curing compound must be compatible with the membrane waterproofing and primer used and also must not prevent full bond between the membrane waterproofing and the concrete deck. The Contractor shall submit certification from the manufacturer of the membrane waterproofing system attesting that the liquid curing compound is acceptable and that they guarantee, based on actual test results, that the liquid curing compound will not prevent the full bond between the membrane waterproofing and the concrete deck when the membrane waterproofing is placed 48 hours after applying the liquid curing compound.

The compound shall be applied in a continuous uniform film by means of power-operated pressure spraying or distributing equipment at the rate directed by the Engineer but not less than one gallon per 200 square feet of surface. The equipment for applying the compound shall provide for adequate agitation of the compound during application and must be approved before work is started. If the compound is too thick for satisfactory application during cold weather, the material may be warmed in a water bath at a temperature not over 100ºF; the compound shall not be thinned with solvents. Should the method of applying the compound produce a non-uniform film, its use shall be discontinued and the curing shall be done by one of the other specified methods.

If rain falls on the newly coated surface before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the Contractor shall apply a new coat of material to the affected areas at the same rate of application as that specified for the original coat. The treated surface shall be protected from injury for a period of at least 3 days. All vehicular and pedestrian traffic is considered injurious to the film of the applied compound and is prohibited except that a minimum of walking will be permitted on the dried film as necessary to carry on the work properly provided any damage to the film is immediately

repaired by the application of a second coat of the compound.

(D) White Polyethylene Sheets .

White Polyethylene Sheets shall be installed to provide a complete cover for the surfaces to be cured. A single thickness shall be used with joints lapped and sealed. All joints in the sheets shall be made watertight by the construction of a securely cemented overlap not less than 4 inches wide or a 12 inch securely weighed down overlap.

The sheets shall be placed immediately following the final finishing operation without marring or otherwise damaging the surface of the concrete. The sheets shall be securely weighted down by methods approved by the Engineer, so that depressions will not be formed in the surface.

Before reusing the sheets they shall be inspected and all holes and tears shall be repaired with patches. The sheets will be rejected when they no longer provide an airtight cover.

(E) Burlap.

The concrete surfaces shall be covered with strips of wet burlap which, after shrinkage, shall be not less than 2-1/2 feet longer than the dimension of the surface to be covered. Approximately 2 feet shall be allowed for shrinkage of new burlap. The strips shall overlap not less than one-half the width of the strip to provide a double thickness of burlap. The burlap shall be laid immediately after the final finishing and shall be maintained wet and in place for the specified curing time.

Burlap shall be clean and shall be thoroughly saturated over its entire area by water immersion for at least 2 hours prior to use. The burlap shall be drained of excess water before application. Burlap shall be placed so as to eliminate wrinkles and large air gaps between the concrete and burlap.

(F) Salt Hay.

The entire concrete surface shall be covered with a layer of hay of not less than 6 inches in uniform thickness which shall be placed directly upon the surface and thoroughly wetted by sprinkling immediately after its final finishing without marring or otherwise damaging the surface of the concrete. The hay shall be free from decayed matter soluble in water. It shall be maintained wet and in place for the specified curing time.

401.19 Protective Coatings for Concrete Surfaces.

(A) General.

Protective coatings shall consist of water repellent treatment or a concrete penetrating sealer treatment as required by the Contract Documents applied to new or repaired concrete surfaces of bridge sidewalks, curbs, decks without a wearing surface, parapets, exposed surfaces of concrete median barriers, and at other locations as may be specified or designated. This specification shall not apply to noise barriers.

Application of the concrete penetrating sealer will not be required on precast concrete parapet sections for MSE or PM retaining walls if the concrete mix design proposed has been certified as meeting the requirements for Chloride Permeability at 56 days as per Section 928, High Performance Concrete (HPC). Documentation from an accredited AASHTO testing agency must be provided to validate the certified properties. Concrete core sampling associated with testing the concrete penetrating sealer application will not be required for parapets where the sealer is not applied.

The water repellent treatment materials shall conform to the requirements of Paragraph 923.06(F). The concrete penetrating sealer materials shall conform to the requirements of Paragraph 923.06(G).

The specified surfaces to receive the water repellent treatment or concrete penetrating sealer shall be cleaned so as to remove dirt, dust, oil, wax, other coatings, efflorescence, and other foreign materials by utilizing high pressure water, sand blasting, or other suitable methods as approved by the Engineer. Large projects may require concrete cleaning utilizing high pressure water only if required by the Contract Documents. Sandblasting will be required to remove acrylic based curing compounds (non-dissipative types).

Application of the materials shall be made by the methods and at the rate of coverage as recommended by the manufacturer.

No surface treatment shall be applied to concrete less than 28 days old. Care shall be taken to prevent spillage of treatment material on asphalt pavements or the bridge deck membrane.

The water repellent treatment material shall be compatible with the curing compound used. A combination

curing and protective-penetrating sealing compound is not permitted

High Performance Concrete (HPC) surfaces shall not be sealed.

(B) SEALER APPLICATION.

Application of the penetrating sealer materials shall be made by the methods and at the rate of coverage as recommended by the manufacturer and not exceeding 225 sq. ft./gal.

Prior to sealer application, the Contractor shall submit product application specifications for approval by the Engineer.

A combination curing and protective-penetrating sealing compound is not permitted.

The concrete surfaces shall be cleaned of dirt, oil, grease, laitance, curing compound or curing compound residue, form release agents and other contaminants which may retard or prevent penetration of the surface treatment material into concrete. The cleaning process shall not cause any undue damage to the concrete surface, remove or alter the existing surface or expose the coarse aggregate of the concrete. Oil, grease, and other contaminants shall be removed with bio-degradable, non-toxic degreasers utilizing a hydrocarbon dispersant. All surfaces shall be cleaned by high pressure water at a minimum 3,000 psi. Surfaces which have been cured using an acrylic based, non-dissipative type curing compound shall first be cleaned by sandblasting.

The concrete penetrating sealer shall be applied with low pressure (15 psi) airless spray equipment at a rate not exceeding 225 sq. ft./gal. and shall be applied. The concrete penetrating sealer shall also be applied within the temperature guidelines stated in the product specification. The concrete surfaces to receive the sealer shall be cured for a minimum of 28 days prior to application. All surfaces scheduled for treatment shall be dry and free of water for a time as specified in the manufacturer's recommendations - minimum of 24 hours. Care shall be taken to prevent spillage of treatment material on asphaltic pavements or bridge deck membranes. Once treated, the surface shall be protected from rain or other surface water for a period of not less than 8 hours after concrete penetrating sealer application. If the treated surface is exposed to rain or water within the 8 hours, it shall be retreated. The concrete penetrating sealer shall be shipped ready for use, and shall not be heated, diluted or altered in any way.

(C) ACCEPTANCE.

Testing of the treated surface shall be used as the basis for acceptance of the completed work. Acceptance will be determined on the basis of one sample for each lot of a maximum lot size of 600 square yards or a minimum lot size of 100 square yards of treated surface area. One sample shall consist of one core, taken one week after treatment. All samples taken within a test area shall be considered representative of its respective acceptance area. Cores shall be 3 inches in diameter and a minimum 3 inches in depth. Prior to coring, reinforcing steel shall be located and avoided during coring. The Engineer will determine the sample locations, and if additional samples are required.

The drilling equipment shall be of sufficient size and power to drill through at least 3 inches of concrete. The drill bit shall be of a dry or water cooled diamond tipped masonry type capable of obtaining a valid test sample at least 3 inches in depth. Each core shall be placed in individual plastic bags tagged with the contract number, lot number and date of coring. The cores shall be delivered to the Engineer for testing by the Authority.

After the core has been removed from the concrete surface, the excess cooling water shall be pumped from the hole and the hole filled flush with the adjacent surface with a non-shrink grout. An epoxy bonding compound applied to the surface in accordance with Subsection 418.03 shall be used for repairs. All core holes shall be treated with a sealer a minimum of seven days after the repair, but no later than 21 days.

The treated concrete cores will be tested for water absorption in accordance with Subsection 923.06 paragraph (F) or (G) as appropriate and as specified below. The control cores will be tested for water absorption.

When the minimum requirements for water absorption are not met, the lot shall be retreated at no cost to the Authority, or the lot may be accepted on written request provided that payment for the lot is reduced in accordance with the treatment payment schedule.

The cost of traffic closings will be the responsibility of the Contractor in areas of retreatment and subsequent concrete core sampling.

Acceptance and payment criteria for Water Repellent Treatment shall be the same as specified herein for penetrating sealer treatment unless required otherwise by the Contract Documents.

Concrete Penetrating Sealer Treatment Payment Schedule Treatment Characteristics	
Lot Acceptance Water Absorption Percent	**Pay Factor**
1.00 or Less (Minimum requirement)	1.00
1.01 to 1.05	0.95
1.06 to 1.10	0.90
1.11 to 1.15	0.85
1.16 to 1.20	0.80
1.21 to 1.25	0.75
1.26 to 1.30	0.60
1.31 to 1.35	0.55
1.36 to 1.40	0.50
1.41 to 1.45	0.45
1.45 to 1.50	0.30
Over 1.50	0.00

Note: When one or both of the pay factors for water absorption or penetration is less than 1.00, the payment for the lot will be determined by multiplying the product of the pay factors by the contract unit price.

Full payment will be made at the Contract unit price for lots when the test cores representing the concrete penetrating sealer treatment meet the minimum requirements specified.

Retreatment with concrete penetrating sealer after the initial coring and testing has been performed by the Authority for acceptance purposes will only be permitted once. When the minimum requirements for water absorption are not met after said retreatment the payment for the lot will be determined by the penetrating concrete sealer treatment payment schedule. The costs for retesting the lots represented by the failing cores will be deducted from the Contractor's final payment.

401.20 Joint Sealers.

Prior to sealing joints with preformed elastic joint sealer, hot-poured rubber asphalt, or cold applied joint sealer, the surfaces of the seams and joints must be clean, dry, and free of all loose aggregate, paint, rust, oil, curing compound and other foreign materials immediately prior to installing the preformed elastic joint sealer or application of the sealing compounds.

Deck joints to be sealed with Preformed Joint Sealer (EVA) shall conform to Paragraph 417.07(F).

(A) PREFORMED ELASTIC JOINT SEALERS.

Preformed Elastic Joint Sealers shall be installed, immediately after the curing period of the concrete slab, by suitable hand or machine tools, so that the installed length shall not exceed by more than 5% the original length of the sealer. The sealer shall be secured in place with the approved lubricant adhesive which shall cover both sides of the sealer over the full area in contact with the sides of the joint. The adhesive shall be applied to the sides of the joint and the sides of the preformed elastic sealer. The sealer shall be set below the level of the roadway surface in accordance with the details shown. The preformed elastic joint sealer shall be in one piece for the full length of transverse joints. In longitudinal joints, the sealer shall be in practical lengths but in no case less than the length of a slab unit. When permitted in longitudinal joints, splices in the preformed elastic joint sealer shall be adequately sealed with additional adhesive. Temperature limitations of the adhesive as guaranteed by the manufacturer shall be observed.

For replacements, the Contractor shall carefully remove and properly dispose of the existing joint sealer. The inside surfaces of the existing joint armor shall be sandblasted to near white metal, in accordance with the Steel Structures Painting Council Surface Preparation Specification SSPC-SP10 and the open concrete joints in the curb, deck and sidewalk shall be cleaned of all debris and the inside surfaces shall be sandblasted immediately prior to the installation of the joint sealing material. All traces of the grit and dust from the blasting shall be removed from the steel and concrete surfaces.

The new sealer shall be installed immediately after the joint cleaning operation.

(B) Hot Poured Joint Sealers.

When applied, the hot-poured sealer shall have a temperature ranging from 350° F to 425°F and the concrete surface and ambient temperature shall be a minimum of 40°F and rising.

(C) Cold Applied Joint Sealers.

Vertical expansion joints in parapets, median barriers, walls, and other similar locations formed with a preformed joint material of the required thickness shall have the exposed face and top joints sealed with cold applied joint sealer.

401.21 Protecting Concrete Bridge Slabs.

No construction equipment, construction vehicles, or storage of materials will be permitted on any concrete surface until the test cylinders therefore have attained a compressive strength of not less than 3,000 pounds per square inch, but in no case less than 7 days after placing the concrete except as allowed by high early-strength concrete if used. However, if, at the option of the Contractor, extra test cylinders for 72 hour strength determinations are taken, stored at the site, and cured under the same conditions and by the same methods used for curing the bridge slab, and these 72 hour cylinder tests indicate in the opinion of the Engineer adequate strength, then workmen and light construction equipment used for the conveyance of concrete will be allowed to traverse new concrete slabs if protected by runways, as approved by the Engineer. Construction equipment used on the bridge slab after 3,000 psi strength is reached shall be limited to vehicles having an axle load not greater than 16 tons.

No public vehicle traffic shall be permitted on newly placed bridge deck concrete until the compressive strength is 4,000 psi or greater as determined from test cylinders cast during placing of the concrete.

Heavy equipment shall not exceed legal loads unless special lanes are provided for in the design and the maximum loads are prescribed. Cranes will only be allowed on new bridge deck slab concrete as specifically approved by the Engineer. Stress analysis calculations submittals for the proposed crane loading will be required. For crane equipment to be permitted, the concrete shall have cured a minimum of 28 days and class design compressive strength has been reached as determined from test cylinders.

401.22 Weep Holes.

Weep holes shall be constructed in concrete walls with 4 inch PVC pipe or as otherwise shown. Polyvinyl chloride (PVC) drainage pipe shall conform to ASTM D2729.

401.23 Measurement.

Each concrete item, with the exception of concrete overlays, will be the total volume of concrete placed as prescribed, measured within the neat lines and planes of the structures as shown on the plans or as directed. No deductions will be made for the volumes occupied by reinforcement steel, conduits and pipes less than 8 inches in diameter, embedded steelwork, or chamfers having leg dimensions 2 inches and less.

Class B Concrete Overlay and Low Slump High Density Concrete Overlay will be measured by the top surface area of each type and each thickness actually placed as prescribed.

Reinforcement Steel, epoxy coated or uncoated, will be the net theoretical weight of reinforcement steel uncoated or shop coated with epoxy actually in place in accordance with the plans or as directed. Support bar, fastenings and fastening devices will not be measured for payment. Reinforcement steel for splices which are unnecessary in the opinion of the Engineer will not be measured for payment. If bars larger than those specified have been permitted to be used, the excess material will not be measured for payment.

Preformed Elastic Joint Sealer will be measured along the total length of joints in which each size sealer is installed.

Water Repellent Treatment will be measured the total surface area upon which the treatment has been placed.

Strip Seal Expansion Joints will be measured along the total length of joints.

Drill and grout reinforcement bars will be measured by the number of each reinforcing bar furnished, drilled and grouted into existing concrete.

Cost for field epoxy coating of exposed existing steel reinforcement to remain in bridge sidewalk, parapet and curb surface repairs shall be included within the sidewalk, parapet, and curb surface repair item.

The weight of the support system for supporting reinforcing steel will not be measured for payment.

Concrete Core Sampling shall be measured by the number of concrete cores delivered to the Engineer in good condition, and this item shall also include the restoration of the core hole as described herein. Concrete core sampling for retests will not be measured for payment.

Concrete Penetrating Sealer Treatment shall be measured by the total surface area upon which the material has been placed.

Sawcut Grooved Deck Surface shall be measured by the square yard of deck that is sawcut with grooves in accordance with Subparagraph 401.17(F)(3).

401.24 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CLASS B CONCRETE OVERLAY, ____" THICK *	SQUARE YARD
CONCRETE IN SUBSTRUCTURE ABOVE FOOTINGS *	CUBIC YARD
CONCRETE IN (DESCRIPTION) *	CUBIC YARD
CONCRETE IN FOOTINGS *	CUBIC YARD
CONCRETE IN SUPERSTRUCTURE *	CUBIC YARD
CONCRETE SEAL IN COFFERDAMS *	CUBIC YARD
DRILL AND GROUT REINFORCEMENT BARS	EACH
PREFORMED ELASTIC JOINT SEALER, ___" X ___"	LINEAR FOOT
LOW SLUMP HIGH DENSITY CONCRETE OVERLAY, ____" THICK *	SQUARE YARD
REINFORCEMENT STEEL	POUNDS
REINFORCEMENT STEEL, EPOXY COATED	POUNDS
STRIP SEAL EXPANSION JOINTS	LINEAR FOOT
WATER REPELLENT TREATMENT	SQUARE FOOT
CONCRETE PENETRATING SEALER TREATMENT	SQUARE FOOT
CONCRETE CORE SAMPLING	EACH
SAWCUT GROOVED DECK SURFACE	SQUARE YARD

Payment will not be made for penetrating concrete sealer treatment until the Engineer has received laboratory certification confirming performance with the acceptability requirements herein.

Payment adjustments for strength and durability for the various Portland cement concrete items listed above with an "*" will be made in accordance with the specified Performance Criteria Category within Table 2 of Subsection 905.23.

All payment adjustments made according to the above are cumulative.

The payment reductions specified in 401.18 are cumulative and will be in addition to any liquidated damages.

No separate Payment shall be made for the QC testing of the surface. Costs associated with the testing shall be included in the bid price for the respective bridge deck slab and approach slab items.

Any adjustment to the concrete mix design specified in the contract documents to allow for the elimination of the requirements for the Concrete Penetrating Sealer and Concrete Core Sampling shall be made at no additional cost to the Authority.

SECTION 402 - PRESTRESSED CONCRETE STRUCTURES

402.01 Description.

This work shall consist of the construction, shipping, and erection of precast prestressed concrete members manufactured in accordance with the Plans and Specifications, Division II, Section 10 of the AASHTO LRFD

Bridge Design Specifications except as herein amended, or as directed by the Engineer.

Materials, test methods, methods of manufacture, or any other item not specifically covered in the Plans and Specifications shall be in accordance with the Prestressed Concrete Institute (PCI) Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products.

402.02 Materials.

Materials shall conform to the following Sections and Subsections:

ADMIXTURES AND CURING MATERIALS 906

AGGREGATES 902

EPOXY RESIN MORTAR. 923.09

GROUT 905.09

PORTLAND CEMENT CONCRETE 905.05

PRESTRESSING REINFORCEMENT 908.02

REINFORCEMENT STEEL 908.01

TRANSVERSE TIE RODS 909.08

402.03 Equipment.

Equipment for jacking, casting of members, and plant manufacturing of prestressed concrete members shall conform to the following requirements.

(A) JACKS.

Prestressing shall be done with jacking equipment. If hydraulic jacks are used, they shall be equipped with pressure gauges. The combination of jack and gauge shall be calibrated and a graph or table showing the calibration shall be furnished. Should other types of jacks be used, calibrated proving rings or other devices shall be furnished so that the jacking force will be known.

Prior to use in manufacture of prestressed members, all jacks to be used, together with their gauges, shall be calibrated and certified by a testing agency.

Calibration of jacks and gauges shall be repeated at intervals of not more than one year. During progress of the work, if any jack or gauge appears to be giving erratic results or if gauge pressure and elongations indicate differing stresses of more than 5 percent, recalibration will be required immediately. Means shall be provided for measuring the elongations of reinforcement to at least the nearest 1/16 inch.

(B) FORMS AND CASTING BEDS.

Only metal forms on concrete-founded casting beds shall be used. The forms and casting beds shall be carefully aligned, substantial and firm, braced and fastened together sufficiently tight to prevent leakage of mortar and strong enough to withstand the action of mechanical vibrators. The forms should be constructed to permit movement of the members without damage during release of the prestressing force. The casting beds and all formwork shall be approved before any concrete is placed therein, but such approval shall not signify relief of responsibility for the results obtained.

(C) PLANT APPROVAL.

All plants manufacturing prestressed concrete members shall maintain certification through the Precast/Prestressed Concrete Institute (PCI) or the Prestress Program of the National Precast Concrete Association (NPCA) in the category applicable to the member being fabricated for the work in the contract and shall be approved by the Authority before manufacture of the members may be started. Requests for such approvals shall be submitted at least 30 calendar days prior to the date of fabrication and include a copy of the PCI & NPCA certificate.

402.04 Shop Drawings.

Before commencing work, the Contractor shall submit, in accordance with the requirements of Subsection 104.08, shop drawings and working drawings covering all aspects of the proposed construction. Shop drawing and working drawing submittals shall include, but not be limited to, form drawings, embedded structural components, pretensioning devices, method of pretensioning and sequence of operations, pick up devices (if

required), all finishing work, and all details, dimensions, size and type of material and other information and data necessary for complete fabrication and erection. In addition, all calculations specific to the Contractor's pretensioning system shall be submitted to the Engineer for review. These calculations shall show all losses, cambers, prestress forces and their accompanying elongations.

If the Contractor elects to use a different pretensioning system than as shown, he shall (at no expense to the Authority) redesign those portions of the work affected or as ordered by the Engineer. The redesign shall be signed and sealed by a New Jersey Registered Professional Engineer employed by the Contractor and shall be submitted to the Engineer for review. Review by the Engineer shall not relieve the Contractor of full responsibility for the structural adequacy of the design, for errors or for omissions.

The Contractor or fabricator may propose an alternate design to accommodate minor variations in shape and dimensions of prestressed concrete members in order to use forms he has on hand. The alternate design will be approved if, solely in the judgment of the Engineer, the proposed variations do not weaken the member or result in an objectionable appearance. However, no variations will be permitted which affect the design or significantly alter the dimensions of other elements of the structure as shown, such as the deck slab, bearings and substructure or compromise the required minimum under clearance. Shop drawings and calculations for the proposed alternative design shall be signed and sealed by a New Jersey Professional Engineer employed by the Contractor, and submitted to the Engineer for review. Review by the Engineer shall not relieve the Contractor of full responsibility for the structural adequacy of the alternative design, or for errors or for omissions.

No additional compensation will be made by the Authority to the Contractor for the use of a different pretensioning system or the substitution of any alternative design which may be approved.

The Contractor shall not proceed with the fabrication of any prestressed concrete member until the shop drawings have been approved. The Authority shall be notified in writing at least 2 weeks prior to the start of fabrication so that all component materials may be sampled and tested and the concrete mix verified. Quality control of the concrete and acceptance testing by the Authority will be in accordance with Section 905.

If prestressed members are to be plant manufactured, the Engineer or his representatives shall have free entry, for the purpose of inspection, to all parts of the prestressed member manufacturer's plant at all times while work is being performed. The manufacturer shall afford the Inspector, without charge, all reasonable facilities to satisfy the Inspector that the materials being furnished and the work being performed are in accordance with the Specifications.

Prestressed concrete members shall be fabricated to plan dimensions within the tolerances specified in Division 5, Section 2 of PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products. Members having dimensions outside the tolerance limits may be subject to rejection unless approved corrective measures are taken. The Engineer will be the sole judge in determining where the function and use of a particular member will be impaired by dimensional excesses from specified tolerances.

402.05 Forms.

Forms shall be constructed in accordance with the applicable requirements of Subsection 401.08, with the following additions:

All forms shall be constructed and maintained true to the shapes and dimensions shown. Bottom forms shall be placed to provide for camber and to allow for automatic cambering resulting from transfer of tendon prestress to the concrete, and shall be maintained in true alignment and of sufficient stiffness to prevent excessive deflection under the load of wet concrete.

Forms shall be designed to anticipate shortening of members due to concrete shrinkage and the transfer of the pretensioning force to the concrete.

The ends of members shall be recessed in the vicinity of the pretensioning tendons to permit epoxy resin mortar encasing of the exposed ends of tendons. The outline of the recessed area shall be a minimum of one inch from the faces of the member.

Lifting devices shall be installed so as not to be visible in the finished structure. After erection, the lifting devices for hollow core deck units shall be removed to a distance of 1/2 inch below the concrete surface and the resulting hole then filled with epoxy resin mortar.

Side forms shall be of steel and shall be supported without resort to ties or spreaders within the body of the member. They shall be braced and stiffened so that no undesirable deflection or curvature takes place under concrete pressure. They shall be so designed that proper cleaning of the forms between uses is facilitated.

The form faces in contact with the concrete shall be thoroughly cleaned after each casting operation and coated with form lacquer or oil before concrete is placed. The form lacquer or oil shall be of such quality as to leave no stains or discoloration on the member faces.

No form ties, spreaders, or forming facilities shall penetrate the body of the member, except those necessary to provide ultimate openings. Before any forms are removed, the concrete shall have attained sufficient strength to prevent injury due to such removal. No forms shall be removed without the approval of the Engineer. Proper care and precautions shall be exercised in removing forms so that no damage results to the finished surfaces.

402.06 Placing Pretensioning Tendons and Application of Prestress Force.

After the forms have been constructed, cleaned, and prepared, reinforcement steel which could not otherwise by placed due to interference with the tendons shall be set in place. All other reinforcement shall be placed after the tendons have been stressed.

Tendons shall be supported by stays, blocks, ties, hangers, or other similar approved measures as required to maintain their proper position and special care must be exercised to prevent contamination by bond breakers such as mud, grease, or other detrimental substances.

All tendons shall be protected against physical damage (kinks, bends, nicks, broken wires, etc.) at all times from completion of manufacture to final encasement in concrete. Tendons that have sustained physical damage at any time will be rejected. The development of visible rust or other results of corrosion shall be cause for rejection, when ordered by the Engineer.

Prior to stressing by jacking, the Contractor shall submit to the Engineer for review the detailed computations of the proposed gauge pressures of his jacking equipment and the corresponding elongations of pretensioning strands as specified in Subsection 402.04.

Pretensioned tendons shall be secured by suitable anchorage devices capable of developing at least 95 percent of the ultimate strength of the tendon, when tested in an unbonded state, without exceeding anticipated set. The anchorage device shall be capable of anchoring stressing loads positively and with a minimum of differential slippage.

Final stressing of the tendons shall be accomplished by the use of the prescribed jacking equipment.

The pretensioning tendons shall be placed symmetrically about the vertical axis of the member, or as otherwise shown, and in proper position to achieve the locations of the center of gravity of the steel (cgs).

After tendons have been positioned, an initial force shall be applied to each tendon, before the end gripping device is applied, to eliminate slack and to provide a uniform initial stress condition in all tendons prior to final stressing. An initial force of approximately 1,000 pounds per 200 feet of each tendon is generally adequate, with a minimum of 1,000 pounds and a maximum of 3,000 pounds per tendon, but not more than 20% of final tensioning force.

All tendons shall be in position before the stressing operation is begun. The prestressing tendons shall be connected to the jack or jacks in such a manner that the prestressing force will be distributed equally among the tendons.

Final stressing of the tendons shall be performed by the simultaneous application of tension to all the tendons to produce an elongation corresponding to the prestressing force given on the plans or in the Supplementary Specifications. This force must be maintained until the concrete has attained the minimum compressive strength for transfer of the stress specified on the plans.

When tendons are tensioned in their draped position, they shall be supported by lubricated rollers with bronze bushings or other low-friction rollers at all hold-up and hold-down points. The stress shall be checked by the use of extenso-meters at each end and near the middle at a point where the tendon changes direction until it is established that uniform strains acceptable to the Engineer are obtained. Provision shall be made for a minimum of 1/2 inch of concrete or epoxy resin mortar cover on all metal parts of the hold-down devices remaining in the beams.

Safety measures must be taken by the Contractor to prevent accidents due to possible breaking of the prestressed steel or the slipping of the grips during the prestressing process.

A record shall be kept of the jacking force and the elongation produced thereby. Several units may be cast in continuous line and stressed at one time.

The Contractor shall be responsible for the correction of losses due to slippage of tendons in vises, loss due to

temperature change between the time of stressing and time of initial set of the concrete, and all other losses peculiar to the method or system of prestressing.

402.07 Mixing, Placing and Curing Concrete.

Concrete construction shall be performed in accordance with Section 401, with the following exceptions or additions:

All concrete for prestressed concrete members shall be thoroughly compacted by means of internal or external vibration or both, as ordered by the Engineer. Surface type vibrators may be used for slab construction. Internal vibrations shall be applied to the concrete for time intervals of approximately 10 seconds and at points not more than 30 inches apart. Vibrators shall be used for compaction only and not for moving concrete horizontally along the forms. The type, number, and application of vibrators shall be approved by the Engineer. The vibrating shall be done with care and in such a manner as to avoid displacement of the reinforcement, prestressing tendons, sole plates, and inserts.

In general, curing of the concrete shall be accomplished by a method that provides for the retention of moisture in order that complete hydration of the cement will take place. The requirements of Subsection 401.18 will govern and the method selected by the Contractor shall meet the approval of the Engineer. In addition, steam curing will be permitted, provided the procedure meets the following condition:

Steam curing shall be done under a suitable enclosure to contain the live steam and minimize moisture and heat losses. The initial application of the steam shall be delayed for a period of from four to six hours after the final placement of concrete in order to allow the initial set of the concrete to take place. The steam shall be at 100 per cent relative humidity to prevent loss of moisture and to provide excess moisture for the proper hydration of the cement. Steam shall not be applied directly onto the concrete. During application of the steam, the ambient air temperature shall be increased at a rate not to exceed 40°F per hour until a maximum temperature of from 140°F to 160°F is reached. The maximum temperature shall be maintained until the concrete has reached the minimum compressive transfer strength specified on the plans. In discontinuing the steam, the ambient air temperature shall not be decreased at a rate greater than 40°F per hour until an ambient temperature of about 20°F above the temperature of the air to which the concrete will be exposed has been reached. The concrete shall not be exposed to temperatures below freezing for six days after casting.

Representative concrete test cylinders cured in the same manner as the members shall be tested for compressive strength at various time intervals. The Contractor shall furnish all necessary cylinders, concrete and curing facilities for the test specimens. The Engineer will make frequent observations of the consistency of the freshly mixed concrete as measured by the slump. A minimum of four sets (three concrete test cylinders each set), shall be cast per casting bed length. One of the four sets required shall be cast from the first pour in the bed and one set shall be cast from last pour in the bed. For determination of prestress transfer strength for each casting bed length, one (1) cylinder from the last set poured, and two (2) additional cylinders chosen at random shall be tested.

The specimens will be tested in accordance with the requirements of ASTM C39. Each cylinder shall have a strength of at least 95 percent of the specified prestress transfer strength required; however, the average strength of the three cylinders must be equal to or greater than the specified prestress transfer strength. The Authority will verify concrete strength by testing three cylinders at 28 days after casting. No cylinder shall have a strength less than 95 percent of the required 28 day strength. The average strength of the three (3) cylinders must be equal to or greater than the required 28 day strength. All testing to determine the prestress transfer strength shall be done by and at the expense of the Contractor. All other testing will be done by the Authority at no cost to the Contractor.

Two copies of concrete cylinder test reports for each cylinder tested by the Contractor to determine the prestress transfer strength shall be submitted to the Engineer. The Contractor shall provide the labor necessary for and the means of obtaining the samples of concrete.

402.08 Detensioning.

No bond stress shall be transferred to the concrete, nor shall end anchors be released, until the concrete has attained the compressive strength for transfer of the stress specified; the compressive strength of the concrete shall be determined by the cylinder tests. If concrete has been steam cured, the detensioning shall be performed immediately following the curing while the concrete is still warm and moist.

Forms, inserts, hold downs, or other devices that would restrict longitudinal movement of the members shall be removed or loosened prior to detensioning.

Prestressing forces shall be released by means of gradually decreasing the jacking pressure. The force in the

tendons shall be released in such an order that lateral eccentricity of prestress will be a minimum. Maximum eccentricity about the vertical centroidal axis shall be limited to one tendon.

After the stress is released, the tendons shall be cut a minimum 1/2 inch from the recessed surface of the end face and the recess completely filled with epoxy resin mortar flush with the surrounding end face.

402.09 Concrete Finishing.

All concrete finishing shall be in accordance with Subsection 401.17, as called for on the plans or as specified.

Except in areas where keys are to be provided, the top surface of all prestressed beams shall be finished reasonably true by striking off at the top of the forms. As soon as its condition permits, before the concrete has fully hardened, all dirt, laitance and loose aggregate shall be removed from the surface by means of a wire brush, which shall leave the coarse aggregate slightly exposed, or the surface otherwise roughened. If the concrete has been allowed to harden so that it is impossible to roughen the top surface by brushing, the surface shall be cleaned and prepared for bond by chipping or by other approved methods.

All exposed reinforcement shall be coated with neat cement paste immediately after form removal.

Beam ends shall be coated with an approved epoxy waterproofing for a distance of 3 times the depth of the beam.

Exposed faces of fascia units shall be given a Class 2, rubbed finish.

402.10 Handling, Storage and Erection of Precast Units.

Special care shall be taken in handling, storing, transporting, and erecting precast, prestressed concrete units so as to avoid any damage. They shall be lifted only at the designated points by approved embedded lifting devices. Methods and details pertaining to lifting the units shall be as shown on the reviewed shop and working drawings. Units damaged by improper storing or handling shall be replaced by the Contractor at his expense.

Precast units shall be transported and stored in the position and with the same points of support that the unit will have when placed in the structure. Precast units shall not be subjected to any damaging torsional or impact stresses. In the event that the Contractor deems it expedient to transport or store precast units in any other position, it shall be done at his own risk.

When erecting structures over existing buildings, structures, utilities, active roadways, walkways, railroads, navigable waterways, recreational and storage areas, catches or protective shielding shall be installed at the locations designated on the plans or as directed by the Engineer before any further operations may proceed over these areas. Design, installation and removal of catches or protective shielding shall meet the requirements of Subparagraph 417.04 (A) (1) Catches, and Paragraph 417.09(B), Methods of Construction. All work shall be done in accordance with the applicable portions of Subsections 104.08, 104.13, 105.14 and 417.04, the contract plans, and as specified herein.

402.11 Rejection of Units.

Any unit displaying one or more of the following defects shall be rejected and a new unit shall be cast at the Contractor's own expense.

(A) Strength Requirement.

Any unit represented by cylinders not meeting the specified strength.

(B) Exposed Prestressing Steel.

Any unit that has one tendon exposed for a length in excess of 24 diameters, or two or more exposed tendons.

(C) Honeycombing.

Honeycombing of the unit to such an extent that chipping away of the honeycombed concrete results in the conditions described in the above paragraph (B).

(D) Stress Cracks.

Any unit that has a stress crack in the area beginning four inches from either end of the unit that is greater than one-half inch in depth and twenty-five ten thousandths (.0025) of an inch in width.

402.12 Shear Key Joints for Box Beam and Hollow Core Deck Units.

Shear key joints in precast box beam and hollow core deck units shall be filled with epoxy resin mortar after stressing of the transverse tie rods as follows:

(A) Stressing Transverse Tie Rods.

Immediately prior to stressing transverse tie rods, the keyways shall be cleared of all debris. All oil, grease, or any other material which may prevent effective bonding of the joint shall be cleaned from the surfaces of the keyway.

Tie rods shall be placed in position through preformed holes and stressed to the tension shown on the plans. Precautions shall be taken to prevent damage to the concrete. The stressing process shall be conducted so that the tension being applied may be measured at all times.

After stressing, the exposed end of the rod at the fascia member shall be removed so that no part of the rod or of the end fitting extends beyond a point one inch inside the exterior face of the fascia member. The cutting shall be done in such a manner as to cause no damage to the rod, fitting, or concrete.

The exposed parts of the end fitting and rod shall be coated with two coats of galvanizing repair paint in accordance with the requirements of ASTM A780, Annex A2, and the recess for end fitting filled with epoxy resin mortar.

When the transverse bars have been stressed to the specified tension, the longitudinal shear keys shall be filled with mortar.

(B) Mixing Of Mortar.

The epoxy resin system used in the mortar has relatively short pot life. Accordingly, no mixing shall be started until all preparations have been made for placing the mortar. Moreover, mixing shall be carried out in strict accordance with the manufacturer's recommendations and the following:

(1) Mixing shall be done as close as possible to the joint to be filled.

(2) All necessary equipment for mixing and placing shall be present at the site and in good working order prior to the start of mixing.

(3) The epoxy resin mortar shall be proportioned by volume in the approximate ratio of 3 parts of sand to 1 part epoxy resin system. The exact ratio of sand to epoxy resin system shall be determined by field trials to produce a dense void-free mortar.

(4) Prior to the addition of the epoxy resin system, the dry sand shall be placed in the mixer and agitated to insure thorough mixing.

(5) The two components of the epoxy resin system shall be thoroughly mixed together before being added to the sand.

(6) The epoxy resin system shall be added to the sand slowly, but mixing time shall not exceed three minutes.

(7) All epoxy resin mortar in any individual batch must be used within 25 minutes after the start of mixing the epoxy resin system.

(8) The epoxy resin mortar shall not be retempered.

(C) Placing Mortar.

Prior to placing the mortar, the keyways shall be tightly caulked below the bottom of the shear key with oakum or an approved equal to avoid leaks. This work shall be done carefully and the caulking material shall not project into the shear key area.

The mortar shall be placed directly in the joints. It shall be placed quickly and continuously and shall not be overworked.

The temperature of the concrete against which the mortar will be placed shall be above 40°F, and the key protected against temperatures lower than 40°F for 12 hours after placing the mortar.

Placing mortar will not be permitted when temperatures are expected or predicted to drop to 40°F or lower at any time during a period of 12 to 15 hours following placement, unless methods of protection are approved by the Engineer.

The joints shall be slightly overfilled with mortar. The excess mortar shall then be struck off flush with the surface of the adjacent units. Traffic on other loading shall not be permitted on the bridge for at least twenty-four hours after the mortar has been placed.

The recommendations of the epoxy manufacturer shall be followed when handling and placing epoxy resin mortar.

402.13 Measurement.

Prestressed Concrete Beams and Prestressed Concrete Deck Units will be the actual lengths of completed members, measured in place, furnished and constructed in accordance with the Plans and Specifications.

Prestressed concrete members other than beams and deck units shall not be measured for payment, but will be paid for as a Lump Sum for each structure.

402.14 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
PRESTRESSED CONCRETE BEAMS, TYPE ___	LINEAR FOOT
PRESTRESSED CONCRETE DECK UNITS, (DEPTH) X (WIDTH)	LINEAR FOOT
PRESTRESSED CONCRETE MEMBERS, STR. NO. __	LUMP SUM

Reinforcing steel and concrete in cast-in-place diaphragms will be measured and paid for as specified in Subsections 401.23 and 401.24, respectively.

SECTION 403 - STEEL STRUCTURES

403.01 Description.

Steel Structures shall include furnishing, fabricating, and erecting all structural steel and metal work required for the construction of steel bridges and other structures. Curb angles, steel nosings, steel expansion joint construction, bridge drainage metalwork, and other metalwork required for the Project, for which provision has not otherwise been made, shall also be included in the work.

Steel Structures shall also include design, installation and removal of catches and protective shielding.

Painting of structural carbon steel shall conform to the requirements of Section 411.

Materials and Construction operations not specifically covered in the Plans and Specifications shall be in accordance with AASHTO Standard Specifications for Highway Bridges or AASHTO LRFD Bridge Design Specifications as applicable, based on the design code noted on the Plans.

403.02 Materials.

Materials shall conform to the following Sections and Subsections:

AUTOMATIC END WELDED STUDS	909.06
BEARING PADS	923.02
BOLTS AND BOLTING MATERIALS	909.02
BRONZE BEARING PLATES	911.02
CASTINGS AND FORGINGS.	909.04
FASTENERS	909.02
FIBERGLASS PIPE	917.06
PAINTS AND COATINGS	913
PINS AND ROLLERS	909.03
STEEL PIPE	909.09
STRUCTURAL STEEL	909.01

ZINC COATING (GALVANIZING) 909.11

403.03 Inspection and Testing.

Inspection and testing shall conform to Subsection 104.05 and the applicable provisions of Section 105, and in addition, shall conform to Section 6 of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code as modified by the following:

Steel bridge bearings are considered to be main load carrying members.

Structural steel fabricating plants shall be certified under the AISC Quality Certification Program in the following categories by the type of work performed:

- Simple Steel Bridge Structures. Includes highway sign structures, parts for bridges (such as cross frames for straight bridges with skews of less than 30 degrees), and un-spliced rolled beam bridges.
- Major Steel Bridges. All bridge structures other than unspliced rolled beam bridges.
- Fracture Critical Members Endorsement. Familiarity with procedures required to produce critical members in accordance with a fracture control plan as defined by AASHTO or AREMA.

Structural steel fabricators certified by AISC for Major Steel Bridges are automatically certified for Simple Steel Bridges.

Quality control inspections by the Contractor shall be performed at least to the extent specified and, additionally, any other testing and inspections necessary to control production quality shall be made. Quality assurance inspections will be performed by the Authority.

(A) SHOP INSPECTION.

The Engineer shall be notified by the Contractor in writing 15 calendar days in advance of the date of beginning of work at the shop so that arrangements for inspection may be made. Any work done prior to inspection may be rejected.

The Contractor shall furnish facilities for the inspection of material and workmanship in the shop. The inspectors shall be allowed free access to the necessary parts of the works.

Inspectors shall have the authority to reject any material or work which does not meet the requirements of the Specifications. In case of dispute, the Contractor may appeal to the Engineer, whose decision shall be final. The acceptance of any material or finished member by the Engineer shall not be a bar to its subsequent rejection, if found defective. Rejected material and workmanship shall be replaced promptly or corrected by the Contractor at his expense.

The Contractor shall furnish certified mill test reports showing ladle analysis of the chemical composition of the steel used in fabricating the various members. Certified mill reports shall be submitted, in accordance with Subsection 105.03, showing chemical and physical properties of the materials to be used. Samples and test pieces shall conform to Subsection 105.03 and 105.12.

(B) NONDESTRUCTIVE TESTING.

Field welded splices shall also be inspected by nondestructive tests at the site of erection.

The Engineer shall be notified in writing not less than 15 calendar days in advance when any shop or field welding is to be under-taken so that arrangements for inspection may be made.

(C) FRACTURE CONTROL PLAN.

Steel bridge members or member components designated as Fracture Critical Members (FCM's) on the plans shall be subject to the provisions of the AASHTO LRFD Bridge Design Specifications and ANSI/AASHTO/AWS D1.5 Bridge Welding Code, Chapter 12.

(D) SHOP PREASSEMBLY AND SURVEY.

(1) General Shop Preassembly Requirements.

All structures which utilize field splices shall be preassembled at the steel fabricator's shop, unless noted otherwise in this specification or in the contract documents. All methods of preassembly shall be clearly shown on the Shop Drawings. All other methods of fabrication and fitment not defined in this section shall be as per the AASHTO LRFD Bridge Construction Specifications, Current Edition with current interims.

For the Purposes of Section 403.03(D), the following definitions shall apply:

"Section" – a portion of a girder between field splices and/or end bearing locations.

"Line" – the plan alignment of a girder as defined in the contract plans from girder end bearing to girder end bearing.

"Complete Assembly" – a method of preassembly by which the fabricator completely assembles a girder to line and camber. All girders which are less than 150 feet in length, or are comprised of less than three sections shall be completely assembled in the fabricator's shop.

"Progressive Assembly" – a method of preassembly by which the fabricator assembles a minimum of three sections or 150 feet of a girder (whichever is greater) to line and camber beginning at one end of the girder line. The fabricator shall remove previously assembled sections from the beginning end of the girder line and add additional sections to the advancing end while maintaining a minimum 3 sections or 150 feet in the progressive assembly at all times. Progressive assemblies shall consist of at least one section of the previous assembly (repositioned if necessary and adequately pinned to assure accurate alignment) at all times.

"Full Component Assembly" – a method of preassembly by which the fabricator fully assembles specific portions of a bridge superstructure to lines and cambers. When girders are continuous because of their attachment to transverse structural steel supporting beams, (framed-through connection), regardless of cross section, full component assembly of these elements is mandatory. All structural steel work through the first girder to girder field splice on both sides of framed-through transverse structural steel supporting beams shall be preassembled. The framed-through transverse box girders within these portions of the structures shall be included in the preassembly. False work that accurately represents the structural steel bearing locations and elevations as shown on the contract plans shall be constructed and used for all full component assemblies. One hundred percent of the bolt holes within the full component assembly shall be reamed to size and checked for bolt fitment. Other portions of a superstructure may be required for full component assembly as specifically called for in the contract plans.

"Complete Structural Assembly" - a method of preassembly by which the fabricator assembles a complete bridge superstructure in its entirety to lines and cambers in order to verify proper fit and alignment. False work that accurately represents the structural steel bearing locations and elevations as shown on the contract plans shall be constructed and used for all complete structural assemblies. No other points of support shall be permitted. The structural steel shall be fully assembled in the sequence(s) and stages as depicted on the contract plans. Fifty percent of the bolt holes (every other bolt hole) within the complete structural assembly shall be reamed to size and checked for bolt fitment. Completely assembled structural steel shall be surveyed by a Licensed Surveyor. In accordance with Section 104.08, the Contractor shall submit Shop Drawings indicating the coordinate locations and elevations of all bearing locations, field splice locations, and tenth (10^{th}) point locations of each span of each girder at the centerline of the girder. Discrepancies from the contract plans shall be clearly noted in all Shop Drawings. This method of assembly will not be required unless specifically called for in the contract plans.

"CNC Fabrication" – a method of fabrication that utilizes Computer Numerical Controlled (CNC) automated machinery to cut or drill components of bridge structure elements to finished size and shape. CNC Fabrication is typically employed for (but not necessarily limited to) fabrication of cut-cambered girder webs, swept flange plates for curved girders, and hole arrays for bolted connections. Where CNC Fabrication is permitted in Section 403.03(D)2, preassembly requirements described in 403.03(D)2.a and 403.03(D)2.b shall be revised as follows:

(a) The fabricator must demonstrate ability to accurately utilize CNC Fabrication methods to construct superstructure elements meeting the dimensions and tolerances published within the Contract Documents. This ability shall be demonstrated by preassembling. For straight girders, a single full length girder line of any continuous multi span unit shall be preassembled to line and camber as outlined in Section 403.03(D)2.a. For curved girders, two full length girder lines, with diaphragms, of any continuous multi span unit shall be preassembled to line and camber as outlined in Section 403.03(D)2.b. Progressive Assembly, as defined in 403.03(D)1, may be used for both straight or curved girders. Selection of girder lines shall be subject to the approval of the Engineer. The fabricator shall clearly indicate on the submitted Shop Drawings which girder line(s) from the overall bridge superstructure are to be preassembled. Successful preassembly of the girder lines shall obviate the need for further Progressive Assembly requirements as they pertain only to the subject bridge. Bridge structures containing multiple independent

superstructure units shall not require multiple preassemblies unless otherwise directed.

(b) Requirements for Full Component Assembly as described in 403.03(D)2.c will remain in effect. Each bridge structure contained within the Plans utilizing a framed through transverse box girder shall be subject to these requirements. Where girders are supported on a transverse box girder and are not framed through it, only the provisions of 403.03(D)2.a or b, depending on curvature, shall apply. Anticipated steel only dead load deflections of the supporting transverse box girder shall be accounted for when performing the progressive assembly for line and camber.

(c) The fabricator shall submit a Quality Control Plan, which shall clearly outline the means and methods exercised to maintain accurate fabrication production. This Quality Control Plan shall, at a minimum, describe procedures and chain of responsibility to be used throughout the fabrication process to transfer relevant information contained in the Contract Documents to the CNC production equipment, including method(s) of verification that final fabrications have been accurately produced. Only one Quality Control Plan shall be submitted for the contract, regardless of the number of bridge structures contained within the Contract.

(d) Failure to preassemble the selected girder line(s) without misfits or the need to ream out-of-alignment bolt holes will be held as basis for disallowing use of reduced preassembly requirements via CNC Fabrication methods by the fabricator for all structures in the Contract. Additional preassembly attempts may be considered by the Authority at the discretion of the Engineer, if the following conditions are met:

i. A letter shall be submitted to the Engineer describing the failed mechanism or procedure causing the failed preassembly attempt.

ii. A revised Quality Control Plan shall be submitted which shall include a clear method of identifying the cause and preventing a recurrence of the previous failed preassembly.

iii. Additional preassembly attempts shall be performed on newly fabricated girders using the revised Quality Control Plan.

(2) Structure Type Specific Preassembly Requirements.

The completeness of preassembly required for each structure type shall be performed as defined below. The sequence of component preassembly in the shop shall be documented and provided to the Contractor for review and approval. The Fabricator's preassembly sequence, with the Contractor's approval stamp, shall be submitted with the Contractor's Erection Plan working drawings for the Engineer's review.

(a) Straight Girder Structures Skewed Less Than 30 Degrees.

As a minimum, the preassembly procedure for straight girder structures with field splices and all bearing lines skewed less than 30 degrees shall consist of either complete assembly or progressive assembly as defined above. Webs of girders may be oriented in the horizontal plane or the vertical plane. Girders shall be fully supported during assembly. CNC Fabrication and associated preassembly requirements as described in 403.03(D)1 may be utilized for structures meeting the requirements of this Subsection unless otherwise indicated on the Contract Plans. Straight girder structures without field splices and with all bearing lines skewed less than 30 degrees are exempt from the provisions of Section 403.03(D) unless explicitly noted otherwise in the contract documents.

(b) Structures Curved in Plan and/or Skewed 30 Degrees or More.

As a minimum, structures which are curved in plan as defined in Section 4.6.1.2 of the AASHTO LRFD Bridge Design Specifications and/or with any bearing line skewed 30 degrees or more shall meet the provisions of 403.03(D)2.a., and shall be assembled with webs oriented vertically. For multi-girder structures, each complete or progressive assembly shall consist of a minimum of two adjacent girder lines including diaphragms or cross frames as per the contract plans. Girder lines assembled by progressive assembly shall consist of at least two sections of an adjacent girder line which has been previously assembled, plus two more sections added to the advancing ends of the girder lines. CNC Fabrication and associated preassembly requirements as described in 403.03(D)1 may be utilized for structures meeting the requirements of this Subsection unless otherwise indicated on the Contract Plans.

(c) Portions of Structures with Complex Framing Elements.

Portions of structures explicitly noted as "Complex" on the Plans shall be preassembled via full component assembly. When girders are continuous because of their attachment to transverse structural steel supporting beams (framed-through connection), regardless of cross section, full component assembly of these elements is mandatory. Other portions of the structure may be assembled via complete or progressive assembly, as appropriate.

(d) Special Structures to be Completely Preassembled.

As a minimum, special structures which have been explicitly designated on the contract plans to be preassembled via compete structural assembly shall meet the provisions of 403.03(D)2.b. The complete and entire steel structure with all secondary framing members shall be preassembled at the fabricator's shop as a complete structural assembly.

403.04 Shop and Working Drawings.

Shop, erection, and other drawings necessary for the fabrication and erection of steel structures shall be furnished in accordance with Subsection 104.08.

403.05 Workmanship and Finish.

Workmanship and finish shall be equal to the best general practice in modern bridge shops. Portions of the work exposed to view shall be finished neatly. Shearing, oxygen cutting, and chipping shall be done carefully and accurately. Unsatisfactory workmanship and finish as determined by the Engineer shall be removed and/or replaced as necessary with painted recleaned and repainted as specified herein by the Contractor at no cost to the Authority.

(A) ASTM A588 Or A709 Weathering Steel - Unpainted.

All surfaces of unpainted stringers of ASTM A588 or A709 steel, shall be commercially blast cleaned. The entire fascia portions, the undersides of the upper and lower flanges, the web surface, the top side of the bottom flange and vertical edge of the bottom flange of any one structure shall be blast cleaned at approximately the same time after fabrication. Such blast cleaning may be done in the shop or in the field except over roadways or where traffic is affected.

Blast cleaning shall be in accordance with the Provisions of the Steel Structures Painting Council's (SSPC) Surface Preparation Specification SSPC-SP 6, (Commercial Blast Cleaning). After blast cleaning, precautions shall be exercised to avoid uneven weathering, by assuring that all exposure to the elements is uniform for the entire surface and that the steel is protected from recontamination; any subsequent contamination or foreign matter shall be removed as soon as practicable in accordance with the same requirements.

Natural oxidation of A588 and A709 weathering steel is not considered as being foreign matter.

Welded areas shall be cleaned by power tool or by blast cleaning to remove all slag, flux and spatter.

Blast cleaning or other special surface preparation will not be required on exposed unpainted surfaces where appearance is of minor consideration.

(B) Substructure Protection.

Finished concrete substructure surfaces shall be protected from the effects of rust staining caused by unpainted weathering steel during construction.

Protection may consist of a suitable plastic wrapping designed by the Contractor and approved by the Engineer that is maintained in place over the substructure beams from the time of erection of the unpainted weathering steel until completion of the superstructure concrete and deck. In lieu of the protection, the Contractor may propose the use of suitable abrasive or chemical cleaners to completely remove rust stains which shall be subject to the approval of the Engineer. Protection costs shall be subsidiary to other items.

(C) All Painted Steel And Metalwork.

All steel surfaces shall be cleaned and painted in accordance with the applicable provisions of Section 411 and any applicable Supplemental Specifications.

(D) New ASTM A709 Grade 50W Steel - Painted.

Cleaning and painting of new ASTM A709 Grade 50W (weathering) structural steel is required at all bridge

deck joint locations. All structural steel surface areas for a distance of one and a half times the depth of the stringers from the deck joint, with the exception of steel designated to be galvanized, shall be cleaned and painted in accordance with the applicable governing provisions of Section 411 and any applicable Supplementary Specifications.

403.06 Fabrication and Welding.

Fabrication of steel structures, including but not limited to straightening material, curving beams and girders, bolt holes, finishing and shaping, bolts and bolted connections, pins and rollers, shop assembling, tests marking and shipping, shall conform to the AASHTO LRFD Bridge Construction Specifications and to the following amendments and additions.

Welding shall conform to the current ANSI/AASHTO/AWS D1.5 Bridge Welding Code. Electro-slag welding will not be permitted for use on fracture critical members or High Performance Steel (HPS) Grade 70 or above. All electro-slag weldments shall be 100% tested as per AWS D1.5 Section 6.7.1.1.

Welding of miscellaneous details (supports for screed rails, form attachments, connection plates, etc.) to members subject to tension or reversal shall only be performed when specifically approved by the Engineer.

Tack welding of miscellaneous details, if approved, shall conform to the ANSI/AASHTO/AWS D1.5 Bridge Welding Code Subsection 3.3.7.

The ANSI/AASHTO AWS D1.5 Bridge Welding Code is amended as follows:

(A) The Following Is Added To The Provisions Of 3.13.2:

All steel backing of welds on the outside faces of fascia girders shall also be removed and the joints ground or finished smooth.

(B) The Following Is Added To The Provisions Of 7.4:

Studs shear connectors shall be installed in the field, only after the structural steel is erected, and prior to placing of reinforcement steel, with automatically timed stud welding equipment connected to a suitable power source.

(C) The Following Is Added To The Provisions Of 6.7:

Butt weld splices in longitudinal stiffeners shall also be tested by nondestructive testing.

All joints subject to tension or reversal of stress, butt weld splices in beam or girder webs, compression, and longitudinal butt welded splices will be tested for the full length of the weld for purposes of quality assurance inspection procedures.

All welds scheduled for nondestructive testing under quality control and quality assurance inspection procedures shall be ground flush for the full length of the weld. Grinding shall be in the direction of applied stress.

For purposes of quality assurance inspection, groove welds will be tested using ultrasonic testing procedures which may be supplemented by radiographic testing.

Identification and/or weight markings shall not be placed on surfaces exposed to view when using steel conforming to A709 in the unpainted condition.

403.07 Camber and Camber Diagrams.

All structural steel members requiring camber shall be cambered at the mill or in the shop. The cambers shall conform to a true parabolic or circular curve without abrupt changes. Where shear lugs or other members are to be welded to flanges or where heat curving of beams and girders is performed, the fabricator shall take the necessary precautions to prevent loss of camber due to these operations. The steel members shall have the required camber when delivered at the bridge site.

A camber diagram shall be furnished to the Engineer by the Contractor showing the camber at points indicated for each member taken from actual measurements while the members are assembled.

403.08 Shipping, Handling and Erection.

(A) Shipping And Handling.

The Engineer shall be notified at least 48 hours prior to shipping of structural steel members so that a final quality assurance inspection of the product can be performed. Structural steel members shall be loaded,

hauled, and unloaded in such a manner that they will not be deformed, damaged, or subjected to stresses in excess of those provided for in the design. All steel girders and like members shall be shipped and stored with their webs vertical unless their size precludes vertical shipment, in which case horizontal shipment may be considered. Points of bearing shall be placed within 20 percent of the length of the girder from the ends secured with chain tie downs. Long members shall be braced during shipment with temporary vertical stiffeners, if not provided for in the design, extending the full height of the web on both sides of the member. Temporary stiffeners shall be located at the bearing points, mid-span, and at additional locations to ensure that the maximum interval between blocking does not exceed 25 feet. Temporary stiffeners shall be in full contact with both flanges and the web. The temporary stiffeners should be padded or made of a material which will minimize damage to the painted surface.

Transportation drawings and calculations signed and sealed by a Professional Engineer licensed in the State of New Jersey shall be prepared by the fabricator and submitted to the designer for approval of all steel members requiring shipment with their web horizontal, or for girders which will extend over 20 percent of the length beyond points of bearing. The procedure for submittal shall be in conformance with Subsection 104.08. Generally when steel members are hauled and stored, they shall be placed in a position similar to their final erected position. Extreme care shall be used in turn-over operations to prevent excessive stresses in the flanges.

Transportation drawings shall include at least the following information:

(1) Drawings or sketches, fully describing the procedures.

(2) Calculations showing the dead load plus impact stresses induced by the loading and transportation procedure. Impact stresses shall be at least 200 percent of the dead load stress.

(3) The location of all support points. Supports shall be detailed to be under the flanges regardless of the member's orientation.

(4) Tie-downs (types and locations) shall be shown. A sufficient number shall be used to provide redundancy so that if any one tie-down fails, the member will remain stable.

(5) Temporary stiffeners shall be shown if they are necessary to provide temporary support to the member during shipping.

(6) Details of a four-way articulating bolster for each truck transporter to ensure that truck movements will not produce unnecessary stresses in the attached structural steel.

(B) ERECTION.

Erection of structures, including but not limited to handling and storing materials, falsework, methods and equipment, straightening bent materials, assembling steel, making bolted connections and correcting misfits, shall conform to current AASHTO LRFD Bridge Construction Specifications and to the following amendments and additions:

Falsework, staging, barges, plant and all tools equipment, machinery and appliances, including driftpins and fitting-up bolts necessary for the expeditious handling of the work, erection of the metalwork, removal of the temporary construction, (including falsework and erection materials), maintenance of traffic and all work necessary to complete the structure shall be provided.

The following precautions shall be exercised in handling all structural steel.

(1) Gouges, scratches, and dents shall be avoided.

(2) Staining by concrete, mortar, oil, paint, grease, food and other foreign substances must be avoided, and any such contamination which occurs shall be removed by the appropriate cleaning specification listed in Subsection 403.05, Workmanship and Finish.

(3) Cover cloths shall be used as necessary for protection of the materials.

(4) Acids shall not be used to remove scale and stains.

(5) Subsection 403.05 specifies blast cleaning of certain surfaces of unpainted fascia stringers and that the blast cleaning may be done in the shop or in the field. If blast cleaning is performed in the field after erection, care shall be taken to cover bridge shoes and pier tops to protect them from being affected by the sandblasting operation. Sandblasting will not be permitted over roadways in use or in areas where blasting will affect traffic.

Erection of structural steel shall not proceed until substructure concrete has cured for the minimum length

of time specified under Subsection 401.18. Unless otherwise directed by the Engineer, embankments in back of abutment walls, other than proprietary abutment walls, shall be constructed to at least 50% of their height prior to the erection of the structural steel. The sequence of construction for proprietary abutment walls shall be in accordance with the Plans and the requirements of the proprietary wall manufacturer.

The exact methods of steelwork erection to be followed will be left to the Contractor's selection. At least 15 days prior to starting the work of erection, the Contractor shall submit to the Engineer full details and information as to the method of erection he proposes to follow, the amount and character of equipment he proposes to use, and where applicable calculated stresses for proposed erection. At least one week prior to the start of erection, a meeting will be held to review these methods and discuss traffic coordination.

Shop and working drawings and all design calculations of falsework shall be submitted to the Engineer in accordance with Subsection 104.08. The review by the Engineer of the erection methods or of drawings and design of falsework or of other drawings and design dealing with the erection shall not relieve the Contractor of full responsibility for the safe and adequate execution of the work.

Should the Contractor find it desirable to use special additional metal parts for the purpose of erection or should his method of erection require that metal be added to certain members, the required modifications and the additional metal parts may be used subject to the approval of the Engineer, but the expense of all such additional metal or of special parts shall be paid for by the Contractor and the parts not forming portions of the permanent structure, including falsework and other temporary erection materials, shall be the Contractor's property and shall, when no longer needed, be removed from the site.

Field splices in multiple-span continuous girders and rolled beams shall be bolted as promptly as practicable after erection, and prior thereto shall be connected with a sufficient number of bolts to adequately provide for all stresses in the splice and to prevent loss of camber.

When erecting structures over existing buildings, structures, utilities, active roadways, walkways, railroads, navigable waterways, recreational and storage areas, catches or protective shielding shall be installed at the locations designated on the plans or as directed by the Engineer before any further operations may proceed over these areas. Design, installation and removal of catches or protective shielding shall meet the requirements of Subparagraph 417.04 (A) (1) Catches and Paragraph 417.09(B), Methods of Construction. All work shall be done in accordance with the applicable portions of Subsections 104.08, 104.13, 105.14 and 417.04, the contract plans, and as specified herein.

403.09 Setting Anchor Bolts and Expansion Bearings.

Anchor bolts shall be set by either of the following methods.

(A) When placed prior to concreting, anchor bolts shall be carefully set at the proper location and elevation shown on the plans by the use of properly supported templates which will insure the correct positioning of the bolts during concrete placing operations. The templates shall be of sufficient strength to support and hold the bolts in their proper positions without displacement when the concrete is being placed. Prior to fabrication of bearing shoes, the Contractor shall field check the exact locations of all anchor bolts to ensure the proper and accurate installation of the shoes.

(B) When specified that the anchor bolts be placed by drilling, the Contractor shall carefully drill the holes in the masonry, using templates, at the location shown on the plans. During the time between the setting of bolts and the placing of the bearings, the Contractor shall prevent the collection of water in holes and its freezing in cold weather by filling the holes with sand to within one inch of the top, and sealing with rubber-asphalt joint filler. Before the bolt is set, the sand and filler material and any other foreign material shall be completely removed from the holes.

The anchor bolts shall be set in a bonded epoxy or resin conforming to the requirements of Subsection 923.22 and in accordance with the epoxy or resin manufacturer’s recommendations and the provisions of the Plans. Anchor bolts shall not be placed in oversized drilled or preformed holes in bearing applications where the bearings are subject to net uplift or tension as indicated on the Plans.

Shoes and bearing plates shall not be placed on bearing area surfaces that are improperly finished, deformed, or irregular. They shall be set rigidly and permanently located to correct alignments and elevations, level in position, and shall have full and even bearing. Bearing plates shall be bedded on the masonry with either sheet lead of 1/8 inch minimum thickness, elastomeric bearing pad, or preformed fabric pad.

Allowance shall be made for the effect of stress deformation and temperature changes when setting bearings. The axis of rockers and segmental roller bearings shall be set in an inclined position so that the

rocker or roller will be vertical under full dead load at a temperature of 68°F. A sketch shall be shown on the erection drawing prepared by the fabricator indicating the proper inclination for setting the bearings at various temperatures.

Wherever possible, the embankment shall be in place in back of abutment walls before bearings are set in order to avoid displacement of bearings due to movement of the abutments.

If necessary, expansion bearings shall be adjusted after all loads from the bridge superstructure and roadway approaches are in place. The Contractor shall prepare and present to the Engineer for approval, a method for making final adjustments in bearing positions at locations where the Engineer has determined that such adjustments are necessary. Bearings shall be in the proper position before the bridge is accepted.

403.10 Deck Joints.

Particular care shall be exercised in the vertical and horizontal alignment of all deck joints to insure correct openings for longitudinal movement, correct meshing of joints transversely, and place top surfaces parallel to the grade without vertical offset for established normal conditions.

Adjustment of the joints to proper alignment shall be obtained by use of shims, oversize holes, and by reaming or drilling of bolt holes, as generally indicated on the plans, or by other methods which the Contractor may propose and the Engineer approve. The Contractor will not be permitted to secure the two halves of a joint in position by welding straps across the joint.

The portion of a steel expansion joint which is anchored to an abutment shall not be permanently placed until all of the concrete in the deck for the adjacent continuous-span unit or the adjacent simple span has been placed. The steel for the abutment side of the expansion joint shall then be set and adjusted as specified above and, after approval by the Engineer, permanently installed by filling the holes in the base plates around the anchor bolts with mortar. The mortar shall be allowed to harden before replacing the washers and tightening the nuts. The concrete shall then be placed on the backwall of the abutments as specified elsewhere herein.

403.11 Alignment.

Before beginning the field bolting, the structure shall be adjusted to correct grade and alignment and the elevations of panel points and ends of floor beams properly regulated. For truss spans, a slight excess camber will be permitted while the bottom chords are being bolted but the correct camber and relative elevations of panel points shall be secured before bolting the top chord joints, the top lateral system, and sway bracing.

403.12 High-Strength Bolts.

The installation of high-strength bolts shall be in accordance with AASHTO LRFD Bridge Construction Specifications.

Where field-welded connections are prescribed, the use of high-strength bolts may be permitted. The design of the alternative connection shall be submitted for approval.

The Contractor shall be responsible for ensuring that proper tightening sequence and method are utilized such that all bolts achieve their specified tension, which is at least 70% of the bolt's specified tensile strength.

403.13 Automatic End-Welded Studs.

Automatic end-welded studs shall be used as shear connectors or for other purposes where called for or directed. Studs and stud welding shall conform to Section 7 of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code.

Stud shear connectors shall be installed in the field only after the structural steel is erected and prior to placing of reinforcement steel.

403.14 Field Splice.

Stringers involving field splices shall be completely preassembled in the shop taking into account their relative position in the finished structure as to grade, camber, and curvature. The built-up stringer or girder may be erected as a unit providing traffic conditions permit. Lateral support shall be provided in hoisting members into position so as to prevent lateral buckling or other damage.

The location of field splice, detailed computations, and erection procedure shall be submitted for approval prior to fabrication. Bolt heads of high-strength bolts shall be on the outside of fascia stringers.

403.15 Defective Work.

The field assembling of the component parts of a structure shall be done by methods which will not cause damage by twisting, bending, or otherwise deforming the metal.

Members which are bent or twisted shall not be erected until the defects are corrected in a satisfactory manner. Only minor defects, which can be remedied without injury to the metal, shall be corrected in the field. Members badly damaged or with major defects, in the opinion of the Engineer, will be rejected. Such members shall be returned to the shop for repairs or replacement at no cost to the Authority.

403.16 Repair Galvanizing.

Where limited areas of galvanized surfaces are damaged during shipping or erection, they shall be repaired by any of the three methods specified in ASTM A780. In all cases, the repair shall achieve the minimum coating thickness specified for the item.

403.17 Cleaning and Painting of Structural Steel.

Shop and field cleaning and painting of structural steel shall conform to the requirements of Section 411.

403.18 Measurement.

Structural steel and related metalwork will be measured on a lump sum basis or on a weight basis, in pounds, as required by the Proposal.

Under contracts containing an item for structural steel, all metal parts, including structural steel, steel expansion dams, stud shear connectors, bridge drainage metal work, and all other metalwork necessary for the complete fabrication, erection and completion of the structure will be paid for as structural steel unless otherwise noted, stipulated or listed as separate pay items in the Proposal.

Catches or protective shielding as required by Paragraph 403.09(B) will not be measured for payment.

(A) Lump Sum Basis.

When payment is specified to be made as a lump sum, no weight measurement of metal will be made. The estimate of the weight of structural steel and related metalwork shown on the plans is approximate only and no guarantee is made, express or implied, that it is the correct weight to be furnished. It shall be the Contractor's responsibility to determine the weight of the metalwork to be furnished under the lump sum item. In the event of discrepancy between the estimated weight shown on the plans and the actual weight furnished, no increase or decrease in the Contract lump sum price bid for the item will be made on account of such discrepancy.

(B) Weight Basis.

When payment is specified to be made on the basis of weight in pounds, all structural steel and related metal work in the fabricated and erected structures will be measured by the computed net weight of metal, or on scale weights certified to the Engineer, when so specified or shown on the plans.

Except as hereinafter provided, the quantity of steel work for which payment will be made will include the weight of the structural steel and other metals for which payment is not elsewhere provided, forming part of the permanent structure. The weight of shop and field paint, galvanizing, temporary erection bolts, boxes and other containers used for shipping, materials used for supporting members during transportation and erection, excess field bolt hardware shipped and not incorporated in the structure, members or parts used for erection purposes but not forming part of the permanent structure, erection members left in place, excess weight of substituted members, excess weight of members increased in size for erection purposes, and materials used for testing, will not be measured for payment.

The weight of the metalwork shall be computed on the following basis:

METALWORK	*UNIT WEIGHT POUNDS PER CUBIC FOOT*
ALUMINUM, CAST OR WROUGHT	173.0
BRONZE, CAST	536.0
COPPER-ALLOY	536.0

COPPER SHEET 558.0

GRAY OR DUCTILE IRON CASTINGS 445.0

IRON, MALLEABLE 470.0

LEAD, SHEET 707.0

STEEL, ROLLED, CAST, COPPER BEARING, NICKEL AND STAINLESS 490.0

ZINC, ROLLED 440.0

The weight of castings shall be computed from the neat dimensions shown on the finally reviewed shop drawings, deducting for open holes. To this weight shall be added 5 percent allowance for fillets and overrun. Scale weights, prior to painting or galvanizing, may be substituted for computed weights in the case of castings or of small complex parts for which accurate computations of weight would be difficult.

The weight of structural steel plates and shapes shall be computed on the basis of the neat finished dimensions of the parts as shown on the finally reviewed shop drawing, deducting for copes, cuts, clips and all open holes, except bolt holes and using (a) the nominal weights of steel plates plus one-half the permissible percentages of overrun in weight given in ASTM A6 and (b) the nominal weights of rolled shapes as listed in handbooks without overrun correction.

The weight of shop and field fillet welds will be based on the following:

Size of Weld Inches	Weight in Pounds per Linear Foot	Size of Weld Inches	Weight in Pounds per Linear Foot
1/4	0.20	5/8	0.80
5/16	0.25	3/4	1.10
3/8	0.35	7/8	1.50
7/16	0.45	1	2.00
1/2	0.55		

The computed weight of shop or field weld metal will be based on the above tabulation with deductions for weights of material removed by weld joint preparation.

The weight of heads, nuts, single washers, and threaded stick through of all high tensile strength bolts, both field and shop, shall be included in the quantity measured for payment on the basis of the following:

Nominal Diameter of Bolt, Inches	Weight per 100 of Bolts, Pounds	Nominal Diameter of Bolt, Inches	Weight per 100 Bolts, Pounds
1/2	19.7	1-1/8	165.1
5/8	31.7	1-1/4	212.0
3/4	52.4	1-3/8	280.0
7/8	80.4	1-1/2	340.0
1	116.7		

The weight of the bolt grips are included in the bolt holes for which no deduction is made in computing the weight of members.

The weight of studs or other shear connectors shall be computed on the basis of the manufacturer's weight charts, and shall include the weight of the welds, except that when an item is included in the Proposal for Shear Connectors, the shear studs will be measured for payment by the number of units.

The weight of shop or field paints, galvanizing, or other protective coatings (when used) will not be included in the calculated weight for pay purposes.

The computed weights shall be supplied by the Contractor on forms which meet the approval of the Engineer. For each shop drawing there shall be given a complete list of all plates, shapes, bolt heads, studs, welds and other parts with the weights thereof. The weights shall be computed and tabulated so as to show for each plate, shape, or other piece: the gross weight (before cuts, copes, clips, etc.): the weight of

each cut, cope, clip and open hole (except bolt holes) to be deducted; and the resulting net weight for each such plate, shape, or other piece. The computations shall include summaries identifying and combining the weights for all individual drawings and a general recapitulation giving the total weights under suitable divisions and the total pay quantity for each item of the Proposal.

When the work has progressed to such stage that the weights of the metal work furnished hereunder can be assembled and determined, the Contractor shall submit to the Engineer, for review, duplicate copies of the computations in an approved form. All weight computations shall be checked by the Contractor before submission for review. The Engineer will make such examination and verification of these data as may appear desirable and will return one copy to the Contractor marked with the Engineer's final review stamp indicating that "No Exceptions are Taken," or with correction of any discrepancies noted thereon. This process shall be repeated until all conflicts are reconciled. Thereafter, the Contractor shall furnish in triplicate copies of the computations so adjusted; and these shall be the agreed upon final quantities of metalwork applicable to the items of the Proposal.

403.19 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SHEAR CONNECTORS	EACH
STRUCTURAL STEEL (APPROXIMATELY _____ POUNDS)	LUMP SUM
STRUCTURAL STEEL	POUND
STRUCTURAL STEEL DECK JOINTS	LUMP SUM

Payment for structural steel shall include all costs for the complete fabrication and erection, shop and field welding, non-destructive quality control testing of welds, galvanizing, and shop and field painting.

In most cases, payment for structural steel deck joints will be included in the item Structural Steel.

No separate payment will be made for catches or protective shielding, but costs thereof shall be included in the price bid for the pay item “Structural Steel”.

Should the Authority permit the Contractor to order and store raw materials for the purposes of fabricating structural steel for bridges, partial payment for the materials will be made as follows:

Payment of up to a maximum of 25% of the total lump sum bid amount of the Structural Steel Pay Item will be made to the Contractor upon confirmed delivery of raw materials to the approved storage facilities, not to exceed the raw materials quantities shown on bills of materials in approved shop drawings.

No payment will be made without substantiating documentation in the form of the following:

(A) Bill(s) of lading for the receipt of the material delivery to the approved storage facility.

(B) All required material certifications.

(C) Proof of insurance for the materials stored at the approved storage facility.

Payment will only be made as a direct reimbursement for costs of materials ordered. No payment will be made for related or unrelated expenses or any other premiums over and above the direct cost of bill(s) of lading from materials vendor(s). No further payments for any work performed as part of the overall contract will be made until proof of payment to the raw materials vendor has been submitted and approved by the Engineer.

No payment will be made for any materials until delivery to the approved storage facility has been confirmed by the Engineer.

When the approved storage facility is on property not belonging to the Authority, the material shall be stored in a fenced area with access limited to the Authority and the Contractor. The stored material shall be covered, or otherwise protected from the elements to the satisfaction of the Engineer. Additionally, the Contractor shall post a sign at the location clearly identifying that the materials are without encumbrances and are to be solely used for this Contract.

Payment for materials does not constitute Authority approval or acceptance of the materials or work. If materials paid for are damaged, stolen or prove to be unacceptable, the Authority retains the right to recover the costs from the Contractor.

Payment for the balance of the total value for each of the Structural Steel Pay Items will be made upon complete

fabrication and erection, shop and field welding, non-destructive quality control testing of welds, galvanizing, and shop and field painting less any retainage as specified in Subsection 108.03.

No separate payment will be made for storage of the material at the approved storage facility.

No separate payment will be made for the insurance required for the storage of the material at the approved storage facility.

SECTION 404 TIMBER STRUCTURES

404.01 Description.

Timber structures, both temporary and permanent, shall include furnishing all materials for and the construction and erection of structures or parts of structures, exclusive of piles, composed of treated or untreated timber, or a combination of both on prepared foundations. Timber structures shall also include construction, reconstruction or repair of timber fender systems with installation of polyethylene wear strips as required by Plans and Supplemental Specifications.

Timber fender repair work shall consist of the complete reconstruction of each fender system portion, which has been damaged or is deteriorated. The work includes replacement of all unusable, damaged, missing or deteriorated timber members throughout each entire fender system, removal, legal disposal and clearing the site of all existing non-usable timber. The work shall be in accordance with the Plans and Specifications and as directed by the Engineer.

404.02 Materials.

Materials shall conform to the following Sections and Subsections:

PLASTIC LUMBER SHEETING. 910.11

POLYETHYLENE WEAR STRIPS 923.35

TIMBER FOR STRUCTURES. 910.01

TIMBER CONNECTORS 910.03

TIMBER PRESERVATIVE. 910.04

Structural shapes, castings, hardware, and paint shall conform to the requirements of AASHTO LRFD Bridge Design Specifications.

Structural glued laminated timber shall conform to National Institute of Standards and Technology (NIST) current Voluntary Product Standards.

Structural glued laminated timber materials, design and construction shall conform to all current applicable American Institute of Timber Construction (AITC) Standards.

404.03 Preservative Treatment.

Timber shall be treated in accordance with Section 910.

404.04 Handling.

Timber on the site of the work shall be stored in piles at least 12 inches above the ground surface. Treated timber shall be close-stacked and piled to prevent warping. Untreated timber shall be open-stacked and shall be so stacked and stripped as to permit the circulation of air between tiers and courses. The ground underneath and adjacent to material piles shall be free of weeds and rubbish and shall be drained to prevent accumulation of water.

Timber shall be handled carefully without sudden dropping, breaking of outer fibers, bruising, or penetrating the surface with tools. Rope slings shall be used when moving the material. Cant hooks, peaveys, pikes, or hooks shall not be used.

404.05 Inspection.

Timber and the operation of preservative treatment will be inspected at the treatment plant, both before and after treating by the certifying agency. The Contractor shall notify the Engineer of the name and location of the treating plant and the certifying agency as soon as he has placed his order for the timber. All such material shall be subject to inspection by the Engineer at the site of the work and previous certification shall not bar

rejection at the site of the work if the material is found defective.

404.06 Methods of Construction.

All timber shall be accurately cut and framed to a close fit in such manner that the joints will have even bearing over the entire contact surfaces. No blocking or shimming will be allowed in joints. Timbers shall be cut off with a saw; no axe is to be used. Unless otherwise specified, nails and spikes shall be driven with just sufficient force to set the heads flush with the surface. Deep hammer marks in wood surfaces shall be considered sufficient cause for rejection of the pieces affected.

Holes for round drift-bolts and dowels shall be bored with a bit one-sixteenth inch less in diameter than the bolt or dowel to be used. The diameter of holes for square drift-bolts or dowels shall be equal to the least dimension of the bolt or dowel. Holes for machine bolts, anchor bolts and rods shall be bored with a bit having the same diameter as the bolt to be used. Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread and the depth of hole shall be such that the point of the screw will extend not less than one inch beyond the end of the bored hole. All holes shall be perpendicular to the face of the wood unless an angular position is required by the plans. When members are prefabricated, the holes in the various members through which one bolt is to pass shall not deviate from a common centerline by more than 1/32 inch and shall not be more than 1/16 inch from required position.

Washers of the types and sizes specified shall be used under all bolt heads and nuts and under all lag screw heads which would otherwise come in contact with wood. The nuts of all bolts shall be effectively locked after they have been finally tightened.

Countersinking shall be done wherever smooth surfaces are required. Recesses formed by countersinking in horizontal surfaces shall be treated as hereinafter required if formed after treatment, and, after the hardware is in place, shall be filled with hot pitch.

Split rings and shear plates shall be installed in precut grooves of dimensions recommended by the manufacturer. Toothed rings and spike grids shall be forced into the contact surfaces of the members joined by pressure equipment and all connectors of this type at a joint shall be imbedded simultaneously and uniformly.

All cutting, framing, and boring of timber shall be done before treatment insofar as this is practicable. If such operations are necessary after treatment, the cuts and any abrasions and surface breaks which do not warrant rejection of the timber shall be trimmed carefully.

Fabrication and erection of steelwork necessary for timber structure shall conform to the applicable provisions of Section 403.

Forms, temporary braces, or other construction of a temporary nature shall not be nailed, spiked, or otherwise attached to timber which will remain in the Project without the approval of the Engineer. All holes remaining after such operations shall be filled by driving nails or spikes flush with the surface or shall be plugged as provided herein for bolt holes.

When repairing bridge fender systems, the existing damaged timbers shall be replaced with new timbers. All repairs shall be made as specified above for new construction. Existing hardware connectors and plates shall be reused only when directed and all loosened timbers found to be in satisfactory condition shall be refastened. New holes shall be drilled and treated as necessary and all existing holes not used shall be treated and plugged as specified above.

Reuse of existing treated timbers in fender reconstruction shall consist of removing, cutting and trimming as necessary, and reuse at locations and in place of existing treated timber members unusable in their present condition and location.

All other untreated surfaces exposed in performing fender repair work, including but not necessarily limited to cut surfaces, broken outer fibers, surfaces bruised or penetrated with tools, and hole plugs, shall be treated as specified above. It is not intended that the entire piece of existing timber be treated. All unusable fender materials (treated timber and hardware) removed are to be legally disposed of by the Contractor.

All cut surfaces of new pressure treated timber and/or existing creosote timber shall be treated in accordance with AWPA Standard M4. Existing timbers to be reused shall be as directed by the Engineer.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New Jersey State Department of Environmental Protection (NJDEP).

Where new support timbers are placed against concrete or granite pier faces and the existing embedded anchor bolts are bent, such bolts shall be straightened and deburred for reuse. Where straightening of a bolt is not

possible, it shall be cut off and fitted with an extension meeting requirements of New Hardware, of Specifications.

At all points and/or areas where new timber or plastic lumber is to connect with existing lumber, the existing timber shall be neatly cut, disassembled and/or completely removed, if unusable and disposed of clear of the site, all as directed by and to the satisfaction of the Engineer.

When applicable, construction of new walers, braces and support timbers will require temporary removal and reinstallation of existing 4 inch x 12 inch timber sheets and connection members that are in good condition. Temporary removal and reinstallation of such timber shall be included in the work and no separate payment will be made.

New 3x10 plastic sheeting shall be fastened in the same way as timber sheeting. Payment for plastic lumber will be made under plastic lumber.

All unusable fender materials (treated timber and hardware) removed are to be legally disposed of by the Contractor.

Where new support timbers are placed against concrete or granite pier faces and the existing embedded anchor bolts are bent, such bolts shall be straightened and deburred for reuse. Where straightening of a bolt is not possible, it shall be cut off and fitted with an extension meeting requirements of New Hardware, of Specifications.

(A) Polyethylene Wear Strips.

Prior to installation of polyethylene wear strips, all timber connections shown on the plans shall be made to the satisfaction of the Engineer.

Installation of the polyethylene sheets shall be as shown on the plans and shall be made using 4'-0" x 10'-0" sheets to the maximum extent practicable. If shorter sheets are used to obtain the exact overall horizontal dimensions, the bolt pattern around the perimeter of the sheet shall be maintained as shown on the plans.

404.07 Measurement.

Timber structures will be measured in 1000 feet board measure (MFBM) of treated and untreated timber computed on the basis of nominal cross section dimensions and actual lengths. No allowance will be made for waste.

New hardware furnished and permanently installed as replacements when reusing existing treated timbers will be measured by the certified weight in pounds. Such hardware will be measured separately for installation above and below mean low water level (MLW). MLW shall be as shown on the plans.

New Timber and Plastic Lumber will be measured separately for installation above and below mean low water (MLW).

Existing timber reused will be measured separately for installation above and below mean low water (MLW).

Timber Fender Repair will be measured per each fender needing repair.

Furnishing and installation of Polyethylene wear strips will be measured by the square foot actually installed, not including gaps between sheets.

404.08 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
New Hardware	Pounds
New Hardware Below MLW	Pounds
Reusing Existing Treated Timbers	MFBM
Treated Timber Structures.	MFBM
Untreated Timber Structures	MFBM
Furnish and Place New Treated Timber Above MLW	MFBM
Furnish and Place New Treated Timber Below MLW	MFBM

REUSING EXISTING TIMBER ABOVE MLW. ..... FBM

REUSING EXISTING TIMBER BELOW MLW ..... FBM

FURNISH AND PLACE NEW PLASTIC LUMBER ABOVE MLW ..... MFBM

FURNISH AND PLACE NEW PLASTIC LUMBER BELOW MLW ..... MFBM

TIMBER FENDER REPAIR ..... EACH

FURNISH AND PLACE POLYETHYLENE WEAR STRIPS ..... SQUARE FOOT

Timber Fender Repair shall include, but not be limited to, all materials and work needed as described in Subsection 404.01 exclusive of other pay items shown in the contract needed for the associated work.

No separate payment will be made for hardware required for installation of polyethylene wear strips, but the costs thereof will be considered incidental to the cost of the item.

SECTION 405 - PILES

405.01 Description.

This work shall consist of furnishing and installing timber, steel, prestressed precast concrete, or cast-in-place (CIP) concrete piles (concrete filled steel pipe piles) of the designated dimensions and type at the prescribed locations and to the required bearing or penetration, as shown on the Plans.

Materials and construction methods not specifically covered or shown on the plans shall conform to the AASHTO LRFD Bridge Design Specifications with current interim revisions and the AASHTO LRFD Bridge Construction Specifications, with current interim revisions.

In instances where Allowable Stress Design (ASD) is utilized in lieu of LRFD, such as building foundations designed in accordance with the International Building Code or structures designed in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, the LRFD terminology will be replaced by the analogous ASD terminology as follows; Nominal becomes Ultimate, Factored becomes Allowable.

405.02 Materials.

Materials shall conform to the following Subsections:

REINFORCEMENT STEEL 908.01

STEEL PILES 909.05

TIMBER PILES 910.02

TIMBER PRESERVATIVE 910.04

COAL TAR EPOXY-POLYAMIDE PAINT 913.07

CONCRETE, MORTAR AND GROUT 905

PRESTRESSED CONCRETE 905.24

405.03 Methods Of Construction.

(A) GENERAL SEQUENCE, SHOP AND WORKING DRAWING SUBMITTALS.

The pile installation process shall be performed in the following sequence:

(1) The Contractor shall submit for approval the qualifications of their pile installation staff and/or subcontractor(s), including a list of a minimum of 3 projects within the last 3 years using a same type and similar size pile to that specified by the Contract Documents. Materials certifications for pile materials and accessories shall be included in this submittal.

(2) The Contractor shall submit equipment specifications for the pile installation rig, hammer, helmet, cushion, leads, followers, and mandrel which shall delineate, at a minimum, the equipment's striking energy per blow, rated speed, source of energy, serial number of the hammer, hammer stroke, hammer efficiency, lifting equipment and pile splicing details (where required).

(3) The Contractor shall perform a wave equation analysis program (WEAP) analysis for each pile type and hammer combination noted above. The WEAP analysis shall indicate the required hammer blows

ranging between 3 and 10 blows per inch at the nominal pile driving resistance shown on the Contract and to substantiate that the compressive and tensile pile stresses are within specified limits. The Contractor shall submit 4 copies of the WEAP analysis, certified by a Professional Engineer registered in the state of New Jersey, for approval to the Engineer 30 days before delivery of the equipment to the Project. A separate WEAP analysis shall be provided for each pile type used to:

(a) Achieve the nominal resistance provided on the Plans, with a penetration rate between 3 and 10 blows per inch.

(b) Provide sufficient surplus driving capacity to overcome the nominal driving resistance provided on the Contract Documents.

(c) Prevent overstressing of piles, where overstress is as defined in the latest version of the AASHTO LRFD Bridge Construction Specifications.

(d) Prevent damage to the pile.

(e) Install the piles to the required tolerances specified. Test piles shall be driven to at least the minimum tip elevation.

Pile driving shall not be permitted within 200 feet of structures supported on shallow foundations and within 100 feet of structures supported on friction bearing deep foundations unless permission is granted in writing by the Engineer and a vibration monitoring plan including threshold vibration levels is submitted and approved in accordance with the Vibration Monitoring Specification 214.

(4) The Contractor shall review and monitor that existing utilities and foundations will not be affected by the pile installation operation. The Contractor shall be responsible for the repair of any damaged facilities, at no additional cost to the Authority.

(5) The Contractor shall submit for review and approval a pile driving sequence plan. The pile driving sequence for individual piles at any location shall be in accordance with one of the following options:

(a) From the center of the pile group outward.

(b) By rows from the center of the pile group to either end.

(c) By rows from one end of the pile group to the other end.

(6) Following a 'no exception taken' level of review by the Engineer of the Contractor's WEAP analysis and equipment selection, pile testing shall be performed as indicated in the Contract Documents in accordance with applicable standards as specified herein.

(a) Static Pile Load Testing shall be performed in accordance with ASTM D1143.

(b) Dynamic Pile Load Testing shall be performed in accordance with ASTM D4945.

(c) Lateral Load Pile Tests shall be performed in accordance with ASTM D3966.

(d) Uplift Pile Load Tests shall be performed in accordance with ASTM D3689.

Unless otherwise specified by the Contract Documents, test pile(s) shall be driven to the minimum tip elevation specified.

(7) Prior to installation of test pile(s) for static pile load tests, the Contractor shall submit working drawings with complete design computations for the pile test setup signed and sealed by a Professional Engineer registered in the state of New Jersey. The design computations shall include, but not be limited to loading frame design, lateral support design, and design of support/reaction piles. Pile test setup design shall be submitted to the Engineer a minimum of 30 days prior to pile driving and setup.

(8) During the installation of the test pile(s), the Contractor shall record a test pile installation log including:

(a) Structure, substructure, and pile identifiers

(b) Date and time driving started

(c) Ground elevation

(d) Name of company performing testing and test performed

(e) Pile type, size and grade

(f) Pile length and number of splices

(g) Pile accessories and coatings installed (i.e. shoes, caps, collars, coal tar epoxy)

(h) Depth of pre-drilling, jetting, or placement through casing

(i) Penetration Rate (blows per foot)

(j) End of initial drive (EOID) tip elevation

(k) Date and time of restrike

(l) Penetration rate at End of Initial Drive (EOID) and/or restrike (blows per inch)

(9) If a restrike is specified or directed by the Engineer, the Contractor shall wait a minimum of 24 hours after EOID, reattach the PDA instruments, warm up the hammer by applying at least 20 blows to another pile outside the zone where warming up said pile could influence the test pile capacity as deemed acceptable by the Engineer and conduct the restrike. Terminate the restrike when one of the following conditions is encountered:

(a) the nominal resistance of the pile is reached

(b) the amount of penetration reaches 6 inches

(c) the total number of hammer blows exceeds 60

If the established hammer blow count is not attained on restrike, the Engineer may direct the Contractor to drive a portion of, or all of the remaining test piles and repeat the restrike procedure. After restrike, the Engineer will determine whether additional pile penetration and testing shall be required. The Engineer may require splicing of a test pile driven to Plan elevation that does not meet the required hammer blow count. The spliced pile shall be driven until the required bearing is obtained.

(10) Upon installation of dynamic test piles where required in the Contract Documents, the Contractor shall complete a CAPWAP wave matching analysis for a representative hammer blow either near the end of driving or as approved by the Engineer and include the analysis results with the load testing results submission.

(11) The Engineer will review the Contractor's load testing results and the test pile installation logs with the Engineer of Record and provide a pile installation criteria, including:

(a) Name of structure and substructure

(b) Penetration at termination (capacity blow count to be achieved over a minimum penetration)

(c) Provisionary criteria if penetration rate is not achieved within a certain number of feet below the production tip.

(d) An order list indicating the production pile length assumed to remain in the completed structure and modified for unanticipated site conditions. The Contractor may increase the lengths as necessary to accommodate handling per their means and methods, at no additional cost to the Authority.

(12) Production pile installation shall be performed in accordance with the pile installation criteria provided by the Engineer of Record. The Contractor shall prepare a log as described in Subparagraph 405.03(A)(8) for all production piles. In addition, the Engineer will verify that the Contractor is adhering to the pile installation criteria and checking pile tolerances. Pile cutoff shall be performed only after acceptance of driven piles and as described herein.

(B) EQUIPMENT.

The Contractor's equipment shall be in good working order and shall match size, make and model submitted to the Engineer for approval. If, in the opinion of the Engineer, any of the Contractor's equipment is deemed unacceptable, the Contractor shall remove the equipment and replace it with an acceptable alternate at no additional cost to the Authority.

(1) Hammer. If the hammer provided does not match the serial number provided in the Contractor's submission, or is not consistently producing the stroke and speed specified in the Contractor's submittal the hammer will be substituted at the Contractor's expense, with a new hammer that meets the satisfaction of the Engineer.

(a) Drop, Air, Diesel, and Hydraulic hammers will be permitted if in accordance with current AASHTO LRFD Bridge Construction Specifications.

(b) The Contractor may use vibratory pile drivers with the approval of the Engineer to advance steel bearing piles. An approved pile hammer shall be used to perform the installation of no less than the final 10 feet of penetration.

Prestressed, precast concrete piles (PCCP) shall be installed using driving equipment, appurtenances, and techniques in accordance with the pile manufacturer's recommendations, subject to approval of the Engineer. The hammer shall be capable of delivering low energy (short stroke) driving through upper soil strata to ensure that the tensile stresses in the concrete piles do not exceed the net pile prestress. The Contractor shall adjust the fuel setting on diesel hammers and have multiple stroke settings on air/steam hammers and hydraulic hammers when directed by the Engineer to provide low energy driving.

(2) Helmet, Cushion, Leads, Followers, and Mandrels shall be in accordance with current AASHTO LRFD Bridge Construction Specifications.

(3) Pile driving equipment, drilling equipment, jetting equipment, and lifting equipment shall be sized to accommodate all relevant overhead clearances. Description of the equipment and any overhead clearance limitations shall be submitted for approval at least 30 days prior to commencement of work.

(C) TESTING.

The Contractor shall furnish and drive test piles of the materials, dimensions, length and at the locations specified on the Contract Documents. Test piles driven at locations where they will form part of the permanent structure shall, upon completion of the driving and load testing, be cut off at the required elevations unless damaged or if the Engineer requires the test piles to be extracted for purposes of examination. Tests piles shall be driven with a hammer of the same size and type to be used in driving the permanent piles.

All extracted piles, or portions thereof, not used as parts of the permanent substructure and pile cutoffs shall become the property of the Contractor and shall be disposed of by the Contractor. If the Engineer directs that test piles be extracted for purposes of examination, payment will be made in accordance with the provisions of Subsection 108.04.

Testing shall be performed as required by the Contract Documents, and in accordance with the requirements specified:

(1) Dynamic Pile Load Tests.

Dynamic Pile Load Tests shall be conducted on specified piles during driving or subsequent redriving, utilizing a Pile Driving Analyzer (PDA) or approved equal, performed by a firm experienced in the use of the equipment, and in accordance with ASTM D4945.

At the completion of the drive or redrive tests, the PDA specialty contractor shall provide to the Engineer, the measured hammer energy, the maximum compressive and tensile stresses in the pile and the pile resistance. In addition a CAPWAP shall be completed and shall be submitted by the Contractor in a report to the Engineer.

(2) Static Pile Load Tests.

Static load tests shall be performed on select piles as indicated in the Contract Documents driven to the tip elevation shown on the plans. Static Pile Load Tests shall be performed in accordance with the requirements of ASTM D1143 following the procedure and load specified on the Plans.

(3) Lateral Pile Load Tests.

Lateral Pile Load Tests shall be performed in accordance with ASTM D3966 if specified on the Plans.

(4) Uplift Pile Load Tests.

Uplift Pile Load Tests shall be performed in accordance with ASTM D3689 if specified on the Plans.

(D) INSTALLATION.

(1) Installation Criteria.

Upon completion of the test pile program the Engineer of Record will update the estimated tip

elevations and End of Driving Criteria included on the Contract Documents if warranted based upon the results of the testing program.

(2) Coating.

The type and limits of coatings shall be applied to piles as specified by the Contract Documents. Coatings shall be applied in accordance with the manufacturer's recommendations.

(3) Accessories.

(a) Caps.

The heads of all concrete piles/ timber piles, except those to be installed by jetting, shall be protected by cushioned caps of an approved design. A suitable driving head for concrete piles shall be provided to fit the top of the pile and to hold a cushion for the pile head. The cushion used should provide only enough protection to prevent injury to the pile so as not to absorb too much of the energy of the blow. When the area of the head of any timber pile is greater than that of the face of the hammer, a suitable cap shall be provided to distribute the blow of the hammer throughout the cross section of the pile. The head shall be cut square and shall be shaped or chamfered to prevent splitting at its periphery.

For precast concrete piles, steel pipe piles or steel shells for cast-in-place concrete piles, the Contractor shall provide driving heads, mandrels or other devices in accordance with the manufacturer's recommendation so that the pile may be driven without injury. If a member or portion thereof is broken at any time during construction, it will be rejected and replaced with a satisfactory member at no expense to the Authority

For steel H-piles, the heads shall be cut squarely and a driving cap shall be provided to hold the axis of the pile in line with the axis of the hammer and to prevent the piles heads from upsetting excessively. Any portions of the piles which become upset or bent in driving shall be cut off.

(b) Collars.

Collars or bands to protect timber piles against splitting and brooming shall be provided where deemed necessary by the Engineer or as indicated on the Contract Documents.

(c) Shoes.

Timber piles shall be fitted with shoes as indicated on the Contract Documents. Where directed, the piles shall be shoed with metal point reinforcement of a design satisfactory to the Engineer, the end of the piles being carefully shaped to secure an even bearing on the point reinforcement.

Prefabricated pile point reinforcement tips, as approved by the Engineer, shall be used as shown or directed to facilitate driving of steel bearing piles.

(4) Splicing.

Full length piles shall be used and no payment will be made for splices less than 80 feet unless directed by the Resident Engineer. In certain circumstances splicing of piles may be permitted. The method of splicing shall be as shown on the Plans or approved by the Engineer. Splicing of steel piles or steel shells shall be performed either by using approved full penetration butt welding of the continuous section to fully develop the full strength of the pile or by use of an approved prefabricated splicing device installed in accordance with the manufacturer's recommendations. Precast concrete and timber piles shall not be spliced.

(5) Preparing Area Prior to Pile Driving.

Unless otherwise specified by the Contract Documents, piles shall not be driven until embankment, as proposed, has been placed and compacted or the excavation, as required, has been completed to the bottom of footing elevation.

(6) Driving.

All piles shall be driven utilizing fixed leads unless written approval is provided by the Engineer. In the event swinging or hanging leads are permitted and shown to produce unsatisfactory results, the Engineer may require the Contractor to hold the leads in position with guys or braces to give the required support. Leads shall be straight and constructed in such a manner as to afford freedom of movement to the hammer, and they shall be held in position by guys or stiff braces to assure firm

support to the pile during driving to the lowest point the hammer must reach. Except where piles are driven through water, the leads shall be of a sufficient length so that the use of a follower will not be necessary. Inclined leads shall be used in driving battered piles.

Followers shall not be used except with the written permission of the Engineer and, when permitted, one pile from each group of ten shall be of sufficient length to be driven without a follower and shall be used as a test pile to determine the average bearing power of the group.

Practical refusal shall be understood to mean the maximum resistance to which the pile can be driven without damage to the pile.

In no case shall timber piles be driven to nominal resistances greater than 36 tons.

All production piles shall be driven to a depth at or below the minimum pile tip elevation, and satisfy the installation criteria (blows per foot) provided by the Engineer.

(7) Pre-Augering.

Pre-augering used to facilitate pile driving will not be permitted unless specified in the Contract Documents or requested by the Engineer. Pre-augered holes shall have a maximum diameter of 80 percent of the pile diameter unless written approval to do otherwise is received from the Engineer of Record. Upon completion of the pre-augering, any voids around the pile shall be filled with granular-type material acceptable to the Engineer of Record and saturated with water. Pre-augering shall be performed only for the piles designated and to the depths specified by the Engineer.

(8) Installing Piles Inside of Structural Casing.

This work will consist of furnishing and installing steel casing conforming to ASTM A252 or A53, with a ¼ inch minimum wall thickness, to the depth and at the locations and diameter shown on the Contract Documents or as ordered by the Engineer. The work also includes the removal and disposal of all materials from the cased hole, as well as furnishing and placing concrete inside the cased hole.

The outside face of casing shall be in intimate contact with the in-situ soils at all times. All solid materials shall be removed from the casing. Voids will not be permitted around the casing. Auguring or drilling will be permitted to not more than 12 inches below the tip of casing.

If the Contractor uses drilling mud or soil slurry, he shall utilize a mud circulating and storage tank and shall be responsible for disposal of such fluids with solids.

Obstructions, buried construction debris, brick, cobbles and other fill materials which may be encountered in the path of casing shall be broken up inside the cased hole and removed.

The casing shall be cut off to the elevation shown on the Contract Documents and remain in place permanently. The concrete shall be placed upward from the bottom of cased hole. It shall displace all drilling fluids as it fills the casing to pile cutoff elevation.

(9) Jetting.

When approved or specified, jetting shall be performed in accordance with the Contract Documents and current AASHTO LRFD Bridge Construction Specifications. The Contractor shall determine the number and arrangement of jets and the volume and pressure of water at the jet nozzles necessary to freely erode the material beneath, and adjacent to the pile without affecting the lateral stability of piles already in place, nor of adjacent existing structures. Control of jetting rates and pressures to maintain a positive flow of water through the jet tips at all times is required. Jetting rates and pressures during easy penetration shall be maintained at minimal levels as required to prevent soil blockage within the jet tips. During hard penetration, the jetting rates and pressures shall be increased to the levels necessary to loosen and freely erode material from beneath the pile toe. Excessive driving in lieu of jetting will not be permitted. The Engineer shall be the sole judge of excessive driving.

The Contractor shall be responsible for all damage to the site and adjacent existing structures caused by unapproved or improper jetting operations. Jetting shall cease and external jet pipes shall be removed when the pile toe has advanced to the minimum prescribed elevation designated on the plans or as directed by the Engineer and the pile shall be driven with an impact hammer adequate to mobilize the required driving resistance until the required driving resistance is attained.

All piles installed by jetting shall be furnished in sufficient lengths such that the pile top is above water or grade until the pile has been advanced to the minimum required tip elevation and jetting operations are completed.

No jetting shall be permitted within 20 feet of any pile previously driven. If jetting occurs at locations and elevations where a previously driven pile or piles are not completely outside the 20-foot radius, those previously driven piles shall be restruck to confirm final pile capacity at no additional cost to the Authority. At substructure locations where jetting is anticipated, the Contractor may jet all piles at any single substructure location before driving them as required.

(10) Piles at Proposed Fill Location.

A non-structural metal casing shall be used to form an opening for piles to be driven through, as the embankment is constructed. Voids between the pile and the casing shall be backfilled with granular material after the pile is driven, or as directed by the Engineer of Record.

(11) Cutoff and Capping.

Piles shall be cut off level at the designated elevation. The length of pile cutoff shall be sufficient to permit the removal of all injured material. Cutoffs of steel bearing piles shall be made at right angles to the axis of the pile. The cuts shall be made in clean straight lines.

Material forced up between the piles shall be removed to correct elevation, at no additional cost to the Authority, before concrete for the foundation is placed.

(E) TOLERANCES AND REJECTION.

(1) Vertical Plumbness Tolerance.

Piles shall be driven with a variation of not more than 2% (1/4 inch per foot) from the vertical or from the batter shown.

(2) Vertical Location Tolerance.

A vertical deviation from the correct cutoff elevations shown on the Contract Documents of not more than ½ inch will be permitted.

(3) Horizontal Location Tolerance.

The maximum variation of the head of a foundation pile shall be no more than 3 inches from the locations as shown in the Contract Plans unless explicitly noted otherwise in the Contract Documents. Piles which are not driven to tolerance limits will be considered cause for rejection and shall be removed at the sole expense of the Contractor. The Engineer of Record may, at his sole discretion, choose to accept piles not driven to tolerance limits.

(4) Heaved Piles.

At the start of pile driving operations, elevations to check on pile heave after driving shall be made and shall continue until the Engineer determines that such checking is no longer required. Elevations shall be taken immediately after the pile has been driven and again after piles with a radius of 15 feet have been driven. If pile heave is observed, level readings referenced to a fixed datum shall be taken on all piles immediately after installation and periodically thereafter as adjacent piles are driven to determine the pile heave range. All end bearing piles that have heaved more than ¼ inch shall be redriven to the required resistance of penetration.

(5) Rejection.

If for any reason the Contractor has not met the requirements of the Contract Documents as determined by the Engineer, then their work is subject to rejection. Correction of this unsatisfactory work shall be accomplished at the expense of the Contractor. If the Contractor believes the work is satisfactory, a written response indicating why and how the work meets the requirements of the Contract Documents shall be submitted. The Engineer shall review and provide a written response within 7 days of the Contractor's submittal. Final judgment of whether or not the piles are satisfactory shall be at the sole opinion of the Engineer.

(F) DEFECTIVE PILES.

The procedure used for driving piles shall not subject them to excessive and undue abuse, causing crushing or spalling of concrete; injurious splitting, splintering and brooming of wood; or deformation of the steel. Manipulation of piles to force them into proper position, considered by the Engineer to be excessive, will not be permitted. Any pile damaged by reason of internal defects, by improper driving, or driven out of its proper location or below the designated elevation, shall be corrected at the sole expense of the Contractor

by one of the following methods selected by the Engineer of Record for the pile in question:

(1) The pile shall be withdrawn or abandoned in place and replaced by a new and, if necessary, longer pile, as directed by the Engineer of Record.

(2) A second pile shall be driven at a location designated by the Engineer of Record adjacent to the defective or low pile

(3) The dimensions of the footing may be extended, as determined by the Authority's Engineer of Record, at no additional cost to the Authority.

(4) Splicing in accordance with Subparagraph 405.03(D)(4).

405.04 Measurement.

Piles of the various types and sizes specified to be furnished and /or driven will be measured by the length of piles actually remaining in the finished work, including buildups or extensions, below the cutoff elevation, except for Test Piles.

Furnishing of timber, steel, and prestressed precast concrete of the designated sizes and types will be measured by the furnished length of piles.

Driving timber, steel, prestressed precast concrete and pipe for cast-in-place concrete piles of the designated sizes and types will be measured by the length of piles actually driven below the ground into the subsurface and accepted in place in the finished structure, exclusive of test piles. Lengths of pile set in structural casing as specified in Section 405.03(D)(8) will be measured for payment. Lengths of piles set within non-structural casings at proposed fill locations as defined in Section 405.03(D)(10) shall not be measured for driving. Structural casing shall be defined as a casing installed for the purposes of providing structural resistance in conjunction with the pile and the material placed within the casing in either an axial or lateral mode. Non-structural casing shall be defined as a casing used only to form an opening for a pile to be set inside and driven through. Non-structural casing shall not contribute to the structural resistance of the pile for design purposes. When non-structural casing is used the ground surface shall be defined at the bottom of the casing in which the pile is set through before driving begins.

Driving timber, steel, prestressed precast concrete and pipe for cast-in-place concrete piles of the designated sizes and types which are out of tolerance but are deemed acceptable by the Engineer of Record will be measured by the length of piles actually driven below the ground into the subsurface and accepted in place in the finished structure, exclusive of test piles. Lengths of pile set in structural casing as specified in Section 405.03(D)(8) will be measured for payment. Lengths of piles set within non-structural casing at proposed fill locations as defined in Section 405.03(D)(10) shall not be measured. Structural casing shall be defined as a casing installed for the purposes of providing structural resistance in conjunction with the pile and the material placed within the casing in either an axial or lateral mode. Non-structural casing shall be defined as a casing used only to form an opening for a pile to be set inside and driven through. Non-structural casing shall not contribute to the structural resistance of the pile for design purposes. When non-structural casing is used the ground surface shall be defined at the bottom of the casing in which the pile is set through before driving begins.

Test Piles of the designated types and sizes will be measured by their length. The length of test piles furnished and driven will be measured as the total length of test piles of the various types shown or ordered by the Engineer, including buildups or extensions necessary for each test pile location. Separate measurement for furnishing test piles will not be made.

Static and Lateral pile load tests will be measured by the number of load tests as shown or ordered by the Engineer actually completed and accepted. Dynamic pile load tests will be measured by the number of drive and/or re-strike tests as shown or ordered by the Engineer actually completed and accepted.

Furnishing Equipment for Driving Piles for the entire Project will be measured on a lump sum basis. No separate measurement will be made when remobilization is required for restriking of piles.

Point reinforcement for piles of the type of pile specified will be measured by the number of approved points actually furnished, used, and accepted. Splices for the various types of piles will be measured by the number of approved pile splices actually completed and accepted. Splices shall not be considered as authorized when such splicing is done to complete piles to the designated order lengths, or when the furnished lengths of such piles are less than the order lengths approved by the Engineer.

Cutoffs made as directed will be measured by their length as determined from the difference between the approved pile lengths as ordered and the lengths remaining in the completed structure. Individual cutoffs of

timber, or steel less than one foot in length, cutoffs from test piles, steel pile cutoffs used as steel pile extensions and cutoffs necessitated by crushing, brooming, splitting or other injuries resulting from careless driving will not be measured for payment.

Protective Pile Coating applied to steel piles or steel pile shells as specified will be measured by the length of pile/ test pile coated and delivered to the project in acceptable condition.

405.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
FURNISHING STEEL PILES, __(*)__	LINEAR FOOT
FURNISHING PRESTRESSED PRECAST CONCRETE PILES, __(*)__	LINEAR FOOT
FURNISHING UNTREATED TIMBER PILES, __(*)__	LINEAR FOOT
FURNISHING TREATED TIMBER PILES, __(*)__	LINEAR FOOT
DRIVING ____(**)____ PILES	LINEAR FOOT
____(**)____ TEST PILES	LINEAR FOOT
DYNAMIC PILE LOAD TESTS	EACH
STATIC PILE LOAD TESTS	EACH
LATERAL LOAD TESTS	EACH
UPLIFT PILE LOAD TEST	EACH
___ INCH STEEL PIPE STRUCTURAL CASING	LINEAR FOOT
FURNISHING EQUIPMENT FOR DRIVING PILES	LUMP SUM
POINT REINFORCEMENT FOR ____(**)____ PILES	EACH
SPLICES FOR ____(**)____ PILES	EACH
PROTECTIVE PILE COATING	LINEAR FOOT

Test Piles driven out of tolerance will be evaluated by the Engineer of Record. Out of tolerance test piles that are not deemed acceptable by the Engineer of Record shall be corrected by the Contractor at no additional cost to the Authority and to the satisfaction of the Engineer of Record. No additional payment will be made for correcting out of tolerance test piles.

No payment will be made for the furnishing pile pay item(s), driving pile pay item(s) or any other appurtenances associated with piles driven out of tolerances that are not deemed acceptable by the Engineer of Record. In accordance with Subsection 106.06 of the Specifications, Work performed, which does not comply with the requirements will be rejected and shall be removed, replaced, or repaired as the Engineer may direct and in a manner satisfactory to him at the Contractor's expense. The Authority shall not be liable or responsible for any damages due to delay.

No separate payment will be made for furnishing and placing pile shoes, if required by the Engineer and pile cut-offs, but all costs thereof will be considered incidental to the cost of the driving pile item. Cut-offs shall become the property of the Contractor and shall be removed and legally disposed of off Authority property.

No separate payment will be made for, disposal of cutoff materials not reused, or for test pile cutoffs, but all costs thereof will be considered incidental to the cost of the pile items.

Payment of 75 percent of the lump sum price bid for Furnishing Equipment for Driving

Piles will be made when the equipment for driving piles is furnished and driving of the test piles has commenced. The remaining 25 percent will be paid when the work of driving piles is entirely completed, regardless of any decrease or increase in the number of pile units actually installed.

In case the required penetration is not obtained by the use of a hammer complying with the above minimum requirements, the Contractor shall provide a heavier hammer, or resort to jetting at his own expense.

The cost of non-structural casings used to leave an opening for piles through an embankment shall be considered incidental to furnishing piles.

The test pile item includes the cost to furnish and drive test pile. No separate payment for furnishing of test piles will be made.

SECTION 406 - SIGN SUPPORT STRUCTURES

406.01 Description.

This work shall consist of the fabrication, furnishing, and erection of overhead span, cantilever, and butterfly sign support structures, and bridge mounted, ground mounted, and roadside sign structures, including the required concrete foundations and anchorages, in accordance with the details as shown or as ordered.

Materials and construction methods not specifically covered in the Plans and Specifications shall be in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

406.02 Materials.

Materials shall conform to the following Sections and Subsections:

ADMIXTURES AND CURING MATERIAL 906

ALUMINUM PIGMENTED ALKALINE-RESISTANT PAINT 913.06

ALUMINUM ALLOYS. 911.01

ELECTRICAL CONDUIT AND FITTINGS 918.08

FASTENERS 909.02

GROUT 905.09

PORTLAND CEMENT CONCRETE. 905.05

REINFORCEMENT STEEL 908.01

STEEL PIPES 909.10

STRUCTURAL STEEL 909.01

ZINC COATING (GALVANIZING) 909.11

Overhead sign structure supports shall be fabricated from one of the following optional pipe or tubular materials:

High-strength low-alloy steel pipe of the nominal diameter and schedule of pipe member as shown on the plans, or cylindrical tubes of the plate thicknesses and dimensions called for on the plans, or tapered structural steel tubes may be used subject to approval of the Engineer.

Nuts, washers, and the upper portion of the anchor bolts shall be galvanized. Bolts shall be threaded prior to galvanizing and shall be furnished with double nuts and washers. Threading and galvanized lengths shall be in accordance with the details shown.

Electrodes for welding steel shall be coated or covered electrodes conforming to the requirements of AWS Specification A5.1 for electrodes of the type or types suitable for the conditions of intended use, and must be approved by the Engineer.

Electrodes for welding aluminum shall conform to the requirements of AWS Specification A5.10 for electrode ER5556 or ER5356.

Aluminum gratings for walkways shall be composed of 1-3/4" x 3/16" bearing bars, pressure locked with 1" x 1/8" crimp bars.

Fittings for aluminum pipe handrails shall be made of virgin aluminum-magnesium alloy which has a 35,000 to 45,000 psi tensile strength as cast.

Safety plates for walkways shall be abrasive impregnated aluminum plates or aluminum plates coated with an abrasive anti-slip coating approved by the Engineer.

Luminaire support channels shall be of extruded aluminum.

Steel surfaces shall be prevented from coming in contact with aluminum surfaces by means of a protective coating or approved pads of Neoprene or similar material placed between the dissimilar metals. The protective

coating shall be zinc-chromate primer, conforming to the requirements of Federal Specification TT-P-645, applied to the aluminum surface.

406.03 Shop Drawings.

Shop, erection, and other drawings necessary for the fabrication and erection of sign support structures shall be furnished in accordance with Subsection 104.08.

406.04 Fabrication.

Fabrication of overhead support structures, bridge mounted support systems, and ground mounted supports shall conform to the following:

(A) Overhead Sign Structures.

The fabrication of steel overhead span, cantilever and butterfly type sign support structures shall conform to the applicable requirements of AASHTO LRFD Bridge Construction Specifications relating to the construction of "Steel Structures" and to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Welding shall be done in accordance with Sections 1 through 6 of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code and Section 10 of the ANSI/AWS D1.1 Structural Welding Code - Steel and the requirements of Subsection 403.06.

The horizontal section of all overhead and cantilever type structures shall be capable of being cambered and have a residual camber of approximately 1" for full dead load by the use of shim plates between flanges or other acceptable means as approved by the Engineer.

Ends of sections shall be cut true and smooth, free from burrs and ragged breaks. Open ends of tubular sections shall be capped as shown. Drain holes shall be provided wherever shown or necessary.

All pipe joints of framed members, except the flanged field splices, shall be fully welded. No splices will be permitted in chord members except where shown or approved.

(B) Bridge Mounted Steel Frame Supports.

Fabrication of steel frame supports shall be performed in accordance with the applicable requirements of Section 403 and AASHTO LRFD Bridge Construction Specifications.

Ends of sections shall be cut true and smooth, free from burrs and ragged breaks. Open ends of tubular sections shall be closed with a 1/4 inch closure plate as shown.

All pipe ends shall be slotted to the depths as required and shall be welded to the attachment plates in accordance with the details shown.

All surfaces of the completed steel support framework shall be finished with a galvanized coating. The support frames shall be fabricated in complete sections of each type, as shown on the plans, so as to provide for ease of handling in pickling and galvanizing tanks so that galvanizing may be done on the fabricated section. Any field welding that may be required and the repair of zinc coatings damaged by handling and erection shall be kept to an absolute minimum.

Galvanized coatings damaged for any reason shall be repaired by the method described in Annex A2 of the standard practice for repair of damaged hot-dip galvanized coatings, ASTM A780.

(C) Supports For Ground Mounted Signs.

Aluminum posts for ground mounted signs shall be fabricated from structural aluminum tubes of the sizes and lengths called for on the plans or as determined from field conditions.

(D) Sign Support Truss, Hangers, Walkway And Railing.

The fabrication of welded aluminum sign support trusses to be mounted on bridge mounted steel frame supports shall be in accordance with the applicable requirements of the Article "Fabrication of Welded Aluminum Structures" in the Section on Aluminum Design of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals", the latest edition of AWS "Recommended Practices for Gas Shielded-Arc Welding of Aluminum and Aluminum Pipe" and as specified herein.

Aluminum material 1/2 inch thick or less may be cut by shearing, sawing, or milling. Material over 1/2 inch thick shall be sawed or milled. Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Reentrant cuts shall be filleted by drilling prior to cutting. Flame cutting will not be

permitted.

All pipe joints of the sign support truss shall be fully welded. No splices will be permitted in chord members. All welding shall be done by qualified welders. Certified proof of the qualifications of welders shall be presented by the Contractor before fabrication begins, if requested by the Engineer. Certification shall be from a commercial or public testing laboratory, with qualifications based on the test prescribed in part B, Section IX, of the ASME Boiler and Pressure Vessel Code.

All welding shall be done in the shop by the inert gas shielded-arc method using electrodes as specified in Subsection 406.02. Welded joints shall be subject to visual inspection by the Engineer and, where deemed necessary, questionable welds shall be tested by radiographic and/or by dye penetrant method. Defects so detected shall be corrected by removing and replacing the entire weld.

Bolt holes shall be drilled to finished size or sub-punched smaller than the nominal diameter of the fastener and reamed to size. The amount by which the diameter of a subpunched hole is smaller than that of the finished hole shall be at least one-quarter the thickness of the piece. The finished diameter of holes shall be not more than 7 percent greater than the nominal diameter of the fastener.

The Contractor shall furnish, fabricate, and install sign hangers, including the horizontal support arms for walkways and luminaire support channels, on bridge mounted sign trusses and overhead span and cantilever sign structures in accordance with the plans or as directed by the Engineer.

The wide flange members forming the vertical sign hangers and the horizontal supports for maintenance walkway grating sections, handrail posts, and luminaire support channels shall be joined by welding; utilizing a stiffener piece as indicated. Both horizontal and vertical legs of hangers and arms shall be continuous pieces. Splices will not be permitted.

The grating shall be fabricated after the hanger locations have been determined as required by the plans, or as directed by the Engineer. The sections of gratings shall be such that one crimp bar at each bearing end rests on a horizontal leg of the sign support hanger arm.

Aluminum walkway gratings shall be fabricated in accordance with the manufacturer's recommendation, cut to the prescribed sizes, and bolted to the wide flange support member.

Collapsible handrail sections shall be secured to a hinged base, the fixed handrail sections secured to a base plate, and the bases bolted to the wide flange supporting member.

Fixed handrail sections shall be welded to an aluminum base plate and the base plate bolted to the end of the walkway grating cantilevering over active traffic lanes.

Luminaire support channels shall be bolted to the wide flange section as shown and shall be continuous without splices between supports.

The luminaire mounting plates and luminaires to be installed on the luminaire support channels shall be as specified in Section 603.

Safety plates shall be bolted to the top of the luminaire support channels with stainless steel bolts, nuts, and lockwashers. The safety plate shall be a single section between handrail hinges. Safety plates and luminaire support channels shall extend beyond the last hanger for a length equal to the limits of the walkway grating.

The workmanship and finish of fabricated aluminum shall be equal to the best general practice in modern fabricating shops.

Aluminum welding shall be done in the shop by welders certified by a commercial or public testing laboratory. Certification shall be as specified above for welding of the support truss.

(E) INSPECTION OF WELDS.

The Contractor shall have the fabricator make his own inspection to maintain quality control. Such inspection shall comply with the provisions of the section on inspection of the American Welding Society Structural Welding Code - Steel (AWS D1.1) by AWS certified welding inspectors in accordance with the appropriate subsections thereof. All welds shall meet the "quality of welds" requirements specified in the sections on "Design of New Bridges" and "Tubular Structures" of the structural welding code. All welds not meeting these quality requirements shall be repaired and/or replaced by the Contractor to meet these requirements and check-tests, without additional cost to the Authority.

Welds shall be visually inspected as specified for procedures techniques and standards of acceptance in accordance with AWS D1.1.

Welds shall be tested using the magnetic particle inspection procedure in accordance with Subsection 403.06 as follows:

(1) 100% of the welds between the chords and the flange plates.

(2) 100% of the welds between the cantilever column and base plate.

(3) 25% of each other type of weld within the complete structure.

Transverse butt welds shall be tested throughout their entire length using radiographic inspection procedures. Longitudinal seam welds shall be tested throughout their entire length using ultrasonic inspection procedures.

The procedures, techniques, standards of acceptance, and methods of repair shall be in accordance with the requirements of AWS D1.1.

All testing of welds, as herein required, shall be certified by a qualified laboratory engaged by the Contractor and approved by the Engineer. The Contractor shall forward the certifications to the Engineer and shall pay for all costs of weld inspection and certification as herein specified.

The Engineer reserves the right to inspect by nondestructive testing techniques all welds and adjacent base metal as he deems warranted. All such additional testing shall be paid for by the Authority and at no cost to the Contractor.

406.05 Erection of Sign Support Systems.

Erection of sign support systems shall be in accordance with the applicable provisions of Section 403, the section on "Steel Structures" of the AASHTO LRFD Bridge Construction Specifications, the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and as specified herein.

Attention is directed to Sections 801, 802 and 803 regarding the maintenance and protection of traffic during work adjacent to or over active roadways. The Contractor is advised that any work on the erection of the sign support systems or other work that might endanger traffic on active Turnpike roadways shall not be commenced until the proper lane closings have been made or traffic slowdowns have been instituted, in accordance with the requirements of Subsection 802.03.

(A) Overhead Sign Structures.

After the end frame or column of the overhead sign structure has been placed over the anchor bolts onto the leveling nuts, the nuts shall be adjusted until the end frame or column is truly vertical. The upper nuts shall then be placed and tightened and the space between the previously placed concrete and the underside of the base plate completely filled with non-shrink grout. Following placement of the grout, exposed surfaces of the grout and concrete shall be kept moist for at least 72 hours by means of wet burlap or fabric mats.

Under no circumstances shall the horizontal section of span type support structures be erected before the expiration of the curing period for the grouted portion of both pedestals.

In order to avoid performing any overhead work across roadways in use, the sign truss for overhead spans shall be fully spliced together and all signs (including changeable message signs, emergency speed warning and speed limit signs), walkways, lighting and other accessories required shall be fully installed thereon before erecting the complete assembly between the previously erected end frames. The sections of each truss shall be positioned on firm blocking, correctly aligned to each other and with the proper camber, before any bolted chord splices are made. At this stage the Contractor shall check the relative alignment of the chord flanges and shall measure the gap, where it exists, between the faces of the flanges. This gap shall be less than 1/16" around the full perimeter of the flange, or else, where a greater gap exists, it shall be reduced to a maximum of 1/16" by the insertion of parallel or tapered shims. The shims shall be circular, and of the same diameter as the flanges; partial shims will not be permitted. When the shims have been positioned all the bolts in all the chord splices shall be inserted, and tightened finger tight, before any are fully tightened. The assembled truss shall be handled and erected with great care and in such a manner as not to damage the truss nor any of the installations thereon.

For cantilever or butterfly type overhead installations, the cantilever sign truss arm or arms shall be provided with all signs of the various types as shown and all sign hangers, walkways, lighting, and other accessories required fully installed thereon before erecting the complete assembly, including the end column, on the anchor bolts of the previously constructed foundation pedestal. Adjustment and tightening of the anchor bolts leveling and top nuts and the placement of the non-shrink grout shall be as specified

above.

Prior to erection, the cantilever sign truss arm shall be bolted to the end post and correctly aligned by insertion of parallel or tapered shims. The shims shall be circular and of the same diameter as the flanges; partial shims will not be permitted. When the shims have been positioned, all the bolts shall be inserted and tightened. The assembled cantilever sign truss and end post shall be handled and erected with great care and in such a manner as not to damage the truss or any installation thereon.

Details of the exact erection method and procedure the Contractor proposes to use for both types of support structures shall be submitted to the Engineer for approval and such changes as may be deemed advisable in the opinion of the Engineer shall be made.

The maintenance walkway shall extend across the entire length of the span or cantilever type structure, extending to a maximum of 1'-6" beyond the left end of the left sign and projecting at least 3 feet into the area over the right shoulder, all as shown on the plans. The length of the vertical portion of all sign hangers shall be such that, when installed, the horizontal arms of all hangers will be at the same elevation across the span. Hangers which are not utilized to carry sign panels shall not project above the minimum dimension shown on the drawings.

The elevation of the top of the pedestal, together with the end post dimensions and the maximum panel height, have been selected to provide a minimum clearance of 17'-0" from the high point of the roadway cross section. This clearance must be maintained.

Before final acceptance, all metal surfaces shall be cleaned free of oil, grease, soil or other discoloration. Cleaning shall be with suitable solvents or by other approved means to the satisfaction of the Engineer. If cleaning is necessary after erection over roadways in use, suitable means shall be provided for the protection of traffic during the cleaning operations.

(B) BRIDGE MOUNTED SIGN STRUCTURES.

The various types of steel frame supports shall be attached to the parapets and, when required, to the stringer webs in accordance with the details shown as specified herein.

Holes for the anchor bolts or anchor rods passing through the concrete parapet shall be core drilled only. Holes for the expanding shield anchorages 6 inches up from the bottom of the parapet fascia shall be drilled to the size of the expansion bolt shank.

All holes shall be carefully laid out prior to drilling, in accordance with the dimensions, depths, and locations detailed on the plans, and shall be completed and cleaned of dust and debris by means of air jets or vacuum cleaners prior to erection of the individual frame supports.

Connections between tubular members and stringer webs shall be made by means of high-strength bolted connections using web stiffener angles on both sides of the web and connector plates between the tubular member and the stiffener angle on the outside of the fascia stringer. Angles, bolt sizes, spacing, and other details shall be as shown on the plans.

Details of the exact erection method and procedure the Contractor proposes to use shall be submitted to the Engineer for approval.

In order to properly install parapet anchorages to attach the steel frame supports without damaging existing chain-link bridge fencing, it may be necessary for the Contractor to temporarily remove portions of bridge fencing. Bridge fencing fabric shall be unfastened from the top and bottom rails and line posts only as necessary to permit the Contractor to gain access to the parapet. The bridge fencing removed shall be replaced upon completion of sign support system erection.

After the steel frame supports have been placed in position, the anchor bolts or rods and expansion anchors shall be tightened and adjusted so that the ends of the frame supports are in proper alignment and ready to receive the sign truss frame, hangers, walkway, and railing.

An erection support, in the form of a steel angle piece, shall be welded to the outer end plates of the end support frames of all bridge mounted support systems at the proper elevations, in accordance with the details shown on the plans. These erection supports shall be used to support the fully assembled sign truss, and all components attached thereto, in its correct position during erection and bolting to the support frames mounted on the bridge fascia.

The Contractor shall fabricate and install sign hangers, including the horizontal support arms for walkways and luminaire support channels, on the sign support truss as specified above prior to erection of the completely assembled sign truss.

Installation of the various signs on the sign hangers shall be performed as specified in Section 509 prior to erection of the completed sign support truss.

In order to avoid the hazards of performing any overhead work across roadways in use, the sign support truss shall be fully constructed and all vertical sign hangers, horizontal support arms, signs, walkways, railings and other accessories required thereon, as described elsewhere herein, fully installed, (exclusive of electrical work) before erecting the complete assembly on the ends of the previously erected steel frame supports. The sections of each sign support truss shall be handled and erected with great care and in such a manner as not to damage the truss nor any of the installations thereon.

The maintenance walkways shall, except as noted, extend a maximum of 1'-6" beyond each end and across the entire length of the sign support trusses as shown on the plans.

All other requirements relative to erection of the bridge mounted sign support system shall be as specified above for overhead sign support structures.

(C) Ground Mounted Sign Supports.

Prior to erection of the tubular aluminum posts, the caps and bases shall be affixed thereto and the underside of posts and bases to be set on the grout and concrete footings shall be given a heavy coat of the specified aluminum - pigmented alkaline - resistant paint. The painted surface shall be completely dry before erecting the posts and bases.

Erection of posts and bases on concrete foundations shall be done as specified in Subsection 406.06.

(D) Electrical Work.

Electrical work for sign lighting and operation shall be as prescribed in Section 603.

406.06 Sign Structure Foundations.

Before any construction is started on the concrete foundation, the Contractor shall first carefully locate the existing underground facilities within or adjacent to the area of excavation, utilizing hand excavation where necessary. Excavation and backfilling for construction of the footings and pedestals of the various overhead and ground mounted sign support structures shall conform to the requirements of Section 205 and as specified herein.

Preparation and placing of concrete and reinforcement steel shall conform to the requirements of Section 401.

Care shall be taken not to damage surrounding grassed areas during any of the Contractor's operations. All damaged surfaces of grassed berm and median areas shall be restored to their original conditions after completion of all work on the foundations, sign structure, and guard rail construction or replacement, in a manner satisfactory to the Engineer. Topsoiling, seeding, fertilizing, and mulching shall be performed in accordance with the requirements of the Sections of Division 700, and as directed by the Engineer.

Temporary or permanent sheeting, as designated on the plans or directed, shall conform to the requirements of Sections 415 and 416, respectively.

Piles, where required, shall be furnished and driven in accordance with Section 405.

(A) Excavation And Backfill.

Excavation for overhead sign structure foundations adjacent to active roadways shall be sheeted on at least three sides closest to the roadway in berm areas and on all sides when located in the median, or at other locations where two opposite edges of a footing are less than eleven feet away from the edge of its adjacent shoulders.

Sheeting shall extend to at least four (4) feet above the adjacent roadway surface. The sheeting shall be provided with flashing amber lights mounted in view of oncoming traffic. Sides of sheeting facing traffic shall be painted white as soon as it is driven.

The bottom of all excavations shall be firm undisturbed earth to provide a suitable bearing area for the foundation. Excavation below the prescribed minimum depth shown on the plans shall be filled with concrete placed directly on the undercut surface, thus increasing the total thickness of the footing by the amount of undercut. Unless ordered by the Engineer to excavate below the prescribed minimum depths, the cost of furnishing and placing such additional concrete shall be borne solely by the Contractor.

Excavations for cylindrical footings for ground mounted signs shall be neatly made, preferably by auger, to the dimensions called for on the plans.

(B) Foundations For Overhead Sign Structures.

The foundations for overhead span and cantilever sign structures shall be constructed to the shapes, dimensions, and elevations shown on the plans.

Forms for exposed faces of the pedestals shall be of plywood, using the minimum practical number of sheets for each face. Form ties will not be permitted through the concrete placed above grade.

Anchor bolts shall be set accurately by means of a template and held rigidly in position during the placement of pedestal concrete. The Contractor shall make periodic checks of the bolt positions and elevations during concreting operations. It is essential that the distance between the centers of anchor bolt groups of the two foundations for each overhead sign support frame be exactly the span length shown on the plans at 68°F. Care shall be taken to protect the threaded portions of anchor bolts and the leveling nuts from damage by concrete or equipment.

Concrete shall be placed and vibrated in the pedestal to within approximately three inches of the final top surface elevation of the pedestal. The top surface of the concrete shall be kept wet for at least 24 hours; after which the end supports and bases of the overhead structure shall be set onto the leveling nuts, the nuts adjusted, and the upper nuts placed and tightened. Promptly thereafter, the space between the previously placed concrete and the underside of the base plate shall be completely filled with non-shrink grout. Exposed portions of the top surface shall be sloped down away from the end frame bases. Following the placing of the grout, exposed surfaces of concrete and grout shall be kept moist for at least 72 hours by means of wet burlap or fabric mats. After the curing period has expired, the forms shall be removed and surface defects pointed with a matching mortar to the satisfaction of the Engineer.

All excavations shall be backfilled around the concrete foundation and pedestal and thoroughly compacted up to the surrounding ground lines. Excess excavated materials shall be properly disposed of in a manner satisfactory to the Engineer.

(C) Foundations For Ground Mounted Signs.

Forms of metal, dressed lumber, or plywood shall be used for the exposed surfaces of the concrete and to a depth of 6 inches below the lowest ground elevation at each post footing. The size and depth of the footings shall be as shown on the plans.

Concrete for footings shall be placed expeditiously and thoroughly rodded, taking care not to contaminate the mix with earth. The concrete shall be carried to within approximately 4 inches of the final top surface elevation of the footing. Embedded anchor bolts shall be carefully set to their proper depth and in their horizontal position by means of templates. Care shall be taken not to permit threaded portions of projecting bolts or the couplings from being coated with concrete. The top surface of the concrete shall be kept wet for at least 24 hours, after which the post (with base attached) shall be set on the projecting bolts and couplings and fastened thereto with the stainless steel stud bolts, nuts and washers, or cap screws. The couplings shall then be adjusted to such positions as will result in the post being truly vertical. Promptly thereafter, the space between the previously placed concrete and the underside of the base plate shall be completely filled with non-shrink grout. The exposed portions of the top surface shall be sloped down away from the post base. Following the placing of the grout, exposed surfaces of concrete and grout shall be kept moist for at least 72 hours by means of wet burlap or fabric mats. After the curing period has expired, the forms shall be removed and surface defects painted with matching mortar to the satisfaction of the Engineer. Any spaces remaining around the footings shall be backfilled and thoroughly compacted. Excess excavated materials shall be properly disposed of.

406.07 Measurement.

Sign support structures of the various overhead types will be measured on a unit basis for each separate sign support structure location.

Aluminum Posts for Ground Mounted signs will be measured by the total weight of aluminum tubular posts, caps, bases, stainless steel bolts, nuts and washers in the bases above the couplings and fastening hardware for sign panel attachment.

Concrete Foundations will be measured by the volume of concrete in place.

406.08 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
ALUMINUM POSTS FOR GROUND MOUNTED SIGNS.	POUND
CONCRETE FOUNDATIONS FOR GROUND MOUNTED SIGNS	CUBIC YARD
CONCRETE FOUNDATIONS FOR OVERHEAD SIGN STRUCTURES	CUBIC YARD
OVERHEAD BUTTERFLY SIGN SUPPORT STRUCTURE _____	LUMP SUM
OVERHEAD CANTILEVER SIGN SUPPORT STRUCTURE _____	LUMP SUM
OVERHEAD SPAN SIGN SUPPORT STRUCTURE _____	LUMP SUM
BRIDGE MOUNTED SIGN SUPPORT STRUCTURE _____	LUMP SUM

Payment adjustments for strength and durability for the Items "Concrete Foundations for Ground Mounted Signs" and "Concrete Foundations for Overhead Sign Structures" will be made in accordance with the specified Performance Criteria Category within Table 2 of Subsection 905.23.

Payment for reinforcement steel will be made in accordance with Section 401.

Payment for sign lighting will be made in accordance with Section 603.

Payment for piles will be made in accordance with Section 405.

Payment for sheeting will be made in accordance with Sections 415 or 416, as applicable.

Payment for sign panels and for U-channel posts will be made in accordance with Section 509.

Separate payment will not be made for foundation excavation for sign support structures.

SECTION 407 – HIGH-LOAD MULTI-ROTATIONAL BEARINGS

407.01 Description.

High-Load Multi-Rotational (HLMR) bearings shall be defined as bearings that consist of an element that allows rotation about any horizontal axis, and may in addition have sliding surfaces to accommodate translation. Translation may be constrained to a specified direction by guidance mechanisms. Bearings may be furnished by any of the Qualified Manufacturers. However, only one type of bearing from one Qualified Manufacturer (Manufacturer) shall be used on a structure.

This work shall consist of the design, furnishing, and fabrication of HLMR bearings, masonry plates, sole plates, anchor bolts, hardware, and bearing pads as shown on the Plans, described herein, recommended by the Manufacturer, or otherwise required to furnish completely installed and functioning HLMR bearings.

Special attention shall be given to placement of shop drawing layout of anchor bolts so that they clear existing reinforcing bars in the piers and also clear above girder flanges, diagonal bracing, diaphragm /floorbeam elements, or other superstructure features which may restrict anchor bolt drilling equipment headroom.

Installation of the bearings shall be the responsibility of the Contractor, in accordance with the Manufacturer's recommendations. Bearings shall be designed based on the loads and movements as described on the Plans. All designs for all elements shall conform to the latest editions (with interims) of the AASHTO LRFD Bridge Design Specifications, the NJTA Design Manual and these Specifications.

Where applicable, this work shall also include the bearing seat preparation including existing anchor bolt removals, as indicated on the Plans or as otherwise required to install the new HLMR bearings.

This work shall also include on-site supervision and technical support furnished by the Manufacturer to assist the Contractor with the installation of the HLMR bearings.

Materials, testing, and fabrication /construction operations not specifically denoted on the Plans and in these Specifications shall be in accordance with the current AASHTO LRFD Bridge Construction Specifications.

407.02 Materials.

Steel used for the fabrication of bearing assemblies shall conform to ASTM A709, Gr. 36, Gr. 50, or Gr. 50W, or an approved equivalent, except for steel that is used for guidance or shear restriction mechanisms. The guidance and shear restriction mechanisms shall be in accordance with the Manufacturer's specifications as approved by the Engineer.

Materials not otherwise specified in this Section shall conform to the following Subsections:

BOLTS AND BOLTING MATERIALS 909.02

PREFORMED FABRIC REINFORCED ELASTOMERIC BEARING PADS ..... 923.02(C)

ANCHOR BOLT EPOXY SYSTEMS ..... 923.22(B)

407.03 Qualified Manufacturers.

Where High-Load Multi-Rotational bearings are noted on the Plans for use, approved products from any Qualified Manufacturer may be provided. The following Manufacturers are qualified for use:

(1) R.J. Watson, Inc.
11035 Walden Ave.
Buffalo, NY 14004
Telephone: 716-901-7020
Fax: 716-901-7015

(2) The D.S. Brown Company
300 East Cherry Street
North Baltimore, OH 54872
Telephone: 419-257-3561
Fax: 419-257-2200

(3) AMSCOT Structural Products Corp.
241 East Blackwell Street
Dover, NJ 07801
Telephone: 973-989-8800
Fax: 973-989-5651

(4) Earthquake Protection Systems
451 Azuar Drive; Building 759
Mare Island, Vallejo, CA 94592
Telephone: 707-644-5993
Fax: 707-644-5995

407.04 Working Drawings.

Working drawings, including design calculations, shall be furnished to the Engineer in accordance with Subsection 104.08. The following information shall be included:

(A) The total quantity of each kind of bearing required (fixed, guided expansion, or non-guided expansion), grouped first according to load range and then by design capacity.

(B) Plan view and section elevation including all dimensions required for fabrication.

(C) Details of all components and sections showing all materials incorporated into the bearing.

(D) All ASTM, AASHTO, and other applicable material designations.

(E) The maximum design coefficient of friction for all sliding surfaces.

(F) Details of any welding process used in the bearing manufacture that does not conform to the approved processes of the current ANSI/AASHTO/AWS D1.5 Bridge Welding Code or the ANSI/AWS D1.6 Structural Welding Code – Stainless Steel.

(G) Vertical, horizontal, rotation, movement, and load capacities.

(H) Paint or coating requirements, as required.

(I) Installation scheme.

(J) Complete design calculations verifying conformance with the provisions of this Section.

(K) Anchorage details.

(L) Bearing pre-set details.

(M) Location of the fabrication plant.

(N) The Manufacturer's name and the name of its representative responsible for coordinating production, sampling and testing, and field supervision of bearing installation(s).

(O) The Manufacturer's certification package, according to Subsection 105.04, that shall contain the following:

(1) Material test reports for all steels used except AISI C1018 and C1020 for which a mill conformance certificate is acceptable.

(2) Certificate of Compliance for all non-ferrous metals.

(3) Material test reports for any elastomeric components.

(4) Certificate of Compliance for PTFE and any adhesive used.

(5) A Certificate of Compliance for the bearings, executed by an officer of the Manufacturer.

(6) Certificate of Compliance for any dowels or bolts supplied.

(7) Test reports for the performance tests.

(P) Completed as-built bearing table.

The design calculations and working drawings shall be signed and sealed by a Professional Engineer licensed in the State of New Jersey. The working drawings must be approved by the Engineer before fabrication of the bearings begins. Such approval shall not relieve the Contractor of any responsibility under the contract for the successful completion of work.

407.05 Fabrication of HLMR Bearing Assemblies.

(A) FABRICATION.

Section 18 – Bearings of the AASHTO LRFD Bridge Construction Specifications shall be followed for the fabrication of HLMR bearing assemblies. For pot type bearings, the provisions of AASHTO Specification M-251, Table X1 shall be followed for elastomer material fabrication and testing where the Shore A Durometer hardness shall be 50+/10 points and samples for compression set tests shall be prepared using a Type 2 die.

(B) COATING OF STEEL SURFACES.

All surfaces, except those defined below shall be coated. The surfaces to be coated shall be shown on the working drawings. Coatings shall not impair the clarity of the bearing identification markings. All flame cut edges of the bearing plates shall be ground to reduce hardness and facilitate blast cleaning. All corners of the sole plate shall be rounded to a 1/16 inch radius. All exposed plain steel surfaces shall be blast cleaned to a near white finish. For all bearings, the pot cavity and all sliding surfaces shall not be coated.

(1) Bearings for Steel Superstructures.

Bearings shall be painted in accordance with Specification Section 411. Quality assurance inspection of coatings will be in accordance with Specification Section 411.

(2) Bearings for Concrete Superstructures.

Bearings shall either be galvanized in accordance with ASTM A-123 or ASTM A-153, as appropriate, or zinc metalized in accordance with AWS C2.2 to a finished coating minimum thickness of 10 mil. Quality assurance inspection will be performed by using magnetic thickness gauges.

(C) TESTING.

Testing shall be performed in accordance with the LRFD Bridge Construction Specifications prior to installation of the bearings, and in the presence of the Engineer. The following provisions shall also apply:

(1) The Long Term Deterioration Testing.

(a) Bearing Design Configurations- Testing shall be conducted on two full size bearings placed back-

to-back. Bearing design configurations which comply with these provisions based on prior testing will be considered as prequalified for use without the need for further long term deterioration testing.

(b) Bearing Materials – Testing shall be conducted on samples of materials used in the fabrication of each lot of 25 or less bearings.

(D) PACKING AND SHIPPING.

(1) Bearings shall be securely banded together, as units, by the Manufacturer. They shall be shipped to the project site and stored without relative movement of the bearing parts or disassembly at any time. The bearings shall be wrapped in moisture resistant and dust resistant material to protect them against shipping, weather, job site conditions, and all other normal hazards.

(2) Each bearing shall be marked in a permanent fashion that will be visible after application of any paint coatings. The marking shall consist of the letters "N.J.T.A.", the location, orientation, order number, lot number, bearing identification number, bridge number, and month and year of manufacture. Unless otherwise specified in the Contract Documents, the marking shall be on a face which is visible after erection of the bridge.

(3) The bearings shall be inspected within one week after arriving on the project. They shall not be disassembled unless the Manufacturer's representative is present. Following the inspection, they shall be re-wrapped and kept clean until installation.

(4) The services of an on-site technical representative, to assist and provide guidance prior to the initial installation of the bearing assembly, shall be provided by the Manufacturer.

(5) When installed, bearings shall be clean and free of all foreign substances.

(6) The sole and top plates of the bearings shall not be removed for separate attachment to the structure except under the direct supervision of the Manufacturer.

(7) With each shipment, a copy of the materials, fabrication and testing compliance certifications shall be enclosed. For all materials used, the Manufacturer shall supply certification data consisting of test reports on the bearing performance tests, for any forgings, castings, or hardened material, mill certificates for all other steels used, a certificate of compliance for the bearing as a whole, and for all anchor bolts, dowels or other accessories, as required.

(8) The Manufacturer shall supply a separate sheet showing the materials, critical dimensions, and clearances for each bearing.

407.06 Measurement.

High-Load Multi-Rotational (HLMR) bearings of the various sizes and types will be measured by the number of each type and size completely installed and fully functional units accepted.

HLMR bearings destroyed or consumed for testing purposes will not be measured for payment

HLMR bearings set on a common masonry plate shall be measured as two individual HLMR bearings.

407.07 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
HLMR BEARING, ___ KIPS – ___ KIPS.	EACH

Payment for HLMR bearings shall include all work associated with design, fabrication, delivery, and construction support required to install the bearings and associated hardware. No separate payment will be made for bedding material, anchor bolts, sole plate, masonry plate, coatings, or field welds required to install the bearings.

No Separate payment will be made for costs required to provide on-site construction support to the Contractor.

No separate payment will be made for additional bearings or bearing materials furnished or otherwise consumed for testing purposes. The cost for these bearings or bearing materials shall be considered as incidental to the HLMR Bearing pay item.

No separate payment will be made for installation including the jacking or supporting of new or replacement

stringers and girders. These costs shall be considered as incidental to the HLMR Bearing pay item. Where HLMR bearings are installed under existing stringers or girders to remain, payment shall be made separately under the structural jacking pay item.

No separate payment will be made where bracing or jacking of HLMR Bearings may be required to set them to final thermal deformations. These costs shall be considered as incidental to the HLMR Bearing pay item.

No separate payment will be made for coatings or repair of damaged coatings. The costs of coatings or repair of damaged coatings shall be considered as incidental to the HLMR Bearing pay item.

SECTION 408 – LAMINATED ELASTOMERIC BEARINGS

408.01 Description.

This work shall consist of furnishing, fabricating, and installing Laminated Elastomeric Bearings.

This work shall also include the furnishing, fabrication, and installation of polytetrafluoroethylene (PTFE)/stainless steel sliding surfaces, masonry plates, sole plates, anchor bolts, hardware, and bearing pads as shown on the Plans, described herein, recommended by the Manufacturer, or otherwise required to furnish completely installed and functioning Laminated Elastomeric Bearings.

Where applicable, this work shall also include the bearing seat preparation including existing anchor bolt removals, as indicated on the Plans or as otherwise required to install the new Laminated Elastomeric Bearings.

Materials, testing, and fabrication/construction operations not specifically denoted on the Plans and in these Specifications shall be in accordance with the current AASHTO LRFD Bridge Construction Specifications.

For information regarding replacement of existing bearings (field measurements, removal of existing bearings, jacking, temporary support, etc.) see Section 418 and 432.

408.02 Materials.

Unless otherwise specified on the Plans, steel used for the fabrication of bearing assemblies shall conform to ASTM A709, Gr. 36, Gr. 50, Gr. 50W, or an approved equivalent.

Stainless steel sliding surfaces, where specified, shall conform to ASTM A240 Type 304 and have a minimum thickness of 16 gauge.

Materials not otherwise specified in this Section or shown on the Standard Drawings, including PTFE sliding surface requirements shall conform to AASHTO LRFD Bridge Construction Specifications and the following Subsections:

BOLTS AND BOLTING MATERIALS 909.02

CAULKING COMPOUND 923.05

ANCHOR BOLT EPOXY SYSTEMS ..... 923.22(B)

408.03 Qualified Manufacturers.

Where Laminated Elastomeric Bearings are noted on the Plans for use, approved products from any Qualified Manufacturer may be provided. The following Manufacturers are qualified for use:

(1) The D.S. Brown Company

North Baltimore, OH

Telephone: 419-257-3561

(2) AMSCOT Structural Products Corp.

Dover, NJ

Telephone: 973-989-8800

(3) Cosmec, Inc./ Dynamic Rubber

Athens, TX

Telephone: 903-677-2871

(4) Tobi Engineering

Glenview, IL

Telephone: 847-724-7880

(5) Scougal Rubber

Reno, NV

Telephone: 775-284-8500

(6) Seismic Energy Products

Athens, TX

Telephone: 903-675-8571

408.04 Shop and Working Drawings.

Shop and Working drawings shall be furnished to the Engineer in accordance with Subsection 104.08. The following information shall be included. Items noted with an * shall only be required for bearings with TFE sliding surfaces:

(A) The total quantity of each kind of bearing required (fixed, guided, or non-guided, guided with TFE sliding surface , or non-guided with TFE sliding surface), grouped according to load range.

(B) Plan view and section elevation including all dimensions required for fabrication.

(C) Details of all components and sections showing all materials incorporated into the bearing.

(D) All ASTM, AASHTO, and other applicable material designations.

(E) The coefficient of friction for all sliding surfaces, where required.

(F) Details of any welding process used in the bearing manufacture that does not conform to the approved processes of the current ANSI/AASHTO/AWS D1.5 Bridge Welding Code or the ANSI/AWS D1.6 Structural Welding Code – Stainless Steel.

(G) Vertical, horizontal, rotation, movement, and load capacities.

(H) A schedule of all bearing offsets, where required, to ensure proper bearing alignment under full dead load.*

(I) Paint or coating requirements, as required.

(J) Installation scheme with blocking or jacking schemes, as required.

(K) Anchorage details.

(L) Location of the fabrication plant.

(M) The Manufacturer's name and the name of its representative responsible for coordinating production, sampling, and testing.

(N) The Manufacturer's certification package, according to Subsection 105.04, that shall contain the following:

(1) Material test reports for all steels used.

(2) Certificate of Compliance for all non-ferrous metals.

(3) Material test reports for elastomeric components.

(4) Certificate of Compliance for PTFE and any adhesive used.*

(5) A Certificate of Compliance for the Laminated Elastomeric Bearings, executed by an officer of the Manufacturer.

(6) Certificate of Compliance for any dowels or bolts supplied.

(7) Test reports for the performance tests.

(O) Completed as-built elastomeric bearing table.

The shop and working drawings must be approved by the Engineer before fabrication of the bearings begins. Such approval shall not relieve the Contractor of any responsibility under the contract for the successful completion of work.

408.05 Fabrication of Laminated Elastomeric Bearing Assemblies

(A) Fabrication.

Section 18 – Bearings of the AASHTO LRFD Bridge Construction Specifications shall be followed for the fabrication of laminated elastomeric bearing assemblies with additional provisions as noted below:

Laminated Elastomeric Bearings shall be fully vulcanized to the sole plates and base plates during the fabrication process. Where size or geometry of the sole or masonry plates make vulcanization impractical, at the permission of the Engineer, the Laminated Elastomeric Bearings may be vulcanized to load plates which may then be shop welded to the sole and masonry plates, as shown on the Standard Drawings. The use of optional load plates, associated welding, and any required adjustment to the substructure bearing seat elevation(s) shall be at no additional cost to the Authority.

The Contractor shall have a minimum 10% of all welds tested by magnetic particle method. Testing shall be performed by an independent laboratory procured by the Contractor. The Contractor shall submit test reports to the Engineer.

(B) Coating of Steel Surfaces.

All surfaces, except those defined below shall be coated. The surfaces to be coated shall be shown on the working drawings. Coatings shall not impair the clarity of the bearing identification markings. All flame cut edges of the bearing plates shall be ground to reduce hardness and facilitate blast cleaning. All corners of the sole plate shall be rounded to a 1/16 inch radius. All exposed plain steel surfaces shall be blast cleaned to a near white finish in accordance with SSPC SP-10.

Sliding surfaces shall not be coated.

Elastomeric bearing pads and steel reinforcement shall not be coated.

(1) Bearings for Steel Superstructures:

Laminated Elastomeric Bearing steel shall be painted in accordance with Specification Section 411. Quality assurance inspection of coatings will be in accordance with Specification Section 411. Only the prime coat shall be applied in the shop. All final coats shall be field applied after the installation of the bearings.

(2) Bearings for Concrete Superstructures:

Bearing steel shall either be galvanized in accordance with ASTM A-123 or ASTM A-153, as appropriate, or zinc metalized in accordance with AWS C2.2 to a finished coating minimum thickness of 10 mil. Quality assurance inspection will be performed by using magnetic thickness gauges.

(C) Testing.

Testing shall be performed by the manufacturer prior to installation of the bearings, and in the presence of the Engineer or designated testing laboratory inspector.

Elastomeric materials and Laminated Elastomeric Bearings shall be tested in accordance with Section 18.2.5 of the latest AASHTO LRFD Bridge Construction Specifications. For the purposes of testing procedure selection, bearings shall be assumed to have been designed using Method B unless otherwise specified on the Contract Plans or elsewhere in these Specifications.

Sampling, testing and acceptance consideration will be made on a lot basis. A lot shall be defined as a group of no more than fifty (50) bearings with the same size elastomeric pad and design load rating manufactured in a reasonably continuous manner from the same batch of elastomer, and cured under the same conditions. This definition supersedes Section 8.2 of the AASHTO M-251 Specification.

(D) Packing and Shipping.

(1) Bearings shall be securely banded together, as units, by the Manufacturer. They shall be shipped to the project site and stored without disassembly. The bearings shall be wrapped in moisture resistant and dust resistant material to protect them against shipping, weather, job site conditions, and all other normal hazards.

(2) Each bearing shall be marked in a permanent fashion that will be visible after application of any paint coatings. The marking shall consist of the letters "N.J.T.A.", the location, orientation, order number, lot number, bearing identification number, bridge number, and month and year of manufacture. Unless otherwise specified in the Contract Documents, the marking shall be on a face which is visible after

erection of the bridge.

(3) The bearings shall be inspected within one week after arriving on the project. Following the inspection, they shall be re-wrapped and kept clean until installation.

(4) When installed, bearings shall be clean and free of all foreign substances.

(5) With each shipment, a copy of the materials, fabrication and testing compliance certifications shall be enclosed along with a certificate of compliance for the bearing as a whole, and for all anchor bolts, dowels or other accessories, as required.

408.06 Measurement.

Laminated Elastomeric Bearings of the various sizes and types will be measured by the number of each type and size installed and accepted.

All labor and equipment necessary to obtain field measurements will not be measured for payment.

Shop and/or field painting, galvanizing/metallizing, welding, and testing of welds will not be measured for payment.

Laminated Elastomeric Bearings set on a common masonry plate shall be measured as two individual Laminated Elastomeric Bearings.

408.07 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
LAMINATED ELASTOMERIC BEARING ___"X___"	EACH
LAMINATED ELASTOMERIC BEARING ___"X___", GUIDED	EACH
LAMINATED ELASTOMERIC BEARING ___"X___", FIXED	EACH
LAMINATED ELASTOMERIC BEARING ___"X___", WITH TFE SLIDING SURFACE, GUIDED	EACH
LAMINATED ELASTOMERIC BEARING ___"X___", WITH TFE SLIDING SURFACE	EACH

No separate payment will be made for additional Laminated Elastomeric Bearings or bearing materials furnished or otherwise consumed for testing purposes. The cost for these bearings or bearing materials shall be considered as incidental to the Laminated Elastomeric Bearing pay item.

No separate payment will be made for grout/leveling pads, fabric pads, TFE sliding surface, masonry plate, sole plate, load/leveling plates, anchor bolts, caulk, elastomeric bearing pads, welding, coatings, or any other materials and hardware required to furnish and install fully functional and accepted Laminated Elastomeric Bearings. The cost for these materials shall be considered as incidental to the Laminated Elastomeric Bearing pay item.

No separate payment will be made for installation including the jacking or supporting of the superstructure as may be required to reset the bearings. These costs shall be considered as incidental to the Laminated Elastomeric Bearing pay item.

No separate payment will be made where bracing or jacking of Laminated Elastomeric Bearings is required to set them to final deformations as indicated on the Plans. These costs shall be considered as incidental to the Laminated Elastomeric Bearing pay item.

No separate payment will be made for coating or repair of damaged coatings. The costs of coatings or repair of damaged coatings shall be considered as incidental to the Laminated Elastomeric Bearing pay item.

SECTION 409 - SEISMIC ISOLATION BEARINGS

409.01 Description.

This work shall consist of the design, furnishing, testing, and installation of seismic isolation bearing systems (Isolators), and the removal and disposal of the existing bearing assemblies. The Isolators shall meet the dimensional limits and performance requirements as shown on the Plans and specified herein.

The subject structures have been analyzed and designed in accordance with the *2010 AASHTO Guide*

Specifications for Seismic Isolation Design. Approved Manufacturers are not required to perform additional analyses provided Isolator characteristics are within 10% of those published within this Specification and on the Plans.

This work shall also include the bearing seat preparation including existing anchor bolt removals, as indicated on the Plans or as otherwise required to install the new Isolators.

This work shall also include the final detailing, furnishing, fabrication, and installation of masonry plates, sole plates, anchor bolts, hardware, and bearing pads as shown on the Plans, described herein, recommended by the Manufacturer, or otherwise required to furnish completely installed and functioning Isolators.

This work shall also include on-site supervision and technical support furnished by the Manufacturer to assist the Contractor with the installation of the Isolators.

409.02 Performance Requirements.

(A) The Isolator is a key structural component which must successfully function in a seismic event at any time throughout the life of the bridge. Isolators must perform reliably under service loads with little or no maintenance.

(B) Temperature Performance - The entire state of New Jersey is located in the Moderate Climate (refer to AASHTO LRFD Bridge Design Specifications, Section 3.12) which corresponds to a 50 Year low temperature of -30ºF and a maximum period of 14 days where temperatures do not rise above 32ºF. The load factor for the calculation of thermal movements shall be 1.20 as per Subsection 3.4.1 of the same specification. The performance of Isolators in such temperature conditions shall be taken into account in the design. Low temperature moduli for grade 3 Natural Rubber, Lead, and polyurethane as well as low temperature static coefficients of friction for PTFE shall be conservatively estimated or verified by prototype testing.

(C) Long Term Performance - Expected variation in Isolator performance over the lifetime of the bridge shall be incorporated in the Isolator design. Design considerations for bearings due to variations in long term performance shall incorporate all anticipated changes over the life of the bearings, including consideration of key Isolator system parameters as described in Section C8.1.2 of the 2010 AASHTO Guide Specifications for Seismic Isolation Design.

(D) The ability to select Isolators is dependent upon performance matching. Isolators must possess similar performance characteristics under service and seismic loads. Performance requirements of the Isolators at each isolation location are specified in the Contract Documents and within this Specification. These performance requirements include: force-deflection/energy dissipation characteristics, dead load and live load forces, maximum horizontal force and displacement due to AASHTO Group Loadings in transverse and longitudinal directions, and maximum force and displacement from seismic loads in transverse and longitudinal directions. Failure of an isolation system to adequately match the performance of the system specified in the Contract documents and within this specification shall be cause for the rejection of the Isolator.

409.03 Qualified Isolator Manufacturers.

The following Isolator Manufacturers have been approved for use.

Lead-Rubber Seismic Isolation Bearings manufactured by:

(1) Dynamic Isolation Systems, Inc.

885 Denmark Drive, Suite 101

McCarran, Nevada 89434

Telephone: (775) 359-3333

Fax: (775) 359-3985

(2) Seismic Energy Products, L.P.

518 Progress Way

Athens, Texas 75751

Telephone: (903) 675-8571

Fax: (903) 677-4980

(3) EradiQuake Seismic Isolation Bearings manufactured by:

R.J. Watson, Inc.

11035 Walden Avenue

Buffalo, New York 14004

Telephone: (716) 901-7020

Fax: (716) 901-7015

(4) Friction Pendulum Isolation Bearings manufactured by:

Earthquake Protection Systems, Inc.

451 Azuar Drive, Building 759

Mare Island, Vallejo, California 94592

Telephone: (707) 644-5993

Fax: (707) 644-5995

Substitution of an alternate isolation system not shown above may be acceptable provided all revisions necessary to accommodate this substitution are completed by the Contractor to the satisfaction of the Engineer. All such revisions shall be performed at no additional cost to the Authority. Reanalysis of the global seismic behavior of the structure will not be required that the provided performance requirements described in this Specification and as shown on the Plans are met by the alternate system.

Where furnished Isolator height varies from dimensions shown on the Plans, the Contractor shall be responsible for adjusting the dimensions of the masonry/sole plates, shims, concrete pedestals or bearing seat elevations. Changes in Isolator Plan dimension (i.e. width and/or length) shall take into consideration the physical limits of the existing abutment seats and/or pier tops. All Isolators shall be centered directly beneath the girder webs. Modifications to existing bearing seats to accommodate Isolator installation, beyond the removal of existing anchor bolts, installing of new anchor bolts, and intentional roughening of the surface to accommodate new grout pads shall only be performed with the approval of the Engineer.

The Isolator properties shown on the Plans have been selected to limit the forces transmitted to substructure units. The bearing characteristics shown on the Plans are for forces and displacement demands computed using the acceleration response spectra as defined in the Supplemental Specification.

409.04 Quality Assurance.

Quality assurance shall be performed by the Manufacturer's representative. Tests on materials and completed Isolators shall be supervised by the Manufacturer or its appointed representative. Two (2) copies of the Manufacturer's quality assurance manual shall be submitted to the Engineer for review and approval as Shop Drawings in accordance with Section 104.08 of the Specifications.

409.05 Contract Documents, Shop and Erection Drawings.

Calculations conforming to Sections 14.2, 16, and 18.1 of the *2010 AASHTO Guide Specifications for Seismic Isolation Design* and the *AASHTO LRFD Bridge Design Specifications current edition* demonstrating that seismic and service/strength design requirements have been satisfied shall be submitted. Assumptions with regard to Isolator long-term performance and behavior under adverse conditions (thermal, creep, etc.) shall be clearly stated and included in the calculations. Appropriate tests results or studies that verify these assumptions shall also be included. Acceptance of these test results or studies shall be deemed adequate at the sole discretion of the Engineer.

Shop and erection drawings, materials certificates, and testing records necessary or required for the fabrication, testing, and installation of Isolators shall be furnished in accordance with Subsection 104.08 and shall as a minimum consist of the following:

(A) Drawings clearly showing the external dimensions of the Isolators and the mechanisms for substructure and superstructure connections.

(B) Certificates of compliance with material and Isolator test criteria as specified herein or as approved by the Engineer.

(C) Manufacturer's installation instructions, including handling and storage directions.

(D) Manufacturer's Quality Assurance Manual.

(E) Complete record of installed bearings, referenced by serial number.

Where Isolators are specified for installation on an existing structure, no fabrication of any materials including Isolators, masonry plates, sole plates, anchor bolts, hardware, and bearing pads and all other appurtenances required to install a complete and functioning bearing assembly shall be fabricated until such time as all shop drawings for these items have been approved by the Engineer.

409.06 Product Delivery, Storage, and Handling.

The Isolators are to be delivered in protective packaging for freight and handling purposes. All Isolators shall be stored at the work site in a shelter that provides protection from physical and environmental damage and in the original packaging until installation. Disassembly of the Isolators is not permitted unless approved by the Engineer and supervised by the Manufacturer.

409.07 Markings.

Both the packaging and Isolator itself shall bear markings to identify (as a minimum) its installed orientation, order number, Isolator identification number, and lot number. Isolator markings shall be permanent and placed such that they are visible after installation and after coating.

409.08 Materials and Materials Testing.

Testing shall be performed in accordance with the below. Testing means and methods not governed by the below shall be as per the *AASHTO Guide Specifications for Seismic Isolation Design*, the *2010 AASHTO LRFD Bridge Construction Specifications.*

Certificates of compliance with material test criteria as specified herein shall be provided to the Engineer.

(A) LEAD-RUBBER SEISMIC ISOLATION BEARINGS.

(1) The elastomer of the Isolators is to be natural rubber, Type NR Grade 3 [Low Temperature Elastomer Grade less than 3 shall not be permitted] per ASTM D4014-89 and conforming to the following requirements:

(a) Heat Resistance - ASTM D573 (158ºF for 7 days).

Change in Durometer Hardness: 10 Shore A points maximum

Change in Tensile Strength: maximum of -25%

Change in Ultimate Elongation: maximum of -25%

(b) Compression Set - ASTM D395 Method B (158ºF for 22 hours).

Permissible set: 25% maximum

(c) Ozone Resistance - ASTM D1149.

100 hours mounting procedure ASTM D518 Procedure A

50±5 pphm ozone in air by volume, 20% strain 100ºF ± 2ºF

No visible cracks at 7X magnification.

(d) Low Temperature Properties.

Low Temperature Compression set ASTM D1229

Compression Set at 14ºF for 7 days @ 25% compression:

Permissible set 65% maximum.

Low Temperature Brittleness ASTM D746 Procedure B

Brittleness at -40ºF; No Failure permitted

Instantaneous Thermal Stiffening ASTM D1043

Stiffness at -40ºF shall not exceed 4 times the stiffness measured at 73ºF.

Low Temperature Crystallization Annex A ASTM D4014

Quad Shear Test at -15ºF for 14 days

Stiffness shall not exceed 4 times the stiffness measured at 73ºF.

(e) Bond of Elastomer to Steel Laminate ASTM D429 Method B.

Peel strength: 40 lb/in minimum.

(f) Tensile Strength and Ultimate Elongation of Elastomer ASTM D412.

Tensile Strength: 2250 psi minimum.

Ultimate Elongation: 550% minimum

(g) Shear Modulus at 50% Shear Strain of Elastomer ASTM D4014.

Shear modulus of the elastomer at 50% shear strain is to be determined.

(2) All steel plates incorporated in the seismic isolation devices shall conform to the following requirements:

(a) Steel laminates used for reinforcement shall be made from rolled mild steel conforming to ASTM A36, A1011 or equivalent. The laminates shall have a minimum nominal thickness of 12 gauge. Plates shall be sandblasted and cleaned of all surface coating, rust, dirt, and mill scale to an SSPC SP-6 level surface preparation before bonding.

(b) All edges on surfaces to be bonded to the elastomer (including perimeter of the central hole) will be deburred and made smooth to remove any sharpness. All corners (in plan) will have a 1/4 - inch minimum radius.

(3) Purity of Lead: The purity of Lead shall be established by chemical analysis from a sample of that used in the Isolators and shall possess a minimum purity of 99%. Lead shall also conform to ASTM B29.

(4) Structural steel mounting, sole, and masonry plates are to conform to ASTM A709 grade 36 or 50 and all requirements of Section 403 - STEEL STRUCTURES.

(B) ERADIQUAKE SEISMIC ISOLATION BEARINGS.

(1) Polyether Urethane Rotational Element shall conform to the following requirements in:

Physical Properties	ASTM Test	Min	Max
Hardness (Durometer 'D')	D2240	60	64
Tensile Stress (psi)			
at 100% elongation	D412	2000	----
at 200% elongation	D412	3700	----
Tensile Strength (psi)	D412	5000	----
Ultimate Elongation (%)	D412	220	----
Compression set (%)			
22 hrs @ 158°F	D395	----	40

(2) Stainless Steel shall conform to ASTM A167 Type 304 or ASTM A240 Type 304. Stainless steel in contact with PTFE sheet shall be polished to a No. 8 bright mirror finish. The minimum thickness of the stainless steel shall be as per Section 16.3.2 of the 2010 AASHTO Guide Specifications for Seismic Isolation Design

(3) Polytetraflourethylene (PTFE) Sheet shall be as per Section 16.2.2 of the 2010 AASHTO Guide Specifications for Seismic Isolation Design

(4) Mass Energy Regulator (MER) spring material shall be manufactured by a method that limits variations in the performance of this material over its design life and expected temperature performance range. Variations in material behavior shall be verified by appropriate test or time history studies and incorporated in the design. Acceptance of these test results or studies shall be deemed

adequate at the sole discretion of the Engineer.

(5) Structural steel mounting, sole, and masonry plates are to conform to ASTM A709 Grade 36 or 50 and all requirements of Section 403 of the Specifications.

(6) Connections of the MER shall be corrosion resistant and shall perform without binding throughout the 75-year design life of the Isolator.

(C) Friction Pendulum Isolation Bearings

(1) The material for the stainless steel for the main concave spherical sliding surfaces shall conform to ASTM Designation A240, Type 304 or 316 stainless steel, equal or better.

(2) The compressive yield strength of the Isolator material shall be at least two times the maximum design bearing pressure.

(3) Other structural components shall conform to ASTM Designation A36, A576, A572, A536, equal or better.

409.09 Fabrication.

Fabrication shall be performed in accordance with the below. Fabrication means and methods not governed by the below shall be as per the AASHTO Guide Specifications for Seismic Isolation Design, the 2010 AASHTO LRFD Bridge Construction Specifications.

All steel surfaces exposed to the atmosphere, except stainless steel or low friction surfaces, shall be coated in accordance with the Plans and Specifications. The surfaces to be coated shall be shown on the working drawings. Coatings shall not impair the clarity of the bearing identification markings. Prior to coating, the exposed steel surfaces shall be cleaned in accordance with the recommendations of the coating manufacturer. Metal surfaces to be welded shall be given a coat of clear lacquer, or other protective coating as approved by the Engineer, if the time of exposure before welding is to exceed three months. The coating shall be removed at the time of welding. No coating will be done to these surfaces prior to welding

Bearings for Steel Superstructures shall be painted in accordance with Specification Section 411. Quality assurance inspection of coatings will be in accordance with Specification Section 411.

Bearings for Concrete Superstructures shall either be galvanized in accordance with ASTM A-123 or ASTM A-153, as appropriate, or zinc metalized in accordance with AWS C2.2 to a finished coating minimum thickness of 10 mil. Quality assurance inspection will be performed by using magnetic thickness gauges.

The Contractor shall provide the Engineer with written notification thirty (30) days prior to the start of Isolator fabrication. This notification shall include all of the information required as a part of the shop drawing submission(s).

Where indicated in the Plans, preformed fabric pads used as bedding shall conform to the requirements of Section 923.02.

(A) Lead-Rubber Seismic Isolation Bearings.

The tolerances of the Isolator dimensions shall be as follows:

Dimension	Tolerance
Thickness of Individual Rubber Layers	±20% of design Value no more than ± 1/8 inch
Thickness of Top and Bottom Cover Rubber	+0, -1/16 inch
Rubber Bearing External Plan Dimensions and Shim Plan Dimensions	± 1/8inch
Masonry and Sole Plate External Plan Dimensions	± 1/4inch
Flatness of Exterior Top and Bottom Surfaces of Completed Bearing	± 1/32 inch from mean surface
Variation from Plane Parallel to the Theoretical Surface	

Dimension	Tolerance
Top	Slope relative to the bottom of no more than 0.005 radians or not to exceed dimensional tolerances, whichever controls.
Sides	± 1/8inch
Overall Bearing Height with masonry and sole plates	± 1/4
Diameter of Central Core	± 1/32 inch

(B) ERADIQUAKE SEISMIC ISOLATION BEARINGS.

(1) The finish of the mold used to produce the polyether urethane element for disk bearings shall conform to best machine shop practices. The shear restriction mechanism shall be connected to the bearing plate by welding or other acceptable means.

(2) Stainless steel sheets shall be attached to their steel substrates with a continuous seal weld.

(3) All welding shall conform to, and all welders shall be qualified in accordance with, the requirements of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code.

(4) Except as noted, all bearing surfaces of steel plates shall be finished to machine flat within 0.010 inches per foot. Out-of-flatness of greater than 0.010 inches per foot on any plate shall be cause for rejection. The bottom surfaces of lower bearing plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 0.0625 inches. Oxygen cut surfaces shall not exceed a surface roughness value of 1000 microinches, as defined by ANSI B46.1.

(5) After assembly including sole plates and masonry plates, Isolator components shall be held together with steel strapping, or other means, to prevent disassembly until time of installation. Packaging shall be adequate to prevent damage from impact as well as from dust and moisture contamination during shipping, storage, and installation.

(C) FRICTION PENDULUM ISOLATION BEARINGS.

(1) The manufacturing methods and quality control shall be in conformance with Section 17 of the 2010 AASHTO Guide Specifications for Seismic Isolation Design

(2) An approved self-lubricating bearing liner material shall be attached via approved means to the articulated slider and housing.

(3) All structural welding shall conform to, and all welders shall be qualified in accordance with, the requirements of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code.

(4) The external Isolator Plan dimensions shall be within + ½" of the values shown in the bearing drawings.

(5) The Isolator height shall be within + ¼" of the values shown in the Isolator drawings.

409.10 Isolator Testing.

Certificates of compliance with Isolator test criteria as specified herein shall be provided to the Engineer.

The deformation characteristics and damping values of the Isolators used in the design and analysis shall be based upon prototype tests conducted to meet the requirements in Section 13 of the 2010 AASHTO Guide Specifications for Seismic Isolation Design. Such tests must validate design properties that may be extrapolated to the actual sizes used in the design.

In addition, prototype testing described in Sections 13.2.2.5 of the 2010 AASHTO Guide Specifications for Seismic Isolation Design shall be performed at standard room temperature and at -5 degrees Fahrenheit for elastomeric bearing designs. Material Friction Testing for sliding surfaces as described in Section 18.1.5.2.3 of the 2010 AASHTO LRFD Bridge Construction Specifications shall be performed at standard room temperature and at -5 degrees Fahrenheit for bearing designs with sliding surfaces. Acceptable system property variations in the prototype tests shall be +/- 10% of the design properties.

Note that prototype tests are to be conducted on the assembled Isolator (not individual Isolator components)

and that these prototype tests are in addition to the tests specified below.

Quality control tests, as defined in the 2010 AASHTO Guide Specifications for Seismic Isolation Design shall be carried out on all bearings to be installed on the bridge. For combined compression and shear quality control tests, a continuous plot of the shear load and shear deflection will be recorded to permit an evaluation of the hysteretic performance of the Isolators.

(A) LEAD-RUBBER SEISMIC ISOLATION BEARINGS.

Quality control tests shall be performed on each Isolator in accordance with Section 15.2 of the *2010 AASHTO Guide Specifications for Seismic Isolation Design* with the following added provisions:

(1) Combined Compression and Shear Tests - Each Isolator will be loaded in compression to the maximum applied dead load plus 50% live load for the particular Isolator type. The compression load will be maintained while the Isolator is deflected in shear. Each Isolator shall be visually inspected both during and after testing. Any resultant defects, such as bond failure, physical destruction, or permanent deformation shall be cause for rejection. Defects such as torn or deformed elastomer or laminate fault shall also be cause for rejection.

(B) ERADIQUAKE SEISMIC ISOLATION BEARINGS.

Quality control tests shall be performed on each Isolator in accordance with Section 17.2 of the *2010 AASHTO Guide Specifications for Seismic Isolation Design* with the following added provisions:

(1) Compression Capacity Tests - Each Isolator will be loaded in compression to the 1.5 times the maximum applied dead load plus 50% live load for the particular Isolator type. Each bearing shall be visually examined both during and after testing. Any resultant defects, such as bond failure, physical destruction, or cold flow of PTFE to the point of debonding shall be cause for rejection. Defects such as extruded or deformed elastomer or cracked steel shall also be cause for rejection.

(2) Combined Compression and Shear Tests - Each Isolator will be loaded in compression to the maximum applied dead load plus 50% live load for the particular Isolator type. The compression load will be maintained while the Isolator is deflected in shear. Upon review of the load deflection curves, if there is any indication of binding or other undesirable response the MER shall be rejected. Each Isolator shall be visually inspected both during and after testing. Any resultant defects, such as bond failure, physical destruction, or cold flow of PTFE to the point of debonding, shall be cause for rejection. Defects such as extruded or deformed elastomer or cracked steel shall also be cause for rejection.

(C) FRICTION PENDULUM ISOLATION BEARINGS.

Quality control tests shall be performed on each Isolator in accordance with Sections 17.2 and 18.4 of the 2010 AASHTO Guide Specifications for Seismic Isolation Design with the following added provisions:

(1) Compression Capacity Tests - Each Isolator will be loaded in compression to the 1.5 times the maximum applied dead load plus live load for the particular Isolator type. Each bearing shall be visually examined both during and after testing. Any resultant defects, such as bond failure, physical destruction, or cold flow of low friction material to the point of debonding shall be cause for rejection.

(2) Combined Compression and Shear Tests - Each Isolator will be loaded in compression to the maximum applied dead load plus live load for the particular Isolator type. Each Isolator shall be visually inspected both during and after testing. Any resultant defects, such as bond failure, physical destruction, or cold flow of low friction material to the point of debonding, shall be cause for rejection.

(3) Wear test data for sliding surface materials shall be submitted for review and approval. Only sliding surface materials which have been previously used in a bridge bearing application for no less than 10 years may be submitted for approval. The wear data shall support an anticipated bearing service life of a minimum of 75 years.

409.11 Installation.

Where Isolators are to be installed on existing structures, final location of anchor bolts shall be the responsibility of the Contractor. Existing bearing seat reinforcing bars shall be avoided when installing Isolator anchor bolts. Locations of new anchor bolts and existing bearing seat reinforcing bars shall be submitted as part of the Isolator shop drawings. Where steel reinforcing bars cannot be avoided for new anchor bolt installations, the Contractor shall contact the Engineer immediately.

The Contractor shall furnish the services of a competent technical representative of the Manufacturer at no additional cost to the Authority. The technical representative shall be present at the work site prior to the start

of any installation of Isolators to instruct the Contractor and the Engineer on installation and inspection procedures. The Manufacturer's technical representative shall supply detailed instructions supplementing those specified herein to for use in installing the Isolators. The Contractor shall be thoroughly familiar with the procedures recommended by the Manufacturer before installation of the system. The Contractor shall furnish the Engineer with a copy of the Manufacturer's printed installation procedures.

Bearing surfaces located at improper elevations or not set level or true to plane shall require either grinding of the surface, grout pack of bearing seats, or modification of the Isolator such that the intended Isolator placement is as originally designed with the least amount of Isolator modification.

The Isolators shall be installed level and normal to the gravity loads. Superstructure gradients or tilted girder flanges shall be accommodated with beveled sole plates. Isolators shall be placed on surfaces that are plane to within 1/16 of an inch and horizontal to within 0.001 radians. Any lack of parallelism between the top of the Isolator and underside of the girder shall be corrected to the satisfaction of the Engineer.

There shall be no obstructions, including bolt extensions, which prevent the Isolators from deforming horizontally in any direction. The area around each Isolator shall be cleaned of debris and construction materials prior to acceptance of the installed Isolator.

Any welding performed on steel in contact with or near the Isolator shall be performed in such a manner as to not damage the Isolator. Caution shall be taken to ensure that the steel temperature directly adjacent to the rubber or polyether urethane elements does not exceed 212oF. Rubber or polyether urethane elements must not be exposed to direct flame or sparks.

Upon completion of all bearing installations, the Contractor shall provide a complete record of the location of each installed Isolator, referenced by serial number, to both the Engineer and the Manufacturer.

409.12 Certificates of Compliance.

The Isolator Manufacturer shall submit Certificates of Compliance for the Isolators indicating that the materials, fabrication, testing, and installation meet the requirements of the Specifications.

409.13 Measurement.

Seismic Isolation Bearing, Type __ shall be measured by the actual number of each type of Isolator installed.

409.14 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SEISMIC ISOLATION BEARING, TYPE __	EACH

Payment for **Seismic Isolation Bearings** shall include all work associated with design, fabrication, delivery, and construction support required to install the bearings and associated hardware. No separate payment will be made for bedding material, anchor bolts, sole plate, masonry plate, coatings, or field welds required to install the bearings.

No separate payment will be made for costs required to provide on-site construction support to the Contractor.

No separate payment made for additional seismic isolation bearings and bearing material required for testing.

Removal and safe disposal of canvas pads coated in red lead shall be incidental to the **Seismic Isolation Bearing** items.

Removal and disposal of existing bearings and anchor bolts shall be incidental to the **Seismic Isolation Bearing** items.

Payment for removal, handling, and disposal of asbestos shall be paid for under **Removal of Asbestos (No-Bid item)**.

SECTION 410 – DAMP-PROOFING AND WATERPROOFING

410.01 Description.

This work shall include furnishing and applying damp-proofing or waterproofing materials to surfaces of concrete at designated locations. Damp-proofing shall consist of a primer and two coats of bituminous materials. Waterproofing shall consist of a primer, three layers of woven cotton or glass fabric, four moppings

of hot bituminous material, and a protection course. Preformed sheet membrane waterproofing shall consist of a primer, membrane sheet, mastic, and a protection course. Epoxy resin waterproofing shall consist of furnishing and applying two coats of epoxy sealing compound and sand to concrete surfaces of abutment seats and pier caps to the limits shown.

Waterproofing of bridge decks shall be as specified in Paragraph 302.05(B).

410.02 Materials.

Materials shall conform to the following Sections and Subsections:

DAMP-PROOFING AND WATERPROOFING 923.06

JOINT FILLERS AND JOINT SEALERS 907

FINE AGGREGATE 902.04

410.03 Methods of Construction.

The concrete surfaces of retaining walls, abutments, and other structures against which earth backfill is to be placed shall be cleaned of all loose and foreign material; all dirt and rough projections shall be removed and all tie holes and other voids shall be pointed. When considered necessary, the Engineer may require the surface to be scrubbed with water and a stiff brush, after which the surface shall be allowed to dry before application of the primer.

Prior to the application of the epoxy resin waterproofing, the concrete surfaces of abutment and pier seats shall be cleaned of dirt, grease, form oil, or other foreign material which may have accumulated.

Waterproofing or damp-proofing materials shall not be applied to the concrete surfaces earlier than seven (7) days after stripping the forms. All surfaces shall be dry and no damp-proofing or waterproofing materials shall be applied in wet weather or when the air temperature is below 40°F.

(A) DAMP-PROOFING MATERIALS.

Damp-proofing materials may be applied cold, but should it be necessary to heat them, the heating shall be the minimum required to produce a free flowing consistency and thorough stirring shall continue throughout the heating period.

Application of the primer and seal coat shall be made by brushing or spraying into all surfaces. Care shall be taken to fill all pores, pin holes, shrinkage cracks, and surface breaks and to form a continuous film.

One coat of primer shall be applied at the rate of 1/8 gallon to each square yard of surface. On the well primed surface, one application of seal coat shall be applied at the rate of 1/10 gallon per square yard. Each coat shall be allowed to dry thoroughly before the following coat is applied.

The Contractor shall exercise particular care to avoid breaking the continuous surface of the primer after the application of the primer and prior to and during the application of the asphalt seal coat. The seal coat shall be applied as soon as the primer has set.

Care shall be taken to confine all material to the areas to be damp-proofed and to prevent disfigurement of any other parts of the work by dripping or spreading of the materials.

Backfilling adjacent to damp-proofed surfaces shall be done in a manner such that the continuous surface of the damp-proofing will not be broken. Stones, rocks or other sharp or hard objects shall not be placed in contact with the damp-proofing.

(B) WATERPROOFING.

The asphalt waterproofing material shall be heated to a temperature between 300 and 350°F. with frequent stirring to avoid local overheating. The heating kettles shall be equipped with thermometers.

The first strip of fabric shall be of one-third width; the second shall be of two-thirds width lapped full width of first strip; the third shall be of full width, lapped full width of second strip; the fourth shall be of full width, lapped full width of the third strip; the fifth shall be of full width lapped two-thirds the width of the fourth strip plus 2 inches. Each succeeding strip shall lap two-thirds the width of the preceding strip so that there will be at least three (3) layers of fabric at all points. No strips less than 12 inches wide shall be used.

Beginning at the low point of the surface to be waterproofed, a section about 20 inches wide and the full length of the surface shall be mopped with the hot bituminous material and, immediately following the

mopping, the first strip of fabric of one-third width shall be rolled onto the hot bituminous material and carefully pressed into place so as to eliminate all air bubbles and obtain close conformity with the surface. This strip and an adjacent section of the surface, of a width equal to slightly more than one-third of the width of the fabric being used, shall then be mopped with hot bituminous material and a second strip of fabric two thirds width shall be carefully pressed into place so as to eliminate all air bubbles and obtain close conformity with the surface. The second strip and an adjacent section of the surface, of a width equal to slightly more than one-third of the width of fabric being used shall be mopped with hot bituminous material and a third strip of fabric of full width shall be carefully pressed into place in the manner prescribed before. The third strip and an adjacent section of the surface shall then be mopped with hot bituminous material and a fourth strip of fabric of full width shall be carefully pressed into place as specified before. This fourth strip and an adjacent section of the concrete surface shall then be mopped with hot bituminous material and the fifth strip of fabric shingled on so as to lap the fourth strip by two-thirds plus not less than two inches. This process shall be continued to completion. The entire surface of the waterproofing shall then be given a final mopping of hot bituminous material. The completed waterproofing shall be a firmly bonded system, composed of three (3) layers of fabric and four (4) moppings of hot bituminous material. Under no circumstances shall one layer of fabric touch another layer at any point or touch the surface as there must be at least four (4) complete moppings of hot bituminous material.

In all cases, the mopping on concrete shall cover the surface so that no gray spots appear, and on cloth it shall be sufficiently heavy to conceal the weave completely. On horizontal surfaces not less than sixteen gallons of bituminous material shall be used for each 100 square feet of finished work and on vertical surfaces not less than twenty gallons shall be used. The work shall be so regulated that, at the close of a day's work, all cloth that is laid shall have received the final mopping of bituminous material. Special care shall be taken at all laps to see that they are thoroughly sealed down.

Waterproofing applied to surfaces which change abruptly in direction shall be reinforced at these points by application of an extra layer of fabric of suitable dimensions. The Engineer shall be the sole judge of what constitutes an abrupt change.

Over the waterproofing system, constructed as specified above, there shall be constructed a protection course as shown. The construction of the protection course (insulation board) where indicated shall follow the waterproofing so closely that the latter will not be exposed without protection for more than twenty-four hours.

At the edges of the waterproofing system and at any points where it is punctuated by drains, pipes, etc., provisions shall be made to prevent water from getting between the waterproofing and the surface waterproofed. After flashing sleeves have been placed over the waterproofing, three additional moppings of bituminous material and two layers of fabric shall be installed over the horizontal flange of the sleeve, lapping the sleeve and lower layers of waterproofing as shown.

Expansion joints, both horizontal and vertical, shall be constructed with sheet copper or lead in accordance with the details. The joints shall be filled with joint filler sealing material as specified. The membrane waterproofing shall be carried continuously across all expansion or construction joints. At the ends of the structure, the membrane shall be carried well down on the abutments or walls and suitable provision made for all movement.

(C) PREFORMED SHEET MEMBRANE WATERPROOFING.

The concrete surface, over which the preformed sheet membrane waterproofing is to be applied, shall be dry and free of dirt, debris, oil, tar, cement, and laitance, as well as protruding steel and wire. The concrete shall be at least 7 days old. All joints or cracks in the concrete shall be filled with a solvent-resistant sealant.

(1) Application Procedures.

Concrete surfaces to be waterproofed shall be primed with the primer recommended by the membrane manufacturer following the prescribed directions. Primed surfaces should be covered with the membrane as soon as the primer coat is tack free. Areas not covered with membrane within 24 hours shall be reprimed.

Joints shall be properly sealed prior to applying the membrane. All slab and wall cracks over 1/16 inch in width and all joints shall be prestripped with 8 inch wide membrane. All joints shall be inspected carefully and resealed as necessary.

All inside and outside corners shall be covered with an initial membrane strip of the prescribed width centered on the axis of the corner, followed by full width membrane application.

Mastic shall be applied to edges of patches, seams, and other locations of drains and other protrusions as recommended by the membrane manufacturer.

(2) Membrane Protection.

The waterproofing membrane shall be protected by installing the specified insulation or protective board over all membrane surfaces. The protection course shall extend continuously from the finished grade line to the bottom of the footing. The protections course shall be applied by using an adhesive recommended by the membrane manufacturer sufficient to insure a permanent bond of maximum strength between the membrane and the protection course. Press the boards firmly to the membrane so that they are in contact over the entire surface. Lay boards in parallel courses, staggering end joints in adjoining courses and stagger joints in each layer with those of layer below. Butt all panels tightly to adjoining panels, forming a continuous and even surface with no voids in the surface or open joints between boards, thereby insuring complete protection for the membrane from abrasion and puncture during backfilling against the foundation walls. Boards that are damaged shall not be used. Extreme care shall be used in performing this work so not to damage the membrane in any way and should damage occur, the membrane shall be immediately repaired following recommendations of the manufacturer and to the satisfaction of the Engineer to assure the permanent waterproofing of all surfaces, as intended, over which the membrane is installed.

(3) Manufacturer's Representative.

The Contractor shall notify the membrane manufacturer, not less than three (3) working days before the waterproofing membrane installation is to commence. A qualified representative from the manufacturer's office shall be available as requested by the Engineer throughout the first full day at the start of the installation. He shall inspect surfaces to receive the material and all unsatisfactory conditions found shall be corrected to comply with the manufacturer's specifications. The manufacturer's representative shall remain on the job until such time he is assured the workmen are thoroughly familiar with the manufacturer's recommended application procedures and that a thoroughly workmanlike and completely waterproof installation will be produced. At the completion of the work and prior to installation of the protective course, the manufacturer's representative shall inspect the completed installation for compliance with manufacturer's specifications, and any part of the installation that in his opinion is found to be defective or not in compliance shall be repaired or replaced immediately, to his satisfaction. All costs that may be incurred for the supervision and inspection by the qualified manufacturer's representative shall be paid by the Contractor.

(4) General Requirements.

The above requirements are intended to represent the procedures required for a particular type of membrane. Materials and the recommended procedures of the manufacturer of other products will be considered provided they are approved by the Engineer.

No applications of waterproofing shall be made when air or surface temperatures are less than 40ºF.

(D) EPOXY RESIN WATERPROOFING.

Unless otherwise specified, the epoxy resin waterproofing material shall be applied to the tops of all abutment bridge seats and pier caps (including bearing pad areas), to the chamfered edge around the periphery of the tops of pier caps, and to the chamfered edge along the front face of abutment bridge seats and to the vertical surfaces immediately below such areas, to the limits shown.

The vertical sides of pier caps below the chamfer along the top edge, and the front face of the abutment below the chamfer along the bridge seat, shall be adequately masked at least one foot below such chamfers to prevent runs, spillages, and inadvertent coatings on such vertical faces.

The waterproofing material shall be applied not earlier than seven (7) days after stripping the forms. Before application, the surfaces shall be thoroughly cleaned of dirt, grease, form oil, curing compound, laitance, or other foreign material which may have accumulated.

The two components of the waterproofing material shall be blended in equal parts by volume, and to each four parts of the mixture thus obtained, there shall be added one part toluene as a thinner. Only sufficient waterproofing material shall be mixed that can be applied in one hour. The ambient temperature shall be between 40ºF. and 85ºF. at the time of application.

The Contractor is warned that the various components of the waterproofing material are toxic and all necessary precautions shall be taken to prevent injury due to their use.

Application shall be by brush only. Two coats shall be applied, the second coat being applied after the first is thoroughly dry. Total finished dry thickness shall be not less than ten (10) mils.

Before the second coat is dry and while still tacky, a layer of sand shall be spread over the horizontal surfaces only, except on bearing areas, and tamped into the waterproofing material. After the waterproofing material has set, all excess sand shall be brushed off. Bearing surfaces of masonry shall receive the application of waterproofing material after they are dressed down to the proper elevation, prior to placing red lead and canvas thereon.

410.04 Measurement.

Damp-proofing, Waterproofing, and Preformed Sheet Membrane Waterproofing will be measured by the surface area and Epoxy Resin Waterproofing will be measured by the surface area complete and accepted, within the neat limits shown or as ordered.

410.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
DAMP-PROOFING	SQUARE YARD
WATERPROOFING	SQUARE YARD
EPOXY RESIN WATERPROOFING	SQUARE FOOT
PREFORMED SHEET MEMBRANE WATERPROOFING	SQUARE YARD

SECTION 411 - PAINTING AND REPAINTING STEEL STRUCTURES

411.01 Description.

This work shall consist of partial or complete paint removal, cleaning and preparing the steelwork surfaces of new and previously painted structures including, but not limited to, those previously painted with basic lead-silico chromate coating systems AN and AE, basic lead-silico coating systems B and C, unpainted new or existing weathering steel structures, and furnishing of all paints and other materials (and equipment) for the specified paint system, and the application thereof on the prepared surfaces to the limits designated.

In general, only the superstructure metalwork components prescribed shall be painted. Unless required otherwise by Contract Plans or Supplemental Specifications, weathering steel conforming to ASTM A588 or A709 Grade 50W shall only be painted in areas specifically required by Paragraph 403.05(C).

411.02 Materials.

The Contractor shall select the blast cleaning medium to be used for field cleaning which shall be silica sand, processed grit, or a reclaimable abrasive or any other method capable of providing the specified anchor profile.

Except as required by Supplementary Specifications, the following paint systems are scheduled for use:

PAINT SYSTEM A (EXISTING STRUCTURAL STEEL)	913.01
PAINT SYSTEM B (EXISTING STRUCTURAL OR WEATHERING STEEL)	913.02
PAINT SYSTEM C (NEW STRUCTURAL AND NEW WEATHERING STEEL)	913.03
WATER TOWER PAINT	913.04

Note: Paint System A shall not be used on steel areas to be encased in new concrete. The system used for these areas shall be approved by the Engineer if not listed in the Contract Supplementary Specifications.

All primer, intermediate and topcoat coating materials shall be packaged in pre-proportioned separate containers such that mixing the entire contents of both containers will yield the correct mixing ratio. For spot priming if required by the contract, lesser amounts may be packaged to eliminate waste. Each container shall bear a label on which shall be clearly shown the name of the coating manufacturer, the name of the product, the lot and batch number, the date of manufacture and the end of shelf life date. The label shall also include complete specific instructions for the opening, mixing, thinning, application and storage of the coating material. The container shall be designed to contain the material within.

Before any painting can be performed, the manufacturer's Certified Test Report and a Materials Certificate will

be required for the primer, intermediate and topcoat which confirms the conformance of the Primer, Intermediate and Topcoat to the material specifications. The Contractor is further advised that the application of each separate paint shipment or batch of paint delivered to the job site will not commence until the Authority's independent testing laboratory approves the paint for conformance to the paint manufacturer's material specifications.

Storage, opening, mixing, thinning and application of the coating materials shall be accomplished in strict accordance with the written requirements and procedures published by the respective coating material manufacturer. The Contractor shall have at the project site at all times the current copies of all technical data sheets, along with the mixing, application and storage recommendations and procedures published by the coating manufacturer for these coating materials.

All paints shall be thoroughly mixed by mechanical means in the original containers to achieve and maintain a homogeneous mixture before removal from those containers. The Contractor shall frequently stir the paint during application to keep the pigments suspended and composition uniform. Paint shall be strained to remove all skins and dried particles. Excessive skinning or partial hardening of the paint due to improper or prolonged storage is cause for rejection.

Containers and all tools and equipment used for storing, mixing, handling and applying paint shall be kept free from accumulation of hardened paint.

Random sampling and testing of the mixed coating material will be conducted by the Authority's testing laboratory to verify that proper mixing procedures are being utilized by the Contractor.

The coatings are supplied for normal use without thinning. Any thinning or other modification of the paint shall be done in strict compliance with the paint manufacturer's written recommendations, with the Engineer's approval. Use of thinners other than those supplied or approved by the paint manufacturer is cause for rejection of the paint and the quantity of steel coated with the improperly thinned paint.

In cool weather the paint may be warmed to reduce the viscosity. Such warming shall be accomplished by heating the paint containers in water or placing them on steam radiators.

Coatings and thinners shall be stored and protected from the weather in enclosed structures at 40 to 110 ^{o}F. The enclosures shall be equipped with a recording thermometer. The above restrictions shall apply unless the manufacturer's requirements are more stringent; in which case, the manufacturer's restrictions shall apply.

It is mandatory that the Contractor obtain the services of a qualified technical advisor employed by the coating manufacturer, who shall be on-site when contract operations commence. The technical advisor shall assist the Engineer and the Contractor in establishing correct application methods, for the primer, intermediate and finish coats, and shall be available for assistance upon request by the Engineer.

411.03 Thickness of Paint.

For all coatings other than coating of new weathering steel, dry film thickness measurements will be made using a calibrated magnetic film thickness gage, Type I or Type II, in accordance with the Steel Structures Painting Council (SSPC-PA2). The Contractor shall furnish the Engineer with the following equipment which shall be new or in good working order. See Paragraph 411.06(F) for measurement requirements for all painting of new weathering steel.

Equipment	Min. # Required
Wet Film Thickness Gages	4
Dry Film Thickness Gages - Tooke Gage	2
Positector 6000 Gage	2
Battery Operated Psychrometer	2
Surface Thermometer	2
Paint Adhesion Test Kit or	1
Elcometer Adhesion Tester	2
Hypodermic Needle Pressure Gage	1
Testex "Press-O-Film"	2
Elcometer Surface Profile Gage	2

Equipment	Min. # Required
Surface Contamination Analysis Test Kit	2
Half-mask Respirators with appropriate filter cartridges shall be properly fitted for each person designated by the Engineer	As Required
Holiday Detector	2
Atkins Digital Thermometer; Accuracy-Plus or Minus 1% of Reading	2

The above noted equipment shall remain the property of the Contractor following Contract completion.

The Engineer shall verify through the use of such equipment that prevailing working conditions meet current acceptable standards. The Engineer shall use this equipment in strict conformance to SSPC-PA2 and ASTM standards.

The paints for the various coats of the Systems listed, conforming to Section 913, shall be applied to yield the following minimum dry film thicknesses:

System A[1]	
Spot Prime	4.0 mils
Intermediate Coat	4.0 mils
Finish Coat (brown)	3.0 mils
Finish Coat (greens)	2.0 mils
For System A	10.0 or 11.0 mils[2]
System B[1]	
Primer	3.0 mils
Intermediate Coat	4.0 mils
Finish Coat (brown)	3.0 mils
Finish Coat (greens)	2.0 mils
For System B	9.0 or 10.0 mils[2]
System C[1]	
Primer	3.0 mils
Intermediate Coat	4.0 mils
Finish Coat (brown)	3.0 mils
Finish Coat (greens)	2.0 mils
For System C	9.0 or 10.0 mils[2]

1 - The dry film thickness of individual coats shall meet the stated minimum values and shall not exceed the manufacturer's published maximum dry film thickness per coating layer. If the manufacturer's minimum required dry film thickness per coat is higher than those above, the manufacturer's value shall govern.

2 - Depending upon color and gloss level specified.

411.04 General Precautions.

The Contractor shall be required to contain, catch, and properly dispose of all blasting and cleaning residue in accordance with the Contract plans, Standard Specifications and any Contract Supplementary Specifications.

The Contractor shall provide protective devices, such as tarps, screens, platforms or covers, and take all necessary precautions to protect pedestrian, vehicular, and other traffic on or underneath the structure from splattering, splashing, or dripping paint and to prevent paint cans, tools, abrasive particles, dust, or any other materials or equipment from dropping onto the roadways, waterways, railroads, and adjacent properties.

Care shall be used to prevent paint dripping, spattering, or being sprayed on finished concrete surfaces, on other painted surfaces, or any parts of the structure, and any such drippings, spatterings, or spraying shall be cleaned off to the satisfaction of the Engineer before the paint has dried. The Contractor shall be fully

responsible for any damage to property of any kind which may result from the operations incident to the application of any paint.

The Contractor shall furnish, construct, and maintain whatever facilities are necessary, such as walkways, platforms, ladders, stairways, and other facilities of usual and suitable character and adequate strength, to provide properly for the work intended, including safe access facilities for close-up and detailed inspection and quality control of the work by the Engineer.

Storage of materials, tools, equipment, and incidental construction aids will be permitted only at the specific locations designated. These storage sites shall be maintained by the Contractor in a safe and neat condition at all times to the expressed satisfaction of the Engineer.

The Contractor is responsible for compliance with all Federal and State laws and regulations regarding construction safety and health standards. Appropriate respiratory protective devices must be provided by the Contractor and must be used during blast cleaning and paint application operations.

All work involving the preparation of metal surfaces, paint application or storage, or the use of flammable or potentially toxic materials must be conducted in accordance with Federal and State safety requirements and the instructions of the paint or material manufacturer.

All paint drums, paint cans, and waste materials must be properly disposed of in a timely manner by the Contractor in accordance with applicable Federal and State requirements.

The Contractor shall be required to comply with all the applicable requirements of Section 411 of the Standard and Supplementary Specifications and to the Product Data Sheets, Application Instructions and Material Safety Data Sheets of these high-performance coatings bound in the applicable Appendix included in these specifications.

(A) POLLUTION CONTROL.

Persons, vehicles and other traffic, underneath or adjacent to the bridges and all portions of the bridge structures and adjacent facilities, shall be protected against damage or disfigurement due to displacement of the containment system or by spatters, splashes, and smirches of paint or coating materials.

The Contractor is advised that the existing coating systems on previously painted bridges designated in the contract may contain red lead and/or basic lead-silico chromate paints as components. All material removed from the previously painted bridges including, but not limited to, the blasting residue, spent blasting medium, rust, paint particles, and dust associated with the surface preparation operations and any other material contaminated in the cleaning process shall be designated and handled as hazardous waste. The handling, storage, and disposal of such waste products shall be in compliance with all requirements of the USEPA, NJDEP, OSHA, and other regulatory agencies with jurisdiction promulgating rules, regulations, standards, and guidelines in effect during execution of the work.

It shall be the Contractor's ultimate responsibility to ensure the health and safety of all the Contractor's employees and subcontracting personnel. The Contractor shall develop a pollution control system for the complete capture, containment, collection, and disposal of the waste generated by the work. The system and the Contractor's reclamation operation shall be in compliance with all USEPA, NJDEP, OSHA, USCG and other regulatory agencies with jurisdiction, rules, regulations, standards and guidelines in effect at the time that the work is in progress. The Contractor shall be liable for any fines or cost incurred as a result of his failure to be in compliance with all federal, state and local laws.

The Contractor shall consider the waste generated by surface preparation, except for waste generated from unpainted areas of weathering steel bridges, as Environmental Protection Agency Hazardous Waste Classification Toxic Lead, EPA classification D008. All waste shall be placed in temporary storage as specified hereinafter.

If at any time during the execution of the work, the pollution control system fails to function at the required level of efficiency, the Contractor shall immediately suspend such operations and shall not resume work until the necessary corrective modifications have been made to the satisfaction of the Engineer.

If the failure is due to adverse weather conditions such as high winds, the Contractor shall immediately suspend the affected operations until the weather conditions become favorable. No additional payment will be made for any corrective actions required.

The Contractor or his representative shall conduct initial project monitoring and air quality testing as required to monitor the effectiveness of his pollution control systems. He shall make those results available to the Engineer. Additional testing to monitor the effectiveness of the pollution control systems employed on the project shall be as directed by the Engineer if results of initial monitoring are judged by the Engineer

to be inadequate. If it is determined that pollution of the environment adjacent to the site has occurred, the Contractor shall cease all operations immediately and shall deploy the emergency management plan, as required. The Contractor shall be responsible for all costs for mitigating and corrective actions.

The Contractor shall comply with 40 CFR, Part 50, Appendix G "National Ambient Air Quality Standard For Lead".

The Contractor shall obtain all permits that are required for the handling and disposal of the debris and material collected during the course of the work. All material shall be reclaimed/disposed of at an approved site(s) by the Contractor or his authorized representative. The Contractor shall present the proper documentation and/or permits as part of the hazardous waste storage and transport plan, demonstrating that he has made the necessary preliminary arrangements to reclaim/dispose of the materials at an approved site(s). The Contractor shall not begin cleaning or blasting operations until he has submitted final documentation substantiating that he has secured an approved reclamation/disposal site(s) for the disposal of materials from the job and all required permits for handling and storing the waste.

The contained waste materials shall be removed, stored in sealed steel drums and disposed of at regular intervals (once each working day minimum) during the execution of the work, as required in accordance with the pollution control plan, field conditions, and at the direction of the Engineer. The Contractor shall also remove all errant waste from the bridge deck, structural steel, piers, abutments and other areas of the work, at least once a day or more frequently if required or as directed by the Engineer. The Contractor shall comply with the applicable sections of the Code of Federal Regulations.

The Contractor shall continuously monitor the quantity of waste captured, contained, collected, stored and disposed of, and shall maintain accurate records of all blasting medium purchased, delivered, stored, and utilized during the execution of the work. Records of the blasting medium delivered and utilized, and of the waste disposed of shall be submitted to the Engineer on a regular basis, to allow for inventory verification inspections. The Contractor's records shall be kept current and be available at all times on site.

The Contractor shall incorporate, as part of the pollution control plan, an emergency management plan outlining specific procedures to be followed in the event of primary containment system failure. Details including equipment, materials and methods to be employed in the event of environmental contamination shall be provided. The necessary components along with the emergency management plan shall be available on site while surface preparation operations are in progress. Also included shall be an outline of those persons to be notified in the event of such failure. The emergency management plan shall comply with all rules and regulations of the applicable agencies, as stated herein. The emergency management plan should be especially detailed where work is primarily over a body of water or adjacent to populated areas.

The review and acceptance of the pollution control plan will not relieve the Contractor of the responsibility for attaining the required degree of capture, containment, collection and disposal, or the required degree of protection of the operating equipment and appurtenances, or to comply with all the laws, rules, regulations, standards or guidelines in effect during the execution of the work.

After receipt of written approval of the pollution control plan and approval of a reclamation/disposal site(s), the Contractor may commence cleaning operations. The pollution control system, as detailed in the pollution control plan, shall be securely installed and properly maintained while the work is in progress. The Contractor shall not deviate from the approved pollution control plan without written approval by the Engineer. The installation of containment enclosures over the traveled roadway shall not reduce vertical clearance to less than 15.5 feet for the full width of the shoulders and lanes. Where existing vertical clearance is less than 15.5 feet no reduction in clearance will be permitted by the installation of containment enclosures over the traveled roadway.

(B) LEVEL OF CONTAINMENT.

The following guidelines are for the determination of the level of containment to be utilized for surface preparation prior to painting of structural steel.

LEVEL 4	This is the standard containment system that will be utilized for any hand or power tool cleaning, and rehabilitation of structural steel.
LEVEL 3	This is the standard containment system that will be utilized in areas of abrasive blast cleaning of weathering steel bridges unless otherwise specified herein

LEVEL 2	This is the standard containment system that will be utilized in areas of abrasive blast cleaning on all previously painted bridges except for situations as specified below for Level 1 protection.
LEVEL 1	This is the standard containment system to be utilized in situations which warrant additional protection for the environmental resources. Level 1 protection will be utilized in areas of abrasive blast cleaning of structures over, or in the immediate vicinity of, wetlands (both tidal and inland), watercourses and water-bodies (other than public water supplies), critical habitats, populated areas, hospitals and public buildings.

(1) Level 4 - Class 4 Containment And Collection Of Surface Preparation Debris.

(a) Description.

This work shall consist of furnishing and erecting S.S.P.C. Guide 6 (CON) Class 4 containment enclosures with natural air flow as required to completely contain and collect water and debris resulting from the power tool, hand tool, water blast and abrasive blast preparation of steel surfaces for painting. Also included is collection and the storage of debris in suitable containers.

The containment, storage and collection of debris shall be done in strict conformance with all OSHA, Federal Environmental Protection Agency, NJDEP and other regulatory agencies with jurisdiction, rules, regulations, standards, and guidelines in effect at the time the work is in progress.

(b) Materials.

Materials and equipment shall be of satisfactory quality to perform the work and shall not be used on the project until and unless they have been reviewed and approved by the Engineer.

Flexible containment walls constructed of fire retardant tarpaulin material shall be impermeable to air and water.

Fifty-five (55) gallon barrels with resealable lids, or lined storage containers sized for the job shall be leakproof; shall conform to the Code of Federal Regulations Title 49, Chapter 1, Paragraphs 173.510A(1),(5) and Paragraph 178.118; and shall not be used on the project until and unless they have been reviewed and approved by the Engineer.

The Contractor shall submit to the Engineer complete copies of detailed shop and working drawings in accordance with Subsection 104.08. All plans and calculations shall be prepared and sealed by a Professional Engineer licensed in New Jersey. These drawings shall detail as described below, the proposed methods for such activities. The Contractor shall not commence with containment enclosure erection and cleaning until and unless the working drawings have been reviewed and approved, in writing, by the Engineer, and shall proceed with such work only within approved containment enclosures.

The working drawings shall include the following:

(1) A construction plan and drawings detailing proposed coating removal operations, removal and transport of waste to a secure storage site.

(2) A plan and drawings detailing the proposed containment enclosure, including details of the following:

  (a) Rigid, solid floor or working platform.
  (b) Containment walls with flexible materials.
  (c) Rigid or flexible supports and bracing for flexible walls.
  (d) Maximum allowable load for the floor or working platform.
  (e) Connections to the bridge, i.e., clamps, rollers. (**Note**: Welding and bolting is not allowed.)
  (f) Entrance/Exit through tarpaulin seams which can be sealed.
  (g) Location of equipment and impact on traffic.

(h) Elevation view of the containment enclosure with indications of any encroachments on the surroundings.

Reference information on enclosures can be obtained from the following sources:

- SSPC Guide 6(CON)
- Steel Structures Painting Manual, Volume 1.
- AASHTO Manual for Assessing Safety Hardware (MASH)

The floor, working platform or ground below the area of surface preparation shall be covered with a waterproof tarpaulin attached and sealed to the enclosure wall and floor around the entire enclosure perimeter. All edges of tarpaulins shall have a two foot flap that clamps over the connected edges around the entire perimeter. These flaps shall be completely fastened 12 in. on center for both edges and sealed completely with the tarpaulin manufacturer's tape.

Any debris released from the enclosure shall be cleaned up by the Contractor immediately.

If the wind velocity is high enough to cause the containment enclosure to billow and emit debris, the Contractor shall immediately cease steel rehabilitation and cleaning and, after cleaning up all the debris, disassemble the enclosure.

All debris resulting from surface preparation shall be contained and vacuum collected daily or more frequently due to debris buildup. Such debris, steel pieces, rust, and paint chips removed by hand or power tool cleaning, shall be stored in leakproof storage containers in the secured storage site, or as ordered by the Engineer. Debris storage of materials removed from all steel structures required in the project shall be in accordance with NJDEP Hazardous Waste Management Regulations.

Storage containers shall not be used on the project until and unless they have been reviewed and approved by the Engineer. Container storage sites shall be in areas that are properly drained and runoff water shall not be allowed to pond. The containers shall be placed on pallets or other approved material and not directly on the ground.

The Contractor shall maintain a secure and approved storage site which shall be large enough to handle all coating debris that is collected and stored on site at any time. The Contractor shall store coating debris only in the secured storage site. During cleaning operations, all surface preparation debris shall be collected from the containment enclosure and the coating debris shall be conveyed to the secured storage site at the conclusion of the work shift. The Contractor shall account for all coating debris transported from the project to the waste reclamation/disposal facility. The Contractor is responsible for the proper handling of the surface preparation debris and coating debris. All spillage shall be cleaned up immediately.

Storage containers shall be closed and covered with a waterproof tarpaulin at all times except during placement, sampling, and disposal of the debris.

The Contractor is liable for any fines, costs, or remediation costs incurred as a result of their failure to be in compliance with all federal, state, and local laws.

(2) Level 3 - Class 3A Containment and Collection of Surface Preparation Debris.

(a) Description.

This work shall consist of furnishing and erecting SSPC Guide 6(CON) Class 3A containment enclosures with negative air pressure as required to contain and collect debris resulting from the abrasive blast preparation of weathering steel surfaces for painting. Also included are the collection and the storage of debris in suitable containers.

The containment and collection of debris shall be done in strict conformance with all OSHA , Federal Environmental Protection Agency, NJDEP, and other regulatory agencies with jurisdiction, rules, regulations, standards, and guidelines in effect at the time the work is in progress.

(b) Materials.

Materials and equipment shall be of satisfactory quality to perform the work and shall not be used on the project until and unless they have been reviewed and approved by the Engineer.

Fifty-five (55) gallon barrels with resealable lids, or lined storage containers sized for the job shall be leakproof; shall conform to the Code of Federal Regulations Title 49, Chapter 1, Paragraphs

173.510A(1),(5) and Paragraph 178.118; and shall not be used on the project until and unless they have been reviewed and approved by the Engineer.

(c) Containment Enclosures With A Suspended Platform.

The Contractor shall submit to the Engineer, complete copies of detailed shop and working drawings in accordance with Subsection 104.08. All plans and calculations shall be prepared and stamped by a Professional Engineer licensed in New Jersey. These drawings shall detail as described below, the proposed methods for such activities. The Contractor shall not commence with containment enclosure erection and abrasive blast cleaning until and unless the working drawings have been reviewed and approved by the Engineer, and shall proceed with such work only within approved containment enclosures.

The shop and working drawings shall include the following:

(1) A construction plan and drawings detailing proposed coating removal operations, abrasive debris classification and separation, removal, and transport of waste to a secure storage site.

(2) A plan and drawings detailing the proposed containment enclosure, including details of the following:

(a) Rigid, solid floor or working platform.

(b) Containment walls with rigid and flexible materials.

(c) Rigid supports and bracing for the floor and wall panels, rigid or flexible supports and bracing for flexible walls.

(d) Calculations using working stress design shall include localized overstress conditions, member stresses, H.S. load rating and maximum dead and live load imposed on the bridge by the containment enclosure, grit blasting/recycling equipment and H.V.A.C. equipment.

(e) Maximum allowable load for the floor/platform.

(f) Wind load and wind stresses imposed on the bridge by the containment enclosure shall be calculated and submitted.

(g) Connections to the bridge, i.e., clamps, rollers.

(Note: Welding and bolting is not allowed.) Each connection to the bridge shall have a tension load cell attached. A multi-channel digital load indicator shall be connected to all the bridge connection load cells and located in an area accessible to the Engineer. The load indicator shall be capable of storing peak load readings.

(h) Auxiliary stationary source lighting.

(i) Dust collection and filtration equipment, including the equipment data sheets and air flow capacity.

(j) Entrance/Exit through tarpaulin seams which can be sealed.

(k) Location of equipment and impact on traffic.

(l) Elevation view of the containment enclosure with indications of any encroachments on the surroundings. The bridge vertical clearance shall be maintained throughout the project.

Note: Unless otherwise noted, the structure loading for containment design shall be in accordance with the Design Specifications utilized for the project and the Load Rating method and live load requirements as specified in the Contract Documents. Regardless, the Operating Rating for all conditions shall remain above 1.0 unless noted otherwise.

The Contractor shall submit to the Engineer, complete copies of detailed shop and working drawings in accordance with Subsection 104.08. All plans and calculations shall be prepared and stamped by a Professional Engineer licensed in New Jersey. These drawings shall detail as described below, the proposed methods for such activities. The Contractor shall not commence with containment enclosure erection and abrasive blast cleaning until and unless the working drawings have been reviewed and approved by the Engineer, and shall proceed with such work only within approved containment enclosures.

(d) Containment Enclosures Without A Suspended Platform.

The working drawings shall include the following:

(1) A construction plan and drawings detailing proposed coating removal operations, abrasive debris classification and separation, removal and transport of waste to a secure storage site.

(2) A plan and drawings detailing the proposed containment enclosure, including details of the following:

(a) Containment walls with rigid and flexible materials.

(b) Rigid supports and bracing for the floor and wall panels, rigid or flexible supports and bracing for flexible walls.

(c) Connections to the bridge, i.e., clamps, rollers.

(d) (Note: Welding and bolting is not allowed).

(e) Auxiliary stationary source lighting.

(f) Dust collection and filtration equipment, including the equipment data sheets and air flow capacity.

(g) Entrance/Exit through tarpaulin seams which can be sealed.

(h) Location of equipment and impact on traffic.

(i) Elevation view of the containment enclosure with indications of any encroachments on the surroundings. The bridge vertical clearance shall be maintained throughout the project.

In addition, if the bridge vertical clearance is greater than 30 feet, the wind load and wind stresses imposed on the bridge by the containment enclosure shall be calculated and submitted.

Reference information on enclosures can be obtained from the following sources:

- SSPC Guide 6(CON)
- Steel Structures Painting Manual, Volume 1.
- AASHTO Manual for Assessing Safety Hardware (MASH)

The containment enclosure shall be sealed across the bridge deck underside between the girders with a rigid material. The floor should be covered with a waterproof tarpaulin attached and sealed to the enclosure wall and floor around the entire enclosure perimeter. All edges of tarpaulins shall have a two foot flap that clamps over the connected edges around the entire perimeter. These flaps shall be completely fastened 12 in. on center for both edges and sealed completely with the tarpaulin manufacturer's recommended tape and caulk.

During abrasive blast cleaning, if the containment enclosure is allowing debris to escape, the Contractor shall immediately stop such work until the enclosure is repaired. Any debris released from the enclosure shall be cleaned up by the Contractor immediately.

The containment enclosure shall be disassembled if the wind velocity is greater than 40 miles per hour, if it is forecast to be higher or when directed by the Engineer. However, if the wind velocity is below 40 MPH, but high enough to cause the containment enclosure to billow and emit dust, the Contractor shall immediately cease abrasive blast cleaning and, after cleaning up all the debris, disassemble the enclosure.

All debris resulting from surface preparation shall be contained and vacuum collected daily or more frequently as directed by the Engineer, due to debris buildup. Such debris, abrasive blast residue and laminar corrosion removed by hand or power tool cleaning, shall be stored in leakproof storage containers in the secured storage site, or as directed by the Engineer. Debris storage shall be in accordance with New Jersey Hazardous Waste Management Regulations.

The Contractor shall maintain a secure storage site which shall be large enough to handle all debris that is collected and stored on site at any time. The Contractor shall store debris only in the secured storage site. During abrasive blast cleaning operations, all surface preparation debris shall be vacuum collected from the containment enclosure and removed to the abrasive recycling reclaimer unit, and the coating debris shall be conveyed to the secured storage site at the conclusion of the work shift. The Contractor shall account for all coating debris conveyed to the secured storage site and all coating debris transported from the project to the hazardous waste treatment/disposal facility. The Contractor is responsible for the proper handling of the surface preparation debris and coating debris. All spillage shall be cleaned up immediately.

Storage containers and sites shall be located so as not to cause any traffic hazard. Container storage sites shall be in areas that are properly drained and runoff water shall not be allowed to

pond. The containers shall be placed on pallets or other approved material and not directly on the ground.

Storage containers shall be closed and covered with a waterproof tarpaulin at all times except during placement, sampling, and disposal of the debris.

Light at the steel surface within the enclosure shall be maintained by the Contractor at a minimum of 50 foot-candles as measured by a light meter. Such lighting shall be maintained throughout the surface preparation, painting, and inspection activities.

Any air exhausted from the containment enclosure, abrasive recycling equipment or vacuum equipment shall be passed through a filtering system. The Contractor is responsible for the design, effectiveness and maintenance of this filtering system. No discharge of debris dust shall be allowed.

The Contractor is liable for any fines, costs, or remediation costs incurred as a result of their failure to be in compliance with this specification and all federal, state, and local laws.

(3) Level 2 - Class 2a Containment And Collection Of Surface Preparation Debris.

(a) Description.

This work shall consist of furnishing and erecting S.S.P.C. Guide 6 (CON) Class 2A containment enclosures with negative air pressure as required to completely contain and collect debris resulting from the removal of coatings in the preparation of steel surfaces for painting. Also included are the vacuum collection and the storage of debris in suitable containers.

The containment and collection of debris shall be done in strict conformance with all OSHA, Federal Environmental Protection Agency, NJDEP and other regulatory agencies with jurisdiction, rules, regulations, standards and guidelines in effect at the time the work is in progress.

(b) Materials.

Materials and equipment shall be of satisfactory quality to perform the work and shall not be used on the project until and unless they have been reviewed and approved by the Engineer.

Rigid walls for the containment enclosure shall be comprised of plywood panels or corrugated panels of steel, aluminum or reinforced fiberglass. Flexible containment walls shall be constructed of fire retardant tarpaulin material which shall be impermeable to air and water.

Fifty-five (55) gallon barrels with resealable lids, or lined storage containers sized for the job shall be leakproof; shall conform to the Code of Federal Regulations Title 49, Chapter 1, Paragraphs 173.510A(1),(5) and Paragraph 178.118; and shall not be used on the project until and unless they have been reviewed and approved by the Engineer.

In meeting the requirements of these specifications, the Contractor shall supply one or more portable light meters with a scale of 0.0-50.0 foot candles.

(c) Construction Methods.

The Contractor shall proceed with one of the following containment methods: (d) - Containment enclosure with a suspended platform, or (e) - Containment enclosure without a suspended platform.

(d) Containment Enclosure With A Suspended Platform.

The Contractor shall submit to the Engineer complete copies of detailed shop and working drawings in accordance with Subsection 104.08. All plans and calculations shall be prepared and sealed by a Professional Engineer licensed in New Jersey, which drawings shall detail as described below, the proposed methods for such activities. The Contractor shall not commence with containment enclosure erection and abrasive blast cleaning until and unless the shop and working drawings have been reviewed and approved by the Engineer, and shall proceed with such work only within approved containment enclosures.

The shop and working drawings shall include the following:

(1) A construction plan and drawings detailing proposed coating removal operations, abrasive debris classification and transport of waste to a secure storage site.

(2) A plan and drawings detailing the proposed containment enclosure, including details of the following:

(a) Rigid, solid floor or working platform.

(b) Containment walls with rigid and flexible materials.

(c) Rigid supports and bracing for the floor and wall panels, rigid or flexible supports and bracing for flexible walls.

(d) Calculations using working stress design shall include localized overstress conditions, member stresses, H.S. load rating and maximum dead and live load imposed on the bridge by the containment enclosure, grit blasting/recycling equipment and H.V.A.C. equipment.

(e) Maximum allowable load for the floor/platform.

(f) Wind load and wind stresses imposed on the bridge by the containment enclosure shall be calculated and submitted.

(g) Connections to the bridge, i.e., clamps, rollers.

(**Note**: Welding and bolting is not allowed.) Each connection to the bridge shall have a tension load cell attached. A multi-channel digital load indicator shall be connected to all the bridge connection load cells and located in an area accessible to the Engineer. The load indicator shall be capable of storing peak load readings.

(h) Auxiliary stationary source lighting.

(i) Dust collection and filtration equipment, including the equipment data sheets and air flow capacity.

(j) Entrance/Exit through tarpaulin seams which can be sealed.

(k) Location of equipment and impact on traffic.

(l) Elevation view of the containment enclosure with indications of any encroachments on the surroundings. The bridge vertical clearance shall be maintained throughout the project.

Note: Unless otherwise noted, the structure loading for containment design shall be in accordance with the Design Specifications utilized for the project and the Load Rating method and live load requirements as specified in the Contract Documents. Regardless, the Operating Rating for all conditions shall remain above 1.0 unless noted otherwise.

(e) Containment Enclosures Without a Suspended Platform.

The Contractor shall submit to the Engineer complete copies of detailed shop and working drawings in accordance with Subsection 104.08. All plans and calculations shall be prepared and sealed by a Professional Engineer licensed in New Jersey, which drawings shall detail as described below, the proposed methods for such activities. The Contractor shall not commence with containment enclosure erection and abrasive blast cleaning until and unless the working drawings have been reviewed and approved by the Engineer, and shall proceed with such work only within approved containment enclosures.

The working drawings shall include the following:

(1) A construction plan and drawings detailing proposed coating removal operations, abrasive debris classification, and transport of waste to a secure storage site.

(2) A plan and drawings detailing the proposed containment enclosure, including details of the following:

(a) Containment walls with rigid and flexible materials.

(b) Rigid supports and bracing for the floor and wall panels, rigid or flexible supports and bracing for flexible walls.

(c) Connections to the bridge, i.e., clamps, rollers. (Note: Welding and bolting is not allowed).

(d) Auxiliary stationary source lighting.

(e) Dust collection and filtration equipment, including the equipment data sheets and air flow capacity.

(f) Entrance/Exit through tarpaulin seams which can be sealed.

(g) Location of equipment and impact on traffic.

(h) Elevation view of the containment enclosure with indications of any encroachments on the surroundings. The bridge vertical clearance shall be maintained throughout the project.

In addition, if the bridge vertical clearance is greater than 30 feet, the wind load and wind stresses imposed on the bridge by the containment enclosure shall be calculated and submitted.

Reference information on enclosures can be obtained from the following sources:

- SSPC Guide 6(CON)
- Steel Structures Painting Manual, Volume 1.
- AASHTO Manual for Assessing Safety Hardware (MASH)

The containment enclosure shall be sealed across the bridge deck underside between the girders with a rigid material. The floor should be covered with a waterproof tarpaulin attached and sealed to the enclosure wall and floor around the entire enclosure perimeter. All edges of tarpaulins shall have a two foot flap that clamps over the connected edges around the entire perimeter. These flaps shall be completely fastened 12 in. on center for both edges and sealed completely with the tarpaulin manufacturer's recommended tape and caulk.

During abrasive blast cleaning, if the containment enclosure is allowing debris to escape, the Contractor shall immediately stop such work until the enclosure is repaired. Any debris released from the enclosure shall be cleaned up by the Contractor immediately.

The containment enclosure shall be disassembled if the wind velocity is greater than 20 miles per hour, if it is forecast to be higher or when directed by the Engineer. However, if the wind velocity is below 20 MPH, but high enough to cause the containment enclosure to billow and emit dust, the Contractor shall immediately cease abrasive blast cleaning and, after cleaning up all the debris, disassemble the enclosure.

All debris resulting from surface preparation shall be contained and vacuum collected daily or more frequently as directed by the Engineer, due to debris buildup. Such debris, abrasive blast residue and paint chips removed by cleaning, shall be stored in leakproof storage containers in the secured storage site, or as directed by the Engineer. Debris storage shall be in accordance with NJDEP Hazardous Waste Management Regulations.

The Contractor shall maintain an approved, secure storage site which shall be large enough to handle all coating debris that is collected and stored on site at any time. The Contractor shall store coating debris only in this storage site. During abrasive blast cleaning operations, all surface preparation debris shall be vacuum collected from the containment enclosure and the debris shall be conveyed to the secured storage site at the conclusion of the work shift. The Contractor shall account for all coating debris conveyed to the secured storage site and all coating debris transported from the project to the hazardous waste treatment/disposal facility. The Contractor is responsible for the proper handling of the surface preparation debris and coating debris. All spillage shall be cleaned up immediately.

Storage containers shall not be used on the project until and unless they have been reviewed and approved by the Engineer. Container storage sites shall be in areas that are properly drained and runoff water shall not be allowed to pond. The containers shall be placed on pallets or other approved material and not directly on the ground.

Storage containers shall be closed and covered with a waterproof tarpaulin at all times except during placement, sampling, and disposal of the debris.

Light at the steel surface within the enclosure shall be maintained by the Contractor at a minimum of 50 foot-candles as measured by a light meter. Such lighting shall be maintained throughout the surface preparation, painting, and inspection activities.

The Contractor is liable for any fines, costs, or remediation costs incurred as a result of their failure to be in compliance with all federal, state, and local laws.

(4) Level 1 - Class 1a Containment And Collection Of Surface Preparation Debris.

(a) Description.

This work shall consist of furnishing and erecting S.S.P.C. Guide 6(CON) Class 1A containment enclosures with negative air pressure as required to completely contain and collect all dust and

debris resulting from the removal of coatings in the preparation of steel surfaces for painting. Also included are the vacuum collection and the storage of debris in suitable containers.

The containment and collection of debris shall be done in strict conformance with all OSHA, Federal Environmental Protection Agency, NJDEP and other regulatory agencies with jurisdiction, rules, regulations, standards and guidelines in effect at the time the work is in progress.

(b) Materials.

Materials and equipment shall be of satisfactory quality to perform the work and shall not be used on the project until and unless they have been reviewed and approved by the Engineer.

Rigid walls for the containment enclosure shall be comprised of plywood panels or corrugated panels of steel, aluminum or reinforced fiberglass. Flexible containment walls constructed of fire retardant tarpaulin material which shall be impermeable to air and water.

Fifty-five (55) gallon barrels with resealable lids, or lined storage containers sized for the job shall be leakproof; shall conform to the Code of Federal Regulations Title 49, Chapter 1, Paragraphs 173.510A(1),(5) and Paragraph 178.118; and shall not be used on the project until and unless they have been reviewed and approved by the Engineer.

(c) Construction Methods.

The Contractor shall proceed with one of the following containment methods: (d) Containment enclosure with a suspended platform, (e) Containment enclosure without a suspended platform.

(d) Containment Enclosure With A Suspended Platform.

The Contractor shall submit to the Engineer complete copies of detailed shop and working drawings in accordance with Subsection 104.08. All calculations shall be prepared and sealed by a Professional Engineer licensed in New Jersey, which drawings shall detail as described below, the proposed methods for such activities. The Contractor shall not commence with containment enclosure erection and abrasive blast cleaning until and unless the working drawings have been reviewed and approved by the Engineer, and shall proceed with such work only within approved containment enclosures.

The working drawings shall include the following:

(1) A construction plan and drawings detailing proposed coating removal operations, abrasive debris classification and separation, removal and transport of waste to a secure storage site.

(2) A plan and drawings detailing the proposed containment enclosure, including details of the following:

   (a) Rigid, solid floor or working platform.

   (b) Containment walls with rigid and flexible materials.

   (c) Rigid supports and bracing for the floor and wall panels, rigid or flexible supports and bracing for flexible walls.

   (d) Calculations using working stress design shall include localized overstress conditions, member stresses, H.S. load rating and maximum dead and live load imposed on the bridge by the containment enclosure, grit blasting/recycling equipment and HVAC equipment.

   (e) Maximum allowable load for the floor/platform.

   (f) Wind load and wind stresses imposed on the bridge by the containment enclosure shall be calculated and submitted.

   (g) Air flow and air recirculation within the enclosure and calculations. Airflow shall meet the S.S.P.C. Guide 6I requirements of 100 ft/min crossdraft and 50 ft/min downdraft and the O.S.H.A. Ventilation Standards. The maximum cross sectional area for air flow within the enclosure shall be 400 square feet.

   (h) Connections to the bridge, i.e., clamps, rollers.

   (Note: Welding and bolting is not allowed.) Each connection to the bridge shall have a tension load cell attached. A multi-channel digital load indicator shall be connected to all the bridge connection load cells and located in an area accessible to the Engineer. The load indicator shall be capable of storing peak load readings.

(i) Auxiliary stationary source lighting.

(j) Dust collection and filtration equipment, including the equipment data sheets and air flow capacity.

(k) Air intake points including filters, louvers, baffles, etc.

(l) Entrance/Exit compartment which can be completely sealed.

(m) Location of equipment and impact on traffic.

(n) Elevation view of the containment enclosure with indications of any encroachments on the surroundings. The bridge vertical clearance shall be maintained throughout the project.

(e) Containment Enclosure Without A Suspended Platform.

The Contractor shall submit to the Engineer complete copies of detailed shop and working drawings in accordance with Subsection 104.08. All calculations shall be prepared and sealed by a Professional Engineer licensed in New Jersey, which drawings shall detail as described below, the proposed methods for such activities. The Contractor shall not commence with containment enclosure erection and abrasive blast cleaning until and unless the working drawings have been reviewed and approved by the Engineer, and shall proceed with such work only within approved containment enclosures.

The working drawings shall include the following:

(1) A construction plan and drawings detailing proposed coating removal operations, abrasive debris classification, and removal and transport of waste to a secure storage site.

(2) A plan and drawings detailing the proposed containment enclosure, including details of the following:

(a) Containment walls with rigid and flexible materials.

(b) Rigid supports and bracing for the floor and wall panels, rigid or flexible supports and bracing for flexible walls.

(c) Air flow and air recirculation within the enclosure and calculations. Airflow shall meet the S.S.P.C. Guide 6I requirements of 100 ft/min crossdraft and 50 ft/min downdraft and the O.S.H.A. Ventilation Standards. The maximum cross sectional area for air flow within the enclosure shall be 400 square feet.

(d) Connections to the bridge, i.e., clamps, rollers.

(Note: Welding and bolting is not allowed).

(e) Auxiliary stationary source lighting.

(f) Dust collection and filtration equipment, including the equipment data sheets and air flow capacity.

(g) Air intake points including filters, louvers, baffles, etc.

(h) Entrance/Exit compartment which can be completely sealed.

(i) Location of equipment and impact on traffic.

(j) Elevation view of the containment enclosure with indications of any encroachments on the surroundings. The bridge vertical clearance shall be maintained throughout the project.

In addition, if the bridge vertical clearance is greater than 30 feet, the wind load and wind stresses imposed on the bridge by the containment enclosure shall be calculated and submitted.

Reference information on enclosures can be obtained from the following sources:

- SSPC Guide 6(CON)
- Steel Structures Painting Manual, Volume 1.
- AASHTO Manual for Assessing Safety Hardware (MASH)

The containment enclosure shall be sealed across the bridge deck underside between the girders with a rigid material. The floor shall be covered with a waterproof tarpaulin attached and sealed to the enclosure wall and floor around the entire enclosure perimeter. All edges of tarpaulins shall have a two foot flap that clamps over the connected edges around the entire perimeter. These flaps shall be completely fastened 12 in. on center for both edges and sealed completely with the tarpaulin manufacturer's recommended tape and caulk.

During abrasive blast cleaning, if the containment enclosure is allowing debris to escape, the Contractor shall immediately stop such work until the enclosure is repaired. Any debris released from the enclosure shall be cleaned up by the Contractor immediately.

The containment enclosure shall be disassembled if the wind velocity is greater than 20 miles per hour, if it is forecast to be higher or when directed by the Engineer. However, if the wind velocity is below 20 MPH, but high enough to cause the containment enclosure to billow and emit dust, the Contractor shall immediately cease abrasive blast cleaning and, after cleaning up all the debris, disassemble the enclosure.

All debris resulting from surface preparation shall be contained and vacuum collected daily or more frequently as directed by the Engineer, due to debris buildup. Such debris, abrasive blast residue and paint chips removed by hand or power tool cleaning, shall be stored in leakproof storage containers in the secured storage site, or as directed by the Engineer. Debris storage shall be in accordance with NJDEP Hazardous Waste Management Regulations.

The Contractor shall maintain a secure storage site which shall be large enough to handle all coating debris that is collected and stored on site at any time. The Contractor shall store coating debris only in the secured and approved storage site. During abrasive blast cleaning operations, all surface preparation debris shall be vacuum collected from the containment enclosure and removed to the abrasive recycling reclaimer unit, and the coating debris shall be conveyed to the secured storage site at the conclusion of the work shift. The Contractor shall account for all coating debris conveyed to the secured storage site and all coating debris transported from the project to the hazardous waste treatment/disposal facility. The Contractor is responsible for the proper handling of the surface preparation debris and coating debris. All spillage shall be cleaned up immediately.

The storage site shall be safe and secure. Storage containers shall not be used on the project until and unless they have been reviewed and approved by the Engineer. The container storage site shall be in an area that is properly drained and runoff water shall not be allowed to pond. The containers shall be placed on pallets or other approved material and not directly on the ground.

Storage containers shall be closed and covered with a waterproof tarpaulin at all times except during placement, sampling, and disposal of the debris.

Negative pressure verification with the portable manometers will be done by the Engineer before and during abrasive blast cleaning and during vacuum collection of all surface preparation debris.

Light at the steel surface within the enclosure shall be maintained by the Contractor at a minimum of 50 foot-candles as measured by a light meter. Such lighting shall be maintained throughout the surface preparation, painting, and inspection activities.

Any air exhausted from the containment enclosure or vacuum equipment shall be passed through a filtering system. The Contractor is responsible for the design, effectiveness and maintenance of this filtering system. No discharge of debris dust shall be allowed.

The Contractor is liable for any fines, costs, or remediation costs incurred as a result of their failure to be in compliance with all federal, state, and local laws.

(f) Temporary Storage And Disposal Of Surface Preparation Waste.

All surface preparation waste shall be designated, treated and handled as hazardous, and as such, the Contractor shall collect and store all such waste in the manner required herein until such time that laboratory testing establishes otherwise.

The Contractor shall not commence cleaning or blasting operations until he has submitted final documentation that he has an approved reclamation/disposal site(s) and all required permits for the handling, storage, and transportation of hazardous waste.

All storage drums shall be completely filled with collected waste and lids shall be sealed at all times except during filling and sampling operations. All drums containing waste from painted steel structures shall be labeled as hazardous waste and shall include all generator information.

The Contractor through an independent certified testing laboratory approved by the Engineer, shall take two (2) composite samples from the waste generated for each structure, when, in the Engineer's opinion, 100 percent of the structure has been cleaned, and/or prior to transport of the drums from the job site, whichever occurs first. The drums shall be stored a minimum 30' away from the edge of traveled roadway on site at each of the structures, in an area designated by the

Engineer, and be removed no later than completion of cleaning at that structure.

Each waste sample taken by the Contractor's testing laboratory shall be analyzed by the TCLP test (Method 1311) to determine the leachable level of lead and arsenic containing wastes for comparison to the Regulatory Threshold limit. The Contractor's testing lab shall also be responsible for reporting the complete elemental makeup of all waste samples in accordance with all EPA and the disposal site requirements prior to the transfer of any hazardous materials. The Contractor shall document and furnish these test results to the Engineer as they become available.

The Contractor's certified independent laboratory shall then process each sample and designate each as hazardous or non-hazardous.

It is the Contractor's responsibility to store all drums in a location that allows for removal and transportation by others without recourse to specialized machinery other than that normally required for hazardous waste disposal. Lane closings will not be permitted for the removal of drums from the work site. The Contractor will be held strictly responsible for all damage to or tampering with sealed drums until such time as they are removed by the Contractor.

Waste designated as hazardous shall be picked up, transported and recycled or disposed of in a manner described in the Contractor's pollution control plan and in accordance with all applicable Federal and State regulations, including, but not limited to, New Jersey Department of Environmental Protection (NJDEP) hazardous waste regulations (NJAC 7:26-1, 4, 7-13A, 16, 16A and 17).

411.05 Cleaning and Painting of Steel Structures.

Along with Subsection 411.06 requirements, cleaning and painting of new and existing structural steel both in the shop and in the field shall be performed as follows:

(A) GENERAL.

Unless otherwise specified, the primer shall be applied in the shop after fabrication is completed. The other coats, hereafter referred to as field coats, shall be applied in the field after erection is completed except that all coats, including the prime coat, for galvanized surfaces may be field applied. Paint shall be applied in accordance with SSPC-PA1 and such additional requirements as specified herein. Surfaces placed in contact in fabrication shall not be painted unless otherwise specified.

For the surfaces of all welds made both in the shop and in the field, and the metal immediately adjacent, the cleaning shall include thorough abrasive blasting or other approved methods which will insure complete removal of slag.

Surface temperature measurements shall be made with Model 315F T1 or other approved model of surface temperature thermometer as manufactured by the Pacific Transducer Corporation Ph. (877)782-2329 or a Bureau of Reclamation Portable Gauge thermometer, or other approved instrument. The dew point shall be determined in accordance with ASTM E337, using a sling psychrometer.

Dust brushes shall be used as necessary to secure clean surfaces immediately before the paint is applied. All small cracks and cavities which are not sealed and watertight shall be filled with a pasty mixture of an approved, non-lead, non-aluminum, paint system compatible primer and linseed oil before the first coat is applied.

In brush application, paint shall be evenly spread and thoroughly rubbed out over the entire surface of the metal with the minimum practicable amount of brushing and all finishing strokes shall be applied in the same direction. All paint brushes and dust brushes shall be approved as to size, shape, and quality. High quality brushes will be required and brushes more than five inches wide will not be permitted. Surfaces inaccessible for brushes shall be painted by the use of daubers or sheepskins specially made for this purpose.

Areas of metalwork which will be in direct contact with concrete shall not be painted.

On existing bridges where either complete or partial removal of the existing paint system is to be done, the Contractor shall clean and apply all required coatings to at least one representative structural steel test area using the equipment, cleaning methods, painting materials, one or more of the application methods in Paragraph 411.05(H) and sequence proposed and/or required to be used for the project for acceptance testing by the Engineer. The number, size and structural steel makeup of the steel test area(s) shall be as approved by the Engineer. If all required coatings are accepted by the Engineer, the applied coatings to the structural steel test area may be used as accepted coatings for the structural steel. Any test area requiring

repainting shall be made at no cost to the Authority and may be cause for the Contractor to make new equipment and methods submittals as deemed necessary by the Engineer.

(B) Cleaning And Surface Preparation Of Unpainted Weathering Steel (ASTM A588 Or A709 Grade 50W).

For the purpose of obtaining a high degree of weathering uniformity of the steel exposed to view, all outside surfaces, including all welds and the bottom surface of the bottom flange of the fascia stringers, shall be blast cleaned in accordance with SSPC-SP6 as soon after fabrication as practical.

In general, the appearance of the surface after commercial blast cleaning shall correspond with Pictorial Standards B Sa 2, or C Sa 2 of the Steel Structures Painting Council Specification SSPC-Vis 1, as a minimum. Standard B Sa 2 shall apply to surfaces with partially rusted mill scale; Standard C Sa 2 shall apply to surfaces with completely rusted mill scale.

The steel shall be kept free and clean of all foreign materials such as grease, oil, concrete spatter, chalk marks, crayon marks, dirt, etc., and any foreign matter that may affect the natural oxidation of the steel.

The steel shall be temporarily protected during concrete operations and any other operation that is likely to result in soiling of the steel.

Any foreign matter which gets on the steel after it has been blast cleaned is to be removed as soon as possible with solvent in accordance with SSPC-SP 1.

(C) Shop Cleaning.

Non-weathering steelwork shall be cleaned in the shop just before it is painted with the primer or joined in shop assembly. Cleaning shall comprise the removal of all rust, mill scale, dirt, oil, grease, and other foreign substances in accordance with the Steel Structures Painting Council Surface Preparation Specification SSPC-SP6, No. 6, Commercial Blast Cleaning, unless another method is specifically permitted.

Accepted blast-cleaned surfaces shall be primed within 24 hours after they are cleaned. Blast cleaning shall be performed only when the provisions specified for painting operations will prevail until the paint is applied within the 24 hour time limitation. The cleaning and painting operations shall be closely coordinated so that at no time shall the temperature of the steel surface or surrounding atmosphere be less than 5°F. above the dew point before the paint is applied. Under no circumstances shall the steel be permitted to rust before painting, regardless of the time elapsed. If any rust forms after blast cleaning, the surface shall be reblasted clean before painting.

In general, the appearance of the surface after commercial blast cleaning shall correspond with the applicable Pictorial Standards of SSPC-VIS 1, "Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning."

The inside of box members shall be abrasive blasted before assembly. After completion of fabrication and bolting or welding of the member, the inside surface shall be hand scraped as necessary to remove all rust, dirt, and other foreign substance which may have accumulated since the surfaces were abrasive blasted; the outside surfaces shall be abrasive blasted; all surfaces shall be swept and dusted so as to be free of loose particles and dust immediately before painting; and then the member shall be painted.

When hand cleaning is specified or directed by the Engineer, the work shall be performed in accordance with the Steel Structures Painting Council Specification SSPC-SP2, Hand Tool Cleaning, except that all rust shall also be removed. Surfaces placed in contact in fabrication shall be similarly cleaned of all rust, loose scale, and dirt before assembly.

(D) Shop Painting.

All painting shall be done in dry weather or under cover. Metalwork shall be free from moisture or frost when paint is applied, and painted surfaces shall not be permitted to become wet by condensation or otherwise be subjected to freezing temperatures until the paint has reached a hard set. No painting shall be done when the air is misty or when the temperature of the metal or the surrounding air is below 40°F.; nor shall any painting be started or continued when there is reasonable indication that the temperature may drop to 40°F. or lower within six hours; nor shall any painting be started when the temperature of the metal or the surrounding air is less than 5°F. above the dew point. Any paint injuriously affected by cold, rain, moisture, or condensation shall be entirely cleaned off and fresh paint applied.

Prior to starting surface preparations, the Contractor shall clean and apply all required coatings including new field coatings to an unpainted structural steel test area using the equipment, cleaning methods,

painting materials, one or more of the application methods in Paragraph 411.05(H) and sequence proposed and/or required to be used for the project for acceptance testing by the Engineer. The size and structural steel makeup of the test area steel shall be as approved by the Engineer. If all required coatings are accepted by the Engineer, and the applied coatings to the structural steel test area may be used as accepted coatings for the structural steel. Any painted test area requiring repainting shall be made at no cost to the Authority and may be cause for the Contractor to make equipment and methods adjustments as deemed necessary by the Engineer.

Shop paint shall be applied either by an approved test area method, wholly by brush or in part by brush and in part by spray in such a way as to secure an even paint film uniform in thickness, tint, and consistency over the entire surface, free from pin holes or excessive brush marks. Edges and corners of all metalwork, including all individual members, bars, shapes, plates, welds, rivets, and bolts shall be striped by brush painting in advance of the application of paint to other parts, whether such subsequent application is by brush or by spray.

Erection marks shall be painted on the shop coat. Surfaces to be welded in the field shall be painted with a manufacturer and Engineer approved weldable primer in the shop. Machined surfaces shall not be primed in the shop but shall be given a coat of readily removable lacquer or other approved rust inhibitive coating before leaving the shop.

Any paint applied by spray shall be with a spray gun of a type and with methods of operation approved by the paint manufacturer and acceptable to the Engineer. Approved uniform air pressure shall be maintained so as to secure even operation. The distance of the spray gun from the part being painted, the angle of application, and all operations shall be subject to approval. Spraying operations shall be by competent operators and shall be carried out so as to secure an even paint film, uniform in thickness over the areas painted. Any areas of film of insufficient or excessive thickness shall, if so ordered, be removed and repainted. If such removal necessitates the removal of undercoats, all such coats shall be replaced in proper order.

Indifferent character of cleaning and painting of metalwork in the shop will not be tolerated and attention of the Contractor is particularly directed to the provisions herein included. Shop painting which is disclosed as being defective or damaged prior to the termination of the Contract under which it was applied, shall be replaced or repaired in an approved manner by the Contractor. Defective painting shall be replaced with the specified paint after the defective paint films have been removed from the affected area and the metalwork has been properly cleaned.

The Contractor shall provide free and uninterrupted access to any places where cleaning and painting may be in progress to the service representatives and inspectors of the manufacturer of the paint, as well as to the Engineer.

(E) FIELD CLEANING AND SPOT-PAINTING NEW NON-WEATHERING STEELWORK.

Areas of steelwork which have not received a coat of the primer in the shop, such as field welds and field bolts, and areas of steelwork which have been painted in the shop and which have been scraped by abrasion or otherwise damaged, shall be cleaned in the field as specified for hand-cleaning in the shop in Paragraph 411.05(C) and shall then receive a coat of the primer.

The shop coating applied to machined surfaces of pins and pin holes shall be removed in the field.

All surfaces not in contact which will not be accessible for painting after erection shall receive the full number of coats specified above. The coats which would normally be applied in the field after completion of erection shall be applied in the field before the parts are erected. Interior surfaces of box members will not be considered as surfaces inaccessible for painting after erection.

All spot and touch-up painting shall be by brush except as otherwise approved for specifically designated areas.

(F) FIELD CLEANING, PAINTING AND SPOT-PAINTING EXISTING STRUCTURAL STEEL.

As a part of the maintenance and repair work, the Contractor shall remove all paint, rust, loose scale, zinc coating, and dirt down to clean bare metal over areas where corrosion has started and over areas which show evidence of failure or incipient failure of the paint film or zinc coating, such as blistering, checking, cracking, flaking, scaling or peeling. In general, old paint that is sound shall not be removed if required or allowed by Contract documents; however, where pin-point corrosion or pitting is closely spaced, the old paint over the entire area of such closely spaced points of corrosion may be removed as necessary or practical.

(1) Previously Painted Non-weathering Steel Bridges.

When required by the Contract documents, the surfaces of all steelwork (including steel substructure beams and piers when applicable) located within a horizontal distance of 10 linear feet either side of the centerline of all bridge joints and abutments shall be blast cleaned in accordance with SSPC-SP6 Commercial Blast Cleaning.

If only partial repainting is specified in contract documents, areas of existing paint that are determined to be generally sound by the Engineer shall be initially cleaned by water-blasting with a minimum pressure of 3,000 psi. and an approved combination of the following surface preparation methods; SSPC-SP2 "Hand Tool Cleaning," SSPC-SP3 "Power Tool Cleaning" and SSPC-SP11 "Power Tool Cleaning to Bare Metal" as required to meet surface preparation requirements. In joint areas existing laminar corrosion shall be removed by "Hand Tool Cleaning" and/or "Power Tool Cleaning" prior to abrasive blasting. The water-blast shall be injected with a detergent cleaner and heated to 180°F at application. The use of rust or other inhibitors shall not be permitted.

At other locations where previously painted steelwork surfaces exhibit poor adhesion of the existing paint system, loose paint, rust, loose scale, blistering, checking, cracking, flaking, scaling, peeling, or closely spaced pinpoint corrosion, blast cleaning shall be employed in accordance with SSPC-SP6 "Commercial Blast Cleaning" to the limits directed by the Engineer or the Contract documents as required to remove unsound coating.

Where complete paint removal is required, blast cleaning shall be in accordance with SSPC-SP6.

(2) Previously Painted Weathering Steel Bridges.

When required by the contract documents, the surfaces of all previously painted areas of steelwork shall be cleaned by water-blasting with a minimum pressure of 3,000 psi followed by SSPC-SP2 "Hand Tool Cleaning" and SSPC-SP3 "Power Tool Cleaning" to remove existing laminar corrosion, followed by SSPC-SP10 "Near White Blast Cleaning". The water-blast shall be heated to 180°F at application. The use of rust or other inhibitors will not be permitted. The Contractor shall repeat abrasive blast cleaning and water-blast cleaning operations as required to achieve removal of chloride contamination to levels specified herein.

SSPC-SP10 "Near White Blast Cleaning" may be used as the sole method for complete paint removal in lieu of the other cleaning procedures above if approved by the Engineer.

(F.1) As part of the work of cleaning and painting all existing steel structures, the Contractor shall completely clean the tops of all piers and abutments; removing all existing concrete rubble and debris, clean all troughs, and remove all abandoned facilities within the project limits, such as rigid metallic conduit, as directed by the Engineer. No payment will be made for any cleaning or removals made outside project limits unless authorized by Engineer.

A standard of cleaning for each of the above specified surface preparation methods shall be established at the job outset for the Engineer's review and approval. The surface for the standard (or control) shall be a flat portion of the surface actually to be cleaned and shall be located by the Engineer. Those standards, once approved by the Engineer, shall serve as a guide for the project. To supplement this standard, SSPC-VIS 1-89 shall be used as the reference for blast cleaning.

Blasting residues, spent blasting medium, rust particles, paint particles, and dust associated with the work shall be captured, contained, collected and disposed of in accordance with Subsection 411.04.

Before and after blast cleaning, and before and after hand and/or power tool cleaning, prior to applying the paint systems, all dissolvable foreign matter, such as oil, grease and dust shall be removed in accordance with the provisions of SSPC-SP1 "Solvent Cleaning" Method 4.1.1 only, as required or directed by the Engineer.

All foreign materials such as dirt, dust, rust scale, sand, bird droppings, and all materials loosened by abrasive blasting operations shall also be completely removed before any painting operations are begun.

The cleaned surface shall be reviewed, and, if meeting applicable SSPC-SP cleaning requirements, approved by the Engineer prior to any painting.

Failure by the Contractor to properly prepare and clean surfaces to be painted in accordance with the specifications shall be cause for rejection by the Engineer. All surfaces which are rejected shall be recleaned and, if necessary, recoated to the satisfaction of the Engineer in accordance with the

specification, at no additional cost to the Authority.

The specified height of the steel surface anchor profile shall be 1-3 mils for Paint System A on previously painted non-weathering steel bridges and 3-5 mils for Paint System B on existing weathering steel structures and shall be uniform. Verification of the profile height shall be performed by the Engineer utilizing extra coarse Testex Replica Tape (1.5 - 4.5 mils). The impressed tape is a record to be filed with the project inspection records. Note: When measuring the profile on the tape, 2 mils will be subtracted (non-compressible mylar thickness) from the micrometer reading.

Replica Tape will not work on the corroded surfaces of A-709 Grade 50W weathering steel structures. Instead, for each lot of abrasive, the Contractor shall supply a non-blasted piece of steel at least one foot square and 1/4 inch thick and blast it on site using their standard procedures. The Engineer will determine if the profile on this piece is acceptable, and will maintain the records.

The surface area of steel to be blast cleaned shall be no greater than the surface area of steel that can be primed or first coated in the same working day.

For cleaning all areas, the compressed air source and equipment requirements shall conform as specified herein.

All compressed air sources shall have oil and moisture separators, attached and functional, properly designed and sized to allow delivered air at the nozzle to be oil-free, moisture-free and of sufficient pressure to accomplish the associated work efficiently and effectively. The tanks on the air compressor and moisture separator shall be drained at the end of each work day. Prior to abrasive blast cleaning, the Contractor shall prove to the inspector that the air is moisture free. Air driven power tools shall be properly lubricated in accordance with the respective power tool manufacturer's instruction, but such lubrication shall not be deposited onto the bridge surface being prepared.

Air driven power tools shall be properly lubricated in accordance with the respective power tool manufacturer's instruction, but such lubrication shall not be deposited onto the bridge surface being prepared.

All surface preparation equipment, hoses and hoppers that the Contractor brings to the site shall be clean and free of any prior cleaning debris.

All fins, tears, slivers and burred or sharp edges that are present on any steel member, or that appear during the blasting operations, shall be removed by grinding to a SSPC-SP11 "Power Tool Cleaning to Bare Metal Finish," and the reblasted area shall provide the required anchor profile.

All abrasive and paint residue shall be removed from steel surfaces with a commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing with clean air. If the double blowing method is used, the top surfaces of all structural steel, including top and bottom flanges, longitudinal stiffeners, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The steel shall then be kept dust free until prime or first coat, as applicable, is applied.

The Contractor shall also clean to bare metal any areas where his operations have caused damage to the existing paint film or zinc coating or to newly applied paint.

Cleaning to bare metal shall be accomplished by abrasive blasting, wire brushing, scraping, chipping, sanding, grinding, either by hand tools or power tools, or by a combination of such methods. Abrasive blasting shall not be conducted when the temperature of the steel surface is less than 5ºF above the dew point.

Rust spots, in particular, shall be thoroughly cleaned and the edges of the existing old paint at such rust spots shall be removed back to sound uncorroded metal. Edges of remaining sound old paint shall be feathered or beveled off toward the cleaned area so that the repainted area will have a smooth appearance. The remaining old paint or zinc coating shall have sufficient adhesion so that it cannot be lifted as a layer by inserting the blade of a putty knife under it.

The steel wire of wire brushes used in the cleaning work shall have sufficient rigidity to clean the surface of the metal, shall be kept free of excess foreign matter, and shall be discarded when they are no longer effective. Scrapers and chisels shall be made of suitable material and shall be stiff enough and kept sharp enough to be effective. Putty knives are specifically excluded from use as a cleaning tool. All tools shall be operated in such a manner that no burrs or sharp ridges are left on the surface and no sharp cuts shall be made into the metal.

Before application of paint, all surfaces of remaining sound old paint and cleaned bare metal shall be

thoroughly cleaned of all bird excrement, soot, dirt, chalked paint, oil, grease, or other foreign materials that may have accumulated on the surfaces. Surfaces of newly applied paint which have become dirty shall likewise be cleaned before recoating. The cleaning shall be done by use of bristle or wood fiber brushes or, where necessary, by wire brushes and/or by use of suitable solvents. The manner and methods of cleaning the surfaces shall be such as to obtain a clean surface free of contaminants or other objectionable substances, without causing injury or damage to the surfaces of the paint film.

All cleaning operations in any space or section shall be completed, and inspected and approved by the Engineer before the application of each coat of paint is started.

Since abrasive blasted steel surfaces are generally warmer than the surrounding air because of the heat generated by the abrasive blasting and are particularly susceptible to new corrosion and condensation, the Contractor shall schedule the priming of abrasive blasted surfaces promptly after cleaning has been approved for a section of steelwork so as to prevent the formation of new corrosion or condensation prior to coating.

All small cracks and cavities not sealed and watertight shall be filled with a pasty mixture of an approved, non-lead, non-aluminum, and paint system compatible primer and linseed oil before complete or spot painting is started.

Paint shall be applied to areas immediately after the specified cleaning has been completed and approved. The Contractor shall be responsible for the removal of any rust formation which may occur subsequent to approval of the cleaned surfaces and prior to the application of the prime coat.

All spot-painting and touch-up painting shall be by brush except as otherwise approved for specifically designated areas.

Galvanized surfaces made bare by the cleaning operations shall be treated before painting in accordance with the requirements of ASTM D6386.

(G) REMEDIATION OF CHLORIDE.

Develop surface preparation procedures and processes which will remove chloride from the surfaces in addition to removing the laminar corrosion, rust, and mill scale. Surfaces that may be contaminated with chloride include, but are not limited to, expansion joints and all areas that are subject to roadway splash or runoff, such as fascia beams and stringers.

Approved methods of chloride removal have included, but are not limited to, steam cleaning or pressure washing and scrubbing before or after initial paint removal, abrasive blast cleaning the steel and allowing it to rust overnight followed by reblasting, blast cleaning with blends of fine and coarse abrasives, or wet abrasive blast cleaning. Provide the proposed procedures for chloride remediation in the Surface Preparation/Painting Plan.

Upon completion of surface preparation, the Contractor shall use field chloride extraction and test procedures (e.g. silver dichromate) approved by the Engineer, to test representative surfaces which were previously rusted (i.e. pitted steel) for the presence of remaining chlorides. Perform a minimum of 3 tests per expansion joint, and 4 tests for each span. If unacceptable results are found, double the frequency for the retesting after additional cleaning. If acceptable results are continually achieved, reduce the test frequency only upon written approval of the Engineer. The Contractor shall record all test results in a daily log or daily report and submit it to the Engineer each seven calendar days.

If chlorides are detected at levels greater than $10ug/cm^2$, continue to clean the affected areas until this level is achieved.

Following chloride testing of less than $10ug/cm^2$, abrasive blast and/or power tool clean the surfaces, as applicable, to achieve the required surface preparation criteria. For surfaces that have already been abrasive blast cleaned, SSPC-SP11 may be used in lieu of SSPC-SP10 for the localized cleaning of the chloride test areas upon approval of the Engineer.

(H) APPLICATION OF PAINT IN THE FIELD.

Except as otherwise specified or approved, no paint shall be applied to new steelwork below the concrete slabs until the concrete is in place, the forms removed (other than stay-in-place forms), and any concrete patching or required rubbing is completed. All steelwork shall be thoroughly cleaned of concrete drippings, stains from concrete, and other objectionable materials before paint is applied.

After the complete prime or spot-painting in the field has been completed and the paint has dried hard, all

surfaces of steelwork shall be painted with the prescribed field coats of paint. No coat shall be applied until the preceding coat has dried hard to the satisfaction of the Engineer and the surface is thoroughly cleaned of any dirt or other foreign material that may have accumulated since the last cleaning or painting. Dust brushes and, if necessary, wire brushes shall be used as painting proceeds to clean off any accumulated dust or other objectionable material. Where areas of the paint coats previously applied have been damaged, such areas shall be restored by cleaning and spot-painting as elsewhere herein specified.

Application of paint in the field shall conform to the applicable requirements for application of paint in the shop in Paragraph 411.05(D) and the following:

Paint shall not be applied in rain, snow, fog or mist, or when the relative humidity exceeds 85 per cent. Paint shall not be applied to wet, damp, frosted or ice-coated surfaces, nor shall it be applied when the temperature of the air, the steel surface or the paint is lower than 40ºF; when the air temperature is higher than 95ºF, or when steel surfaces are at a temperature which will cause blistering or porosity, and in no event over 125 ºF.

Paint shall be applied wholly by brush the approved test area method except that surfaces not accessible to brushes shall be coated by means of daubers, sheepskins or by spraying with suitable, approved equipment. Approval to spray certain inaccessible areas on the structure shall not be considered approval to spray other areas. All edges, corners, crevices, rivets, bolts, welds, and sharp edges shall be stripe painted by brush in advance of the application of paint to other parts.

Brush painting shall be the only method permitted for painting above the deck elevation on all truss type bridges. Dust brushing shall immediately precede the application of each coat of paint.

Each coat of paint must be approved before a succeeding coat may be applied. Except as otherwise specified herein or approved by the Engineer, field painting of structural steel shall proceed promptly after the steelwork has been completely erected, inspected, cleaned as necessary, and spot painted.

Before the regular painting of each coat for any span or section is done, all painting which must be done with a swab, such as inside areas, areas of two angle sections, and other areas not possible to reach with a brush, shall first be completed.

The coating of paint shall be smoothly and uniformly spread so that every part of the surface will be covered with at least the minimum specified thickness and so that no excess paint will collect at any point.

All Contractor activities associated with the coating work described and specified herein shall be conducted in accordance with all applicable Federal (OSHA), State and local safety regulations and SSPC-PA Guide 3 "A Guide to Safety in Paint Application."

The Contractor shall provide sufficient and safe access for the inspector to conduct inspection duties.

Coating of the structures will be permitted only between sunrise and sunset except as permitted or required by the provisions of Sections 802 and 803 specified herein.

Coatings shall be applied on clean dry surfaces only. Coatings shall not be applied when the temperature of the air, paint or metal, or the relative humidity is expected to be outside of specified limits before the paint is fully cured, nor shall coatings be applied when a combination of temperature and humidity conditions are such that moisture condenses on the surface being coated.

None of the coatings shall be applied when the wind velocity exceeds 20 MPH or causes a hazard to traffic through blowing sand or paint, when the air is misty, or when in the opinion of the Engineer or upon notification by the State Police, conditions are unsatisfactory for the work. Also, paint shall not be applied upon damp or frosted surfaces, or when the metal is hot enough to cause the paint to blister, produce a porous paint film, or cause the vehicle (binder) to separate from the pigment.

Coatings shall not be applied when the relative humidity is above 85%, when there is falling rain or when the steel surface temperature is lower than 5 ºF above the dew point. The dew point shall be determined by the Engineer utilizing a psychrometer and appropriate tables.

Paint application shall be in accordance with SSPC-PA 1 and the following:

The first, prime or spot prime coat, as applicable, shall be applied immediately after inspection and acceptance of the surface. The prime or spot prime coat shall be applied the same day the metal is cleaned, but not until the cleaning operation is far enough ahead to eliminate the danger of dirt or other material from the cleaning operations from falling or blowing on the fresh paint. All blast cleaned surfaces shall be first coated, primed or spot primed, as applicable, the same day prior to any contamination, formation of rust, or any other deterioration of the prepared surface.

The minimum curing time between coats shall be in accordance with the manufacturer's written recommendations.

Depending on site conditions, additional time may be required for proper curing before applying succeeding coats. It is the applicator's responsibility to determine if the coating has cured sufficiently for proper application of succeeding coats; however, succeeding coats shall not be applied until each coat is approved by the Engineer. The maximum time interval between coats and required surface preparation procedures, should this interval be exceeded, shall be in accordance with the manufacturer's written recommendations.

The coatings shall be smoothly and uniformly spread so that every part of the surface will be covered with at least the minimum specified thickness, and so that no excess coating will collect at any point. A dense and uniform appearance is required after each applied coating has cured.

If the coating is too thin or if portions of the surface are not completely coated, such portions of the work shall be recoated. If the application of the coating at the required thickness in one coat produces runs, bubbles or sags, the coating shall be applied in multiple passes of the spray gun. Where excessive coating thickness produces surface defects such as "mud-cracking," such coating shall be removed back to soundly bonded coating and the area recoated to the required thickness. In areas of deficient primer thickness, the areas shall be thoroughly cleaned with power washing equipment, as necessary to remove all dirt. The areas shall then be wire brushed, vacuumed, or otherwise prepared as directed, and then recoated.

Any cracks or defects found in the steel by the Contractor should be immediately reported to the Engineer.

The coatings shall be applied using the approved methods and equipment used for the test area(s) and applicable additional requirements specified herein and/or as approved by the Engineer, that will attain satisfactory results and the film thicknesses specified.

The Contractor shall provide a suitable facility for the storage of the coatings in accordance with the latest applicable regulations. The coating storage facility must provide suitable protection from the elements and insure that the paint is not subjected to temperatures outside of the manufacturer's recommendations. The Engineer shall be provided access to the stored paint at any time for inspection.

(1) Spray Painting.

Spray nozzles and pressures shall be in accordance with the manufacturer's recommendations. Airless spray equipment shall be utilized when allowed in accordance with the manufacturer's recommendation.

Compressed air supply lines shall be provided with oil traps and moisture separators. The traps and separators shall be changed on a regular basis. Compressed air shall be in accordance with the blotter test as described in ASTM D 4285.

Whenever painting operations are interrupted, the zinc-rich primer remaining in the fluid hose shall be expelled from the hose. Spray equipment which is used for application of the zinc-rich primer shall be thoroughly cleaned at the end of each workday with an approved solvent. The leftover solvent and paint waste material shall be disposed of properly.

The level of containment to be achieved for spray painting the paint systems which develop a "dryfall" overspray product shall be Level 3. The level of containment to be achieved for spray painting the paint systems which do not develop a "dryfall" product shall be Level 2. The Engineer shall determine if the overspray product is considered dryfall by testing the overspray at a distance no greater than the least distance from the steel to be painted to a tarp opening, or to the floor, whichever is less. The tarp opening and floor locations shall be determined from the pollution control plan.

(2) Brush Painting.

Brushes preferably shall be round or oval in shape, but if flat brushes are used they shall not exceed 4.5 inches in width. All brushes shall have sufficient body and length of bristle to spread the paint in a uniform coat.

The paint shall be manipulated under the brush to produce a uniform, even coat in contact with the metal or previously applied paint, and shall be worked into all corners and crevices. In general, the primary movement of the brush shall describe a series of small circles to fill all irregularities in the surface, after which the coating shall be brushed out and smoothed by a series of parallel strokes until the paint film has an even thickness.

(3) Roller Painting.

Rollers, when used, shall be of a type which does not leave a stippled texture in the paint film. Rollers may be used only on flat, even surfaces. The rollers shall be manipulated in a manner which produces a paint film of even thickness with no skips, runs, sags, or thin areas. The roller operation should be closely followed by a bristle brush to level off any air bubbles.

(4) Inaccessible Surfaces.

On surfaces which are determined by the Engineer to be inaccessible for painting by regular means, the paint shall be applied by sheepskin daubers or sprayed, or by other means if necessary, to ensure coverage of the proper thickness of paint.

(5) Technical Representative.

When directed by the Engineer, a technical representative of the paint manufacturer supplying the specified paint shall be made available by the Contractor, at the job site, for consultation, to observe the preparation of the previously painted steel surfaces, and to insure the proper application of the required coatings. The representative shall be made available for a minimum of three full working days (30 hours), one day each for the start of surface preparation, application of primer top coats. No paint of this system shall be applied without the specific approval of the Engineer.

(6) Painting Sequence.

Preparation of steel surfaces and application of paint systems on new steel structures shall be performed in accordance with the Contractor's proposed sequence and schedule as approved by the Engineer.

Cleaning and painting shall proceed by sections as may be approved, usually consisting of one complete span. The cleaning and painting of each coat on each span, or other specified sections, shall be entirely completed and accepted before proceeding with the succeeding coat. In general, no coat of paint shall be applied until the preceding coat has dried hard. When any span or section is cleaned, ready for painting, or when any coat thereof is painted, the foreman shall call the attention of the Engineer thereto, who will give permission for painting to proceed when he is satisfied that previous work is completed. A suitable time as the Engineer may approve shall elapse after the last portion of one coat has been applied before the first portion of the next coat is applied. Where areas of the paint coats previously applied have been damaged by the Contractor's operations, such areas shall be restored by spot-cleaning and spot-painting with all prescribed coats.

When more than one bridge is to be painted, the Engineer reserves the right to specify the sequence in which the structures shall be painted.

(7) Removal of Unsatisfactory Paint.

If the paint coat lifts, blisters, wrinkles, or shows evidence of having been applied under unfavorable conditions, or if impure or unauthorized paint has been used, or if for any other reason the painting is unsatisfactory, the paint shall be removed and the metal cleaned and repainted at Contractor expense.

The coating performance shall be considered unsatisfactory if rusting occurs; the new coating or existing underlying paint coat lifts or debonds, blisters, wrinkles, has excessive runs or sags, or shows evidence of application under unfavorable conditions, the workmanship is poor, impure or unauthorized coatings have been used, or for other such reasons as determined by the Engineer. The unsatisfactory coating shall be removed, the metal recleaned and repainted as specified herein, by the Contractor at Contractor expense.

(8) Lettering.

Upon completion of the finish paint coat, the bridge shall be lettered as follows:

BR. NO. _____

DATE PAINTED: (MONTH AND YEAR)

CONTRACT NO. _____

The lettering shall be 2-5/8" to 2-3/4" high and 3/8" to 1/2" wide using yellow paint conforming to Federal Specification TT-E-489 matching color chip No. 13538 of Federal Standard No. 595.

The lettering shall be placed at two locations on the structure of the bridge where directed.

411.06 Cleaning and Painting of New Weathering Steel.

This work shall consist of the shop cleaning, preparing and painting of new ASTM A588 or A709 Grade 50W Steel areas near bridge deck joint areas, furnishing of all paints and other materials for the specified paint systems, and the application thereof to the properly prepared surfaces to the limits designated in Paragraph 403.05(C).

(A) General.

The shop cleaning, surface preparation and painting of new ASTM A588 or A709 Grade 50W (weathering) steel shall be performed on the surfaces of all steelwork including bearings and bearing components located within a distance of three times the stringer web depth measured from each stringer end at the abutments and from each side of the joint centerline at the piers. Secondary structural members partially located within the above-designated limits shall be completely painted. Structural steel members located between adjacent stringers of a different size shall be painted to the greater of the two designated limits. The limits of painting shall be measured along the longitudinal axis of each stringer.

Equipment to be used and methods of painting shall be established in accordance with test area requirements of Paragraph 411.05(D).

A complete coating system of an inorganic zinc-rich primer, high-build epoxy intermediate coat and a urethane finish coat shall be selected from one of the approved coating systems specified under Standard Specification Subsection 913.03.

Whenever the term "Coat" or "Coating" is used hereinafter, it shall constitute as many applications as are necessary to achieve the specified dry film thickness.

Whenever there is a discrepancy between these specifications and the manufacturer's recommendations, with the approval of the Engineer, the manufacturer's recommendations shall govern.

(B) Surface Preparation.

Where oil and grease are present, these shall be removed in accordance with the SSPC Surface Preparation Specification using No. 1 Solvent Cleaning (SSPC-SP 1). This cleaning shall be performed prior to blasting. If contamination remains after blasting, the surface shall be recleaned with solvent.

All steel shall be blast-cleaned in accordance with SSPC-SP10, Near White Blast Cleaning, from the most current SSPC publication. The surface area of steel to be blast-cleaned shall be no greater than the surface area of steel that can be prime-coated in the same working day.

Compressed air supply lines shall be provided with oil traps and moisture separators. The traps and separators shall be changed on a regular basis. Compressed air shall be in accordance with the blotter test as described in ASTM D 4285.

All fins, tears, slivers, and burred or sharp edges that are present on any steel member, or that appear during the blasting operations, shall be removed by grinding.

All reaming and drilling of holes in the steel shall be completed and free of burrs or other imperfections, such as torn or ragged edges, prior to blast cleaning.

All abrasive and paint residue shall be removed from steel surfaces with a commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing with clean air. If the double blowing method is used, the top surfaces of all structural steel, including top and bottom flanges, longitudinal stiffeners, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The steel shall then be kept dust free until the prime coat is applied.

Care must be taken to protect freshly-coated surfaces from subsequent blast cleaning operations. Blast-damaged primed surfaces shall be thoroughly wire brushed or, if visible rust occurs, reblasted. The wire brushed or blast cleaned surfaces shall be vacuumed and reprimed.

(C) Mixing The Coatings.

Coatings shall be mixed in accordance with SSPC-PA1 and the following:

The coatings shall be mixed in the original containers. The prime coat shall be mixed with a high shear mixer to a smooth, lump-free consistency. Paddle mixers or paint shakers shall not be used. The mixing shall continue until all of the metallic powder or pigment is in suspension, taking care that all of the coating solids that might have settled to the bottom of the container are thoroughly dispersed. The zinc-rich primer mixture shall be strained through a 30-60 mesh screen to remove large particles. Paint containers for spray

applications shall be equipped with a mechanical agitator so the mixture is in motion throughout the application period.

In general, the coatings are supplied for normal use without thinning. If it is necessary to thin the coating for proper application, the thinning shall be done in accordance with the manufacturer's recommendations.

(D) CONDITIONS FOR PAINTING.

Conditions for painting shall be in accordance with SSPC-PA1 and the following:

Paint shall be applied on clean, dry surfaces only. Paint for the prime and final coats shall not be applied when the temperature of the air, paint or metal is below 40ºF, or when the temperature is expected to fall below 40ºF before the paint is cured. The minimum temperature shall be 50ºF for the intermediate coat. The coatings shall not be applied when the relative humidity is greater than 85 percent nor when a combination of temperature and humidity conditions are such that moisture condenses on the surface being coated. The relative humidity shall be a minimum of 50 percent during the curing time of the inorganic type primers.

For cases where the manufacturer's written recommendations for acceptable painting conditions differ from the above, the stricter conditions shall govern.

None of the coatings shall be applied when the wind velocity exceeds 20 MPH, when the air is misty, or when, in the opinion of the Engineer, conditions are unsatisfactory for the work. Also, paint shall not be applied upon damp or frosted surfaces, or when the metal is hot enough to cause the paint to blister, produce porous paint film or cause the vehicle (binder) to separate from the pigment.

Paint shall not be applied when the steel surface temperature is lower than 5 ºF above the dew point. The dew point shall be determined by the Engineer utilizing a psychrometer and appropriate tables. The dew point requirement may be presumed to be satisfied if a thin, clearly defined film of water applied to the cleaned vertical surface with a damp cloth, evaporates within 15 minutes, as determined by the Engineer.

Zinc salts, oils, dust, dirt, and other contaminants shall be removed before each coat of paint and any repair coats are applied in the field. The primed surfaces shall be cleaned by a high-pressure water washing (800 PSI min.).

(E) PAINT APPLICATION.

Paint application shall be in accordance with SSPC-PA 1 and the following:

The prime coat shall be applied immediately after inspection and acceptance of the surface. The primer shall be applied the same day the metal is cleaned (within 8 hours maximum). If the same is blast cleaned and remains unpainted overnight, it shall be blast cleaned again prior to priming. Succeeding coats shall not be applied until each coat is approved. The minimum curing time between coats shall be in accordance with Subsection 913.03. Depending on the prevailing conditions, additional time may be required of proper curing before applying succeeding coats. It is the applicator's responsibility to determine if the coating has cured sufficiently for proper application of succeeding coats. The maximum/minimum time intervals between coats and required surface preparation procedures shall be in accordance with the manufacturer's written recommendations.

Prior to the application of the full prime coat, a prime coating (striping) shall be applied to all edges of plates and rolled shapes, corners, crevices, welds, and bolt heads. The full prime coat shall not be applied before the striping has set to touch.

The coating of paint shall be smoothly and uniformly spread so that every part of the surface will be covered with at least the minimum specified thickness and so that no excess paint will collect at any point. A dense and uniform appearance is required after each applied coating has cured.

If the paint coating is too thin or if portions of the surface are not completely coated, such portions of the work shall be repainted. If the application of the coating at the required thickness in one coat produces runs, bubbles or sags, the coating shall be applied in multiple passes of the spray gun. Where excessive coating thickness produces surface defects such as "mud-cracking," such coating shall be removed back to soundly bonded coating, and the area recoated to the required thickness. In areas of deficient primer thickness, the areas shall be thoroughly cleaned with power washing equipment as necessary to remove all dirt. The areas shall then be wire brushed, vacuumed or otherwise prepared as directed, and then recoated.

All dry spray shall be removed by sanding, if necessary, prior to the application of the succeeding coat.

Surfaces of steel which will be in contact with or embedded in concrete and contact surfaces at field bolted

connections shall be given a prime coat of paint only. These surfaces shall be masked during subsequent coating operations when applicable. Surfaces within 2 inches of field welds (except for stud shear connectors) shall not be painted, but shall receive a light coat of rust-inhibitive coating, and shall be masked during subsequent coating operations.

All bolted shop connections shall be removed prior to the blasting and coating of the girders or beams. The parts shall be blasted separately, primed, and then reassembled and the bolts fully torqued.

Coatings other than the inorganic zinc-rich primer shall be applied using brushes, rollers, spray equipment, or any combination of equipment that will attain satisfactory results and the film thickness specified. Spray application is required for the zinc-rich primer, unless otherwise approved in writing by the Engineer.

(1) Spray Painting.

Spray nozzles and pressures shall be in accordance with the manufacturer's recommendations.

Whenever painting operations are interrupted, the zinc-rich primer remaining in the fluid hose shall be expelled from the hose. Spray equipment which is used for application of zinc-rich primer shall be thoroughly cleaned at the end of each workday.

Compressed air supply lines shall be provided with oil traps and moisture separators. The traps and separators shall be changed on a regular basis. Compressed air shall be in accordance with the blotter test as described in ASTM D 4285.

(2) Brush Painting.

Brushes preferably shall be round or oval in shape, but if flat brushes are used, they shall not exceed 4.5 inches in width. All brushes shall have sufficient body and length of bristle to spread the paint in a uniform coat.

The paint shall be manipulated under the brush to produce a uniform, even coat in contact with the metal or previously applied paint, and shall be worked into all corners and crevices. In general, the primary movement of the brush shall describe a series of small circles to fill all irregularities in the surface, after which the coating shall be brushed out and smoothed by a series of parallel strokes until the paint film has an even thickness.

(3) Roller Painting.

Rollers, when used, shall be of a type which does not leave a stippled texture in the paint film. Rollers may be used only on flat, even surfaces. The rollers shall be manipulated in a manner which produces a paint film of even thickness with no skips, runs, sags, or thin areas. The roller operation should be closely followed by a bristle brush to level off any air bubbles.

(4) Inaccessible Surfaces.

On surfaces which are inaccessible for painting by regular means, the paint shall be applied by sheepskin daubers or sprayed, or by other means, if necessary, to ensure coverage of the proper thickness of paint.

(F) Number Of Coats And Film Thickness.

A minimum number of 3 coats shall be applied by either of the following methods: primer, intermediate and finish in shop; or prime in shop, intermediate and finish in field.

The Dry Film Thickness of paint shall be within the ranges provided in Section 913.

The dry film thickness of the prime coat at the contact surfaces or bolted friction splices on main members, and the top of top flanges where stud shear connections are to be welded shall be within the range recommended by the manufacturer for welding applications. All other contact surfaces and surfaces to be in contact with concrete shall be within the normal primer dry film thickness range provided in Section 411.03.

The dry film thickness for each coat will be determined by the use of a magnetic dry film thickness gage. The gage shall be calibrated and used in accordance with SSPCPA 2. A Tooke film thickness gage shall be used in accordance with ASTM D 4138 to verify the coating thickness when requested by the Engineer. If the Tooke gage shows that the primer coat is not within the specified thickness range, the total coating system will be rejected even if the total dry film thickness exceeds the minimum mil thickness for the three-coat system provided in Section 913.

(G) Color.

The Contractor shall furnish the Engineer with a minimum of 3 color samples, or the number of samples as required by the Engineer to approve a match to the A588 or A709 Grade 50W steel where applicable.

The primer shall contrast the base metal.

The color for the intermediate coat shall be white or an approved color that contrasts with the prime and finish coats.

(H) Unsatisfactory Paint Performance And Removal.

The paint performance shall be considered unsatisfactory if rusting occurs or if the paint coat lifts, blisters, wrinkles, has excessive runs or sags, or shows evidence of application under unfavorable conditions, if the workmanship is poor, if impure or unauthorized paint has been used, or for other such reasons as determined by the Engineer. The unsatisfactory paint shall be removed, the metal recleaned and repainted as specified herein, by the Contractor at his expense.

(I) Handling, Storage And Erection.

The paint shall be allowed to cure before loading and shipping the steel. Extreme care shall be exercised in handling the steel in the shop, during shipping, during erection, and during subsequent construction of the bridge. The steel shall be insulated from the binding chains by softeners approved by the Engineer. Hooks and slings used to hoist steel shall be padded. Diaphragms and similar pieces shall be spaced in such a way that no rubbing that may damage the coatings will occur during shipment. The steel shall be stored on pallets at the job site or by other means approved by the Engineer, so that it does not rest on the dirt, so that water pockets are not formed, or so that components do not fall or rest on each other. All shipping and job site storage details shall be submitted to the Engineer for approval prior to shipping the steel.

Temporary attachments or supports for scaffolding or forms shall not damage the coating system. In particular, sufficient support pads shall be used for fascia bracing.

Unpainted surfaces, including field welded areas, shall be cleaned and the complete coating system shall be applied.

Damaged and contaminated coating shall be repaired as directed by the Engineer, in accordance with the manufacturer's written recommendations.

In damp or cold weather, the shop work shall be kept under cover until thoroughly dry, or until weather conditions permit exposure.

(J) Provisions For Inspection.

The Contractor shall provide free and uninterrupted access to any places where cleaning and painting may be in progress, to the service representatives and inspectors of the manufacturers of the paint, as well as to the Engineer.

411.07 Measurement.

No measurement will be made for painting or other protective coating applied on all newly erected steel structures. The cost thereof shall be included in the contract bid price for structural steel.

Temporary storage and recycling of hazardous and temporary storage and disposal of non-hazardous surface preparation waste will be measured for payment by the actual number of 55-gallon drums completely filled with collected waste, stored and disposed of as specified.

No separate payment will be made for the Lead Health and Safety Plan, but the costs thereof shall be included in the bid price for the various items of work.

No separate payment will be made for the Pollution Collection and Control Plan, but the costs thereof shall be included in the bid price for the various items of work.

No separate payment will be made for the Emergency Management Plan, but the costs thereof shall be included in the bid price for the various items of work.

Repainting previously painted steelwork surfaces/structural members and weathering steel structures, bridge railing and all other bridge appurtenances will be paid for on a lump sum basis, per structure, according to the estimated weight of steel or estimated square footage of steel coated. No separate payment will be made for the work set forth in 411.05(F.1), but the costs thereof shall be included in the bid price for the various items of

work.

Repainting Steelwork Structures, if and where directed by the Engineer will be paid for per ton for the total weight of steel to be coated.

No separate payment will be made for steel surface preparation or containment, collection, storage and disposal, but the costs thereof shall be included in the bid price for the various items of work.

All other related work plans, tasks and/or items shall be considered incidental to the various bid items and will not be measured or paid for separately.

411.08 Payment.

Payment will be made under:

PAY ITEM ..... ***PAY UNIT***

TEMPORARY STORAGE AND RECYCLING OF SURFACE PREPARATION,

HAZARDOUS WASTE, 55-GALLON DRUM ..... EACH

TEMPORARY STORAGE AND DISPOSAL OF SURFACE PREPARATION,

NON-HAZARDOUS WASTE, 55-GALLON DRUM ..... EACH

REPAINTING STEELWORK, STRUCTURE NO. _____ (APPROX._____ TONS) ..... LUMP SUM

REPAINTING STEELWORK, JOINT AREAS, STRUCTURE NO. _____

(APPROX. _____ SQUARE FEET) ..... LUMP SUM

REPAINTING STEELWORK, STRUCTURES, IF AND WHERE

DIRECTED BY THE ENGINEER ..... TON

Payment for Temporary Storage and Recycling of Surface Preparation Hazardous Waste, 55-Gallon Drum will not be made until the original fully executed manifests have been submitted to the Engineer, and final disposal of the material has been verified to the Engineer's satisfaction.

SECTION 412 - BRIDGE DRAINAGE STRUCTURES

412.01 Description.

This work shall consist of furnishing and installing pipes, scuppers, inlets, downspouts, and troughs for surface drainage of new bridge deck construction and repairing, removing, or modifying existing bridge drainage systems.

412.02 Materials.

Materials shall conform to the following Sections and Subsections:

CASTINGS AND FORGINGS. 909.04

ELASTOMERIC SHEET. 923.07

EXPANSION ANCHORS ..... 909.02(E)

FASTENERS AND HARDWARE 909.02

FIBERGLASS PIPE 917.06

GASKETS. 923.12

PAINT 913

STEEL PIPE 909.09

STRUCTURAL STEEL 909.01

ZINC COATING 909.11

412.03 Methods of Construction.

Bridge drainage structures shall be fabricated, welded, and erected in accordance with the applicable provisions

of Section 403.

Damaged galvanized surfaces shall be repaired in accordance with ASTM A780. All structural steel other than A709 weathering steel or galvanized steel as required shall be painted in accordance with Section 411.

(A) SHOP DRAWINGS.

Shop drawings shall be furnished in accordance with the requirements of Subsection 104.08.

(B) DROP INLET FRAMES AND GRATES.

The bearing surfaces of drop inlet frames and grates shall be machined so that the grates will have uniform bearing on the frames and shall be match marked at the foundry prior to delivery. All bolt holes shall be drilled.

The inlet and drainage pipe supports shall be set to proper grade, all connections made to structural steel, the forms placed, and all such preparations approved before placing concrete.

(C) BRIDGE DRAINAGE PIPES.

Bridge drainage pipe systems, consisting of horizontal runs of piping, downspouts at piers and abutments, couplings, fittings of all types, open reducers, and other appurtenances shall be fabricated and erected at the locations and in accordance with details shown.

Bridge drainage pipe shall be steel or fiberglass in accordance with the contract documents. Plastic pipe is not permitted.

Connections of pipes to scupper outlets shall be made with a Victaulic style flange connection as per the contract drawings. For connections to existing scuppers that are not compatible with Victaulic style flange connections, the contractor shall submit a connection detail for approval by the Engineer. The use of Fernco-style connections will not be permitted.

Connections of steel pipes and fittings shall be made with a threaded gasketed coupler system or bolted gasketed flange system.

Connections of fiberglass pipes and shall be made with adhesive bonded socket joints except at connections to scupper outlets where a grooved fiberglass adapter shall be provided. Fiberglass pipe and fittings are to be supplied with socket ends to accommodate joining the pipe and fittings. Installation of the adhesive bonded socket joints will be in accordance with the manufacturer's procedures. A manufacturer's representative shall be on-site to ensure proper installation of fiberglass pipe and fittings. Saddled branch connections will not be allowed.

All hanger or support spacings shall not exceed those recommended by the pipe manufacturer. Hanger straps and supports shall have a minimum 1-1/2 inch strap width.

Fiberglass pipes shall be secured with straps that have a minimum of 180 degrees of contact with the pipe. At all supports, the contractor shall attach a split fiberglass pipe protective sleeve bonded in place to protect the pipe from direct contact with the strap. In instances where the support wraps completely around the pipe, a protective sleeve that completely wraps around the pipe shall be installed. At supports for vertical pipe runs, an anchor sleeve shall be installed directly above the strap to prevent vertical movement of the pipe. The anchor sleeve shall be a split pipe with a minimum length of 2 x the pipe diameter and shall be thicker than the protective sleeve to ensure that pipe slippage is restrained by the strap being caught on the anchor sleeve. All sleeves shall be secured in place with adhesive and shall be the same color and finish as the pipe.

(D) DRAINAGE TROUGHS.

Drainage troughs shall be constructed for the conveyance of drainage collected at the finger or tooth joints. The troughs shall be fabricated of either a reinforced elastomeric material or structural steel, or both.

(E) MODIFICATIONS TO EXISTING BRIDGE DRAINAGE STRUCTURES.

At certain designated locations, the Contractor shall modify segments of the existing bridge drainage system by removal and disposal of portions of drainage pipe, troughs, and inlets, including joints, fittings, hanger assemblies, support brackets, and other appurtenances.

Additional modifications to existing drainage systems shall consist of installing new sections of drainage pipes to new discharge points, removal, and salvage of existing inlet grates, plugging the abandoned inlets with concrete, and such other modifications as called for.

The Contractor shall verify by actual field inspection and measurements the condition of the various components of the drainage systems to be modified, repaired, or relocated. The shop drawings shall be based on the field measurements taken by the Contractor.

Care shall be exercised during this work so as to prevent damage to the existing structure and portions of the drainage system to remain. Work over active roadways and railroad tracks shall be performed in strict accordance with the requirements and restrictions of the State, municipalities, railroad companies, or other agencies having jurisdiction over such facilities. Additional requirements shall be as prescribed in Section 106 and Division 800.

Materials removed by the Contractor in performance of this work, with the exception of inlet grates, shall become the property of the Contractor. Inlet grates shall remain the property of the Authority and shall be delivered to the Turnpike at the designated location. Where lengths of drainage pipe are required to construct modifications to drainage systems, the Contractor may salvage and reuse removed pipes, subject to approval of the Engineer. All other materials shall be disposed of off the site by the Contractor.

412.04 Measurement.

Inlet frames and grates and scuppers will be measured by the actual number fabricated and installed.

Bridge drainage pipes and drainage troughs of the various types and sizes will be measured by the length complete in place as shown, from inlet to discharge point.

Modifications to existing bridge drainage pipes and drainage troughs will be measured by the number of each type and size of modification specified.

Bridge Drainage Structures for new bridges where the item Structural Steel is included in the proposal will be measured for payment in accordance with Subsection 403.18.

412.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
INLET FRAMES AND GRATES	EACH
SCUPPERS	EACH
___" DRAINAGE PIPE, (TYPE)	LINEAR FOOT
DRAINAGE TROUGH, (TYPE)	LINEAR FOOT
MODIFY ____" DRAINAGE PIPE, (TYPE)	LINEAR FOOT
MODIFY DRAINAGE TROUGH	EACH

No separate payment will be made for the labor, materials, equipment, handling and storage required for the installation of the U-bolt nuts where required. All costs shall be included in the price for the various other items in the Contract.

SECTION 413 - UNDERBRIDGE SLOPE PROTECTION

413.01 Description.

This work shall consist of the construction of various types of new underbridge slope protection and the repair of existing underbridge slope protection at various locations.

413.02 Materials.

Materials shall conform to the following Sections and Subsections:

ADMIXTURES AND CURING COMPOUNDS.	906
ASPHALT CEMENT	904.01
BITUMINOUS PAINT	913.07
BROKEN STONE	902.02
EMBANKMENT, GRADE A	901.01

FINE AGGREGATE 902.04

FLASHING 911.03

GROUT 905.09

JOINT SEALER 907.02

MORTAR 905.10

PORTLAND CEMENT CONCRETE. 905.05

WELDED WIRE FABRIC REINFORCEMENT ..... 908.04(C)

STONE 902.06

EMULSIFIED ASPHALT, GRADE RS-1 ..... 919.15

CURING MATERIALS 906.07

PREFORMED EXPANSION JOINT FILLER 907.01

GRANITE PAVING BLOCK 923.39

REINFORCEMENT STEEL 908.04

BAGS 923.40

GEOTEXTILES 923.21

TREMIE CONCRETE 905.05

COMMON EMBANKMENT ..... 203.02.

COARSE AGGREGATE ..... 902.05.

413.03 Preparation of Slopes or Channels.

Immediately prior to construction of the slope or channel protection, the slopes or subgrade surfaces shall be shaped and trimmed to an even surface and to the required lines and grades and thoroughly compacted by use of mechanical or vibrating tampers or rollers or other methods approved by the Engineer. Any prepared surface to receive concrete slope protection shall be dampened just prior to concrete placement.

Where directed, remaining granite block from the existing slope protection shall be removed. Granite blocks not to be reused on this project shall be disposed of in accordance with Section 201.

The undermined areas below the existing abutment footings shall be filled in with tremie concrete in accordance with Section 401 to the satisfaction of the Engineer.

The eroded areas of the slopes shall be filled with Common Embankment, regraded and thoroughly compacted by the use of mechanical or vibrating tampers or rollers, so that the original grade of the slope is attained.

Existing blocks surrounding the eroded areas to be repaired as well as dislocated blocks shall be removed as required in order to regrade and compact the slope.

413.04 Stone Slope Protection.

Stone slope protection beneath structures shall be constructed by spreading No. 2 broken stone evenly and tamping and rolling the layer to a smooth surface and of the specified thickness. The broken stone may be dumped on the earth slope and spread by mechanical means.

When bituminous treated stone slope protection is called for, the Contractor shall place and compact a 4 inch layer of No. 3 or 4 broken stone on the prepared foundation using a vibrating tamper to key the stone together. Asphalt cement, viscosity Grade AC-20, shall then be sprayed on the aggregate at a temperature of from 300^{o} to 375^{o} and at the rate of 0.9 to 1.1 gallons per square yard, avoiding the formation of a surface mat.

If painting is required, immediately after the asphalt cement has penetrated and before the asphalt cement has cooled, approximately 20 pounds per square yard of No. 8 broken stone shall be spread uniformly to fill the voids in the previous layer and set using a vibrating tamper. A second application of asphalt cement shall then be applied at the rate of 0.9 to 1.1 gallons per square yard. After allowing sufficient time for the second application of asphalt cement to set, a spray application of green paint shall be uniformly applied at the rate of 0.3 to 0.5 gallon per square yard. Foot traffic shall not be permitted on the treated stone until the paint has dried. Care shall be taken to prevent spilling of the asphalt cement or paint onto adjacent concrete surfaces.

Application of the asphalt cement on the stone slope protection shall not be performed if the temperature is below 50°F, or if the aggregate is damp.

413.05 Concrete Slope Protection.

(A) Concrete Slope Protection.

Concrete slope protection shall be constructed by placing concrete on the prepared subgrade surfaces in accordance with the requirements of Subsection 413.03, except that the concrete consistency shall be such that it will not flow on the slope. The concrete shall be tamped, screeded, and then finished with a wood float to an even neat uniform surface to the proper grade. Forms shall be left in place for not less than 24 hours after finishing.

Edge beams and key beams shall be formed to the Plan details and placed monolithically with the slab.

Welded wire fabric reinforcement shall be placed in the beams and slab to conform with the arrangements shown.

The concrete slope protection shall be provided with 1/2 inch deep tooled construction joints and dummy joints rounded to a 1/2 inch radius with an edging tool in accordance with the details and at the locations shown on the plans.

A one inch joint shall be provided between the concrete slope protection slab and the face of the abutment or other structure by means of premolded joint filler placed prior to concrete placement. The joint shall be cleaned of all loose concrete and the space filled with hot-poured joint sealer.

(B) Concrete Bag Slope Protection.

Concrete bag slope protection shall be constructed by placing bags, filled approximately three-quarters full with dry concrete mix, on the prepared foundation. No water shall be added to the bags of dry concrete mix until the bags are placed and tamped as specified below. The filled bags shall be securely fastened with hog rings, by sewing or other methods. Leaking bags shall not be used.

The bags of concrete mix shall be bedded by hand on the surface with the fastened ends in the same direction and with the joints staggered. The bags shall be rammed and packed against each other and tamped on the surface in such a manner as to form close contact and secure a uniform surface. Bags of concrete ripped or broken in placing shall be removed and replaced before the placed bags are soaked with water. Immediately after the bags of concrete are placed and tamped, they shall be thoroughly soaked by sprinkling with water applied under low pressure.

(C) Granite Block Slope Protection.

Granite block slope protection shall be constructed by placing blocks on a 2-inch layer of aggregate base course.

The base course shall be dry, clean, and free of adhering matter and frost when the block is placed thereon. The mortar for the cushion course shall be 1:3, cement-sand mortar, thoroughly mixed without water in a mechanically operated batch mixer of a size suitable for the work. The dry mortar shall be placed on the base course in a uniform layer having a thickness of 2 inches. The layer shall not be placed more than 15 feet in advance of laying the blocks, and shall be covered with the blocks without delay.

The blocks shall be set in straight rows with the longitudinal joints staggered one-half the length of the block. The blocks in each row shall be of uniform width, and the joints at the surface shall be not less than ¼ inch and not more than ½ inch in width. The blocks shall be set plumb and fully bedded on the mortar cushion without crowding it into joints. Rammers or tampers shall be of the type and weight that do not break the blocks. The best face of the block shall be uppermost.

Blocks that do not have a firm bedding or which have been damaged shall be taken up, reset, and rerammed.

The surface shall be tested with a straightedge, and blocks found to be above or below the grade shall be taken up, reset, and rerammed. Fine aggregate, gravel, or other material shall not be placed in the joints. Blocks shall be laid not more than 15 feet in advance of ramming.

Joints shall be filled with grout where specified. The grout shall be mixed in a mechanically operated batch mixer as specified for mixing the cushion course, with only sufficient water to permit the grout to enter the joints to the full depth. The amount of water shall be kept constant in all batches. The mixing time shall not be less than 90 seconds, and the mixture shall be kept agitated until used. The joints shall be filled

completely with grout so that an excess appears on the surface. The excess grout shall be swept or scraped into the joints. The grouting operation shall be repeated before initial set until the joints remain completely filled. The surface shall then be swept and all excess grout shall be removed before it has developed initial set. Grout shall not be applied when the temperature of the atmosphere or the blocks is below 40 ºF or during rainy weather.

Granite block slope protection shall be constructed as directed by the Engineer.

413.06 Repairs to Underbridge Slope Protection.

When the Contract calls for repairs to be made to areas of underbridge slope protection, the Contractor shall make the restoration of the various types. Construction shall conform to the applicable requirements for new Underbridge Slope Protection.

(A) Concrete Slope Protection.

The limits of slope paving to be removed and replaced will be delineated by the Engineer and suitably marked. The outline of each area to be removed will first be saw cut to a depth of one-half (1/2) inch with a power saw capable of making straight cuts. Concrete within one foot of the saw cut shall be removed in such a manner so as to leave the reinforcing wire mesh projecting from the remaining concrete in good condition.

Eroded subgrade shall be filled to subgrade lines with underbridge slope fill material consisting of a mixture of the eroded on-site soil supplemented as necessary with Embankment, Grade A. The fill material shall be a stable material which can be properly compacted by the methods and to the densities specified.

Eroded underbridge slope areas shall be cleaned of vegetation and debris and scarified prior to placement of slope fill material. The fill material shall be placed and compacted in layers not to exceed 12 inches. Water shall be added as required to attain optimum moisture content. Fill layers shall be compacted to at least 90% of maximum dry density (AASHTO T99, Method C). The fill material shall be graded and shaped so as to construct the slope to match the lines and grades of the adjacent subgrade or as otherwise directed.

New wire mesh shall be placed so as to provide a 12 inch lap with the wire mesh projecting from the remaining concrete.

Within any area of concrete slope replacement, expansion or construction joints shall be reconstructed to match the existing locations in accordance with the details shown. All details or design in the existing slope pavement shall be duplicated in the repaired section.

(B) Stone Slope Protection.

The Contractor shall restore the slope areas by regrading existing material and such additional Embankment, Grade A material as required to produce a compacted surface as specified above upon which to place the stone slope protection.

(C) Granite Block Slope Protection.

Areas damaged shall be repaired as directed. Existing dislocated granite blocks shall be reused, where possible.

413.07 Measurement.

Slope protection and repairs to existing slope protection of the various kinds will be measured by the surface area.

Repair of existing granite block slope protection will be measured as Repair Granite Block Slope Protection.

Underbridge Slope Fill Material will be measured by the volume of material in place.

413.08 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
Bituminous Treated Stone Slope Protection.	Square Yard
Concrete Slope Protection	Square Yard
Painted Bituminous Treated Stone Slope Protection	Square Yard

REPAIR CONCRETE SLOPE PROTECTION ..... SQUARE YARD

REPAIR STONE SLOPE PROTECTION ..... SQUARE YARD

STONE SLOPE PROTECTION ..... SQUARE YARD

UNDERBRIDGE SLOPE FILL MATERIAL. ..... CUBIC YARD

CONCRETE BAG SLOPE PROTECTION, ___" THICK ..... SQUARE YARD

TREMIE CONCRETE ..... CUBIC YARD

REPAIR GRANITE BLOCK SLOPE PROTECTION ..... SQUARE YARD

Payment for Excavation will be made in accordance with Section 202.

SECTION 414 - BRIDGE RAILING AND FENCING

414.01 Description.

This work shall consist of fabricating and erecting new metal railings on bridge and wingwall parapets, removing and resetting existing bridge railing where required, replacing missing or damaged bridge railing at the locations shown, and repairing or replacing anchorages for bridge railing and guardrail attachments.

This work may also include all required removal of damaged bridge railing, base plates and anchor bolts; and shall include furnishing, fabricating and installing new painted steel railing, fabricating and installing delineator brackets and heat straightened and/or recutting threads of existing anchor bolts.

All material removed shall become property of the Contractor and shall be legally disposed of off Turnpike property. The Contractor's bid price shall consider the salvage value of existing aluminum or steel or steel rail to be removed.

(A) FUTURE ADDITIONAL BRIDGE RAILING.

This item provides for the replacement of additional bridge railing, which has been damaged after the date of final preparation of contract documents. The Contractor shall supply and install the additional railing at the new work locations designated by the Engineer. The Engineer may delineate those new work locations within a period up to two months (60 calendar days) prior to the contract completion date.

Work under this paragraph shall include all work set forth in Subsection 414.01 and shall be performed in accordance with the requirements specified herein and the contract plans.

Bridge railings shall be of the types shown, consisting of metal pipe, structural shapes, castings and other materials, fabricated in accordance with the dimensions and details given and erected where shown.

414.02 Materials.

Materials shall conform to the following Sections and Subsections:

ANCHOR BOLTS, STAINLESS STEEL ..... 909.02(C)

CONCRETE 905.05

ELASTOMERIC BEARING PAD ..... 923.02(A)

EPOXY BONDING COMPOUND 923.08

LEAD 911.04

NEOPRENE WASHERS 923.15

NON-SHRINK HIGH STRENGTH MORTAR 905.11

PAINT 913

REINFORCING STEEL 908.01

STAINLESS STEEL HARDWARE 909.02

STRUCTURAL STEEL AND STEEL PIPE 909.01

STAINLESS STEEL, ANCHORS ..... 909.02(C)

STEEL HANDRAIL 909.12

STEEL POSTS AND PLATES 909.13

DELINEATOR BRACKETS 911.01

CAULKING SEALANT 923.25

LEAD SHIMS 923.29

414.03 Shop Drawings.

Shop drawings and such other drawings as are necessary for the fabrication and erection of the metal railing on bridge structures shall be furnished in accordance with Subsection 104.08. Minor variations in details of metal railings differing from those shown may be permitted, however, no major departures from the design will be accepted.

The Contractor shall field verify all measurements shown on the contract plans and submit shop drawings to the Engineer detailing rail dimensions, profiles, welds, tolerances, horizontal radii, surface coatings and all other details for review and approval prior to ordering materials or fabrication.

414.04 Bridge Railing.

At specific locations of new construction or where necessary to replace missing or damaged bridge railing, the Contractor shall provide new steel bridge railings and posts conforming to the requirements shown and in accordance with the approved shop drawings.

(A) FABRICATION.

Steel rails and posts shall be formed, shaped, and rolled to the profiles and dimensions as shown. Base plates shall be planed and milled to yield flat and even surfaces. The edges shall be cut true and square. Bolt holes of the proper size shall be drilled or reamed into base plates. Posts shall be welded to base plates and railings. Welds shall be continuous around the perimeter of the posts at their intersections with the rails and the base plates. Finished welds shall be smooth. The metal to be welded shall be in full contact before welding.

Steel rail and posts shall be formed, shaped and rolled to profiles and dimensions shown on the plans and measured in the field. The new steel rail shall match existing adjacent rail at each location.

The bridge railing shall be blast cleaned after fabrication and immediately prior to paint system application in accordance with SSPC-SP10 (Near-White Blast Cleaning). Railing shall be painted in accordance with Subsections 411.03, 411.04 and 913.01 and the manufacturer's recommendations.

(B) ERECTION AND INSTALLATION.

All railings shall be erected true to the prescribed lines, grades, and dimensions. Posts shall be vertical or perpendicular to the grade. Base plates shall be positioned with anchor bolts set into the concrete parapet by means of templates or as directed.

Where necessary for vertical alignment of railing, lead strips shall be placed under the perimeter of base plates. The strips shall be 1-1/4 inches wide and of the required thickness. The strips, when placed, shall project 1/8 inch from the base plates. When the railing has been properly aligned, the nuts shall be tightened on the anchor bolts and the lead shims caulked to form a watertight seal between the base plates and the concrete of the parapet or other foundation. The anchor bolts shall be tightened again, where necessary. Care shall be taken to prevent injury to the concrete and impairment of the bond between the bolt and the concrete. After final tightening of the anchor bolt nuts, the bolts shall not project more than 1/4 inch above the nut and shall be peened so as to prevent loosening of the nuts and present a smooth surface and neat appearance.

After erection and installation, any abraded or otherwise damaged paint coatings shall be cleaned, smoothed, and touch-up painted in accordance with Section 411.

Damaged anchor bolts which are determined by the Engineer to be salvaged shall be straightened to plumb alignment by heat bending and the bolt threads recut as required for proper rail installation and attachment.

Beveled neoprene washers shall be installed as required to properly seat the anchor bolt nuts.

Lead shims shall be used under the new rail to match the existing rail.

Delineator bracket assemblies shall be installed at locations determined by the Engineer. The Contractor

shall supply aluminum mounting brackets with hardware Type A and Type B, fabrication shall be as shown on Standard Drawing No. DE-1. Delineator panels will be supplied by the Authority and installed by Contractor. Brackets not installed shall be delivered to the Northern Division Maintenance Yard at Interchange 14, Newark.

414.05 Combination Bridge Railing and Bridge Fencing.

The combination of bridge railing and chain link bridge fencing shall be erected and installed at the designated locations in accordance with Subsection 414.04 and the details shown. Bridge fencing shall be of the types and heights shown, and as specified in Section 511.

When replacement of existing bridge railing is required on a structure where there is bridge fencing, the Contractor shall remove the chain link bridge fencing as necessary to properly install the bridge railing. The bridge fencing shall be reinstalled at the end of each day's work.

414.06 Anchor Bolt Stud Replacement.

Existing anchor bolts are fabricated of carbon steel, stainless steel, or a bimetallic bolt which is comprised of a stainless steel threaded stud welded to a carbon steel shank as shown on the plans. Where the exposed portion of the anchor bolt has been severely bent, sheared, or stripped of threads, the damaged section shall be cut off and a new stainless steel stud shall be butt welded to the remaining anchor bolt shank as shown on the plans. The stainless steel stud shall be of a length such that the top of the stud shall project a maximum of 1/4 inch above the nut when the bridge handrail is installed.

The top of the existing concrete parapet shall be removed as necessary to permit a proper weld of the two materials below the top of the parapet. This concrete area shall be cleaned after the bolts are welded, coated with bonding compound, and replaced with non-shrink high strength mortar closely matching the adjacent concrete parapet top in appearance.

All welding shall conform to the requirements of the latest specifications of the Structural Welding Code (AWS D1.1) published by the American Welding Society. All welds shall be tested to withstand the impact of a chipping hammer as directed by and in the presence of the Engineer.

All welding shall conform to the requirements of Section 7 of the Bridge Welding Code (AWS D1.5) published by the American Welding Society. Stainless steel electrodes shall be used.

414.07 Anchor Bolt Group Replacement.

Anchor Bolt Group Replacement shall include the removal and reconstruction of portions of concrete parapets and installation of new anchor bolts as shown on the plans and as directed by the Engineer. It shall also include the removal and reconstruction of parapet at locations which require the installation of beam guardrail anchorages. Typical parapet reconstruction involves one to three linear feet of parapet.

The lateral limits of the area to be removed and replaced will be suitably marked and delineated by the Engineer. Outline of such area shall first be cut where required to a depth of one-half (1/2) inch with a power saw capable of making straight cuts. All parapet faces shall be marked and saw cut.

The minimum depth of parapet concrete removal, measured vertically from the top of parapet, shall be 12".

For any sections which require removal of the parapet and railing, and contain expansion, contraction, or open joints, such joints shall be reconstructed to match the existing field condition.

The Contractor shall exercise due care in handling the railing on parapets to be reconstructed. Railing is to be reused where noted as "existing rail to remain" on the plans.

All anchor bolts and connection hardware shall be new materials.

Removal and reconstruction of the parapet shall conform to Subsection 418.04.

414.08 Measurement.

Bridge railing will be measured by the length, in place and accepted.

Anchor Bolt Stud Replacement will be measured by the actual number of anchor bolt studs replaced.

Anchor Bolt Group Replacement will be measured by the actual number of parapet sections removed and reconstructed to accommodate groups of anchor bolts.

Replacement bridge railing will be measured as new railing.

Future Additional Bridge Railing will be measured by the length, in place and accepted.

Any required realignment of anchor bolts and recutting of anchor bolt treads will not be measured for payment but shall be included as part of bridge railing pay item.

Any required furnishing and installation of beveled neoprene washers and delineator bracket reassemblies will not be measured for payment.

Caulking sealant will not be measured for payment.

New anchor bolts will be measured by the actual number of anchor bolts replaced.

414.09 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
ANCHOR BOLT GROUP REPLACEMENT.	EACH
ANCHOR BOLT STUD REPLACEMENT	EACH
BRIDGE RAILING	LINEAR FOOT
FUTURE ADDITIONAL BRIDGE RAILING	LINEAR FOOT
NEW ANCHOR BOLT	EACH

Bridge fencing will be paid for under Subsection 511.05.

SECTION 415 - TEMPORARY SHEETING

415.01 Description.

This work shall consist of the construction, maintenance, and removal or cutting off of temporary sheeting at prescribed locations during excavations and staging, or at other locations where required to perform the work in accordance with prevailing laws and regulations.

415.02 Materials.

For the item Temporary Sheeting, the Contractor may use any size and type of sheeting and system of bracing that is approved and is adequate and effective in safely withstanding the forces to be sustained during construction, except that Temporary Sheeting used in median areas and within 10 feet of outside roadway shoulders shall be steel sheet piles conforming to Paragraph 909.05(C).

Materials for the item Temporary Sheeting to remain in place shall be steel sheet piles conforming to Paragraph 909.05(C).

415.03 Shop Drawings.

Detailed shop and design drawings shall be furnished in accordance with the requirements of Subsection 104.08 for all sheeting and supporting members. Design calculations shall be included and signed by a Professional Engineer licensed in the State of New Jersey.

415.04 Methods of Construction.

Structural members for the temporary sheeting and bracing system shall be of adequate size and cross section with physical properties for proper functioning, shall be driven to the depths necessary, and shall be braced to protect workers, adjoining properties and structures, utility installations, and the public from hazards of slides and cave-ins.

The temporary sheeting shall be tight and continuous for its entire length.

Temporary sheeting used in median areas shall be sheet piles and shall remain in place. In all other locations, the Engineer may authorize leaving sheeting, other than untreated timber, in place. All sheeting to remain in place shall be cut off at an elevation two feet below finished grade or three feet below existing or proposed paved surfaces.

All temporary sheeting to remain in place, as shown on the plans, shall be interlocking steel sheeting. The sheeting shall be driven in place prior to excavating.

Temporary sheeting to remain in place shall project above the original ground a minimum height of 4' in order to protect the excavation and the adjacent traffic protection materials including the precast concrete barrier.

Temporary sheeting to remain in place shall be cut off 2' below finished grade after the excavation has been completely backfilled to the cut off elevation of the sheeting.

Driving of temporary sheeting shall be performed with equipment prescribed in Section 405, except that lighter driving equipment may be used. Sheeting shall be driven in such increments of penetration as may be found necessary to prevent distortion, twisting out of position, or pulling apart at the interlocks.

415.05 Measurement.

Temporary sheeting, of either type, will be measured by the projected surface area, exclusive of indentations based on the pay limits shown on the plans.

If pay limits are not designated on the plans, and temporary sheeting is specifically shown, pay limits shall extend from the bottom of the excavation to the ground line adjacent to the excavation at the time the sheeting is placed (or 4' above the ground line for temporary sheeting to remain in place) and for the actual length of the bottom of the excavation sheeted.

415.06 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TEMPORARY SHEETING	SQUARE FOOT
TEMPORARY SHEETING TO REMAIN IN PLACE	SQUARE FOOT

SECTION 416 - PERMANENT SHEETING

416.01 Description.

This work shall consist of furnishing and driving sheet piling of the type, weight, dimensions, and length, and at the designated locations as shown or specified and which is to be left in place to become a permanent part of the finished project.

416.02 Materials.

Permanent sheeting materials shall conform to the following Subsections:

COAL TAR EPOXY-POLYAMIDE COATING.	913.07
STEEL SHEET PILES	909.05
TIMBER PRESERVATIVES.	910.04
TIMBER SHEET PILES	910.07

Provide catalyst components for coatings specific for resin components. Use thinners which are compatible with the coatings.

Concrete for concrete sheet piles shall be as specified for prestressed concrete piles in Section 405. Concrete materials, proportioning, and construction requirements shall conform to Section 401.

Materials not covered by the above provisions shall conform to Division 2, Section 2 of the AASHTO LRFD Bridge Design Specifications.

Steel sheeting and structural steel shapes may be used material provided that such used material is in good condition, of the structural quality specified, free from excessive corrosion and detrimental damage, and has the written approval of the Engineer. All steel sheet piles, whether new or used, shall be "Hot Rolled." "Cold Formed" steel sheet piling will not be accepted.

416.03 Driving Sheeting.

Sheet piles shall be driven in place prior to excavating with adequate hammers as necessary to drive the sheeting to the required depth, as shown or directed, in a satisfactory condition. Equipment shall conform to the requirements of Section 405. Sheeting shall be guided during driving by means of templates of substantial construction to insure accurate positioning, and in increments of penetration so as to prevent distortion,

twisting, or pulling apart of the adjacent sections at the interlocks. Details of the template and driving methods proposed by the Contractor shall be approved by the Engineer prior to incorporation in the work.

Each section of permanent sheeting shall be driven to the elevation given on the plans and the top cut off in a straight line at the prescribed elevation. Ends of timber sheeting at the cut off line shall be treated in accordance with the American Wood Protection Association Specification M4.

416.04 Protective Coating of Steel Sheeting.

Before driving, the surfaces of the steel sheet piling requiring coating as called for on the plans or as directed shall be satisfactorily cleaned and painted with the prescribed protective coating to the limits required.

Prior to blast cleaning of surfaces to be painted, remove visible oil, grease, and drawing and cutting compounds by solvent cleaning SSPC-SP1(1982) Solvent Cleaning. After solvent cleaning the sheeting surfaces to be protective coated shall be blast cleaned in accordance with the requirements of Steel Structures Painting Council SSPC-SP10(Near-White Blast Cleaning), then remove residual dust from blasted surfaces by blowing with dry, oil-free air, vacuuming or sweeping to provide a surface profile of at lease 2.5 mils thickness.

Promptly coat the surface with three applications of coal tar epoxy-polyamide at the rate and in accordance with the procedures and instructions of the materials manufacturer if other than as specified herein. Epoxy-polyamide coatings consist of a two-component system that includes a pigmented polyamide resin, Component A and an epoxy resin, Component B. Mix both components in a ratio of 1 to 1 by volume. Do not thin coatings when doing so will result in total volatile organic compounds exceeding limits enacted by local air pollution control district. When thinning is allowed and is necessary, such as during cold temperature application or to improve application characteristics, add up to 1 pint of ethylene glycol monoethyl (EGM) either for each gallon of the coating.

Mix components of coating by power stirring until a smooth, uniform consistency results. Stir coating periodically during its induction period. Use the following table for induction time and pot life of mixed batches.

Ambient Temperature Degrees F	Induction Time (in hours)
40 to 50	2 at 70 Degrees F
50 to 60	2
60 to 70	1 to 1.5
70 and above	0.5 to 1

Apply primer coating to dry surfaces not more than 4 hours after near white blast cleaning. Apply coats of each system so that finished surfaces are free from runs, sags, brush marks and variations in color.

Allow the previous coat to dry to tack free condition but not more than 72 hours before applying the next coat. If more than 72 hours elapses between coats, clean surface, apply a 2 mil wet film thickness of previous coat, allow to cure to a tacky film, and apply a full thickness of the next coat. Touch up shall be done with the same thickness of coating as for the original coat and shall include cleaning and painting of field connections, welds, and all damaged or defective paint or rusted areas.

Damaged or rejected areas shall be cleaned of all foreign or loose material and promptly recoated. The top coat shall be dry before driving, but in no case shall the sheeting be driven before the top coat has cured for at least 72 hours.

Steel sheet piles shall be shop coated with the three-coat Epoxy-Polyamide system for their full length. Apply three coats with each coat at a dry film thickness of between 3 mils and 4 mils. Provide a total system maximum dry film thickness of 16 mils for steel sheet piles.

After repair of holidays, each dry film thickness shall be measured in the presence of the Engineer using a magnetic dry film thickness gage in accordance with:

(A) ASTM D7091-12, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals; and

(B) ASTM E376-96 Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods.

Re-measure after an additional coat is applied, to verify that it meets minimum thickness requirements.

416.05 Measurement.

Permanent sheeting of the various types will be measured by the square foot of the projected design sheeting area as specified on the plans, complete and accepted in place, exclusive of indentations of piling sections.

Protective Coating will be measured by the square foot of the projected design sheeting area as specified on the plans, complete and accepted in place, exclusive of indentation of piling sections. Where coating is to be applied to both the front and back sides, each side will be measured separately.

416.06 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
PERMANENT CONCRETE SHEETING, TYPE ____	SQUARE FOOT
PERMANENT STEEL SHEETING, TYPE ____	SQUARE FOOT
PERMANENT TREATED TIMBER SHEETING, TYPE _____	SQUARE FOOT
PROTECTIVE COATING	SQUARE FOOT

Separate payment for wales, bracing, tie-rods, and other members required by the sheeting design will not be made.

SECTION 417 - BRIDGE DECK REHABILITATION

417.01 Description.

This work shall include removal, disposal, and replacement or reconstruction of bridge deck slabs, asphalt and concrete overlays, deck joints, headblocks, parapets, handrails, median barriers, sidewalks/safetywalks and curbs; installation, maintenance, and removal of temporary catch and shielding systems; and construction of similar bridge deck repairs under emergency conditions.

The work shall also include various bridge deck repair items at locations as directed by the Engineer. All materials to be removed shall become the property of the Contractor and shall be properly disposed of by the Contractor off Authority property unless otherwise authorized in writing by the Engineer.

The Contractor is advised that the work will be performed over waterways, private property, railroads, roadways, certain Authority properties, and that during construction, removal and other operations, he will be required to comply with the provisions of Subsections 106.16 through 106.18 and shall provide means for safely catching or otherwise preventing all steelwork, concrete, tools, other objects, and debris resulting from his operations from falling to the ground (private property or Authority property), waterway, and/or onto the railroad/roadway below.

The Contractor is hereby advised that the existing coating system on previously painted bridges contains red lead and/or basic lead Silico Chromate paints as components. Activities such as bolt removal, torch or mechanical cutting, welding on structural steel and other activities related to the items described herein may cause lead or other hazardous materials to be emitted. The Contractor shall include provisions in the Pollution Control Plan, Lead Health and Safety Plan, and Emergency Management Plan as required to be submitted in Subsection 411.04 to address exposure activities as described above.

The Contractor is hereby advised that existing conduit located within Authority safetywalks and other locations may be made from Transite (Asbestos material). When identified on the plans or encountered in the field, the Transite Conduit shall be removed in its entirety. Activities related to the removal of this conduit may cause asbestos to be emitted. The Contractor shall include provisions in the Pollution Control Plan and Asbestos Health and Safety Plan to address asbestos exposure activities as described. Handling, removal and disposal shall be performed in accordance with all applicable regulatory agency requirements.

417.02 Materials.

Materials for deck slab replacement, spall repairs, joint reconstruction, and overlays shall conform to Subsections 302.02, 401.02, 403.02, and Division 900:

ANTI-CORROSION COMPOUND / CONCRETE SEALER

ASPHALT CEMENT

ASPHALT SEALING MATERIALS

AUTOMATIC END WELDED STUDS

CONCRETE PENETRATING SEALER TREATMENT

CRACK SPANNING MEMBRANE

ELASTOMERIC CONCRETE

EPOXY BONDING COMPOUND

EPOXY MORTAR

FIELD ANTI-CORROSION COATING

FLASHING

HIGH STRENGTH BOLTS, NUTS & WASHERS

HOT POURED JOINT SEALER

JOINT SEALERS

METHACRYLATE SEALER

MORTAR

NON-METALLIC, NON-SHRINK, MORTAR OR GROUT

NON-SHRINK, HIGH EARLY STRENGTH MORTAR

NON-SHRINK, HIGH STRENGTH MORTAR

PENETRATING SEALER AND CORROSION INHIBITOR

POLYESTER RESIN OR EPOXY RESIN GROUT

PORTLAND CEMENT CONCRETE (CLASS A AND B)

PREFORMED ELASTOMERIC JOINT SEALER

PREFORMED JOINT FILLER

PREFORMED JOINT SEALER

EPOXY COATED REINFORCEMENT

REINFORCEMENT BAR, EPOXY COATED

REINFORCEMENT BAR COUPLER

STAY-IN-PLACE FORMS (SIPS)

RUBBER ASPHALT CONCRETE

SILICONE JOINT SEAL

SKID RESISTANT COATING

STRIP SEAL EXPANSION JOINT

STRUCTURAL STEEL

TIMBER FIRE RETARDANT TREATMENT (CATCHES)

WATER REPELLENT TREATMENT

WATERSTOPS

Repairs shall be performed using the following materials:

Repair	Material Description
Concrete Deck Replacements and deck repairs	Class A concrete.

Repair	Material Description
Concrete deck replacements and deck repairs with construction duration less than four (4) days but greater than 24 hours	Class A, High Early Strength concrete.
Deck repairs with construction duration less than 24 hours	Non-shrink, high early strength mortar.
Concrete Bridge Barriers	Class A
Emergency concrete deck replacement	Class A, High Early Strength concrete unless limited time durations (Non-shrink, high early strength mortar).
Spall Repair, Type 1	Non-shrink, high strength mortar.
Spall Repair, Type 2	Non-shrink high strength mortar, waterproofing membrane, and HMA Bridge Surfacing.
Spall Repair, Type 3	No longer used.
Spall Repair, Type 4	Class A concrete with waterproofing membrane, and HMA Bridge Surfacing as necessary.
Spall Repair, Type 5	Non-shrink, high early strength mortar.
Spall Repair, Type 5A	Non-shrink, high early strength mortar.
Spall Repair, Type 5B	Non-shrink, high early strength mortar.
Emergency Spall Repair, Type 5	Non-shrink, high early strength mortar.
Spall Repair, Type 6	Class A concrete, waterproofing membrane, and HMA Bridge Surfacing.
Spall Repair, Type 6A	Non-shrink, high early strength mortar.
Emergency Spall Repair, Type 6	Class A concrete, waterproofing membrane, and HMA Bridge Surfacing.
Spall Repair, Type U	Non-shrink, high early strength mortar suitable for vertical and overhead repairs.
Joint Reconstruction, Type 1	Elastomeric concrete.
Emergency Joint Reconstruction, Type 1	Non-shrink, high strength mortar.
Joint Reconstruction, Type 1A	Class A concrete unless limited time durations (Non-shrink, high early strength mortar). See Paragraph 417.07(D).
Joint Reconstruction, Type 1P	Rubber asphalt concrete.
Joint Replacement, Type 1P	Rubber asphalt concrete.
Joint Reconstruction, Type F	Strip Seal Expansion Joint.
Joint Reconstruction, Type FJ	Preformed Joint Filler.
Joint Seal Replacement, Type ___	Preformed Elastomeric Joint Sealer.
Joint Seal Replacement, Type IV___	Wabo®Inverseal Joint System.
Silicone Joint Sealer	Silicone Joint Seal.
Deck Joint Reconstruction	Match the adjacent deck reconstruction material. If no reconstruction scheduled, use Class A concrete.
Headblock Repair, Type 1	Class A, High Early Strength concrete.
Headblock Repair, Type 2 and Type 3	Class A concrete.
Headblock Repair, Type 2 and Type 3 with construction duration less than four (4) days but greater than 24 hours	Class A, High Early Strength concrete.

Repair	Material Description
Emergency Headblock Repair	Non-shrink, high early strength mortar.
Sidewalk, Safety walk and Curb Surface Repairs	Class B concrete.
Concrete Parapet Repairs	Class A concrete with water repellent treatment.
Parapet Surface Repairs	Class B concrete.
Parapet/Median Barrier replacement or reconstruction	Class A concrete.

The Contractor shall submit mix designs for all concrete and mortar mixes required for the contract including concretes with High Early Strength designations (if required).

Class A Concrete for repairs as noted in table above shall be capable of obtaining 3,000 psi in 72 hours.

The Class A, High Early Strength Concrete shall be that which achieves a compressive strength of 3,000 psi in 24 hours and shall contain a water reducing admixture conforming to Division 900 unless otherwise specified on the Plans. Class A, High Early Strength Concrete may be used at other areas subject to the approval of the Engineer.

Concrete for sidewalk or safety walk repairs may be Class A at the Contractor's option at no additional cost to the Authority.

Vehicular traffic will not be permitted to travel over slabs or repair areas constructed with Class A Concrete until a minimum compressive strength of 4,000 psi has been attained, as indicated by test specimens, but in no case less than 72 hours, unless otherwise authorized in writing by the Engineer.

Vehicular traffic will not be permitted to travel over slabs or repair areas constructed with High Early Strength Concrete until a minimum compressive strength of 3,000 psi has been attained, as indicated by test specimens, but in no case less than 24 hours, unless otherwise authorized in writing by the Engineer.

Vehicular traffic will not be permitted to travel over slabs or repair areas constructed with Non-shrink, high early strength mortar for a period of 4 hours, unless otherwise authorized in writing by the Engineer.

At the discretion of the Engineer, the Contractor may be required to use non-shrink, high early strength mortar for various repair items when setting/curing time of concrete may be impacted due to unforeseen circumstances. The Contractor shall not plan or perform his work assuming this material will be allowed for use in all cases, especially in areas where multi-day lane closings are permitted.

Touch-up of damaged epoxy coated reinforcement shall be made with field anti-corrosion coating.

(A) DELIVERY OF MATERIALS.

The Contractor shall furnish and deliver various repair materials or shall stock pile these materials in his staging area as noted below. The Contractor shall be in strict conformance with Subsection 105.07 as it pertains to the stock piling of materials at his staging area.

(1) Materials Delivered to Maintenance Facility.

The following Maintenance Facilities should be utilized for work along:

Southern Turnpike (Milepost 0 to 83, and the PHMTE)	Maintenance District at Milepost 38.0 Northbound
Northern Turnpike (Milepost 83 to 122, and the NB-HCE)	Northern Division Headquarters at Interchange 14
Southern Parkway (Milepost 0 to 126)	Whitehorse Maintenance Facilities at Milepost 41.0 Southbound
Northern Parkway (Milepost 126 to 172)	Clark Maintenance Yard at Milepost 137.0 Southbound

The Contractor shall furnish and deliver the following materials to the respective Maintenance Facility

as listed above or as directed by the Engineer; the materials shall become the property of the Authority upon delivery:

Material	Quantity
High-Early Strength Cement Patch Mix (Set 45, Rapid Set) or Approved equal with at least one year shelf life	56 - 50 lb. bags (1 pallet)
#6 Epoxy Coated Reinforcement Bars (5 ft. Length)	200 Each
#6 Epoxy Coated Reinforcement Bars (10 ft. Length)	100 Each

The Contractor shall also furnish and deliver High Performance Pavement Cold Patch as prescribed in Section 302 to the above listed Maintenance facility or as directed by the Engineer.

(2) Materials to be Stock Piled in Contractor's Staging Area.

The Contractor shall furnish and deliver to his staging area the following materials for the performance of the various emergency repairs as described in Paragraph 417.12(A) and as directed by the Engineer:

Material	Quantity
High Early Strength Cement Patch Mix (Set 45, Rapid Set or approved equal) with at least one year shelf life, to yield 2 C.Y. Each	4 Each
Tie wire	1 Case
#5 Epoxy Coated Reinforcement Bars (25 ft. Length)	120 Each
#6 Epoxy Coated Reinforcement Bars (20 ft. Length)	70 Each

The Contractor shall furnish and stock pile High Performance Cold Patch in his staging area as prescribed in Section 302.

At the end of the project all unused materials with a shelf life of a year or more shall be delivered to the respective Maintenance Facility as listed above or as directed by the Engineer.

417.03 Equipment.

Equipment used shall be subject to approval of the Engineer and shall comply with the following:

(A) Surface Preparation Equipment.

(1) Sawing and Sealing Deck Joints.

Equipment used for sawing and sealing joints in bituminous concrete overlay over deck joints shall conform to Section 312 and the following:

Sawing equipment shall be capable of making straight vertical cuts to the specified depth. The blades shall be of such size and configuration that the desired dimensions of the sawcut are achieved in one pass.

Sealing equipment shall consist of a kettle, or melter, and applicator wand. The melter shall be constructed as a double boiler, with the space between the inner and outer shells filled with oil or other heat transfer medium. The melter shall include positive temperature control, mechanical agitation, recirculation pumps, and thermometers for continuous reading of the temperature of both the sealing compound and the heat transfer medium. The applicator wand shall be heated or insulated to maintain the pouring temperature of the sealant during placing operations. Pouring pots or similar devices shall not be used to fill sawed joints.

(2) Power-Driven Hand Tools.

Power-driven hand tools will be permitted with the following restrictions:

Jack hammers heavier than nominal 90-pound class shall not be used. Jack hammers heavier than nominal 30-pound class shall not be used within 6 inches of structural steel (girders, stringers, floorbeams, diaphragms, etc.), concrete beams or shear connectors, and reinforcement and deck joint steelwork to remain and shall be used when stipulated within these Specifications. Jack hammers of a nominal 30-pound class or lighter, and approved hand operated pavement breakers, may be used within the 6 inch limits.

Jack hammers or mechanical chipping tools shall not be operated at an angle in excess of 45° measured from the surface of the slab.

Pneumatic tools shall not be placed in direct contact with reinforcement steel, deck joint steel work or the waterstop. Pneumatic hammers shall not be placed in direct contact with reinforcement steel to avoid damaging the bond between the reinforcement steel and concrete to remain; hand tools shall be employed for final cleaning.

(3) Hand Tools.

Hand tools such as hammers and chisels shall be used for removal of final particles of unsound concrete or to achieve the required depth.

(4) Sand-Blasting Equipment.

Sand-blasting equipment shall be capable of removing rust, oil, concrete laitance, and other foreign material from the surfaces against which an overlay or new concrete slab will be placed.

(5) Removal and Scarification Equipment.

Equipment for scarifying surfaces of bridge decks, to obtain the required depth of surfacing and concrete removal, shall be a self-propelled, power-operated, planing, grinding or cutting machine capable of removing the specified depth of concrete (1/4 inch minimum) across the cutting path, including the removal of the existing asphalt surfacing without heat. It shall be capable of establishing profile grades by referencing from either existing pavement or from an independent grade control and shall have positive means for controlling cross slopes. The equipment for scarifying shall have a floating type head permitting variable depths of cut and a positive means for locking to a specific depth to prevent damage to existing reinforcement steel, sound concrete surfaces, underlying steel surfaces, and bordering deck joints.

The equipment shall also have an effective means for removing materials cut from the surface and for preventing dust and other materials resulting from the operation from escaping into the air.

Pneumatic hammers, scabblers, and other hand tools shall be used to scarify concrete headers and to remove surfacing adjacent to curbs, steel deck joints, drainage structures, and at other areas not accessible to the machine.

(6) Demolition Equipment.

Equipment for removing curbs, walkways, barriers and parapets may include hydraulic hammers (Hoe Ram) with hammer operations in a horizontal position, concrete crushers and hydraulic shears or pneumatic hammers employing pointed and blunt chisel-edge tools, all subject to the approval of the Engineer. It shall be demonstrated to the Engineer that the use of such equipment shall not damage existing deck and reinforcement steel to remain to any extent greater than that which would occur using conventional power driven hand tools.

Except as outlined above, hoe rams, concrete crushers, shears and any other special/mobile demolition equipment will not be permitted, unless the project calls for the complete demolition of the superstructure, including all concrete and supporting steel superstructure.

(B) Placing And Finishing Equipment.

Placing and finishing equipment for Portland cement concrete shall meet the requirements of Section 401.

Placing and finishing equipment for asphalt concrete shall meet the requirements of Section 302.

417.04 Concrete Deck Replacement.

Concrete deck replacement shall consist of removal and disposal of sections of bridge deck slabs for their full depths and for the full distance between stringers at the designated locations and lateral/ longitudinal limits, and replacement thereof with new reinforced concrete slabs, with or without overlays.

Removal of deck slabs and the replacement thereof with new reinforced concrete deck slabs shall be in conformance with Section 401 and the following:

(A) Removal Of Deck Slabs.

Removal of Existing Concrete Deck shall consist of the removal of concrete deck, parapets /median barriers (on bridges or wingwalls), portions of safetywalks/sidewalks, SIP forms, reinforcement, existing drainage

inlets, deck joint material, and all other features designated to be removed per the plans or necessary to complete the deck/parapet replacement. This work is typically associated with deck reconstruction work.

Removal of Existing Non-Composite Concrete Deck shall consist of removal of existing non-composite reinforced concrete decks and SIP Forms where present, and all else described above.

Concrete Deck Replacement and Concrete Deck Replacement with Catches shall consist of the replacement of isolated deck areas typically associated with deck repair work.

The longitudinal and lateral limits of each area to be removed and replaced will be delineated by the Engineer and suitably marked. Except along the edges of embedded steelwork at transverse roadway joints, and where the deck slab replacement extends into walks and curbs, the outline of each area shall first be cut to a depth of two (2) inches including the asphalt and latex modified concrete overlays or three quarters (3/4) inch in areas where there is no asphalt overlay, with an approved power-saw. The deck slab removal shall be to the centerline of stringer or as shown in the Plans. The power-saw shall be normal to the slab in order to achieve a vertical face. In the event that reinforcement steel is encountered during sawing operations, the depth of saw-cut shall immediately be adjusted to a shallower depth so as not to damage the reinforcement bars. If so directed, saw-cutting shall again be carried down to the specified depth at other locations of removal provided reinforcement steel is not again encountered. Where overbreakage occurs resulting in a featheredge, the featheredge shall be squared up to a vertical face in an approved manner.

Reinforced concrete slab sections shall be removed by means of pneumatic hammers or full depth saw cutting. Full depth saw cutting will not be permitted within 6 inches of any structural element (girders, stringers, floorbeams, diaphragms, deck joint steelwork, etc.) to remain.

Reinforced concrete deck slab sections that are non-composite with the stringers, floorbeams, diaphragms, or girders may be removed by saw cutting directly over the supporting members that are to remain. This work shall include removal of decks with and without stay in place forms. The method shall be allowed on a trial basis. The trial section shall include deck areas from the original construction and deck areas that were replaced via other contracts where stay in place forms and carrier bars were installed, if both exist. The selection of the trial section shall be approved by the Engineer.

Where noted on the plans that existing reinforcement is to be retained, full depth saw-cutting will not be permitted within a minimum of 2 feet from the centerline of stringer, except within the first interior bays where full depth saw-cutting will not be permitted within a minimum of 2'-6"from the centerline of fascia stringer or as otherwise noted on the plans. When saw-cutting, a shielding system with an effective containment for runoff shall be employed to avoid any leakage to roadways, railroads or other facilities below the removal areas. Pneumatic hammers greater than a nominal 30-pound class shall be subject to the same restrictions as full depth saw cutting. Fillets at intersecting limit lines shall be carefully removed.

The Contractor shall not commence demolition until catches and or/shielding systems are installed as required per the plans, and the temporary concrete construction barrier is in place between the traffic and the work area.

For non-isolated deck replacements, the Contractor shall obtain elevations by accurate field survey along the stringer top flanges prior to removal of any load from or placement of temporary load on the bridge deck or superstructure. The number and location of the required elevations shall be as shown in the Plans. The elevations may be obtained using underbridge access vehicles or through the use of pilot holes along the top flange (maximum six inch diameter holes).

The Contractor shall survey the tops of the stringers after removal of the existing surfacing, deck slab, parapet, safetywalk, and bridge rail; all construction debris and equipment shall be removed from the spans prior to the survey. All survey points shall be at the same location and shall use the same datum of that which was performed prior to removal operations.

The elevations shall be used by the Contractor to calculate haunch values and shear stud heights. The elevations, calculated haunch values, and shear stud heights shall be submitted to the Engineer for review a minimum of thirty (30) days in advance of pouring the decks. The Contractor will be responsible for determining the haunch depths and properly setting the stay-in-place forms to achieve the required deck slab thickness and approved proposed deck grades and cross slopes.

Existing reinforcement steel projecting from the cut faces of remaining slabs shall not be cut flush but shall be cut at the location shown to serve as dowels into the new slab sections. Bending of these bars by use of suitable approved tools will be permitted for staged construction or to aid in lapping. The minimum diameter of bend shall be six (6) bar diameters as measured on the inside of the bar. Only one cycle of

bending shall be permitted on any individual bar.

Care shall be taken to preserve the bond of such dowels in the existing concrete slabs. These dowels shall be thoroughly cleaned of all concrete fragments, foreign matter and corrosion and field epoxy coated prior to placing and tying new reinforcement.

When the construction stage duration will last longer than five (5) days, existing reinforcement to remain shall be thoroughly cleaned and coated with field anti-corrosion coating. For shorter construction stages, i.e. five (5) days or less, a field anti-corrosion coating is not required. Prior to placing and tying new reinforcement, the existing reinforcement to remain shall be thoroughly cleaned. Where reinforcing steel bars to remain are damaged, the Contractor will be permitted to repair the reinforcement by lap splicing a bar of the same size to the required length or coupling onto the existing reinforcement if clearance and cover requirements are not compromised. Welding of reinforcement steel, where permitted, shall conform to Subsection 401.09. Damage to coated reinforcement and/or coated couplers shall be repaired by field applying an anti-corrosion coating. Other existing reinforcement within the replacement sections shall be removed and disposed of by the Contractor. Concrete fragments shall also be removed from exposed steel anchor straps, riser bars used to support reinforcement and shear studs as applicable. Anchor straps and riser bars shall be thoroughly cleaned in accordance with these Specifications. Straps damaged or intentionally removed shall be replaced. Shear studs, if removed by Contractor operations, shall be replaced; welding shall conform to the requirements of Section 403.

Where deck overhang, safetywalk, and parapet are to remain, the Contractor shall use extreme care in making the saw-cuts, breaking out of the concrete, and removing of the reinforcement steel. The Contractor is advised that particular attention must be paid to the cutting of the top transverse reinforcing steel of the existing deck slab so as to leave certain bars in place in accordance with the directions noted on the plans and as directed by the Engineer. The Contractor shall submit to the Engineer for review, details of the method he proposes to use to temporarily support the deck overhang, safetywalk, parapet, and median barrier to remain during the slab breakout and replacement.

Where existing flashings are encountered at filled joints, the Contractor shall use extreme care during removal of concrete, formwork, and placing new reinforcement steel and concrete so as to prevent damage to these flashings. Damaged flashings shall be repaired or replaced and joints refilled by the Contractor to the satisfaction of the Engineer at no cost to the Authority.

Where deck replacement is required and permanent metal forms have been used in forming the existing deck, these forms and their supports shall be removed. Screed supports from prior constructions shall be removed from stringer flanges by saw-cutting or horizontal torch cutting, in a fashion which will not damage the structural steel or reinforcement to remain.

Extreme care must be taken to prevent damage to existing steelwork to remain during the deck removal process. Damage to any supporting steel member (i.e. flange plate, flange angle, flange cover plate, or deck joint steelwork) that reduces a members section by more than 5 percent shall be repaired by the Contractor at his own expense. The Contractor shall submit to the Engineer for approval his means and methods for restoring the damaged member to its full capacity. When noted on the plans that existing flange material is in tension or that the supporting steelwork is designated as a fracture critical member (FCM) the Contractor shall take extreme care to prevent damage to the supporting steelwork. Under such circumstances the Contractor, at his own expense, shall repair all damaged steelwork in a manner to be approved by the Engineer.

The procedures and methods for Removal of Existing Concrete Deck, Concrete Deck Replacement, and Concrete Deck Replacement with Catches shall be submitted for review in accordance with the requirements of Subsection 104.08. All procedures shall be thoroughly detailed and include types of equipment proposed, a sequence of operations, methods of protection for existing steel work or bridge components to remain in place and calculations demonstrating structural adequacy of the existing bridge superstructure components during demolition and details for protection of all areas of the bridge to remain. Any removal or demolition methods which compromise the structural integrity of those areas of the superstructure to remain will be rejected. These submissions are in addition to those required for catches and temporary support systems. Submissions are subject to review and approval of other agencies and owners if construction is scheduled over ROW's and/or properties of those agencies of owners. Should the Engineer take no exceptions to the Contractor's proposed methods and procedures, this shall not be construed as an approval by other agencies and property owners and their requirements must still be met.

No concrete debris from deck replacements or any other construction operations shall be left on abutment slopes, Authority right-of-way or any other property, unless otherwise specified in the Plans.

At the end of each day's operations, Contractor shall provide positive closure for any deck replacement area from which the reinforcement steel and concrete have been removed. Fencing or roping of the open holes will not be considered adequate security.

Structural steel paint, other than the top of the top flange, which is damaged by construction activities shall be restored to the satisfaction of the Engineer in accordance with Section 411.

All debris on the surface of the deck shall be promptly swept up and removed. The steel structure and tops of substructures shall be cleared of all debris. In certain designated locations, the Authority may permit the Contractor to dump and spread broken concrete, asphalt surfacing and debris (except bridge drainage metalwork, reinforcing steel and stay-in-place forms) at a location and in a manner satisfactory to the Engineer. Reinforcing steel and other metal work shall be removed daily and disposed of off the Authority's property.

At those locations not designated as requiring catches, the Contractor may drop the removed materials and debris directly to the ground. In certain of these locations on the project in order to protect the public and properties beneath the deck replacement area, the Contractor shall provide and station personnel below the deck during breakout and reinforcement steel removal as directed by the Engineer. Materials dropped to the ground shall be removed within three (3) days, except that in certain areas removal of debris may be required by the Engineer to be removed the same day as the breakout.

Catches and shielding, where required, shall be designed in accordance with Subsection 417.11.

(B) BRIDGE DRAINAGE.

Functioning drainage scuppers shall be left in place prior to placing new concrete. Existing scuppers which have been previously plugged shall be removed with the deck slab concrete.

Where shown, existing drop inlets (supported on structural steel) shall be set to new grades, in accordance with the plans and specifications or the direction of the Engineer, prior to placing new concrete. The new concrete shall be placed flush with the top of roadway adjacent to the inlet in accordance with the drainage and adjustment details.

(C) CONCRETE DECK SLAB CONSTRUCTION.

Methods of reinforced concrete slab construction including formwork, curing and other associated construction shall conform to the requirements of Section 401 and the following:

(1) Forms.

Forms shall be placed expeditiously after existing reinforcement bars have been removed. Forms shall be of such design as to minimize damage to existing paint on structural steel surfaces.

The Contractor shall submit to the Engineer for review complete design and details of formwork which he proposes to use.

All wood forms must be removed upon completion of work. Removal operations shall be carried on from a platform of scaffolding or staging erected below the deck of the bridge. The platform where form removal is in progress shall be continuously accessible for inspection purposes. The nature and extent of the platform shall be such as to permit inspection of the underside of the new concrete deck slab, the cleaning of structural steel, the damage to painted surfaces, and the repainting of such damaged areas.

If the Contractor elects to use permanent metal forms, the following special requirements, in addition to those specified in Paragraph 401.08(B), shall govern their use:

Forms and reinforcement shall be positioned in accordance with the details given. Attachment of forms to form supports shall be made by sheet metal screws only, unless otherwise directed.

No loose sheets shall be left on the bridge deck at the end of the working day.

(2) Reinforcement Steel.

Reinforcement steel shall be fabricated by cold bending using motive power machines. Hooks and bends shall be dimensioned in accordance with the "Manual of Standard Practice for Detailing Reinforced Concrete Structures" (latest edition to ACI 315).

The Contractor shall determine the exact lengths of all reinforcing bars required for the preparation of working drawings. New transverse bars shall be continuous between faces of existing concrete.

The reinforcement shall be carefully placed and secured in proper position as shown on the plans. Dowels extending from remaining deck concrete may be bent down slightly using an approved tool if necessary to facilitate lapping and tying to new reinforcement.

The deck reinforcement steel shall be supported on and secured to the support bars set in position above the tops of stringers where shown.

Bending of new reinforcement steel in the field will not be permitted on bars larger than size No. 8, or when the temperature is less than 30ºF.

Welding of bar reinforcement, where shown or directed, shall be in accordance with the requirements of the most current edition of AWS D1.5. Suitable ventilation shall be provided when welding epoxy coated reinforcement bars.

This work shall also include furnishing and applying a field anti-corrosion coating to all exposed reinforcement steel during removal of existing concrete for various work in the Contract. The Contractor shall clean the existing reinforcement steel to receive the field anti-corrosion coating in accordance with the manufacturer's recommendations.

(3) Finishing Bridge Slabs.

Finishing for the surface of replacement slabs may be by means of hand-controlled equipment. A vibratory screed of a type approved by the Engineer shall be used for transverse screeding.

(4) Protecting Concrete Bridge Slabs.

In order to comply with the requirements specified in Subsection 417.02, the Contractor may be required to schedule continuous 24 hour operations when replacing deck slabs during any one of the periods when traffic will be restricted by lane closings in each roadway, as specified in the Supplementary Specifications. The concrete in these areas shall be placed and finished no later than 24 hours prior to the reopening of the lane closed, except as otherwise specified.

(5) Membrane Waterproofing for Bridge Decks and HMA Bridge Surfacing.

On decks requiring membrane waterproofing and asphalt surfacing, after the new concrete has been placed and cured a minimum of 48 hours, the waterproofing membrane sheets shall be placed over the entire deck replacement area. Placing and bonding the membrane waterproofing to the deck replacement area and the HMA Bridge Surfacing or Superpave HMA shall be in accordance with Section 302. HMA Bridge Surfacing or Superpave HMA shall not be placed until the concrete slab has cured for a minimum of 72 hours.

The minimum cure time prior to the membrane application for the various concrete repairs shall be as follows:

Membrane Waterproofing Application Table		
Repair Item	**Material Specified**	**Minimum Cure Time Prior to Membrane Application**
Concrete Deck Replacement (Large Areas)	Class A Class A "high early"	48 hours 36 hours
Emergency Concrete Deck Replacement (Individual Panel, Non-Scheduled)	Class A "high early" with water reducer	24 hours
Spall Repair, Various Types	Non-Shrink, High Strength Mortar Non-Shrink, High Early Strength Mortar	12 hours 3 hours
Spall Repair Type 4 (Small Area)	Class A Class A "high early"	48 hours 24 hours
Spall Repair Type 5 (Small Areas)	Non-Shrink, High Early Strength Mortar	3 hours

Membrane Waterproofing Application Table		
Repair Item	**Material Specified**	**Minimum Cure Time Prior to Membrane Application**
Spall Repair Type 6 (Small Area)	Class A Class A "high early"	48 hours 24 hours
Emergency Spall Repair Type 5 (Small Repair, Non-Scheduled)	Non-Shrink, High Early Strength Mortar	2 hours
Emergency Spall Repair Type 6 (Small Repair, Non-Scheduled)	Non-Shrink, High Early Strength Mortar	2 hours

For temperatures below 50ºF, concrete and water releasing mortars shall be covered with insulating (thermal) blankets to maintain normal or rapid strength attainment.

Appropriate heating shall be used for complete drying of the surface if precipitation occurs during the curing cycle. Cost shall be included in the price bid for the item "Membrane Waterproofing".

Any curing compound applied to the concrete shall be compatible with the membrane as approved by the membrane manufacturer.

Any exposed structural steel to receive membrane waterproofing shall be cleaned by abrasive blasting, in accordance with the membrane manufacturer's recommendation, prior to the membrane application. Cost shall be included in the price bid for the item "Membrane Waterproofing".

(6) Cleaning and Spot Painting.

All areas of metalwork on which paint has been damaged by concrete drippings, by the cleaning off of drippings, by broken concrete, by the erection or removal of formwork or platforms to catch broken concrete, or by any other of the Contractor's operations, shall be cleaned by hand-cleaning methods as specified in Subsection 411.05. After such cleaning, the exposed metal shall be spot painted in accordance with the requirements of Section 411. Where only the surface coats have been damaged, the Contractor shall apply one finish coat as specified or as directed. On each individual span or section of deck replacement, all such repairing of painted surfaces shall be done only after all other under deck work required to be performed by the Contractor on that span or section has been completed.

(D) EMERGENCY CONCRETE DECK REPLACEMENT.

Emergency concrete deck replacement shall consist of removal and disposal of sections of bridge deck slabs for their full depths and for the full distance between stringers, to the designated limits, and replacement thereof with new reinforced concrete slabs under emergency conditions, if and where directed by the Engineer. Work shall include furnishing, placing and removing concrete construction barrier and temporary impact attenuators, installing and removing catches for concrete deck removals, furnishing and placing stay in place forms and epoxy coated reinforcement steel, construction of new diaphragms as required, membrane waterproofing and asphalt concrete bridge surfacing, providing heating and thermal protection, and all else necessary to complete the emergency concrete deck replacement.

When directed to make emergency concrete deck replacements, the Contractor shall begin work immediately after the necessary lane closings have been installed by the Contractor or by the Authority's maintenance forces and shall perform and complete all work required to remove and replace the concrete deck slab and have the lane available for opening to traffic within 48 hours of the Notice to Proceed.

The Contractor may be directed to perform emergency concrete deck replacement at any time while the Contract is in force (date Contract is awarded to date of execution of final estimate by the Chief Engineer).

All deck slab replacement work shall be constructed in accordance with the requirements specified in the Paragraphs (A) through (C) above. HMA Bridge Surfacing (or Superpave HMA) shall be in accordance with Section 302.

(E) ACCEPTANCE.

Final acceptance of the finished deck surface shall be in accordance with applicable portions of Subsection 401.12.

417.05 Removal of Existing Surfacing.

Removal of Existing Surfacing shall consist of the removal and disposal of portions of existing overlays of asphalt concrete bridge surfacing and waterproofing materials or concrete from bridge deck surfaces and also shall include removal and disposal of deck joint headers, epoxy mortar, epoxy concrete and other surface patching materials at the locations shown or designated and as directed where evidence of possible deterioration of the underlying concrete slab is present.

The limits of each area of bridge deck surfacing to be removed, including spall areas, will be delineated by the Engineer and suitably marked. The outline of each area (except adjacent to existing concrete headers, concrete curbs, or joint steelwork to remain) shall first be cut to a depth of approximately 1-1/4" with an approved power saw. The saw-cut shall not penetrate the underlying concrete surface. The power saw shall be normal to the surface in order to achieve a vertical face in the adjoining existing surfacing to remain. Where overbreakage occurs resulting in a featheredge, the featheredge shall be squared up to a vertical face in an approved manner.

The Contractor shall be aware that the thickness of existing pavement at each bridge will vary. Existing pavement thicknesses, if available have been provided on the Plans based on available as-built information, as well as selective ground penetrating radar scans and pavement coring. The Contractor is advised to verify the thickness of pavement at each bridge during his prestage work and prior to joint replacements and milling.

The Contractor shall carefully and completely strip the concrete bridge deck slab of all overlying materials, including bituminous surfacing and waterproofing materials, such as coal-tar epoxy resins and fabric membranes. The bare concrete surface shall be exposed throughout the entire area. Removal of overlying materials shall be by methods and equipment approved by the Engineer which will not score or otherwise damage sound concrete surfaces or underlying steel surfaces bordering bridge deck joints.

The Contractor, with the approval of the Engineer, may choose to use milling or scarifying machines as specified in Paragraph 417.03(A). Power-driven hand tools as specified therein shall be used at locations not accessible to machines.

In all areas bounded by designated joint reconstruction limits, concrete shall be removed from the original bridge deck slab and abutment headblock to sound concrete, or as shown. Existing epoxy patches within these limits shall be removed to their entire depth regardless of their condition.

Spalled areas encountered within the removal limits or as outlined by the Engineer shall be removed to the full depth of unsound and deteriorated concrete as directed by the Engineer in accordance with the procedures prescribed in Subsection 417.06. Reinforcement damaged by the use of milling or scarifying machines as specified in Paragraph 417.03(A) shall be repaired in accordance with the procedures outlined for Spall Repair Type 2 in Subsection 417.06. Damaged reinforcement may be repaired by butt welding a bar of the same size to the required length or coupling onto the existing rebar if clearance and cover requirements are not compromised.

All surfacing, concrete, and other materials resulting from the removal operations shall be collected by machine, power broom, vacuum, hand brooming, or other approved means. All debris shall be removed immediately and not allowed to accumulate. Flushing of the debris will not be permitted. All removed materials shall become the property of the Contractor and shall be disposed of by the Contractor clear of the site.

Within the limits of removal of existing surfacing, any damage, depressions, or spalls that are from one-quarter (1/4) inch to one (1) inch in depth below the surface of original concrete shall be filled and leveled with epoxy mortar. Epoxy mortar shall be mixed, placed, and cured in accordance with the recommendations of the manufacturer of the epoxy resin binder. Depressions deeper than one (1) inch shall be repaired as specified in Subsection 417.06 for spall repairs.

At specific locations where asphalt surfacing and membrane waterproofing is required to be removed, the concrete deck shall be scarified to no more than a maximum depth of 1/4 inch which shall include milling and manual scabbing or milling and approved machine scabbing.

The removal operations shall leave the exposed concrete deck completely free from gouges, continuous grooves or ridges and shall have a uniformly textured appearance such as a steel diamond plate pattern.

If in the opinion of the Engineer the Contractor is not meeting the requirements specified herein, all removal operations shall be discontinued until the milling or scabbing equipment is repaired or replaced and the Contractor's construction methods re-evaluated to the satisfaction of the Engineer.

Prior to removal of existing surfacing on structures where dowel bars were left from previous concrete barrier installations, the Contractor shall remove from the pavement/deck the existing dowel bars and repair the deck to the limits as shown on the contract drawings.

Bridge drop inlets filled with concrete and/or asphalt as indicated in the contract documents or as directed by the Engineer shall be removed and legally disposed of off Authority property prior to the removal of existing surfacing. The existing surfacing and concrete deck surrounding each inlet shall be removed full depth to the limits shown on the plans in order to expose the existing deck reinforcement. The deck slab and reinforcement shall be removed and replaced in accordance with Section 401 and Subsection 417.04. The existing structural steel supports for the inlet frames and grates shall remain. The use of hand tools will be required to remove portions of surfacing not accessible to milling machines, such as adjacent to deck joints, bridge drains or concrete curbing.

The Engineer will conduct a job meeting prior to the commencement of any pavement removal operations with the Contractor or Subcontractor, if one is used for this purpose, and review the methods and equipment proposed for this operation as well as insuring that the Contractor and the Subcontractor are completely familiar with requirements contained in these Specifications.

Removal of Latex Modified Concrete Overlay, Variable Thickness shall include the removal of an existing latex modified concrete overlay to the limits provided and at the locations shown in the Plans. All material removed and contained shall be legally disposed of off Authority Right-Of-Way.

Removal of Asphalt Surfacing and Scarify Concrete shall consist of removal of the asphalt concrete overlays, the waterproofing membrane, and a portion of the concrete deck surface by scarifying existing bridge decks. Scarification shall be in accordance with Paragraph 417.08(A).

417.06 Spall Repairs.

Spall repairs shall consist of the removal and replacement of deteriorated deck concrete and previously placed patching materials with the specified materials required for the various types of spall repairs designated.

All removed material shall become the property of the Contractor and shall be legally disposed of by the Contractor off Authority property. Spall Repairs will be classified as to type, dependent upon the materials to be removed and replaced in accordance with the following:

Welding of bar reinforcement, where shown on the plans or directed by the Engineer, shall be in accordance with the requirements of the most current AWS D1.5. Suitable Ventilation shall be provided when welding epoxy coated reinforcement bars.

Adequate measures shall be taken to prevent concrete chips and pieces from flying into adjacent roadway lanes or dropping below the steelwork. This shall include the use of catches, tarps, etc., subject to the approval of the Engineer. At spall repair types as identified on the Plans, or at areas designated by the Engineer, the Contractor will be required to install a temporary catch system prior to performing spall repairs. Temporary catches shall be in accordance with Subsection 417.11. Shop drawings for temporary catch systems shall be submitted to the Engineer in accordance with Subsection 104.08.

The Contractor shall furnish and apply a field anti-corrosion coating to all exposed reinforcement steel during removal of existing concrete.

(A) Spall Repair, Type 1.

The lateral limits of each Type 1 spall repair area to be removed and replaced adjacent to bridge joint reconstruction, in areas of bridge decks from which the existing surfacing materials are removed under Removal of Existing Surfacing, and concrete surfaced bridge decks will be delineated by the Engineer and suitably marked. The outline of each such area shall first be cut to a depth of one-half (1/2) inch into existing concrete with a power-saw.

The depth of concrete removal shall be as prescribed by the Engineer. Unsound concrete shall be removed completely.

Extreme care shall be taken where reinforcement steel is uncovered to prevent damage to the steel or its bond in the surrounding concrete. Pneumatic tools shall not be placed in direct contact with reinforcement steel. The steel shall be cleaned of all attached concrete, the smaller fragments to be removed with hand tools. All debris shall be promptly swept up and removed from the site. Damaged exposed reinforcement steel shall be repaired by welding.

Bitumen and oil from temporary patches and all rust shall be completely removed from exposed reinforcement steel utilizing a sand blast.

The surfaces to receive patching material shall be free of oil, solvent, grease, dirt, dust, bitumen, loose particles, and foreign matter. An air jet shall be used to remove dust and other particles just prior to patching the hole.

Non-shrink high strength mortar shall be mixed, applied, and cured in strict compliance with the manufacturer's recommendations. The repaired surface area shall match the existing exposed concrete deck surface.

A full time employee of the company manufacturing the patching material shall be available upon 48-hour notice to recommend mixing, placing, and curing procedures on the job site, based on existing climatic and job conditions.

Reinforcement bars that have lost 25 percent or more of their original cross sectional area shall be supplemented by providing new bars of the same diameter. Supplemental bars shall be welded to the existing bars. Where reinforcement is broken or missing, new bars of the same diameter shall also be welded to the existing bars.

Spall Repair, Type 1 quantities shown on the plans, per bridge, are based on direct proportion of the area of the bridge deck to be resurfaced. Depending on field conditions these quantities could fluctuate substantially.

(B) SPALL REPAIR, TYPE 2.

The lateral limits of each Type 2 spall repair area to be removed and replaced on asphalt surfaced bridge decks outside the areas from which the existing surfacing materials have been removed under Removal of Existing Surfacing will be delineated by the Engineer and suitably marked. Except at transverse expansion joints, the outline of each such area shall first be cut to a depth of two (2) inches.

At transverse expansion joints, the saw-cut shall be made generally parallel to the joint. If a major spall occurs within the lane being worked in, the Engineer may direct that the saw-cutting be skewed from the joint so as to include the large local repair area.

The depth of concrete removal, size of pneumatic hammers, care to be taken to prevent damage to reinforcement steel or its bond in the surrounding existing concrete, cleaning of surfaces to receive patching materials, and mixing, application, and curing of non-shrink high strength mortar shall all conform to the requirements specified above for Type 1 spall repairs.

Membrane waterproofing, including installation, sealing around peripheral limits, and surface preparation of concrete, shall conform to the requirements specified under Section 302 and such other requirements as specified above under Paragraph 417.04(C).

Bridge deck surfacing shall conform to Section 302 except that placement and compaction shall be performed with equipment appropriate to the spall repair size as directed by the Engineer.

Reinforcement bars that have lost 25 percent or more of their original cross sectional area shall be supplemented by providing new bars of the same diameter. Supplemental bars shall be welded to the existing bars. Where reinforcement is broken or missing, new bars of the same diameter shall also be welded to the existing bars.

Where Spall Repair, Type 2 is called for, and upon removal of the existing surfacing, spalls of one inch or less in depth are revealed, those spalls from one quarter inch to one inch in depth below the surface of the original concrete shall be repaired as specified under Subsection 417.05, and the membrane waterproofing and bridge deck surfacing replaced as specified under Section 302 and such other requirements as specified above under Subsection 417.04.

(C) SPALL REPAIR, TYPE 3.

Spall Repair, Type 3 is no longer used.

(D) SPALL REPAIR, TYPE 4.

The lateral limits of each Type 4 spall repair area to be removed and replaced adjacent to filled or armored deck joints, in areas of bridge decks from which the existing surfacing materials are removed under Removal of Existing Surfacing will be delineated by the Engineer and suitably marked. Except along the filled joint, the outline of each such area shall be first cut to a depth of one-half (1/2) inch into existing concrete with a power saw. The cuts shall be straight and parallel to the existing deck joint and the lane lines.

The concrete removal shall be made for the full depth of the deck slab down to the top of the structural steel and diaphragm.

Extreme care shall be taken to prevent damage to steel diaphragms, reinforcement steel, deck joint armoring and attachments and existing waterstop or their bond in the concrete to remain. The steel and

waters-top shall be cleaned of all attached concrete with smaller fragments removed with hand tools. All debris shall be promptly swept up and disposed of away from the site. Damages to exposed steelwork, reinforcement steel, deck joint steel work and waterstop shall be repaired or the items replaced by the Contractor in a manner satisfactory to the Engineer. After cleaning the existing reinforcement steel, the Contractor shall apply a field anti- corrosion coating.

All exposed steelwork and remaining concrete shall be cleaned of all bitumen, oil, rust, and other foreign matter utilizing a sand blast or suitable brushing methods as approved by the Engineer.

The Contractor shall install a new copper waterstop and preformed joint filler, in accordance with the details shown, prior to placing concrete. Where new waterstop meets existing, the new waterstop shall be soldered to the existing waterstop to provide a watertight seal.

Concrete replacement shall conform to the applicable provisions of Subsection 417.04. The Contractor shall furnish and install the formwork required for proper construction of the deck.

Saw-cutting and sealing of the joint after replacement of the asphalt concrete bridge surfacing shall be in accordance with Section 312.

Immediately after the lane closing has been installed, the Contractor shall erect and maintain sections of barrier as shown in the Drawings at each Spall Repair Type 4 location. These barriers shall not be removed until after the repairs have been made and cured or as directed by the Engineer.

Where no concrete construction barrier is called for, the Contractor shall place a barrier to protect the spall repair area in accordance with the details shown in the plans immediately after the lane closing has been installed.

(E) SPALL REPAIR, TYPE 5.

The lateral limits of each Type 5 spall repair area to be removed and replaced on asphalt surfaced bridge decks within areas of the bridge deck from which the existing surfacing has been removed, will be delineated by the Engineer and suitably marked. Written approval by the Engineer to use Type 5 spall repairs on asphalt surfaced bridge decks is required. The outline of each such area shall first be cut to a depth of one-half (1/2) inch into existing concrete with a power-saw.

Adequate measures shall be taken to prevent concrete chips and pieces from flying into the adjacent roadway lanes or dropping below the steelwork. This shall include the use of catches, tarps, etc. subject to the approval of the Engineer. All debris shall be swept up promptly and legally disposed of off Authority property.

The depth of concrete removal, size of pneumatic hammers, care to be taken to prevent damage to reinforcement steel or its bond in the surrounding existing concrete, and cleaning of surfaces to receive patching materials shall all conform to the requirements specified in Paragraph (A) above for Spall Repair, Type 1.

The Contractor's attention is directed to the fact that, because of the nature of the spall repair proposed herein, detailed consultation and cooperation will be required between the Contractor, the manufacturer of the blended cement patch mix and the Engineer in order to utilize the technical experience and proficiency required in preparing substrate, mixing, placing, finishing and curing the product and its associated application techniques.

The Contractor shall arrange with the manufacturer of the patching material to have a field representative available at the site during the initial phase of Type 5 spall repair work to acquaint the Contractor's forces with the proper method of priming and mortar preparation and application.

The mortar shall be mixed utilizing a mortar type drum unit or by suitable mechanical means approved by the manufacturer and the Engineer. The mortar shall be mixed with the quantity of pre-weighed components in the proportions specified by the manufacturer. Aggregate, as described in the material specifications, shall then be added in the proportions specified, as recommended by the manufacturer and as directed.

Upon completion of the complete cleaning and preparation of areas over which the spall is to be repaired as outlined above and in accordance with the manufacturer’s recommendations, the mortar shall be placed and thoroughly compacted until minimum air voids are obtained.

The placed mortar patch shall be finished by troweling, screeding, or by a suitable method approved by the manufacturer and the Engineer. The finished mortar patch shall be the same elevation and cross slope as the adjacent concrete surface. The final patch shall be smooth and completely seal the existing edges of the

deck to remain with no porosity.

All areas to receive the blended cement patch mix shall be selected by the Engineer.

(F) SPALL REPAIR, TYPE 5A.

Spall Repair, Type 5A shall conform to Paragraph 417.06(E) for Spall Repair, Type 5 except that the repair shall be flush with the top of the adjacent bridge surfacing using the materials specified in the table above.

(G) SPALL REPAIR, TYPE 5B.

Spall Repair, Type 5B shall conform to Paragraph 417.06(E) for Spall Repair, Type 5 except that the repair shall be flush with the top of the adjacent bridge surfacing (asphalt concrete wearing surface, LMC overlay, or bare concrete deck). The replacement material shall be comply with Division 900 and shall completely fill the opening in the concrete deck and the adjacent bridge surfacing (asphalt concrete wearing surface, LMC overly, or bare concrete deck). The material shall be installed monolithically from the lower limit of the concrete deck repair to the top of the adjacent riding surface. The top surface of the repair shall be flush with the adjacent top of roadway and shall be finished in accordance with Paragraph 401.12(C).

(H) EMERGENCY SPALL REPAIR, TYPE 5.

The Contractor may be directed to perform Emergency Spall Repair, Type 5 within the Emergency Pavement Replacement areas, at any time including night time and weekends, while the contract is in force (date contract is awarded to date of execution of final estimate by the Chief Engineer).

When directed to make Emergency Spall Repair, Type 5, the Contractor shall begin the work immediately after the necessary lane closings have been installed by the Authority's maintenance forces, or when directed by the Engineer, and shall perform and complete all work required to perform the Emergency Spall Repair Type 5, as directed by the Engineer and have the lane open to traffic within 12 hours of the notice to proceed or within the time frame predetermined by the Engineer.

Emergency Spall Repair, Type 5 shall be performed in accordance with the requirements specified in Paragraph (E) above for Spall Repair, Type 5.

Emergency Spall Repair, Type 5 at locations where no pavement removal is required, shall be constructed flush with the top surface of the adjacent concrete or asphalt surfaces. The perimeter of all repair areas shall be sealed with asphalt cement (AC-20).

(I) SPALL REPAIR, TYPE 6.

Spall Repair, Type 6 shall be those areas where concrete removal being done under Spall Repair, Types 1 and 2 extends for the full depth of the deck slab. The determination for a full depth repair shall be made by the Engineer during the removal of the deteriorated concrete at which point the removal operation shall cease and catches installed if directed by the Engineer. Where no concrete construction barrier is called for, the Contractor shall place a barrier to protect the Type 6 spall repair area in accordance with the details shown in the plans.

Adequate measures shall be taken to prevent concrete chips and pieces from flying into the adjacent roadway lanes or dropping below the steelwork. This shall include the use of catches, tarps, etc. subject to the approval of the Engineer. All debris shall be swept up promptly and legally disposed of off Authority property.

Spall Repair, Type 6 shall be constructed in accordance with (A) and (B) above except that the Contractor shall furnish and install the formwork required for proper construction of the deck and provide catch systems in accordance with Subsection 417.11.

Contractor shall remove all formwork and catch systems upon completion of the work.

(J) SPALL REPAIR, TYPE 6A.

Spall Repair, Type 6A shall conform to Paragraph 417.06(I) for Spall Repair, Type 6 except that the repair shall be constructed flush with the top of the adjacent riding surface using the materials specified in the table above. Spall Repair, Type 6A shall only be performed where expressly authorized by the Engineer.

(K) EMERGENCY SPALL REPAIR, TYPE 6.

The Contractor may be directed to perform Emergency Spall Repair, Type 6 on bridge decks, at any time including night time and weekends while the contract is in force (date contract is awarded to date of execution of final estimate by the Chief Engineer).

When directed to make Emergency Spall Repair, Type 6, the Contractor shall begin the work immediately after the necessary lane closings have been installed by the Authority's maintenance forces, or when directed by the Engineer, and shall perform and complete all work required to perform the Emergency Spall Repair Type 6, as directed by the Engineer and have the lane open to traffic within 12 hours of the notice to proceed or within the time frame predetermined by the Engineer

Emergency Spall Repair, Type 6 shall be performed in accordance with the requirements specified in Paragraph (I) above for Spall Repair, Type 6 and the following:

The Contractor's attention is directed to the fact that, because of the nature of the spall repair proposed herein, detailed consultation and cooperation will be required between the Contractor, the manufacturer of the blended cement patch mix and the Engineer in order to utilize the technical experience and proficiency required in preparing substrate, mixing, placing, finishing and curing the product and its associated application techniques.

The mortar shall be mixed utilizing a mortar type drum unit or by suitable mechanical means approved by the manufacturer and the Engineer. The mortar shall be mixed with the quantity of pre-weighed components in the proportions specified by the manufacturer. Aggregate, as described in the material specifications, shall then be added in the proportions specified, as recommended by the manufacturer and as directed.

Upon completion of the complete cleaning and preparation of areas over which the spall is to be repaired as outlined above and in accordance with the manufacturer's recommendations, the mortar shall be placed and thoroughly compacted until minimum air voids are obtained.

The placed mortar patch shall be finished by troweling, screeding, or by a suitable method approved by the manufacturer and the Engineer. The finished mortar patch shall be the same elevation and cross slope as the adjacent concrete pavement. The final patch shall be smooth and completely seal the existing edges of the deck to remain with no porosity.

Emergency Spall Repair, Type 6 at locations where no pavement removal is required, shall be constructed flush with the top surface of the adjacent concrete or asphalt surfaces. The perimeter of all repair areas shall be sealed with asphalt cement (AC-20).

(L) REPAIR UNDERDECK SPALLS (CLEAN AND COAT).

The lateral limits for Repair Underdeck Spalls (Clean and Coat) are as identified on the plans or as suitably marked and delineated by the Engineer.

This work shall include chipping and removing the unsound concrete to sound concrete, cutting guide rail anchor bolts that extend through the deck in underdeck areas to be repaired, or where directed by the Engineer, cleaning of the surface of the concrete and the exposed reinforcement steel as required and applying an anti-corrosion coating to the exposed reinforcing steel.

Concrete removal shall be by means of hand held pneumatic tools only. Care shall be taken so as to prevent damage to existing sound concrete, reinforcement steel or structural steel encountered during concrete removal. Damage to such items shall be repaired or replaced by the Contractor, as directed by the Engineer, at no additional cost to the Authority.

The Contractor is advised that he is required to cut any existing guide rail anchor bolts that extend through the deck within areas of Repair Underdeck Spalls (Clean and Coat) or where directed by the Engineer.

Adequate measures shall be taken to prevent concrete chips and pieces from flying into adjacent roadway lanes, sidewalks, and waterways. All debris shall be promptly swept up and removed from the site.

Extreme care shall be taken where reinforcement steel is uncovered to prevent damage to the steel or its bond in the surrounding concrete to remain. Pneumatic tools shall not be placed in direct contact with reinforcement steel. The steel shall be cleaned of all attached concrete with smaller fragments removed with hand tools. Damaged exposed reinforcement steel shall be repaired in accordance with methods prescribed in Paragraph 417.06(A).

After removal of deteriorated and unsound concrete, the surfaces of the remaining concrete shall be cleaned of all loose concrete, dust, and other foreign materials, and the exposed reinforcement bars, anchor straps and structural forms shall be cleaned of any adhering particles of concrete, rust and scale by hand tools or using other suitable methods acceptable to the Engineer.

Exposed reinforcement bars, cut anchor bolts, anchor straps, structural forms, and any other exposed steel shall be coated immediately after cleaning with a field anti-corrosion coating.

Existing concrete surfaces shall not be coated.

The Contractor is responsible for protecting all utilities in the vicinity of the Repair Underdeck Spalls (Clean and Coat) work. Any damage to the existing utilities and/or their supports shall be repaired by the Contractor to the satisfaction of the owner at no cost to the Authority.

If concrete removal limits exceed half of the deck thickness, the Contractor shall cease work. The Engineer shall be immediately notified to determine if a Spall Repair, Type 6 is warranted.

(M)Spall Repair, Type U (Overhead Deck Spall Repair).

Spall Repair, Type U (Overhead Deck Spall Repair) shall consist of removing all delaminated and/or deteriorated deck concrete on the underside of the deck or deck overhang to a minimum depth of one (1) inch above the top of the bottom layer of existing reinforcement steel and to a maximum depth of 50% of the deck thickness.

All exposed reinforcement steel shall be coated with a field-applied anti-corrosion coating.

For Spall Repair, Type U (Overhead Deck Spall Repair), patch material shall be placed level with the bottom of the existing concrete deck and shall be in accordance with Division 900 and installed in accordance with the manufacturer's instructions.

If concrete removal limits exceed the limits specified, the Contractor shall cease work. The Engineer shall be immediately notified to determine if a full depth (Spall Repair, Type 6) repair is warranted.

417.07 Joint Reconstruction.

In general, the Contractor shall reconstruct the deck joints and joints at abutment headblocks by removing existing concrete deck, headers, and headblocks to the designated limits, reconstructing new deck, headers and headblocks, and replacing existing steel riser bars with new steel riser bars, where required. Where reconstruction of the deck, headers, or headblocks are of greater depth than 1-1/2 inches, epoxy coated reinforcement steel bars may be required.

At all joint reconstruction areas (regardless of construction staging duration), the Contractor is required to furnish and apply field anti-corrosion coating to all exposed reinforcement steel, anchor straps, riser bars, and joint support steelwork that is to remain.

This work also consists of sealing existing pavement joints with new sealers. Joint sealers shall consist of furnishing and installing new proprietary joint sealers of the required sizes as indicated on the plans.

Preformed joint-filler shall be installed to the final grade and position in a straight line and/or straight plane with temporary supports. The Contractor shall furnish a shop drawing for the temporary supports. Any required trimming and cutting shall be performed prior to placement of adjacent concrete or other cementitious materials.

Removal of existing asphalt concrete surfacing and repairing spalls therein shall be in accordance with Subsections 417.05 and 417.06, respectively.

Welding of bar reinforcement, where shown or directed, shall be in accordance with the requirements of the most current AWS D1.5. Suitable ventilation shall be provided when welding epoxy coated reinforcement bars.

Contractor shall provide catch or shielding systems in accordance with Subsection 417.11 where applicable. Reconstruction of joints of the various types shall be performed in accordance with the details shown.

(A) Pavement Riser Repairs.

The steel pavement riser bars shall be fabricated, as detailed on the plans, and in accordance with field dimensions. The Contractor shall obtain accurate field dimensions and locate all discontinuities in the existing steelwork prior to fabrication of the new steel pavement riser bars. Fabrication shall conform to the applicable provisions and requirements of Section 403.

The top surface of existing steelwork shall be leveled by grinding or other approved methods to provide a level bearing suitable for welding the steel riser bar, when so required.

The new steel pavement riser bars shall be welded to the underlying steelwork utilizing automatic feed wire welding equipment. All weld slag shall be thoroughly removed during and after completion of the welding operation.

Upon completion of the welding to existing steelwork, the entire bar shall be cut to match the elevation of the pavement riser bar of the adjacent deck joint. The cutting of the steel bar shall be by a machine

mounted acetylene torch operating as a pantograph from the adjacent asphalt surface. A tolerance of 1/16 inch plus or minus will be required in matching the adjacent surface elevation.

The Contractor shall submit to the Engineer for approval the method and type of cutting equipment he proposes to use to accomplish this operation. Hand-held cutting will not be permitted. All slag, rough edges, and irregularities beyond the tolerance of 1/16 inch shall be removed or, if too low, the steel bar shall be replaced.

(B) JOINT RECONSTRUCTION, TYPE 1.

All certifications from the manufacturer's representative to the Engineer shall be in writing.

Upon completion of the placement of membrane waterproofing and asphalt concrete surfacing materials, the Contractor shall saw-cut and remove the new asphalt concrete surfacing and membrane waterproofing within the prescribed limits of joint reconstruction. The saw-cut shall be made where required, parallel to the joint and the lane lines, to a depth of one and one-quarter (1-1/4) inches with a power saw. Concrete removal shall be by means of hand held tools only.

The asphalt and concrete shall be chipped out and removed to a minimum depth of 1-1/2 inches below the final pavement surface grade within the limits designated for the new header or headblock in such a manner as not to damage the portions of existing concrete or the existing steelwork which are to remain.

Where called for, the concrete shall be removed to a minimum depth of 1 inch below the top of the existing joint bulb angle.

The Contractor shall exercise care during removal of the existing asphalt and membrane at joints so as not to damage the existing steelwork at the joints. Any damage caused by the Contractor's operation shall be repaired at no additional cost to the Authority.

All materials between the saw-cut and the deck joint steelwork shall be completely removed so as to produce a blockout area in which all surfaces are completely clean (free of dust) and dry.

At certain other locations, reconstruction of headers or headblocks will require a greater depth of concrete removal. The limits of removal shall be to sound concrete or to such other limits as directed.

The entire exposed concrete and/or steel surfaces shall be thoroughly cleaned of any asphalt, membrane, grease, oil, tar, dirt, paint, rust, and all mill scale by blast cleaning. The blast cleaning of exposed metal surfaces shall be in accordance with the steel structures painting council surface preparation specifications for blast cleaning to near white. After blast cleaning, the entire exposed surface shall be cleaned by high pressure air and vacuumed simultaneously to assure a clean surface free of loose particles.

Immediately after mixing, the elastomeric concrete shall be placed in the header blockout recess and completely distributed and well compacted beneath and around the deck joint anchor bars and against the faces of the joint armor, riser bars and saw-cut joint. The surface shall be troweled smooth and flush with the surfacing and the top of steel or riser bar.

The Contractor shall arrange with the elastomeric concrete producer to supply a representative present at the site who is completely knowledgeable and competent in all aspects with the material and all equipment necessary to properly install the elastomeric concrete.

The representative shall be responsible to advise the Engineer and the Contractor that the correct installation methods are being followed; certify to the Engineer that all materials are being used in accordance with the company's requirements; train assigned personnel in the correct methods of installation and certify to the Engineer that the material has been correctly installed. The representative shall be on the site at all times to assure their material is being properly mixed, placed and cured and that the blockout has been properly prepared.

The elastomeric concrete material shall be installed in strict accordance with the written instruction of the manufacturer. The Contractor shall anticipate the cure time for elastomeric concrete between 1 and 3 hours, depending on the ambient temperature during installation. Therefore, based on some stages of work which are limited in allowable hours of work, the Contractor shall provide a suitable means of maintaining temperatures of the elastomeric concrete above 50 degrees F, such as warming blankets, windbreaks, and/or ground/surface heaters. Ultimately, the Contractor shall adhere to the manufacturer’s recommendations for curing. Two weeks prior to the first intended installation, the Engineer shall be supplied with two copies of the written instructions.

The newly placed elastomeric concrete shall be cured in accordance with the manufacturer's instructions. Vehicular traffic will not be permitted on the new header until accepted by the manufacturer’s on-site

representative.

All exposed concrete cold joints and interfaces between steel deck joint armoring and concrete shall be sealed with methacrylate, and all joints between concrete and asphalt shall be sealed with asphalt cement (AC-20).

Joint Seal Replacement associated with the joint reconstruction shall be performed in accordance with Paragraph 417.07(I).

(C) EMERGENCY JOINT RECONSTRUCTION TYPE 1.

The Contractor may be directed to perform Emergency Joint Reconstruction, Type 1, at any time including night time and weekends, while the contract is in force (date contract is awarded to date of execution of final estimate by the Chief Engineer).

When directed to make Emergency Joint Reconstruction, Type 1, the Contractor shall begin the work immediately after the necessary lane closings have been installed by the Authority's maintenance forces, or when directed by the Engineer, and shall perform and complete all work required to perform the Emergency Joint Reconstruction, Type 1, as directed by the Engineer and have the lane(s) open to traffic within 12 hours of the notice to proceed or within the time frame predetermined by the Engineer.

Emergency Joint Reconstruction, Type 1 shall be performed in conformance with the requirements of Paragraph 417.07(B) except for the joint repair material.

(D) JOINT RECONSTRUCTION, TYPE 1A.

Where the concrete of the existing joint header has failed or deteriorated, as determined by the Engineer, the Contractor shall chip out and remove the existing concrete to sound concrete or to a minimum depth as defined in the plans.

At the discretion of the Engineer, the Contractor may be required to use non-shrink, high early strength mortar for Joint Reconstruction, Type 1A when setting/curing time of concrete may be impacted due to limited staging durations. The Contractor shall not plan or perform his work assuming this material will be allowed for use. The Contractor shall also protect the existing joint sealer during reconstruction operations. Damage to the existing joint sealer, by the Contractor, as determined by the Engineer, shall be replaced in kind at the direction of the Engineer.

Concrete removal shall be by means of hand held pneumatic tools only. Care shall be taken so as to prevent damage to existing sound concrete, reinforcement steel or other embedded steelwork encountered during concrete removal. Damage to such items shall be repaired or replaced by the Contractor, as directed by the Engineer, at no additional cost to the Authority.

Where the depth of removal extends below the steel joint armor, the Contractor shall temporarily support the joint armor as necessary to prevent displacement thereof.

After the removal of deteriorated and unsound concrete, the surfaces of the remaining concrete shall be cleaned of all loose concrete, dust and other foreign materials and the exposed reinforcement bars, anchor straps and surfaces of the joint steelwork in contact with the concrete shall be cleaned of adhering particles of concrete, rust and scale by sandblasting or using other suitable methods acceptable to the Engineer. Where the anchor straps are missing, deteriorated or damaged during concrete removal, or removed for the convenience of the Contractor, new equivalent straps of steel (1/2" x 3" cross section) shall be furnished and installed as replacements. Where new steel straps are to be attached, the area of deck joint steel shall be ground to white metal. New epoxy coated reinforcement steel bars shall be installed with appropriate welds as directed by the Engineer.

Immediately prior to placement of the new concrete in the joint header area, the surfaces of the concrete and steel shall receive a complete, even coating of the bonding compound applied in accordance with the manufacturer's written instructions.

The placed concrete shall be finished by troweling, screeding or by a suitable method approved by the Engineer. The finished concrete surfaces shall conform to the profile and cross slope of the roadway, adjacent new or proposed pavement and/or steel bar.

Whenever a repair area has been prepared for construction of the concrete joint header and because of inclement weather or less than 24 hours are available to construct the joint header prior to a necessary opening of a lane to traffic, the Contractor shall place a temporary fill of asphalt concrete in the joint area to accommodate the passage of traffic until such time as the lane can again be closed to traffic.

As soon as the lane is closed again, the Contractor shall remove the temporary fill, clean the area of concrete and steel surfaces as specified above, and complete the header repair.

(E) JOINT RECONSTRUCTION TYPE 1P.

Where shown on the plans, deck joints shall be reconstructed by removing the asphalt surfacing to the limits shown, modifying the existing joint, and installing hot pour rubber asphalt headers and steel plate spanning the joint opening.

All procedures for the removal of the existing joints, including staged construction, shall be as directed by the Engineer and as recommended by the manufacturer of the asphaltic plug joint system. The joint system shall be installed in strict accordance with the following specifications and the manufacturer's instructions. In the event that there are discrepancies between these specifications and the manufacturer's instructions, with the approval of the Engineer, the manufacturer's requirements shall govern. Two weeks prior to the first intended installation, the Engineer shall be supplied with two copies of the manufacturer's specifications, instructions and guidelines.

The Contractor shall arrange with the manufacturer of the joint system to assign a representative to the Project. The representative shall be completely knowledgeable and competent in all aspects with the joint systems materials and installation procedures.

The representative shall be present during each joint systems installation to assure proper preparation, mixing, installation and curing. The representative shall be responsible to advise the Engineer and the Contractor that the correct installation methods are being followed; certify to the Engineer that all materials are being used in accordance with the manufactures requirements; train assigned personnel in the correct methods of installation; and certify to the Engineer that the joint system has been properly installed.

All certifications from the manufacturer's representative to the Engineer shall be in writing.

The Contractor shall sawcut the pavement transversely at the determined width along the joint. The Contractor shall remove all material, including wearing surface, waterproof membrane, concrete header or approach slab, and any old joint material between the sawcuts and to a depth which will allow the new joint system to be properly installed. The trench shall be cut to a minimum depth of two (2) inches. This will form the blockout for the asphaltic plug joint. The bottom surface of the blockout, called the joint table, shall be parallel with the plane of the roadway surface (true and flat).

Spall Repair, Types 1 and 4 shall be performed as directed by the Engineer in accordance with Subsection 417.06.

Headblock repairs shall be performed at the locations shown on the Plans or as directed by the Engineer to raise the top of headblock to the top of pavement surface and to provide a proper blockout for installation of Type 1P joint system. Headblock repairs shall be performed in accordance with Paragraph 417.07(L).

The area of joint reconstruction shall be prepared in accordance with methods described for Joint Reconstruction, Type 1 in Paragraph 417.07(B). Concrete removal shall be by means of hand held tools only. Care shall be taken when removing existing materials so as to prevent damaging existing sound concrete to remain. Damage to sound concrete shall be repaired by the Contractor in accordance with Section 401, as directed by the Engineer, at no additional cost to the Authority.

The joint blockout area shall be prepared by cleaning free of dust and drying the blockout area and a minimum 6 inches on either side of the blockout.

For installing the joint system, the Contractor shall use the manufacturer's specified aggregate premixed with the manufacturer's specified binder.

The asphaltic plug joints, which are in compliance with Division 900 for Rubber Asphalt Concrete, shall not be installed when the temperature is below 55 degrees F.

The time after completion of the joint material placement that the joint can be opened to traffic shall be as recommended by the joint manufacturer. Vehicular traffic will not be permitted to travel over the reconstructed joint for a minimum period of one (1) hour after the joint installation is completed, unless otherwise authorized in writing by the Engineer. Additional curing time may be required for joint thickness in excess of 4 inches. The Contractor shall coordinate with the manufacturer and allow additional curing time as required.

The preparation and installation of the elastic joint sealer (including primers) at barrier curbs, parapets and sidewalks shall conform to the manufacturer's installation procedures and recommendations.

Methods and materials shall be in accordance with Division 900 and the manufacturer's recommendations.

All certifications from the supplier's representative to the Engineer shall be in writing.

(F) JOINT REPLACEMENT, TYPE 1P.

Where shown on the Plans, existing Type 1P deck joints shall be reconstructed by removing the asphalt surfacing to the limits shown, modifying the existing joint, replacing the steel plate spanning the joint opening and installing rubber asphalt concrete.

The existing Type 1P deck joint shall be removed by saw cutting and not through use of a milling machine.

Installation of the new Type 1P joint shall be in accordance with Paragraph 417.07(E).

(G) JOINT RECONSTRUCTION TYPE F.

Joint Reconstruction Type F shall consist of partially removing existing "Finger" joint steel work and portions of concrete barrier, parapet and safetywalk at the required Structure locations; placing new steel plates; furnishing and installing a strip seal joint system; and reconstructing the concrete barrier, parapet, and safetywalk as shown on the plans.

The lateral limits of joint steel, safety walk, parapet and concrete median barrier to be removed shall be in accordance with details and dimensions shown on the plans or as directed by the Engineer.

Steel and weld metal shall be oxygen cut, provided a smooth and regular surface free from cracks and notches is secured and provided that an accurate profile is met by the use of a mechanical guide.

Contractor shall remove all existing drainage steel components (deflection plates, trough, piping and bolts) and shall repair all holes left by the removal of the existing concrete anchors with non-shrink mortar as shown on the plans or as directed by the Engineer. The drainage steel components removed shall become the property of the Contractor and properly disposed of by the Contractor off Authority property.

In all oxygen cutting, the cutting flame shall be so adjusted and manipulated as to avoid cutting beyond (inside) the prescribed lines. Roughness of oxygen cut surfaces shall not be greater than that defined by the American National Standards Institute (ANSI) surface roughness value of 1,000 for material up to and including 4 inches thick and 2,000 for material greater than 4 to 8 inches thick. Roughness that exceeds these values and occasional notches or gouges not more than 3/16 inch deep on otherwise satisfactory surfaces shall be removed by machining or grinding. Cut surfaces and edges shall be left free of slag. Correction of defects shall be faired to the oxygen cut surfaces with a slope not exceeding 1 in 10. Defects in oxygen cut edges shall be repaired by welding for occasional notches or gouges less than 7/16 inch deep for material up to 4 inches thick and less than 5/8 inch deep for material over 4 inches thick. Such weld repairs shall be made by suitably preparing the defect, welding with low hydrogen electrodes 5/32 inch in diameter and grinding the completed weld smooth and flush with the adjacent surface to produce good workmanship type finish, acceptable by the Engineer. All welded repairs to main material shall be subject to ultrasonic inspection at random locations as determined by the Engineer.

The steel extrusions of the strip seal joint system shall be installed flush with adjacent steel surface so that the final riding surface conforms accurately with the cross slopes and profiles of the roadway measured at the existing lane lines. The Contractor shall determine by field measurements all dimensions which will affect fabrication and installation of the joint steelwork. For this purpose, it will be necessary for the Contractor to obtain elevations of the existing joints which are to be reconstructed.

Armored joints shall be furnished without any temporary tie plates or straps.

Armored joints shall be ready for inspection by the Engineer and/or the Authority's testing laboratory at the fabricator's plant, a minimum of ten days prior to the Contractor accessing any part of the roadway and/or commencement of any construction which will incorporate the new armored joints.

The profile for safetywalk repairs/replacements shall follow (be parallel to) the profile of the parapet meeting the armored joints.

The strip seal component shall be recessed sufficiently below finished grade of the bridge deck so that under all combinations of motion there will be no projection above the deck surface.

The strip seal shall be continuous for the full length of the joint. Field splices will not be permitted except where specifically called out on the plans.

The strip seal shall be mechanically locked into place within the steel locking lugs, and shall be installed using a lubricant adhesive.

The strip seal shall be installed at an ambient temperature no greater than 85 degrees F.

The Contractor shall provide detailed joint installation method, procedures and time frames as indicated on the plans, to the Engineer for review and approval prior to the start of any joint reconstruction work.

The strip seal expansion joint system shall be installed in strict accordance with the manufacturer's written instructions.

The Contractor shall not start the installation of the expansion joint system until a trained factory representative of the manufacturer is on the job site to provide direction and assistance throughout the installation work.

(H) JOINT RECONSTRUCTION, TYPE FJ.

Joint Reconstruction, Type FJ consists of sawing and sealing over existing filled joints within areas of Removal of Existing Surfacing, Spall Repairs, and Concrete Deck Replacements as shown on the Plans. The lateral limits of joint reconstruction shall be in accordance with dimensions shown on the Plans or as directed by the Engineer.

Removal of the bridge surfacing shall be performed in accordance with Subsection 417.05.

After removal of the bridge surfacing, the Engineer shall delineate areas of Deck Replacements and Spall Repairs, which shall be performed in accordance with Subsections 417.04 and 417.06. The reinforcement steel to remain shall be cleaned of all concrete fragments, rust and foreign matter and shall be coated with anti-corrosion material. New epoxy coated bars shall be installed as shown on the Plans.

Guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from mechanical damage. Where required and as directed by the Engineer, new nonmetallic waterstops shall be installed in continuous strips, without splices, except that splices will be permitted at those locations required by staged construction. All splices of nonmetallic waterstops shall be made in accordance with the manufacturer's recommendations. The heat used shall be sufficient to melt but not clear the plastic. Installation of waterstops shall conform to Paragraph 401.13(D). Forms shall be so designed that they can be removed without damaging the waterstop.

Where required and as directed by the Engineer, preformed joint filler shall be installed in accordance with the manufacturer's written recommendations. Temporary supports for preformed joints and steel edge angle as per approved shop drawings shall be utilized to maintain proper, straight horizontal and vertical alignment during placement of adjoining concrete. Prior to installation of the preformed joint filler and the cold poured joint sealer, the surfaces of the seams and joints must be clean, dry, and free of all loose aggregate, paint, rust, oil, curing compound and other foreign materials.

Immediately prior to concrete placement for these repairs, faces of existing concrete shall be completely and evenly coated with a bonding compound immediately prior to placing concrete. During placement of the concrete, it shall be worked in the vicinity of the joints to ensure maximum density and imperviousness.

In accordance with the details provided in the Plans, the Contractor shall furnish and place crack spanning membrane strip prior to placing membrane waterproofing and HMA Surface Course.

Adequate measures shall be taken to prevent concrete chips and pieces from flying into the adjacent roadway lanes or dropping below the bridge. This shall include the use of catches, tarps, etc. subject to the approval of the Engineer. All debris shall be swept up promptly and legally disposed of off Authority Right-Of-Way.

Upon completion of the HMA Bridge Surfacing, the Contractor shall sawcut a ¾" deep joint with two passes of a double-bladed saw.

Saw cut shall be thoroughly cleaned with a water blast (50 P.S.I. minimum) immediately after sawing to remove any sawing slurry, dirt, or deleterious matter remaining in the saw cut cavity. Saw cuts shall be blown with air to provide dry surfaces prior to sealing. All sawing slurry from the wet sawing process shall be immediately flushed from the pavement surface. Saw cuts shall be sealed immediately after cleaning.

The joint shall be sealed with hot-poured sealant. A copy of the sealant manufacturer's recommendations pertaining to the heating and application of the joint seal shall be submitted prior to the start of work. The manufacturer's recommendations shall be adhered to. The temperature of the sealant in the field application equipment shall not exceed the recommended safe heating temperature. Sealant material shall not be heated at the pouring temperature for more than six hours and shall not be reheated.

The sealant shall fill the saw cuts such that after cooling, the level of the sealer shall be flush with the adjacent pavement. Care shall be taken in sealing so that saw cuts are not overfilled and their final

appearance shall present a neat line. Sealant shall be tack free prior to opening to traffic. Sand, cement, or other fine material shall not be spread on the sealed joints to allow early opening to traffic.

(I) JOINT SEAL REPLACEMENT, TYPE _.

Joint seals or glands shall be replaced in accordance with the details and limits as shown on the Plans and as directed by the Engineer.

The proposed Joint Seal Replacement, Type __W is referred to as the "Preformed Elastomeric Joint Sealer" in accordance with Division 900. The proposed Joint Seal Replacement, Type IV___ is referred to as the "Wabo®InverSeal Joint System" in accordance with Division 900.

Where the designated joint seal replacement is noted to be a strip seal gland, the replacement system shall be an in-kind replacement of the existing gland as manufactured by the same fabricator as the existing joint system to ensure proper seal and fitment with the existing joint armor extrusion(s). Where the manufacturer of the strip seal gland is not designated on the Plans, it shall be as directed by the Engineer.

Before commencing work, the Contractor shall submit, in accordance with the requirements of Subsection 104.08, shop drawings covering all aspects of the proposed construction including manufacturer's written joint preparation and installation procedures.

Field measurements may be obtained under slow-downs according to the Authority's Manual for Traffic Control in Work Zones. Field measurements shall include the location of the existing support bars for determination as to whether the existing support bars require removal for the proper installation of the new joint seal. The Contractor shall also take field measurements at all safetywalks, sidewalks, parapets, curb lines, shoulder lines and lane lines to verify the seal size specified in the Plans. The Contractor's field dimensions shall be submitted in accordance with Subsection 104.08 to determine if changes in seal size are required at a location or if multiple sizes are required at one location. Changes in seal size within joint locations should be expected.

The Contractor shall arrange for field measurement of all joints by the manufacturer's technical representative.

At locations where new joint sealers are to be installed, the existing armored joints shall be prepared by removing the existing elastomeric joint seals and properly disposing of them. All materials removed by the Contractor in performance of this work shall become the property of the Contractor and shall be disposed of off the Authority's right-of-way. The exposed and interior surfaces of all joint armor shall be cleaned by mechanical methods, including but not limited to saw cutting, milling, routing, hand grinding, and by abrasive blast cleaning to provide a smooth consisting white steel surface to conform to the SSPC Standard SP10, "Near White Blast Cleaning" to properly bond with the new joint sealer system The Contractor is expected to exercise extreme caution to contain the spoils caused by this cleaning operation by using appropriate containment methods. The interior concrete surfaces of the parapet deck joints shall be cleaned free from dirt, water, and any other loose foreign debris which may be detrimental to effective joint sealing.

Use of the joint milling machine shall be in accordance with the manufacturer's instructions. The machine shall be calibrated to mill the minimum depth of joint armor as required to obtain the desired cleaned surface for the representative to approve the cleaned joint.

Adequate measures shall be taken to prevent debris from being transported into the adjacent roadway lanes or dropping below the deck level of the bridge. This shall include the use of catches, shielding, tarps, etc. subject to the approval of the Engineer. All debris shall be collected at the end of each work shift and legally disposed of off Authority Right of Way.

After each section of a joint is cleaned to white metal, it shall be coated in accordance with ASTM A780 A2 using an approved zinc rich paint. The Contractor shall follow the replacement joint system manufacturer's recommendation regarding use of any coatings in conjunction with the replacement joint system bonding agent(s). Where the replacement joint system manufacturer indicates use of a different coating product, or use of bare metal, areas of the joint armor to be bonded shall coated as dictated by the joint system manufacturer and be masked off and protected from drips and overspray. After installation of the joint sealer, all remaining exposed steel armoring surfaces shall be painted as noted above.

A final abrasive blast cleaning and the installation of the joint seals shall be performed under the direct supervision of a Preformed Elastomeric Joint Sealer representative. Final cleaning and approval of the cleaned joint shall be during daytime hours in natural sunlight or with acceptable nighttime lighting as approved by the Engineer.

The seal shall be installed such that it extends up the vertical or beveled curb faces, across sidewalks and

safetywalks, and a minimum of one foot up parapet faces, but in accordance with the plans.

The joint seals shall be installed in one piece for the full length of each joint during shoulder/lane closings in accordance with Division 800. Splices shall be allowed where changes in sealer width are required only. Sealer corners at curbs shall be fabricated by mitering the joint sealers. Miters shall be fabricated in an off-site fabrication area or an on-site trailer. Jigs, clamps or other devices shall be used to support the mitered joint during gluing. Open ends of closed cell joint sealers shall have glued caps bonded to them. Heated field vulcanization shall not be performed except at the permission of the Engineer. The Joint Seal parapet deck joint seal shall be set to the proper width for ambient temperature at the time of installation and shall be installed in strict accordance with the manufacturers written instructions.

The replacement joint system representative shall observe the initial sealer installation and other sealer installations as requested by the Engineer. The representative shall also be available to resolve installation problems.

No installation may be performed in wet conditions, or when rain is expected for 1 hour after installation. All surfaces must be dry prior to installation. During installation, the ambient temperature shall not be lower than 40 ^{o}F or higher than 75 ^{o}F. Seal installation will not be permitted when the ambient air temperature is at or is anticipated to be above 75^{o}F or the manufacturer's recommendations during the day of installation.

(J) SILICONE JOINT SEALER.

Silicone Joint Sealer consists of furnishing all labor, equipment and materials for filling existing open joints in median barriers, barrier curbs, parapets and sidewalks with silicone sealant in accordance with the details shown on the Plans. This includes removing existing joint sealer materials, if necessary, cleaning the existing joint surfaces, and installation of new backer rod and silicone sealer material in accordance with the manufacturer's recommendations.

For Silicone Joint Sealer, the lateral limits of joint replacement work shall be delineated and suitably marked in accordance with the details and dimensions shown on the Plans or as directed by the Engineer.

At the locations where Silicone Joint Sealers are to be installed, the existing armored joints shall be prepared by removing any existing joint sealer. Adequate measures shall be taken to prevent any debris from flying into the adjacent roadway lanes or dropping below the bridge. This shall include the use of catches, tarps, etc. subject to the approval of the Engineer. All materials removed by the Contractor in performance of this work shall become the property of the Contractor and shall be disposed of legally off Authority property.

After the removal of the existing sealer (where it may exist), the exposed and interior surfaces of all joint armor shall be cleaned by mechanical methods, including but not limited to routing, hand grinding, and/or by abrasive blast cleaning to provide a smooth consistent white steel surface to conform to the SSPC Standard SP10, "Near White Blast Cleaning" to properly bond with the proposed silicone joint system. The concrete surfaces shall be cleaned and the backer rod and silicone sealer shall be installed in strict conformance with the manufacturer's written instructions.

Where Silicone Joint Sealer is to be installed, the final abrasive blast cleaning and the installation of the backer rod and joint sealant shall be performed under the direct supervision of the manufacturers' representative. Final cleaning and approval of the cleaned joint shall be during daytime hours, in natural sunlight, or with acceptable nighttime lighting as approved by the Engineer.

After each section of a joint is cleaned, a backer rod, approximately 25% greater in diameter than the joint opening is to be positioned in the joint such that the top of the rod is one inch below the riding or walking surface. The silicone sealer system shall be applied in one direction only to a thickness of ½ inch minimum, while not exceeding 5/8 inch and shall maintain a ½ inch recess from the riding surface. After installing the sealant, the Contractor shall immediately clean all excess material from the edges of the joint opening to prevent the excess from curing.

The Silicone Joint Sealer shall not be installed when the surface temperature is less than 40^{o}F or greater than 70^{o}F and shall be installed in accordance with the manufacturer's requirements.

At locations where the thickness of the joint armor cannot accommodate the manufacturer's suggested backer rod, the Contractor shall provide material and filler to achieve the recommended sealant thickness and to prevent the sealant from bonding to the underside of the joint armor. The type of filler material to be used is subject to the approval of the Engineer.

(K) DECK JOINT RECONSTRUCTION.

Deck Joint Reconstruction consists of removing portions of existing concrete headblocks, approach slabs or deck concrete; existing steel joints; portions of concrete barriers, safetywalks, and curbs; cleaning existing reinforcement bars and exposed top flanges of stringers, box beam girder pier caps, and diaphragms, including shear connectors and end welded studs (exposed steel surfaces to remain); applying anti-corrosion coating to existing reinforcement bars and exposed steel surfaces to remain; furnishing and installing reinforcement and reinforcement bar couplers; furnishing and installing new epoxy coated reinforcement bars; drilling and grouting reinforcement bars; and reconstructing the concrete barriers, safetywalks, curbs, and headers/headblocks as shown on the Plans.

The Contractor shall provide detailed joint installation methods, procedures and time frames as indicated on the Plans, to the Engineer for review and approval prior to the start of any joint reconstruction work.

For Deck Joint Reconstruction, the lateral limits of abutment headblock, approach slab, joint steel work, or other areas to be removed and replaced shall be delineated and suitably marked in accordance with the details and dimensions shown on the Plans or as directed by the Engineer.

Deck Joint Reconstruction is required at location where the existing deck joint is to be replaced with a strip seal expansion joint outside the limits of "Concrete Deck Replacement" and "Concrete Deck Replacement with Catches".

The Contractor is alerted that stay-in-place form removal may be required within limits of Deck Joint Reconstruction (possible on deck sides only).

Adequate measures shall be taken to prevent concrete chips and pieces from flying into the adjacent roadway lanes or dropping below the bridge. This shall include the use of catches, tarps, etc. subject to the approval of the Engineer. All debris shall be swept up promptly and legally disposed of off Authority Right-Of-Way. The Contractor is required to furnish, install and remove a temporary catch system at locations shown in the Plans, or at the direction of the Engineer, in accordance with Subsection 417.11. The Contractor will be required to submit shop drawings and methods of construction to any property owner or agency in accordance with Subsections 104.08 and 804.03, and the Appendices for the temporary catch system. The catch system shall remain in place during the entire construction duration. All debris collected on the catch system must be completely removed prior to removal of the catch system.

The outline of the area shall first be cut to a depth shown on the Plans, after the removal of the existing asphalt overlay, with a power saw capable of making straight cuts. The power saw shall be normal to the slab in order to achieve a vertical face as shown on the plans. In the event that reinforcement steel is encountered within the prescribed depths of cut during the sawing operations, the depth of saw cut shall immediately be adjusted to a shallower depth so as not to damage the steel reinforcing bars. If so directed by the Engineer, sawcutting shall again be resumed at the specified depth at other locations of removal provided reinforcement steel is not again encountered.

Where overbreakage occurs resulting in a featheredge, the featheredge shall be squared up to a vertical face in a manner approved by the Engineer.

Reinforced concrete slab sections, headblocks, and approach slab sections shall be removed by means of hand held pneumatic hammers (not exceeding 30 lbs.) employing pointed and blunt edged chisels.

All concrete shall be carefully chipped off in a manner which will not damage the portions to remain or reinforcement steel which is to be left projecting. Care shall be taken to preserve the bond of the reinforcement steel in the existing concrete. The reinforcement steel to remain shall be cleaned of all concrete fragments, rust and foreign matter and shall receive a field applied anti-corrosion coating. New epoxy coated bars shall be installed as shown on the plans. Pneumatic hammers or tools shall not be placed in direct contact with reinforcement steel. Hand tools shall be used for final cleaning. Any damage to reinforcement bars to remain shall be repaired or replaced at the Contractor's expense as directed by the Engineer.

At abutment joint locations, the concrete in the abutment headblock or concrete in the approach slab shall be removed to sound concrete or to a minimum depth, as determined by the Engineer. Concrete removal is not expected to go to a depth greater than the approach slab seat.

Steel and weld metal to be removed, in accordance with the details and dimensions shown on the plans or as directed by the Engineer, shall be oxygen cut providing a smooth and regular surface free from cracks and notches.

In all oxygen cutting, the cutting flame shall be so adjusted and manipulated as to avoid cutting beyond

(inside) the prescribed lines. Roughness of oxygen cut surfaces shall not be greater than that defined by the American National Standards Institute (ANSI) surface roughness value of 1,000 for material up to and including 4 in. thick and 2,000 for material greater than 4 to 8 in. thick. Roughness exceeding these values and occasional notches or gouges not more than 3/16 in. deep, on otherwise satisfactory surfaces, shall be removed by machining or grinding. Cut surfaces and edges shall be left free of slag. Correction of defects shall be flared to the oxygen cut surfaces with a slope not exceeding 1 in 10. Defects in oxygen cut edges shall be repaired by welding for occasional notches or gouges less than 7/16 in. deep for material up to 4 in. thick and less than 5/8 in. deep for material over 4 in. thick. Such weld repairs shall be made by suitably preparing the defect; welding with low hydrogen electrodes 5/32 in. in diameter and grinding the completed weld smooth and flush with the adjacent surface to produce good workmanship type finish, acceptable by the Engineer. All welded repairs to main material shall be subject to ultrasonic inspection at random locations as determined by the Engineer.

Concrete surfaces shall be formed flush with the top of strip seal extrusion and the adjacent existing concrete surfaces.

The reinforcement steel to remain and exposed top flanges of stringers, box beam girder pier caps, and diaphragms, including shear connectors and end welded studs (exposed steel surfaces to remain), shall be cleaned of all concrete fragments, rust and foreign matter. Abandoned holes in the web from existing connections that were removed shall be filled with high strength bolts.

Existing reinforcement steel may require bending to avoid conflict with the joint and anchorage systems.

The reinforcement steel to remain shall be cleaned of all concrete fragments, rust and foreign matter and shall receive a field applied anti-corrosion coating. New epoxy coated bars shall be installed as shown on the Plans. Pneumatic hammers or tools shall not be placed in direct contact with reinforcement steel. Hand tools shall be used for final cleaning. Any damage to reinforcement bars to remain shall be repaired or replaced at the Contractor's expense as directed by the Engineer.

New reinforcement steel shall be installed as required to conform to new construction in accordance with the details shown on the plans or as directed by the Engineer. Touch-up of epoxy coating shall be required for finishes damaged during installation.

Faces of existing concrete and existing steel work shall be completely and evenly coated with a bonding compound immediately prior to placing concrete.

The steel expansion joint system shall be fabricated and installed flush with adjacent concrete surfaces so that the final riding surface conforms accurately with the cross slopes and profiles of the roadway measured at the existing lane lines. The Contractor shall determine, by field measurements, all dimensions which will affect fabrication and installation of the joint steelwork. For this purpose, it will be necessary for the Contractor to obtain elevations of the existing joints, which are to be reconstructed.

The armored joint shall be furnished without any temporary tie plates or straps.

The strip seal gland shall be mechanically locked into place within the steel locking lugs of the extrusion, and shall be installed using a lubricant adhesive.

The strip seal expansion joint system shall be installed at an ambient temperature not greater than 85 degrees F.

The Contractor shall determine the width of the working joint at the time of installation, taking into consideration the ambient temperature at the time of installation.

The strip seal gland component shall be recessed sufficiently below finished grade of the bridge deck so that, under all combinations of motion, there will be no projection above the deck surface.

The concrete shall be a transit mix; use of bag or ready mix products will not be permitted.

All joints between proposed concrete and steel extrusions shall be sealed with a methacrylate sealer.

The Contractor shall provide detailed joint installation methods, procedures and time frames as indicated on the Plans, to the Engineer for review and approval prior to the start of any joint reconstruction work.

The strip seal expansion joint system shall be installed in strict accordance with the manufacturer's written instructions and Paragraph 401.13(E) prior to placing concrete. The new strip seal gland shall be properly installed in one continuous piece across the entire length of strip seal assembly. Field splicing of strip seal gland will not be permitted.

(L) HEADBLOCK REPAIR, TYPES 1, 2, AND 3.

Where the existing header concrete material has failed or deteriorated, the Contractor shall chip out and remove the existing concrete material to sound material or to a minimum depth as defined in the plans below the top of roadway, whichever produces the greater depth. Type 1 repairs will vary in depth from a minimum depth of 1 in. below reinforcement steel to a maximum depth of 4 in. Type 2 repairs shall be to a maximum depth of 8 inches. All repairs of more than 8 inches in depth shall be considered to be Type 3. Type 3 repairs shall be carried to sound concrete, as determined by the Engineer, but are not expected to go to a depth greater than the construction joint as shown.

Concrete removal shall be by means of hand held pneumatic tools only. Care shall be taken so as to prevent damage to existing sound concrete, reinforcement steel or other embedded steelwork encountered during concrete removal. Damage to such items shall be repaired or replaced by the Contractor, as directed by the Engineer, at no additional cost to the Authority.

Where the depth of removal extends below the steel joint armor, the Contractor shall temporarily support the joint armor as necessary to prevent displacement thereof.

After the removal of deteriorated and unsound concrete, the surfaces of the remaining concrete shall be cleaned of all loose concrete, dust and other foreign materials, and the exposed reinforcement bars, anchor straps and surfaces of the joint steelwork in contact with the concrete shall be cleaned of adhering particles of concrete, rust and scale by sandblasting or using other suitable methods acceptable to the Engineer and field coated with an anti-corrosion coating. Where the anchor straps are missing, deteriorated or damaged during concrete removal, or removed for the convenience of the Contractor, new equivalent straps of steel (1/2" x 3" cross section) shall be furnished and installed as replacements. Where new steel straps are to be attached, the area of deck joint steel shall be ground to white metal. New epoxy coated reinforcement steel bars shall be installed with appropriate welds as directed by the Engineer. The existing preformed joint filler shall be removed to the limits of concrete removal and replaced with new joint filler material.

The new preformed joint material shall be properly cut and installed in proper alignment with the existing joint, shall conform to the roadway profile and cross slope and set one inch below the roadway surface to allow for one inch wood nailer to be installed along the top. The wood nailer shall be removed prior to the paving operations. After the paving, the asphalt concrete bridge surfacing shall be sawcut and removed from the area above the preformed joint filler material. The recess shall be filled with hot pour joint sealer. The finished surface in the transverse headblock direction shall follow the profile of the roadway. The finished surface in the longitudinal headblock direction shall follow the cross slope of the existing joint.

At all headblock repair areas (except for construction duration less than 24 hours), the Contractor is required to furnish and apply field anti-corrosion coating to all exposed reinforcement steel, anchor straps, riser bars, steel studs, and joint support steelwork that is to remain.

Immediately prior to placement of the new concrete in the headblock area, the surfaces of the concrete and steel shall receive a complete, even coating of the bonding compound applied in accordance with the manufacturer's written instructions.

The placed concrete shall be finished by troweling, screeding or by a suitable method approved by the Engineer. The finished concrete surfaces shall conform to the profile and cross slope of the roadway, adjacent new or proposed pavement and/or steel bar.

After curing of the concrete headblock, the Contractor shall saw-cut and remove the pavement behind the headblock to limits as shown in the plans, clean the opening of all debris, place the premoulded joint filler, and top of hot poured joint sealer. The premoulded joint filler shall be cut evenly with a saw to achieve the required length.

Whenever a repair area has been prepared for construction of the concrete headblock and because of inclement weather or less than 24 hours are available to construct the headblock prior to a necessary opening of a lane to traffic, the Contractor shall place a temporary fill of asphalt concrete in the joint area to accommodate the passage of traffic until such time as the lane can again be closed to traffic.

As soon as the lane is closed again the Contractor shall remove the temporary fill, clean the area of concrete and steel surfaces as specified above, and complete the headblock repair.

Immediately after the lane closing has been installed, the Contractor shall place an approved barrier to protect the headblock work area. This barrier shall not be removed until after the new headblock repairs have been made and fully cured or as directed by the Engineer.

(M) EMERGENCY HEADBLOCK REPAIR.

The Contractor may be directed to perform Emergency Headblock Repairs, at any time including night time and weekends while the contract is in force (date contract is awarded to date of execution of final estimate by the Chief Engineer).

When directed to make emergency headblock repairs, the Contractor shall begin the work immediately after the necessary lane closings have been installed by the Authority's maintenance forces, or when directed by the Engineer, and shall perform and complete all work required to repair the headblock, and have the lane available for opening to traffic within 12 hours of the notice to proceed or within the time frame predetermined by the Engineer.

Emergency Headblock Repair shall be performed in accordance with the requirements specified in Paragraph (L) above for headblock repair and the following:

Removal of the existing header concrete for emergency headblock repairs shall be carried to sound concrete, as determined by the Engineer, but concrete removal depth in general is not expected to be greater than 8 inches.

The Contractor's attention is directed to the fact that, because of the nature of the repair proposed herein, detailed consultation and cooperation will be required between the Contractor, the manufacturer of the blended cement patch mix and the Engineer in order to utilize the technical experience and proficiency required in preparing substrate, mixing, placing, finishing and curing the product and its associated application techniques.

The mortar shall be mixed utilizing a mortar type drum unit or by suitable mechanical means approved by the manufacturer and the Engineer. The mortar shall be mixed with the quantity of pre-weighed components in the proportions specified by the manufacturer. Aggregate, as described in the material specifications, shall then be added in the proportions specified, as recommended by the manufacturer and as directed.

The new preformed joint material shall be properly cut and installed in proper alignment with the existing steel joint, shall conform to the roadway profile and cross slope and set one inch below the roadway surface to allow for one inch wood nailer to be installed along the top. The wood nailer shall be removed prior to the paving operations. After the paving, the asphalt concrete bridge surfacing shall be sawcut and removed from the area above the preformed joint filler material. This area shall be filled with a hot pour joint sealer. The finished surface in the transverse headblock direction shall follow the profile of the roadway. The finished surface in the longitudinal headblock direction shall follow the cross slope of the existing joint.

Upon completion of the complete cleaning and preparation of repair areas as outlined in Paragraph (L) above and in accordance with the manufacturer's recommendations, the mortar shall be placed and thoroughly compacted until minimum air voids are obtained.

The placed mortar patch shall be finished by troweling, screeding, or by a suitable method approved by the manufacturer and the Engineer. The finished mortar patch shall conform to the profile and cross slope of the adjacent concrete pavement and/or steel bar. The final patch shall be smooth and completely seal the existing edges of the header to remain with no porosity.

417.08 Concrete Bridge Deck Overlays.

Bridge deck overlays or toppings (Asphalt and membrane, Latex Modified Concrete and HPC) shall be placed on prepared deck surfaces at the designated locations to the thickness and limits shown.

(A) CONCRETE SCARIFICATION.

At the specific locations where a concrete overlay is to be placed on the existing bridge deck slab, the existing asphalt surfacing and membrane waterproofing or concrete overlay shall be removed in accordance with Subsection 417.05 and the existing concrete shall be scarified to a minimum depth of 1/4 inch.

Saw-cutting and chipping with pneumatic hammers may be used to scarify concrete headers or remove surfaces adjacent to curbs and steel plates at deck joints not accessible to the milling machine. Equipment to be used shall conform to Paragraph 417.03(A).

Spalled areas encountered within the scarification limits shall be removed to the full depth of unsound and deteriorated concrete and repairs made thereto in accordance with the procedures prescribed in Subsection

417.06.

All asphalt surfacing and concrete pavement materials resulting from the scarifying operations on the bridge decks shall be completely removed by machine, power broom, vacuum, hand brooming, or other approved means. The removed materials shall either be disposed of by the Contractor off the site or salvaged for reuse elsewhere on the Project. All debris shall be removed immediately and not allowed to accumulate. Flushing of the debris will not be permitted.

(B) Preparation Of Surface For Overlay.

Following removal of existing surfacing and scarification of the concrete deck slab surface as specified above, all loose, disintegrated, or unsound concrete shall be removed from the bridge deck to receive the overlay in accordance with Subparagraph 401.11(A)(3).

(C) Placing And Finishing.

Overlays shall be placed, finished, textured, cured and accepted in accordance with the applicable provisions of Section 401 and Division 900, except that finishing may be by manual methods if approved by the Engineer.

The Contractor shall take every reasonable precaution to secure a smooth-riding bridge deck. Prior to placement operations, he shall review his equipment, procedures, personnel, and previous results with the Engineer and the inspection procedures will be reviewed to assure coordination. Precautions shall include the assurance that concrete can be produced and placed within the specified limits, continuously and with uniformity.

(D) Emergency Pavement Replacement.

Emergency Pavement Replacement shall consist of saw cutting, removal and disposal of portions of existing overlays of asphalt concrete bridge surfacing and waterproofing material, and replacement thereof with new asphalt concrete bridge surfacing under emergency conditions, if and where directed by the Engineer. Work shall include sawcutting of the existing pavement to limits delineated by the Engineer, removing of the existing pavement and membrane waterproofing, placing new asphalt concrete bridge surfacing, and all else necessary to complete the Emergency Pavement Replacement work within the time frame described below.

The Contractor may be directed to perform Emergency Pavement Replacement work at any time including night time and weekends, while the contract is in force (date contract is awarded to date of execution of final estimate by the Chief Engineer).

When directed to make Emergency Pavement Replacements, the Contractor shall begin the work immediately after the necessary lane closings have been installed by the Authority's maintenance forces, or when directed by the Engineer, and shall perform and complete all work required to remove and replace the membrane waterproofing and asphalt concrete bridge surfacing, and have the lane available for opening to traffic within 12 hours of the notice to proceed or within the time frame pre-determined by the Engineer.

When spall repairs are required, within the Emergency Pavement Replacement areas, they shall be performed in accordance with the requirements of Paragraph 417.06(H) Emergency Spall Repair, Type 5.

Asphalt concrete bridge surfacing shall be in accordance with Section 302.

417.09 Sidewalk, Parapet and Curb Surface Repairs.

This work consists of repairs to concrete surfaces of parapets, safetywalks, sidewalks, and curbs.

When repairing sidewalks the Contractor shall utilize the adjacent top of parapet profile in order to establish a uniform and even top of sidewalk profile.

(A) Removal Of Damaged And Deteriorated Concrete.

The limits of each area to be repaired will be delineated by the Engineer and suitably marked. The outline of each area shall first be cut to a depth of one-half (1/2) inch with an approved power saw capable of making straight cuts.

The damaged and deteriorated concrete shall be removed to sound concrete or to a depth of 2 inches, whichever is deeper. Concrete removal shall be by means of hand tools or hand held pneumatic tools only. Care shall be taken so as to prevent damage to existing sound concrete, reinforcement steel, or other embedded items encountered during concrete removal, such as conduit and junction boxes. Damage to

such features shall be repaired by the Contractor as directed by the Engineer at no additional cost to the Authority.

Provisions for collection and disposal of the concrete and any other materials removed shall be as specified in Paragraph 418.03(A).

Conduit encountered during removal operations that is not rigid metallic conduit shall be replaced in accordance with Section 601. The Contractor shall furnish temporary conduit support system during concrete removal operations in accordance with Section 601.

For parapet repair and reconstruction areas as required or directed by the Engineer, the Contractor shall provide means for catching broken concrete and reinforcement steel. Prior to any demolition, the Contractor shall submit shop drawings to the Engineer for review and approval detailing the proposed catch system. The catch shall remain in place until the newly placed concrete has cured or as directed by the Engineer. Catch and/or shielding as required shall conform to Subsection 417.11.

Deteriorated, damaged and loose concrete shall be removed to sound concrete by chipping or other approved methods and to depths determined by the Engineer. The minimum depth of removal shall be as shown on the Plans or referenced Standard Drawings. Contractor shall provide means for preventing or catching broken concrete and debris from falling through the open joints.

The Contractor shall use caution when removing concrete around existing utility conduits. Any exposed utility conduits to remain, which become damaged, shall be replaced as directed by the Engineer at no cost to the Authority.

Parapet repair may extend into safetywalk and deck portion of structure.

Exposed reinforcement steel shall be cleaned of all adhering concrete and of any rust and scale. Any exposed steel reinforcement to remain in the new construction, which becomes damaged, shall be replaced or repaired by welding as directed by the Engineer at no cost to the Authority. All exposed existing steel reinforcement to remain in the new construction shall receive field anti-corrosion coating. Existing reinforcement projecting from existing concrete sections to remain, that exhibits section loss due to rusting, shall be replaced with new epoxy coated reinforcement drilled and grouted in accordance with Paragraph 401.09(A) above at the direction of the Engineer.

(B) CONCRETE REPAIRS.

After the removal of deteriorated and unsound concrete, surfaces of the remaining concrete sidewalk, parapet, and curb shall be cleaned of all loose concrete, dust, and other foreign materials and the exposed reinforcement bars cleaned of adhering particles of concrete, rust and scale, and the repair areas shall be cleaned and coated with bonding compound within 24 hours.

Immediately prior to the placement of the concrete patching material, the surfaces shall receive a coating of epoxy bonding compound applied in accordance with the manufacturer's written instructions. Additional coating shall be applied if concrete placement does not take place within manufacturers required timeframe.

The new concrete for repair of spalled areas shall be placed immediately against the epoxy bonding compound and while the coating is still wet or tacky. If the coating dries before the new concrete is poured, another coating shall be reapplied as herein described at no additional cost.

Concrete shall be mixed, placed, finished, and cured in accordance with the applicable provisions specified in Section 401.

Lane or shoulder closings will remain in place during the curing time.

Contraction and construction joints in bridge parapets shall be consistent with the corresponding joints in the portion of existing adjacent parapet.

Prior to placement of the new concrete or grout in the parapet repair areas, the surfaces of the concrete shall receive a coating of the bonding compound and the reinforced steel shall receive an anti-corrosion coating as referred to in Division 900.

In some instances, existing bridge rail will remain in place while repair is being made for anchor bolt group or parapet surface repair. Some jacking, using wooden wedges, may be required to raise base of post in this situation.

(C) PROTECTIVE COATINGS FOR CONCRETE SURFACES.

The furnishing and application of the water repellant treatment shall be as specified in Subsection 401.19. The treatment shall be applied to the new exposed concrete surfaces and shall overlap the existing concrete as directed by the Engineer.

(D) VERTICAL SPALL REPAIR.

Work under this section includes removing and replacing deteriorated concrete on the surfaces of the parapet, median barrier and noise barrier and the application of a water repellent material all in accordance with the Plans and Specifications or when directed by the Engineer.

This work shall also include removing and replacing deteriorated concrete on the surfaces of the parapet and the application of a water repellent material all in accordance with the Plans, Specifications or when directed by the Engineer.

Removal of damaged and deteriorated concrete shall be as specified in Paragraph 417.09(A), except that the depth of the saw-cut outlining the repair area shall be 1 inch.

After removal of deteriorated, unsound concrete, and/or sound concrete to the prescribed depth, the surfaces of the remaining concrete shall be cleaned of all loose concrete, dust and other foreign materials and the exposed reinforcement bars cleaned of adhering particles of concrete, rust and scale, and receive a field anti-corrosion coating. Immediately prior to the placement of the concrete, where called for, the surfaces shall receive a complete and even coating of epoxy bonding compound applied in accordance with Paragraph 417.09(B). Forms shall match the existing concrete profile.

(E) CONCRETE PARAPET REPAIR.

Prior to performing any work associated with Concrete Parapet Repair the Contractor shall install temporary shielding systems as directed by the Engineer. Shop Drawings shall be submitted in accordance with Subsection 104.08.

The limits of concrete parapet to be removed and replaced shall be delineated and suitably marked in accordance with the details and dimensions on the plans or as directed by the Engineer.

The Contractor shall furnish temporary conduit support system during concrete removal operations in accordance with Section 601, where conduit is present in the parapet repair area.

Contractor shall remove, store, and reset the bridge railing sections to be reused, as determined by the Engineer, in accordance with Section 414. Contractor shall furnish and install new bridge railing sections as noted in the plans and as directed by the Engineer in accordance with Section 414.

Adequate measures shall be taken to prevent concrete chips and pieces from flying into the adjacent roadway lanes or dropping below the bridge. This shall include the use of catches, tarps, etc. subject to the approval of the Engineer. All debris shall be swept up promptly and legally disposed of off Turnpike Right-Of-Way.

The perimeter of the repair shall be saw cut as indicated on the plan details. Deteriorated concrete parapet sections requiring repair shall be removed by means of hand held pneumatic hammers (not exceeding 90 lbs.) employing pointed and blunt edged chisels to the limits depicted in the plans.

All concrete shall be carefully chipped off in a manner which will not damage the portions to remain or reinforcement steel which is to be left projecting. Care shall be taken to preserve the bond of the reinforcement steel in the existing concrete. Pneumatic hammers or tools shall not be placed in direct contact with reinforcement steel. Hand tools shall be used for final cleaning. Any damage to reinforcement bars to remain shall be repaired or replaced at the Contractor's expense as directed by the Engineer. Any damage caused by the Contractor to the existing concrete deck, sidewalk, or deck joints during removal or construction operations, will require the Contractor to make repairs at the direction of the Engineer at no cost to the Authority.

The Contractor shall protect existing conduit (where present). If any portion of the conduit is damaged as a result of the Contractor's operations, the conduit shall be repaired to the complete satisfaction of the Engineer at no cost to the Authority.

New reinforcement shall be installed according to details in the plans and as directed by the Engineer. Drilling and grouting of reinforcement, if required at the direction of the Engineer, shall be performed in accordance with Section 401.

The Contractor shall remove all formwork and temporary catch/shielding systems, and re-establish the

electrical systems (where present), after completion of the work.

417.10 Parapet Reconstruction.

(A) Description.

The work consists of excavation; removal of existing concrete parapet, safetywalk system and railing; reconstruction of the existing bridge wingwall and retaining wall; and construction of a new high performance concrete parapet.

(B) Methods of Construction.

Prior to beginning demolition work on the existing parapet, the Contractor shall take all necessary precautions to protect elements of the bridge that are to remain. The Contractor shall submit Shop Drawings and procedures in accordance with Subsection 104.08 for all methods to be used to protect the existing structure to remain; and for methods of removal, salvage, temporary support, and reinstallation of existing conduits and junction boxes attached to the rear face of the parapet(s).

The existing railing shall be removed and legally disposed of. The existing concrete parapet, safetywalk, approach slab, wingwall and retaining wall, shall be removed by means of pneumatic hammers within limitations noted in Subsection 417.03. Extreme care shall be taken to prevent damage to existing reinforcing bars that are to remain. These bars shall be cleaned of all concrete fragments, foreign matter and corrosion and covered with a field anti-corrosion coating. Pneumatic hammers shall not be placed in direct contact with the reinforcement steel to avoid damaging the bond between the bars and the existing concrete to remain. Hand tools shall be used for final cleaning. Bending of these bars by use of suitable approved tools will be permitted as necessary to aid in lapping with new reinforcing bars.

The Contractor is required to excavate to the limit shown in the details on the Plans for removal of portions of existing wingwalls, retaining walls, and approach slabs. The excavated materials may be salvaged and reused as backfill material only where permitted in the Plans. Excavation shall be performed in accordance with Section 202. The areas shall be restored to existing ground elevations. Areas shall be restored using top soil and seeding or asphalt berm surfacing to match existing conditions.

If required by the Authority, as directed by the Engineer, the Contractor shall salvage and deliver the existing handrail to the appropriate Maintenance facility.

Drilling and grouting of reinforcement steel shall be performed in accordance with Section 401.

Portions of concrete wingwalls, concrete retaining walls and approach slabs shall be reconstructed in accordance with the details provided in the Plans.

Temporary electrical provisions and permanent electrical provisions are required and shall be provided in accordance with the requirements of Division 600.

417.11 Shielding and Catch Systems.

(A) Description.

This work shall consist of the design, furnishing, fabricating, installation, and removal of all shielding, catches required for deck repair and deck construction on bridges. All work shall be done in accordance with the applicable portions of Subsections 104.08, 104.13, 105.14, and 106.02, the Contract Plans, and as specified herein.

The Contractor is required to furnish, install and remove the temporary catch (or shielding) systems at fascia's of parapet replacement areas and localized deck replacement areas within the limits designated on the plans.

This work will require, in some cases, special consideration to install and remove catches or shielding around existing bridge mounted or carried utilities or other bridge appurtenances. These instances may require special forms to span over conflicting components. This work is incidental the various catches and shielding items but must be accounted for in the labor, materials and installation of the same.

Non-weathering metal connection materials to be painted, including inside areas of existing or newly drilled holes shall be painted in accordance with the requirements of Section 411 except connection materials to be embedded in new concrete shall not be painted with epoxy mastic paint containing aluminum.

The Contractor shall submit, at least four (4) weeks prior to construction, shop drawings and calculations

for temporary shielding and catch systems. Such drawings and calculations shall be accompanied by relevant as-built plans, field notes, and measurements that were used in the preparation of the same.

The traffic lanes shall be closed, in accordance with requirements of Division 800 of the Standard and Supplementary Specifications, below the areas where said temporary catch system is being installed.

Field welding of the catch to any structural component to the bridge shall not be permitted.

(B) METHODS OF CONSTRUCTION.

Only ASTM A325 high strength bolts, nuts and hardened washers with a coating compatible with the fascia steelwork shall be used. Removed existing bolt materials shall not be reused.

Bolt diameter shall be limited to 3/4 inch, placed in 7/8 inch diameter drilled holes. Bolts shall be provided with appropriately sized washers and plates for adequate bearing and bending strength.

Holes shall be positioned as near as practical to the top flange, spaced no closer than 3 feet on centers. Where existing angles or connection plates are bolted/riveted to the fascia girder, those existing web holes shall be used to support proposed fascia catches.

The Contractor shall obtain approval of the Engineer for his method of removing any required bolts or rivets. Any damage to the existing steel as a result of bolt or rivet removal shall be repaired at the Contractor's expense and to the satisfaction of the Engineer.

The Contractor shall provide the necessary equipment to facilitate access by field personnel for inspection of all bolt and rivet removals. The same equipment can then be used to facilitate repairs once a location requiring a new high strength bolt is identified.

The Contractor shall submit design computations prepared by a licensed Professional Engineer in the State of New Jersey to verify the adequacy of the fascia stringer to support the temporary loads imposed. The Contractor shall not only consider girder shear and bending stresses, but torsion, local web buckling, punching shear and lateral flange bending as the case may be.

Material added such as stiffeners or diaphragms to bolster the capacity of the fascia girder and/or distribute forces to adjacent interior stringers shall be of the same or higher strength material and have a coating compatible with the existing steelwork and be permanently left in place.

Permissible girder loads and stresses shall be in conformance with the latest AASHTO LRFD Bridge Design Specifications for Highway Bridges, and the AASHTO Guide Design Specifications for Bridge Temporary Work, including Interims.

All cantilevered deck form support systems shall be designed in accordance with Subparagraph 417.11(C)(1) and the current edition AASHTO Guide Design Specifications for Bridge Temporary Works, with the modifications as follows:

Design wind loads as defined in Section 2.2.5 and Appendix C of the above noted guide specification shall also be applied vertically on the horizontal plan area of the fascia catch, and horizontally on the vertical elevation area of the side enclosure system, whether it be open handrail, partially open snow fence, closed plywood, or of any other construction. The design loads on these elements shall be used for consideration of uplift due to wind conditions on cantilevered deck form support systems. An uplift restraint system shall be furnished and installed where calculated wind uplift forces due to either vertical or horizontal wind forces exceed the dead load of the cantilevered deck form support system. All uplift restraint systems shall be positively attached to the bridge superstructure via cables, clamps or other devices as approved by the Engineer. Additionally, all uplift restraint systems that rely solely on cable tie down systems shall be supplemented with an intermediate uplift restraint system spaced at no more than 16 feet on center and shall be positively attached to the bottom flange of the fascia girder. For the purposes of wind uplift design only, a factor of safety of 1.0 shall be utilized and live load shall not be considered.

The effective loading combination as shown below is added to Table 2.3 of the AASHTO Guide Design Specifications for Bridge Temporary Works. Group V loading shall be considered for cantilevered deck form support system designs:

Table 2.3 Load Combinations

Group	Load Combination	Percentage of Basic Allowable Stress or Load
Group V	DL + DP + Wu	100%

Where:

DL = design dead load

DP = dead load of supported permanent structure (where applicable)

Wu = uplift force due to wind load

Once the fascia catches are removed, the holes in the web shall be filled with compatible high strength bolts, nuts and washers placed under both the nut and head of the bolt. If other than weathering steel, the bolts shall be galvanized or painted to match existing steelwork.

Any damage to the fascia steelwork, including its coating system as applicable, shall be repaired to the satisfaction of the Engineer at no additional cost to the Authority.

In no case, shall the catch reduce the existing under clearances of the bridges to less than 14 feet - 6 inches over roadways.

The traffic lanes shall be closed, in accordance with requirements of Division 800 of the Standard and Supplementary Specifications, below the areas where said temporary catch is being installed.

The Contractor shall take extreme care to neither distort the fascia girder nor introduce details requiring future maintenance.

(C) CATCHES.

Installation, maintenance and removal of catches and shielding systems shall be performed at locations shown on the Plans and as directed by the Engineer. Where required to protect structures, buildings, houses, utilities, streets, railroads, traffic, waterways, recreational and storage areas located beneath the work site, the Contractor shall provide means of safely catching all broken concrete, reinforcement steel, stay-in-place forms, and other debris resulting from the removal of deck slabs at locations designated on the plans as requiring catches or as may otherwise be directed by the Engineer.

The catch areas shall include the installation and removal of approved protective platforms and the catching, rehandling and disposing of concrete, asphalt, reinforcement steel and debris from the platform catches and such other work required where concrete is dropped to the ground and subsequently removed or spread out at the site.

All spans over railroad tracks, roads or streets open to traffic, and navigable portions of waterways shall be so constructed that no portion of the platform or supporting members will extend below the level of the lowest superstructure steelwork or 14′-6″ clearance if maintained over roadways and 22′-0″ if maintained over railroads, whichever is most restrictive. If any existing underclearance is less than these values, then it shall be maintained without any further reduction. No shoveling of debris off the ends of the platforms to the river or ground level below the work area will be permitted. All railroads, roadways, and navigable waterways must remain open to traffic at all times.

The Contractor shall submit details of the catch and proposed installation method to the Engineer for review. The catch shall be designed so as to prevent any small particles, dust and other objects from falling below the superstructure steelwork. Materials so collected shall be promptly removed by hand from above the deck and a vacuum used to clean up all dust and small particles.

Catches and shielding shall be in place prior to handrail, fencing, parapet and safetywalk removal, deck removal, bridge formwork installation, and the placement of new concrete deck and parapet.

All catches and shielding required to protect buildings, structures, utilities, active roadways, walkways, railroads, navigable waterways, recreational and storage areas located beneath the work site shall remain in place until the newly placed concrete has cured in accordance with the specifications or until directed by the Engineer. Fascia catches and shielding for these areas shall also remain in place until any fencing, light standards and other parapet mounted appurtenances have been properly installed. Catches in all other areas shall remain in place until all demolition debris has been removed to the satisfaction of the Engineer and the installation of the Stay in Place (SIP) form has been completed (if applicable). However, these areas shall be restricted from public access until the bridge deck has been placed.

In areas of parapet reconstruction along retaining walls and wingwalls, the Contractor shall provide means from preventing broken concrete and any construction debris or materials from falling to the ground below unless shielding is provided which prevents these materials from encroaching into areas of active traffic.

Catch Systems for removal of existing features/facilities and new construction shall include complete design, furnishing, installing, and removal of a structural framing and shield to be supported from

stringers to provide an adequate and substantial temporary catch system to protect vehicular traffic or facilities below the bridge and adjacent bridges from falling construction materials or other objects and to shield traffic from construction activity.

For deck, parapet, safetywalk, wingwall and railing removal, and new deck and parapet construction an outrigging type catch system, which encloses the soffit and parapet, shielding traffic or facilities adjacent to or below from falling debris, concrete spillage, and any overhead construction activity, shall be used. The catch system shall be a continuous horizontal and vertical enclosure without openings and of the specified width and height. The Contractor is also required to furnish, install and remove temporary shielding systems at locations determined by the Engineer.

Details of all catch and protective shielding systems shall be designed by the Contractor. All timber catch or temporary flooring systems shall be in accordance with Subsection 105.14. Catch and Temporary flooring used as working platforms must comply with OSHA 29CFR, Part 1926-Safety and Health Regulations for Construction, Subpart L – Scaffolds. The selection of sizes, materials, their arrangements and details shall be the Contractor's option and responsibility, but subject to approval of the Engineer. The Contractor shall obtain the Engineer's approval of the method, design and details of the catch system he intends to use for the protection of traffic or facilities. No demolition, removal or other construction work shall be performed above traffic or facilities prior to such approval. Any materials dropped on the temporary catch system shall not be allowed to accumulate and shall be removed promptly.

(1) Catch Design.

Before commencing removal, the Contractor shall submit to the Engineer for review and approval by the date stipulated in Subsection 104.08 or at least four (4) weeks in advance of the time he proposes to install the system, shop drawings showing details of the catch and proposed installation method. Shop drawings shall also be submitted to other agencies having jurisdiction when the work is performed outside the Authority's ROW. These detailed working drawings shall show all elements of the system, including design calculations, details and the sequence of operations. The plans and calculations shall be prepared, signed and sealed by a Professional Engineer licensed in the State of New Jersey. Should the Contractor's operation or construction staging require the Contractor to install and remove the catch system more than once, no additional payment will be made. The temporary catch system shall be designed to withstand dead load, live load with impact, and wind load in accordance to AASHTO Guide Design Specifications for Bridge Temporary Works, or greater if heavier loads are anticipated. Welding between the temporary catch system and webs of stringers is not permitted.

Catch and Temporary flooring used as working platforms shall comply with OSHA 29CFR, Part 1926-Safety and Health Regulations for Construction, Subpart L – Scaffolds in accordance with Paragraph 106.02(C) of these Specifications shall be subject to the following provisions:

For the purposes of design, Section 1926.451(a)(1) of Subpart L is further defined as follows:

Each scaffold and scaffold component shall be designed to resist the following load case:

1.0DL + 4.0MIL < Failure

Where:

DL = Self Weight of Scaffold System

MIL = Maximum Intended Load applied or transmitted to the Scaffold, including personnel, collected debris, construction materials, equipment, or any other load which will be placed on the Scaffold.

Failure = Yielding Strength or Stress of the Scaffold System. For timber applications, "Failure" shall be defined as the allowable timber stresses, as determined by the National Design Specifications for Wood Construction (NDS), current edition.

In no case shall the design load be less than 0.8 psi (115 psf).

This load case shall be considered in addition to and independent of load cases as required by the AASHTO Guide Design Specifications for Bridge Temporary Works. Final Scaffold design shall be based upon the controlling load case.

Bolted connections between the temporary catch system and webs of stringers are not permitted except at temporary overhang supports at bridge fascia.

In no case, shall the temporary catch system reduce the vertical under-clearances of the bridges to less than 14 feet - 6 inches over roadways.

Plywood for use in catch systems that will be exposed during cutting operations shall be exterior fire retardant treated and conform to Division 900.

417.12 Force Account for Emergency and Routine Bridge Repairs.

(A) DESCRIPTION.

Force Account for Emergency and Routine Bridge Repairs work shall include the following items as modified herein below. These repairs shall be performed on a routine or an emergency basis as directed by the Engineer.

Routine Bridge Repairs	Emergency Bridge Repairs
Concrete Deck Replacement and Concrete Deck Replacement with Catches	Emergency Concrete Deck Replacement
Pavement Removal, Variable Depth	Emergency Pavement Removal, Variable Depth
Headblock Repairs, Types 1, 2 and 3	Emergency Headblock Repairs, Types 1 and 2
Spall Repairs, Types 1, 2, 4, 5, 5A, 5B, 6, 6A	Emergency Spall Repair, Type 1, 4, 5, 5A, 5B and 6
Joint Reconstruction, Type ___	Emergency Joint Reconstruction, Type ____
Joint Replacement, Type 1P	Emergency Joint Replacement, Type 1P
Paving	Placement of High Performance Cold Patch Material
Vertical Spall Repair	Emergency Temporary Surfacing
Guide Rail Replacement	Install, Maintain and Remove Steel Protection Plate

The Contractor may be directed to perform repair work under the force account item during scheduled or non-scheduled times until the expiration of the "Force Account" period stipulated in the Contract Agreement.

When directed to make emergency repair work under the force account item, the Contractor shall begin the work immediately after the necessary lane closings have been installed or when directed by the Engineer, and shall perform and complete all work required and have the lane available for opening to traffic within the time frame stipulated hereafter or determined by the Engineer.

For allowable nighttime and weekend closing hours, see Division 800. All lane closings for the repair work under the force account pay item shall be performed by the Contractor's forces or the Authority's Maintenance forces as directed by the Engineer.

The Contractor shall prepare and submit his plan for providing the necessary labor, equipment and material to perform the emergency repair work, within the time frames stipulated for the various repairs, to the Engineer for review and approval 30 days after Contract is awarded.

The Contractor shall stock within his yard Concrete Repair Materials as specified in Paragraph 417.02(A) for the performance of the various emergency repairs as described herein and as directed by the Engineer. At the end of the project all unused materials with remaining shelf life shall be delivered to the Maintenance Facility denoted in Paragraph 417.02(A) as directed by the Engineer. Materials not accepted will be disposed of by the Contractor.

All materials to be removed as part of this work shall become the property of the Contractor and shall be properly disposed of by him off Authority Right-Of-Way unless otherwise noted herein, unless authorized in writing by the Engineer, or unless otherwise directed to be salvaged.

(1) Pavement replacement shall consist of saw cutting, removal and disposal of portions of the existing pavement and waterproofing material, and replacement thereof with new membrane waterproofing (exclusive of emergency repair areas) and HMA Surface Course to the limits delineated by the Engineer.

When spall repairs are required, within the pavement replacement areas, these repairs shall be performed in accordance with the requirements of Paragraphs 417.06(H) and (K).

HMA Surface Course shall be in accordance with Section 302.

(2) Emergency Spall Repairs shall consist of removal of previously placed patching materials and replacement of deteriorated deck concrete with the specified materials required for the various emergency types of spall repairs designated. Emergency spall repairs shall be constructed flush with the top of the surrounding asphalt or concrete surfaces and the perimeter of the repair area sealed with asphalt cement (AC-20).

(3) Emergency Headblock Repairs shall consist of removing deteriorated concrete; cleaning and retaining existing reinforcement, joint armor anchors and joint steelwork; addition of new reinforcement steel; doweling in additional reinforcement as directed by the Engineer; replacement of anchor bolts with adhesive anchors; and placing new repair material, as specified herein, to the depths specified in the plans and up to proper grade lines.

(4) Emergency Joint Reconstruction of various types shall consist of removing deteriorated existing concrete deck, concrete headers, abutment headers, and steel riser bars and replacement thereof with new repair material as specified herein.

(5) Emergency Joint Reconstruction, Type 1 shall be constructed with new repair material as specified herein. Emergency Joint Reconstruction, Type 1P and Emergency Joint Replacement, Type 1P shall be constructed using rubber asphalt concrete. Emergency Joint Reconstruction, Type 1A shall be constructed using high early strength blended cement repair mix.

(6) Emergency Temporary Surfacing shall consist of placing temporary asphalt surfacing over the spall area, bridge resurfacing area or deck slab replacement area. It shall be performed in accordance with Section 302.

When spall repairs are required, within the Temporary Surfacing area, these repairs shall be performed in accordance with the requirements of Paragraph 417.06(E) Spall Repair, Type 5 as directed by the Engineer.

417.13 Measurement.

Concrete Repair Material will be measured on a lump sum basis furnished and delivered to the designated locations identified in Paragraph 417.02(A). Rapid set mortar, reinforcement bars, cement patch mix, and tie wire will not be measured separately for payment. High Performance Cold Patch will be measured in accordance with Division 300. Delivery to either the designated Maintenance facility or to the Contractor's staging area will not be measured separately for payment.

Concrete Deck Replacement and Concrete Deck Replacement with Catches will be measured by top surface area of new concrete placed as prescribed.

Removal of Existing Concrete Deck and Removal of Existing Non-Composite Concrete Deck will be measured by the square yard in plan area from each deck cut line to the next deck cut line or the fascia limit of concrete for the removal of parapet segments. No additional projected area will be measured for safetywalks and parapets. Removal and legal disposal of existing bridge appurtenances (inlets, conduits, lighting, joint materials, handrails, signs, etc.) within the limits of deck removal will not be measured separately for payment.

Removal of existing deck concrete and reinforcing steel, and placement of new concrete at isolated deck replacement areas will not be measured separately for payment, but shall be included in item entitled "Concrete Deck Replacement" or "Concrete Deck Replacement with Catches". Removal and reconstruction of safetywalks and medians adjacent to, or affected by, isolated bridge deck replacements and deck joint reconstruction will not be measured separately for payment.

Removal of SIP Metal Forms will be measured by the square yard of surface area of SIP Form in the deck slab replacement requiring such removal.

Furnishing and applying water repellent treatment to exposed concrete surfaces, where noted on the Plans, will not be measured separately for payment.

Reinforcement Steel, Epoxy Coated and Reinforcement Bar Couplers at deck replacement areas and "Deck Joint Reconstruction" will be measured separately for payment in accordance with Section 401. Epoxy coated reinforcement required at all other repair areas within Section 417 will not be measured separately for payment.

Reinforcement Steel, Field Anti-corrosion coating will not be measured separately, but will be incidental to the various repair items.

Removal of Existing Surfacing will be measured by the square yard of surfacing removed at areas greater than four (4) square yards and where identified in the Plans. Removal of existing asphalt surfacing will NOT be measured separately for payment at isolated deck replacement areas or at any other repair areas located outside

the limits of Removal of Existing Surfacing as shown in the Plans (except for Spall Repair, Type 2) but shall be incidental to these repair items. Scarification of existing concrete deck within limits of Removal of Existing Surfacing will not be measured separately for payment.

Removal and Replacement of Existing Surfacing on bridge decks between saw-cut lines and deck joints or headers in areas showing evidence of cracking or possible deterioration of underlying concrete (spalling), but where significant spalls are not present, will be measured by the surface area. Removal and Replacement of Existing Surfacing on bridge decks shall be individual areas of up to 36 square feet (4 square yards) in size and will be measured to the nearest square foot.

Removal of Asphalt Surfacing and Scarify Concrete will be measured by the surface area of bridge deck removed and scarified as prescribed.

Spall Repair of the various types will be measured by the surface area at the plane of the existing Portland cement concrete deck of the appropriate repair, regardless of depth. Individual area measurements will be computed to the nearest one-half square foot with individual areas measuring less than one square foot to be considered as one square foot.

At isolated spall repair areas greater than four (4) square yards, bridge surfacing and membrane waterproofing will be measured separately when required for the repair. At isolated spall repair areas (those located outside the limits of Removal of Existing Surfacing as shown in the Plans) less than four (4) square yards, removal of existing surfacing, membrane waterproofing, and bridge surfacing (where required) will NOT be measured separately.

Spall Repair, Type 2 areas shown on the plans or delineated by the Engineer, will be measured by square foot of asphalt surface area removed, regardless of depth of removal. No separate measurement or payment will be made for the removal of existing surfacing, removal of existing membrane waterproofing, placement of new membrane waterproofing, and placement of new HMA.

Repair Underdeck Spalls (Clean and Coat) will be measured by the square foot of surface area regardless of depth of removal. Protecting existing utilities, concrete removal, cleaning exposed reinforcement and steelwork, furnishing and applying anti-corrosion coating to exposed reinforcement and steelwork will not be measured separately for payment.

Within limits of Spall Repair, Type 6, placement and removal of catch system, removal of existing asphalt and membrane waterproofing; and placement of new membrane waterproofing, asphalt concrete bridge surfacing and traffic striping; when required, will not be measured separately for payment.

At Joint Reconstruction, Type 1P, removal of existing concrete header, deck joint seal material, joint steelwork, and bituminous overlay; preparation of surfaces; furnishing and installing the deck joint system; and joint reconstruction or sealer installation at the barrier curbs, parapets and sidewalks will not be measured separately for payment. Joint Reconstruction, Type 1P will be measured by the linear foot completed and in place along the centerline of the joint for the limits and for the depth shown on the Plans.

At Joint Replacement, Type 1P, removal of the existing Type 1P joint, the preparation of surfaces, furnishing and installing new deck joint, or for joint replacement or sealer installation at the barrier curbs, parapets and sidewalks will not be measured separately for payment.

When the average area of asphaltic plug joint material is equal to 80 square inches or less, Joint Replacement, Type 1P will be measured by the linear foot, measured curb line to curb line along the centerline of the deck joint, regardless of the area of the joint. When the average area of asphaltic plug joint material is greater than 80 square inches, payment for the first 80 square inches will be made as specified, and an additional payment for Additional 1P Deck Joint Material will be made for the average area in excess of 80 square inches, on a cubic foot basis, based on the volume calculated by multiplying the excess area by the measured distance, curb to curb along the centerline of the joint. No separate measurement or payment will be made for joint replacement at the barrier curbs, parapets and sidewalks, the cost of which will be included in the linear foot item for deck joint replacement.

Joint Reconstruction, Type 1A shall be measured by the linear foot, complete and in place along the top surface of the joint armoring. Each side of the joint will be measured separately where identified on the Plans. Removal and disposal of existing concrete; furnishing and installing new concrete; furnishing and installing new epoxy coated reinforcement steel; sawcutting; furnishing and applying epoxy bonding compound; furnishing and installing methacrylate sealer; and furnishing and installing pavement joint sealer will not be measured separately for payment. Preformed Elastomeric Joint Sealer Replacement will be measured separately for payment.

Joint Reconstruction, Type FJ will be measured by the linear foot, curb line to curb line along the centerline of

the joint. Removal and disposal of the waterstop or preformed joint filler; and furnishing and installing a new waterstop or preformed joint filler; guards; joint replacement at the barrier curbs, parapets and sidewalks; sawcutting; cleaning/water blasting sawcuts; and furnishing and installing hot poured joint sealer will not be measured separately for payment. Spall repairs and concrete deck replacements will be measured separately for payment in accordance with this Subsection. Crack Spanning Membrane will be measured separately for payment in accordance with Subsection 302.09.

Deck Joint Reconstruction will be measured by the linear foot, complete and in place along the top surface of the joint armoring at Strip Seal Expansion Joint outside the limits of "Concrete Deck Replacements" and "Concrete Deck Replacements with Catches". Deck Joint Reconstruction will be measured separately along each side of the Strip Seal Expansion Joint only where identified on the Plans. Removal and disposal of existing concrete; furnishing and installing new concrete; furnishing, installing, and removing temporary catch (where required); sawcutting; and furnishing and applying epoxy bonding compound will not be measured separately for payment. Removal of stay-in-place forms, strip seal expansion joints, furnishing and placing new epoxy coated reinforcement steel, reinforcement couplers and drill and grout reinforcement bars will be measured separately for payment in accordance with Sections 401 and 417.

Pavement Riser Repair will be measured by the linear foot along the top of the replaced bar.

Joint Reconstruction Type F, complete in place on both sides of the joint centerline, will be measured by the length along the joint centerline. No separate payment will be made for the demolition of the existing concrete safety walk and median barrier, removal of existing drainage steel components, structural steel and hardware to support the strip seal joint system, and the reinforcement steel and concrete within the limits shown on the plans. All costs thereof shall be included in the price bid for the item "Joint Reconstruction Type F".

Silicone Joint Seal will be measured along the total length of the joint in which the sealer is installed.

Joint Seal Replacement of the various types will be measured by the linear foot of seal installed along the centerline of deck joint including the vertical face of curbs, parapets and the top of safetywalks. Cleaning and preparation of steel surfaces for joint reconstruction or replacement will not be measured separately for payment.

Headblock repair of the various types will be measured by the length, complete and in place, along the top of the joint armor, regardless of the width of the headblock.

The services of a manufacturer's representatives; removal of existing joint seal elements, support bars, and preparation and cleaning of existing joints to receive new joint seals; furnishing and installation of new joint materials; and cleaning and painting steelwork will not be measured separately for payment at joint replacement/reconstruction and joint sealer work.

When encountered, removal and disposal of abandoned loop detectors will not be measured separately for payment.

Removal of Latex Modified Concrete Overlay, Variable Thickness will be measured by the square yard of surfacing overlay removed. Disposal of removed material and debris will not be measured separately for payment.

Furnishing and placing joint sealing materials, such as asphalt cement (AC-20) and methacrylate sealer at repair areas, will not be measured separately for payment. Placing joint sealing materials, such as asphalt cement (AC-20), to seal roadway cracks as directed by the Engineer outside of repair areas will be measured in accordance with Section 302.09. Cleaning and preparation of cracks will not be measured separately for payment.

Sidewalk, Parapet, and Curb Surface Repairs will be measured by the square foot of exposed surface area repaired, regardless of depth. Individual area will be computed to the nearest one square foot with individual areas measuring less than one square foot to be considered as one square foot. Conduit encountered that is not rigid metallic conduit shall be replaced and shall be measured separately for payment in accordance with Subsection 601.11 if encountered. Any rigid metallic conduit(s) damaged by the Contractor's operation during repair construction shall be repaired and or replaced in accordance with Division 600 at no additional cost to the Authority. Providing temporary conduit support and temporary electrical connections; and furnishing and placing water repellent treatment will not be measured separately for payment regardless if it is within the limits of the sidewalk repairs.

Vertical Spall Repair will be measured by the square foot of vertical exposed surface area repaired at parapets, median barriers, and noise barriers, regardless of depth, where shown on the Plans or where directed by the Engineer. Individual area will be computed to the nearest square foot with individual areas measuring less than one square foot to be considered as one square foot. Furnishing and installing new epoxy coated

reinforcement steel, will not be measured separately for payment.

Concrete Parapet Repair will be measured by the length in place along the parapet. Removal and disposal of existing concrete, reinforcement, and other materials deemed not suitable for reuse by the Engineer; cleaning existing reinforcement to remain; furnishing and installing new concrete; sawcutting; and furnishing and applying epoxy bonding compound and methacrylate sealer will not be measured separately for payment. Removal, storage, and re-installation of existing bridge railing and anchor bolts; and furnishing and installing new bridge railing and anchor bolts will be measured for payment in accordance with Subsection 414.08. Furnishing, installing, and removing temporary shielding systems will be measured separately for payment in accordance Subsection 417.11.

Parapet Reconstruction Location No. ___ shall be measured on a linear foot. Removal and disposal of existing concrete, bridge railing and reinforcement steel; furnishing and placing new concrete; excavation and backfilling; slope and surface restoration; approach slab reconstruction; and removing, salvaging, temporarily supporting and reinstalling existing junction boxes at the rear face of parapets will not be measured separately for payment

Furnishing, installing, maintaining, and removing temporary catches and temporary shielding associated with various items will not be measured separately for payment. Furnishing, installing, maintaining, and removing temporary catches and temporary shielding for fall protection or work platforms for the Contractor's convenience will not be measured separately for payment. Catches installed where shown on the plans or as directed by the Engineer will be measured by the square yard, complete and in place, along the top of the catches.

Temporary Shielding shall be installed in bays adjacent to scheduled deck replacements, or at other locations, in the event that the Engineer determines that the condition of the concrete is such that shielding is necessary to ensure against the possible falling of debris onto the surface below. In such cases, the Contractor shall be paid for such work at the unit price bid for item entitled "Furnishing, Installation and Removal of Temporary Shielding". The determination as to whether or not such shielding is required shall be at the sole discretion of the Engineer.

Furnishing, Installation and Removal of Temporary Shielding will be measured by the square foot of surface area, complete and in place, along the top of the shielding. Furnishing, Installation and Removal of Temporary Shielding will only be measured for payment where required on the Plans or as directed by the Engineer. Catch systems required for isolated deck replacement panels or spall repairs will not be measured separately for payment.

Furnishing and Installation of Temporary Shielding will be measured by the square foot of the surface area, complete and in place, along the top of the shielding which is to remain in place. Furnishing and Installation of Temporary Shielding will only be measured for payment where required on the Plans or as directed by the Engineer.

Furnishing, Installation and Removal of Temporary Catch will be measured by the linear foot, complete and in place along the top of parapet where required on the Plans or as directed by the Engineer. The limits of the temporary catch and shielding systems shall be 10′ beyond the limits of Parapet Reconstruction or Deck Replacement in each direction parallel to the Roadway, and as shown on the plans for areas outboard of the parapets and beneath the bridge deck.

Force Account for Emergency and Routine Bridge Repairs (No-Bid) provides a value for reimbursement to the Contractor for costs calculated on a Cost Plus basis for the time and material used in accordance with Subsection 108.04. Lane closings for Force Account work will be measured in accordance with Division 800.

417.14 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CONCRETE REPAIR MATERIAL	LUMP SUM
REMOVAL OF EXISTING CONCRETE DECK	SQUARE YARD
REMOVAL OF EXISTING NON-COMPOSITE CONCRETE DECK	SQUARE YARD
CONCRETE DECK REPLACEMENT *	SQUARE YARD
CONCRETE DECK REPLACEMENT WITH CATCHES *	SQUARE YARD
REMOVAL OF SIP METAL FORMS	SQUARE YARD

EMERGENCY CONCRETE DECK REPLACEMENT * ..... SQUARE YARD

REINFORCEMENT BAR COUPLER ..... EACH

REMOVAL OF EXISTING SURFACING ..... SQUARE YARD

REMOVAL AND REPLACEMENT OF EXISTING SURFACING ..... SQUARE FOOT

REMOVAL OF LATEX MODIFIED CONCRETE OVERLAY, VARIABLE THICKNESS ..... SQUARE YARD

REMOVAL OF ASPHALT SURFACING AND SCARIFY CONCRETE ..... SQUARE YARD

SPALL REPAIR, TYPE _____ * ..... SQUARE FOOT

EMERGENCY SPALL REPAIR, TYPE ___ ..... SQUARE FOOT

REPAIR UNDERDECK SPALLS (CLEAN AND COAT) ..... SQUARE FOOT

JOINT RECONSTRUCTION, TYPE _____ * ..... LINEAR FOOT

JOINT REPLACEMENT, TYPE 1P ..... LINEAR FOOT

JOINT SEAL REPLACEMENT, TYPE ___ ..... LINEAR FOOT

EMERGENCY JOINT RECONSTRUCTION, TYPE __ * ..... LINEAR FOOT

PAVEMENT RISER REPAIR ..... LINEAR FOOT

ADDITIONAL 1P DECK JOINT MATERIAL ..... CUBIC FOOT

SILICONE JOINT SEAL ..... LINEAR FOOT

DECK JOINT RECONSTRUCTION ..... LINEAR FOOT

EMERGENCY PAVEMENT REPLACEMENT ..... SQUARE YARD

HEADBLOCK REPAIR, TYPE _____ * ..... LINEAR FOOT

EMERGENCY HEADBLOCK REPAIR ..... LINEAR FOOT

SIDEWALK, PARAPET AND CURB SURFACE REPAIRS * ..... SQUARE FOOT

VERTICAL SPALL REPAIR ..... SQUARE FOOT

CONCRETE PARAPET REPAIR ..... LINEAR FOOT

PARAPET RECONSTRUCTION, LOCATION NO. ____ ..... LINEAR FOOT

CATCHES ..... SQUARE YARD

FURNISHING, INSTALLATION AND REMOVAL OF TEMPORARY SHIELDING ..... SQUARE FOOT

FURNISHING, INSTALLATION AND REMOVAL OF TEMPORARY CATCH ..... LINEAR FOOT

FURNISHING AND INSTALLING TEMPORARY SHIELDING ..... SQUARE FOOT

FORCE ACCOUNT FOR EMERGENCY AND ROUTINE BRIDGE REPAIRS (NO-BID) ..... USD

Payment adjustments for strength and durability for the various Portland cement concrete items listed above with an "*" will be made in accordance with the specified Performance Criteria Category within Division 900.

No separate payment will be made for any survey work required to determine the pavement, deck, and stringer elevations prior to demolition and stringer elevations after removal of the deck, but the cost thereof will be included in the unit price bid for the pay item "Concrete Deck Replacement" or "Concrete Deck Replacement with Catches".

No separate payment will be made for the removal and legal disposal of existing bridge drainage inlets; abandoned scuppers; abandoned rigid metallic conduit; abandoned parapet mounted lighting standard bases; non-working light fixtures attached to the underside of deck; deck joint materials including structural supports; armored joints; parapet and handrail; and safetywalk within the limits of deck slab replacement at locations of Removal of Existing Concrete Deck, but the costs thereof will be included in the unit price bid for the pay item "Removal of Existing Concrete Deck".

The demolition, removal, and disposal of the concrete deck, bridge parapets, existing SIP forms, existing bridge inlets, portions of existing wingwalls, and associated reinforcement steel scheduled for replacement shall be paid for separately under the pay item entitled "Removal of Existing Concrete Deck".

No separate payment will be made for required removal and reconstruction of safetywalks and medians adjacent to or affected by bridge deck replacements, but the cost for all necessary work shall be included in the bid price for concrete deck replacement items

Payment for Reinforcement Steel, Epoxy Coated at concrete deck replacement areas or reconstruction areas and "Deck Joint Reconstruction" shall be paid for separately in accordance with Subsection 401.24. No separate payment will be made for epoxy coated reinforcement required at all other repair areas within Section 417, but the costs thereof will be included in the unit prices bid for the various repair items.

No separate payment will be made for cleaning reinforcement steel or field anti-corrosion coating, but the costs thereof will be included in the unit prices bid for the various repair items in the Contract.

No separate payment will be made for water repellent treatment applied to exposed concrete on curbs, sidewalks, medians, parapets and deck replacements.

At localized deck replacement areas, no separate payment will be made for field measurements, furnishing, installation and removal of catches, removal and disposal of concrete deck slab and reinforcement steel; and associated removal and disposal of existing deck joint steelwork, but the costs thereof will be included in the various pay items "Concrete Deck Replacement" or "Concrete Deck Replacement with Catches".

No separate payment will be made for the temporary support of utility conduits required at any structure where utility conduits/supports are in bays with catches or shielding, during deck panel replacement, or as necessary during any other work on this project. All costs shall be included in the price bid for the item Concrete Deck Replacement or Concrete Deck Replacement with Catches.

No separate payment will be made for removal of existing asphalt surfacing and membrane waterproofing at isolated deck replacement areas or at any areas located outside the limits of Removal of Existing Surfacing as shown in the Plans (except for Spall Repair, Type 2), but the costs thereof will be included in the unit price bid for their respective pay items in the Proposal. No separate payment will be made for scarification of existing concrete deck within the limits of Removal of Existing Surfacing, but the costs thereof will be included in the unit price bid for the pay item "Removal of Existing Surfacing".

No separate payment will be made for the removal and legal disposal of frames and grates for concrete/asphalt filled bridge drop inlets located within areas of Removal of Existing Surfacing but the cost thereof shall be included in the bid price for the item Removal of Existing Surfacing.

No separate payment will be made for removal and disposal of abandoned loop detectors (when encountered), but the cost thereof will be included in pavement removal items in the Contract.

No separate payment will be made for removal of existing surfacing at isolated spall repair areas (those located outside the limits of Removal of Existing Surfacing as shown in the Plans) greater than four (4) square yards, but the costs thereof will be included with the various spall repair items in the Proposal. Payment will be made for bridge surfacing and membrane waterproofing (where required) for the spall repair. No separate payment will be made for asphalt surfacing at isolated spall repair areas (those located outside the limits of Removal of Existing Surfacing as shown on the Plans) less than four (4) square yards, but the costs thereof will be included in the unit prices bid for the repair items in the Contract.

No separate payment will be made for removal of existing surfacing, membrane waterproofing, or bridge surfacing at isolated spall repair areas (those located outside the limits of Removal of Existing Surfacing as shown in the Plans) less than 4 square yards, but the costs thereof (when required) will be included with the unit price bid for the pay item "Removal and Replacement of Existing Surfacing".

Separate payment for spall repairs 1/4" to 1" deep will not be made but will be included as part of the cost of the Removal of Existing Surfacing or Removal and Replacement of Existing Surfacing.

Payment for Spall Repair, Type 2 and Removal and Replacement of Existing Surfacing shall include the Asphalt Concrete Bridge Surfacing and Membrane Waterproofing required for said repair and replacement.

Payment for Spall Repair, Type 6 and 6A shall include, when required, placement and removal of catch system, removal of existing asphalt and membrane waterproofing; placement of new membrane waterproofing, asphalt concrete bridge surfacing and traffic striping.

No separate payment will be made for installing catch and shielding system, protecting existing utilities, cutting existing guide rail anchor bolts, concrete removal, cleaning exposed reinforcement and steelwork, furnishing and applying anti-corrosion coating to exposed reinforcement and steelwork of Repair Underdeck Spalls regardless of depth of removal, but the costs thereof will be included in the unit price bid for the pay item "Repair Underdeck Spalls (Clean and Coat)".

No separate payment will be made for the preparation of steel surfaces to accept new elastomeric concrete headers, cutting any existing bolts, removing/re-installing nuts, removing existing deck or abutment header concrete, removing any existing grout pads above steel plates, furnishing and installing shear studs onto existing steel plates (if noted on plans), and all other labor and materials required to complete the joint reconstruction work as shown on the plans or as directed by the Engineer. All costs shall be included in the pay item "Joint Reconstruction, Type 1".

No separate payment will be made for removal of the existing Type 1P joint, the preparation of surfaces, furnishing and installing new deck joint, or for joint replacement or sealer installation at the barrier curbs, parapets and sidewalks, but the costs thereof will be included in the unit price bid for the pay item "Joint Replacement, Type 1P". Payment will be made for headblock repairs under the pay items "Headblock Repair, Type ____".

Payment for asphaltic plug joint material in excess of an average plug joint area of 80 square inches will be made under pay item entitled "Additional 1P Deck Joint Material".

No separate payment will be made for removal and disposal of existing concrete; furnishing and installing new concrete; furnishing and installing new epoxy coated reinforcement steel; spall repairs; sawcutting; applying epoxy bonding compound; and furnishing and installing pavement joint sealer, but the costs thereof will be included in the unit price bid for the pay item "Joint Reconstruction, Type 1A".

No separate payment will be made for joint replacement at the barrier curbs, parapets and sidewalks; sawcutting; cleaning/water blasting sawcuts; and furnishing and installing hot poured joint sealer, but the costs thereof will be included in the unit price bid for the pay item "Joint Reconstruction, Type FJ". "Removal of Existing Surfacing", "Spall Repair, Type __", "Concrete Deck Replacements", and "Concrete Deck Replacements with Catch" will be paid for in accordance with this Subsection. No separate payment will be made for guards; removal and disposal of the waterstop or preformed joint filler; and furnishing and installing a new waterstop or preformed joint filler, at existing filled joints but the cost thereof will be included in the unit price bid for the various deck repair pay items. "Crack Spanning Membrane" will be paid for in accordance with Subsection 302.10.

No separate payment will be made for removal and disposal of existing concrete, steelwork, deck joint material, and joint steelwork; cleaning existing steelwork surfaces exposed by concrete removal; furnishing and installing new concrete; furnishing, installing, and removing temporary catch (where required); sawcutting; and furnishing and applying epoxy bonding compound and methacrylate sealer, but the costs thereof will be included in the unit price bid for the pay item "Deck Joint Reconstruction". Payment will be made for "Strip Seal Expansion Joints", "Removal of SIP Metal Forms", "Reinforcement Steel, Epoxy Coated", "Reinforcement Bar Couplers", and "Drill and Grout Reinforcement Bars" in accordance with Sections 401 and this section.

No separate payment will be made for the measures taken by the Contractor to prevent concrete chips, steel fragments and debris from flying into the adjacent roadway lanes or dropping below the bridge (including the use of catches, tarps and shielding systems), but the costs thereof will be included in the unit price bid for the appropriate various pay items unless specifically required by the Engineer.

No separate payment will be made for placing and removing temporary barricades at joint reconstruction, spall repair or headblock repair/reconstruction items, but costs thereof will be included in the unit price bid for the various pay items.

No separate payment will be made for the removal of existing joints and the preparation of concrete surfaces for silicone joint sealant installation, but the costs thereof will be included in the unit price bid for the pay item "Silicone Joint Seal." Concrete deck and headblock repairs including cleaning and applying anti-corrosion coating to reinforcement steel to remain and new reinforcement steel will be paid for separately under the applicable spall repair items.

No separate payment will be made for the preparation of concrete or steel surfaces for installation of joint sealers removal and/or disposal of debris from joint reconstruction operations. All costs are to be included in the unit prices bid for the appropriate joint reconstruction items.

No separate payment will be made for furnishing and placing joint sealing materials, such as asphalt cement (AC-20) at the locations shown on the Plans or as identified in the Specifications. All costs thereof shall be included in the price bid for the various items of work in the Contract requiring same.

No separate payment will be made for the services of a manufacturer's representatives; removal of existing joint seal elements, support bars, and preparation and cleaning of existing joints to receive new joint seals; furnishing and installation of new joint materials; and cleaning and painting steelwork, but the costs thereof will be included in the unit price bid for the various joint replacement/reconstruction and joint sealer items.

Payment for Asphalt Concrete Bridge Surfacing and Membrane Waterproofing overlaying Concrete Deck Replacement will be made in accordance with Section 302.

No separate payment will be made for disposal of removed material and debris associated with removal of existing LMC Overlay, but the costs thereof will be included in the unit price bid for the pay item "Removal of Latex Modified Concrete Overlay, Variable Thickness".

No separate payment will be made for furnishing and placing asphalt cement (AC-20), methacrylate sealer, or waterstops at the locations shown in the Plans or as identified in the Specification, but the cost thereof will be included in the prices bid for the various items of work in the Contract.

No separate payment will be made for the work involved with verification of the existing pavement thickness but all cost thereof shall be included in the unit price bid for the pay item "Mobilization".

No separate payment will be made for removal of existing concrete header, deck joint seal material, joint steelwork, bituminous overlay, and membrane waterproofing; preparation of surfaces; furnishing and installing the deck joint system; and joint reconstruction or sealer installation at the barrier curbs, parapets and sidewalks, but the cost thereof will be included in the unit price bid for the pay item "Joint Reconstruction, Type 1P". Payment will be made for headblock repairs under the pay items "Headblock Repair, Type____" and "Deck Joint Reconstruction" as shown on the Plans.

No separate payment will be made for temporary conduit support and temporary electrical connections at safetywalk/parapet repairs (if encountered), but the costs thereof will be included in the various repair items in the Contract.

No separate payment will be made for removal and disposal of existing concrete, reinforcement, and other materials deemed not suitable for reuse by the Engineer; cleaning existing reinforcement to remain; furnishing and installing new concrete; sawcutting; and furnishing and applying epoxy bonding compound and methacrylate sealer, but the costs thereof will be included in the unit price bid for the pay item "Concrete Parapet Repair". Payment for furnishing, installing and removing temporary shielding at Concrete Parapet Repair will be made under the pay item "Furnishing, Installation and Removal of Temporary Shielding" in accordance with Subsection 417.11. Payment for Removal, storage, and re-installation of existing bridge railing; and furnishing and installing new bridge railing will be made under the pay items "Reset Bridge Railing" and "Bridge Railing" in accordance with Subsection 414.09.

No separate payment will be made for removal and disposal of existing concrete, bridge railing and reinforcement steel; furnishing and placing new concrete; excavation and backfilling; slope and surface restoration; approach slab reconstruction; and removing, salvaging, temporarily supporting and reinstalling existing conduit and junction boxes at the rear face of parapets, but the costs thereof will be included in the lump sum price bid for the pay item "Parapet Reconstruction Location No. ____".

No separate payment will be made for water repellent treatment applied to parapets, safety walks or curbs and medians affected by the various repairs or modifications, but the costs thereof will be included in the unit prices bid for the respective repair pay items.

No separate payment will be made for field measurements associated with the furnishing, installation and/or removal of shielding, but the costs thereof will be included in the pay items "Furnishing, Installation, and Removal of Temporary Shielding" or "Furnishing and Installing Temporary Shielding".

No separate payment will be made for furnishing, installation, maintenance and removal of catches and shielding associated with the pay items "Concrete Deck Replacement with Catches", "Deck Joint Reconstruction", "Joint Reconstruction, Type__", "Spall Repair, Type ___", "Repair Underdeck Spalls (Clean and Coat)", and "Removal of SIP Metal Forms" or for catches installed for fall protection, work platforms or for the Contractor's convenience at any work area, but the cost thereof will be included in the unit price bid for the various items in the Contract.

Payment will be made for "Furnishing, Installation and Removal of Temporary Shielding" only at locations identified on the Plans or as directed by the Engineer. No payment will be made unless the approved shielding system is installed in accordance with approved shop drawings. Payment for Furnishing, Installation and Removal of Temporary Shielding will be made at 60% of the unit price bid after acceptance for installation and 40% of the price bid after removal.

No separate payment will be made for all labor and materials associated with the modification of catches or shielding, either temporary or permanent, required to install same in bays where utilities of other bridge appurtenances conflict with normal installation. All costs shall be included in the price bid for the appropriate repair items.

No separate payment will be made for labor and fabricated metal work for fascia catches and deck support installation, but shall be included in the bid price per square yard for "Concrete Deck Replacement With Catches".

Payment for "Furnishing, Installation and Removal of Temporary Catch, Location No. ____" will be made at 60% of the unit price bid after acceptance for installation and 40% of the price bid after removal. No payment will be made unless the approved catch system is installed in accordance with approved shop drawings. No separate payment will be made for furnishing, installing or removing catch or support systems required for construction of the deck slab, deck slab overhang, or parapet. No separate payment will be made for multiple installations and removals at any one structure, but the costs thereof will be included in the unit price bid for the pay item "Furnishing, Installation and Removal of Temporary Catch, Location No. ___."

Payment for work under Force Account for Emergency and Routine Bridge Repairs, excluding lane closings, will be made on a Cost Plus basis in accordance with Subsection 108.04.

No separate payment will be made for furnishing and delivering of the following to the prescribed locations (rapid set mortar, reinforcement bars, cement patch mix, and tie wire), but the costs thereof will be included with the lump sum price bid for the pay item "Concrete Repair Material". High Performance Cold Patch will be paid for in accordance with Division 300.

SECTION 418 - BRIDGE STRUCTURAL REPAIRS

418.01 Description.

This work shall consist of repairing deteriorated concrete of bridge piers, abutments, wingwalls, leveling pads, diaphragms; waterproofing concrete surfaces of abutments, piers, pier caps and bridge seats; repairing cracks in structural concrete; repairing and resetting bridge bearings; replacing dowels/pintles, rocker plates, masonry plates; repairing girders, stringers and other structural steel work or repair missing or loose hardware; cleaning bridge seats; and removing and replacing damaged steel stringers and diaphragms.

This work shall also consist of all work and materials associated with relieving the portion of the load of the superstructure over individual bearing points as indicated on the Plans or as directed by the Engineer. Jacking and temporarily supporting the stringers will be required to perform concrete repairs to the bearing areas, other areas underlying the bearing areas which are influenced by the stringer's load as indicated on the plans or as directed by the Engineer.

This work shall also include the removal, storage and reinstallation of various bridge appurtenances as required for gaining access to repair areas as indicated on the Plans or in the Specifications. This may include removal of beam guide rail and re-installing an upgraded connection to substructure units as shown on the plans or as directed by the Engineer.

This work may include the completion of various items of work on an emergency basis and work shown as "if and where directed" on the Plans at locations to be determined by the Engineer and shall be paid for through "Force Account" in accordance with Subsection 108.04. The Contractor shall notify the Authority of any structural defects which may need emergency repair and if repair is within the limits and duration of the project.

The Contractor is hereby advised that the existing coating system on previously painted bridges may contain red lead and/or basic lead Silico Chromate paints as components. Activities such as structural steel removal, handrail removal, rivet or bolt removal, access ladder and platform removal, torch or mechanical cutting, welding on structural steel and other activities related to the items described herein may cause lead emissions. The Contractor shall include provisions in the Pollution Control Plan, Lead Health and Safety Plan, and Emergency Management Plan as required to be submitted in Subsection 411.04 to address other lead exposure activities as described above.

The Contractor is advised that the work will be performed over waterways, private property, railroads, roadways, certain Authority properties, and that during construction, removal and other operations, he will be required to comply with the provisions of Subsections 106.16 through 106.18 and shall provide means for safely catching or otherwise preventing all steelwork, concrete, tools, other objects, and debris resulting from his operations from falling to the ground (private property or Authority property), waterway, and/or onto the railroad/roadway below.

418.02 Materials.

Materials for bridge structural repairs shall conform to Subsections 401.02, 403.02, and Division 900.

EPOXY CRACK SEALANT

EPOXY MORTAR

EPOXY RESIN SYSTEMS

EPOXY RESIN WATERPROOFING

EPOXY BONDING COMPOUND

FASTENERS AND HARDWARE

NON-SHRINK GROUT

PAINTS

PINS AND ROLLERS

BRONZE BEARING PLATES

BEARING PADS

SEALANT

BONDING AGENT

ANTI-CORROSION COATING

NON-SHRINK HIGH STRENGTH MORTAR

FIELD ANTI-CORROSION COATING OF EXISTING REINFORCEMENT STEEL

WATERSTOPS

ELASTOMERIC BEARINGS

REINFORCEMENT BAR

WELDED WIRE FABRIC

PORTLAND CEMENT CONCRETE (CLASS A AND B)

NON-METALLIC, NON-SHRINK MORTAR OR GROUT

COLD APPLIED JOINT SEALER

REINFORCEMENT BAR COUPLERS

ADHESIVE ANCHORS

SUBSTRUCTURE WATERPROOFING

SUBSTRUCTURE MEMBRANE WATERPROOFING

PREFORMED BEARING PADS

NON-SHRINK HIGH STRENGTH MORTAR

TIMBER FOR STRUCTURES

STAINLESS STEEL

STAINLESS STEEL HARDWARE

STRUCTURAL STEEL

GROUT

RAPID SETTING STRUCTURAL REPAIR MORTAR

UNDERWATER CONCRETE PATCH MATERIAL

CONCRETE PENETRATING SEALER

Materials required for spall repairs and resurfacing shall conform to Section 417.

For repair of concrete diaphragms, Class A high early strength concrete shall be used.

Repair Substructure Concrete shall be made using Class B air-entrained concrete conforming to Division 900.

When the total area to be repaired on a pier or abutment element is equal to or greater than 100 SF or 1 CY, the repairs shall be made using a 3/8" stone ready mix Class B concrete, packaged bag mix material will not be permitted. When the total area to be repaired on a pier or abutment is less than 100 SF or 1 CY, the use of packaged bag mix repair material shall be permissible. Packaged bag material shall be material packed and ready for mixing just prior to use in accordance with the manufacturer's instructions. The material shall be: Deck Mix AE as manufactured by U.S. Concrete Products, LLC, Timonium MD, Five Star Structural Concrete S300 as manufactured by Five Star Products, Inc. Fairfield CT., Masterpatch 240 CR or LA40 Repair Mortar (for small areas which require an extremely high slump) manufactured by BASF or Sika MonoTop 611 manufactured by Sika Corp., Lyndhurst, NJ.

When Class A, High Early Strength Concrete is used for repairs, the temporary support shall not be removed until concrete or grout sample cylinders have reached a compressive strength of 3,000 psi, but in no case less than 6 hours. When Class B concrete is used for repairs, the temporary support shall not be removed until after 14 days or until concrete or grout sample cylinders have reached a compressive strength of 3,000 psi, but in no case less than 72 hours.

Touch-up of damaged epoxy coated reinforcement shall be made with field anti-corrosion coating.

Jacks used for temporary support structure shall have a minimum rated capacity of one and a half the total dead load and live load indicated on the plans and as adjusted as necessary for the actual jacking point. Each jack shall have the maximum rated capacity clearly shown on the manufacturer's nameplate attached to each jack. Jacks shall be equipped with pressure and height gauges that will enable the applied lifting forces and height of jacking to be monitored at all times. Any lifting equipment deemed by the Engineer to be inadequate or faulty may be directed to be replaced. Loads shown on the plans do not include construction loading.

Structural steel for jacking/supporting operations shall conform to Section 403 and Division 900.

418.03 Repair Substructure Concrete.

The Contractor shall repair areas of spalled or damaged concrete on surfaces of piers, abutments, bearing pads, and such other areas as may be shown or directed.

Where spall repairs are scheduled for more than one face (or surface) of a substructure element these repairs shall proceed one face or surface at a time with no demolition, or concrete removal started on any other face, until work on the previous face is complete and concrete cured (minimum 3,000 psi). Noncontiguous areas (areas separated by at least three times the element thickness) can be repaired simultaneously, unless noted otherwise or unless otherwise directed by the Engineer.

(A) Removal Of Spalled Concrete.

The Contractor is alerted to the fact that abutment bridge seats and pier caps are often times covered with debris that must be cleaned prior to performing spall repairs, subsequent waterproofing repair and/or placement and bearing replacement.

The Contractor shall provide a containment system to prevent blasting medium and debris from falling from abutment bridge seats and pier caps. The system shall be approved, by the Engineer, prior to beginning work. Adjacent roadways, sidewalks, railroads, and ROW of others shall be protected during the cleaning operations through the use of temporary shielding or other containment measures. The Contractor shall contain, collect and dispose of all materials off Authority ROW at completion of the cleaning operations.

The Contractor is required to provide access for the Engineer in order for the Engineer to layout all concrete repair areas. Access will require the Contractor to provide the necessary manpower and equipment (ladders, manlifts, underbridge inspection equipment, maintenance and protection of traffic devices, etc.) for the Engineer to reach all spall repair areas delineated in the Contract or otherwise assigned by the Engineer. The Contractor shall be prepared to provide this access early on in the project (within one month of Contract award).

The lateral limits of each area to be removed and replaced shall be as shown or will be delineated by the Engineer and suitably marked. The outline of each such area shall first be cut to a depth of one half (1/2) inch with an approved power saw capable of making straight cuts.

Deteriorated, damaged, and loose concrete shall be removed to sound concrete by chipping or other approved methods and to depths determined by the Engineer. The minimum depth of removal shall be as shown on the plans; however, if reinforcement bars are exposed, the removal shall continue until at least 1" beyond the bars. The limits of the cavity for deep, narrow repairs (depth equals or exceeds twice the width) shall be undercut to lock the repair in place. All exposed reinforcing steel shall be cleaned and protected

from damage and shall remain in place.

Damaged concrete may be removed by means of approved hand held pneumatic chipping hammers, not exceeding 30 pounds. Pneumatic tools should not be placed in direct contact with reinforcement steel. Extreme care shall be taken when reinforcement steel or anchor bolts are uncovered so as not to damage the steel or the anchor bolt or their bond in the surrounding sound concrete.

Adequate provisions must be made to prevent pieces of broken concrete from interfering with or striking traffic, or from falling below the structure. Details of platforms, catches, or other methods of collecting materials resulting from the preparation of spall areas for repair shall be of the Contractor's design and shall be submitted to the Engineer for approval before commencing concrete removal. Materials collected shall not be allowed to accumulate but shall be promptly removed and disposed of away from the Authority right of way. Materials shall not be dumped into waterways, but must be properly removed and disposed of in a legal manner.

The limits of Spall Removal shall be sounded by the Engineer a minimum of three times, once for original layout of spall, second to verify that all unsound concrete has been removed prior to forming and pouring of the spall, and the final sounding is necessary for final acceptance of the spalled area repaired.

All materials removed by the Contractor in performance of this work shall become the property of the Contractor and shall be disposed of off the Authority's right of-way.

The surfaces exposed by concrete removal shall be cleaned of all unsound concrete and loose particles by vacuum or air jet, and be free of all oil, solvent, grease, dirt, dust bituminous and foreign matter before placing concrete or non-shrink grout.

For Repair Spalled Concrete, Type 1-___ (Pier, Abutment, etc.), the Contractor shall chip out and remove the existing concrete to sound concrete, or a minimum of 4 inches below the concrete surface. Sound concrete shall have a minimum compressive strength of 2,000 psi as determined by the Contractor and field verified by the Engineer with a hand held nondestructive compressive strength testing device or similar. For areas where required depth is greater than 8 inches, the item will be Repair Spalled Concrete, Type 2-___ (Pier, Abutment, etc.).

For the items, Repair Concrete Footings, the Contractor shall chip out and remove the existing concrete to sound concrete. Sound concrete shall have a minimum compressive strength of 2,000 psi as determined by the Contractor and field verified by the Engineer with a hand held nondestructive compressive strength testing device or similar.

The item Reconstruct Bearing Area shall include the repair of deteriorated concrete or the complete reconstruction of existing bearing pads (pedestals) at locations called for in the Plans and as directed by the Engineer. The bearing pad is limited to the area from the seat elevation to the underside of the masonry plate. This item includes spall repairs to be performed at an existing bearing pad even when no bearing work is to be performed. This item shall include drilling and grouting of proposed reinforcement as indicated on the plan details.

The Contractor is required to jack and support the existing stringer when repairs are to be performed under the item Reconstruct Bearing Area. Temporary jacking and support during spall repairs shall be in accordance with Subsection 418.08.

Any appurtenances such as drain pipes, conduits and/or their supports, signage and guide rail and guide rail attachments that would interfere with the repair work shall be removed or relocated prior to the removal of damaged concrete and reinstalled after the completion of repairs. Elements to be reinstalled shall be stored to the satisfaction of the Engineer. Costs of removing, storing, and installing appurtenances shall be included in the related items. Refer to Subsection 106.18.

After removal of spalled concrete and acceptance of removal limits by the Engineer, the repair areas shall be cleaned and coated with bonding compound within 24 hours. Additional coating shall be applied in accordance with manufacturer’s recommendations if concrete placement does not take place within manufacturers required timeframe. No more than 500 square feet of chipped out repair areas shall be left exposed at any time.

For extensively damaged pier columns, pier caps and abutments, spall repair shall be limited to chipping out and filling one quarter of the surface area to be repaired on a column, cap or abutment, but no more than 500 square feet, at any time as approved by the Engineer. The forms shall match the existing concrete profile and shall match the existing architectural details of the existing pier. The Contractor shall complete all concrete repairs as soon as the surface preparations are completed or as soon as feasible, no concrete surfaces shall remain unpatched during the winter months (December thru March) or for an extended

period of time greater than 7 days or unless directed by the Engineer. The Contractor shall repair/replace bearings and repair bearing pedestals as soon as feasible once temporary support is in place. Repairs requiring temporary support shall be performed expeditiously to minimize the duration that temporary support is required.

Loads from the superstructure will not be permitted to be transferred to the new pads until after 14 days or until concrete or grout sample cylinders have reached compression strength of 3,000 psi, but in no case less than 3 days.

The length of time between the start of concrete removal operations and the placement of concrete materials shall not exceed seven (7) calendar days.

The Contractor is responsible for determining appurtenances that will require temporary relocation during the bidding process and account for the costs and time to complete this work depending on the Contractor's methods for constructing the repairs.

The Contractor shall not perform concrete placement or grouting associated with substructure repair work during the period between December 1 and March 15.

For concrete diaphragm repair, all deteriorated and unsound concrete shall be removed for a minimum of 1" beyond the main reinforcement. The Contractor shall follow the repair details for substructure repair as noted on the construction plan except depth of concrete removal, which shall be as mentioned in this Paragraph.

(B) CONCRETE REPAIRS.

After removal of deteriorated and unsound concrete, surfaces of the remaining concrete and exposed reinforcing steel shall be thoroughly cleaned of all loose and adhering particles. Immediately prior to the placement of concrete patching material, the surfaces shall receive a coating of epoxy bonding compound applied in accordance with the manufacturer's written instructions.

The new concrete for repair of spalled areas shall be placed immediately against the epoxy bonding compound and while the coating is still wet or tacky. If the coating dries before the new concrete is poured, another coating shall be reapplied as herein described at no additional cost.

Spalled concrete pedestals that project above the abutment seats or top of pier caps shall be restored to their original dimensions.

For repairing scaled bearing pads, the epoxy resin binder components shall be mixed in accordance with the manufacturer's instructions and one part fine aggregate, by loose volume, shall be mixed with one part binder to produce the necessary mortar.

Scaled bearing pad surfaces shall be repaired by trowelled application of mortar with minimum thickness of one quarter inch. Maximum thickness of each layer shall be one inch. Layers shall be applied to build up to required full thickness.

Mixing of Portland cement concrete shall conform to Section 401. Concrete shall be placed within forms at repair locations as shown and where directed.

Whatever method of placing the patch material is employed, it shall be such that the material will completely fill the space to be replaced, be thoroughly compacted, and free of air pockets.

Placing of concrete, forming, removal of forms, finishing, and curing of the new concrete shall conform with the applicable requirements of Section 401.

Where installation of forms prohibits the use of epoxy bonding compound due to installation and drying problems, slow setting bonding agent shall be applied to concrete contact surfaces. Bonding agent application conditions and procedures shall be as recommended by the manufacturer. Concrete shall be placed within a period of 48 hours after the application of the bonding agent. If this time period is exceeded, another coating of the material shall be applied.

All reinforcing steel in the spall repair area shall be coated with an anti-corrosion coating as specified in Division 900. Steel surface preparation and application conditions and procedures shall conform to manufacturer's recommendations. Reinforcement bars that have lost 25 percent or more of their original cross sectional area shall be supplemented by providing new bars of the same diameter. Supplemental bars shall be welded to the existing bars. Where reinforcement is broken or missing, new bars of the same diameter shall also be welded to the existing bars.

Cavities left in concrete after removal of form ties or form anchors shall be filled with non-shrink mortar

similar to that of which the concrete for spall repair is prepared or non-shrink grout.

Repaired areas within limits of the existing waterproofing shall be coated with gray epoxy resin waterproofing. The waterproofing shall extend one foot onto existing waterproofed surfaces adjacent to the repair area in accordance with Subsection 418.05.

If during the completion of the bearing area reconstruction work, existing anchor bolts are encountered that are broken, missing or have lost more than 25% of their original section, new rods matching the diameter of the original bolt shall be drilled and grouted as directed by the Engineer.

All spall repairs 4" or greater in depth shall be reinforced with epoxy coated welded wire fabric and anchored into sound concrete by drilling and grouting dowels as indicated on the plans or as directed by the Engineer. Reinforcement and drilling and grouting shall be in accordance with Section 401.

Epoxy bonding compound shall be applied for quick-setting patch material only if recommended by the manufacturer. Epoxy bonding compound shall be applied to the surface of sound concrete in the repair area just prior to placing the patching material.

Adequate provisions shall be made to prevent pieces of broken concrete from interfering with or striking traffic, or from falling below.

Details of platforms, catches or other methods of collecting materials resulting from the preparation of spall areas for repair shall be of the Contractor's design, signed and sealed by a Professional Engineer licensed in the State of New Jersey, and shall be submitted to the Engineer for review before commencing concrete removal in accordance with Subsection 104.08. Materials collected shall not be allowed to accumulate, but shall be promptly removed and legally disposed of away from the Authority Right-of-Way.

Placing, forming, removal of forms, finishing and curing of the patch material shall conform to the applicable requirements of Paragraph 418.03(A) and the patch material manufacturer's specifications and recommendations. All details of design, such as chamfers, in the existing structure shall be duplicated in the repair work under this Subsection.

Concrete placed for repair of spalls shall be fully cured and shall be completed before substructure waterproofing or substructure membrane waterproofing material is applied if indicated.

(C) Cleaning of Bridge Seats.

Where called for in the contract plans, and where no substructure waterproofing or substructure membrane waterproofing is specified, abutment/pier bridge seats and bearings shall be cleaned of all dirt, debris, and other foreign substances to the satisfaction of the Engineer. Typical debris encountered may include asphalt millings, asphalt sealant, concrete debris, and any other debris.

Limits of cleaning and debris removal will include pier and abutment bridge seats, bearing areas, bearings, adjacent backwalls, and any appurtenances in contact with the bridge seat.

Following removal of debris by hand, Contractor shall thoroughly clean the bridge seat areas specified with power washing equipment (1,500 psi maximum). Areas of the substructure units with subsequent dirt as a result of the bridge seat cleaning shall be cleaned in a similar fashion.

Removal of existing paint, coatings or waterproofing membranes shall not be performed.

All resulting debris and dirt not collected by adjacent stormwater inlets shall be cleaned by the Contractor to the satisfaction of the Engineer.

Adjacent roadways, waterways, sidewalks, and ROW of others shall be protected during the cleaning operations through the use of temporary shielding. The Contractor shall contain, collect and dispose of all materials off Authority's ROW at completion of the cleaning operations.

418.04 Epoxy Resin Injection.

Cracks in designated portions of concrete structures, and the void between the tops of steel stringers and diaphragms and the bottoms of the concrete haunches and deck slab on various structures, shall be repaired by the introduction of an injected epoxy resin system to fill these cracks and voids at the locations shown or as directed.

(A) General Requirements.

The Engineer will delineate the size, extent, and location of cracks in concrete structures to be repaired and the extent of haunch removal and void repairs to be made at the various stringers as the work progresses.

Deteriorated, damaged, and loose surface concrete shall be removed from along the cracks in concrete structures. Concrete haunches shall be removed so as to expose the opening between the deck concrete and the top of stringer or diaphragm by use of chipping hammers or other approved methods. The extent of haunch removal shall be as necessary to place injection posts and wedges.

Adequate provisions for the collection and disposal of pieces of broken concrete shall be made as required under Paragraph 418.03(A).

(B) PREPARATION OF CONCRETE CRACKS AND HAUNCH VOIDS.

The voids between the concrete of the deck and the top of stringers and diaphragms shall be held open, to prevent deck vibration during the epoxy injection, by means of driving steel wedges between the stringer or diaphragms and the concrete at approximately three (3) foot intervals along the length of the opening on each side of the structural steel member. Holes, every three (3) feet along the haunch, shall be drilled into the void to allow the insertion of injection ports consisting of polyethylene one-way valves, 3-inch long by 1/2 inch diameter copper tubing, or black iron pipe nipples which shall be fastened in place by the use of the epoxy-resin gel.

A hollow-core stopper drill or an equivalent drill in which dust is sucked out a hole in the top of the drill to the outside shall be used in providing entry ports at approximately 3 foot intervals for injection of the epoxy resin adhesive into the cracks in the concrete.

The void between the concrete and the steel shall then be cleaned, as practicable as possible, by vacuuming, blowing out with oil-free compressed air, or other methods approved by the Engineer. Surfaces of the remaining concrete in crack voids and exposed reinforcing steel shall be thoroughly cleaned of all loose and adhering particles.

The Contractor shall inform the Engineer as to when crack repairs will be performed and, unless inspection is specifically waived in writing, injection of epoxy adhesive shall be performed only in the presence of the Engineer.

The surface preparation of concrete, steel, and the mixing and preparation of the materials for sealing and grouting shall be done in strict accordance with the manufacturer's printed instructions.

(C) SEALING OF CRACKS.

The line of cracks or length of voids shall be temporarily sealed with the epoxy crack sealant. The temporary sealer shall provide entry ports for the pressure injected epoxy resin adhesive and shall be capable of containing the injected epoxy resin. The lengths of crack or void between the injection ports shall be sealed by forcing the epoxy-resin gel into the void using a spatula or trowel. The gel shall be allowed to harden before proceeding with the grouting.

(D) INJECTION OF EPOXY RESIN ADHESIVE.

Equipment used in injecting epoxy resin adhesive into cracks shall be of a positive displacement type pump, fixed ratio, automatic mixing of two components at the nozzle and equipped with rubber nozzle arrangement that will allow injection of adhesive at pressures of up to 300 psi to assure complete penetration of cracks. The machine shall be equipped with a pressure gauge at or near the nozzle to check working pressure. Consideration will be given to a request by the Contractor for the use of different equipment.

However, in order to receive approval the Contractor shall perform, at no cost to the Authority, all tests required by the Engineer to show that the performance of the different equipment is in every respect at least as satisfactory as the specified equipment.

Injection shall begin at the lower entry port and continue until there is evidence of the epoxy adhesive at the entry port directly above or, as the case may be, adjacent to the port being pumped. At this time, the injection shall be discontinued and the port being pumped shall be sealed. The injection shall then be transferred to the next port that indicated travel of the adhesive in the cracks. Injection shall be one continuous operation until the crack is completely filled.

The epoxy adhesive manufacturer's recommendations shall be strictly followed as to requirements for safety precautions in handling the epoxy, storage, and mix proportions of the two components and application temperatures. Efforts shall be made to inject the epoxy adhesive at times when temperatures are suitable, consistent with the manufacturer's recommendations for good construction practice.

The Contractor shall exercise care in the performance of the epoxy injection operation to avoid seepage or drippings of the epoxy resin onto the steel work. In the event that epoxy seeps or drips onto the steel, the

Contractor shall, when directed by the Engineer, clean such surfaces to the satisfaction of the Engineer at no additional cost to the Authority.

When all work is completed and the materials have dried and cured, the crack repair areas exposed to public view shall be ground smooth to match the surrounding concrete.

(E) EPOXY INJECTION SYSTEMS.

Possible epoxy injection system suppliers for use are listed in, but are not limited to, Division 900.

418.05 Substructure Waterproofing.

(A) SUBSTRUCTURE WATERPROOFING.

Sealing of cracks, as specified in Subsection 418.04, and concrete placed for repair of spalls, as specified in Subsection 418.03, shall be fully cured and all other work in the vicinity of the substructure unit shall be completed before waterproofing material is applied. The substructure unit shall be thoroughly cleaned by sandblasting and/or water-blasting to remove all existing coatings, laitance, grease, rust, waxes, algae, slime, and pollutant coatings. Cleaning shall include the removal of existing waterproofing materials which are peeling or otherwise deteriorating by cutting, scraping, and sandblasting. Asphalt and concrete spillage shall be removed. If water-blasting is used, the equipment must be capable of a minimum of 4,000 psi.

Adjacent roadways, waterways, sidewalks, and ROW of others shall be protected during the cleaning operations through the use of containment system. The Contractor shall contain, collect and dispose of all materials off Authority ROW at completion of the cleaning operations. The Contractor is alerted to the fact that abutment bridge seats and pier caps may be covered with debris. Contractor shall clean entire bearing areas, pier top and abutment seats prior to preparing concrete surfaces for waterproofing.

After thorough cleaning of the substructure unit, any depression deeper than 1/2 inch shall be filled with epoxy mortar. Epoxy mortar shall be in accordance with Division 900.

Prior to application of the epoxy resin waterproofing, the perimeter of the steel masonry plate with the concrete substructure shall be sealed. The sealant shall comply with Division 900.

The two components of the epoxy waterproofing material shall be blended in accordance with manufacturer's instructions. At the time of application, temperatures shall be over 50°F.

Application shall be by brush or roller. Two different colored coats shall be applied. The first coat shall be tan. The second coat shall be gray and shall be applied after the first coat is thoroughly dry. The total finished dry thickness shall be not less than twelve (12) mils.

All holes in the surfaces to be covered are to be coated completely inside including air pockets exposed by sandblasting operations.

Before the second coat is dry and while still tacky, a layer of sand shall be spread over the horizontal surfaces only on the waterproofing material. After the waterproofing material has set, all excess sand shall be brushed off.

(1) Pier.

The waterproofing material shall be applied to the pier cap seat, exposed concrete bearing pads and extend down the vertical surface one foot below the seat elevation, or to the limits shown on the Plans.

(2) Abutment.

The waterproofing material shall be applied for the full height of the front face of the abutment backwall and headblock, the abutment seat and drainage trough (if present), exposed concrete bearing pad surfaces and the vertical front face for the abutment extended one foot below the seat elevation or to the limits shown on the Plans.

(B) SUBSTRUCTURE MEMBRANE WATERPROOFING.

Concrete placed for repair of spalls, as specified in Subsection 418.03, shall be fully cured and all other work in the vicinity of the substructure unit shall be completed before waterproofing material is applied. The concrete surfaces to receive the waterproofing membrane system shall be thoroughly cleaned by sandblasting to remove all existing coatings, laitance, grease, rust, waxes, algae, slime, and pollutant coatings. Cleaning shall include the removal of existing waterproofing materials which are peeling or otherwise deteriorated by cutting, scraping and sandblasting. Galvanized or painted bearings and

structural steel shall be protected from damage by the abrasive blast cleaning operation. Any damage shall be repaired by the Contractor to the satisfaction of the Engineer. Existing asphalt and concrete spillage shall be removed.

The Contractor is alerted to the fact that abutment bridge seats and pier caps may be covered with debris. Contractor shall clean entire bearing areas, pier top and abutment seats prior to preparing concrete surfaces for waterproofing.

The Contractor shall provide a containment system to prevent blasting medium and debris from falling from pier caps. The system shall be approved, by the Engineer, prior to beginning work. Adjacent roadways, sidewalks, and ROW of others shall be protected during the cleaning operations through the use of temporary shielding or other containment measures. The Contractor shall contain, collect and legally dispose of all materials off Authority ROW at completion of the cleaning operations.

After thorough cleaning of the substructure unit, any depression deeper than ½ inch shall be filled with non-shrink high strength mortar. Existing cracks shall be pre-treated as per the manufacturer's recommendations.

The perimeter of the steel masonry plates at the interfaces with the concrete substructure shall be sealed using a sealant in accordance with Division 900.

Material, air and surface temperature shall range between 32 degrees F and 85 degrees F during application and cure, unless a special formulation is being used and the manufacturer has been consulted and issues a written approval. The maximum application/substrate/material temperature shall be 104 degrees F. Material shall not be placed when rain is forecast within 24 hours. Relative humidity at the time of application in the specific location of the application shall be less than 85 percent and the surface temperature shall be at least 5 degrees above the dew point.

Sufficient material to place the entire membrane system shall be in storage at the site prior to any field preparation, so that there shall be no delay in procuring the material for each day's applications.

The material shall be stored so as not to be damaged from the elements and to ensure the preservation of their quality and fitness for the work. The storage space shall be kept clean and dry, shall contain a recording high-low thermometer, and the temperature of the storage space shall not fall below or rise above that recommended by the manufacturer. Every precaution shall be taken to avoid contact with flame.

Stored materials, even though accepted before storage, shall be inspected by the Engineer prior to their use in the work and shall meet the requirement of the Contract at the time of use. Any material which is rejected because of failure to meet the required tests or that has been damaged so as to cause rejections shall be immediately replaced at no additional cost to the Authority.

The entity ("applicator") performing the work of this section shall submit proof of having the skill and experience necessary for the installation of the specified membrane system placed on jobs of equal complexity to this Contract. Such proof shall include but not be limited to the name and resume of the individual superintendent who will be responsible for the field work. The resume shall list experience with such installation, including the project name, the name of the owner for whom the work was performed and the scope of the work performed, and shall be submitted to and approved by the Engineer prior to commencing these operations. A Technical Representative from the material manufacturer must be on site for such time until the applicator has demonstrated competence in material application as determined by the Engineer.

All handling, mixing and addition of components for the primer and waterproof coating shall be performed in a safe manner to achieve the desired results in accordance with the manufacturer's recommendations as approved or directed by the Engineer. The system shall not be applied when weather or surface conditions are such that the material cannot be properly handled, sprayed, and cured within the specified requirements.

(1) Pier.

The waterproofing material shall be applied to the top of the pier cap, all exposed concrete bearing pad surfaces, the chamfered edge around the periphery of the pier cap and the vertical surface extending one (1) foot below the seat elevation or as shown on the Plans.

(2) Abutment.

The waterproofing material shall be applied to the full height of the front face of the abutment backwall and headblock, the abutment seat and drainage trough (if present), exposed concrete bearing

pad surfaces and the vertical front face of the abutment extending one (1) foot below the seat elevation or as shown on the Plans.

418.06 Repair Bearings, Reset Bearings and Replace Masonry Plates.

Bridge bearings on piers and abutments at structures as shown shall be adjusted to normal vertical, transverse, and longitudinal position. The work includes removing by grinding or chipping the existing welds or rivets or utilizing carbon arc burning where permitted, disassembling and refurbishing the bearings, removing and replacing masonry plates, removing, inspecting and replacing dowels as necessary, reassembling the bearings, adding steel shim plates, caulking existing rivet or bolt holes, drilling new holes as required, and removal of coatings/corrosion and spot painting as required.

Jacking to remove and refurbish existing bearings shall be performed in accordance with Section 432.

Shop and working drawings shall be submitted for resetting and repairing of existing bearings which shall include a written procedure describing how the work shall be completed with a general sequence and specific procedures describing: removal and cleaning of existing bearings, resetting bearing into its normal vertical, transverse, and longitudinal positions, disassembling, repairing and reassembling of frozen bearings, removing, inspecting, replacing dowels/pintles as necessary, replacing missing or excessively rusted keeper plates as necessary, adding preformed fabric pads, reinstallation and repainting of bearings, and plug welding of existing rivet holes, etc. Catalog cuts for materials and equipment, a full description and drawings of paint and paint preparation containment systems and a debris disposal plans shall also be submitted. Provide with shop drawing submittals detailed field measurements to verify the dimensions shown on the Contract Plans. The bearing shop drawings complete with all dimensions required to install the bearings without field adjustment shall be signed and sealed by a Professional Engineer licensed in the State of New Jersey and shall contain a statement certifying the dimensions shown for each bearing were field verified. The shop drawings shall include adjustments to the bearing component dimensions shown on the plans, based on the Contractor's field measurements on an individual bearing by bearing basis.

The Contractor shall be fully and solely responsible for the adequacy of temporary shoring and its construction. Shop drawing review comments revising the shop drawings shall not be considered to relieve the Contractor of such responsibility.

All surfaces or edge irregularities shall be ground smooth so as to provide straight edges and full bearing surfaces between sole plates, shims, and bottom of stringer flanges to permit proper welding. Steel shims of the required thicknesses, which will eliminate the gap between the sole plate and the hinge pin or rocker plate, shall be installed between the bottom flange of the stringers and the sole plates in their adjusted positions. The shim plates shall be welded to the flanges and the sole plates welded to the shim plates at the properly adjusted location. All paint shall be removed at the bottom of stringers in areas where shim plates, in adjusted position of sole plates, will make contact. The Contractor with assistance from the information shown on the plans will determine the amount and direction of movement of each sole plate so that, when resetting rockers, resetting bearings, repairing bearings, or replacing masonry plates, the rocker stem will be vertical at 68°F. The existing base plate, masonry plate, and anchor bolts shall remain in an undisturbed position, except where necessary to replace the masonry plate.

If the sole plate, after its position has been adjusted, extends beyond the end of the stringer/girder, that portion extending beyond the end of the stringer/girder shall be removed.

After sole plates have been adjusted at locations where the end of the stringer/girder is located within one inch of the abutment backwall, the end of the stringer/girder shall be removed to provide at least one inch clear space. If the end of the stringer/girder is located within one inch or another stringer/girder end, the end of the stringer/girder shall be removed to provide at least one inch clear space.

With rocker stem or bearing shoe in proper reset position, the sole plate shall be welded to the stringer as shown or as directed.

After sole plates have been welded in their adjusted positions, all rivet holes of previous riveted connection in stringer flanges and sole plates shall be plug welded, full depth

All dimensions which will affect the details of fabrication of the materials to be used in adjusting the bearing shall be verified by the Contractor and actual shim plate thicknesses shall be determined after the blocking of the stringers has been accomplished and the existing gap measured.

All steel fabrication and erection shall be done in accordance with Section 403.

All new weld material, those portions of existing steel work where paint film has been damaged by the Contractor's operations, and where uncoated metalwork is exposed as a result of repair work, shall be properly

cleaned and painted except where steelwork consists of A709 weathering steel, unless otherwise noted.

After cleaning, the exposed metal shall be spot painted to match the existing paint system. The dry film thickness for each coat shall be not less than 2 mils.

Cleaning and preparation of steel surfaces and painting shall be in accordance with the applicable requirements of Section 411.

Broken or damaged welds or rivets shall be repaired as necessary.

(A) RESETTING ROCKER BEARINGS.

All work of resetting rockers and bearings requiring jacking of stringers shall be performed as expeditiously as possible. Such work shall be completed, the jacks released, and the stringers returned to their original position within the same day. Jacking against concrete diaphragms is not permitted.

Under no circumstances will the bearing, when in the jacked position, with component parts disassembled, be left unattended for any period of time without the load bearing jack positively locked-off and under no hydraulic pressure, or where permitted by the Engineer, bearing on approved hard wood or steel blocking.

The elevation of the existing bridge joint shall be taken into consideration when resetting rockers or bearings or repairing sliding bearings. Correction of the joint elevation is part of the repair. Upon completion of the repair, the joint shall be set even to within a tolerance of 1/8 inch.

This work shall include the effort of field measurement as necessary to carry out the work identified by the Plans, cleaning top of pier, removing debris buildup around bearing, ensuring bearing is not restrained from movement, and jacking and blocking of the stringer as necessary in order to carry out the work as shown on the Plans.

The Contractor shall furnish and install replacement stainless steel dowels/pintles. Each bearing shall be completely disassembled. Existing dowels shall be removed and replaced. During the process of dismantling and cleaning the bearing components, existing dowels/pintles shall be removed from within their sockets; new stainless dowel/pintles of the same size as existing shall be furnished and replaced by the Contractor. New stainless dowels/pintles shall conform to the material specification of Division 900. Any remaining new dowels/pintles after completion of the contract shall be turned over to the Authority. Removal and replacement of dowels/pintles shall be any suitable methods and equipment acceptable to the Engineer.

The Contractor shall disassemble, thoroughly clean and sandblast as required, and reassemble the bearing. Sandblast the bearings by commercial blast cleaning in accordance with SSPC-SP6. Sandblast only the faying surfaces of the existing rocker stem, rocker plate, base plate, and sole plate. Reassemble the bearing device upon completion of cleaning and painting of faying surfaces. Contractor shall ensure the bearing device is not frozen after reassembling.

This work shall also include replacing of the keeper plates. Keeper plate shall be replaced as shown on the Plans. The cleaning of the rocker bearing components shall be completed as necessary for the welding of new keeper plates to the existing rocker bearing.

The Contractor shall install a 1/8" preformed fabric pad under the masonry plate to eliminate the gap between the sole plate and the hinge pin and ensure full bearing contact of the adjusted bearing.

This work shall also include field cleaning, sandblasting and painting of the bottom of stringer flange and other disturbance area in order to carry out the work identified by the Plans.

The work shall also include plug weld of the existing rivet holes, saw cutting of the stringer bottom flange if necessary, preparing the cut surface for welding, field welding the sole plate to stringer bottom flange as shown on the Plans.

Replacement of anchor nuts if existing nuts are missing and tightening of existing nuts if existing nuts are loosened shall be performed. New nuts shall match original dimension and specification of the existing.

This work shall also include the work of installing replacement sole plate, field drilling, field reaming, field bolting, seal welding and other related works identified by the Plans.

(B) REPAIR OF BEARINGS AND REPLACEMENT OF MASONRY PLATES.

Jacking and shoring to remove and refurbishing existing bearings shall be performed in accordance with Section 432.

Repair of bearings and replacement of masonry plates shall also include the resetting of rockers and

bearings.

Each rocker or bearing shall be completely disassembled. Dowels/pintles shall be removed, inspected, and replaced unless otherwise directed.

Where deteriorated dowels are encountered during the process of dismantling and cleaning the bearing components, the Engineer will direct that they be removed from within their sockets and replaced with stainless steel dowels. Removal and replacement shall be by suitable methods and equipment acceptable to the Engineer.

The bearing shall be thoroughly cleaned and sandblasted as required. Upon completion of cleaning and painting of faying surfaces, the bearing devices shall be reassembled.

Replacement of masonry plates shall be done as directed by the Engineer. Where possible, replacement parts shall match the original materials and dimensions of the parts to be removed and installations shall be as originally performed.

Concrete bearing surfaces shall be thoroughly cleaned of all coatings and any other substances and shall provide uniform bearing.

Setting bearing plates and preparation of surfaces including bedding pads shall conform to Section 403.

New Pin provides for furnishing replacement pins for expansion and fixed bearings when directed by the Engineer. Pins shall conform to original plan dimensions and specifications unless otherwise directed.

New Bronze Bearing Plate and New Sole Plate provide for furnishing and installing replacement plates when directed by the Engineer. Plates will conform to the original plan or as directed by the Engineer.

All surfaces or irregularities on any component part of the bearing assembly consisting of the sole plate, rocker plate, rocker pin, rocker bearing surface and masonry plate shall be built up with weld metal up to 1/4 inch or ground smooth up to 1/4 inch as part of Repair Bearing. Final surface shall be shop ground to match the original plan dimensions and finish, unless otherwise directed. Elements requiring adjustment of surfaces in excess of 1/2 inch will be replaced with new elements with the approval of the Engineer.

Severely deteriorated keeper plates shall be removed and replaced, and missing plates shall be replaced as directed by the Engineer and shall be included under the item Repair Bearing Rocker. The cleaning of the rocker bearing components shall be completed as necessary for the welding of new steel keeper plates to the existing rocker bearing.

Rockers shall not be placed on bearing area surfaces that are depressed or have been improperly finished. The rocker shall have full and even bearing.

Depressions shall be filled by weave welding (back step method if large concentrated area in order to minimize concentration of heat) or grinding high areas to provide straight edges and full bearing surfaces. The grinding process to remove high areas will be unacceptable if it creates a problem for water to pond on.

Sandblasting of bearings will be required by commercial blast cleaning in accordance with SSPC-SP6 and as directed by Engineer.

The Contractor shall supply the required number of 1-inch diameter and/or 1 1/4-inch diameter stainless steel dowels (pintles) for the completion of Repair Bearing, Rocker. After completion of the contract, any remaining dowels shall be turned over to the Authority.

New Masonry Plate shall be done only where shown on plans or as directed by the Engineer for depression greater than 1/2 inch on the masonry surface and shall be a separate pay item. Thickness of the new plate will be determined from field measurements so as to avoid the need for shims. Setting masonry plates and preparation of surfaces shall conform to Subsection 403.09.

New Rocker provides for furnishing replacement rockers and pins, if required for expansion bearings at locations called for on the plans and when directed by the Engineer. Rockers and pins shall conform to original plan dimensions and specifications unless otherwise directed.

Re-Grind Rocker provides for building up with weld metal to a maximum of 1/2 inch or removal of a maximum of 1/2 inch on the rocker surface at locations called for on the plans and when directed by the Engineer. Final surface shall be shop ground to match the original plan dimensions and finish, unless otherwise directed.

New Rocker or Re-Grind Rocker may be required to correct a badly rusted rocker surface or to lower the deck and remove a vertical offset across an expansion joint.

New Bronze Bearing Plate, New Sole Plate and New Base Plate provide for furnishing and installing replacement plates when directed by the Engineer. Plates will conform with original plan or as directed.

Repair Bearing, Sliding Plate provides for removal of existing deteriorated structural steel bearing assembly and replacement as shown on plans or as directed.

Replace Anchor Bolt provides for chipping out concrete from pedestal, pier or abutment to remove and replace an existing damaged bolt, where directed. New bolt will be inserted and concrete repaired as required, in accordance with Subsection 418.03. Alternatively, anchor bolt may be inserted into core drilled or star drilled holes in substructure concrete and secured with polyester resin or epoxy resin grout. Diameter of the bolt and exposed length shall match the original design or current standard, as directed. If required, new holes will be cut through the masonry plate and old holes will be plug-welded.

Materials and work shall conform to the provisions of Section 403.

418.07 Structural Steel Repairs.

Replace Structural Steel Diaphragm provides for removal of existing deteriorated wide flange or channel section diaphragms and connection plates as required and replacement with new wide flange or channels in accordance with plan detail and at plan locations or where directed. The void created above the diaphragm and the concrete deck shall be injected with epoxy materials and work shall conform to the provisions of Division 900.

Repair of Structural Steel provides for cleaning and painting the existing deteriorated diaphragms, stringers, or other structural members and installing repair plates in accordance with details shown on the plans or as directed by the Engineer.

All steel fabrication, materials, workmanship and erection associated with structural steel repairs shall conform to the applicable provisions of Section 403 and Division 900. Cleaning, preparation of steel surfaces and painting required for structural steel repairs shall be in accordance with the applicable requirements of Section 411 and Division 900.

Prior to preparation of shop drawings and fabrication, the Contractor shall verify and determine by accurate field measurements all dimensions which will in any way effect fabrication and erection of steelwork. All dimensions shall be shown on the shop drawings and noted as to which were determined by field measurements. Field dimensions and data shall be submitted with the shop drawings. Discrepancies between field dimensions and Plan or reference drawing dimensions shall immediately be brought to the attention of the Engineer and noted as such on the submission of field measurement data. The Contractor is alerted to the fact that obtaining measurements will require the use of underbridge and other access vehicles and equipment. Contractor installed lane/shoulder closings, local road lane closings, railroad access, and waterway access may also be required for obtaining field measurements.

At the completion of all welded repairs to primed repair members, clean the weld slag and repair primer in accordance with the requirements for cleaning existing steelwork noted in Section 411.

No member shall be removed from a structure unless its replacement is on site and ready for installation.

All material removed as part of the work on this project shall not re-used and shall become the property of the Contractor. The Contractor must dispose of all material in a legal fashion and off of the Authority's Right-of-Way.

Where existing painted surfaces are disturbed, the Contractor shall properly collect, protect and dispose of loosened or removed paint materials in accordance with Section 411.

Materials removed shall be disposed of outside of the Authority's Right of Way.

(A) Repair Of Structural Steel, Type A.

This work provides for repair of holes and section loss in the web of a stringer, diaphragm, or other structural member at the locations shown on the plans and as directed by the Engineer. The Contractor shall clean the structural steel at the specific locations shown to determine the extent of the repairs required and the exact dimensions of the repair plates prior to fabrication. Repairs shall then be constructed as shown on the plans and per the approved shop drawings. Repair plates should be placed on both sides of the existing member whenever possible.

(B) Repair Of Structural Steel, Type B and Repair Of Structural Steel, Type C.

This work provides for repair of holes and section loss in the bearing stiffener of a stringer at the locations

shown on the plans and as directed by the Engineer. The Contractor shall clean the structural steel at the specific locations shown to determine the extent of the repairs required and the exact dimensions of the repair plates prior to fabrication. Repairs shall then be constructed as shown on the plans and per the approved shop drawings. Repair plates should be placed on both sides of the existing member whenever possible.

(C) RIVET REMOVAL AND REPLACEMENT WITH HIGH STRENGTH BOLTS.

Where required to complete steel repairs, removing and replacing rivets with new high strength bolts shall be performed at the locations shown on the plans or as directed by the Engineer. Repairs shall be constructed as shown on the plans and approved Shop Drawings, as required.

Where directed on the Plans, the Contractor shall also inspect riveted connections and replace deteriorated rivets with new high strength bolts. The Engineer will approve all proposed rivet replacements prior to starting the removal process. Rivets shall be considered as 'deteriorated' and suitable for replacement when the following conditions are noted:

- The rivet is missing or sheared.
- 50% or more of the rivet head is missing or where it has corroded to the point where 50% or more of the head can be removed with a 2 lb ball-peen hammer.
- The rivet can be moved or turned by hand.

Where rivets cannot be clearly identified as 'deteriorated', the Engineer will visually inspect the rivets and determine their condition.

The Contractor shall submit to the Engineer for approval his proposed method for rivet removal in accordance with Subsection 104.08. Rivet removal will not be permitted until the removal method has been approved and demonstrated successfully in the judgment of the Engineer. In the event that the Engineer determines that rivet removal work is resulting in damage to the existing steel, the Contractor shall cease rivet removal operations until a new proposed method has been demonstrated and approved by the Engineer.

Rivets to be removed shall have their heads removed with a rivet-buster, by cutting, air-arc gouging, or grinding and the shank driven, drilled, cored, or jacked out as required.

Special provisions shall apply where air-arc gouging methods are to be used:

(1) All air-arc equipment operators shall be certified welders. Air-arc gouging procedures shall be performed in accordance with AWS D1.5 C-3.2.6. In the presence of the Engineer, each operator shall demonstrate the ability to remove the heads from four (4) button head ASTM F-1852 bolts mounted in a vertically oriented 12″ x 12″x ½″ thick plate without visibly damaging the plate, or raising the temperature of the plate to a temperature of greater than 150 degrees Fahrenheit. Operators which have not operated the air-arc equipment for 30 calendar days or more shall be required to re-demonstrate their ability as outlined above.

(2) 50% of all rivets scheduled for removal shall be circled and crossed on the rivet head to remain using a 150 degree Fahrenheit "Tempilstik" heat sensitive chalk before air-arc gouging of the opposite rivet head. These rivets shall be submitted to the Engineer for review. Air-Arc operators who submit rivets with melted chalk shall be subject to recertification or expulsion from the worksite at the discretion of the Engineer.

(3) The Engineer reserves the right to request recertification of any Air-Arc operator at any time at his discretion.

The method employed by the Contractor shall minimize damage to connected components. Care shall be taken not to enlarge rivet holes. Unless otherwise noted, all bolts shall be the same diameter as the rivets being replaced. If the bolts will not fit the existing rivet holes, the holes shall be carefully reamed to accommodate the bolts. High-strength bolts shall be installed after the nicks, burrs, and foreign substances that might interfere with seating of the bolt head and nut washers are removed. Light grinding may be ordered by the Engineer.

At locations where surrounding material has been damaged as a result of the Contractor's operations, the surrounding material shall be repaired at Contractor's expense to the satisfaction of the Engineer. When reaming of more than 1/16-inch in diameter greater than the original hole diameter shown on the plans and installing an oversize bolt is required for the repair, the reaming, furnishing and installing of oversized bolts shall be at the Contractor's expense.

The Contractor shall submit a Quality Control Plan for all rivet removal operations in accordance with

Subsection 104.08.

High strength bolt installation shall be in accordance with Section 403.

Bolts shall be installed in vacated rivet holes as soon as is practicable. Only one vacant rivet hole per connection may be present at any time unless otherwise noted on the plans.

Where additional plates prohibit removing only one rivet at a time and replacing it with a new high strength bolt, the Contractor may, at the permission of the Engineer, temporarily occupy vacated rivet holes with drift pins.

Threads in bolts are to be excluded from all shear planes. The Contractor shall be responsible for maintaining an adequate inventory of bolt sizes and lengths such that rivet replacement operations may proceed in a timely fashion. After all bolts have been installed and fully tightened, the Contractor shall test all bolts for full torque via calibrated Skidmore type wrench.

(D) BOLT HOLES.

All bolt holes are to be drilled. Burning of bolt holes is strictly prohibited. Upon drilling of a bolt hole or removal of a rivet or bolt, the base metal around the hole shall be examined for surface irregularities and deterioration. All oxidized material, nicks, burrs, steel peaks and cusps that would interfere with the setting of bolt heads, nuts and washers shall be removed. All bolts shall be of sufficient grip length to ensure a minimum stick through of 1/8 inch beyond the nut.

Where irregularities to the surface of the hole prevent normal alignment or insertion of the bolt without damage to the threads, the hole shall be reamed as required to facilitate proper installation.

Where reaming and enlarging of a bolt hole is required, as approved by the Engineer, the Contractor shall install high strength bolts which are 1/16" smaller in diameter than the final hole. Installation requirements and procedures remain as before.

The Contractor shall field drill all necessary holes in the existing steelwork to insure the proper fit using a template or the new or existing steelwork to be erected. Holes shall be drilled full size or sub drilled and reamed.

(E) REPLACE BOLT.

This work involves the removal and/or installation of a new bolt at locations identified and material specified in the contract plans.

This work will involve preliminary field measurements to confirm the size and length of the bolt needed, limitations of access, and to confirm measures needed to install the new bolt.

Contractor may be required to ream or drill the existing hole to account for any misalignment in the connecting steel members.

418.08 Temporary Supports.

In accordance with Subsection 418.06, the Contractor shall jack and temporarily support stringers when existing bearings or bearing areas are to be repaired or replaced.

In addition, the Contractor may need to jack and temporarily support stringers at other locations as shown on the Plans or as directed by the Engineer.

Loads at centerline existing bearing points, if shown on the plans, are for temporary support bidding purposes only. The Contractor is fully responsible for determining the loads required depending on the temporary support system he intends to use.

(A) GENERAL.

The design of the temporary supports shall be in accordance with the current editions of the AASHTO Standard Specifications for Highway Bridges, the AASHTO Guide Design Specifications for Bridge Temporary Works, and as modified by the Design Manual of the New Jersey Turnpike Authority.

The specified jacking loads are at each bearing. The Contractor shall select the location of the lift points and calculate the required lifting force at the actual jacking location.

The jack shall be designed for one and a half (1.5) times the calculated total jacking load and for minimum horizontal forces equal to 10% of those capacities.

The temporary supports shall be designed to support the calculated total jacking load and for minimum

horizontal forces equal to 10% of those loads with appropriate factors of safety.

The item Temporary Support provides for jacking and temporary supporting stringers or girders to remove the loads specified in the plan from the bearing location and transfer the reaction to a structurally and adequately sound portion of the abutment, pier, or ground.

The Contractor shall provide calculations, means and methods for temporary support operations, plans and details signed and sealed by a Professional Engineer licensed in the State of New Jersey to the Engineer for approval prior to performing work or fabrication.

The Structures will remain in service during the jacking (whenever possible) and temporary support operations and all elements of the system (jacking tower, jack, foundation, etc.) shall be designed to carry the specified live load and anticipated dead load in accordance with the requirements of the NJTA Design Manual and applicable AASHTO Bridge Design Specifications.

The Contractor shall provide proof or certification from the jack manufacturer that the jacks to be used in the project are capable of allowing traffic flow over a bridge during lifting operations. A maximum of 50% of the bearings in any one bearing line are permitted to be jacked simultaneously.

Temporary support structures and their components including foundations shall be designed based on the actual existing field conditions and in accordance with AASHTO Guide Design Specifications for Bridge Temporary Works.

Approval of the jacking and temporary support systems shall be at the sole discretion of the Engineer.

No materials shall be ordered and no work shall be performed on the jack support scheme until the Engineer's written approvals have been obtained. Approvals by the Engineer shall in no way relieve the Contractor of his responsibility to ensure the safety and adequacy of the existing structural members, jacking, and temporary support systems. Any damage to any portion of the existing structure to remain in place resulting from the Contractor's misuse of the jacking system shall be repaired by him to the complete satisfaction of the Engineer, all at the Contractor's sole expense.

Temporary blocking shall be a structural grade hardwood in good condition as approved by the Engineer. Blocking shall be furnished and installed at the stringer locations as directed by the Engineer. The proposed blocking shall be installed on both sides adjacent to interior stringers and at the inside of fascia stringer locations indicated. Each blocking area shall be approximately 2 feet by 2 feet in plan dimension and the height shall be as required to support the lower end diaphragm member. Field adjustments and timber shims may be utilized as required to insure a tight fit.

(B) SHOP DRAWINGS.

The Contractor shall prepare and submit shop drawings for all temporary support systems in accordance with Subsection 104.08. The Contractor shall submit a proposed jacking scheme along with detailed working drawings and calculations in support of the design to the Engineer for his review indicating his jacking operation and temporary support system, and the equipment and materials he intends to use. The integrity of the existing connection configurations and the size and condition of any existing diaphragms and stringers to be utilized during the jacking operations shall be field verified by the Contractor prior to any work. The Contractor shall not implement such operations/systems until these drawings have been reviewed and approved by the Engineer. Such working drawings shall be signed and sealed by a Professional Engineer licensed in the State of New Jersey. All work shall be performed in accordance with the reviewed working drawings and no deviation therefrom will be allowed without written approval from the Engineer. The Engineer's review shall in no way relieve the Contractor of the responsibility for the safety, adequacy and operation of the system throughout the period of its use.

(C) CONSTRUCTION.

Approximate theoretical loads/reactions at stringers/bearings may be indicated on the Plans.

All repair work requiring temporary support of stringers shall be done as expeditiously as possible and shall be scheduled such that the time required to temporarily support the stringers is kept to a minimum.

Ground-mounted jacking assemblies will be subject to approval by the Engineer and shall be protected from vehicular impact, where needed. Before any jacking operations begin, the Contractor shall place adjacent to the stringer blocking or plates with a minimum bearing length of eight (8) inches and a width equal to the flange of the member being jacked so as to distribute the load with no direct concentration on the flange at the jack head. Stiffeners shall be installed as required. The stringers shall not be jacked any higher than the minimum required to complete the scheduled repair and not to exceed 1/8 inch.

No jacking or temporary supports will be permitted on the surface of unsound concrete, or within the zone of influence of unsound concrete.

Stringers shall not be supported on jacks, except during actual jacking operations. Grillages, bolsters or other suitable means of the temporary shoring shall be used to support the superstructure for the duration of the repair work.

Provisions for expansion and contraction of the superstructure caused by temperature and/or for transverse and longitudinal superstructure loads must be made for the temporary support system if it is to be maintained for any length of time.

Any damage done to the stringers, diaphragms, deck slab, slope protection, roadway, or any other bridge or utility components due to the Contractor's actions or operations shall be repaired, or the components shall be replaced as directed by the Engineer, at no cost to the Authority.

The amount of jacking movement to release and remove each bearing shall be kept to a minimum (1/8" max.). The Contractor shall submit to the Engineer, at least 30 days prior to the start of jacking operations, the method he intends to use and the procedure he intends to follow for the removal of existing bridge bearings and the installation of the new bridge bearings. The Contractor must receive written approval of these methods and procedures before commencing the work.

Under no circumstances will the bearing area, when in the jacked position, with components disassembled, be left unattended for any period of time without blocking.

The Contractor must provide a means to constantly measure the possible deflection or yielding of the temporary supports and shall continuously monitor this at all times. This precaution is important because the deflection, shifting or yielding of the temporary supports will induce permanent residual stresses into the structure or may be an indication of the introduction of unanticipated loads onto the jack supports. The Contractor shall immediately notify the Engineer of any such condition. Any yielding and/or deflection of the temporary support systems shall be immediately corrected by the Contractor. The Contractor's attention is directed to the fact that it is of extreme importance to safeguard the temporary support systems. It will be the sole responsibility of the Contractor to provide and maintain adequate protection of the temporary support systems for the duration of the Contract.

The temporary jack support system, when no longer required, shall be removed and relocated and installed at another appropriate jacking point or removed from the site and disposed of by the Contractor. Any damage to the structure caused by the temporary jack support system shall be repaired, in accordance with the Specifications and as directed by the Engineer.

Jacks with higher capacity than those required herein may be allowed, but the Contractor shall be responsible for monitoring the jack loads to ensure the safety of the structure. The larger jacks may change loadings and load eccentricities and thereby require dimensional and design changes to the temporary supports. The Contractor shall be responsible for any necessary modifications.

The jack systems shall be equipped with direct reading gages to read the jack force in pounds or kips. Jacks shall be calibrated prior to each use, in the presence of the Engineer.

The Contractor shall make every effort to reduce the duration of the jacking operations and shall submit for approval the proposed jacking operation schedule to the Engineer 14 calendar days prior to the start of jacking.

Waiver of any requirement or restriction by the Engineer may only be made upon written request by the Contractor and written approval of the waiver request by the Engineer.

The Contractor is alerted to the fact that it is intended that the jacking take place while vehicular traffic is using the structure whenever possible. Additionally, other operations may be conducted while the structure is supported on the temporary support systems. The Contractor shall be responsible for additional loads imposed on the jacking system by his operations. These facts highlight the need for safe operations of the jacking and temporary support systems.

The Contractor shall include in his submission of methods and procedures the accommodations for loadings imposed by his operations. It is recommended that other operations be carefully limited and controlled so as not to impart excessive loads to any temporary works.

The Contractor shall provide precast concrete construction barrier (with joint classification as per NJTA Standard) for protecting the Temporary Support when the support frame is exposed to vehicular traffic. Payment will be in accordance with appropriate items in Division 800.

418.09 Emergency Repairs for Bearing and Temporary Support/Shoring.

Bridge bearings may require repair and bridge girders or stringers may require temporary support on an emergency basis at structures shown on the Plans or other structures not shown on the Plans but located within the Contract limits. Emergency repair work shall be initiated by the Contractor within six (6) hours after verbal notice (confirmed in writing as to date and time) or written notice to proceed from the Engineer. Shop drawings, submissions, and construction for bearing repair and temporary shoring (under emergency conditions) shall conform to the requirements above for Repair Bearing. The Contractor will be provided with the design load from the Engineer for any temporary support or shoring condition within six (6) hours after verbal notice.

The Contractor shall be prepared with materials, equipment and manpower to construct temporary shoring at locations with varying site conditions. The expected locations will involve constructing supports founded on existing ground (level or sloped) in front of abutment faces of piers; at abutment or pier cap seat elevations; within waterways; adjacent to active traffic; adjacent to railroad traffic; and at heights above ground varying from 5 feet and greater. The Contractor shall assume that such shoring can be founded on the foundation of the substructure unit (after excavation to expose the footing); on timber cribbing placed on level or sloping ground (requires excavation); at abutment seat or pier cap elevations by directly supporting the stringer, girder or diaphragms if adequate room is available; or from temporary supports anchored to abutment faces or pier caps. The temporary shoring shall be designed in accordance with the provisions for jacking methods described in this Subsection 418.08. The Contractor is responsible for preparing the design and fabrication of a stable jacking column, tower, or anchored support capable of supporting vertical loads in the approximate range of 50 kips to 200 kips, for an unspecified period of time such that the shores should be considered permanent construction or until other repairs are made.

The specific location of the emergency bearing repair and temporary shoring will be determined by the Engineer on an as needed basis.

418.10 Measurement.

Removal, storage and reinstallation of various bridge appurtenances as required for obtaining access to repair areas as indicated on the Plans or in the Specifications will not be measured separately for payment. Furnishing and installing new hardware for reinstallation of bridge appurtenances will not be measured separately for payment, except for beam guide rail upgrades where specified in the Contract Plans. Guide rail improvements will be measured for payment in accordance with Section 510.

Locating existing underground facilities, dewatering, and soil erosion measures required for obtaining access to repair areas as indicated on the Plans or in the Specifications will not be measured separately for payment.

Providing access for the Engineer will not be measured for payment.

All labor, materials, and costs necessary to relocate, de-energize, or otherwise provide safe access to the existing electric utilities attached to the structure, or otherwise in conflict with the proposed work, will be measured for payment as outlined in Section 601.

Repair Spalled Concrete, Type ___- Abutment or Repair Spalled Concrete, Type ___- Pier will be measured by the exposed surface area of the completed repair.

Individual areas of spall repair will be computed to the nearest square foot with individual areas measuring less than one square foot to be considered as one square foot.

Reinforcement Steel, Welded Wire Mesh, Epoxy Coating and Drill and Grout Reinforcement Bars for supplementing deteriorated existing steel reinforcing and for supplementing spall repairs shall not be measured separately but all cost shall be included in the various spall repair items.

Repair Concrete Diaphragm will be measured by the Square Foot of the surface area of the completed repair, regardless of depth.

Field anti-corrosion coating of reinforcement steel where called for in the Plans or in the Specifications will not be measured separately for payment.

Epoxy Resin Injection will be measured by the length along the crack or void being repaired.

Furnish Epoxy Resin for injection into cracks and voids will be measured by the total number of gallons of the mixed epoxy components actually injected. Components wasted for any reason will not be measured for payment.

Substructure Waterproofing and Substructure Membrane Waterproofing will be measured by the square

footage of the system applied including spall repair locations.

Cleaning bearing areas, pier caps, and abutment seats of debris, providing shielding/containment systems for cleaning operations, legally disposing of debris, and cleaning and painting of repair areas shall not be measured for payment where not specifically called for in the contract plans, and the costs shall be included in the items requiring same. However, where the item "Clean Bridge Seat" is specified in the contract plans, or if directed by the Engineer, cleaning and disposing of debris collected from bridge seats shall be measured for payment by the linear feet of bridge seat cleaned, regardless of the amount of debris collected and regardless of the width of the bridge seat.

Reconstruct Bearing Area shall be measured by the number of bearing areas reconstructed, where spall repair is required on the concrete pedestal or on the bridge seat under the masonry plate as denoted on the plan or as may be directed by the Engineer. Repair of adjacent spalled area not actually under the masonry plate will be included under this item to a maximum of four square feet regardless of depth without separate payment. For repairs at piers where abutting stringers in adjacent spans will have bearing areas reconstructed, the four square feet of included repair of adjacent spalls shall be measured individually per bearing with limits extending along the centerline of the pier and to the lateral extent of repairs. Spall repairs in excess of the included four square feet shall be paid for under the appropriate spall repair item.

Replace Anchor Bolt, for the replacement of anchor bolts or swedge anchor dowels, will be measured by the number of new anchor bolts installed. Repair of adjacent areas will be included under the item to a maximum of four square feet regardless of depth without separate payment.

The items Repair Bearing, Sliding Plate; New Masonry Plate; Replace Anchor Bolt; New Bronze Bearing Plate; New Rocker; Re-Grind Rocker; New Sole Plate; New Pin; New Bearing Pad; all Repair/Reset Rocker and Bearing items; Repair Bearing Area-Abutment/Pier; and Reconstruct Bearing Area will be measured by the number installed new, repaired or reset as prescribed or where directed by the Engineer.

Drilling and grouting reinforcement at bearing pad (pedestal) or anchor rods for replacing deteriorated existing anchor bolts or for necessary cleaning and field anti-corrosion coating applied shall not be measured separately but all cost shall be included in the item "Reconstruct Bearing Area."

Repair of Structural Steel, Type ____ will be measured by the number of complete and accepted repairs described in this specification, plans, and as directed by the Engineer.

Cleaning and painting of all steel members, within a minimum of 1 foot of steel repairs areas or within the limits as specified in the contract plans, will not be measured separately for payment and all costs are to be included in the Repair of Structural Steel, Type __ item. If additional areas are directed by the Engineer to receive cleaning and painting, these areas will be measured under Section 411.

Replace Structural Steel Diaphragm will be measured by the number of each diaphragm removed and replaced, regardless of size or location. Concrete or epoxy required to repair the existing concrete deck above the diaphragm, furnishing and installing new high strength bolts, and all other work noted to be required on the contract plans will not be measured separately for payment.

The removal/replacement of rivets shall be incidental to the repair item and no separate measurement will be made.

Replace Bolt will be measured by the number of each bearing connection bolt installed at locations shown in the contract plans or as directed by the Engineer.

Replace Rivets with High Strength Bolts will be measured by the number of rivets removed and replaced, regardless of diameter, using high strength bolts at areas which are not part of another repair type. High strength bolts that are furnished and installed for structural steel repairs and other work in the Contract will not be measured separately for payment.

Temporary Support will be measured by the number of stringer or beam ends blocked or jacked and temporarily supported. Design calculations, detailed drawings, shop drawings or work associated with gaining necessary approvals regardless of the temporary support system used shall not be measured separately for payment.

Jacking and temporary support of stringers necessary to permit the reconstruction of bearing areas and other repairs shall be individually measured and paid for under item entitled "Temporary Support" based on the actual number of stringers jacked and supported only where indicated on the Plans and as directed by the Engineer. Measurement shall be based on each end of a stringer that is jacked and supported, and shall be inclusive of all labor, materials, equipment, etc. necessary to jack, support, and release the stringer subsequent to completion of repairs.

Temporary Blocking will not be measured for payment. All work associated with furnishing and installing the temporary blocking shall be included under the specific repair items. For any repair location, not shown on the plan, temporary blocking will be paid under Force Account for Emergency and Routine Repairs as approved or directed by the Engineer.

Removal and replacement of existing drainage troughs, piping, or other incidental bridge components that may be required to avoid conflict for jacking or structural steel repairs (e.g. bridge drainage pipe during diaphragm replacement) will not be measured separately for payment and is considered incidental to the various related repair pay items.

Emergency repairs and emergency temporary shoring will not be measured separately for payment but measurement will be made on a Cost Plus basis in accordance with Subsection 108.04 under the pay item Force Account for Emergency and Routine Bridge Repairs and as approved by the Engineer.

418.11 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
Repair Spalled Concrete, Type ___ - Abutment *	Square Foot
Repair Spalled Concrete, Type ___ - Pier *	Square Foot
Repair Concrete Diaphragm	Square Foot
Furnish Epoxy Resin	Gallon
Epoxy Resin Injection	Linear Foot
Substructure Waterproofing	Square Foot
Substructure Membrane Waterproofing	Square Foot
Repair Bearing Area - Abutment *	Each
Repair Bearing Area - Pier *	Each
Reconstruct Bearing Area *	Each
Repair Bearing	Each
Reset Bearing	Each
Repair Bearing, Sliding Plate	Each
Repair Bearing, Rocker	Each
Reset Bearing, Rocker	Each
New Sole Plate	Each
New Masonry Plate	Each
New Bronze Bearing Plate	Each
New Rocker	Each
New Pin	Each
Replace Anchor Bolt	Each
Clean Bridge Seat	Linear Foot
Repair of Structural Steel, Type ___	Each
Replace Structural Steel Diaphragm	Each
Repair Concrete Footing	Each
Temporary Support	Each
Replace Bolt	Each
Replace Rivets with High Strength Bolts	Each

Payment adjustments for strength and durability for the various Portland cement concrete items listed above

with an "*" will be made in accordance with the specified Performance Criteria Category within Division 900.

No separate payment will be made for labor, equipment and materials for field measurements, temporary support of lateral bracing or other existing structural steel or components, temporary catches and shielding at repair areas, removal and disposal of existing steelwork, cleaning and painting or repair thereof, and all else necessary and incidental to the repair/replacement items, but the costs thereof will be included in the unit price bid for the various repair items.

No separate payment shall be made for the removal, storage and reinstallation of various bridge appurtenances as required for obtaining access to repair areas as indicated on the Plans or in the Specifications, but the costs thereof will be included in the unit prices bid for the various repair pay items in the Contract. No separate payment will be made for furnishing and installing any hardware that may be required for reinstallation. Payment for guide rail improvements/attachments will be made in accordance with Section 510.

No separate payment will be made for providing access to the Engineer throughout the duration of the Contract, but the costs thereof will be included in the unit price bid for the various items of work in the Contract.

No separate payment shall be made for locating existing underground facilities, dewatering, and soil erosion measures at repair locations, but costs thereof will be included in the unit price bid for the various items of work in the Contract.

No separate payment will be made for installation of containment for preventing or catching broken concrete and debris from falling through open joints; for reinforcement steel which requires replacement, as directed by the Engineer; or for field anti-corrosion coating of reinforcing, but the costs thereof will be included in the unit prices bid for the respective repair items.

No separate payment will be made for reinforcement steel or wire mesh or drilling and grouting at spall repair areas.

No separate payment will be made for reconstructing chamfers. The cost for reconstructing chamfers shall be included in the price bid for Repair Spalled Concrete, Type ____ - Abutment or Repair Spalled Concrete, Type ____ - Pier.

Payment for substructure waterproofing will include the cost for furnishing and applying all materials required for filling depressions, sealing around masonry plates and waterproofing substructure, including waterproofing concrete spall repairs.

No separate payment will be made for preformed bearing pads.

No separate payment will be made for the placement of grout or epoxy mortar leveling pads equal to or less than 1" thick at locations as required. The cost for the grout or epoxy mortar and placement of this material shall be included in the price bid for Laminated Elastomeric Bearing ___" x ___" under Section 408.

No separate payment will be made for any necessary drilling and grouting of reinforcement at bearing pad (pedestal) locations or for anchor rods or for necessary cleaning and field anti-corrosion coating applied to exposed reinforcement, but the costs thereof will be included in the unit price bid for the pay item "Reconstruct Bearing Area".

No separate payment will be made for cleaning bearing areas of debris, except where a specific item is provided. The costs of which shall be included in the prices bid for various items of work in the contract requiring same. Areas of bridges seats specified for Clean Bridge Seat, where shown on the contract plans, will be measured for payment on a linear foot basis of the length of bridge seat cleaned, regardless of bridge seat width and regardless of the amount of debris.

No separate payment will be made for repairs spalls within 6" of substructure pedestals adjacent to Reconstruct Bearing Area, regardless of depth, but the costs thereof will be included in the unit price bid for the pay item "Reconstruct Bearing Area". Payment for spalls outside the 6" offset will be made in accordance with this Subsection 418.03.

Where shoring of existing bearings with blocking is to be performed without jacking, the cost of the shoring shall be considered incidental to the items; Pier Repair Bearing Area-Abutment/Pier, or Reconstruct Bearing Area.

No separate payment will be made for field measurements, bracing of other adjacent existing structural steel or components, temporary shielding at repair areas, removal and disposal of existing steelwork including access ladders and platforms, cleaning and painting or repair thereof, and all else necessary and incidental to the Repair Structural Steel, Type _____ and Repair of Structural Steel, Type ____ items.

No separate payment shall be made when rivets are replaced as part of a larger structural repair as designated on the plans. All costs thereof shall be included in the larger structural repair item (s).

No separate payment will be made for the strengthening of bridge components (stringers, diaphragms, etc.), including web stiffeners and any and all other hardware required for jacking, temporary support and/or blocking. The cost shall be included in the pay item Temporary Support.

No separate payment shall be made for field measurements, furnishing materials, design, installation, removal and ground improvement and restoration and all else necessary for installing and removing temporary supports. All costs are considered incidental to the Temporary Support item.

Payment for Structural Jacking for repair or replacement of existing bearings or for the work to be performed under the items Repair Bearing Area and Reconstruct Bearing Area shall be made in accordance with Subsection 432.05.

Payment for repairs at bearing areas will be made for each bearing area where repairs are constructed, and payment for this item shall specifically exclude any payment for jacking and temporary support. All such jacking and temporary support shall be paid for under item entitled "Temporary Support". At bridge piers where bearings areas at back to back stringers are to be reconstructed and the stringers have individual pedestals, separate payment shall be made for each individual bearing area reconstructed, and for the individual jacking and support of each stringer.

No separate payment will be made for temporary blocking. All work associated with furnishing and installing the temporary blocking shall be included under the specific repair items. For any repair location, not shown on the plan, temporary blocking will be paid under Force Account for Emergency and Routine Repairs as approved or directed by the Engineer.

No additional payment will be made for the design calculations, detailed drawings, shop drawings or work associated with gaining necessary approvals regardless of the temporary support system used.

SECTION 419 - WIRE ROPE

419.01 Description.

This work consists of removal of damaged wire rope and furnishing and installing new 3/4 inch wire rope for lashing pile clusters.

419.02 Materials.

Wire Rope Material shall conform to ASTM A603-98.

419.03 Methods of Construction.

Where called for on the plans, the Contractor shall remove damaged wire rope and install new wire rope as directed by the Engineer.

419.04 Measurement.

Measurement for wire rope will be measured by linear foot.

419.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
WIRE ROPE	LINEAR FOOT

The removal of wire rope will not be paid for.

SECTION 420 - PILE TOP PROTECTION

420.01 Description.

This work consists of the removal of damaged pile top protection, material, furnishing and installing new pile top protection.

420.02 Materials.

Material shall conform to the following subsection:

HARDWARE 910.08

PILE TOP PROTECTION 910.09

PROTECTIVE COATING 910.10

420.03 Methods of Construction.

The damaged timber pile top areas as directed by the Engineer shall be treated in accordance with AWPA Standard M4.

Upon this shall be placed a sheet of 0.032 inch thick copper. The sheet shall be of sufficient size to project at least 4 inches outside of the pile and it shall be bent down, nearly trimmed and securely fastened to the faces of the pile with approved hardware in accordance with Section 910.08. The sheet covering will not be required on the heads of piles which are fully covered by caps, walers or other timber construction.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New Jersey State Department of Environmental Protection (NJDEP).

420.04 Measurement.

Measurement for pile top protection will be measured by the number actually protected as specified.

420.05 Payment.

Payment will be made under:

PAY ITEM ..... PAY UNIT

PILE TOP PROTECTION ..... EACH

SECTION 421 - REPAIR PILE

421.01 Description.

This work consists of saw-cutting and removal of existing damaged timber pile sections and installation of replacement of timber sections as directed by the Engineer.

421.02 Materials.

Materials shall conform to the following subsection.

TIMBER PILES 910.02

HARDWARE 910.08

421.03 Methods of Construction.

The existing damaged sections designated by the Engineer shall be horizontally saw-cut and removed. Pile shall be trimmed, the saw section and trimmed surfaces shall be treated in accordance with AWPA Standard M4 with the addition that at least three coats of preservative shall be applied.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New Jersey State Department of Environmental Protection (NJDEP).

A replacement section shall be installed to conform to the appropriate Subsection of 404.06.

421.04 Measurement.

Measurement for repair pile will be measured by the actual number of piles repaired as specified.

421.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
REPAIR PILE	EACH

SECTION 422 - REMOVE HOLLOW PILE TOP AND VERTICAL WALER TOP

422.01 Description.

The work consists of removal of hollow pile and vertical waler top in accordance with the plans and specifications or as directed by the Engineer.

422.02 Materials.

Materials is defined as hardware as required.

422.03 Methods of Construction.

This work shall include the saw-cutting of hollow pile and vertical waler tops to sound material. The saw cut sections of timber shall be trimmed carefully, then treated in accordance with AWPA Standard M4 with the addition that at least three coats of preservative shall be applied.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New Jersey State Department of Environmental Protection (NJDEP).

Where hardware connections are effected by the removal of the timber, new holes must be drilled to make a new connection in sound material. All existing hardware shall be reused if possible. New hardware shall be used where required, as directed by the Engineer. All work shall be done in accordance with the Plans and Specifications and with the approval of the Engineer.

422.04 Measurement.

Measurement for removing hollow pile top and removing vertical waler top will be measured by the number actually removed as specified.

422.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
REMOVE HOLLOW PILE TOP	EACH
REMOVE HOLLOW PILE TOP AND REFASTEN HARDWARE	EACH
REMOVE HOLLOW VERTICAL WALER TOP	EACH
REMOVE HOLLOW VERTICAL WALER TOP AND REFASTEN HARDWARE	EACH

SECTION 423 - REFASTEN CONNECTIONS

423.01 Description.

This work consists of refastening existing treated timber members to other members in the existing system as directed by the Engineer.

423.02 Materials.

As required.

423.03 Methods of Construction.

The work shall include the re-tightening of all loose existing bolts and lag screws, replacing all missing bolts, lag screws and boat spikes with new hardware as necessary to connect all the members of the existing fender system and restoring certain damaged connections to their original conditions, all as directed by the Engineers.

If existing conditions prohibit the refastening of timber at the present location because the timber is split,

damaged or deteriorated, then new holes can be drilled at a different location to make a new connection in sound material. Existing abandoned holes shall be filled with splash zone coating A788. New scabs, shims, pieces of wales or bracing may be used to make the new connection. All existing hardware shall be reused if possible. New hardware shall be used where required as directed by the Engineer.

423.04 Measurement.

Measurement for refasten connections will be measured by the actual number refastened as prescribed.

423.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
REFASTEN CONNECTION	EACH

SECTION 424 – SEAL TOP SURFACE OF TIMBER

424.01 Description.

Work under this section covers application of sealer to top surfaces of timber fenders to protect them from weather as directed by the Engineer.

424.02 Materials.

Material shall conform to the following:

PROTECTIVE COATING	AWPA STANDARD M4

424.03 Method of Construction.

The existing and new timber top and side surfaces at the elevation of the top waler shall be treated in accordance with AWPA Standard M4 with the addition that at least three coats of preservative shall be applied.

The Contractor shall obtain all necessary permits pertaining to the purchase and field application of wood preservatives from the U.S. Environmental Protection Agency (EPA) and the New Jersey State Department of Environmental Protection (NJDEP).

424.04 Measurement.

Measurement for top surface of timbers will be measured by the number actually coated as specified.

424.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SEAL TOP SURFACE OF TIMBER	SQUARE FOOT

SECTION 425 - NOISE BARRIERS

425.01 Description.

The work includes constructing ground, bridge and retaining wall mounted noise barriers. Ground, bridge and retaining wall noise barriers shall be made of precast concrete. All noise barriers shall consist of posts, panels, purlins, girts, foundations, where applicable, and all other associated members and attachments necessary for fabrication and erection. The Contractor, at its option, may utilize prestressed concrete posts and panels in lieu of the proposed precast posts and panels. However, the design calculations and detailed drawings shall be submitted in accordance with Section 104 of the Standard Specifications, for the Authority's approval. Prestressed posts and panels shall conform to Section 402. Plants shall be certified in accordance with Section 402. Prestressed posts and panels may only be proposed by the Contractor where the proposed noise barrier is protected behind NJTA standard barrier curb.

All the applicable provisions of Divisions 400 and 900 shall apply except as modified herein.

Materials and methods of construction not specifically covered in the Plans and Specifications shall conform to AASHTO LRFD Bridge Design Specifications and AASHTO LRFD Bridge Construction Specifications, ACI

Manual of Concrete Practice, and the PCI Manual 117. The applicable editions and revisions of standards and specifications shall be the editions and revisions that are current at the time of bidding.

425.02 Materials.

Materials shall conform to the following Subsections:

BROKEN STONE 902.02

GRAVEL 902.03

ALUMINUM BOLTS, NUTS, AND WASHERS 911.01

PORTLAND CEMENT CONCRETE 905.05

MORTAR AND GROUT 905.10-15

PREFORMED EXPANSION JOINT FILLER 907.01

JOINT SEALANT 907.02

REINFORCEMENT STEEL IN STRUCTURES (EPOXY COATED) ..... 908.01(B)

DOWELS ..... 908.04(E)

BOLTS AND BOLTING MATERIAL 909.02

STRUCTURAL STEEL 909.01

ADHESIVE ANCHORS ..... 909.02(F)

ZINC COATING ON STEEL 909.11

BEARING PADS, ELASTOMERIC 923.02

Unless required otherwise by Contract documents, concrete for precast noise barrier posts and panels shall be Class P (5,000 psi minimum compressive strength at 28 days), with the posts tinted to match the panels, conforming to Subsection 905.05, and in accordance with the shapes, sizes and connections as detailed on the Plans.

A consistent source of cement, fine aggregate and coarse aggregate shall be used for all precast elements to ensure uniformity of color. Cement of the same brand and coming from the same mill shall be used throughout the entire job to minimize color variation.

Precast concrete noise barrier reinforcement shall be epoxy coated conforming to Paragraph 908.01(B). Prestressing strands, where used, shall not be coated.

Precast concrete shall be integrally colored using an approved concrete coloring system as specified in Section 913.08:

The exact quantity of pigment to be added shall be determined in accordance with the manufacturer's recommendations and shall be based on the preparation, examination, and approval of at least one - 2 foot by 2 foot by 4 inch test panel. The test panel(s) shall be prepared in accordance with Subsection 425.05, Subpart B utilizing the specified integral color to produce one or more 2 foot by 2 foot by 4 inch test panels as required by Contract Documents.

Unless specified otherwise, the integrally tinted test panel(s) shall display a color designated "Cliffside Brown" for approval by the Engineer prior to fabrication of the Prototype Post and Panel Assemblies.

Curing materials and methods of construction for curing integrally colored concrete shall be in accordance with the manufacturer's recommendations if different than as specified herein. The tint used for all the concrete in the posts and panels shall be from the same batch.

If permitted or as directed by the Engineer, a concrete penetrating stain may be used to adjust the tint and color of a new or existing post or panel to match adjacent posts and panels for a particular noise barrier. All penetrating stain shall color match and be compatible with the integrally colored concrete.

Penetrating stain used shall be as specified in Subsection 913.09.

The Contractor shall submit Certificates of Compliance in accordance with Subsection 105.04.

A form release oil, compatible with the integral color and based on the integral color manufacturer's recommendations, shall be used.

The color of grout used for filling holes at recessed inserts shall match the color of precast panels and posts or the surface to which it is applied.

Vertical backing rod for panel joints at posts shall be 3/4 inch diameter closed cell polyethylene cord.

A two square foot sample of the proposed formliner for each type of required finish shall be submitted to the Authority for approval. No panels shall be fabricated prior to receiving approval of the sample formliner.

Formliners shall conform to the details shown on the Plans and be comparable to that supplied by Scott Systems, Inc., Aurora, CO, Ph (303) 341-1400. Formliners for fluted finishes shall be the full height of the panel with no horizontal butt joints.

Lightweight concrete conforming to Subsection 905.09 shall be used for all bridge mounted noise barrier posts and panels as shown on the Plans.

Bearing pads for panels shall be 70 durometer neoprene.

Concrete for cast-in-place foundations shall be Class C.

425.03 Working Drawings.

Working drawings shall be furnished in accordance with Subsection 104.08. Minor variations in details may be permitted subject to approval of the Engineer; however, any major departure from the design shown on the Plans will not be approved. If minor variations are submitted on the working drawings, they shall be clearly noted on the drawings.

Prior to fabrication, the Contractor shall submit complete working drawings and erection plans. Working drawings shall cover each type of unit to be used and shall show exact dimensions and handling details.

Working drawings shall include the width and location of all construction haul roads adjacent to noise barriers being constructed.

Working drawings for bridge and retaining wall noise barriers shall show complete mounting details including the required locations of all threaded inserts. Reinforcement steel patterns in precast panels and in bridge and retaining wall parapets shall be shown on the Shop Drawings to ensure proper installation and to avoid conflicts. Complete plan and elevations shall be included.

Working drawings for post and panel roadway noise barriers shall include the plan and elevation drawings of the barriers. Noise barrier drawings shall clearly show the top and bottom elevations of the wall at each post location as well as indicate all steps, post-hole diameters and depths and proposed ground line at the front and rear face of the noise wall. Reinforcement steel patterns in precast panels shall be shown to ensure proper installation and to avoid conflicts. If post-hole casings are required, they shall also be shown.

Erection details shall be complete in every detail including handling points and anchorage details and shall include erection instructions and sequence of operations. Method(s) of stabilization of post holes prior to placing concrete shall also be included.

425.04 Shop Inspection.

At all times while the work is being performed, the Engineer or the Engineer's representatives shall have free access, for the purpose of inspection, to all parts of the manufacturer's operations that concern the manufacture of the materials ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy the inspector that the material is being furnished in accordance with the Specifications.

425.05 Precast Concrete Noise Barriers.

(A) General.

The fabricator of precast concrete noise barriers shall have a minimum of five years' experience with architectural assemblage of similar products. The fabricator chosen by the Contractor to provide noise barrier components shall be certified by Prestressed Concrete Institute (PCI) or National Precast Concrete Association (NPCA) for manufacturing of precast concrete products. Certification and documentation of experience shall be submitted to the Engineer for approval prior to the commencement of any fabrication work including shop drawing preparation. All precasting operations shall be performed indoors within a controlled environment and from a central batch mixer. A plastic or other temporary structure is acceptable provided it is sturdy enough to endure weather conditions and is able to maintain environmentally controlled conditions. The enclosure shall not be heated by fossil-fueled heaters unless the exhaust fumes are vented to the outside away from the enclosure. Deformed Welded Wire Fabric may be

used as an alternate to reinforcing bars for precast concrete panels. The Welded Wire designation and spacing shall meet the minimum area of steel as determined by design. Deformed welded wire fabric shall not be shipped in rolls but shall be shipped in mats. Mesh sheets shall be overlapped not less than one mesh in width or as required by design, whichever is greater. Overlaps shall be fastened securely at the ends and edges.

(B) PROTOTYPE POSTS AND PANELS.

Prior to the start of normal noise barrier fabrication and prior to the fabrication and construction of the prototype test posts and panels, the concrete precaster shall construct and submit to the Engineer for initial color and finish approval, 1 or more - 2 foot by 2 foot by 4 inch sample panels. The sample panels shall be constructed utilizing the approved noise barrier concrete mix design and all specified color and finish combinations. Each of the specified color and finish combinations shall be included on one side only of each sample panel.

Fabrication of the prototype posts and panels shall not commence until working drawings have been approved by the Engineer. The concrete precaster shall then construct and assemble, at its plant or at a location determined by the Engineer if there is more than one precaster involved with the Project, an acceptable sample noise barrier wall consisting of at least 2 posts and 3 sections of panels of dimensions required by the contract documents. One prototype post to post and full panel height surface area shall be furnished for each type of finish required by the contract documents. If the Contract requires noise barriers on both roadways and one or more bridges, the location and number of prototypes will be per Contract Documents. The assembled noise barrier samples shall show the specified color and all finishes. The wall shall be the same size and configuration as the noise barriers to be used on the Project. These test sections will be used to determine the acceptability of the various surface treatments, color, and quality of construction of both the roadway and residential sides of the noise barrier. Any modifications necessary to the drawings or the prototype shall be provided at no additional cost to the Authority.

Integrally colored posts and panels shall be uniform in color consistency and free from discoloration and blemishes. The Contractor shall be responsible for maintaining uniformity of color of all posts and panels. Posts and panels which, in the opinion of the Engineer, are not uniform in color shall be replaced or corrected to the satisfaction of the Engineer or replaced at no additional cost to the Authority.

The Engineer shall be notified in writing, at least 14 days prior to the construction of the sample noise barrier wall so that the Engineer or appropriate Authority representatives may be present to inspect and determine the acceptability of the finished prototype posts and panels. Inspection will take place no later than sixty (60) calendar days after the date of award of the contract.

The Engineer, in conjunction with Authority personnel, will determine whether the color and various surface treatments of the posts and panels are acceptable. If prototype test sections are found to be unacceptable, the concrete precaster shall make additional samples until an acceptable product is produced at no additional cost to the Authority.

After approval and acceptance by the Authority the prototype shall be left at the Contractor's plant to become the standard of comparison for all future post and panel components to be fabricated in connection with the Contract.

The prototype posts and panels may be used on the Project at the end of precasting operations when approved by the Engineer.

The Contractor may use the sample noise barrier, which was previously submitted for color and texture approval, for the application and approval of the concrete penetrating stain. Final approval of all color and surface features on the sample noise barrier must be received prior to the application of the stain on the sample noise barrier.

(C) CONCRETE PLACEMENT.

Concrete shall be deposited only in the presence of the Inspector and by methods approved by the Engineer. All reinforcement shall be free of dirt, loose rust, grease, and other deleterious substances. All items to be encased in the concrete shall be accurately placed in the position shown on the Plans and firmly held during the placing and setting of the concrete.

Concrete shall be vibrated internally or externally, or both, as required.

The type, number, and method of application of vibrators shall be approved by the Engineer. Internal vibrations shall be applied to the concrete for time intervals of approximately ten seconds and at points not more than 18 inches apart. Vibrators shall not be used to move concrete horizontally in the form. The

vibrating shall not displace any reinforcement inserts.

Form liners, where required, shall not leak at the joints and seams must be fused according to the manufacturer's recommendations. No unfused seams will be permitted. The placement of seams will be subject to the approval of the Engineer. Form liner seams shall be placed so that the architectural finish will be unbroken and continuous.

Precast concrete posts and panels shall be free of honeycombing or voids and shall be true to size and dimensions within the following limits:

(1) Casting Tolerances.

(Overall height and width measured at the face adjacent to the mold when cast):

10 feet or under	+/- 1/8 inch
Over 10 feet	+ 1/8 inch, - 3/16 inch
Thickness	+/- 1/8 inch
Out of square	1/4 inch along diagonals

(2) After Casting Tolerances.

Bowing and warping: 1/360 panel dimension with a maximum of 3/4 inch; differential bowing or camber between adjacent members of the same design shall not exceed 3/8 inch.

(3) Position Of Cast-In Items.

Recessed handling inserts	+/- 3/8 inch
Reinforcement	+/- 1/2 inch
Threaded inserts	+/- 1/4 inch
Out-of-square	+/- 1/8 inch

(D) FINISHING CONCRETE SURFACES.

The caps of all exposed surfaces of the concrete posts and the top concrete panels shall receive an ordinary surface finish conforming to Subsection 401.17 unless required otherwise by the Plans or Supplemental Specifications. Unless required otherwise by Supplemental Specifications or if matching the existing adjacent surfaces is not required, the remainder of the exposed surfaces of the posts and panels shall be formed using the form liner type or types as required to produce the following finishes:

Residential Side of Posts	Ordinary Surface Finish
Roadway Side of Posts	Broom Finish
Residential Side of Panels	Raked Finish
Roadway Side of Panels	Non-Absorptive Fluted Finish

All finishes for concrete surfaces initially specified on the Plans or in the Supplemental Specifications will need final approval by the Engineer. The minimum concrete over the rebars shall be maintained. Prior to commencing with panel production, the required finishes will be evaluated and approved according to the Specifications and as directed by the Engineer.

(E) CONCRETE CURING.

Curing of the precast units shall be done using the more stringent of the tinting manufacturer's recommendations, NPCA Standards or any of the methods specified in Division 3, Section 4 of the PCI Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products. The curing method to be used shall be submitted in writing for approval prior to the start of fabrication. If steam is used, Subsection 3.4.2 of the PCI Manual is amended as follows:

(1) The applications of steam within the enclosure shall be delayed for a period of five to six hours when the air temperature is 50°F or lower and shall be delayed for a period of three hours when the air temperature is 50°F or higher.

(2) If retarders are used, the waiting period shall be from four to six hours regardless of the air temperature.

(3) The curing temperature shall be maintained at 143+15°F for a period of 12 hours.

Two concrete test cylinders, similarly cured, shall be tested after the curing procedure specified. Should the tests indicate that the precast units have not achieved a compressive strength of 5,000 psi, the precast units shall be cured further until the required strength is reached.

Forms may be removed after the precast units have achieved a compressive strength of 3,000 psi.

Samples for strength tests for determination of form stripping and 28 day compressive strength shall be taken for every 50 cubic yards of concrete produced. Strength shall be determined using cylinder compressive strengths. Cylinder strength tests shall be performed at the expense of the Contractor by an independent test laboratory approved by the Authority. Results of such tests, as well as records of weather conditions and other pertinent information, shall be recorded. Test results shall be approved by the Authority in addition to any additional acceptances required for the approval of the panels and posts.

The acceptance or failure of the concrete shall be determined in accordance with Subsection 401.16 and as specified herein. The Engineer may use testing results obtained from concrete cores or nondestructive testing before requiring any corrective action or removal and replacement of the concrete.

(F) STAINING CONCRETE SURFACES.

Where permitted or as directed by the Engineer, the color of precast concrete noise barriers may be adjusted by the application of a concrete penetrating stain to correct unacceptable coloring of tinted concrete for both new and existing noise barriers. The concrete penetrating stain shall be a water based material which carries its color and water repellent protection into the concrete.

The color of the concrete penetrating stain shall match the approved noise barrier test panels that have been precast utilizing an integral color.

The concrete penetrating stain shall comply with New Jersey state laws regulating the use of volatile organic compounds and solvents and the following:

(1) Test Staining.

Prior to any staining operations, the Contractor shall complete a test staining program for color acceptance and surface area coverage. This work shall be performed either at the concrete precaster's plant on the sound barrier prototype wall or at the Project site on a portion of an erected sound barrier under the same circumstances as the actual staining. One complete sound barrier section, including posts, shall be stained.

Prior to ordering, a sample shall be submitted for approval of the concrete stain and color. Accompanying the sample shall be the manufacturer's literature which shall include materials specifications, physical properties, including ASTM test methods utilized, manufacturer's recommended application rates for the various surface textures and porosity, current application instructions, and material safety data sheets.

The Contractor shall apply the stain according to the manufacturer's recommendations. The stain test sample must be approved by the Engineer and the Authority prior to actual staining operations and the ordering of any further quantities of stain. When approved, the sample area shall serve as a standard of acceptance for all further work.

A standard for color shall be established based on the approval of the full size noise barrier staining. A stain batch (with sealer if required) shall be designated by batch number and date and will remain the standard for the entire Project.

The final color and form liner finish shall match that of the adjacent existing noise barrier components unless specified otherwise.

(2) Application Procedures.

The concrete penetrating stain shall be applied in strict accordance with the manufacturer's written instructions and precautions. Manufacturer's instructions shall prevail if conflicting with specifications herein. Surfaces to receive the concrete penetrating stain shall be structurally sound, fully cured, clean, dry, and free from dust, curing agents, oil, grease, efflorescence, and any other contaminants that could prevent proper adhesion. If necessary, the surfaces to be stained shall be pressure washed until all surface contamination has been completely removed. In addition, glazed or glossy surfaces must be

chemically or mechanically abraded to remove gloss to allow adhesion.

Prior to use, the stain shall be thoroughly mixed using the appropriate mechanical means and shall be mixed during spraying operations as required by the manufacturer to maintain uniformity.

All concrete stain and sealer is to be of the same batch and lot. The material shall be delivered to the spraying site in original, sealed 5 gallon or 30 gallon approved containers or open head 55 gallon drums, clearly labeled with the manufacturer's name, brand name, type of material, batch and lot numbers, date of manufacture, and color.

At the time of stain application, both the concrete and air temperatures must be between 42 and 90ºF. The concrete shall be completely dry. Stain shall not be applied unless weather conditions permit complete drying of material prior to rain, fog, dew, or temperatures beyond the prescribed limits.

The concrete penetrating stain shall be spray-applied. The stain shall be applied in thin coats. The rate of application shall be in accordance with the manufacturer's recommendations. The area of coverage may vary depending on absorption rates of the various surface materials and textures to obtain complete coverage.

The completed stain surfaces shall be consistent with the quality and appearance of the approved sample area. If unevenness in color and lines of work termination exist, the Engineer may have all such surfaces re-sprayed by the Contractor. Re-spraying, if required, shall be carried to a natural break-off point.

Stain may be brushed or roller applied only at locations where over-spray would affect adjacent materials and where not practical for spray application. Adequate protection shall be provided to protect adjacent persons, vehicles, and property from over spray during staining operations.

(G) Storage And Transportation.

After curing, the units shall be stored, stacked, and transported in a manner to prevent the development of cracks or other deformities.

The top side of all precast concrete units shall be marked for identification and proper placement on the erection drawings. In addition, the length, size, and type of reinforcement shall be marked on the unit.

425.06 Foundations.

(A) Post Holes.

Post holes for noise barriers shall be constructed by drilling or augering as shown on the Plans or as otherwise approved. Excavation of post holes shall not start until final earth grading has been completed along the proposed alignment of the noise barrier for a distance of at least five panels in each direction. Prior to post hole excavation, the Contractor shall verify the location of any existing utility conduits by making use of the State's One Call System as specified in Subsection 106.18. Additionally, prior to any excavation, the Contractor shall contact G4S Technology for a markout of any fiberoptic lines that may exist within the project limits. If an existing utility conduit is encountered during the construction of post holes, the Authority shall be contacted. The conduit may be relocated or the post may be relocated by the Contractor as directed by the Engineer. Any damage done to existing utility lines shall be repaired by the Contractor.

The actual location of any post hole shall not vary from the specified location of the axial center of the post embedded in that hole by more than one (1) inch in any direction. The actual diameter of the hole constructed may be larger at no additional cost to the Authority, but may not be more than a one (1) inch smaller than the nominal diameter indicated on the Plans.

If borings in the general vicinity of the noise barriers indicate conditions which may impede the advance of drilling or augering equipment, other suitable equipment and procedures may be required to construct the post holes at the locations and to the depth specified.

If rock is encountered, the Contractor shall continue the hole to the required depth with machine augers, or other suitable tools as approved by the Engineer, at no additional expense to the Authority

The Contractor shall be responsible to take all measures and precautions necessary to prevent disturbance to the surrounding soil or the collapse of the post-hole sides. Where soil surrounding the hole is disturbed as a result of the Contractor's operations, all such disturbed soil shall be removed, as directed by the Engineer, and replaced with earth embankment which shall be compacted in accordance with Subsection 203.03 at no cost to the Authority.

The post-hole concrete shall be poured against undisturbed earth or smooth wall permanent metal casing installed in such a manner that the outside of the permanent casing bears against minimally disturbed earth. A temporary steel casing may be used to keep the post hole open prior to placing concrete. The holes shall be free of all loose earth, broken rocks, cobbles, boulders, remnants of abandoned structures, utilities, and other debris and materials.

In the event ground water is encountered, the Contractor shall submit a detailed foundation construction method for the Engineer's approval prior to commencing construction. Where it is impractical to completely dewater the drilled or augered hole for concrete placement, the Contractor may use tremie concrete placement methods subject to the Engineer's approval.

A minimum six (6) inch layer of crushed stone shall be placed at the specified bottom of the hole following the completion of the excavation. The material on which the crushed stone is placed shall be firm and shaped to an even surface. The stone bed shall be compacted by means of approved flat-faced tampers or by other means approved by the Engineer.

Where soft unsuitable material, organic or inorganic, is encountered and determined to be unsuitable by the Engineer, the post hole shall be excavated as directed by the Engineer. The additional excavation shall be backfilled with crushed stone. The unsuitable material shall be disposed of in accordance with Paragraph 202.03(B).

(B) Voids.

The Contractor shall check for voids around the installed permanent metal casings, and if deemed necessary by the Engineer, any permanent metal casing that has been installed such that a void exists around the casing or the soil has been excessively disturbed, shall have the void repaired by one of the following methods:

(1) The voids shall be grouted. Grout shall conform to Section 905 except that it shall have a 1:3 (cement to fine aggregate) ratio and the nonmetallic grout provisions shall not apply. Grout shall be applied at a pressure equal to one-half of the overburden pressure at the bottom of the casing.

(2) The voids shall be backfilled with pneumatically applied sand thoroughly tamped into place.

(3) The voids shall be backfilled with soil excavated from the hole. The backfill shall be in 8 inch loose lifts and compacted by the density control method as provided for in Section 203.

The remedial method shall be as specified by the Engineer and shall depend upon the extent of the voids or the disturbance. Should one of the remedial methods listed above be used, corrugated metal casing can be substituted for smooth wall metal casing.

(C) Metal Casings.

Permanent metal casings shall be steel or aluminum. Steel casing shall be zinc-coated.

425.07 Erection.

(A) Precast Concrete Panels And Posts.

Precast units shall be installed according to the approved erection schedule, the approved shop and erection drawings, as shown on the plans or as directed by the Engineer. The units shall be erected in a manner to prevent excessive bending about either axis. Precast concrete panels shall be set with the face of the panel plumb and the top of the panel level. Special care shall be taken in setting the bottom panel in an exact horizontal position. The faces of adjacent units shall be flush within a tolerance of plus or minus 1/16 inch.

Precast structural members shall be handled carefully at all times so that no overstressing, crazing, chipping, or cracking of the concrete occurs. The post, panel, and other components shall be analyzed by the Contractor to reflect the actual method of construction to be used. The analysis shall be performed to verify that no adverse conditions to any components, as stated above, occur. If required from the analysis, temporary strengthening for the various components may be required and shall be provided by the Contractor. Damaged panels shall not be patched, but rather replaced with new panels. Damaged materials occurring as a result of Contractor negligence as determined by the Engineer shall be replaced at no additional cost to the Authority. Handling and erection of the panel units and posts shall be performed using suitable equipment. After the precast panels are erected, all lifting hook holes shall be filled with grout. The grout shall be stained to match the color of the panels.

(1) Ground Mounted Posts.

Ground mounted precast posts shall be set plumb, unless otherwise shown on the Plans, and set in the holes and secured in place in a precise position to accept the panels. The precast posts shall be set into the holes a minimum of six (6) inches above the layer of crushed stone. After setting and securing the precast posts, the Contractor shall embed each precast post in Class C concrete to a depth as shown on the Plans and in such a manner that the specified fixed positions of the noise barrier elements are achieved within the following tolerances:

(a) The plan position of the embedded posts shall not vary more than 1/2 inch in any horizontal direct from the theoretically symmetrical and interlocking positions with the panels to be inserted as shown on the Plans. Vertical posts shall not be out-of-plumb more than ½ inch.

(b) The vertical position of the embedded posts shall not vary more than 1/2 inch from the position shown on the Plans.

(c) The panel seat area shall be constructed such that the top of the panel is level and within 1/4 inch of the elevation shown on the Plans.

The panel units shall not be erected before the foundation concrete has reached the specified 28-day compressive strength. Care shall be taken to prevent foundation concrete from staining the precast posts. Any visible foundation concrete splashed onto the posts shall be removed.

(2) Installing Precast Panels.

Precast panels shall be lowered into the posts as shown. The top side of the bottom panel shall be leveled. Each succeeding panel shall be engaged to the panel below by means of a polyethylene rod inserted horizontally in the grooves cast in the panels. The Contractor shall ensure that the panels are level and the roadway faces of the panels are aligned. Install the vertical backer rods on each side of the panels at the post and caulk the balance of the joint with sealant in color to match the adjacent surfaces.

In addition to the tolerances for the holes and posts, the erection tolerance for the joint dimensions shall be as follows:

Nominal joint width of 1/4 inch: To vary not more than plus 1/4 inch or minus 1/8 inch.

Where difficulties of inserting and securing panels or the construction of concrete barrier curbs arise as a result of the Contractor's performance or delivery of faulty product sizes, the Contractor shall make all corrective adjustment, repairs or replacements as approved by the Engineer at no cost to the Authority. Such corrective actions shall not impair the structural integrity or the architectural requirements of the noise barrier.

Precast concrete noise barriers shall not permit the passage of light after they are erected.

If recessed handling inserts are used they shall be the Contractor's option and responsibility and shall be galvanized in accordance with ASTM A153.

(3) Concrete Barrier Curb.

For ground mounted noise barriers with concrete barrier curb in front, preformed expansion joint filler shall be attached to the face of the noise barrier panels and the surfaces of the posts shall be coated with a bond breaker. Immediately after finishing the concrete, the joint between the concrete barrier curb and the panel shall be filled with grout and then sealed with cold-applied joint sealer.

(4) Bridge or Retaining Wall Mounted Posts.

Provide anchor bolts, nuts, washers and bearing pads, all as detailed on the Plans and as required to secure the posts to the barrier parapet. All pipe inserts, bolts, nuts and washers shall be galvanized steel in accordance with AASHTO M232 (ASTM A153), and where welding is called for, galvanizing shall be after welding.

Recesses in posts provided for bolt heads and nuts shall be filled with epoxy grout in color to match the posts and the barrier parapet.

(B) ANTI-GRAFFITI PROTECTION.

The Contractor shall be responsible for maintaining the noise barrier free of graffiti until the project has been accepted by the Authority. Any graffiti on the noise barriers prior to acceptance shall be removed by

the Contractor to the approval of the Engineer, or the element shall be replaced, with no additional cost to the Authority.

425.08 Measurement.

Posts of the various types will be measured by the linear foot furnished and installed.

Panels of the various types will be measured by the square foot of panel furnished and installed, including portions below the proposed front face groundline, as shown on the Plans.

Removal of unsuitable material as directed by the Engineer will not be measured for payment.

Additional crushed stone used to replace unsuitable material, as directed by the Engineer, will be measured for payment by the cubic yard of crushed stone actually placed. Only that quantity of crushed stone used to replace unsuitable material excavated will be measured for payment.

Noise Barrier Foundation will be measured by the linear foot for the depth of the drilled or augured shaft as shown on the Plans or directed by the Engineer.

Foundation concrete, casing and tremie concrete, if used, will not be measured for payment, however payment adjustments for foundation concrete will be made in accordance with Subsection 905.23.

The cost of the prototype post and panel assembly shall be considered incidental and included in the various items included in Section 425.

Concrete penetrating stain will not be measured for payment.

425.09 Payment.

PAY ITEM	*PAY UNIT*
GROUND MOUNTED NOISE BARRIER PANEL, TYPE____	SQUARE FOOT
GROUND MOUNTED POST, TYPE _____	LINEAR FOOT
GROUND MOUNTED END POST, TYPE _____	LINEAR FOOT
BRIDGE MOUNTED NOISE BARRIER PANEL, TYPE____	SQUARE FOOT
BRIDGE MOUNTED POST, TYPE _____	LINEAR FOOT
BRIDGE MOUNTED END POST, TYPE _____	LINEAR FOOT
RETAINING WALL MOUNTED NOISE BARRIER PANEL, TYPE____	SQUARE FOOT
RETAINING WALL MOUNTED POST, TYPE _____	LINEAR FOOT
RETAINING WALL MOUNTED END POST, TYPE _____	LINEAR FOOT
ADDITIONAL CRUSHED STONE	CUBIC YARD
NOISE BARRIER FOUNDATION	LINEAR FOOT

Payment of precast concrete posts and panels shall include the cost of fabrication, storage, delivery, handling and installation.

Separate payment will not be made for any remedial work required to complete the noise barriers, including replacement of unacceptable test posts and panels, for re-staining of panels and posts due to unevenness in color and lines of work termination, for relocation of utility conduits or noise barrier posts due to interference with post hole construction, and repair of utility conduits damaged during post hole construction, for replacement or remediation of disturbed soils adjacent to post holes as a result of the Contractor's operations; and for temporary strengthening of the various precast structural components as may be required from the Contractor's analysis of adverse conditions that may occur during handling.

No separate payment will be made for reinforcement, form liner or other finishing requirements, integral pigment coloring, 2' x 2' test panels, use of any sealer applied over the stain, any barrier curb joint materials, neoprene pads or anchor bolts. All costs thereof shall be included in the applicable item for Noise Barrier Panels and Posts.

No separate payment will be made the application of the concrete penetrating stain. All associated costs thereof shall be included in the items for Noise Barrier Panels and Posts.

No separate payment will be made for cleaning, pressure washing or any other preparation required prior to

application of the penetrating concrete stain. All costs thereof shall be included in the applicable item for Noise Barrier Panels.

No separate payment will be made for excavation, dewatering, sediment filtration devices, reinforcement, crushed stone and concrete in the foundations. All associated costs thereof shall be included in the item for Noise Barrier Foundation.

No separate payment will be made for any required graffiti removal taken prior to erection and acceptance of the noise barrier wall materials.

Payment adjustments for strength and durability of the foundation caisson concrete used to support the noise barrier posts will be made in accordance with the specified Performance Criteria Category within Table 2 of Subsection 905.23.

The cost for the disposal of unsuitable material, as directed by the Engineer, shall be included in the pay item Additional Crushed Stone.

SECTION 426 - MECHANICALLY STABILIZED EARTH (MSE) WALLS

426.01 Description.

This work shall include the design and construction of Mechanically Stabilized Earth (MSE) wall structures composed of precast concrete facing panels, cast-in-place and/or precast parapets, m oment slabs, copings, concrete leveling pads, soil reinforcement elements, joint materials, fasteners, Select Backfill, and all other appurtenant items of construction within the Common Structure Volume (CSV) as shown on the Plans, included as part of the selected MSE Wall System, or as specified herein.

This work shall also include MSE wall structures constructed in two-stages at specified locations. The primary stage shall consist of soil reinforcement elements and Select Backfill with a flexible facing which consists of welded wire and geosynthetics. The secondary stage shall consist of precast concrete facing panels and all other appurtenances as shown on the Plans. The sequence of construction shall be as shown on the Plans.

Design and construction of MSE walls shall be in accordance with the current editions of the AASHTO LRFD Bridge Design and Construction Specifications with Interims, except as noted otherwise herein. The design shall be in accordance with the current NJTA Design Manual, and shall be signed and sealed by an engineer licensed in the State of New Jersey.

All labor, materials, equipment, and tools required to prepare the site, construct the leveling pad, construct the wall, place and compact the Select Backfill, and construct the coping and traffic barrier shall be supplied by the Contractor.

The following are defined for the allocation of responsibilities as described herein:

"Engineer" shall be defined in paragraph 101.02B.

"Engineer of Record" shall be defined as the Professional Engineer licensed in NJ, responsible for the preparation of the Contract Documents.

"Wall Manufacturer" shall be defined as the MSE wall supplier/vendor and shall also include a Professional Engineer licensed in NJ, responsible for the preparation of the Working Drawings and calculations associated with the MSE Wall.

426.02 Materials.

Materials shall conform to the current editions of AASHTO LRFD Bridge Design and Construction Specifications with Interims, modifications herein and the provisions of the wall system selected for construction in the contract.

The Wall Manufacturer shall determine corrosion protection in accordance with site specific conditions and current AASHTO LRFD Bridge Design Specifications, considering the potential for aggressive conditions including tidal, flood, ground water or stray electrical currents.

Where aggressive conditions are encountered, the use of soil reinforcements fabricated from stainless steel Grade 316L may be considered provided all connections are composed of like metals. In such a case, minimum corrosion rates shall be submitted by the Wall Manufacturer for review and approval at the sole discretion of the Engineer of Record and final concurrence of the Authority.

The Wall Manufacturer shall make recommendations regarding the corrosion rates that shall provide the required 75 or 100 year service life. Galvanization shall be considered an acceptable form of metallic protection

if in accordance with AASHTO LRFD Bridge Design Specifications. Aluminized and epoxy type coatings shall not be considered as an acceptable form of corrosion protection and shall not be approved for use.

The use of Geosynthetic Reinforcing will only be allowed where specified on the plans.

If geosynthetic reinforcement is connected to wall panels with metallic connection components, both the geosynthetic and metallic materials must be evaluated for electrochemical conditions of their respective material types and the Select Backfill material must satisfy the requirements of both 925.03 and 925.05 to ensure electrochemical compatibility.

Select Backfill conforming to the requirements herein shall be used within the CSV as shown on the Plans and specified in Subsection 925.03 and/or 925.04 and may be procured from off-site sources or from on-site borrow excavation.

Except as may be modified within this Section, all applicable provisions of Sections 400 and 900 shall apply in furnishing MSE Wall Systems.

Bearing pads shall conform to the requirements of the Wall Manufacturer.

(A) MSE WALL SYSTEMS.

The following MSE Wall Systems are permissible for use in this Contract:

(1) Earth Tec Retaining Wall System

EarthTec, Inc.
413 Browning Court
Purcellville, VA 20132
703-771-7305

The Reinforced Earth Company
12001 Sunrise Valley Drive, Ste 400
Reston, VA 20191
Tel: 800-446-5700

(2) SINE WALL MSE Panel System

SINE WALL, LLC
1788 Heritage Center Drive
Suite 202
Wake Forest, NC 27587
(919) 453-2011

SSL MSE Plus Retaining Wall System as manufactured by SSL
4740 Scotts Valley Drive, Suite E
Scotts Valley, CA 95066
831-430-9300

(3) Tricon Retained Soil Wall System

Tricon Precast, Ltd.
15505 Henry Rd.
Houston, Tx 77060
877-387-4266

The Contractor shall make their own arrangements to purchase the materials and services from one of the manufacturers of the permissible MSE Wall Systems listed above. Selection of only one (1) type and material of soil reinforcing element and connection element will be permitted per wall. No more than two (2) Wall Manufacturers will be permitted for use on the Contract.

An on-site technical representative from the selected Wall Manufacturer shall be present to assist and instruct during the installation of the first two-panel courses of the first wall in the contract, as a minimum.

(B) MISCELLANEOUS

Materials not noted above shall conform to the following subsections:

CONCRETE 905.05

STEEL REINFORCING ELEMENTS 925.01

GEOSYNTHETIC REINFORCING ELEMENTS.....925.02

SELECT BACKFILL FOR MSE WALLS WITH STEEL REINFORCING ELEMENTS 925.03

SELECT BACKFILL FOR MSE WALLS WITH GEOSYNTHETIC REINFORCING ELEMENTS .925.04

HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE LINER SYSTEM 925.05

CLASS 2 GEOTEXTILE FABRIC 925.06

FILTER FABRIC 923.21

Precast concrete facing panels shall be Class P.

426.03 Methods Of Construction.

(A) GENERAL.

Methods of construction shall conform to the current editions of AASHTO LRFD Bridge Design Specifications with Interims and AASHTO LRFD Bridge Construction Specifications with Interims, modifications herein and the provisions of the permitted wall system selected for construction in the contract.

(1) Clearing, grubbing, and excavation shall be performed in accordance with Division 200, and as required by the Plans. If poor subgrade conditions are encountered in the opinion of the Engineer, the Engineer of Record shall be notified prior to the continuation of wall construction.

(2) Each shipment shall be clearly marked with the Wall Manufacturer's name and batch identification. The Contractor shall provide an on-site storage area from time of delivery until installation. The Contractor shall protect reinforcing elements from dirt, water and other sources of damage. Reinforcing elements shall be protected from cutting, distortion, or other damaging conditions during loading, transportation and unloading at the site.

(3) Leveling pads shall be surveyed following installation prior to setting the first course of panels, and the results shall be submitted to the Engineer.

(4) Reinforced wall fill placement shall closely follow erection of each course of facing panels. Select Backfill shall be placed in such a manner to avoid damage or disturbance of the wall materials, misalignment of facing panels, or damage to soil reinforcement or facing members. The Contractor shall place backfill to the level of the connection and in such a manner as to ensure that no voids exist directly beneath reinforcing elements.

(5) Select Backfill shall be compacted to a minimum of 95% of the maximum dry density as determined by AASHTO T99 (Standard Proctor) or greater if specified by the Wall Manufacturer. The in-place compacted dry density of the Select Backfill shall be tested in accordance with AASHTO T310 Method B. In-place field density testing should be performed every 500 feet linearly after each succession of placement of lifts totaling 3 feet vertically. If the wall is less than 500 feet long, a minimum of two locations shall be tested per wall after each succession of placement of lifts totaling 3 feet vertically. Additional testing may be performed if deemed necessary by the Engineer. If greater than 50 percent of Select Backfill is retained on the ¾" sieve, laboratory Standard Proctor (AASHTO T99) and field density testing (AASHTO T310) is not required, and satisfactory compaction shall be considered less than 0.25" of displacement during the last pass of the compacting equipment, provided the lift thickness requirements specified herein are satisfied. The optimum Select Backfill moisture content to achieve minimum required compacted soil density shall be as determined by AASHTO T99.

The specified compaction of the Select Backfill shall be accomplished by use of large, smooth drum, vibratory rollers with the exception of the 5 foot zone directly behind the facing panels.

Within the 5 foot zone directly behind the facing panels, small, single or double drum, hand operated, walk-behind vibratory rollers, or walk-behind vibrating plate compactors shall be used, and at least three passes shall be made.

The compaction equipment shall be capable of providing uniform density throughout the depth of the layer of the Select Backfill being compacted with no disturbance to the vertical or horizontal alignment of the previously placed panels.

If there is evidence of wall displacement or disturbance, compaction shall be stopped and an alternate method shall be implemented, which does not impact the wall.

Select Backfill material that is composed primarily of gravel with less than 40 percent passing the ¾

inch sieve shall be encapsulated in a Class 2 Geotextile Fabric, as defined in Subsection 925.06, to within 3 feet below the wall coping. Adjoining sections of geotextile fabric shall be overlapped by a minimum of 12 inches.

(6) At MSE walls locations where post construction settlement is expected but no ground improvement is specified, placement of the pavement box, barrier parapet, coping, moment slab or approach slab shall not begin until the rate of settlement has sufficiently diminished and the anticipated additional post construction settlement is less than one inch. The Engineer will evaluate the actual settlement based on field instrumentation data to verify the diminished rate of settlement and the projected settlement remaining. The Engineer will be the sole judge to determine that the rate of settlement is below the required threshold and that the anticipated additional post construction settlement is less than one inch. Construction of the pavement box shall only be performed upon written authorization from the Engineer.

At two-stage MSE walls, placement of second stage shall not begin until the rate of settlement has sufficiently diminished and the anticipated additional post construction settlement is less than one inch. The Engineer will evaluate the actual settlement based on field instrumentation data to verify the diminished rate of settlement and the projected settlement remaining. The Engineer will be the sole judge to determine that the rate of settlement is below the required threshold and that the anticipated additional post construction settlement is less than one inch. Construction of the second stage shall only be performed upon written authorization from the Engineer.

For one or two stage MSE walls, ensure that the wall coping system will accommodate any construction or post construction settlement, without requiring cutting of the precast panels or units. The uppermost soil reinforcing element shall be located so as to not interfere with the coping and/or moment slab after a minimum anticipated settlement of 1 inch has taken place.

(7) Wall materials damaged during backfill placement shall be removed and replaced by the Contractor, at no additional cost to the Authority. The Contractor may submit alternative corrective procedures to the Engineer for consideration. Proposed alternative corrective procedures shall have the concurrence of the Wall Manufacturer and Engineer of Record, in writing, prior to the acceptance by the Engineer.

(B) CONSTRUCTION METHODS SPECIFIC TO STEEL REINFORCED MSE WALLS.

Soil reinforcement shall be uniformly tensioned to remove any slack in the material or in the connections to the facing panels. Where an individual soil reinforcement element has multiple connections to a facing panel, a minimum of two connections per layer per panel shall be in full contact upon tensioning the element, with maximum gaps of 1/16 inch at remaining connections.

Repairing scratches or other imperfections in corrosion protection on steel reinforcing elements shall be performed in accordance with Section 925 and the manufacturer's recommendations.

Select Backfill shall be spread by moving the machinery parallel to or away from the wall facing and in such a manner that the steel reinforcement remains normal to the face of the wall or at the specified angle. Construction equipment shall not operate directly on the reinforcement. A minimum fill thickness of three (3) inches over the steel reinforcement shall be required prior to operation of vehicles. Sudden braking and sharp turning shall be avoided.

(C) CONSTRUCTION METHODS SPECIFIC TO GEOSYNTHETIC REINFORCED MSE WALLS.

Geosynthetic reinforcement shall not be unwrapped until just before installation. Geosynthetic reinforcement shall not be left exposed for more than 1 day before covering, except when installed for erosion control devices, two stage walls and interior staged MSE wall faces where exposed in-place geotextile is planned.

Geosynthetic reinforcement shall be stored in conditions above 20ºF and not greater than 140ºF. Geosynthetic reinforcement shall be covered and protected from sunlight prior to placement in the wall system.

Geosynthetic Reinforcement shall be held in place with wire staples or anchor pins to remain taught while placing Select Backfill. Steel anchor pins with a diameter of at least 3/16" and a length of at least 18" with a point at one end and a head at the other end that will retain a steel washer with an outside diameter of at least 1.5" or as per manufacturer's recommendations shall be used.

Geosynthetic Reinforcement shall be installed in accordance with the manufacturer's site-specific wall erection instructions. Geosynthetic Reinforcement shall be placed in continuous longitudinal rolls in the direction of the main reinforcement. Joints parallel to the wall shall not be permitted.

Geosynthetic Reinforcement coverage shall be 100 percent of embedment area unless otherwise shown in the Working Drawings or otherwise approved by the Engineer. Adjacent sections of Geosynthetic Reinforcement need not be overlapped, except when exposed in a wrap-around face system, at which time the reinforcement rolls shall be overlapped or mechanically connected per the manufacturer's requirements.

During construction, the surface of the fill shall be kept horizontal. Geosynthetic Reinforcement shall be placed directly on the compacted horizontal fill surface. The reinforcement shall bear uniformly on the compacted reinforced soil from the connection to the wall to the free end of the reinforcing elements. The reinforcement placement elevation shall be at the connection elevation to two (2) inches higher than the connection elevation.

The Select Backfill shall be spread by moving the machinery parallel to or away from the wall facing and in such a manner that the Geosynthetic Reinforcement remains taut. Construction equipment shall not operate directly on the Geosynthetic Reinforcement. A minimum fill thickness of six (6) inches over the Geosynthetic Reinforcement shall be required prior to operation of vehicles. Sudden braking and sharp turning shall be avoided.

(D) PRECAST PANEL UNIT PRODUCTION/TOLERANCES .

(1) All units shall be manufactured within the following tolerances:

(a) All dimensions shall be within 1/4 inch.

(b) Location of panel connection devices shall be within 1 inch.

(c) Squareness as determined by the difference between the two diagonals shall not exceed 1/2 inch

(d) Surface defects on smooth and textured formed surfaces measured over a length of 5 feet shall not exceed 1/4 inch and 5/16 inch, respectively.

(2) Units shall be rejected because of failure to meet any of the requirements specified above. In addition, any or all of the following defects, as assessed by the Engineer shall be sufficient cause for rejection:

(a) Defects that indicate imperfect molding.

(b) Defects indicating honeycombed or open texture concrete.

(c) Defects in the physical characteristics of the concrete units, such as:

(1) Stained front face due to excess form oil or other reasons.

(2) Signs of aggregate segregation.

(3) Broken or cracked corners.

(4) Tie strips bent or damaged.

(5) Lifting inserts not usable.

(6) Exposed reinforcing steel.

(7) Cracks at the PVC pipe or pin.

(8) Insufficient concrete compressive strength.

(9) Deviation from flatness of exposed surface in excess of 1/8 inch per 5 feet

An additional inspection shall be made prior to erection to determine any damage which may have occurred during storage.

The Engineer will determine whether spalled, honeycombed, chipped, or otherwise defective concrete shall be repaired or be rejected. Repair of concrete, if allowed, shall be done in a manner satisfactory to the Engineer at no additional cost to the Authority.

Repair to concrete surfaces which will be exposed to view after completion or construction shall be approved by the Engineer.

(E) WALL CONSTRUCTION/TOLERANCES.

Finished MSE walls shall be erected within the following tolerances:

(1) The overall vertical alignment tolerance, or plumbness, from top to bottom of the structure, shall not

exceed 1/2 inch per 10 foot of wall height.

(2) Deviation from horizontal alignment shall not exceed ¾ inch.

(3) Vertical and horizontal alignment tolerance, or plumbness, shall not exceed ¾ inch when measured with a 10 foot straight edge on a selected wall section.

(4) The maximum allowable offset between any two panels shall not exceed ¾ inch.

(F) High Density Polyethylene (HDPE) Geomembrane Construction.

Where a MSE wall is constructed supporting a roadway that will be subjected to chemical deicing, installation of a High Density Polyethylene (HDPE) geo-membrane liner system, as shown on the Plans and specified in this Section 925.05 shall be included. All labor, materials, transportation, handling, storage, supervision, tools and other equipment that may be necessary to install and test the HDPE liner system shall be included.

Before liner installation, the area that is to be lined shall be smooth and free of sharp objects or debris of any kind. Atmospheric exposure of geo-membrane to the elements following lay down shall be a maximum of fourteen (14) days. The Contractor shall install HDPE geo-membrane liner free of holes and tears.

The HDPE shall be placed below the pavement, above the first row of reinforcement, over the parapet moment slab (where present), and over specified areas as shown on the plans. The HDPE shall be sloped to drain away from the facing panels.

HDPE shall not be installed during periods of precipitation or in conditions of excessive moisture such as fog or dew. The HDPE liner shall be placed in accordance with the HDPE manufacturer's recommendations and as approved by the Engineer.

All seams of the HDPE geo-membrane liner system shall be, as per the manufacturer's specifications, sealed or overlapped to prevent leakage. Seams shall be oriented parallel to the line of maximum slope. Seams shall have a minimum finished overlap of 4 inches, unless a greater overlap is specified by the HDPE manufacturer.

Field testing of seams, according to the manufacturer's specifications, shall be conducted to verify satisfactory seaming conditions.

When backfilling, care shall be taken to prevent damage to the HDPE liner system. Any tears, punctures or holes incurred during the installation process shall be assessed by the Engineer and the membrane shall either be repaired in accordance with recommendations of the membrane manufacturer or replaced at the Engineer's discretion at no additional cost to the Authority.

Perforations through the liner shall be limited. Where penetrations are necessary, the Contractor shall provide details demonstrating the method(s) of sealing the penetration for approval by the Engineer.

(G) Construction Stormwater Management.

At the end of each construction period, the Contractor shall slope the last placed layer of backfill away from the wall facing to direct runoff or rainwater away from the wall face. Surface runoff shall not be allowed to enter the wall construction site from adjacent areas.

426.04 Working Drawings.

Working Drawings shall be prepared and submitted in accordance with the requirements specified under Subsection 104.08. The CSV shown on the Plans is anticipated to envelop the majority of potential wall system reinforced earth volume requirements. However, should the limits of structure volume for the proposed wall system extend beyond the limits of the CSV, the wall system shall be submitted as a Substitution in accordance with this specification. The Substitution must be approved by the Engineer prior to submitting Working Drawings. At a minimum, Working Drawings shall include the following:

(A) Design calculations, signed and sealed by a Professional Engineer licensed in the State of New Jersey, in conformance with current edition of AASHTO LRFD Bridge Design and Construction Specifications with Interims and modifications herein and the provisions of the approved wall system selected for construction in the contract. MSE walls shall be designed for a minimum 75 year design life. MSE walls which support embankments under bridge abutments shall be designed for a 100 year design life. All MSE wall components shall be designed for the 100-year flood elevation. Walls shall be designed for rapid drawdown conditions to account for the differences in hydrostatic pressure for a 100-year design flood; and/or rapid draining embankment material can be used as Select Backfill.

Load Factor Design (LFD) methodology shall be used for the Internal Strength and Stability for Barrier Parapet and Moment Slab System. Allowable Stress Design (ASD) methodology shall be used for External Stability for Moment Slab.

External stability of the wall including bearing capacity and settlement shall be the responsibility of the Engineer of Record.

Internal stability including but not limited to reinforcement tensile resistance, reinforcement pull-out resistance, reinforcement long term durability (i.e. corrosion, creep, and degradation from ultraviolet radiation), connection details, coping, and moment slab will be the responsibility of the Wall Manufacturer's Professional Engineer Licensed in NJ preparing the Working Drawings.

Any out of tolerance joint spacing, wall plumbness, or other deformation of the wall will be the responsibility of the Contractor, unless the Contractor can adequately document with survey results that settlement occurred and the deformation was not a result of the construction means and methods to the satisfaction of the Engineer.

If the Wall Manufacturer preparing the Working Drawings elects to modify the unit weight and friction angle of the Select Backfill material, the Engineer shall be notified to verify with the Engineer of Record that the changes will not impact the wall's external stability. These modifications shall only be allowed with the approval of the Engineer of Record.

(B) General notes, design parameters, soil characteristics of Select Backfill, type of reinforcing straps and factors of safety and/or load and resistance factors.

(C) An elevation view of the wall showing:

(1) Elevations along the top of the wall, at beginning and end of wall, at 25 foot intervals, at changes in grade, at changes in Common Structure Volume (CSV) limits; and at precast panel unit joints where indicative of wall geometry.

(2) Elevations and step locations for leveling pads and/or footings.

(3) The location of the final ground line.

(4) Number and type of precast panel units.

(5) A numbered panel layout for fabrication and erection purposes.

(6) Designation of breaks in vertical alignments and elevations.

(7) Locations and elevations/inverts of any utilities or drainage which passes through/below the retaining wall or the Common Structure Volume.

(D) A plan view of the wall showing:

(1) The offset from the construction baseline to the face of precast wall units at all changes in horizontal alignment.

(2) Right-of-Way (ROW) limits and their relationship to the wall with offsets and stations to wall corners and ends.

(3) Locations of piles, drilled shafts, noise walls, sign structures, or other appurtenant items which are supported by the wall or its parapet/coping.

(4) Locations and alignments of any utilities or drainage which passes through/below the retaining wall or the CSV.

(5) The offset from the construction baseline to limits of CSV at all changes in horizontal alignment and offsets of CSV limits.

(E) Typical sections of walls showing:

(1) Limits of cut and fill work.

(2) Limits of Select Backfill, retained backfill behind the CSV, and drainage materials.

(3) Limits of CSV and associated appurtenant items such as drainage features and soil reinforcing elements.

(4) Location of final ground lines.

(F) Precast panel unit details for all panel types, including non-standard panels, with all dimensions necessary

to construct the panels with locations in the member of all appurtenant items such as reinforcement steel, soil reinforcing element attachment points, and lifting devices. In the case of two-stage construction, flexible facing details, connectors between first and second stage construction, precast panel units , fill type between flexible facing and precast panel units, and other pertinent details.

(G) Details for footings, leveling pads and footing or leveling pad step details, where required.

(H) Details for precast barriers, copings, connections to all appurtenant items such as railings, fences, lighting standards, and noise barriers.

(I) Details for wall construction and soil reinforcing element placement to accommodate any obstructions such as piles, drilled shafts, utilities, acute corners, slip joints, highway lighting systems, drainage structures and any other obstructions.

(J) Details for any cast in place elements with all dimensions necessary to construct the elements with locations in the member of all appurtenant items such as reinforcement steel.

(K) Detail for any architectural treatments such as facing finish, texture, and color.

(L) The Wall Manufacturer's installation manual including sequence of construction. Two bound copies of the approved manual shall be furnished to the Engineer.

426.05 Substitutions.

Wherever requirements for wall components, proprietary components, or methods of construction are specified, it is intended to establish a standard of quality and shall not be interpreted to preclude substitutions by Contractors, subject to conditions given hereinafter.

Substitution will be considered when such proposed substitution equals or exceeds that specified with respect to quality, workmanship, service, maintenance, economy, reliability of operation, code compliance, and aesthetics.

When the Contractor requests substitution, they shall first thoroughly investigate its proposed substitution and certify to the Engineer, in writing, that said proposed substitution is equal to that specified. The Contractor shall include with said certification all required data, samples, reports and tests to substantiate its findings. The Engineer will decide if such substitution is equal to that specified; and if found to be so, may then approve the substitution. The Engineer's decision will be final and binding to all parties.

Where proposed substitution requires modifications to the CSV shown on the Plans or the selected wall system extends beyond the limits of the CSV shown on the Plans, the Contractor shall quantify all impacts and adjustments to affected item quantities such as but not limited to excavation, backfill, and sheeting and the Project schedule as a part of its substitution request. Additional costs which arise from quantity or schedule impacts of the substitution shall be borne solely by the Contractor. Approval of the disposition of the pay limits and quantities to accommodate the substitution shall be integral to the approval of the substitution.

Approved substitutions shall be at no additional cost to the Authority. Rejection of a requested substitution shall not be considered as a basis for a claim against the Authority, including claims of delay of time and loss of money.

426.06 Measurement.

(A) Mechanically Stabilized Earth Walls will be measured by the total square feet of wall panel area supplied and constructed in the completed wall. The area measured will be the product of the average vertical height between final rear face and front face ground lines and the total lengths of the wall as given on the Plans. Within the CSV or except as may otherwise be provided for, no quantity other than the square foot wall area as defined above will be measured for payment.

(B) Common Structure Volume (CSV)

The CSV is the volume that contains all components of all retaining wall systems considered for construction at a given site. The limits of the CSV are defined as:

(1) End Limit Planes: Vertical planes, normal or radial to the wall alignment, at begin and end stations of the wall system.

(2) Forward Limit Plane: Vertical plane(s) two feet or other designated distance shown on the Plans forward of the fascia. The fascia is defined as the forward limit of wall coping or barrier parapet face, wall panel or unit face or other physical feature as shown on the plans

(3) Rear Limit Plane: Vertical plane(s) at the rear limits of the Select Backfill. For the purposes of defining the CSV, this limit will be located parallel to the Forward Limit Plane and at minimum distance of 70% of the average vertical dimension between the Bottom Limit Plane and the Top Limit Plane, plus one (1) foot and will include any porous fill, all wall appurtenances such as drainage systems, pertinent retained fill and any work to be included in the wall pay item.

(4) Bottom Limit Plane: Horizontal Plane(s) at the lower elevations of the wall to include the leveling pad(s)/footing(s), the undersides of the Select Backfill or modular units and excavations required for the construction of the Select Backfill or modular units, extending between the Forward and Rear Limit Planes of the CSV.

(5) Top Limit Plane: Plane(s) defining the configuration (slope, roadway, pavement box, etc) at the top of the wall extending between the forward and rear limits of the CSV. Where finished grade of an MSE wall is defined by a pavement system, the CSV Top Limit Plane shall be defined as the underside of the pavement system subgrade material as noted in the Plans.

Unless otherwise noted in the Plans or Specifications, all components of the wall system and all components, elements or appurtenances , such as copings, parapets, barriers, moment slabs, wall underdrains, geo-membrane liner systems, etc., founded on or located within the CSV or attached to any component of the wall system within the CSV shall be included in the MSE wall.

426.07 Payment

Payment will be made under:

PAY ITEM	*PAY UNIT*
MECHANICALLY STABILIZED EARTH WALLS	SQUARE FOOT

No additional payment will be made for Substitutions under Subsection 426.05.

No additional payment will be made for costs resulting from submission, approval or rejection of Substitutions under Subsection 426.05.

Payment for electrical items will be made in accordance with Division 600, unless otherwise noted on the Plans.

SECTION 427 - PREFABRICATED MODULAR (PM) WALLS

427.01 Description.

This work shall include the design and construction of Prefabricated Modular Wall (PMW) structures composed of precast concrete modular units, cast-in-place and precast parapets, moment slabs, copings, concrete leveling pads/footings, joint materials, Select Backfill, and all other appurtenant items of construction within the Common Structure Volume (CSV) as shown on the Plans, included as part of the approved Prefabricated Modular Wall System, or as specified herein.

Design and construction of precast modular walls shall be in accordance with AASHTO LRFD Design and Construction Specifications with Interims, except as noted herein. The design of the Barrier Parapet and Moment Slab shall be in accordance with the current NJTA Design Manual wherein:

- Load Factor Design (LFD): Internal Strength and Stability for Barrier Parapet and Moment Slab System
- Allowable Stress Design (ASD): External Stability for Moment Slab

All such designs shall be signed and sealed by a Professional Engineer licensed to practice in the State of New Jersey.

All other labor, materials, equipment, and tools as required to prepare the site, construct the leveling pad, construct the wall, place and compact the Select Backfill, and construct the coping and traffic barrier shall be supplied by the Contractor.

The following are defined for the allocation of responsibilities as described herein:

- "Engineer" shall be as defined in Subsection 101.02
- "Engineer of Record" shall be defined as the Professional Engineer licensed to practice in the State of New Jersey, responsible for the preparation of the Contract Documents
- "Wall Manufacturer" shall be defined as the PM wall supplier/vendor and shall also include a Professional Engineer licensed to practice in the State of New Jersey, responsible for the preparation of the Working

Drawings and calculations associated with the PM Wall System.

427.02 Materials.

Materials shall conform to the current editions of AASHTO LRFD Bridge Design and Construction Specifications with Interims, requirements of the Subsections listed herein and the provisions of the wall system selected for construction in this Contract.

Except as may be modified within this Section, all applicable provisions of Sections 400 and 900 shall apply in furnishing PM Wall Systems, including the following:

CONCRETE 905.05

MORTAR 905.11

CURING MATERIALS 906.07

REINFORCEMENT STEEL 908.01

Precast concrete modular units shall be Class P.

Filler for joints for footings shall conform to Subsection 907.01.

Filler for front face horizontal joints between units shall be closed-cell polyethylene foam backer rod conforming to AASHTO M 153, Type 1.

Filter fabric placed inside the units over all vertical joints in the front face shall be 12 inches wide and conform to Subsection 923.21.

Weep holes, where shown on the Plans, shall be constructed in the manner and at the locations required. Ports or vents for equalizing hydrostatic pressure shall be placed below low water, if shown. Forms for weep holes through concrete shall be 4 inch clay pipe, polyvinyl chloride, or unreinforced concrete drain pipe.

Underdrains, where shown on the Plans, shall conform to Section 501.

Coarse aggregate layer shall be material obtained from an approved commercial source and processed into stone size ASTM C33, size No. 67.

Select Backfill conforming to the requirements herein shall be used within the CSV as shown on the Plans and as specified in Paragraph 427.02(B) and may be procured from off-site sources or from on-site borrow excavation.

(A) PREFABRICATED MODULAR WALL SYSTEMS.

A list of PM Wall Systems that are acceptable for use on this Contract is located on the Qualified Products List which is available on the Authority's website:

* Height limitation of fifteen (15) feet as measured from the underside of the bottom-most wall unit for any level run of constructed wall.

The Contractor shall make their own arrangements to purchase materials and services from one (1) of the manufacturers of the permissible PM Wall Systems listed above. Selection of only one (1) wall system will be permitted for use on this Contract.

An on-site technical representative from the selected PM Wall Systems manufacturer shall be present to assist and instruct during the installation of the first two-module courses, as a minimum.

(B) SELECT BACKFILL.

Where specific pervious backfill materials or material gradation designations are noted on the Plans, no substitutions will be permitted for those materials.

Pervious backfill material used within the PM Wall System units shall be free from deleterious materials, shale or poor durability particles and shall conform to the properties specified by the wall manufacturer. Unless otherwise specified these materials shall meet the following gradation limits as determined by AASHTO T 27:

Pervious backfill:

Sieve Size	Percent Passing
3 inches	100

Sieve Size	Percent Passing
No.200	0-15

The Contractor shall determine the optimum moisture content and maximum dry density of the backfill in accordance with AASHTO T 99 unless otherwise specified.

Pervious backfill shall be used behind all units within the CSV and shall conform to Section 901.01

The frequency of sampling and testing of backfill material shall be performed at least once for every 1000 cubic yards of material placed for all tests denoted above. A minimum of two samples per structure shall be taken. Additional samples shall be taken whenever the appearance or behavior of the material changes and as directed.

The Contractor shall furnish to the Engineer a Certificate of Compliance certifying that the backfill material complies with this Section.

A copy of all test results performed by the Contractor which are necessary to ensure compliance with these Specifications shall also be furnished.

427.03 Methods of Construction.

(A) GENERAL.

Methods of Construction shall conform to the current editions of AASHTO LRFD Bridge Design and Construction Specifications with Interims, with modifications herein and the provisions of the permitted Wall System selected for construction in this Contract.

At PM Walls locations where post construction settlement is expected but no ground improvement is specified, placement of the pavement box, barrier parapet, coping, moment slab or approach slab shall not begin until the rate of settlement has sufficiently diminished and the anticipated additional post construction settlement is less than one inch. The Engineer will evaluate the actual settlement based on field instrumentation data to verify the diminished rate of settlement and the projected settlement remaining. The Engineer will be the sole judge to determine that the rate of settlement is below the required threshold and that the anticipated additional post construction settlement is less than one inch. Construction of the pavement box shall only be performed upon written authorization from the Engineer.

(B) FABRICATION.

The Contractor shall use an approved proprietary supplier/vendor in accordance with these Specifications to fabricate precast concrete PM Wall elements. Precast concrete wall elements shall be Class P, fabricated at a plant certified by the Precast Concrete Institute (PCI) in the category applicable to this work. The Contractor shall ensure that the plant fabricating the precast concrete wall elements is certified in accordance with the PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products (MNL-116), and provide written documentation to the Engineer.

(1) Placing Reinforcement Steel.

Reinforcement steel shall be placed in accordance with Subsection 401.09. Prior to placement of the concrete, reinforcement steel shall be placed in position as detailed on the approved working drawings. Reinforcement shall be firmly tied to prevent displacement during concrete placing operations.

(2) Forms.

The PM units shall be cast in steel forms to ensure the production of uniform products. Forms shall be placed on a flat surface with the front face of the form facing down.

(3) Concrete Placement.

Concrete shall be placed in accordance with Subsection 401.11. Prior to concrete placement, The Contractor shall ensure that the reinforcement steel and any other embedded materials are free of loose rust, frost, dirt, oil or contaminants that may prevent a proper bond with the surrounding concrete. The transporting, placement, and consolidation of concrete shall be by methods that will prevent the segregation of the concrete materials and the displacement of the reinforcement steel from its proper position in the form. Consolidation of concrete shall be with internal vibrators. The fabricator may elect to use external vibration to supplement internal vibration.

(4) Precast Concrete Element Fabrication Tolerances.

Fabrication of precast concrete wall elements shall be done to ensure elements are free of honeycombing or voids and true to the size and dimensions specified in the table below.

Dimensional Tolerances	
Length and Height of Face	± 3/16 inch
Deviation from Square for Units < 10 feet wide [1]	5/16 inch maximum
Deviation from Square for Units ≥ 10 feet wide [1]	13/16 inch maximum

[1] Measure deviation from square on the diagonal

(C) CURING.

Prefabricated modular units shall be cured by any one of the methods specified in the PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products (MNL-116).

If steam curing is used however, the applications of steam within the enclosure shall be delayed for a period of five to six hours when the air temperature is 50 °F or lower, and shall be delayed for a period of three hours when the air temperature is 50 °F or higher. If retarders are used, the waiting period shall be from four to six hours regardless of the air temperature. The curing period shall be maintained at 143 °F +/- 9 °F for a period of 12 hours.

Two concrete test cylinders, similarly cured, shall be tested after the curing procedure specified. Should either test cylinder indicate the precast units have not achieved a compressive strength of 4,000 psi or greater, the precast units shall be cured further until the required strength is achieved.

(D) FORM REMOVAL AND CONCRETE FINISHING.

The Fabricator shall ensure that precast concrete elements remain in forms for the duration of the specified curing period. Forms shall not be removed until the concrete has achieved the stripping strength as defined herein. If handling devices are used, they shall be removed and the holes shall be filled with concrete or approved mortar. Once the precast concrete elements have achieved the required stripping strength, they may be removed from the forms at any time when removal can be accomplished without damage to the element itself.

Unless otherwise indicated on the Contract Drawings, these Specifications or the approved working drawings, the finish of the front face shall be an ordinary surface conforming to Subsection 401.17. The rear face shall have a uniform surface finish free of open pockets of aggregate. The fabricator shall complete the surface finishing operations before placing each precast element in storage or packing for shipment.

(E) ACCEPTANCE REQUIREMENTS AND QUALITY CONTROL.

The Contractor shall notify the Engineer in writing at least 21 days prior to the start of production. The Fabricator shall keep all applicable records according to PCI Division 1, Quality Control, and supply copies of these records to the Engineer. The Fabricator shall also ensure that the quality control technician performing all tests is certified as an American Concrete Institute (ACI) Field Testing Technician, Grade 1.

The quality of materials, the process of manufacture, and the finished precast concrete units shall be subject to inspection by the Engineer prior to shipment. Individual precast concrete units will be inspected for the dimensional tolerances specified herein and for any observable damage. Precast concrete units will be rejected by the Engineer because of any of the following:

(1) Variations in the exposed face that substantially deviate in texture.

(2) Dimensions not conforming to the tolerances specified in Subparagraph 427.03(B)(4).

(3) Honeycombed or open texture not properly repaired.

(4) Defects which would affect the structural integrity of the unit.

(5) Defects in the physical characteristics of the concrete units, such as:

(a) Stained front face due to excess form oil or other reasons.

(b) Signs of aggregate segregation.

(c) Broken or cracked corners.

(d) Lifting inserts not usable.

(e) Exposed reinforcing steel.

(f) Cracks at the PVC pipe or pin.

(g) Insufficient concrete compressive strength.

(h) Insufficient cover over reinforcement steel

(i) Deviation from flatness of exposed surface in excess of 1/8 inch per 5 feet

An additional inspection shall be made prior to erection to determine any damage which may have occurred during storage.

The Engineer will determine whether spalled, honeycombed, chipped, or otherwise defective concrete shall be repaired or be cause for rejection. Repair of concrete, if allowed, shall be done in a manner satisfactory to the Engineer at no additional cost to the Authority.

Repair to concrete surfaces which will be exposed to view after completion or construction shall be approved.

(F) SHIPMENT.

The Contractor shall store, stack and transport precast concrete elements using methods that do not cause the development of cracks or other damage.

The name of the manufacturer, name of Contract, date of manufacture, wall element mark numbers, and type of unit in accordance with the approved erection drawings shall be clearly marked in the inside face of each unit.

The precast units shall not be shipped until the minimum 28-day compressive strength has been attained and a minimum of 72 hours after fabrication and shall, in the opinion of the Engineer, meet the acceptance criteria in Paragraph 427.03(E). Shipments to the site shall include a list of products included in the shipment and certification statement for each product, which shall be provided to the Engineer.

Handling devices, as required, shall be galvanized and shall be provided for the purpose of handling and placing. Care shall be taken during storage, transporting, hoisting, and handling of all units to prevent cracking or damage.

Units damaged by improper storing, transporting, or handling shall be replaced or repaired to the complete satisfaction of the Engineer, and at no additional cost to the Authority.

(G) INSTALLATION.

Excavate to the limits of the CSV or as otherwise indicated on the Plans. The foundation bed for the structure shall be approved by the Engineer before erection is started. Prior to wall construction, the foundation bed shall be compacted with a vibratory compactor in accordance with this Section and the PM Wall System supplier's requirements. Any foundation soils found to be unsuitable shall be removed and replaced with coarse aggregate.

At each unit foundation level, either a precast or cast-in-place footing and/or a leveling pad shall be provided. The footings shall be Class B concrete, be given a wood float finish, and shall reach a compressive strength of 2,000 psi before placement of precast wall units. The completed footing surface shall be constructed in accordance with grades and cross slopes shown on Plans. When tested with a straightedge, the surface shall not vary more than 1/8 inch in 10 feet.

The units shall be installed in accordance with the manufacturer's recommendations. Special care shall be taken in setting the bottom course of units to true line and grade. While erecting each subsequent course, line, and grade shall be examined, and deviations shall be corrected to prevent cumulative inaccuracies in alignment. Joint filler and rubber pads shall be installed. Joints at corners or angle points shall be closed.

Prefabricated modular wall units shall be filled one course at a time, with pervious backfill, while maintaining the wall in the vertical position to provide for the required final vertical alignment of the completed wall. Bin Wall Type Units 4 feet or less in height shall be filled in one layer and then thoroughly compacted with a vibratory tamping device. Bin Wall Type Units which are more than 4 feet in height shall be filled in two approximately equal layers and thoroughly compacted after each layer is placed. Modular walls that rely on the capacity of perpendicular stems such as T Walls shall be backfilled and compacted in 12 inch lifts.

Select Backfill shall be compacted to a minimum of 95% of the maximum dry density as determined by AASHTO T99 (Standard Proctor) or greater if specified by the Wall Manufacturer. The in-place compacted dry density of the Select Backfill shall be tested in accordance with AASHTO T310 Method B. In-place field density testing should be performed every 500 feet linearly after each succession of placement of lifts totaling 3 feet vertically. If the wall is less than 500 feet long, a minimum of two locations shall be tested per wall after each succession of placement of lifts totaling 3 feet vertically. Additional testing may be performed if deemed necessary by the Engineer. If greater than 50 percent of Select Backfill is retained on the ¾" sieve, laboratory standard proctor (AASHTO T99) and field density testing (AASHTO T310) is not required, and satisfactory compaction shall be considered less than 0.25" of displacement during the last pass of the compacting equipment, provided the lift thickness requirements specified herein are satisfied. The optimum Select Backfill moisture content to achieve minimum required compacted soil density shall be as determined by AASHTO T99.

Unless otherwise noted on the working drawings, backfill material, in the common structure volume behind the wall, shall conform to Paragraph 427.02(B).

When erecting a battered wall, placement of backfill behind the wall shall closely follow erection of successive courses of units. At no time shall the difference in elevation between the backfill and the top of the last erected course exceed 6 feet.

All units above the first course shall interlock with the lower courses. Vertical joint openings on the wall's front face shall not exceed 13/16 inch.

The front face vertical joints shall have 1 foot wide strips of filter fabric behind each joint starting 2 feet below grade.

The overall vertical alignment tolerance, or plumbness or line of batter, from top to bottom of the structure, shall not exceed 1/2 inch per 10 foot of wall height.

Deviation from horizontal alignment shall not exceed ¾ inch.

Vertical and horizontal alignment tolerance, or plumbness/batter should not exceed ¾ in. when measured with a 10 ft. straight edge on a selected wall section.

The maximum allowable offset between any two units should not exceed ¾ inch.

(H) CONSTRUCTION STORMWATER MANAGEMENT.

The Contractor shall slope the last placed level of backfill away from the wall facing to rapidly direct runoff of rainwater away from the wall face. Surface runoff shall not be allowed to enter the wall construction site from adjacent areas.

427.04 Working Drawings.

Working drawings shall be prepared and submitted in accordance with the requirements specified under Subsection 104.08. The CSV shown on the Plans is anticipated to envelop the majority of potential wall system reinforced earth volume requirements. However, should the limits of structure volume for the proposed wall system extend beyond the limits of the CSV, the wall system shall be submitted as a Substitution in accordance with this specification. The Substitution must be approved by the Engineer prior to submitting Working Drawings. At a minimum, working drawings shall include the following:

(A) Design calculations, signed and sealed by a Professional Engineer licensed to practice in the State of New Jersey, in conformance to current edition of AASHTO LRFD Bridge Design and Construction Specifications with Interims, with modifications herein and with the provisions of the approved PM Wall System selected for construction in this Contract. PM walls shall be designed for a 75 year design life. All PM wall components shall be designed for the 100-year flood elevation. Walls shall be designed for rapid drawdown conditions to account for the differences in hydrostatic pressure for a 100-year design flood; and/or rapid draining embankment material can be used as Select Backfill.

(B) General notes, design parameters, soil characteristics of backfill materials, and factors of safety and/or load and resistance factors.

(C) An elevation view of the wall showing:

(1) Elevations along the top of the wall, at beginning and end of wall, at 25 foot intervals, at changes in grade, at changes in Common Structure Volume Limits; and at prefabricated modular unit joints where indicative of wall geometry.

(2) Elevations and step locations for leveling pads and/or footings.

(3) The location of the final ground line.

(4) Number and type of prefabricated modular units.

(5) A numbered modular unit layout for fabrication and erection purposes.

(6) Designation of breaks in vertical alignments and elevations.

(7) Locations and elevations/inverts of any utilities or drainage which passes through the retaining wall or the Common Structure Volume.

(D) A plan view of the wall showing:

(1) The offset from the construction baseline to the face of prefabricated wall units at all changes in horizontal alignment.

(2) ROW limits and their relationship to the wall with offsets and stations to wall corners and ends.

(3) Locations of piles, drilled shafts, noise walls, sign structures, or other appurtenant items which are supported by the wall or its parapet/coping.

(4) Locations and alignments of any utilities or drainage which passes through the retaining wall or the Common Structure Volume.

(5) The offset from the construction baseline to limits of Common Structure Volumes at all changes in horizontal alignment and offsets of CSV limits.

(E) Typical sections of walls showing:

(1) Limits of cut and fill work.

(2) Limits of pervious backfill, porous fill, retained backfill and drainage materials.

(3) Limits of Common Structure Volume and associated appurtenant items such as drainage features.

(4) Location of final ground lines.

(F) Prefabricated modular unit details for all unit types, including special modules, with all dimensions necessary to construct the units with locations in the member of all appurtenant items such as reinforcement steel, and lifting devices.

(G) Details for footings, leveling pads and footing or leveling pad step details, where required.

(H) Details for precast barriers, copings, connections to all appurtenant items such as railings, fences, lighting standards, and noise barriers.

(I) Details for wall construction to accommodate any obstructions such as piles, drilled shafts, utilities, highway lighting systems, and drainage structures.

(J) Details for any cast in place elements with all dimensions necessary to construct the elements with locations in the member of all appurtenant items such as reinforcement steel.

(K) Detail for any architectural treatments such as facing finish, texture, and color.

(L) The manufacturer's installation manual including sequence of construction. Two bound copies of the approved manual shall be furnished to the Engineer.

427.05 Substitutions.

One wall system shall be selected by the Contractor and only that wall system shall be constructed in this Contract.

Wherever requirements for wall components, proprietary components, or Methods of Construction are specified, it is intended to establish a standard of quality and shall not be interpreted to preclude substitutions by Contractors subject to conditions given hereinafter.

Substitution will be considered when such proposed substitution equals or exceeds that specified with respect to quality, workmanship, service, maintenance, economy, reliability of operation, code compliance and aesthetics.

When the Contractor requests substitution, it shall first thoroughly investigate its proposed substitution and certify to the Engineer, in writing, that said proposed substitution is equal to that specified. It shall include with said certification all required data, samples, reports and tests to substantiate its findings. The Engineer will

decide if such substitution is equal to that specified; and if found to be so, may then be approved. The Engineer's decision will be final and binding to all parties.

Where proposed substitution(s) require modification to the CSV as shown on the Plans, the Contractor shall quantify all impacts and adjustments to affected item quantities such as but not limited to excavation, backfill, and sheeting and the Project schedule as a part of its substitution request. Additional costs which arise from quantity or schedule impacts of the substitution shall be borne solely by the Contractor. Approval of the disposition of the pay limits and quantities to accommodate the substitution shall be part and parcel to the approval of the substitution.

Approved substitutions shall be at no additional cost to the Authority. Rejection of a requested substitution shall not be considered as a basis for a claim against the Authority, including claims of delay of time and loss of money.

427.06 Measurement.

Prefabricated Modular Walls will be measured by the total number of square feet of retaining wall face area. The area measured will be the product of the average vertical height between final rear face (upper) and front face (lower) ground lines and the total lengths of the wall as given on the Plans. Within the Common Structure Volume or except as may otherwise be provided for, no quantity other than the wall area will be measured for payment.

(A) Common Structure Volume.

The Common Structure Volume (CSV) is the volume that contains all components of all retaining wall systems considered for construction at a given site. The limits of the CSV are defined as:

(1) End Limit Planes: Vertical planes, normal or radial to the wall alignment, at begin and end stations of the wall system.

(2) Forward Limit Plane: Vertical plane(s) two feet or other designated distance shown on the Plans forward of the fascia. The fascia is defined as the forward limit of wall coping or barrier parapet face, wall panel or unit face or other physical feature as shown on the plans

(3) Rear Limit Plane: Vertical plane(s) at the rear limits of the Select Backfill. For the purposes of defining the CSV, this limit will be located parallel to the Forward Limit Plane and at minimum distance of 70% of the average vertical dimension between the Bottom Limit Plane and the Top Limit Plane, plus one (1) foot and will include any porous fill, all wall appurtenances such as drainage systems, pertinent retained fill and any work to be included in the wall pay item.

(4) Bottom Limit Plane: Horizontal Plane(s) at the lower elevations of the wall to include the leveling pad(s)/footing(s), the undersides of the select backfill or modular units and excavations required for the construction of the select backfill or modular units, extending between the Forward and Rear Limit Planes of the CSV.

(5) Top Limit Plane: Plane(s) defining the configuration (slope, roadway, pavement box, etc.) at the top of the wall extending between the forward and rear limits of the CSV. Where finished grade of a PM Wall is defined by a pavement system, the CSV Top Limit Plane shall be defined as the underside of the pavement system subgrade material as noted in the Plans.

Unless otherwise noted in the Plans or Specifications, all components of the wall system and all components, elements or appurtenances , such as copings, parapets, barriers, moment slabs, wall underdrains, etc., founded or located within the CSV or attached to any component of the wall system within the CSV shall be included in the Prefabricated Modular Wall.

427.07 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
Prefabricated Modular Walls	Square Foot

No additional payment will be made for Substitutions under Subsection 427.05.

No additional payment will be made for costs resulting from submission, approval or rejection of Substitutions under Subsection 427.05.

Payment for electrical items will be made in accordance with Division 600 unless otherwise noted on the Plans.

SECTION 428 – HIGH PERFORMANCE CONCRETE (HPC)

428.01 Description.

This work shall consist of the construction of portland cement concrete deck slabs, headblocks, bridge sidewalks, unsurfaced bridge approach slabs, integral abutment relief and sleeper slabs and cast-in-place parapets with the use of High Performance Concrete (HPC). HPC is defined as concrete that meets special performance and uniformity requirements that cannot always be obtained by using conventional ingredients, normal mixing procedures and typical curing practices. Construction shall be as specified in Sections 304 and 401 except as modified herein.

This work shall also consist of furnishing and installing methacrylate crack sealer for the sealing of cold joints and the interface between new concrete and metal such as scuppers or deck joints as shown on the Plans.

428.02 Materials.

Materials shall conform to the following Sections and Subsections:

AGGREGATES.....902

CONCRETE, MORTAR AND GROUT.....905

PORTLAND CEMENT CONCRETE.....905.05

CONCRETE ADMIXTURES, CURING MATERIALS AND FILM EVAPORATORS.....906

FLY ASH.....923.37

SILICA FUME.....905.08 AND 906.05

JOINT MATERIALS.....907

REINFORCEMENT STEEL.....908.01

PERMANENT METAL BRIDGE DECK FORMS.....909.07

CONCRETE PENETRATING SEALER TREATMENT.....923.06(F)

EPOXY BONDING COMPOUND.....923.08

EPOXY RESIN MORTAR.....923.09

WATERSTOPS.....923.17

METHACRYLATE CRACK SEALER.....923.06(I)

Materials, admixtures and methods of construction not specifically covered in the Plans and these Specifications shall conform to the latest edition of the AASHTO LRFD Bridge Design Specifications.

The ratio of coarse aggregate to fine aggregate shall be a minimum of 1.5 with a total coarse aggregate content not lower than 1800 lbs. per cubic yard.

The total amount of cementitious material should be limited to 700 lbs. per cubic yard.

In order to achieve the desired resistance to chloride penetration, an appropriate proportion of pozzolanic material of silica fume and fly ash shall be provided in the mix design.

Proportions of pozzolanic materials shall be such that silica fume will replace a maximum of 5% of portland cement by weight and fly ash a maximum of 20% of the portland cement.

(A) SILICA FUME.

Prior to submitting a mix design, a sample of the silica fume admixture shall be submitted to the Authority's testing laboratory and tested for conformity against the requirements of the latest AASHTO M 307 or ASTM C 1240 standard and shall be accompanied by a copy of the manufacturer's recommendations. Silica fume admixture shall be approved by the Engineer prior to its use on the Contract. Only one brand of silica fume admixture shall be used for the entire duration of the Contract. Silica fume admixture may be supplied either in dry or in slurry form. If the slurry form is used, it shall be homogeneous and agitated to prevent separation. The Contractor shall submit a procedure for the introduction of the silica fume into the mix for the Engineer's approval.

(B) Fly Ash.

Fly ash for HPC shall conform to ASTM C 618, Class F except that the loss on ignition shall not be more than 2.5 percent. Fly ash used to control alkali-silica reactivity shall be Class F and shall contain not more than 1.5 percent available alkali in accordance with ASTM C 618, Table 1A. Before each source of fly ash is approved, certified results of tests conducted by a testing agency shall be submitted to and verified by the Engineer. Accompanying the certification shall be a statement from the supplier listing the source and type of coal, the methods used to burn, collect, and store the fly ash, and the quality control measures employed. Fly ash, Class C will not be permitted for use.

Conformance to the requirements for loss on ignition and fineness shall be determined by the supplier for each truck load of fly ash delivered to the mixing site. The test values determined shall be included on the delivery ticket. The Engineer may require that the fly ash not be used until the Authority has performed tests for loss on ignition and fineness.

428.03 Mix Design and Fabrication of the HPC.

(A) Fabrication Requirements.

For the construction of the HPC item of work, the HPC shall be fabricated in accordance with the requirements of Section 401, or as stated within this Section.

(B) Mix Design Verification.

In the development of the HPC mix design, the following performance requirements, in accordance with the indicated test method, shall be achieved. The verification mix shall be produced in the batching plant using those materials and equipment to be used for production. A minimum of 8 cubic yards shall be produced for each of the two (2) required mix designs for verification of the HPC. The Authority's testing laboratory shall cast samples from each of the two concrete batches. A report to document these results shall be provided to the Engineer. The Contractor shall obtain the results of these standard tests from an AASHTO accredited testing agency, that is approved for the portland cement concrete testing methods specified in the below table. The Contractor shall submit a list of their testing laboratory's accreditations.

The mix design verification testing shall be accomplished by the Contractor at no cost to the Authority.

The Authority's testing laboratory's results will govern the acceptance of the mix design.

Performance Characteristic	Standard Test Method	Performance Required	Mold Size
Scaling Resistance (x = visual rating of the surface after 50 cycles)	ASTM C 672	x = 3 maximum	12" x 12" x 3"
Freeze-Thaw Durability (x = relative dynamic modulus of elasticity after 300 cycles)	AASHTO T 161 ASTM C 666 Proc. A	X = 80% minimum	3" x 3" x 10"
Chloride Permeability 56 days (coulombs)	AASHTO T 277, ASTM C 1202	1,000 maximum	4" x 8" cylinder
28 days surface resistivity (kOhm-cm)	AASHTO TP 95	25.0 minimum	4" x 8" cylinder
90 day ponding	AASHTO T259/T260	0.55 maximum	3" thick min. 28 $in.^2$ min. surface area (6" x 6" x 3")
56 days Free Shrinkage	ASTM C 157	450 microstrains maximum	4" x 4" x 11¼" prism
28 day Compressive Strength (Verification Strength)	AASHTO T 22 ASTM C 39	5,000 PSI minimum	6" x 12" cylinder

Performance Characteristic	Standard Test Method	Performance Required	Mold Size
Early Age Concrete (Verification Strength) 3 day Compressive Strength	AASHTO T 22 ASTM C 39	3,500 PSI minimum	6" x 12" cylinder
Flexural Strength	ASTM C 78	700 PSI minimum	See ASTM C 78

Notes:

(1) For the Scaling Resistance performance testing, as prescribed in the Standard Test Method, specimens shall be moist cured for 14 days and then air cured for 14 days. For the Surface Resistivity testing, specimens shall be moist cured for 28 days.

(a) If the chloride permeability requirement has been achieved in 28 days, the chloride permeability shall be considered acceptable. If the required chloride permeability is not achieved in 28 days, the HPC sample shall be tested at 56 days. Final acceptance of the HPC sample for chloride permeability will be determined by the results of AASHTO T259/T260.

(b) A minimum of two (2) mix designs shall be submitted for approval and verification in accordance with Subsection 905.05 at the preconstruction conference. To expedite the approval procedure, the Authority will perform verification testing and review concurrently with that conducted by the Contractor. The Contractor shall submit all required samples to the Authority for independent mix design verification testing. If the mix designs are not approved by the Authority, the mix designs shall be modified and resubmitted for approval.

(c) In accordance with the above referenced AASHTO T277 test, at 28 and 56 day intervals (cure time prior to test), AASHTO TP95 test, and AASHTO T259/T260 test, the Authority will perform chloride permeability testing to document the quality of the HPC mix design and to verify the results submitted in the above referenced report.

(d) The Contractor may contact personnel at Rutgers University to obtain guidance in developing the HPC mix design for the project. Dr. Hani Nassif, telephone number 848-445-4414, may be contacted for such guidance.

(2) For the Free Shrinkage Test (ASTM C157) the curing method and duration should be consistent with the NJTA Specifications. The test is to be performed on specimens that are cured using a modified curing procedure as per NJTA Specifications by applying wet burlap for 14 days instead of the 28 days cure specified in the ASTM C157 procedure. The following readings as specified by ASTM C157, which is ½ hour after de-molding, another reading at 14 days of curing, and in air storage after curing 4, 7, 14 and 28 days and 8, 16, 32 and 64 weeks.

428.04 Production of the HPC.

(A) As per the provisions of Paragraph 401.11(C), a plan of operation for placement of the HPC items shall be submitted for review and approval by the Engineer. This plan shall be submitted at least 20 working days prior to the proposed start of placing bridge deck concrete. In addition to the requirements of Paragraph 401.11(C), the plan shall also include a description of the HPC batching and mixing facilities, a description of the HPC transport equipment, the method of HPC placement, an outline of the curing procedures to be used for the production units and test samples and the quality control tests and procedures that the fabricator will perform.

The plan shall also include the procedures for reducing the atmospheric evaporation rate below 0.75 kilograms per square meter per hour through a combination of monomolecular evaporation retarders and fog misting, wind shields or other methods.

The following is added to the requirements of Paragraph 401.11(C):

Cast-in-place parapets on deck slabs and at retaining walls shall be constructed using the alternate panel method. Following placement of conduits, lighting standard anchorage, reinforcement and deck joints, alternate parapets shall be poured. The remainder of the panels shall be poured once the initial panels have cured a minimum of 24 hours.

Should the Contractor prefer to construct the bridge or retaining wall parapets using a slip forming method, a written request to do so shall be submitted to the Engineer which shall include a record of the Contractor's previous successful experience performing slip forming and curing HPC parapets on a minimum of two (2) example projects completed within the past five (5) years. At the request of the

Engineer, a site visit may be required to inspect the general quality of construction, grade, alignment, finish and cracking of the example projects. This site visit shall be coordinated by the Contractor and shall be at no additional cost to the Authority. Acceptance of this previous construction utilizing slip form methods shall be at the sole discretion of the Engineer and will not constitute final approval of the slip form construction methods for use on the project. Slip forming of HPC parapets for bridges constructed under staged-construction with live load will not be permitted. Slip forming of HPC parapets for bridges with integral abutments will not be permitted.

Upon acceptance of the written request, the Contractor shall be required to submit a detailed HPC slip forming procedure for review and approval of the Engineer. The preparation and submittal of this procedure shall be at no additional cost to the Authority. At a minimum, the Contractor's HPC slip forming procedure shall conform to the requirements of Paragraph 401.08(C) and shall include the following:

(1) A list of parapet types and locations for the project intended to be constructed using slip form methods.

(2) Proposed date and location at the project site of a test section having a minimum length of 100 feet to verify that the proposed equipment, material, and methods are capable of producing concrete parapets that meet the plans and specifications in accordance with Paragraph 401.03(D).

(3) Detailed description and manufacturer's product information for the type of slip forming equipment to be used on the project, including, but not limited to, the slip form machine and the concrete mold. At a minimum, the equipment specified shall be in accordance with Paragraph 401.03(D).

(4) An HPC slip form parapet mix design. The mix design shall be the approved HPC mix design for the project modified to reduce the slump to 1" +/- ½". Any admixtures required to produce the HPC slip form parapet mix design shall be included with the submission.

(5) Method for maintaining and controlling the grade and alignment of the HPC parapet during the slip forming operation.

(6) Detailed plans to address the construction of non-standard parapet sections such as (but not limited to) locations with junction boxes and lighting standard blisters.

(7) Details for all joints in all types of parapets intended to be slip formed on the project. The details shall include the maximum joint spacing and the saw cutting methods/details to be used to create the joints as shown in the Contract Documents at locations both with and without conduit.

(8) Detailed plans to address the placement of the parapet reinforcement, including a scheme for securing the reinforcement to restrict it from moving during the HPC slip forming operation, as well as methods to maintain the required concrete cover at the parapet faces and at the joints.

(9) Detailed plan for curing of the HPC parapet in accordance with the Paragraph 428.04(B).

Upon review and approval by the Engineer of the Contractor's HPC slip forming procedure, the test section shall be poured and cured in accordance with the approved procedures. No separate payment will be made for the HPC parapet test section. Acceptance of the test section shall be at the sole discretion of the Engineer and shall be based on an inspection of this test section for cracking, alignment, grade, surface finish, etc. after the required wet cure period has expired. Any test section of parapet which is not approved by the Engineer will be removed from the bridge or retaining wall to the satisfaction of the Engineer and at no cost to the Authority.

Once the test section is accepted by the Engineer, the Contractor shall proceed with additional HPC parapet slip forming on the Contract. The Engineer's approval for slip forming HPC parapets is a conditional approval and will be subject to the Contractor's ability to perform the work in accordance with the established procedures and the Contract Documents. This Engineer's approval to slip form HPC parapets may be rescinded at any time.

The measurements for air temperature, relative humidity and wind speed shall be taken at the location of the concrete placement. Concrete temperatures shall be taken from the sample used for slump and air content tests. These measurements and calculations shall be performed at least once per hour, beginning with the initial concrete placement and whenever, in the opinion of the Engineer, changes in the atmospheric condition merit such. The Contractor shall supply all the instruments necessary to take these measurements, subject to approval by the Engineer, including two (2) battery operated psychrometers, two (2) concrete thermometers and two (2) wind gauges. These instruments shall become the property of the Contractor after final Acceptance. All instruments shall be certified by an independent laboratory that has

been approved by the Engineer. The instruments shall be certified to be in good working order and as having been calibrated within the two months immediately prior to use. No separate payment will be made for providing these instruments.

Placement shall not begin, or shall be discontinued, in the event of rain. The Contractor shall provide a sufficient number of approved covers and take adequate precautions to protect freshly-placed concrete from rain. The Engineer may order the replacement of any material damaged by rain.

(B) The Contractor is advised that curing of the HPC shall be performed in accordance with the provisions of Subsection 401.18. Furthermore, wet burlap, for the curing of the deck slab concrete, shall be placed within ten (10) minutes after the concrete is struck off.

If it is anticipated that the ten (10) minute limitation will not be met, the concrete placement operation shall be stopped. A cold joint shall be formed and the Contractor shall submit a revised plan of operation for review and approval by the Engineer before resumption of the HPC placement.

The curing by wet burlap and white polyethylene sheets shall be for a minimum period of fourteen (14) calendar days for the bridge decks, headblocks, sidewalks, bridge approach slabs and integral abutment relief and sleeper slabs. Cast-in-place HPC bridge and retaining wall parapets constructed using the alternate panel method shall be cured using wet burlap and white polyethylene sheets for a minimum period of seven (7) calendar days. The contractor shall contain water runoff from the wet burlap curing of parapets over active facilities. Cast-in-place HPC parapets on bridges and retaining walls constructed using slip forming methods shall be cured by utilizing a liquid curing compound in accordance with Paragraph 401.18(E).

(1) The finishing machine equipment shall be set up so that the HPC is placed only 5 to 8 feet ahead of the machine.

(2) To demonstrate that the Contractor can place, finish and cure the HPC, a trial HPC placement of a minimum of 6 cubic yards of the HPC shall be placed at the project site at a location that is acceptable to the Engineer. A 9.25-inch thick and minimum 15-foot wide slab, cast into structurally-supported stay-in-place forms, shall be constructed to simulate the placement of the HPC bridge deck.

The location shall not be a structural element that is to remain in place. The trial HPC shall be placed, finished and cured in accordance with these Specifications at least seven (7) calendar days prior to the start of the HPC placement. No separate payment will be made for the HPC trial placement.

(3) Technical Representative(s) of the Contractor's ready-mix concrete supplier/manufacturer shall participate in the meetings between the Contractor and the Authority's Engineer as part of the planning process and prior to concrete placement operations. The Technical Representative(s) shall be on-site for trial slab placement and at least the initial two (2) bridge deck casting operations. The need for further involvement by the Technical Representative(s) shall be as determined by the Engineer.

(4) The Contractor shall have personnel on-site certified through the ACI Inspector Certification Program with the certification level of "Concrete Construction Special Inspector" whom are experienced with HPC and shall be responsible for all quality control measures related to curing and placing the HPC. The Contractor's designee for all HPC quality control measures shall be a single point of contact.

(5) Application of Concrete Penetrating Sealer is not required for HPC decks, parapets, sidewalks, bridge approach slabs, relief slabs or sleeper slabs.

428.05 HPC Acceptance Requirements.

(A) The requirements specified in Subsection 401.16 for control and acceptance testing of Class B concrete shall be adhered to in the fabrication of the HPC elements.

(B) Acceptance testing performance measures for production HPC shall consist of the following parameters:

Performance Characteristic	Standard Test Method	Performance Required
Percent Air Entrainment *		6.0 ± 1.5 (#57 Aggregate) 6.0 ± 1.5 (#67 Aggregate) 7.0 ± 1.5 (#8 Aggregate)
Slump *		3" ± 1"

Performance Characteristic	Standard Test Method	Performance Required
Chloride Permeability **		
56 days (coulombs)	AASHTO T 277 ASTM C 1202	1,100 maximum
28 days surface resistivity (kOhm-cm)	AASHTO TP 95	22.5 minimum
90 day ponding	AASHTO T 259/T 260	0.65 maximum. Total integral chloride to 1.6 in depth.
56 days Free Shrinkage***	ASTM C 157	450 microstrains maximum
28 day Compressive Strength	AASHTO T 22 ASTM C 39	4,500 PSI minimum
Early Age Concrete (Verification Strength)		
3 day Compressive Strength	AASHTO T 22 ASTM C 39	3,150 PSI minimum

When concrete pumping is used for placement, the percent air entrainment and slump testing shall be performed at the discharge of the truck chute as well as at the discharge end of the concrete pump.

* As per the guidance stated in Subsection 401.02, and in accordance with Subsection 905.03 and Paragraphs 905.05(B) and (C), when a Superplasticizer (Type F admixture) is used, the Slump and Air Content values for the HPC shall be as follows:

Slump: 6" ± 2".

Air Content: Increase both the target value and tolerance percentages by 0.5.

As per Paragraph 428.04(A), the required Slump values for the HPC slip form parapet concrete mix design shall be 1" ± ½".

** For chloride permeability testing, additional cylinders shall be provided in accordance with Subsection 905.22 for AASHTO T227, AASHTO TP95 and AASHTO T259/T260 testing to the Authority.

*** For the Free Shrinkage Test (ASTM C157) the curing method and duration should be consistent with the NJTA Specifications. The test is to be performed on specimens that are cured using a modified curing procedure as per NJTA Specifications by applying wet burlap for 14 days instead of the 28 days cure specified in the ASTM C157 procedure. The following readings as specified by ASTM C157, which is ½ hour after de-molding, another reading at 14 days of curing, and in air storage after curing 4, 7, 14 and 28 days and 8, 16, 32 and 64 weeks.

(C) For quality acceptance limits, testing, sampling and pay adjustments see Subsections 905.21, 905.22 and 905.23.

(D) Retarder admixtures shall not be permitted when bridge decks are poured under staged construction with live load.

(E) Superplasticizers (Type F water reducing, high range admixtures) and mid-range water reducing admixtures shall be permitted, but the use of such admixtures may not delay the set time beyond 4 hours.

428.06 Measurement.

Measurement for the bridge deck, headblocks, sidewalks, bridge and parapets shall be made as described in Subsection 401.23 and shall include all incidental sealers and caulks required by the Specifications or noted in the Plans unless specifically called for to be measured separately.

Measurement for bridge approach slabs shall be made in accordance with Subsection 304.05.

Measurement for the integral abutment relief and sleeper slabs will be measured by the total volume of HPC placed as prescribed and shown on the plans or as directed. No deductions will be made for the volume of the reinforcement steel, embedded steelwork or chamfers having leg dimensions 2" and less.

428.07 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CONCRETE IN DECK, HPC	CUBIC YARD
CONCRETE IN SIDEWALK, HPC	CUBIC YARD
CONCRETE IN HEADBLOCK, HPC	CUBIC YARD
CONCRETE IN PARAPET, HPC	CUBIC YARD
RELIEF SLAB, 18" THICK, HPC	CUBIC YARD
SLEEPER SLAB, HPC	CUBIC YARD
BRIDGE APPROACH SLAB, HPC	SQUARE YARD
HPC CRACK SEALING	COST PLUS

No separate payment will be made for the methacrylate crack sealer used for sealing cold joints or concrete/steel interfaces, but all the cost thereof shall be included in the unit price bid for the bid item Concrete in Deck, HPC.

No separate payment will be made for the modification of the HPC concrete mix design, the saw cutting of parapet joints, any additional support needed to secure the reinforcement against movement during slip forming or test sections required due to the Contractor's request to slip form the HPC parapets on bridges or retaining walls.

Sealing of cracks that develop in the HPC bridge deck, sidewalk, approach slab, relief slab, sleeper slab or headblock shall be paid on a cost plus basis in accordance with Subsection 108.04.

SECTION 429 – DRILLED SHAFTS

429.01 Description.

This work consists of constructing cast-in-place reinforced concrete drilled shafts and rock sockets, as required, to serve as structural foundations for bridge structures and sign structures where indicated on plans. This work shall provide reinforced concrete shafts cast in cylindrically excavated holes extending sufficiently into soil or rock to adequately support the structure and all externally applied loads for which the shaft was designed. This work shall consist of furnishing all equipment, materials, tools, labor, services, and incidentals necessary to construct the drilled shafts in accordance with these specifications, as shown on the plans, and as directed by the Engineer. The work shall include excavation, installation and removal of temporary casing, installation of permanent steel casing, the use of drilling slurry, installation of reinforcement, placing concrete, finished shaft top preparation, furnishing and installation of CSL steel tubes, CSL testing and disposal of excavated soils.

429.02 Materials.

Materials shall conform to the following Sections and Subsections:

CONCRETE, MORTAR AND GROUT.	905
ADMIXTURES AND CURING MATERIALS	906
REINFORCEMENT STEEL FOR STRUCTURES	908

(A) CONCRETE.

Drilled shaft concrete shall conform to the requirements of Section 905, except where modified by this Section.

The concrete mix for drilled shafts shall be dense, homogeneous, fluid and resistant to segregation, and shall consolidate under self-weight such that vibrating or rodding will not be required.

The concrete shall have a set time that ensures fluidity is maintained throughout the shaft concrete placement and removal of temporary casing, if used.

Minimum 28 day compressive strength of the concrete shall be 4000 psi unless otherwise specified.

Slump shall be measured at the point of discharge as defined in ACI. At time of placement shall be 7 inches (1± inch) for concrete that is placed by the tremie method. The slump at the time of placement shall be 8 inches (1± inch) for concrete that is pumped through a tremie. Where self-consolidating concrete (SCC) is specified on the Plans, its mix design and placement shall conform to Self-Consolidating Concrete (SCC) for Drilled Shafts Specification

The maximum water per cement ratio of a concrete mix to be placed underwater shall be 0.45.

The use of a high range water-reducing admixture may be used to achieve the above properties.

(B) CASING.

If required, the Contractor shall be responsible for selecting the rigid casing used to stabilize shaft construction, unless otherwise specified in the Contract Documents. A casing with sufficient strength to withstand handling and installation stresses, and all pressures and forces acting on the casing including those from the soil and ground water shall be used.

Permanent casing shall conform to ASTM A252, Grade 2 seamless or spiral welded pipe, unless otherwise specified.

Casings shall be smooth, non-corrugated, clean, and be watertight. Corrugated casing shall be permitted only with the approval of the Engineer.

Shop drawings for temporary and permanent steel casing shall be furnished in accordance with Subsection 104.08.

(C) DRILLING SLURRY.

Drilling slurry is defined as mineral slurry, polymer slurry, natural slurry formed during the drilling process, water, or other fluids used to maintain stability of the drilled shaft excavation, to aid in the drilling process, or to maintain the quality of the rock socket. In addition, the terms mineral slurry and polymer slurry, as used herein, will be defined as the final mixed composite of all additives, including manufactured mineral or polymer slurry additives required to produce the drilling slurry.

Drilling slurry may be used if detailed in the approved installation plan, if in accordance with these Specifications, and if approved in writing by the Engineer. The use of drilling slurry does not excuse the Contractor from their responsibility to install shafts free of defects. If defects are noted in shafts whether or not slurry was used, the Contractor shall repair all defects to the approval of the Engineer at no additional cost to the Authority.

The material used to make the slurry shall not be detrimental to the concrete or surrounding ground strata. Mineral slurries shall have both a mineral grain size that remains in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. Polymer slurries shall have sufficient viscosity and gel characteristics to transport excavated material to suitable screening systems or settling tanks. The percentage and specific gravity of the material used to make the slurry shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. If approved by the Engineer, the Contractor may use water and on-site soils as drilling slurry. In that case, the range of acceptable values for density, viscosity and pH, as shown in the following table for bentonite slurry, shall be met, except that maximum density shall not exceed 70 pounds/cubic foot. When water is used as the drilling fluid to construct rock sockets in limestone, dolomite, sandstone or other formations that are not erodible, the requirements for slurry testing will not apply.

An acceptance range of values for the physical properties of drilling slurry will be as shown in the table below.

Range of Acceptable Values for Mineral and Polymer Slurries in Fresh Water Without Additives					
Property	**Bentonite**	**Emulsified Polymer**	**Dry Polymer**	**Units**	**Test Method**
Density (Unit Weight)				lb/ft^3	Mud Weight (Density), API 13B-1, Section 1
At Introduction	63.5 - 66.8	< 63	< 63		
Prior to Concrete	63.5 - 70.5	< 63	< 63		

Range of Acceptable Values for Mineral and Polymer Slurries in Fresh Water Without Additives					
Property	**Bentonite**	**Emulsified Polymer**	**Dry Polymer**	**Units**	**Test Method**
Viscosity At Introduction	32 - 60	33 - 43[b]	50 - 80[b]	sec/qt	Marsh Funnel and Cup, API 13B-1, Section 2.2
Prior to Concrete	32 - 60	33 - 43[b]	50 - 80[b]		
pH At Introduction	8 - 10	8 - 11	7 - 11	-	Glass Electrode, pH Meter, or pH Paper
Prior to Concrete	8 - 10	8 - 11	7 - 11	-	
Sand Content At Introduction	< 4	< 1	< 1	Percent by Volume	API Sand Content Kit, API 13B-1, Section 5
Prior to Concrete	< 10	< 1	< 1		
Maximum Contact Time[a]	4	72	72	Hours	

a Without agitation and sidewall cleaning.

b Higher viscosities may be required to maintain excavation stability in loose or gravelly sand deposits.

(D) Access Tubes for Crosshole Sonic Logging Test.

Access tubes for crosshole sonic logging shall be 1.5 inch to 2.0 inch inside diameter schedule 40 steel pipe. Use of PVC pipe will not be permitted. The pipes shall have a round, regular internal diameter free of defects or obstructions, including any at pipe joints, in order to permit the free, unobstructed passage of the source and receiver probe. The tubes shall be watertight and free from corrosion with clean internal and external faces to ensure passage of the probes and a good bond between the concrete and the tubes. Tubes shall be filled with water as per Paragraph 429.05(A).

429.03 Quality Assurance.

(A) Contractor Qualifications.

Construction of the drilled shafts shall be directly and exclusively performed by a Contractor or Subcontractor with a supervisor and workforce experienced in the construction of drilled shafts, and meeting the following qualifications:

(1) The installation of drilled shaft foundations shall be performed by a Contractor specializing in drilled shaft construction with no less than five (5) years of experience installing drilled shafts. The Contractor performing the Work described herein shall have successfully completed not less than five (5) contracts with drilled shafts of similar diameter, length, capacity and complexity to those shown on the Plans. Experience shall be relevant to the anticipated subsurface materials, groundwater conditions, and any special construction techniques required.

(2) The supervisory personnel in charge of daily operations shall have a minimum of five (5) years of work experience on at least three (3) projects installing drilled shaft foundations. The drilled shaft supervisor shall be present at the site during the entire drilled shaft construction process (i.e. drilling, coring, placing of reinforcement, concreting, etc.) to troubleshoot any problems that may arise during the construction process. Experience must include the direct supervisory responsibility for the on-site construction operations for drilled shafts utilizing the construction techniques required.

(3) The drill-rig operators must have at least three (3) years of work experience on projects using the drilled shaft foundation excavation methods approved for this project.

(4) A specialty slurry consultant shall be retained by the Contractor performing the work if excavation with polymer slurry is utilized or when polymer slurry is mixed with mineral slurry. The specialty slurry consultant performing the Work described herein shall have successfully implemented slurry design and management plans for the installation of drilled shafts under slurry excavation of drilled shafts of similar diameter, length and complexity to those shown on Plans for a minimum of three (3) projects and with five (5) years of experience. Experience shall be relevant to the anticipated subsurface materials, groundwater conditions, and any special construction techniques required. The specialty slurry consultant's technical representative shall be present at the site during the entire drilled shaft construction process where slurry is utilized.

(B) DRILLED SHAFT INSTALLATION PLAN.

A Drilled Shaft Installation Plan shall be prepared by the Contractor for approval by the Engineer. The plan shall include a descriptive narrative of the plans and shall provide at a minimum the following information:

(1) A summary of the Contractor's experience and qualifications as detailed above on projects of a similar nature and scope. Include the name and telephone number of someone for each project cited who can be contacted as a reference. The Drilled Shaft Contractor shall be selected by the Contractor and be approved by the Engineer. Approval will be based on qualifications and previous experience on similar projects. Judgment regarding adequacy of the qualifications as detailed above shall at the sole discretion of the Engineer.

(2) Description of overall construction operation sequence and the sequence of drilled shaft construction when in groups or lines.

(3) A list containing the description, size and capacities of proposed equipment including but not limited to cranes, drills, augers, bailing buckets, final cleaning equipment, de-sanding equipment, slurry pumps, concrete pumps, temporary steel casing, and slurry sampling and testing equipment. As appropriate, the narrative shall describe why the equipment was selected, and describe equipment suitability to the anticipated site and subsurface conditions. The narrative shall include a project history of the drilling equipment demonstrating the successful use of the equipment on shafts of equal or greater size in similar subsurface geotechnical conditions.

(4) Details of equipment and procedures for drilled shaft installation, including drawings showing consecutive steps of drilled shaft installation and drawings with measurements showing that the proposed equipment can perform the specified work. Drawings shall be included that show the areas that are planned to be used for staging, plan view layout of the proposed sequence of drilled shaft installation, and details of placement, splicing, and centering devices for steel reinforcing.

(5) Mix design for the concrete and documentation from an independent laboratory showing that the mix design conforms to the submitted mix and meets the strength requirements indicated on the Contract Documents. The mix design and documentation shall be submitted for approval at least 30 calendar days prior to use.

(6) The Contractor shall submit a detailed Slurry Management Plan specific to the Project, prepared and signed by the approved specialty slurry consultant describing the slurry materials, the mix proportions, mixing methods and quality control methods. The Contractor's Slurry Management Plan shall include detailed provisions for controlling the quality of the slurry, including tests to be performed, the frequency of those tests, the test methods, and the maximum and/or minimum property requirements that must be met to ensure that the slurry meets its intended functions in the subsurface conditions at the construction site and with the construction methods that are to be used. The Slurry Management Plan shall include a set of the slurry manufacturer's written recommendations and shall include testing as indicated in Section 429.02(C).

(7) Details of drilled shaft excavation methods including the proposed drilling methods. If applicable, this shall include a review of method suitability to the anticipated site and subsurface geotechnical conditions including boulders and obstruction removal techniques.

(8) Details of proposed methods to clean shafts after initial excavation.

(9) Procedures for control and removal of spoils.

(10) Details of the method(s) to be used to ensure drilled shaft stability (i.e., prevention of caving, bottom

heave, etc. using temporary casing, permanent casing, slurry, or other means) during excavation and concrete placement. The details shall include a review of method suitability to the anticipated site and subsurface geotechnical conditions.

(11) Details of shaft reinforcement, including methods to ensure centering/required cover, cage integrity during placement, placement procedures, and cage support.

(12) Details of concrete placement including proposed operational procedures for concrete pump or tremie including initial placement, raising during placement, and overfilling of the shaft concrete, and provisions to prepare the completed shaft top at its final shaft top elevation.

(13) Details of equipment and procedures for drilled shaft load testing, including drawings showing instrumentation locations and narrative describing testing procedures.

(C) RECORDS.

Actual drilled shaft location data specified in items 1 through 17 shall be submitted to the Engineer within one working day after a drilled shaft is installed. Items 18 and 19 shall be submitted to the Engineer within 3 days from the date when the operation is performed. The Contractor shall provide the Engineer with written tabulations of the following information:

(1) Drilled shaft location.

(2) Elevation of top of drilled shaft measured to the nearest ½" inch.

(3) Deviation from design plan location measured to the nearest 1/10" inch.

(4) Plumbness (deviation from vertical).

(5) Date of drilling; concrete placement

(6) Shaft designation

(7) Type and size of shaft

(8) Elevation of ground surface

(9) Elevation of bottom of shaft

(10) Elevation of top of rock

(11) Length of casing

(12) Log of drilling operations and materials encountered

(13) Composition and properties of drilling slurry

(14) Concrete composition and measured slump

(15) Method of concrete placement

(16) Volume of concrete placed

(17) Log of concrete placement operations

(18) Results of integrity testing or post installation testing.

(19) Description of any grouting operations to repair shaft

Within seven working days after the completion of installation of all the drilled shafts, and before removing the drilled shaft installation equipment from the site, the Contractor shall provide the Authority with a plan certified by a Professional Land Surveyor registered in the State of New Jersey showing the as-installed location of all drilled shafts installed to the tolerances indicated in these specifications and as shown on the Plans.

429.04 Installation of Drilled Shafts.

The following requirements shall apply to all installations of Drilled Shafts:

(A) EQUIPMENT.

Drilled shafts shall be installed with approved drilling equipment. The proposed drilled shaft installation equipment and methods shall be subject to the approval of the Engineer and approval shall be secured before mobilization. Approval by the Engineer shall not relieve the Contractor of their responsibility to

provide equipment with sufficient power, downward thrust and torque, materials, and methods to adequately perform the work in a safe, timely, workmanlike manner. Approval shall not be reason to hold the Authority and/or the Engineer responsible for the Contractor's or drilled shaft subcontractor's failure to perform the Work.

The Contractor shall perform the excavations required for the shafts through whatever materials are encountered, to the dimensions and elevations shown in the Plans or otherwise required by these Specifications. The Contractor's methods and equipment shall be suitable for the intended purpose and whatever the materials encountered.

The Contractor shall provide equipment capable of constructing shafts to a depth equal to the deepest shaft shown in the Plans plus 15 feet or plus an additional length of three times the shaft diameter, whichever is greater, except when the Plans instruct the Contractor to provide equipment capable of constructing shafts to a greater depth.

The Contractor shall provide all equipment, including concrete pumps or tremie pipes required for the placement of concrete into the drilled shafts in accordance with the Contract Documents. The minimum inside diameter of concrete pump lines or the tremie pipe shall be greater than six times the maximum aggregate size.

(B) SHAFT EXCAVATION.

The Contractor shall protect existing utilities within the drilled shaft installation work zone within the influence of the Contractor's installation methods in accordance with the requirements of the Authority or authorities having jurisdiction. Prior to excavations for shafts, the Contractor shall locate and pre-excavate to expose portions of the existing utilities within the shaft work area, and provide support and protection as necessary such as not to adversely affect the integrity of the utilities due to construction activities. The Contractor shall repair or replace any construction-induced damage to the satisfaction of the Authority or governing authority at the Contractor's expense. The excavation and support methods shall be subject to approval by the Engineer.

Drilled shafts shall be located and staked by the Contractor prior to the start of installation work. The Contractor shall maintain all location stakes and shall establish all elevations required.

The Contractor shall employ at no additional expense, a Professional Land Surveyor licensed in the State of New Jersey, experienced in this type of work, who shall establish lines and grades. The Contractor shall be responsible for the correct location of drilled shafts and keeping a record of drilled shafts installed.

Excavation for shafts shall be advanced by rotary drilling methods approved by the Engineer which do not permit loss of ground and which will not adversely affect existing utilities and adjacent structures. Equipment used shall be capable of excavating through the type of materials expected to be encountered, including boulders, rubble, and other obstructions, if present. When the material encountered cannot be drilled using conventional earth augers and/or underreaming tools, provide special drilling equipment, including but not limited to rock augers, core barrels, rock tools, air tools, and other equipment as necessary to continue the shaft excavation to the size and depth shown on the plans.

Drilling tools and excavation procedures shall be utilized that minimize negative pressure in the excavation that might induce soil heave into the bottom of the excavation. An auger, if used, shall be withdrawn slowly. At completion of the excavation, clean the shaft bottom with an air-lift system or a clean-out bucket equipped with a one-way flap gate that prevents spoil in the bucket from re-entering the excavation.

The shaft excavations shall be of the sizes and dimensions and shall be carried to the depths shown on the Plans.

The Contractor bears full responsibility for selection and execution of the method(s) of stabilizing and maintaining the drilled shaft excavation. The walls and bottom of the drilled shaft excavation shall be protected so that side wall caving and bottom heave is prevented, and so that the soil adjacent to the drilled shaft is not disturbed. The Contractor may excavate the drilled shaft without excavation protection, provided the Contractor can demonstrate that the soil/rock is stable and above the water table and zones of seepage. The dry construction method, wet construction method, temporary casing method, permanent casing method, or combinations, as necessary, shall be used to produce sound, durable concrete drilled shafts free of defects. Acceptable protection methods include the use of casing, drilling slurry or both as described below.

(1) Dry Construction Method.

(a) The dry construction method shall be used only at sites where the groundwater table and site

conditions, generally stiff to hard clays or rock above the water table, are suitable to permit construction of the shaft in a relatively dry excavation and where the sides and bottom of the shaft remain stable without any caving, sloughing or swelling and allow visual inspection prior to concrete placement. The dry method shall consist of drilling the shaft excavation, removing accumulated seepage water and loose material from the excavation and placing the shaft concrete in a relatively dry excavation with less than three inches of standing water at the bottom of the excavation at the time of concrete placement. The dry construction method shall be used only with the written approval of the Engineer and when shaft excavations, as demonstrated in a demonstration shaft or first production shaft, have 12 inches per hour or less of seepage.

(2) Wet Construction Method.

(a) This method shall consist of drilling the shaft excavation below the water table, keeping the shaft filled with water, natural slurry formed during the drilling process, mineral slurry or polymer slurry to contain seepage and groundwater movement, and to maintain stability of the hole perimeter until excavation to the final depth and placement of the reinforcing cage and concrete has been completed. This procedure will require placing the shaft concrete with either a tremie or concrete pump beginning at the shaft bottom, and displacing the water or slurry as concrete is placed. Where drilled shafts are located in open water areas, shafts shall be constructed by the wet method using casings extending from above the water elevation to the plan casing tip elevation to protect the shaft concrete from water action during placement and curing. The casing shall be installed in a manner that produces a positive seal at the bottom of the casing.

(b) The slurry method of excavation consists of using drilling slurry to maintain stability of the excavation. Slurry, if used, shall conform to the requirements of this Specification unless otherwise approved by the Engineer.

(c) Where slurry is used to maintain a stable excavation, the slurry level in the excavation shall be maintained to obtain hydrostatic equilibrium throughout the construction operation at a height required to provide and maintain a stable hole, but not less than five feet above the water table. The Contractor shall provide casing, or other means to meet these requirements, to aid in alignment and position, and to prevent sloughing of the top of the shaft excavation.

(d) The Contractor shall clean, re-circulate, de-sand, or replace the slurry as needed in order to maintain the required slurry properties. Slurry shall be completely cleaned prior to concrete placement by circulation to control uniformity and remove coarse materials.

(e) When any slurry samples are found to be unacceptable as detailed in Paragraph 429.04 (E), the Contractor shall take whatever action is necessary to bring the slurry to within specified requirements. Concrete shall not be placed until the slurry in the hole is re-sampled and test results produce acceptable values.

(f) If the slurry remains in the hole for more than 12 hours or if caking develops, the hole shall be roughened or re-reamed with appropriate new bottom cleaning and slurry testing prior to concreting.

(3) Excavation Support using Temporary Casing.

(a) In stable soils the Contractor shall conduct casing installation and removal operations and shaft excavation operations such that the adjacent soil outside the casing and shaft excavation for the full height of the shaft in not disturbed.

(b) If the Contractor is utilizing casing that is adequately sealed into competent soils such that water cannot enter the excavation, the Contractor may, with the Engineer's approval, continue excavation in soils below the water table provided the water level within the casing does not rise or exhibit flow.

(c) As the temporary casing is withdrawn, a sufficient head of fluid concrete shall be maintained to ensure that water or slurry outside the temporary casing will not breach the column of freshly placed concrete.

(d) Casing extraction shall be at a slow, uniform rate with the pull in line with the axis of the shaft. Excessive rotation of the casing shall be avoided to limit deformation of the reinforcing steel cage.

(e) The Contractor shall remove all temporary casings from the excavation as concrete placement is completed, unless permission has been received from the Engineer to leave specified temporary casings in place.

(4) Excavation Support using Permanent Casing.

(a) Where permanent casing is specified in the Contract Documents, excavation shall conform to the specified outside diameter of the shaft.

(b) The casing shall be advanced by methods that do not create void space outside the casing. After the casing has been filled with concrete, any void space that exists shall be filled with a material which approximates the geotechnical properties of the in-situ soils and as approved by the Engineer.

(c) Where, in the opinion of the Engineer, soil conditions will permit heave of soil or flow of water into the bottom of the casing, drilling fluid shall be introduced into the casing and maintained at a level above the ambient ground water level.

(d) Drilling ahead of the casing shall not be allowed, except where the soils below the bottom of the casing are self-supporting, as determined by the Engineer.

(e) Tops of permanent casing for the shafts shall be removed to the top of the shaft or finished ground line, whichever is lower, unless the top of the permanent casing is shown in the Plans at a different elevation.

(f) For shafts constructed within a permanent body of water, tops of permanent casing for shafts shall be maintained at the 100 year flood elevation for a minimum of three days after concrete placement before it is cut off to the required elevation as indicated on the Contract Documents.

Shaft casing, if applicable, shall be installed by either rotating or oscillating the casing. Vibratory placement of casing shall not be permitted within 200 feet of structures supported on shallow foundations and within 100 feet of structures supported on friction bearing deep foundations unless permission is granted in writing by the Engineer and a vibration monitoring plan including threshold vibration levels is submitted and approved in accordance with the Vibration Monitoring Specification 214.

When a rock socket is required, the Engineer will be the sole judge as to what constitutes the top of sound rock. The Engineer may order additional depths of rock socket below the top of sound rock as deemed necessary to improve the foundation. If the top surface of the sound rock is found to be inclined across the width of the shaft, the contractor shall immediately notify the Engineer.

Where drilled shafts extend into rock, the elevation of the top of sound rock shall be verified during construction by attaching a thin cable with calibrated depth marker, metal tape, or other approved equipment to the Contractors extended Kelly Bar prior to rock excavation. The distance from a known elevation to the top of rock shall be measured in five locations. The measurement shall be recorded at the center, north, east, west and south portions of drilled shaft. If the estimated elevation of top of rock shown on the Contract Drawings differs more than three (3) feet from the average of the five measurements, the Engineer shall be notified immediately and consulted as to directions on how to proceed. If the top surface of the sound rock is found to be inclined across the width of the shaft, the Contractor shall immediately notify the Engineer.

Construction of the shafts shall be performed so that placement of reinforcing steel and concrete is a continuous operation performed the same day that the excavation is completed, unless otherwise directed by the Engineer.

Approved cutting shoes of hardened steel shall be welded to the bottom of each steel casing. In shafts that are to be socketed into rock, the casing shall be advanced sufficiently into the sound rock so as to prevent inflow of soil and water.

Rock sockets below the casing, where shown, shall be drilled or chopped into the rock to the depths necessary to provide the required depth of socket in sound rock as shown on the Plans, or as otherwise directed by the Engineer. The Contractor shall remove all rock fragments, soil or other foreign matter so as to provide a clean bearing surface at the bottom. The total length of rock socket as specified in the Plans shall be measured below the bottom of casing, and not the top of rock, where the casing has been embedded into the rock stratum.

If necessary, splicing the steel casing shall be accomplished with a partial penetration butt welded with no backer bars permitted inside or outside the casing unless otherwise noted on the Plans. The ends of the casings shall be square-cut so that the sections shall bear on each other and shall be connected to the sleeves by continuous welds.

(C) OBSTRUCTIONS.

An obstruction is defined as a specific object (including, but not limited to, boulders, logs, and man-made objects) encountered during the drilled shaft excavation operation which prevents or hinders the advance of the drilled shaft excavation.

When the Contractor encounters conditions that are considered an obstruction, the Contractor shall notify the Engineer immediately. Whether or not the conditions encountered will be considered an obstruction shall be at the sole discretion of the Engineer.

When efforts to advance past the obstruction to the design drilled shaft tip elevation result in the rate of advance of the drilled shaft drilling equipment being significantly reduced relative to the rate of advance for the portion of the drilled shaft excavation in the geological unit that contains the obstruction, then the Contractor shall remove, bypass or break up the obstruction. The contractor shall employ special procedures or tools when the hole cannot be advanced using conventional equipment.

Drilling tools lost in the excavation will not be considered obstructions and shall be promptly removed by the Contractor. All work required to remove lost tools or to perform associated corrective work, including but not limited to repair of hole degradation due to removal operations, will be non-compensable and any effect on time of performance non-excusable.

(D) DEMONSTRATION SHAFTS.

When required by the Contract Documents, , the Contractor shall demonstrate the adequacy of methods and equipment used during construction of the first drilled shaft, which shall be an out of position demonstration shaft, constructed with reinforcement as identified for production shafts on the Plans. This demonstration shaft shall be drilled in the position as shown on the Plans or as otherwise directed by the Engineer and drilled to the maximum depth for any production shaft shown on the Plans. If at any time the Contractor is unable to demonstrate, to the satisfaction of the Engineer, the adequacy of methods or equipment and alterations required, an additional demonstration shaft(s) may be required at no additional cost to the Authority. Demonstration shafts shall be cut off 3 feet below ground line, buried or otherwise disposed of as specified in the Contract Documents or as otherwise directed by the Engineer. Once approval has been given to construct production shafts, no changes will be permitted in the methods of equipment used to construct the shaft without approval from the Engineer. When a demonstration shaft is not required, construction of the first production shaft will be used to determine if the methods and equipment used by the Contractor are acceptable. Failure at any time to demonstrate to the Engineer the adequacy of methods or equipment will be cause for the Engineer to require appropriate alterations in equipment or method by the Contractor to eliminate unsatisfactory results.

(E) SLURRY.

(1) Preparation.

Prior to introduction into the shaft excavation, the manufactured slurry admixture shall be pre-mixed thoroughly with clean, fresh water and for adequate time in accordance with the slurry admixture manufacturer's recommendations allotted for hydration. Slurry tanks of adequate capacity will be required for slurry mixing, circulation, storage and treatment. No excavated slurry pits will be allowed in lieu of slurry tanks without written approval from the Engineer. Adequate desanding equipment will be required as necessary to control slurry properties during the drilled shaft excavation, in accordance with the values provided in Section 429.02 (C).

(2) Control Tests.

Control tests using a suitable apparatus shall be performed by the Contractor on the slurry to determine density, viscosity, sand content and the pH of freshly mixed slurry, recycled slurry and slurry in the excavation. Tests of slurry samples from within one foot of the bottom and at mid-height of the shaft shall be conducted in each shaft excavation during the excavation process to establish a consistent working pattern. A minimum of four sets of tests shall be conducted during the first eight hours of slurry use on the project. When the results show consistent behavior, the testing frequency may be decreased to one set every four hours of slurry use, or as otherwise approved by the Engineer. Reports of all tests, signed by an authorized representative of the Contractor, shall be furnished to the Engineer on completion of each drilled shaft. An acceptance range of values for the physical properties is provided in Section 429.02 (C).

(3) Sampling.

When slurry samples are found to be unacceptable, the Contractor shall bring the slurry in the shaft excavation to within specification requirements. Concrete shall not be placed until resampling and testing results produce acceptable values. Prior to placing shaft concrete, the Contractor shall take slurry samples from within one foot of the bottom and at mid-height of the shaft. Any heavily contaminated slurry that has accumulated at the bottom of the shaft shall be removed. The Contractor shall perform final shaft bottom cleaning after suspended solids have settled from the slurry mix. All excavated material, slurry and slurry contaminated material shall be removed and disposed of off-site in accordance with the NJDEP and USEPA regulations, and as approved by the Engineer.

(F) REINFORCING STEEL.

Reinforcing steel shall be free of mud, oil, or other coatings that adversely affect bond. Reinforcing bars shall be placed as shown on the Plans with cover of not less than three (3) inches where exposed to soil.

The reinforcing cage shall be rigidly braced to retain its configuration during handling and construction. Individual or loose bars will not be permitted. All intersections of vertical and horizontal bars must be tied. Where ASTM A706 reinforcing steel bars are used to fabricate the reinforcing cage, all intersections of vertical and horizontal bars shall be welded.

The reinforcing steel cage, consisting of longitudinal bars, ties, cage stiffener bars, spacers, centralizers, and other necessary appurtenances, shall be completely assembled and placed as a unit immediately after the shaft excavation is inspected and accepted, and prior to concrete placement. The reinforcement shall be carefully positioned and securely fastened to provide the minimum clearances specified or shown on the Plans, and to ensure that no displacement of the reinforcing steel cage occurs during placement of the concrete.

Bracing steel that constricts the interior of the reinforcing cage shall be removed after lifting the cage to allow access for a concrete tremie tube for concrete placement.

The elevation of the top of the steel cage shall be checked before and after the concrete is placed. If the upward displacement of the rebar cage exceeds 6 inches, or if the downward displacement exceeds 2 inches, the drilled shaft will be considered defective. The elevation of the top of the cage shall not differ by more than two inches between any two points. Corrections shall be made by the Contractor to the satisfaction of the Engineer.

(1) Spacers.

(a) Concrete spacers or other approved non-corrosive spacing devices shall be used at sufficient intervals, near the bottom and along the shaft at intervals not exceeding 10 feet, to ensure concentric location of the cage within the shaft excavation. When the vertical steel is greater than one inch in diameter, the maximum spacing may be increased to 15 feet. As a minimum, a set of spacers shall be provided within 2 feet of both the top and bottom of the shaft. In addition, one set of spacers shall be provided at both 2 feet above and below each change in shaft diameter. Non-corrosive spacers shall be provided at a minimum of one spacer for each foot of excavation diameter at each level, with a minimum of four (4) spacers per level to maintain the required reinforcement clearances. The spacers shall be of adequate dimension to maintain the specified clearance between the outside of the reinforcing cage and the side of the excavated hole or casing.

(b) Spacers fabricated from concrete shall be constructed equal in quality and durability to the concrete specified for the shaft. Spacers fabricated from reinforcing steel shall be epoxy coated.

(2) Reinforcing Ties, Splices and Clearances.

(a) ASTM A615 reinforcing steel in the shaft shall be double-wire tied and supported so that it will remain within the allowable tolerances given in the Contract Documents after it has been lifted and placed into the shaft.

(b) Mechanical bar splices shall be staggered such that no more than 50 percent of the splices are within a 2-lap splice distance. Welding of ASTM A615 reinforcing steel will not be permitted. The reinforcing steel cage shall have sufficient rigidity to prevent racking or permanent deformations during delivery or installation.

(3) Bottom Supports.

The reinforcing cage bottom supports shall be positioned such that the reinforcing steel is not allowed

to come into contact with the soil or rock and to ensure that the bottom of the cage is maintained at the proper distance above the base of the shaft as identified in the Plans or as otherwise directed by the Engineer. The bottom supports shall not be used to support the weight of the cage. The bottom of the reinforcing cage shall not be greater than 6 inches above the bottom of socket.

(4) Reinforcing Steel Extension.

Where shafts are extended to final authorized tip elevations lower than the estimated minimum tip elevations, the reinforcing cage shall be extended to the authorized tip elevation by lap splicing or mechanical splicing. Splices of adjacent bars will not need to be staggered in this situation and all of the reinforcing bars may be spliced at a given location Lap splices shall be tied firmly enough to support the full weight of the reinforcing cage above the lap zone. Horizontal reinforcing bands shall be added in the bottom extension zone at a vertical spacing no more than 6 inches center to center.

(G) CONCRETE PLACEMENT.

The handling, measuring, proportioning, mixing, and placing of concrete shall conform to Section 401. Concrete shall be placed only in the presence of the Engineer.

CSL tubes shall be filled with water as per Paragraph 429.05(A).

Concrete placement shall commence as soon as possible after completion of drilled shaft excavation by the Contractor and within 8 hours of inspection by the Engineer. Immediately prior to positioning the reinforcing cage or structural steel core, clean the bottom of shaft excavation as specified in 429.04 (B).

Concrete shall be placed using a concrete pump or a tremie pipe from the bottom of the excavation upward so as to avoid segregation. Concrete shall not be allowed to fall freely.

Air, water, or slurry shall not be injected into the shaft concrete during placement. A disposable plug/pig shall be used in the concrete pump line or tremie pipe to separate the fresh concrete from the slurry at the start of concrete placement. The plug shall be inserted so that the first flow of concrete pushes the plug out of the pipe and prevents slurry mixing and contamination as the concrete placement commences.

The concrete pump line or tremie above the shaft shall consist of a tube constructed in sections having couplings fitted with sealed gaskets. The means of supporting the concrete pump line or tremie shall be such as to permit free movement of the discharge end over the entire top of the concrete, and to permit its being lowered rapidly when necessary to choke off or retard the flow. The outside of the tremie line shall be smooth so that there is no possibility of a projection becoming hooked on the reinforcing cage as the line is withdrawn during concrete placement.

The tremie, if used, shall be filled by a method that prevents washing of the concrete. The tremie discharge end shall remain immersed as deep as practical in the concrete, but shall be no less than 5 feet at all times after initiation of concrete placement flow. The concrete line shall contain sufficient concrete to prevent any water entry.

If concrete flow is halted and the concrete line's discharge end is for any reason raised out of the shaft concrete, flow shall be reinitiated only after fully recharging the concrete line with fresh concrete by 1) inserting a foam or rubber plug or pig into the concrete line at the concrete hopper end, 2) placing the discharge end approximately 6 inches above the top of the shaft concrete, 3) resuming concrete flow, recharging the pump or tremie line and depositing what will be classified as waste concrete on the top of the previously placed shaft concrete, 4) discharging waste concrete until the line is fully recharged with fresh concrete and the pig is pushed completely through the line, 5) without halting the flow of fresh concrete plunging the discharge end of the concrete line into the shaft concrete to within 6 inches or less of the shaft bottom or to a level as directed by the Engineer, 6) continuing concrete placement without further interruption, and 7) placing a final volume of additional concrete in the shaft no less than the volume of waste concrete placed to recharge the line in the process of resuming concrete flow. This procedure shall be applied without exception as necessary to avoid injecting any air, any water, any slurry, or any concrete that has flowed through a line filled with air, water, or slurry into the shaft concrete.

The concrete placement shall be continuous until the work is completed, resulting in a seamless, uniform shaft. Where sign structure drilled shafts are to be constructed, the Contractor may, at his sole expense, elect to include a cold joint at the underside of the sign structure anchor bolts in order to facilitate more precise anchor bolt placements. Where the Contractor elects to include a cold joint, its location shall be included in the Contractor's shop and working drawing submission(s). No cold joints will be permitted for drilled shafts for bridges. If the concrete placement operation is interrupted, the Engineer may require the Contractor to prove by core drilling or other tests that the drilled shaft contains no voids or horizontal

joints. If testing reveals voids or joints, the Contractor shall repair them or replace the drilled shaft at no expense to the Authority.

Final concrete placement elevation details shall be as specified herein for shaft top preparation. A hole shall not be progressed within five drilled shaft diameters of a previously installed drilled shaft until the concrete has been in place for a minimum of 2 days.

(H) SHAFT CONSTRUCTION TIMING.

Every effort shall be made by the Contractor in planning, coordinating, and carrying out the work to minimize the time between the start of excavation and completion of shaft concrete placement. Each step in the process of initially drilling, satisfactorily cleaning the shaft bottom, placing reinforcing steel, and completing concrete placement shall be coordinated to avoid delays during or between each work step. In general, the time between rock socket excavation and completion of concrete placement is expected to be 24 continuous hours or less. The time between the completion of the excavation and commencement of concrete placement shall be 12 hours or less.

For cases where four (4) or more continuous hours elapse between inspection of the drilled shaft and commencement of concrete placement, any reinforcing steel already placed in the shaft shall be removed, the shaft bottom shall be satisfactorily cleaned, reinforcing steel immediately placed in the shaft, and concrete placement immediately commenced.

(I) SHAFT TOP PREPARATION.

(1) If tremie concrete is used, the top-most concrete placed in the shaft shall be considered waste concrete and shall be either:

   (a) Pushed upward and ejected completely out of the top of the casing and wasted as final concrete is placed. Waste concrete must be allowed to evenly overflow the full top circumference of the casing, and may not be channeled or bleed off by notches or holes cut in the casing top. Any fresh concrete in the casing at a level above the plan shaft top level after ejecting all waste concrete may be dipped or pumped out to the plan top elevation while still plastic by methods and equipment approved by the Engineer, or allowed to cure in place for removal later.

   (b) Pumped upward to a level at least 2 feet clear distance above the plan shaft top level and allowed to cure in place for removal later.

(2) Waste concrete shall be considered to be the top 2 feet of initial concrete placed, plus the height of any additional volume of waste concrete deposited in the shaft where concrete placement was halted and restarted, plus any additional amount necessary to produce full strength, non-segregated concrete at the plan shaft top level.

   Final shaft top preparation may commence only once the drilled shaft concrete obtains an average unconfined compression strength of at least 2500 psi, or, in lieu of concrete strength testing, beginning seven (7) full days after completion of concrete placement. Final top preparation steps shall consist of:

   (a) Cutting off any extra casing above the top of casing plan elevation.

   (b) Cutting off any cured over-pour concrete to the plan shaft top elevation by approved methods.

   (c) Verification by the Engineer that the exposed concrete consists of full strength concrete with a typical, non-segregated mortar and aggregate distribution.

   (d) Approved non-destructive strength testing by the Contractor where required by the Engineer to verify that concrete has full design strength.

   (e) Removal of additional concrete below the plan shaft top level as necessary to reach full-strength, non-segregated concrete.

(J) BI-DIRECTIONAL OSTERBERG LOAD CELL (O-CELL) TESTS.

Bi-directional Load tests, when specified in the Contract Documents, shall be completed and submitted to the Engineer for review and approval before construction of any production drilled shafts. The locations of the load test shaft(s), the maximum loads to be applied, the test equipment to be supplied by the Contractor and the actual sequence of the load testing shall be as shown on the Plans or as specified in the Contract Documents. After completion of testing, test shafts shall be cut off at an elevation three feet below the finished ground line. The portion of the shaft(s) cut off shall become the property of the Contractor and shall be disposed of by the Contractor in a manner approved by the Engineer.

(1) Bi-Directional Load Cell Installation.

The Contractor shall install load cells and load test instrumentation in accordance with the bi-directional load cell supplier recommendations, instructions, and procedure manual(s), as approved by the Engineer.

The Contractor shall be responsible for coordinating with the load cell supplier to determine and/or verify all required equipment, materials, quantities, procedures, and all other applicable items necessary to complete the load testing shown on the Plans. The Contractor shall supply all materials required to install the bi-directional load test equipment, conduct the load test, and remove the load test apparatus as required.

(2) Load Testing and Reporting.

Perform load tests according to ASTM D 1143 unless otherwise specified in the Contract Documents. If the test apparatus shows signs of negative effects due to the construction activities, immediately cease testing and do not resume until the conditions are favorable for testing.

Two Linear Variable Differential Transformer (LVDT) vibrating wire displacement gauges shall be attached to each load cell to monitor the expansion and contraction of the load cell. In addition, two LVDT gauges shall be mounted on an independent reference beam and set on opposite sides of the top of the test shaft to monitor axial shaft displacement.

Two telltale rods shall be set on the top of each load cell to monitor the displacement of the top of the load cell. The telltale shall consist of a 3/8-inch diameter stainless steel rod, greased for reducing friction and corrosion, and placed inside a constant 3/4-inch diameter pipe or other as approved by the Engineer. Individual sections of telltales shall be joint coupled flush so that each rod is of uniform diameter throughout its length.

For each load test, the load shall be placed on the drilled shaft in increments of five percent of the estimated maximum test load shown on the Plans, or until the nominal resistance load (as indicated by the instruments) is approached, or to the maximum capacity of the load cell, whichever occurs first. Unless the maximum capacity of the load cell has been reached, increments of 2.5 percent of the estimated maximum test load shall then be applied until the limiting load is attained, or the drilled shaft top displacement reaches 2 inches, or to the maximum extension of the load cell. When the load cell will be used for a subsequent loading stage, the Engineer may interrupt the loading sequence at a load cell opening of approximately 3 inches, or less. In addition to the requirements of ASTM D 1143, each load increment shall be maintained for a minimum period of 5 minutes, with complete sets of readings obtained and recorded from all gauges and instruments at 1, 2 and 5 minutes after application of the load increment. Each increment of load shall be applied within the minimum length of time practical and the instrument system readings shall be taken immediately. It is intended that the addition of a load increment and the completion of the instrument system readings shall be completed within 5 to 15 minutes. The Engineer may elect to hold the maximum applied load for up to one hour.

The load shall be removed in decrements of about 10 percent of the maximum test load. Each decrement of load shall be removed within the minimum length of time practical and the instrument system readings shall be taken immediately. It is intended that the removal of a load decrement and the completion of the instrument system readings shall be completed within 5 to 15 minutes. The Engineer may also require a reloading cycle with ten loading increments and five unloading decrements. The final recovery of the drilled shaft shall be recorded for a period up to one hour after the last unload interval.

The Contractor shall provide the preliminary test report containing the load displacement curves and other test data to the Engineer within three days of completing each load test. The Contractor shall provide the final report on the load tests to Engineer within ten days after completion of each load test. The test report shall include at least the following items:

(a) Test shaft identification number and location.

(b) Date(s) of testing.

(c) Description of the test shaft details, instrumentation and test procedures.

(d) Tables presenting all instrumentation data.

(e) Plots of load versus displacement (up and down) for each load cell level, for each stage of the test.

(f) Plots of load along the length of the drilled shaft determined from the strain gauge data for at least

ten applied load increments.

(g) Summary of unit side resistance along the length of the drilled shaft and end bearing resistance.

(h) Plots of creep displacement for each load increment.

(i) Plot of equivalent top-of-shaft displacement for the test shaft, developed from the load test data.

After completion of the load test to the satisfaction of the Engineer, and when authorized in writing by the Engineer, the Contractor shall flush all hydraulic fluid from the bi-directional load cells and hydraulic lines, and replace with cement grout in accordance with the approved Drilled Shaft Installation Plan. The Contractor shall also grout any voids remaining outside the load cells after completion of the load test. The Contractor does not have to grout test shafts that will not be used as production shafts.

(K) FIELD QUALITY CONTROLS.

(1) Inspection.

The Contractor shall cooperate with the Engineer and furnish services as may be required for inspecting and obtaining data.

Unless the accuracy and precision of other methods are demonstrated to the satisfaction of the Engineer, the plan position of the center of each shaft shall be determined by optical survey measurements to a minimum of four points arranged around the shaft casing perimeter at the four compass directions. These measurements are to be geometrically averaged to calculate the best-fit mathematical center of the shaft at the measurement elevation. Then the calculated center of the shaft at the measurement level shall be reduced to calculate the mathematical center of the shaft at the proposed final shaft top elevation by adjustment using the shaft plumbness measurement information.

The Contractor shall retain the services of a Cement and Concrete Reference Laboratory (CCRL) accredited independent testing laboratory for performing the testing of concrete placed within the drilled shafts

Shaft construction operations shall be performed only in the presence of the Engineer.

In addition to all other inspection requirements for concrete as specified in this Section and in these Specifications, the Engineer may direct that cores be obtained to check on the quality of concrete placed if the Engineer suspects that the quality of the concrete was compromised.

A comparison of the computed volume of the excavation (theoretical) with the volume of concrete placed (actual) shall be made. A plot of depth versus volume shall be computed. The Contractor shall provide cooperation and whatever assistance necessary to accurately monitor the volume of concrete placed at all times during the pour.

When inspection is considered impossible or impractical, or as indicated on the Contract Plans the bottom of the rock socket of all end-bearing drilled shafts shall be inspected by the Contractor in the presence of the Engineer in the "wet", inspection shall be performed utilizing a Shaft Inspection Device (SID) as specified in Subsection 923.45. Inspection shall be carried out as follows:

(a) SID tests shall be conducted with the SID camera pointing down, aligned parallel to the axis of the drilled shaft. The SID shall be placed on the bottom of the rock socket in a way that the bell of the SID can be purged of water enough that the bottom of the shaft is fully visible. A minimum of three measuring devices are to be placed at the bottom of the inside of the bell to measure sediment depth, spaced equally around the bell perimeter and with gradations at ½ in and 1 ½ inch from the bottom of the bell which shall be easily visible to the camera.

(b) The shaft shall be inspected at center, north, east, south, and west locations within the rock socket with the Engineer present for all inspections.

(c) Sediment thickness at the bottom of the shaft shall be estimated by the Engineer in terms of percent of view with sediment thicknesses greater than ½ inch and percent of view with sediment thickness greater than 1 ½ inch at each location. If the average percent of view of sediment thickness greater than ½ inch between all five locations is greater than 50%, or if the sediment thickness at any point is greater than 1 ½ inch, the SID test shall be considered failed and the bottom of the shaft shall be air lifted. After the Contractor has completed air lifting, the SID test shall be repeated.

(d) All SID tests shall be recorded on DVD with audio commentary by the Engineer, identifying the shaft being tested, the test location within the shaft, and the percent of view with sediment

thickness greater than ½ inch and 1 ½ inch. Recordings shall be provided to the Authority upon completion of drilled shaft installation.

(L) ALIGNMENT AND TOLERANCES.

During construction of the shafts, the Contractor shall make frequent checks on the plumbness, alignment and dimensions of the shafts and shall correct immediately any deviation exceeding the allowable tolerances. The plumbness shall be checked by plumbing the Contractor's extended Kelly bar with a full size drill bucket when it is down to the bottom of the drilled shaft with an accurate 6 ft. carpenter's level placed against the exposed part of the Kelly bar, followed by measurements of offset from the Kelly bar to the permanent casing or reference stakes driven into the ground in four compass directions.

For out of round tolerance of steel casings before and after installation, the departure of any point on the periphery of the casing from a true circle shall not exceed one inch, measured radially.

Unless otherwise shown on the Plans, shafts for bridges shall be constructed so that the axis of the shaft, measured at the top of the shaft, is within 3.0 inches of the plan location. Shafts for sign structures shall be constructed so that the axis of the shaft, measured at the top of the shaft, is within 1.0 inch of the plan location

Shafts shall be plumb, to within 1.0 percent of the length based on the total length of the shaft.

Cutoff elevation tolerance for shafts for bridges shall be plus one (1) inch or minus three (3) inches from the top of the shaft elevation shown in the Contract Drawings. Cutoff elevation tolerance for shafts for sign structures shall be plus or minus one half (1/2) inch from the top of the shaft elevation shown in the Contract Drawings.

Drilled shaft steel reinforcing bars for bridge foundations shall be no higher than six (6) inches above or two (2) inches below the elevation shown on the Plans. Drilled shaft steel reinforcing bars for sign structure foundations shall be no higher than zero (0) inches above or one (1) inch below the elevation shown on the Plans.

The reinforcing cage shall be concentric with the drilled shaft excavation within a tolerance of 1 inch.

Shaft reinforcing steel shall extend to the final authorized tip elevation and the bottom of the reinforcing cage shall be no more than 6 inches above the bottom of drilled shaft, regardless of the final tip elevation.

The diameter of the drilled shaft shall not be less than the diameter shown on the Plans.

Access tubes for crosshole sonic log testing shall extend from the bottom of the shaft to no less than three feet above the top of the shaft.

(M)SHAFT ACCEPTANCE.

Drilled shafts may be rejected by the Engineer because of damage, failure to advance through obstructions, mislocation, misalignment, or failure to install the drilled shaft to the proper bearing stratum, or the results of the CSL testing indicate defects. Rejection of a shaft based on the shaft integrity testing requires conclusive evidence that a defect exists in the shaft which will result in inadequate or unsafe performance under design loads. If the CSL records are complex or inconclusive, the Engineer may require additional testing to confirm the location of the defect. The Engineer may also require coring or excavation of the shaft to verify shaft conditions.

The Contractor shall submit a written plan of action to the Engineer for approval, showing how to correct the problem and prevent its reoccurrence. The drilled shaft shall be repaired, augmented or replaced to the satisfaction of the Engineer. To mitigate and/or to remedy unaccepted drilled shafts, the Contractor may be required to provide additional drilled shafts or supplement drilled shafts to meet specified requirements at no cost to the Authority.

When otherwise acceptably installed drilled shafts fail to meet the specified tolerances, the Contractor shall provide an accurate as-built survey to the Engineer. The Engineer will then analyze the total loads on each individual drilled shaft based on the survey data. If the load on any drilled shaft exceeds 10 percent of the specified load capacity, corrections shall be made in accordance with a design approved by the Engineer at no cost to the Authority.

429.05 Crosshole Sonic Logging of Drilled Shafts.

The nondestructive testing method called Crosshole Sonic Logging (CSL) shall be used on all production and demonstration drilled shafts 48 hours after the placement of all concrete in a shaft and must be completed

within 20 calendar days after the concrete placement. The Engineer may specify a longer minimum time if concrete mix designs or other factors result in slower setting concrete. The CSL tests shall be conducted by an experienced independent testing Consultant approved by the Engineer prior to testing.

(A) PREPARATION FOR TESTING.

A number of tubes shall be installed in each shaft to permit access for CSL. The number of tubes installed shall be the greater of 3 or the nearest integer value of the diameter of the drilled shaft measured in feet.

The pipes shall each be fitted with a watertight shoe on the bottom and a removable cap on the top. The pipes shall be securely attached to the interior of the reinforcement cage. The tubes shall be installed in each shaft in a regular, symmetric pattern such that each tube is equally spaced from the others around the perimeter of the cage. The Contractor shall submit to the testing organization their selection of tube size, along with their proposed method to install the tubes, prior to construction. The tubes shall be as near to parallel as possible.

The tubes shall extend no greater than 4 inches from the shaft bottoms to at least 3 feet above the shaft tops. Any joints required to achieve full-length tubes shall be made watertight. Care shall be taken during reinforcement installation operations in the drilled shaft hole so as not to damage the tubes. After placement of the reinforcement cage, the tubes shall be filled with clean water as soon as possible. After the tubes are filled with water and monitoring has verified the water level has not dropped due to leaks, the tube tops shall be capped or sealed to keep debris out of the tubes prior to concrete placement. The pipe caps or plugs shall not be removed until the concrete in the shaft has set. Care shall be exercised in the removal of caps or plugs from the pipes after installation so as not to apply excess torque, hammering, or other stresses which could break the bond between the tubes and the concrete.

(B) CSL TESTING.

CSL tests shall be conducted between pairs of tubes. The approved testing Consultant shall test all possible ray paths of all shafts. Additional logs shall be conducted at no additional cost in the event anomalies are detected. The CSL tests shall be carried out with the source and receiver probes in the same horizontal plane, unless test results indicate potential defects in which case the questionable zone may be further evaluated with angled tests (source and receiver vertically offset in the tubes).

CSL measurements shall be made at depth intervals of 0.2 feet or less, and shall be done from the bottom of the tubes to the top of each shaft. The probes shall be pulled simultaneously, starting from the bottoms of the tubes, over a depth measuring device. Any slack shall be removed from the cables prior to pulling to provide for accurate depth measurements of the CSL records. Any defects indicated by longer pulse arrival times and significantly lower amplitude/energy signals shall be reported to the Engineer, and further tests shall be conducted as required to evaluate the extent of such defects.

(C) CSL TEST RESULTS.

The CSL results shall be presented to the Engineer in a report. The report shall include recommendations as to the acceptability, unacceptability, soundness, etc., of the drilled shaft. The report shall be checked, stamped approved, and signed by a Professional Engineer registered in the state of New Jersey. The report shall be submitted directly to the Engineer. The test results shall include CSL logs with analyses of:

(1) Initial pulse arrival time versus depth

(2) Pulse energy/amplitude versus depth

A CSL log shall be presented for each tube pair tested with any defect zones indicated on the logs and discussed in the test report as appropriate.

(D) EVALUATION OF CSL TEST RESULTS.

The Engineer will evaluate the CSL test results and determine whether or not the drilled shaft construction is acceptable. If the Engineer determines that the drilled shaft is acceptable, the CSL tubes shall be dewatered and grouted. CSL tubes extending above the top of the drilled shaft shall be cut-off flush with the finished drilled shaft surface, where applicable. The grout shall be of the same strength or higher than the strength of the concrete used in the original drilled shaft. The Contractor's grout mix shall not include calcium chloride based additives. If the Engineer determines that the drilled shaft is unacceptable, the shaft shall be cored to allow further evaluation of the shaft. Cores shall be taken without additional compensation.

(E) FURTHER EVALUATION.

If the CSL records are inconclusive or show an anomaly, the Engineer may require coring or the performance of Crosshole Tomography to verify the shaft condition. The details of the Crosshole Tomography, if directed by the Engineer, shall be submitted for review and approval. The Crosshole Tomography analysis shall include the development of three dimensional volumetric images for the entire shaft. This shall be presented in color and coded to indicate variations in sonic velocity. The images and complete discussion of the data shall be presented in the report by the testing Consultant.

429.06 Measurement.

Drilled shafts will be measured by total linear feet of drilled, installed and accepted drilled shafts. The limits for payment for drilled shafts will be as shown on the Plans. For shafts without a rock socket, measurement will be from the plan top of the shaft elevation to the bottom of the shaft. For shafts with a rock socket, measurement will be from the plan top of the shaft to the top of the rock socket. Top of the rock socket will be defined as the upper elevation at which sound rock occurs across the entire width of the shaft, as determined by the Engineer. Reinforcement steel placed within the pay limits of drilled shafts will not be measured or payment. All costs to fabricate, furnish, and install reinforcement shall be included in the drilled shaft pay item. Furnishing equipment, mobilization for drilled shaft installation, CSL testing or any further evaluation will not be measured, and all costs shall be included in the drilled shaft pay item.

The accepted rock sockets, if required, will be measured for payment to the nearest linear foot of length along the axis of each rock socket in-place from the top of sound rock elevation, as determined by the Engineer, to the bottom of the rock socket as built. Reinforcement steel placed within the pay limits of rock socket will not be measured or payment. All costs to fabricate, furnish, and install reinforcement shall be included in the rock socket pay item.

When obstructions are encountered, the Contractor shall notify the Engineer immediately and upon concurrence of the Engineer, the Contractor shall begin working to core, break up, pull out, push aside, or remove the obstruction. Lost tools or equipment in the excavation as a result of the Contractor's operation shall not be defined as obstructions and shall be removed at the Contractor's expense.

Demonstration shafts, if required, performed in accordance with these Specifications and accepted by the Engineer, will be measured for payment to the nearest linear foot of length along the axis of each shaft in-place from the top of plan shaft elevation to the as built bottom of rock socket elevation.

Load tests, performed in accordance with these Specifications and accepted by the Engineer, are measured per each for test shafts successfully installed in accordance with the dimensions and details shown on the Plans, and carried successfully to the capacity specified or to shaft failure. This item shall include everything necessary to assemble, install, conduct and remove the drilled shaft load test, under the direction of the Engineer and the Testing Consultant. All costs associated with the normal production of the drilled shafts shall be considered incidental to the drilled shaft pay item(s).

429.07 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
____" DIAMETER DRILLED SHAFTS	LINEAR FEET
____" DRILLED SHAFT FOR SIGN STRUCTURES	LINEAR FEET
____" DIAMETER ROCK SOCKET	LINEAR FEET
____" DIAMETER DEMONSTRATION SHAFT	LINEAR FEET
____" DIAMETER DRILLED SHAFT LOAD TESTS	EACH
OBSTRUCTIONS	LINEAR FEET

Payment for Drilled Shafts will be considered full compensation for all permanent or temporary steel casing required, costs of drilling, excavation, disposal of excavated material, slurry, cleaning, an acceptable method of inspection as required, furnishing and placing reinforcing steel and concrete, grouting and incidental work and material required by the contract documents or otherwise needed to construct a complete and fully functional drilled shaft. Payment for any drilled shaft installed and accepted will be at the contract unit price per linear foot for the diameter of the drilled shafts specified, irrespective of the character of the material actually encountered during excavation. No additional compensation will be made for concrete required to fill an

oversized casing or for oversized excavation. If the method of construction requires that drilled shaft casing be seated into the sound rock such that the bottom of the casing is below the determined top of sound rock elevation, payment for excavation below the top of the sound rock layer (top of the rock socket) will be included in the payment for the rock socket.

Payment for Rock Sockets will be considered full compensation for drilling, excavation, disposal of excavated material, slurry, cleaning, dewatering, an acceptable method of inspection as required, furnishing and placing reinforcing steel and concrete, and incidental work and material according to the Contract Documents or otherwise needed to construct a complete and fully functional rock socket. For payment purposes the length of any rock socket installed and accepted shall be paid for at the contract unit price per linear foot for the diameter of the rock socket specified, irrespective of the character of the material actually encountered during excavation.

Payment for Demonstration Shafts will be full compensation for drilling, excavation, disposal of excavated material, slurry, cleaning, dewatering, an acceptable method of inspection as required, furnishing and placing reinforcing steel and concrete, and incidental work and material necessary to satisfactorily construct the demonstration shaft according to the Contract Documents or otherwise needed to construct a complete and fully functional demonstration shaft.

Drilled Shaft Load Tests will be paid per test shaft successfully installed and successfully loaded to failure or load specified.

Drilling Obstructions shall be paid for at the contract unit price per linear foot.

No separate payment will be made for reinforcement steel, steel pipe for CSL testing, and concrete within the drilled shaft limits or rock socket limits as shown on plans. The costs thereof shall be included in the above drilled shaft or rock socket pay item.

No separate payment will be made for CSL testing and/or further evaluation associated with determining the integrity of the drilled shaft.

No separate payment shall be made for all services, permits, labor, equipment, transportation, materials, testing, and supplies for the complete work, including, without limitation, mobilization and demobilization for completion of the work. No payment will be made for drilled shafts abandoned because of defects in the work or other fault of the Contractor.

SECTION 430 - SELF-CONSOLIDATING CONCRETE (SCC) FOR DRILLED SHAFTS

430.01 Description.

This work consists of the use of Self-Consolidating Concrete (SCC) for drilled shaft construction. SCC is a highly flowable, non-segregating concrete that can spread into place without any mechanical consolidation.

430.02 Materials.

The design, control and acceptance testing requirements of a SCC mixture will be according to Section 905, except as modified herein.

Materials shall conform to the following Sections and Subsections:

FINE AGGREGATES 902.04

COARSE AGGREGATES 902.05

AIR-ENTRAINMENT ADMIXTURES 906.02

SCC shall use a water-reducing, high-range admixture (HRWR) to reduce the required water content for a concrete mixture by 5 to 10%. The admixture shall meet the requirements of ASTM C494/ C494M-08(a), Type F. Samples of the admixture necessary for the acceptance tests will be selected at random from stockpiled supplies. The use of air entrainment admixtures will not be required except as noted herein.

A viscosity modifying admixture (VMA) may be used and will be evaluated according to the test methods and mix design proportions referenced in ASTM C494/ C494M-08a, Type S. The following physical requirements shall be met:

(A) For initial and final set times, the allowable deviation of the test concrete from the reference concrete shall not be more than 1.0 hours earlier or 1.5 hours later.

(B) For compressive and flexural strengths, the test concrete shall be a minimum of 90 percent of the reference concrete at 3, 7 and 28 days.

(C) The length change of the test concrete shall be a maximum 135 percent of the reference concrete. However, if the length change of the reference concrete is less than 0.030 percent, the length change of the test concrete shall be a maximum 0.01 percentage units greater than the reference concrete.

(D) The relative durability factor of the test concrete shall be a minimum 80 percent.

Admixtures shall be free of calcium chlorides or any other chlorides that may initiate or promote corrosion of the reinforcement steel. Locate bulk storage tanks for chemical admixtures inside a heated area with an ambient temperature of not less than 320F. Chemical admixtures that have been allowed to freeze shall not be allowed for use until they have been agitated and retested.

The samples of the admixtures shall be tested as per the requirements of the respective ASTM Standards stated above and the test results shall be submitted to the Engineer for approval.

430.03 Mix Requirements.

The SCC mix shall conform to the criteria for strength, slump flow, visual stability index, passing ability and water to cement ratio as specified herein.

The SCC shall conform to Class A concrete strength requirements provided in Paragraph 905.05(A), Portland Cement Concrete, Composition of Mix, and Subsection 905.21, Quality Acceptance Limits for Portland Cement Concrete Pay Adjustment.

The slump requirements in Section 905 do not apply. The fresh concrete for slump flow retention testing will be sampled at the point of discharge into the tremie or pumpline and stored in a sealed container that is not exposed to direct sunlight or vibration. The concrete for slump flow retention testing shall be stored for a minimum of one hour longer than the duration of the concrete placement operations as indicated in the contractor's installation plan. The SCC shall be in accordance with the criteria included in Table 1.

Compliance with air entrainment criteria noted in Table 1 will only be required for portions of drilled shafts extending above the finished grade line at the drilled shaft face.

Table 1 – Requirements for SCC for Drilled Shafts

Property	Test Method	Criteria
Air Entrainment (As Req'd)	As per Standard Specification	
Coarse Aggregate No. 89	Subsection 906.02 & 902.05	6.5 $\pm$ 2.0%
Coarse Aggregate No. 8		7.5 $\pm$ 2.0%
Fresh Concrete Slump Flow	ASTM C1611 / C1611M-05	18-24 inches
Slump Flow Retention	ASTM C1611 / C1611M-05	14 inches minimum
Visual Stability Index		
Plastic Concrete	ASTM C1611 / C1611M-05	1 maximum
Passing Ability	ASTM C1621 / C1621M-08	1.5" maximum

The water to cementitious materials ratio (W/C) shall be 0.40, +/- 0.05 after including any reductions for admixtures. The test methods and frequency for W/C shall be in accordance with Paragraph 905.22 (A), Quality Assurance Testing Standards and Frequency of Testing. The quantity of retarding admixture stipulated in the submitted mix design shall be adjusted as required to accommodate temperature variations. A table stipulating the required retarding admixture for temperature ranges anticipated during concrete placement operations shall be submitted as a Shop Drawing with the mix design and installation plan in accordance with Section 104.08 of the Standard Specifications.

The aggregates shall be proportioned so that the fine aggregate is less than 50 percent by weight of the total aggregate.

430.04 Verification of Pumpability.

A verification of pumpability will be performed at least 10 days before the placing of the SCC in the drilled shaft by pumping a trial batch through the proposed pump for the placement of the SCC into the drilled shaft. The proposed methods for mixing the concrete, including any anticipated time delays, shall be simulated for verification.

Perform slump flow, and visual stability index (plastic concrete), passing ability testing on the verification batch. Make concrete cylinders for compression testing as specified in Paragraph 905.05 (C).

The mix shall be approved based on the criteria for the compressive strength provided in Subparagraph 905.21 (A)(1) and the criteria provided in Table 1 above.

430.05 Control and Acceptance Testing.

The Engineer will perform acceptance testing as specified in Section 905 at a rate according to Subsection 905.22, Quality Acceptance Testing, Sampling, and Inspection for Portland Cement Concrete Pay Adjustment. The Engineer will perform visual stability index test for plastic concrete, according to ASTM C 1611/C1611M-0.5, at a rate of at least 1 test per day. The Engineer will perform the passing ability test at the same rate as the slump flow test.

If any of the properties provided in this section do not conform to the respectively criteria, redesign of the mix shall be considered at the discretion of the Engineer.

SECTION 431 - ALTERNATE RETAINING WALL DESIGNS

431.01 Description.

The provisions of this Section apply to construction at various locations on the Plans where alternate retaining wall designs are permitted. The Plans offer the Contractor the option of constructing alternate types of proprietary retaining walls, either Mechanically Stabilized Embankment Retaining Walls or Prefabricated Modular Retaining Walls, at each site.

Substitute wall types may be submitted for approval in accordance with Subsections 426.05 and 427.05 of the (Standard) Supplementary Specifications.

At each site, the Plans define and indicate the Common Structure Volume which applies to all alternates, proprietary and non-proprietary.

Under this Section, work shall include construction of the wall complete, together with all other appurtenant items of construction within the Common Structure Volume (CSV) designated on the plans, including, but not necessarily limited to, removing existing structures, excavation and embankment, leveling pads, footings, special backfill materials, underdrain pipe and stone pockets, impervious membrane, temporary sheeting, copings, piles, pile driving equipment, and drainage items. Where reinforced concrete parapets are part of the wall, construction shall include epoxy-coated reinforcement, bridge chain-link fence, noise barrier, embedded rigid metallic conduit, and junction boxes for roadway lighting facilities.

For the disposition of excess excavation materials within the Common Structure Volume, the provisions of Subsection 202.03 shall apply.

Final design of alternate retaining walls shall be submitted as Working Drawings in accordance with Subsections 104.08, 426.04 and 427.04.

431.02 Materials and Methods of Construction.

All materials, Methods of Construction, and other work pertaining to reinforced concrete cantilever walls shall conform to Sections 401.

All materials and Methods of Construction pertaining to construction of proprietary wall alternates shall conform to the applicable provisions of Section 426 for mechanically stabilized earth walls and of Section 427 for prefabricated modular walls.

431.03 Working Drawings.

According to the provisions of Subsection 104.08, final design of alternate retaining walls shall be submitted for approval as shop drawings. Additionally, final designs shall conform to the current AASHTO LRFD Bridge Design Specifications and to Subsections 426.04 and 427.04 of the Supplementary Specifications. The shop drawings shall include detailed computations and all details, dimensions, and quantities necessary to construct the wall. The design and fully detailed plans shall be prepared to Authority standards current at the time of submission and shall be consistent with the Plans.

431.04 Measurement.

Measurement shall be made in accordance with Subsections 426.06 and 427.06 of the (Standard) Supplementary

Specifications.

431.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
RETAINING WALL, LOCATION NO. ___	SQUARE FOOT

Separate payment for excavation, muck excavation, temporary sheeting, chain link fence, cast-in-place concrete gutters, concrete leveling pad, concrete wall panels, panel connections, barrier parapets, lighting standard bosses, moment slabs, reinforcement steel, epoxy coated reinforcement steel, impervious membrane, concrete penetrating sealer treatment, and concrete core sampling will not be made.

Payment for stripping of topsoil will be made in accordance with Subsection 202.05.

SECTION 432 – STRUCTURAL JACKING

432.01 Description.

This work includes the design, furnishing, assembly, erection, use, and removal of temporary jacking systems for the purposes of repairing or replacing bearings. This work also includes any required modifications to the existing superstructure at proposed jacking points such as, but not limited to additional lateral bracing and supplementary jacking stiffeners to remain.

This work also includes the design, furnishing and installation of sheeting, excavation, dewatering, or other earthwork required to provide adequate bearing for any jacking support systems which may be founded either on the existing structure footings or on earthen embankments.

This work also includes all labor and materials necessary to remove and dispose of an existing bridge bearing and to clean and prepare the mating surfaces of both the underside of the Girder and the bearing seat surface on the supporting substructure for the installation of a new or refurbished bearing.

For the purposes of this work, regardless of member nomenclature noted on the Plans (stringer, girder, beam, etc.), members to be jacked as noted on the Plans or per the work described in this specification will be defined as "Girder(s)".

432.02 Materials.

Steel materials shall be in accordance with Section 403 of the Standard Specifications.

Concrete materials shall be in accordance with Section 401 of the Standard Specifications.

Jacks for bearing replacement jacking schemes shall be as specified in Subsection 909.14. Jacks shall have a rated capacity (safe working load) equal to or greater than the Design Jacking Load as defined in Paragraph 432.03(B). The rated capacity shall be shown clearly on the jack.

Where permitted by the Engineer, hardwood blocking or cribbing may be used to temporarily support Girders.

432.03 Methods of Construction.

(A) REMOVAL AND DISPOSAL OF EXISTING BEARINGS.

Existing bearings shall be detached from the superstructure via the removal of existing welds or other fasteners attaching the bearing to the bottom of the Girder. Welds shall be removed via grinding. Carbon arc burning may be utilized to remove weldments at the sole discretion of the Engineer. Removal of existing fasteners such as rivets or bolts at ends of Girders may be performed via chipping, cutting torch, or thermic lance, as approved by the Engineer. Removal of existing fasteners at interior support of continuous Girders or at any point on members designated as fracture critical in the either the Contract Plans or on the original plans shall only be performed via unthreading, grinding, chipping, or by use of thermal methods in accordance with Paragraph 418.07(C). Where existing steelwork exhibits deterioration or section loss of greater than 1/16 inch at sole plate faying surfaces, the Contractor shall contact the Engineer immediately.

Removal of existing paint coatings, rust, and detritus and spot painting shall be performed as required to provide an even bearing surface for new or refurbished bearing components. All surfaces or edge irregularities shall be ground smooth so as to provide straight edges and full bearing surfaces between sole

plates, shims, and bottom of Girder flanges to permit proper welding. Where shim plates or sole plates are to be welded to the bottom flange of the Girder, the existing steel shall be cleaned to bare white metal via either sandblasting or power tool methods, as approved by the Engineer. After cleaning, exposed metal shall be spot painted to match the existing paint system. Where supplementary stiffeners on painted steel Girders are to be installed as part of the Contractor's proposed jacking scheme, they shall be cleaned to bare white metal and painted to match the existing paint system. Cleaning and preparation of the existing steel surfaces and painting shall be in accordance with the applicable requirements of Section 411.

Existing anchor bolts shall be removed to the limits required to remove the bearing(s) and the existing masonry plates and bedding material down to sound concrete. Anchor bolts may be removed via mechanical or thermal cutting methods except where bearings are supported by steel substructure or superstructure elements. Anchor bolt removal in steel substructure or superstructure elements shall only be performed via unthreading, grinding, chipping or by use of thermal methods in accordance with Paragraph 418.07(C) unless permitted otherwise by the Engineer. Local excavation greater than ½ inch in depth of the concrete seat to remove the anchor bolts will only be permitted at the discretion of the Engineer. Portions of abandoned existing anchor bolts left in concrete substructure elements shall be cut-off such that the top of the abandoned portion of the anchor bolt is a minimum of ½ inch below the final seat elevation for the new or refurbished bearing. Voids created by anchor bolt removal shall be filled with an approved non-shrink grout in accordance with Subsection 905.12. Where cleaned existing bridge seats exhibit deterioration or unsound concrete of a depth exceeding 1/16 inch under existing masonry plates to be reused or new masonry plates to be installed, concrete repairs or bearing seat reconstruction shall be performed in accordance with Subsection 418.03 of the Specifications.

Existing bearings to be replaced shall be removed from the site and legally disposed of. Removal and disposal of existing bearings shall be considered incidental to the bearing replacement item.

Installation of new anchor bolts, bedding materials, and bearings shall be performed in accordance with Sections 408, 438, and 439, as appropriate and as indicated on the Plans and in the Specifications.

Refurbishment and/or resetting of existing bearings shall be performed in accordance with Section 418, where indicated on the Plans.

(B) TEMPORARY JACKING.

Temporary jacking systems, including beams, brackets, plates, shapes, shims, welds, bolts, rods and all other required appurtenant hardware and materials shall be fabricated in accordance with Section 403 of the Specifications.

The Contractor shall prepare and submit Shop Drawings for all temporary jacking systems. These Shop Drawings shall include all pertinent details and complete design calculations including verification of the ability of the existing superstructure to be supported at the proposed jacking points. Where supplementary stiffeners are required to maintain the stability of the superstructure during jacking, these stiffeners shall be designed as permanent appurtenances. Supplementary stiffeners shall be of the same material as the Girder to which they are attached. Supplementary stiffeners may only be attached to Girders via bolted connection. Preparation of the existing steelwork surfaces where supplementary stiffeners are required shall be in accordance with Section 411.The Engineer, at his sole discretion, may permit supplementary stiffeners to be welded to Girders. Stitch welding will not be permitted. Refusal of the Engineer to permit attachment of supplementary stiffeners via welding will not be considered as grounds for additional payment. The Contractor shall assume that all supplementary stiffeners are to be bolted to Girders. All supplementary stiffeners shall remain after bearing replacement work is complete. Temporary jacking support systems shall be designed, signed and sealed by a Professional Engineer licensed in the State of New Jersey and must be approved for use by the Engineer.

All temporary jacking systems, as well as the jacks themselves, shall be designed to support a Design Jacking Load of no less than the following load combination:

Design Jacking Load = 2.0(DL + LL +Impact +Anticipated Construction Loads)

The temporary jacking system shall be designed to support the Design Jacking Load at all bearing locations prior to reaching the yield point of the supporting steelwork or the allowable compressive stress of supporting concrete. The Design Jacking Load shall not exceed the safe working limit of the jack. All horizontal loads and rotations or translations as provided on the Plans shall be considered in the design of the temporary jacking system and the selection of the jack, but under no circumstances shall the horizontal design load be taken as less than 10% of the Design Jacking Load. The Contractor shall consider thermal forces or translations in the temporary jacking system where temporary support of the Girder(s) extends for greater than twelve (12) hours.

Where/if excavation, dewatering, or temporary sheeting is required to establish solid founding for the support of temporary jacking systems, this work shall be performed in accordance with Subsection 106.18, and Sections 205, 208, and 415, respectively. Excavation and dewatering activities shall be performed in accordance with Section 205. Shop Drawings with full design calculations signed and sealed by a Professional Engineer licensed in the state of New Jersey shall be submitted for all dewatering methods and temporary sheeting or cofferdams proposed for use. All components of the temporary systems, with the exception of supplementary stiffeners as described above, shall be removed upon completion of the work. Components such as sheeting, concrete anchors, and/or other alterations made to the structure to support the temporary systems may remain in place only at the express written permission of the Engineer.

If excavation is required to perform jacking operations, soil removed from each jacking pit location may be replaced back into each excavation when complete unless otherwise noted on the Plans.

Where temporary jacking systems are designed to be supported at grade level, the Contractor shall protect these systems from damage due to vehicular or construction equipment impact. Where temporary jacking systems are located at grade level and are within thirty (30) feet of an active lane of vehicular traffic, these systems shall be protected with an impact resistant barrier designed to resist vehicular impact forces as defined in Subsection 3.6.5 of the AASHTO LRFD Bridge Design Specifications, current edition.

No materials shall be ordered and no work shall be performed until the Engineer's written approvals have been obtained. Approval by the Engineer shall in no way relieve the Contractor of responsibility for the safety and adequacy of the temporary jacking systems. Any damage to any portion of the existing structure to remain in place resulting from the Contractor's use of the temporary jacking system shall be repaired to the satisfaction of the Engineer and at no additional cost to the Authority.

For applications where new bridge bearings are to be installed, no jacking shall be performed until the replacement bearing assembly and all appurtenant materials required for installation at each specific location are on-site and ready for installation.

For applications where existing bearings are to be refurbished or reset, no jacking shall be performed until all tools and materials required to refurbish or reset the bearings are on-site and ready for use. Where existing bearings are to be refurbished off-site and the time required to reinstall the bearing exceeds five (5) calendar days, the Contractor shall design and furnish temporary bearings or dunnage to support the bridge. Temporary bearings and/or dunnage shall be designed, signed and sealed by a Professional Engineer licensed in the state of New Jersey. Design calculations and shop drawings shall be provided for review by the Engineer. No work shall be performed until the calculations and shop drawings have been approved by the Engineer.

Where all bearings at any bearing line are to be replaced, they shall be replaced in a single continuous operation. However, where it is not practical to replace all bearings within a bearing line in a single continuous operation, the Contractor shall pre-position all subsequently installed bearings within that bearing line such that they exhibit a deflected shape to match any thermal movement observed at the bearing(s) already installed. Thermal deflection differences for all bearings at a bearing line shall be limited to a tolerance of +/- 1/8" as measured from the first bearing installed.

The amount of jacking movement used to release and replace each bearing shall be kept to a minimum. The Contractor shall submit to the Engineer, at least 30 days prior to the start of jacking operation, the methods to be used and the procedures to be followed for the jacking operation intended for the removal of the existing bearings and the installation of the new bearings. The Contractor must receive written approval of these methods before commencing work.

The following requirements and restrictions shall be closely adhered to by the Contractor during jacking operations:

(1) A Girder may not be raised more than ¼" unless otherwise allowed by the written permission of the Engineer.

(2) Only one end of any single span Girder may be jacked and temporarily supported at any time. Adjacent bearing points on continuous span girders may not be jacked and/or temporarily supported at the same time. No more than 50% of the bearings at any girder bearing line may be jacked simultaneously.

(3) Jacking systems shall not be utilized to support the weight of the superstructure at any one bearing for more than five (5) calendar days. New or refurbished bearings, new anchor bolts, and all appurtenant materials and hardware necessary to provide a complete and functional bearing assembly shall be installed and ready to support the bridge structure within this time frame unless otherwise permitted

by the Engineer. The noted five (5) calendar days time frame shall begin when the temporary jacking system hydraulics are pressurized, and shall end when the bridge superstructure bears its full load on the new permanent bearing system and no pressure is present in the temporary jacking system hydraulics.

(4) Jack hydraulics may not be used to support the loads after jacking the Girder. All loads must be transferred to an approved temporary support mechanism or the jacks must have secured lock nuts.

(5) Jacks with higher capacity than required may be allowed, but the Contractor shall be responsible for monitoring the jack loads to ensure the safety of the structure. The larger jack may alter loading distribution and eccentricity and thereby require dimensional or design changes to the temporary jacking system.

(6) The jack system shall be equipped with direct reading gages to read the jack force in pounds or kips. Jacks shall be calibrated within the past 90 calendar days. The Contractor shall furnish proof of calibration or shall calibrate the jacks in the presence of the Engineer.

(7) The Contractor shall monitor the temporary jacking system for possible deflection, settlement, or yielding of the jacking system components. Where temporary jacking systems are founded on soil, or on existing concrete soil bearing footings, they shall be continuously monitored throughout the jacking process.

(8) The Contractor shall furnish, in writing, the anticipated loading at each jack location. Where jacking operations incur jack loads in excess of 110% of the anticipated loads, jacking operations shall be immediately suspended and the Engineer shall be immediately notified.

(9) The Contractor shall provide, at no additional cost to the Authority, a Professional Engineer registered in the State of New Jersey, to be present at all jacking operations and to check pertinent dimensions and requirements set forth on the Plans, the approved Shop Drawings, and herein to certify that all stipulations are met before the actual commencement of jacking.

(10) Jacking systems may not be removed from service until such time as any placed concrete or grout materials have achieved a minimum 3000 psi compressive strength and the new or repaired bearing assembly is fully installed and attached to both the supporting substructure and the supported Girder as per the Contract Plans.

(11) A temporary jacking system, when no longer required at one location, may be relocated and installed at another location. Re-use of jacks and jacking system components shall be subject to the approval of the Engineer. Temporary jacking system components and/or equipment which is damaged, in poor condition, or otherwise deemed unsuitable for use in the sole opinion of the Engineer shall not be used and shall be removed from the site.

(12) The Contractor's attention is directed to the fact that it is of extreme importance to safeguard temporary support systems. It will be the sole responsibility of the Contractor to provide and maintain adequate protection of the temporary support systems for the duration of the Contract.

(13) All residue, debris, or waste materials generated during the execution of the work to be performed shall be removed from the site and legally disposed of. The work area shall be cleaned and restored to the satisfaction of the Engineer.

432.04 Measurement.

Structural Jacking, where quantified on a "Lump Sum" basis, will not be measured for payment.

Structural Jacking, where quantified on an "Each" basis, will be measured by the actual number of individual bearing locations that have been jacked.

Excavation, temporary sheeting, and dewatering, where/if required, shall be considered as incidental to the Structural Jacking item and will not be measured for payment.

Removal of existing bearings, cleaning/preparation of existing surfaces shall be considered incidental to the Structural Jacking pay item.

Design, fabrication, and installation of any required modifications to the existing superstructure at proposed jacking points such as, but not limited to additional lateral bracing and supplementary jacking stiffeners shall be considered as incidental to the Structural Jacking item and will not be measured for payment.

Painting and/or spot painting shall be considered as incidental to the Structural Jacking item and will not be measured for payment.

Removal of all residue, debris, or waste materials generated during the execution of the work shall be considered as incidental to the Structural Jacking item and will not be measured for payment.

432.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
STRUCTURAL JACKING	LUMP SUM
STRUCTURAL JACKING	EACH

(A) Payment for Structural Jacking, when measured on a "Lump Sum" basis, will be made as follows:

20% when the proposed jacking system is approved for use.

30% when 50% of the Girder bearings at the proposed jacking location(s) have been reloaded with the jacking system depressurized and no longer in contact with the jacked Girder.

30% when 100% of the Girder bearings at the proposed jacking location(s) have been reloaded with the jacking system depressurized and no longer in contact with the jacked Girder.

20% when all residue, debris, or waste materials generated during the execution of the work to be performed have removed from and the work area has been cleaned and restored to the satisfaction of the Engineer.

(B) Payment for Structural Jacking, when measured on an "Each" basis, will be made as follows:

20% when the proposed jacking system is approved for use at the proposed jacking location(s).

60% when the Girder bearing(s) at the proposed jacking location have been reloaded with the jacking system depressurized and no longer in physical contact with the jacked Girder.

20% when all residue, debris, or waste materials generated during the execution of the work to be performed have removed from and the work area has been cleaned and restored to the satisfaction of the Engineer.

No additional payment will be made of spot painting.

No additional payment will be made for removal of all residue, debris, or waste materials generated during the execution of the work.

No additional payment will be made for any required modifications to the existing superstructure at proposed jacking points such as, but not limited to additional lateral bracing and supplementary jacking stiffeners.

Payment for furnishing and installation of new Laminated Elastomeric Bearings shall be covered under Section 408.

Payment for furnishing and installation of new High Load Multi Rotational Bearings shall be covered under Section 407.

Payment for furnishing and installation of new Seismic Isolation Bearings shall be covered under Section 409.

Payment for refurbishment and resetting of existing bearings shall be covered under Section 418.

SECTION 433 – TEMPORARY STRUCTURES

433.01 Description.

This work includes the design, furnishing, construction and maintenance of all Temporary Structures as required to maintain traffic in accordance with the construction sequence as shown on the Plans. This work includes all related components required for a complete and functional Temporary Structure, including, but not limited to foundations, substructure and superstructure elements, approaches, bearings, expansion joints, traffic barriers, drainage troughs and downspouts as required to convey water to a drainage collection system, embedded steel anchorages, riding surface, coating systems, field painting and touchup, concrete penetrant coatings, joint fillers, and sealants, all necessary fittings and accessories, and/or other components as required or necessary.

This work also includes the complete removal of the Temporary Structure and all related appurtenances to a depth of two (2) feet below the finished grade after the completion of the Project or at such time that the

Engineer has determined that the Temporary Structure is no longer required to facilitate the work.

This work also includes the maintenance and upkeep of the Temporary Structure and the supported temporary roadway for the entire duration of its use, including but not limited to impact damage repairs, joint maintenance, damaged/deteriorated asphalt repair, drainage equipment repair/cleaning, and deicing or snow removal as required.

433.02 Materials.

Materials shall conform to Division 900 – MATERIALS of the Specifications or as shown on the Plans. Materials proposed by the Contractor but not explicitly addressed in the Specifications or shown on the Plans may be approved for use at the sole discretion of the Engineer. Rejection of contractor proposed materials not shown on the Plans or in the Specifications will not be considered grounds for additional payment.

433.03 Shop and Working Drawings.

Shop and working drawings, including design calculations, shall be furnished to the Engineer in accordance with Subsection 104.08. Shop and Working Drawing submittals shall include the name, address, telephone number, contact person, and evidence of qualifications of all structural engineers, geotechnical engineers and fabricators utilized by the Contractor for the design and construction of all components of the Temporary Structure. At a minimum the following information shall be included (where applicable):

(A) A complete set of design calculations for the bridge geometry, foundation design, substructure design and superstructure design signed by a licensed engineer registered in the State of New Jersey. These calculations shall clearly include the following information as preamble:

  (1) Type and grade of structural materials with relevant ASTM / AASHTO specification designations.

  (2) Modulus of elasticity, "E", for all structural materials.

  (3) Allowable material stresses in bending, compression, and shear.

  (4) Stress factors used for short term duration loading (timber design).

  (5) References for design live and dead load data used for standardized or manufactured components.

  (6) Specification references for all design criteria utilized.

(B) Design live and dead loads with appropriate load factors (where applicable).

(C) General plan, elevation and typical sections indicating superstructure and substructure type selected (minimum vertical and horizontal clearances shall be shown).

(D) Foundation type selection and design utilizing soil boring information and soil parameters presented in the Contract Documents.

(E) The total design reaction at each substructure foundation.

(F) Foundation plan, including pier/bent orientation and deep foundation element (piles and/or drilled shafts) layout plan clearly showing existing/proposed utilities, existing foundations, and other local obstructions.

(G) Substructure abutment/pier/bent geometry, superstructure bearing seat elevations, bearing details, bearing elevations, and bottom of foundation elevations.

(H) Framing plans, including beam/truss types, lengths, and spacing.

(I) Beam/Truss detail plan sheets including member sizes, connection details, miscellaneous details, and anticipated deflections and camber.

(J) Deck details, reinforcing steel layout, riding surface details and approach details.

(K) Finished grade elevations along the deck crown line and gutter lines at twenty foot maximum intervals.

(L) Support details for utilities or third party owned facilities to be supported from the Temporary Structure. These details shall be in accordance with the provisions set forth in the Contract Documents and shall be submitted for review by the Engineer and the Utility Owner or owner of the third party facility.

(M) Approach fill and pavement box details, as well as roadside protection and drainage details as required.

(N) Proposed grading plan, as well as required and actual vertical and lateral clearances.

(O) Fabricator's or Manufacturer's specifications and installation instructions for proprietarily designed or furnished materials and hardware including test reports and other data. The documentation shall show compliance with the relevant materials requirements of these Specifications as approved by the Engineer.

433.04 Methods of Construction.

The Contractor shall bear sole responsibility for proper fitment and alignment of all Temporary Structure components. Temporary Structures shall be fully assembled with all attendant approach work and shall be made ready for use no later than ten (10) working days prior to the scheduled shifting of traffic onto the Temporary Structure. The Engineer shall inspect the Temporary Structure within three (3) working days of when the Contractor issues notice that it has been made ready for use. The Engineer will be the sole judge of whether the Temporary Structure is ready for use. Where the Engineer notes deficiencies in the Temporary Structure, the Contractor shall make repairs within five (5) working days from the issuance of notice of any deficiencies. The Temporary Structure will be accepted only after the Engineer has inspected the Temporary Structure and found no deficiencies.

Maintenance and Protection of Traffic required for the installation, maintenance and removal of the Temporary Structure, including any temporary sheeting or supported excavations which are required, shall be in accordance with Division 800 of the Specifications, as appropriate. The Contractor shall conform to the limitations and restrictions for the agency or owner having jurisdiction over the feature crossed in accordance with the provisions set forth in the Contract Documents. The Contractor shall procure all necessary traffic permits and approvals required to install, maintain and remove the Temporary Structure prior to the commencement of any work. The Contractor shall also comply with the requirements of all permits documents as provided in the Contract Documents in accordance with Subsection 106.10 and shall abide by all temporary construction easements acquired for the Contract.

Deep foundation elements shall be installed as per Sections 405 for piles and Section 436 for drilled shafts, as appropriate. Installation of deep foundation elements such as piles or drilled shafts shall not damage, settle, or otherwise alter the alignment and functionality of adjacent structures to remain in service either permanently or until such time as they are removed from service and traffic is shifted to the Temporary Structure.

Sheeting or supported excavations to install the Temporary Structure shall be designed and constructed in accordance with Sections 415 and 416 of the Specifications, as appropriate.

Concrete substructure and superstructure elements shall be constructed in accordance with Sections 401 and 402 of the Specifications, as appropriate.

Steel substructure and superstructure elements shall be constructed in accordance with Section 403 of the Specifications.

Timber substructure and superstructure elements shall be constructed in accordance with Section 404 of the Specifications.

Asphalt concrete surfacing shall be in accordance with the applicable provisions of Sections 302 and 401 of the Specifications.

Bridge drainage elements shall be constructed in accordance with Section 412 of the Specifications.

Bridge railing and fencing elements shall be constructed in accordance with Section 414 of the Specifications.

All superstructure and substructure materials shall become property of the Contractor and are to be legally disposed of by the Contractor off Authority property.

Areas disturbed by the presence or removal of the temporary structure shall be restored to the satisfaction of the Engineer.

433.05 Measurement.

Temporary Structures will be measured on a Lump Sum basis for each completely designed, installed, fully functional and maintained Temporary Structure.

Complete removal of the Temporary Structure and the restoration of the site in accordance with the Contract Documents shall not be measured for payment.

433.06 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TEMPORARY STRUCTURE, ONE WAY	LUMP SUM
TEMPORARY STRUCTURE, TWO WAY	LUMP SUM
TEMPORARY STRUCTURE, PEDESTRIAN BRIDGE	LUMP SUM

Payment in the amount of 75% will be made after acceptance of the Temporary Structure by the Engineer. The remaining 25% payment will be made after the Temporary Structure has been removed and the disturbed or damaged site has been restored to the satisfaction of the Engineer.

Pay Item for "Temporary Structure, _____" includes payment for the complete design, furnishing, construction, and removal of the required Temporary Structure and approaches, including all required appurtenances.

No additional payment will be paid for maintenance and repair of the Temporary Structure. These costs shall be considered incidental to the Temporary Structure pay item.

No additional payment will be made for excavation required to construct the Temporary Structure. These costs shall be considered incidental to the Temporary Structure pay item.

No additional payment will be made for the design and installation of temporary sheeting or supported excavations as required to construct the Temporary Structure. These costs shall be considered incidental to the Temporary Structure pay item

No additional payment will be made for relocating utilities or third party owned facilities to the Temporary Structure. These costs shall be considered incidental to the Temporary Structure pay item.

No additional payment will be made for Temporary Structure removal or site restoration. These costs shall be considered incidental to the Temporary Structure pay item.

Payment for Maintenance and Protection of Traffic required for the installation, maintenance and removal of the Temporary Structure shall be accordance with Division 800 of the Specifications, as appropriate.

SECTION 434 - PNEUMATICALLY APPLIED MORTAR

434.01 Description.

This work shall consist of the repair of concrete structures, protection of structural steel, or any other use of pneumatically applied mortar as may be designated. Work will include the furnishing and pneumatically applying of Portland cement, mortar, and reinforcement steel (if required) on prepared surfaces of concrete or steel at the locations and to the dimensions and details shown in the Specifications or as directed.

Work shall also include removal of all loose, soft, honeycombed and disintegrated concrete, removal of sound concrete in areas designated for repair, preparation of the surface, and mixing and applying the pneumatically applied mortar to areas where total depth of concrete repair does not exceed 6 inches. Protective coatings over structural steel shall not exceed 1-1/2 inches.

Application shall be by the dry-mix method whereby sand and concrete are pre-mixed, fed into a hose under regulated pressure, and then mixed with water at a discharge nozzle; the resulting mortar is then ejected under pressure onto the surfaces prepared therefore.

434.02 Materials.

Materials shall conform to the following Subsections:

FINE AGGREGATE	902.04
PORTLAND CEMENT	905.01
WATER	905.04
REINFORCEMENT STEEL	908.01
EPOXY BONDING COAT	905.18

434.03 Equipment.

Equipment for mixing and placing the pneumatically applied mortar shall be as follows:

(A) Mixing Equipment.

Mixing equipment shall be capable of thoroughly mixing the sand and cement (the sand particles shall be thoroughly coated with cement) in sufficient quantity to maintain placing continuity. The mixing time shall be not less than 1 minute. The mixer shall be self-cleaning and capable of discharging all mixed material without any carry over from one batch to the next. It shall be inspected and thoroughly cleaned at least once a day to prevent accumulations of batched material.

(B) Delivery Equipment.

Delivery equipment shall be of a design and size which will give satisfactory results. The equipment shall be capable of discharging the sand-cement mixture into the delivery hose under close control and shall deliver a continuous smooth stream of uniformly mixed material at the proper velocity to the discharge nozzle.

(C) Discharge Nozzle.

Discharge nozzle shall be equipped with a manually operated water injection system for directing an even distribution of water through the sand-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water and shall be convenient to the nozzleman.

The nozzle shall be capable of delivering a conical discharge stream of thoroughly mixed mortar.

(D) Air Compressor.

Air compressor shall be of sufficient capacity to provide, without interruption, a volume* of 60 to 225 cubic feet per minute at a pressure* range of 30 to 60 psi, as required by the size of the nozzle employed. The air compressor capacity shall include allowances for air consumed in blowing rebound, cleaning, sandblasting, and for incidental uses.

(E) Water Pump.

Water pump shall be of sufficient size and capacity to deliver the water at a pressure* of not less than 15 pounds in excess of the required air pressure.

(F) General.

Equipment shall be approved by the Engineer prior to the application of any mortar. Equipment shall be thoroughly cleaned at the end of each shift. Equipment parts, especially the nozzle liner and water injection system, shall be regularly inspected and replaced as required.

434.04 Methods of Construction.

Pneumatically applied mortar construction shall conform to all requirements of the "Specifications for Materials, Proportioning, and Application of Shotcrete" (ACI 506.2) published by the American Concrete Institute, except as modified by these Specifications, and shall be performed in general compliance with "Recommended Practice for Shotcreting" (ACI 506) published by the American Concrete Institute.

(A) Working Personnel.

Only experienced workmen shall be employed to operate the equipment. The qualifications of all workmen operating equipment shall be proved to the satisfaction of the Engineer, but his approval of men or their qualifications shall in no way relieve the Contractor of his responsibility to produce satisfactory results.

A nozzleman shall not be considered qualified unless he has had considerable experience in operating the same type of equipment proposed for use under the same conditions likely to be encountered in the work. This experience shall include work on surfaces similar to those of the work to be performed, both in horizontal and vertical planes.

(B) Mortar.

Mortar shall be mixed in the proportions of 1 part of cement to 3 parts of sand, volumetrically measured. When ready to be used the sand shall have a moisture content of from 4 to 8 per cent by weight. All materials shall be thoroughly mixed and passed through a 1/4 inch sieve to remove lumps or oversize particles before being placed in the delivery equipment. Mixed materials shall be used within 45 minutes or discarded.

Proper consistency shall be controlled at the nozzle valve by the nozzleman and a low water-cement ratio must be maintained. The mix shall be sufficiently dry so that it will not sag or fall from vertical or inclined

surfaces or separate in horizontal work. Water content shall not exceed 3-1/2 gallons per bag of cement, including the moisture in the sand.

These volumes and pressures are required for operation at the level of the equipment and with a maximum hose length of 100 feet. Higher pressures shall be required if the height of the operation and/or the length of hose is increased beyond that described.

(C) PREPARATION OF SURFACES.

In areas of concrete repair work, all loose and disintegrated concrete shall be removed with pneumatic or hand tools. The surface shall then be thoroughly sandblasted to remove all dirt and loose particles. Special care shall be taken to clean thoroughly any exposed steel reinforcement. All concrete around the reinforcement where bond is broken shall be chipped away to a minimum depth of 1/2 inch below the reinforcement and the steel shall be sand-blasted. Prior to application, the concrete surface shall be scoured clean with an air-water jet; free water shall then be blown away with compressed air. The concrete surface shall be kept damp 3 hours in advance of application. Mortar shall be applied only when the surfaces are still damp.

Surfaces of structural steel to be protected by pneumatically applied mortar shall be thoroughly cleaned of paint, rust, grease, and other foreign material. The Contractor may be required to sandblast for this purpose when so directed.

The newly chipped and sandblasted concrete surfaces or primed steel surfaces shall be coated thoroughly with epoxy bonding coat prior to application of the mortar.

(D) FORMS.

Forms where required, shall be structurally sufficient and of such design that rebound or accumulated loose sand can freely escape or be readily removed. Shooting strips shall be used at corners, edges, and on surfaces where necessary to obtain true lines and proper thicknesses.

(E) PLACING REINFORCEMENT STEEL.

In areas of concrete repair work, existing reinforcement steel which has suffered loss of section by corrosion shall be replaced with new material of the same size as the original. Butt welded joints shall be used. In all cases, replacement of corroded steel shall be under the direction of the Engineer. When mesh is required for building up surfaces, it shall be fastened to the concrete by expansion bolts of the size and at the spacing shown. Adjacent sheets shall be lapped at least four inches in each direction and all laps tied at intervals not to exceed 18 inches. No reinforcement steel or wire mesh shall be located closer than 3/4 inch from any finished surface. Where repairs are necessary for depths of three inches or more over a considerable area, two or more layers of reinforcement shall be used with the first layer being placed approximately 3/4 inch away from the existing concrete.

When a protective coating of pneumatically applied mortar is to be placed over structural steel, the wire mesh reinforcement shall be cut in sheets of the proper size. The separate sheets shall be bent carefully in such a manner as to follow closely the outlines of the members to be covered and shall be securely held in the manner shown so that the mesh is approximately 3/4 inch away from the surfaces of the members. Adjacent sheets shall be lapped at least 4 inches.

(F) APPLICATION OF MORTAR.

Mortar shall not be applied to a surface containing frost or ice. Where standing or running water is encountered it shall be removed before applying the mortar. Positive means for checking the thickness of each layer shall be used. Protection from freezing or quick drying shall be provided. No work shall be performed without the permission of the Engineer when the ambient temperature is lower or likely to fall lower than 50°F. in the shade.

The nozzle shall be held perpendicular to, and 3 to 4 feet from, the surface to which the mortar is applied. It shall be moved in a narrow range to produce a spreading effect over a small area. When coatings one inch or more in thickness are to be applied to vertical or under-surfaces, applications of mortar shall be made in layers not exceeding 3/4 inch in thickness. In shooting vertical surfaces, the work shall begin at the bottom and work upward. On horizontal surfaces, the limit of thickness is reached when material starts to spatter or show other evidence of excess moisture.

The original surface, and each surface which is permitted to harden before applying succeeding layers, shall be washed with water and air blasted and brushed to remove loose material. Sand which rebounds and does not fall clear of the work or which collects on horizontal surfaces shall be blown off from time to

time to avoid leaving sand pockets. Should any deposit of sand be covered with mortar, it shall be cut out and replaced with a fresh application.

At the end of any day's work or similar stopping period, the freshly placed mortar shall be tapered to a thin edge. Before shooting the adjacent section, the tapered portion shall be cleaned and washed. Square joints will not be permitted.

Care shall be taken during application to secure a true surface as near as practicable in finishes to that of the existing adjacent concrete work. Reworking by screeding or troweling will not be permitted. The finished surfaces shall be workmanlike in appearance, of uniform color, straight and true, and satisfactory to the Engineer.

Prior to construction, test specimens shall be made by each application crew using the equipment, materials and mix proportions proposed for each type of repair on the Project.

Test panels shall be at least 30 inches x 30 inches for each mix, each type of repair and for each shooting position to be encountered on the job including the overhead position. The same reinforcement as is in the structure shall be provided in at least half the panels to test for proper embedment of the reinforcing steel. Test panels shall be fabricated in the same thickness as the structure, but thickness shall not be less than 3 inches or the least dimension of the proposed repair, whichever is less. Test panels shall be field cured in the same manner as the work. Test panels shall be gunned preferably against similar support conditions, such as a 6 inch thick precast concrete slab section or equivalent, to simulate actual field conditions for concrete repairs to pier surfaces. Panels shall be field cured in the same manner as the work, except that test specimens shall be soaked in water for a minimum of 40 hours prior to testing.

At least five 3 inch diameter cores or 3 inch cubes shall be cut from each test panel not earlier than five days after applying the mortar. The specimens shall be delivered to the Engineer for testing. Test specimens are to be cured and tested in accordance with AASHTO T 24.

For acceptance purposes, the average 28-day core strengths, as a minimum, shall be equal to f'_c = 3,500 psi for cores with L/D = 2.0. For cores with L/D between 1.0 and 2.0, the correction factors specified in AASHTO T 24 shall apply. For cube specimens, the average strength, as a minimum, shall be equal to f'_c /0.85.

The cut surfaces of the specimens will be examined carefully and additional surfaces shall be exposed by sawing or breaking portions of the test panels, as directed. The mortar shall be bonded to the existing substrate and reinforcing bars and shall be sound and uniform. Cut and broken surfaces shall be free of honeycomb, laminations, and sand pockets.

Unreinforced test panels, from which four cubes or cores shall be obtained, shall be at least 12 inches square and 3 inches thick and shall be made during each day of application of pneumatically applied mortar. The cores shall be tested in pairs for 28-day strength. The average compressive strength for these pairs shall be 3,300 psi minimum. If 25 square yards or less per day are applied, sampling requirements may be reduced or waived.

The mortar shall be applied in one or more layers to the total thickness required to restore the area as detailed over the original lines of the adjoining surface. Where the cavity exceeds 4 inches in depth, a layer of mesh shall be used for each 3 inch depth of mortar. However, in no case shall wire mesh be placed behind existing reinforcement.

The time interval between applying successive layers in sloping, vertical, or overhanging work must be sufficient to allow initial set to develop. During the time initial set is developing, the surface shall be cleaned to remove the thin film residue in order to provide bonding with succeeding applications.

Unless otherwise designated, the areas of concrete and encasement to be repaired will be determined before work begins and access to the areas shall be provided.

(G) CURING.

Pneumatically applied mortar shall be cured with liquid curing compound in accordance with Paragraph 401.18(A).

434.05 Measurement.

Pneumatically Applied Mortar will be measured by the actual surface areas of concrete repair or areas of the members to be covered with mortar or by the number of 94 pound bags of cement in the mortar.

Reinforcement steel will be measured as prescribed in Subsection 401.23.

434.06 Payment.

Payment will be made under:

	PAY ITEM	PAY UNIT
PNEUMATICALLY APPLIED MORTAR		SQUARE FOOT
PNEUMATICALLY APPLIED MORTAR		BAG

Reinforcement steel will be paid for in accordance with Subsection 401.24. Cost of furnishing and application of epoxy bonding coat is subsidiary to the applied mortar.

SECTION 435 – OVERHEAD SPAN VARIABLE MESSAGE SIGN AND VARIABLE SPEED LIMIT SIGN SUPPORT STRUCTURES

435.01 Description.

This work shall consist of the fabrication, furnishing, and erection of overhead span Variable Message Sign and Variable Speed Limit Sign (VMS/VSLS) support structures, including the required concrete foundations and anchorages, in accordance with the details as shown or as ordered.

Materials and construction methods not specifically covered in the Plans and Specifications shall be in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

435.02 Materials.

Materials shall conform to the following Sections and Subsections:

ADMIXTURES AND CURING MATERIAL	906
ELECTRICAL CONDUIT AND FITTINGS	918.08
FASTENERS	909.02
PORTLAND CEMENT CONCRETE.	905.05
REINFORCEMENT STEEL FOR STRUCTURES	908.01
STEEL PIPES FOR SIGN SUPPORT STRUCTURES	909.10
STRUCTURAL STEEL	909.01
ZINC COATING (GALVANIZING) ON STEEL	909.11
EPOXY RESIN WATERPROOFING	923.06

Overhead span VMS/VSLS support structures shall be fabricated from the following optional materials:

High-strength low-alloy steel HSS square tubing of the nominal size and thickness of the member as shown on the plans, or fabricated plate with a single longitudinal seam weld of thicknesses and dimensions as called for on the plans.

All bolts, nuts, washers, and bolts of ½" in diameter or greater and anchor bolts shall be galvanized. All bolts, nuts, and washers less than ½" in diameter shall manufactured from a stainless steel with a minimum Chromium content of 18% and an minimum Nickel content of 8% (Type 18-8).

Steel surfaces shall be prevented from coming in contact with aluminum surfaces by means of approved pads of Neoprene or similar material placed between the dissimilar metals. Where steel elements are to be bolted to aluminum elements, only stainless steel fasteners shall be used.

Electrodes for welding steel shall be coated or covered electrodes conforming to the requirements of AWS Specification A5.1 for electrodes of the type or types suitable for the conditions of intended use, and must be approved by the Engineer.

Specific appurtenances and materials for the overhead span VMS/VSLS support structures shall be as per the approved bill of materials shown in the plans. Substitutions shall be permissible at the written consent of the Authority.

Variable Message Signs and Variable Speed Limit Sign units shall be furnished to the Contractor by the Authority. The Contractor will be responsible for inspecting the units and verifying that they are in good working order prior to acceptance from the Authority. The Contractor shall take care not to damage the units either in storing or handling after acceptance from the Authority. After acceptance by the Authority, any units which do not function to the satisfaction of the Engineer will be repaired or replaced at no additional cost to the Authority.

435.03 Shop Drawings.

Shop, erection, and other drawings necessary for the fabrication and erection of sign support structures shall be furnished in accordance with Subsection 104.08.

435.04 Fabrication.

The fabrication of overhead span VMS/VSLS support structures shall conform to the applicable requirements of AASHTO Standard Specifications for Highway Bridges relating to the construction of "Steel Structures" and to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 2001, 4th Edition with interims through 2006. Welding shall conform to ANSI/AASHTO/AWS D1.1 Structural Welding Code - Steel and the requirements of Subsection 403.06.

The truss of all overhead span VMS/VSLS support structures shall be capable of being cambered to the dimensions as shown on the plans. Cambering shall be accomplished by extending the top chord of the truss and shortening the bottom chord of the truss, or by other acceptable means as approved by the Engineer.

Ends of sections shall be cut true and smooth, free from burrs and ragged breaks. The interior of all tubular members shall be free of loose material, including but not limited to laitance, shavings, cutting fluids, and loose hanging burrs prior to the member being sealed via welded joint fabrication or end cap installation. Open ends of tubular sections shall be capped as shown on the plans. Drain holes shall be provided wherever shown or necessary.

All tube-to-tube joints of the sign support truss shall be fully welded. No splices will be permitted in chord members. All welding shall be performed by qualified welders. Certified proof of the qualifications of welders shall be provided by the Contractor to the Engineer prior to fabrication. Certification shall be from a commercial or public testing laboratory, with qualifications based on the test prescribed in part B, Section IX, of the ASME Boiler and Pressure Vessel Code.

All welding shall be performed in the shop by the inert gas shielded arc method using electrodes as specified in Subsection 439.02. Welded joints shall be subject to visual inspection by the Engineer and, where deemed necessary, questionable welds shall be tested by radiographic and/or by dye penetrant method. Defects so detected shall be corrected by removing and replacing the entire weld.

Bolt holes shall be drilled to finished size or sub punched smaller than the nominal diameter of the fastener and reamed to size. The amount by which the diameter of a subpunched hole is smaller than that of the finished hole shall be at least one quarter the thickness of the piece. The finished diameter of shop drilled holes shall be not more than 1/16" greater than the nominal diameter of the fastener and the finished diameter of field drilled holes shall be not more than 1/8" greater than the nominal diameter of the fastener.

The Contractor shall furnish, fabricate, and install walkway grating, expanded metal fencing, access ladder and door assemblies, and all associated hardware and appurtenances on overhead span VMS/VSLS support structures in accordance with the plans or as directed by the Engineer.

Steel walkway gratings shall be fabricated in accordance with the manufacturer's recommendation, cut to the prescribed sizes, and bolted to the structure truss in accordance with the plans.

The workmanship and finish of fabricated materials shall be equal to the best general practice in modern fabricating shops.

(A) Inspection of Welds.

The fabricator shall be required to make his own inspection to maintain quality control. Such inspection shall comply with the provisions of the section on inspection of the American Welding Society Structural Welding Code Steel (AWS D1.1) by AWS certified welding inspectors in accordance with the appropriate subsections thereof. All welds shall meet the "quality of welds" requirements specified in the sections on "Design of New Bridges" and "Tubular Structures" of the structural welding code. All welds not meeting these quality requirements shall be repaired and/or replaced by the Contractor to meet these requirements and check tests, with no additional cost to the Authority.

Welds shall be visually inspected as specified for procedures techniques and standards of acceptance in accordance with AWS D1.1.

Welds shall be tested using the magnetic particle inspection procedure in accordance with Subsection 403.06 as follows:

(1) 100% of the welds between the end frame columns and upper and lower base plates.

(2) 25% of each other type of weld within the complete structure.

Transverse butt welds shall be tested throughout their entire length using radiographic inspection procedures. Longitudinal seam welds shall be tested throughout their entire length using ultrasonic inspection procedures.

The procedures, techniques, standards of acceptance, and methods of repair shall be in accordance with the requirements of AWS D1.1.

All testing of welds, as herein required, shall be certified by a qualified laboratory engaged by the Contractor and approved by the Engineer. The Contractor shall forward the certifications to the Engineer and shall pay for all costs of weld inspection and certification as herein specified.

The Engineer reserves the right to inspect by nondestructive testing techniques all welds and adjacent base metal as he deems warranted. All such additional testing shall be paid for by the Authority and at no cost to the Contractor.

435.05 Erection.

The erection of Overhead Span VMS/VSLS Support Structures shall be in accordance with the applicable provisions of Section 403, the section on "Steel Structures" of the AASHTO Standard Specifications for Highway Bridges, the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and as specified herein.

The Contractor shall refer to the Plans for project specific details for Maintenance and Protection of Traffic to erect the VMS/VSLS Support Structures.

Attention is directed to Sections 801, 802 of the Standard Supplementary Specifications regarding the maintenance and protection of traffic during work adjacent to or over active roadways. The Contractor is advised that any work on the erection of the overhead span VMS/VSLS support structure or other work that might endanger traffic on active Turnpike roadways shall not be commenced until the proper lane closings have been made or traffic slow downs have been instituted, in accordance with the requirements of Subsection 802.03 of the Standard Supplemental Specification.

After the end frame of the structure has been placed over the anchor bolts onto the leveling nuts, the nuts shall be adjusted until the end frame is truly vertical. The upper nuts shall then be placed and tightened.

Under no circumstances shall the horizontal section of span type support structures be erected before the expiration of the pedestal concrete curing period as specified in Subsection 401.04.

In order to avoid performing any work outside of the limits of the protected interior of the structure truss while over roadways in use, the truss for shall be fully fitted with both the VMS and VSLS units, walkways, and other accessories required shall be fully installed thereon before erecting the complete assembly on to the previously erected end frames. The assembled truss shall be handled and erected with great care and in such a manner as not to damage the truss nor any of the installations thereon.

Details of the exact erection method and procedure the Contractor proposes to use shall be submitted to the Engineer for approval and such changes as may be deemed advisable in the opinion of the Engineer shall be made.

The elevation of the top of the pedestal, together with the end post dimensions and the maximum panel height, have been selected to provide a minimum clearance of 18' 0" from the high point of the roadway cross section. This clearance must be maintained.

Before final acceptance, all metal surfaces shall be cleaned free of oil, grease, soil or other discoloration. Cleaning shall be with suitable solvents or by other approved means to the satisfaction of the Engineer. If cleaning is necessary after erection over roadways in use, suitable means shall be provided for the protection of traffic during the cleaning operations.

435.06 Support Structure Foundations.

Before any construction is started on the concrete foundation, the Contractor shall first carefully locate the existing underground facilities within or adjacent to the area of excavation, utilizing hand excavation where necessary. Excavation and backfilling for construction of the footings and pedestals of the various overhead and ground mounted sign support structures shall conform to the requirements of Section 205 and as specified herein.

Preparation and placing of concrete and reinforcement steel shall conform to the requirements of Section 401.

Construction of drilled shaft foundations shall conform to the requirements of Section 436

Care shall be taken not to damage surrounding grassed areas during any of the Contractor's operations. All damaged surfaces of grassed berm and median areas shall be restored to their original conditions after completion of all work on the foundations, VMS/VSLS support structure, and guard rail construction or replacement, in a manner satisfactory to the Engineer.

Topsoiling, seeding, fertilizing, and mulching shall be performed in accordance with the requirements of the Sections of Division 700, and as directed by the Engineer.

Reconstruction of existing Berm and Shoulder Pavement shall be performed in accordance with the requirements of Subsections 303 and 310, as applicable.

Demolition of existing Median Barrier, where required, shall be performed in accordance with Subsection 210. Reconstruction of Median Barrier, where required, will be performed in accordance with Subsection 508.

Removal and Resetting of Guard Rail shall be performed in accordance with Subsection 510.

Temporary or permanent sheeting, as designated on the Plans or directed, shall conform to the requirements of Sections 415 and 416, respectively.

Piles, where required, shall be furnished and driven in accordance with Section 405.

(A) Excavation and Backfill.

Excavation for overhead sign structure foundations adjacent to active roadways shall be sheeted on at least three sides closest to the roadway in berm areas and on all sides when located in the median, or at other locations where two opposite edges of a footing are less than eleven feet away from the edge of its adjacent shoulders. Sheeting is not required for drilled shaft foundations.

Sheeting shall extend to at least four (4) feet above the adjacent roadway surface. The sheeting shall be provided with flashing amber lights mounted in view of oncoming traffic. Sides of sheeting facing traffic shall be painted white as soon as it is driven.

The bottom of all excavations shall be firm undisturbed earth to provide a suitable bearing area for the foundation. Excavation below the prescribed minimum depth shown on the plans shall be filled with concrete placed directly on the undercut surface, thus increasing the total thickness of the footing by the amount of undercut. Unless ordered by the Engineer to excavate below the prescribed minimum depths, the cost of furnishing and placing such additional concrete shall be borne solely by the Contractor.

All excavations shall be backfilled around the concrete foundation and pedestal and thoroughly compacted up to the surrounding ground lines. Excess excavated materials shall be properly disposed of in a manner satisfactory to the Engineer.

(B) Foundations for Overhead Span VMS/VSLS Support Structures.

The foundations for overhead span VMS/VSLS support structures shall be constructed to the shapes, dimensions, and elevations shown on the Plans.

Forms for exposed faces of the pedestals shall be of plywood, using the minimum practical number of sheets for each face. Form ties will not be permitted through the concrete placed above grade.

Anchor bolts shall be set accurately by means of a template and held rigidly in position during the placement of pedestal concrete. Great care shall be taken to ensure orientation of the anchor bolt template is correct prior to placing concrete. The Contractor shall make periodic checks of the bolt positions and elevations during concreting operations. It is essential that the distance between the centers of anchor bolt groups of the two foundations for each overhead sign support frame be exactly the span length shown on the plans at 68°F. Care shall be taken to protect the threaded portions of anchor bolts and the leveling nuts from damage by concrete or equipment.

Concrete shall be placed and vibrated in the pedestal to within approximately three inches of the final top surface elevation of the pedestal, as indicated on the plans. The top surface of the concrete shall be kept wet for at least 24 hours; after which the end supports and bases of the overhead structure shall be set onto the leveling nuts, the nuts adjusted, and the upper nuts placed and tightened. Exposed portions of the top surface shall be sloped down away from the end frame bases. After the curing period has expired, the forms shall be removed and surface defects pointed with a matching mortar to the satisfaction of the Engineer.

Epoxy Resin Waterproofing shall be applied to the tops of the support structure pedestals to the limits shown on the Plans and as indicated in Section 410.03 (D) of the Standard Specifications.

435.07 Measurement.

Overhead span VMS/VSLS support structures will be measured on a unit basis for each separate sign support structure location.

Concrete Foundations will be measured by the volume of concrete in place with the exception of drilled shafts. Drilled Shafts, regardless of diameter, will be measured in accordance with Section 436.

Concrete Pedestals will be measured by volume of concrete in place.

435.08 Payment.

Payment will be made under:

PAY ITEM ..... ***PAY UNIT***

OVERHEAD SPAN VMS/VSLS SUPPORT STRUCTURE_____ ..... LUMP SUM

Payment for demolition of median barrier will be made in accordance with Section 210

Payment for construction of median barrier will be made in accordance with Section 508

Payment for restoration of berm and / or shoulder pavement will be made in accordance with Sections 303 and 310, as applicable.

Payment for reinforcement steel will be made in accordance with Section 401.

Payment for piles will be made in accordance with Section 405.

Payment for drilled shafts will be made in accordance with Section 429

Payment for electrical items will be made in accordance with Sections 601-603.

Payment for sheeting will be made in accordance with Sections 415 or 416, as applicable.

No separate payment will be made for Epoxy Resin Waterproofing, the costs of which shall be included in other associated foundation items.

Separate payment will not be made for foundation excavation for overhead span VMS/VSLS support structures.

VMS and VSLS will be furnished to the Contractor by the Authority. Separate payment will not be made for picking-up signs from their place of storage, delivery to the site or installation of the signs onto the sign structures, the costs of which shall be included in the costs bid the Pay Item Overhead Span VMS/VSLS Suort Structure_____.

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SECTION 501 – UNDERDRAINS

501.01 Description.

This work shall consist of the construction of underdrains and bleeder drains for subsoil drainage at the designated locations, to the prescribed lines, grades, and dimensions.

501.02 Materials.

Materials shall conform to the following Subsections:

PIPE FOR UNDERDRAINS.....917.04

OUTLET PIPE 917.04

AGGREGATES FOR UNDERDRAINS.....902.05

FILTER FABRIC.....923.21

501.03 Methods of Construction.

Excavation and backfilling of trenches and installation of pipe shall be in accordance with Subsection 206.03 and Subsection 502.03, respectively, except as hereinafter specified.

(A) PIPE UNDERDRAINS.

All underdrain, with the exception of the semi-circular pipe underdrain, shall be laid on a 3-inch minimum layer of aggregate for underdrain.

Perforated pipe shall be installed with the perforations in the bottom half of the pipe.

Semi-circular pipe underdrains shall be installed directly on the bottom of the trench and joints made in accordance with the manufacturer's recommendations.

Corrugated metal pipe underdrains shall be joined with coupling bands.

After the joints have been made, the trench shall be backfilled with aggregate for underdrain to the elevation shown on the Plans. Aggregate material shall be placed in 6 inch layers and thoroughly compacted with mechanical tampers or vibratory soil compactors.

Outlet pipes shall be installed in conformity with the requirements for underdrain.

The outlet pipe shall conform to the slope as shown on the Plans. All field cuts of corrugated metal pipe underdrain shall be coated with galvanizing repair compound or zinc paint conforming to the requirements of ASTM A780, Annex A2.

Suitable caps shall be installed and firmly secured at each upper end of underdrains in accordance with the pipe manufacturer's recommendations and as approved by the Engineer.

(B) BLEEDER DRAINS.

Excavation for bleeder drains shall not commence until the subgrade or subbase surfaces have been prepared in accordance with the requirements of Subsections 209.03 and 203.03 respectively.

Trenches for bleeder drains shall be backfilled with underdrain backfill material to the limits shown on the Plans. In grassed areas, trenches shall be backfilled to within 5 inches of the final ground surface, at which level filter fabric shall be placed, and then brought to grade with topsoil. Backfill material shall be placed in 6 inch layers and thoroughly compacted with mechanical tampers or vibratory soil compactors.

(C) FILTER FABRIC UNDERDRAIN.

Filter fabric underdrain shall consist of underdrains using filter fabric and aggregate. The trench in which the fabric is to be installed shall be prepared to a relatively smooth state free of sharp protrusions, depressions, and debris. The fabric shall be placed with a long dimension parallel to, and centered with alignment of the trench. It shall be placed in the trench in reasonable conformance with the shape of the trench and shall be smooth and free of tension, stress, folds, wrinkles, or creases. The fabric shall be installed, so that any splice joints have a minimum overlap of at least two feet. The overlap of the closure at the top of the trench shall be approximately the width of the trench.

Damaged or displaced fabric shall be replaced or repaired at the direction of the Engineer.

Aggregate for filling shall be placed in the fabric lined trench by method which will not cause the permeability of the material to be impeded and which will result in the trench being completely filled to the lines shown.

The filter fabric shall be overlapped at the top of the trench and the remainder of the trench shall be backfilled in accordance with Subsection 206.03.

(D) COMBINATION UNDERDRAIN.

Combination underdrain shall be a pipe underdrain with filter fabric, constructed in accordance with the appropriate provisions of (A) and (C) above.

501.04 Measurement.

Underdrains of the various types and sizes specified to be furnished and installed will be measured by the length, in place along the centerline of the pipe, including elbows and tees.

501.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
____ - INCH OUTLET PIPE	LINEAR FOOT
____ - INCH BLEEDER DRAIN	LINEAR FOOT
____ - INCH PIPE UNDERDRAIN	LINEAR FOOT
____ - INCH COMBINATION UNDERDRAIN	LINEAR FOOT
FILTER FABRIC UNDERDRAIN	LINEAR FOOT

Payment for rock excavation will be made in accordance with Subsection 206.05.

Separate payment will not be made for the excavation and backfill required, but the cost thereof shall be included in the cost of those items to be constructed.

SECTION 502 - STORM DRAINS

502.01 Description.

This work shall consist of the construction and any required cleaning of pipe drains, slope drains and other drainage components for surface drainage at the designated locations, to the prescribed lines, grades, and dimensions.

This work shall also consist of the construction of a cured-in-place pipe liner and the patching of existing pipe joints at the locations shown on the Plans or as directed by the Engineer.

502.02 Materials.

Materials shall conform to the following Subsections:

REINFORCED CONCRETE PIPE	917.02
DUCTILE IRON PIPE	917.03
CORRUGATED METAL PIPE	917.05
HIGH DENSITY POLYETHYLENE (HDPE) PIPE	917.08
JOINT-SEALING COMPOUND	907.02
RUBBER GASKET JOINT	907.05
HALF SECTION CORRUGATED METAL PIPE	917.05
ALUMINUM FLASHING	911.01
BURLAP	923.24
STAPLES	919.32

Portland cement concrete for pipe plugs and pipe encasements shall conform to Subsection 504.02 for incidental concrete.

The cured-in-place pipe liner shall conform to ASTM F 1216.

The pipe joint patch material shall be as specified in Subsection 917.02.

502.03 Methods of Construction.

Excavation, pipe bedding and backfilling shall conform to the requirements of Subsection 206.03 and the following.

(A) Excavation, Pipe Bedding and Backfilling.

Excavation shall not be started until the exact locations of utility structures have been determined in the field by the Contractor. If there are existing drainage facilities at the site, flow in such facilities shall be maintained during construction of the new drains. If the existing facilities are inadequate or if there are no existing facilities for keeping the site and the work well drained, the Contractor shall provide temporary facilities (drains, ditches or trenches) as may be deemed necessary and practical by the Engineer, outside the limits of the new drain construction until the new drainage facilities are completed and put into service. Drainage design is not the responsibility of the Contractor.

At all drains to be constructed where embankment is to be placed, the embankment shall be constructed and consolidated as specified for roadway embankment in Paragraph 203.03(E) to a height of not less than 3 feet above the future location of the top of the drain or to the finished level of the embankment for a minimum distance of 10 feet each side of the drain, and a trench shall then be excavated for the placing of the drain. The Contractor shall provide for temporary flow of water without damage to such embankments.

Where trench openings for pipes remain open overnight within or adjacent to roadways open to traffic, the traffic on such roadways shall be adequately maintained and protected to the satisfaction of the Engineer.

The Contractor shall maintain existing roadways, where storm drains are installed, in good serviceable condition, and all depressions shall be immediately repaired to the satisfaction of the Engineer.

Where the ends of pipes are to enter existing concrete or masonry walls, the pipe and wall shall be neatly cut to fit at the face of the wall and the pipe shall be grouted in place.

Where storm drains are constructed in two or more stages, a temporary pipe plug shall be constructed in the end of the pipe at the termination of each stage except where it is required to keep the pipe open for temporary drainage.

(B) Installation.

Pipe shall be laid beginning at the downstream end of the pipe. Immediately before laying, the interior surface and the ends of the sections of pipe shall be cleaned by wiping or other procedure as necessary. Bell and spigot pipe shall be placed with the bell end upgrade. All pipe shall be firmly bedded in the underlying soil or bedding material for its entire length. Joints shall be watertight, adjoining sections of pipe shall form a continuous and smooth invert, spigots or tongues shall be fully entered, and the joints, except those made with bolted or threaded couplings, shall be slightly flexible. Broken or otherwise damaged pipe shall be replaced. Drains shall be kept free of any deposit or debris.

Pipe shall be inspected before backfill is placed. Any pipe found to be out of alignment, damaged, or which shows any settlement after laying, shall be taken up and relaid or replaced without extra compensation.

Half section corrugated metal pipe shall be installed as detailed on the Plans. At retaining walls, provide 16 gauge (0.064 inch) aluminum alloy flashing bolted to the pipe and to the walls using stainless steel fasteners. At the opposite side of the half section and where walls do not occur provide aluminum flashing and burlap for soil stabilization as shown. All aluminum flashing shall be bituminous coated. All fastener heads shall be covered with a bitumastic sealant.

Burlap shall be laid parallel to pipe with ends lapped 3 to 6 inches and stapled on 12-inch centers, with staples spaced on 24-inch centers throughout the field of the burlap. Staples shall be driven at an angle approximately 30 degrees from perpendicular to grade and flush with surface of burlap.

(C) Concrete Pipe Joints.

Joints in concrete pipe shall be made with either rubber gaskets or joint sealing compound.

(1) Rubber Gasket Joints shall be installed in accordance with the manufacturer's instruction.

(2) Joint-Sealing Compound shall be installed in accordance with the sealant manufacturer's instructions, as approved by the Engineer, so that the joint is completely filled with the sealing compound.

(D) CORRUGATED METAL PIPE JOINTS.

Corrugated metal pipe joints shall have the connecting bands neatly fitting the corrugations, and the connections shall be made in a neat and workmanlike manner. All bolts shall be drawn tight and burred.

When the Plans call for corrugated metal pipe to be connected to reinforced concrete pipe, the connection shall be made in accordance with the details shown on the Plans, and the cost thereof shall be included in the price bid for the connecting corrugated metal pipe.

Joints for corrugated metal pipe half sections shall be made by lapping the corrugations as detailed and bolting with stainless steel fasteners. All fastener heads shall be covered with a bitumastic sealant.

(E) PIPE PLUGS.

The ends of existing pipes indicated on the Plans to be permanently plugged shall be filled with Class D concrete for the full cross-sectional area of the pipe. The thickness of the pipe plug for pipes up to 48" in diameter shall be 1/3 the nominal diameter of the pipe but not less than 8". For pipes larger than 48" in diameter, the thickness of the pipe plug shall be as noted on the Plans.

(F) EXISTING DRAINAGE WORK.

In order to insure proper drainage, it may become necessary to clean existing storm drains of accumulated silt, sand, and other debris. The work will consist of cleaning the existing drainage pipes of the current drainage system that may or may not connect to any proposed drainage sections to be extended within the Contract area. The work shall include the cleaning of existing underground concrete and corrugated metal pipes, and inlets.

Methods and equipment used by the Contractor in cleaning pipes shall be subject to the approval of the Engineer. Work shall be performed as follows:

1) Field Measurement and Inspection.

The Contractor shall verify, by actual field inspection and measurement, the condition of the various components of the drainage systems to be cleaned. In order to determine the condition of the drainage system, the Contractor shall provide equipment and materials necessary to inspect the entire drainage system within the limits of the contract to the first upgrade structure, or as directed by the Engineer, prior to the cleaning of any part of the drainage system.

2) Cleaning Underground Pipes.

The Contractor shall thoroughly clean the underground concrete and/or corrugated metal pipes, as required and directed by the Engineer, from all dirt, debris and foreign matter. In the event that during or after cleaning the pipe, it is found by the Engineer that the drainage is not free flowing between inlets or manholes, due to a break or other defect, then such cleaning will cease and payment will be made to the Contractor for the actual length of pipe cleaned by the Contractor. Existing pipe outlets that are buried shall be located and uncovered as directed by the Engineer.

(G) RELAID PIPE.

Existing pipes to be relaid which are outside the limits of excavation for new pipes shall be removed and the trenches shall be backfilled and compacted. The pipe shall be cleaned and relaid as specified for new pipe.

(H) PIPE LINER.

Prior to the construction of the pipe liner and the patching of the pipe joints, the pipes shall be thoroughly cleaned, as specified in Section 201B.

The pipe liner shall be constructed in accordance with ASTM F 1216 and the Manufacturer's requirements.

(I) PATCH PIPE JOINTS.

For patching of the pipe joints, all loose and disintegrated concrete shall be removed from the pipe joints, and the sound concrete shall be removed for a depth of not less than 1/4 inch. The remainder of the area and all exposed reinforcement shall be cleaned and roughened. The patch depths shall be at least one inch.

Pneumatic tools may be utilized, but not to the extent that they damage the remaining concrete or reinforcement. The patch material shall be applied in accordance with the Manufacturer's requirements.

If dewatering is required, the method shall be submitted to the Engineer for approval, prior to the commencement of work.

(J) HDPE PIPE

Installation shall be in accordance with ASTM D2321, and as per the manufacturer's latest installation guidelines.

502.04 Measurement.

Storm drains of the various types and sizes, specified to be furnished and installed, will be measured by the length in place along the centerline of the pipe, including tees and elbows, except that the length between the inner faces of catch basins, inlet and manhole walls will not be measured for payment.

Flared End Sections will be measured by the number of each type and size furnished and installed.

Cleaning existing storm drains of the various types and sizes will be measured along the centerline of the pipe, including any lengths passing through inlets or manholes.

Relaid pipe of the various sizes and kinds will be measured as specified above for pipe.

Pipe Liner of various sizes will be measured by the linear foot of pipe.

Patch Pipe Joints will be measured by the number of each, with the patch being a pipe joint circumference.

502.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
__ INCH (TYPE) PIPE, (CLASS OR GAUGE)	LINEAR FOOT
__ INCH (TYPE) FLARED END SECTIONS	EACH
CLEANING EXISTING STORM DRAINS	LINEAR FOOT
__ INCH HALF SECTION CORRUGATED METAL PIPE	LINEAR FOOT
RELAID (SIZE AND KIND) PIPE	LINEAR FOOT
___" PIPE LINER	LINEAR FOOT
PATCH PIPE JOINTS	EACH

There will be no separate payment for the uncovering of existing pipe, inlet cleaning, disposal of materials or water used in cleaning operations.

Separate payment will not be made for the excavation and backfill required, but the cost thereof shall be included in the cost of those items to be constructed.

Separate payment will not be made for aluminum flashing and burlap soil stabilization, but all costs therefore shall be included in the price bid for the item, Half Section Corrugated Metal Pipe, scheduled in the proposal.

Payment for rock excavation will be made in accordance with Subsection 206.05.

Separate payment will not be made for pipe plugs.

Payment for concrete for permanent pipe plugs, encasements or saddles will be made in accordance with Section 504.

SECTION 503 - MANHOLES AND INLETS

503.01 Description.

This work shall consist of construction, alteration and/or reconstruction of inlets and manholes, as described at the designated locations to the prescribed lines, grades and dimensions, in accordance with the Plans, Specifications and the Construction Details plan requirements.

This work shall also include the excavation and backfill required for the items to be constructed or repaired, and any required restoration of grass areas disturbed by construction, which shall be topsoiled and seeded, in accordance with Sections 703 and 704.

Inlet reconstruction, as a part of resurfacing work, shall also include any required excavation and removal of walls or portions of the walls of existing damaged inlets, the repair of the inlets from the existing inlet foundation to the prescribed new elevations, or the repair of portions of existing walls from the top of sound walls to the prescribed new elevations, and furnishing and installing cast iron extension frames for inlets to the prescribed new elevations, prior to resurfacing work. The Contractor shall also repair all damaged inlets prior to the resetting work.

503.02 Materials.

Materials shall conform to the following Subsections:

PORTLAND CEMENT CONCRETE. 905.05

MORTAR 905.10

REINFORCEMENT STEEL 908.01

CONCRETE BLOCK 916.01

CLAY OR SHALE BRICK 916.02

CONCRETE BRICK 916.02

HEAD FRAME, GRATE AND COVER. 909.04

LADDER RUNG 916.05

503.03 Methods of Construction.

Manholes and inlets shall be constructed in accordance with the following.

(A) EXCAVATION AND BACKFILLING.

Excavation and backfilling shall be in accordance with Subsection 206.03.

(B) CONCRETE CONSTRUCTION.

Concrete construction shall be in accordance with Section 401.

(C) BLOCK AND BRICK CONSTRUCTION.

Block and brick shall be laid with staggered joints. All horizontal joints, all vertical joints of brick, and all keyways of vertical joints of concrete block shall be filled with mortar. All horizontal joints, and in brick, all vertical joints shall be not more than 3/8 inch wide. The outside wall shall be plastered with a minimum of 1/2 inch thickness of mortar troweled to a smooth finish.

Inlet and outlet pipes shall extend through the walls of manholes and inlets for a sufficient distance beyond the outside surface to allow for connections, but shall be cut off flush with the wall on the inside surface.

The concrete or brick and mortar shall be so constructed around the pipes as to prevent leakage and form a neat connection.

(D) PRECAST CONCRETE INLETS AND MANHOLES.

Precast concrete inlets and manholes may be substituted for cast-in-place structures, unless otherwise specified. Precast structures shall be placed on a 6 inch bed of compacted coarse aggregate Size No. 57. Reinforcement steel shall have a minimum of 2 inch cover. Handling devices, if used, shall be removable and the holes filled with concrete. Prior to ordering precast units, the Contractor shall verify the elevations of existing drainage systems that will be connected to new precast unit and shall submit shop and working drawings for review, in accordance with Subsection 104.08, showing inverts and appropriate dimensions for each unit.

(E) INVERTS.

Inverts shall be constructed to cause the least possible resistance to flow. The shape of the inverts shall conform uniformly to inlet and outlet pipes. The finish shall be smooth and uniform.

(F) INLETS.

To provide temporary drainage, one or more blocks shall be omitted in selected course or courses of the structure. Prior to construction of base and surface courses at inlets, where blocks are temporarily omitted, the required blocks shall be placed and the inlet walls completed.

Curb inlet castings shall be set to final grade after adjacent curb forms have been set and approved, and prior to the placement of concrete for the adjacent curb.

(G) FRAMES, GRATES AND COVERS.

Frames, grates, and covers shall be fitted together and match-marked before being delivered to prevent rocking of covers and grates. All frames shall be set firm and snug.

If frames are to be anchored, or the grates or covers are bolted to the frames, all anchors or bolts shall be in place and tightened before the concrete or mortar is placed, and shall not be disturbed until the mortar or concrete has set.

When heads are to be placed upon previously constructed masonry, the bearing surface of masonry shall be brought to line and grade, and present an even bearing surface, in order that the entire face or back of the casting will come in contact with the masonry. Frames shall be set in mortar beds or anchored to the masonry, as indicated.

Exposed surfaces of existing head frames, covers and gratings shall be hand-cleaned with a wire brush. Oil and grease shall be removed with gasoline, benzene or other suitable solvents.

Existing heads to be reused shall be carefully removed and substantially cleaned of mortar fragments, prior to resetting. Heads to be reused that are damaged by the Contractor during the process of the work shall be replaced in kind by the Contractor at Contractor expense.

An extension frame, as manufactured by Campbell Foundry Company, Harrison, New Jersey, Ph. (973)483-5480, will be used to reset Type G1 frame of inlets.

(H) RECONSTRUCTION AND CONVERSION OF EXISTING STRUCTURES.

Existing manholes and inlets shall be modified as follows:

(1) At designated locations, new inlets and manholes shall be constructed, using existing frames grates and covers reclaimed from the Project inlets and manholes that are to be abandoned or removed. They shall be removed carefully from the existing drainage structures. All concrete, mortar, and other adhering matter shall be removed from the castings. The existing castings shall be stored safely and any which are lost, broken, or damaged shall be replaced without additional compensation. Frames and gratings, which are damaged by the Contractor's operations, shall be replaced in kind by the Contractor at his expense.

(2) Reconstructing Inlets and Manholes shall consist of removing and cleaning the existing castings, removal of the walls and ladder rungs to the specified depth, disposal of the masonry, reconstruction of the walls, installing new frames, covers, grates or ladder rungs, if necessary, and resetting frames at the specified grade.

(3) Converting Existing Inlets Into Manholes shall conform in general to the requirements specified above for the reconstruction of inlets and manholes, except that the inlet walls shall be removed to the necessary depth and either a satisfactory wall transition shall be constructed from the existing rectangular or square section to a circular section, and the walls corbelled to meet the diameter of the manhole frames, or a concrete slab to accommodate the new frame shall be constructed upon the existing walls, which have been adjusted to the proper elevation. New manhole frames and covers of the design shown for standard manholes shall be furnished and set on the reconstructed walls. The existing inlet heads shall be salvaged and reused, as needed on the Project.

(4) Cast iron extension frames for inlets and extension rings for manholes shall be used to raise existing structures to proposed grades and elevations. Before applying epoxy, the surfaces of the existing frame to receive the epoxy and the lower bearing surfaces and sides of the extension frames or rings shall be sand blasted or brushed clean with a mechanically-driven wire wheel to ensure adhesion of the epoxy to the surfaces. The prepared surfaces shall then be wiped with a rapid-evaporating degreasing agent such as 1, 1, 1 Trichlordethane. The extension frame or ring shall be placed in the existing casting and checked for fit. Any excess void space shall be noted and extra epoxy shall be applied at that location. The epoxy shall be applied in accordance with the manufacturer's recommendations and the extension frame or ring shall be pressed firmly into the uncured epoxy to

ensure uniform contact between the frame and epoxy. The grate or cover shall then be placed on the extension frame or ring in such a manner as not to change the position of the frame or ring. If existing grates or covers are loose and wobble after being set in the extension frames or rings, they shall be ground to obtain a tighter fit or they shall be replaced as directed.

When structures contain existing frame or ring extensions, these frame or ring extensions shall be removed. The castings shall then be raised using new extension frames or rings.

Adjustment of frames in excess of 1 foot shall be considered reconstructing manholes and inlets.

(5) Repair inlet shall conform in general to the requirements specified for the reconstruction of inlets and manholes except that the walls or portions of walls of the existing damaged inlet may require repair or reconstruction from the existing inlet foundation to the prescribed new elevation. The repair of portions of the existing walls shall begin from the top of the undamaged portion to the prescribed new elevations. The removal of deteriorated concrete shall be accomplished with hand-held tools. The replacement shall be made using a bonding compound and a stiff Class A concrete as approved by the Engineer. The Engineer shall determine the damaged area(s).

(6) The Engineer will designate the locations of temporary barrier curb to be installed by the Contractor at the inlet sites under the installed shoulder or lane closings.

For each affected inlet the Contractor shall, in accordance with Section 800, pick up, place and return the required number of sections of temporary barrier curb complete with rail, flashing lights and batteries.

(7) New frames, covers and grates shall be furnished and set on existing structures as indicated on the plans.

The work of this section shall include restoration of grass areas disturbed by construction. The affected areas shall be topsoiled and seeded in accordance with Subsections 703.01 through 703.03 and Subsections 704.01 through 704.03. The type of seed will be determined by the Engineer.

503.04 Measurement.

Manholes, inlets and frames with grates or covers of the kinds and types required will be measured by the number of each.

Inlets of the various types shall include the proper frame and grate. Manholes of the various types shall include the frame and cover.

Reset Frame will be measured by the number and type worked on.

Repair inlets will be measured by the area of interior walls in the inlet actually repaired.

When applicable, The Pickup and Return of Temporary Barrier, the Installation and Removal of Temporary Barrier, and the Restoration of Grass Areas Disturbed by Construction shall be Topsoiled and Seeded will not be measured for separate payment, but the cost thereof shall be incidental to the Repair Inlets Item.

Reset Frames will be measured by the number worked on.

503.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
INLET, TYPE __	EACH
INLET, TYPE __, USING EXISTING FRAME & GRATE	EACH
INLET CONVERTED TO MANHOLE	EACH
MANHOLE, TYPE __	EACH
MANHOLE, TYPE __, USING EXISTING FRAME & COVER	EACH
MANHOLE, TYPE __, USING NEW SQUARE FRAME & CIRCULAR COVER	EACH
RECONSTRUCTED INLET, TYPE __, USING EXISTING GRATE AND FRAME	EACH
RECONSTRUCTED MANHOLE, TYPE __ USING EXISTING COVER AND FRAME	EACH
RECONSTRUCTED INLET, TYPE __, USING NEW GRATE AND FRAME	EACH

RECONSTRUCTED MANHOLE, TYPE __ USING NEW COVER AND FRAME ..... EACH

NEW INLET FRAME & GRATE, TYPE __ ..... EACH

NEW MANHOLE FRAME AND COVER..... EACH

RESET FRAMES..... EACH

RESET FRAME, TYPE G-1 WITH EXTENSION..... EACH

REPAIR INLETS ..... SQUARE FOOT

Payment adjustments for strength and durability for the various Portland cement concrete items listed above will be made in accordance with the specified Performance Criteria Category within Table 2 of Subsection 905.23.

Payment for rock excavation will be made in accordance with Subsection 206.05.

Separate payment will not be made for new frames and grates needed for reconstructed inlets, and new frames and covers needed for reconstructed manholes.

Separate payment will not be made for the excavation and backfill required, but the cost thereof shall be included in the cost of those items to be constructed. Unless otherwise provided for, the placement of dense graded aggregate and asphalt materials required for restoration will not be paid for separately.

SECTION 504 - MINOR CONCRETE STRUCTURES AND INCIDENTAL CONCRETE

504.01 Description.

This work shall consist of the construction of concrete gutters, splash pads, aprons, headwalls, and other incidental concrete appurtenances.

504.02 Materials.

Materials shall conform to the following Subsections:

PORTLAND CEMENT CONCRETE 905.05

REINFORCEMENT STEEL..... 908.01

PREFORMED JOINT FILLER 907.01

JOINT SEALER 907.02

SAND BEDDING 902.04

504.03 Methods of Construction.

Incidental concrete shall be provided where called for in the Plans and Specifications.

(A) EXCAVATION AND BACKFILLING.

Excavation and backfilling shall be in accordance with Subsection 206.03.

(B) CONCRETE CONSTRUCTION.

Concrete construction shall be in accordance with Section 401, except that batching and mixing equipment may be of a size and type suitable for the work to be done and subject to the approval of the Engineer. Concrete for gutters, splash pads and aprons shall be finished with a wood float to an even smooth surface at the proper grade.

Gutters shall be provided with 1/4 inch wide expansion joints, filled with preformed joint filler, and sealed with the prescribed joint sealer. Expansion joints shall be spaced at intervals of 20 feet maximum, unless otherwise prescribed.

504.04 Measurement.

Concrete gutters of the various thicknesses will be measured by the surface area constructed in accordance with the Plans and Specifications.

All other minor concrete structures or incidental concrete appurtenances, constructed in accordance with the Plans and Specifications, will be measured within the neat lines and planes of the concrete components and the volume computed in cubic yards.

504.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CONCRETE GUTTER, ___ INCHES THICK	SQUARE YARD
INCIDENTAL CONCRETE	CUBIC YARD

Payment for reinforcing steel will be made in accordance with Section 401. No separate payment will be made for wire mesh reinforcement.

Separate payment will not be made for the excavation and backfill required, but the cost thereof shall be included in the cost of those items to be constructed.

SECTION 505 - ASPHALT CONCRETE LIP CURB AND LIP CURB INLETS

505.01 Description.

This work shall consist of construction of hot plant-mixed asphalt concrete lip curb and lip curb inlets.

This work shall also include the excavation and backfill required for the items to be constructed.

505.02 Materials.

Materials shall conform to the following Sections and Subsections:

ASPHALT CONCRETE	903
AGGREGATES	902
TACK COAT	904.02
TIMBER PLANKS.	910.06

505.03 Methods of Construction.

At the Contractor's option, lip curb may be constructed by machine-laid or hand-laid methods. The curb shall conform to the details shown on the Plans for the method of construction employed.

Excavation and backfill shall be in accordance with Sections 202.03 and 203.03.

All operations, requirements, equipment and procedures associated with mixing, transporting and placing the asphalt concrete curb shall conform to the applicable requirements of Section 302.

The mixture shall be transported to the job site in tight vehicles that have been cleaned of all foreign material. Covers and other insulation shall be provided. In no case shall the temperature of the delivered material vary more than $\pm$ 15°F from the temperature approved by the Engineer for the job-mix formula. When variations in the size of loads, speed of trucks, length of haul, and conditions of trucks interfere with orderly continuous operations, the Engineer may order suitable corrections to be made.

In order to maintain proper alignment, the Contractor shall stretch a string line or draw a chalk line to delineate the front edge of the curb.

The mixture shall not be placed when the ambient temperature is less than 40°F.

The temperature of the mixture at the time it is placed shall be between 275°F and 350°F, and no mixture shall be placed on any surface cooler than 40°F.

The berm surfacing upon which the lip curb is to be constructed shall be dry and cleaned of loose of deleterious material. Immediately after cleaning, tack coat shall be applied to the area where the lip curb will be placed at a rate between 0.05 and 0.10 of a gallon per square yard. The exact rate between such limits will be established by the Engineer in accordance with the job conditions.

Unless otherwise permitted, the curb construction shall be a continuous operation in one direction so as to eliminate curb joints. Where joints are permitted, they shall be carefully made in such a manner as to insure a

continuous bond between the previously laid and the new sections of the curb. All contact surfaces of previously constructed curb shall be painted with a thin uniform coat of hot asphalt material just prior to placing the fresh curb material.

(A) Machine-Laid Lip Curb.

The curb-forming devices on the machine shall be such as will provide the curb section called for, laid and compacted in an even homogeneous manner, with no supplementary forming.

On irregular sections, or in areas of restricted operations where it is impracticable to place asphalt concrete curb by machine, the Contractor may, as permitted by the Engineer, place the mixture by hand, in wood or metal forms constructed to the required shape (machine laid alternative) of curb. Mixture placed by hand shall be tamped into place and screeded to a smooth finish. Forms may be removed as soon as the mixture has cooled to air temperature. The surface may be hot-troweled for a smooth finish.

Machine laid curb must be placed before guide rail posts are installed.

(B) Hand-Laid Lip Curb.

Any irregularities in the berm surfacing that would prevent a smooth and uniform setting and alignment of the backing planks shall be corrected as directed by the Engineer. The backing planks shall be carefully aligned both horizontally and vertically and substantially staked in place. Timber planks and stakes shall not be removed but shall remain as an integral part of the hand-laid curb.

The hand-laid curb shall be compacted, as directed, by the use of any suitable compacting devices and shall be finished off to the required dimensions and surface so that the completed curb will present a neat and uniform appearance.

(C) Lip Curb Inlets.

Lip curb inlets shall be constructed at the location and to the grades and details shown on the Plans. All work shall be finished neatly and the inlet shall make a smooth transition with the asphalt concrete lip curb. Special care shall be taken that the finished inlet will be free from cracks or holes that would allow the seepage of water.

The curb portion of the drain shall be formed as specified for machine or hand-laid curb. Hand-tamping methods may be employed to compact and form the asphalt apron.

Excavation and backfilling shall meet the requirements specified under Subsection 206.03.

505.04 Measurement.

Asphalt Concrete Lip Curb will be measured by the length along the face at the gutter line.

Asphalt Concrete Lip Curb Inlets will be measured by the number constructed.

505.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
Asphalt Concrete Lip Curb	Linear Foot
Asphalt Concrete Lip Curb Inlet	Each

Separate payment will not be made for the excavation and backfill required, but the cost thereof shall be included in the cost of those items to be constructed.

Section 506 - Concrete Curb

506.01 Description.

This work shall consist of construction of Portland cement concrete curbs and solid concrete noses.

506.02 Materials.

Materials shall conform to the following Subsections:

Portland Cement Concrete	905.05

PREFORMED JOINT FILLER 907.01

CURING COMPOUND 906.07

506.03 Methods of Construction.

The underlying foundation and backfill for the curb or nose shall be well compacted by means of flat-faced mechanical tampers, or by other means approved by the Engineer, in accordance with Subsection 203.03 with excavation in accordance with Subsection 202.03.

Methods of construction shall conform to the applicable requirements of Section 401, except that the batching and mixing equipment may be of a size and type suitable for the work to be done and subject to the approval of the Engineer. Metal forms shall be used, unless otherwise approved by the Engineer, and shall be lubricated with an approved material that will not cause stains. The concrete shall be tamped and spaded, or vibrated so that the forms are completely filled, the concrete thoroughly compacted, and mortar is flushed to the face and top. Before initial set, the top, and as soon as the forms can be removed, the face shall be finished with a wood float to an even smooth and dense surface. Edges shall be rounded to the required radius with suitable edging tools. Expansion joints shall be provided, as noted on the Plans and shall be filled with 1/2 inch preformed joint filler to within 1/4 inch of exposed surfaces. 1/4 inch tooled contraction joints shall be made midway between expansion joints in curbs. Curb joints shall be neatly rounded to a 1/4 inch radius. Where the curb or nose is adjacent to concrete pavement, preformed joint filler shall be provided.

The curb shall be cured with clear or translucent liquid compound, in accordance with Subsection 906.07; which shall be applied as soon as the concrete has been finished. The rate and manner of application shall be as described in Paragraph 401.18(E), except that only one application shall be made.

The finished curb or nose shall be true to the required grades, lines, and curvatures.

(A) Fabrication Tolerances.

(B) All cast-in-place and precast concrete barrier curbs, regardless of the method of construction, shall conform to the following finished tolerances:

BAR REINFORCEMENT COVER ..... -0 + 1/2 INCH

WIDTH (TOP) ..... -0 + 1/4 INCH

WIDTH (BOTTOM) ..... -0 + 1/2 INCH

SURFACE STRAIGHTNESS (DEVIATION FROM THEORETICAL CENTERLINE OF INDIVIDUAL SECTION OF UNIT) ..... 1/2 INCH IN 20 FEET

VERTICAL ALIGNMENT (DEVIATION FROM A LINE PARALLEL TO THE THEORETICAL GRADE LINE) ..... 1/2 INCH IN 20 FEET

HORIZONTAL AND VERTICAL MISALIGNMENT BETWEEN ADJACENT PRECAST UNITS ..... 3/16 INCH

All precast concrete barrier curbs shall also conform to the following tolerances in addition to the above:

(1) Cross sectional dimensions shall not vary by more than 3/16 inch.

(2) The vertical centerline shall not be out of plumb by more than 3/16 inch.

(3) When checked with a 10 foot straight edge surface irregularities shall not exceed 3/16 inch.

(4) Longitudinal dimensions shall not vary from the dimensions shown by more than 3/16 inch per 10 feet of barrier.

Reinforcement cover shall be verified while the concrete is still plastic, except in the case of cured precast units. In that case, cover will be verified in accordance with established Authority procedures.

All precast concrete barrier curbs used for construction purposes shall be fabricated with white cement concrete, in accordance with Sections 402, 905, and as specified herein, unless required otherwise by Contract Documents.

506.04 Measurement.

Curbs and solid concrete noses of the various types and kinds will be measured by the length, measured in place along the face of curb, and along the centerline of the solid concrete nose.

506.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CONCRETE CURB, TYPE ___	LINEAR FOOT
SOLID NOSE	LINEAR FOOT
DROP CURB	LINEAR FOOT

Payment adjustments for strength and durability for the various Portland cement concrete items listed above will be made in accordance with the specified Performance Criteria Category within Table 2 of Subsection 905.23.

Separate payment will not be made for the excavation and backfill required, but the cost thereof shall be included in the cost of those items to be constructed.

SECTION 507 - GRANITE CURB

507.01 Description.

This work shall consist of construction of granite curb at toll islands and other locations.

507.02 Materials.

Materials shall conform to the following Subsections:

GRANITE CURB	923.13
STONE ANCHORS	908.05
PORTLAND CEMENT CONCRETE	905.05
MORTAR	905.10
PREFORMED JOINT FILLER	907.01
JOINT SEALER	907.02

507.03 Methods of Construction.

Shop drawings, showing the piecing and jointing points for the curbing, shall be submitted for the Engineer's review in accordance with the requirements of Subsection 104.08. After review, the shop drawings shall serve as a basis for full size templates of the various pieces. The templates shall be test assembled and corrected, if necessary, to produce a smooth curve at all points. Each piece of curbing shall then conform, within the specified limits, to template and shall be piece-marked.

The stone anchors shall be grouted into the holes in the stones by an approved method. The stones shall be accurately set on concrete supports, true to line and with the top surface at the required grade. The surrounding concrete shall then be placed in back of, under, and around the granite stone, and thoroughly compacted. Care shall be taken to prevent any movement of the stones already in place while placing and compacting the concrete. When required by the Engineer, the stones shall be supported by such bracing and formwork, as may be necessary to prevent movement.

Stones shall be fitted with one-fourth (1/4) inch end joints. In no case shall the joint be less than one-eighth (1/8) inch nor greater than three-eighth (3/8) inch. The joints shall be carefully filled with cement mortar and shall be neatly pointed on the top and exposed front portion. After pointing, the stones shall be satisfactorily cleaned of all excess mortar that may have been forced out of the joints. Expansion joints shall be dressed in the field, if necessary, to secure uniform bearing on the preformed joint filler. The preformed joint filler shall be cut to fit and the joint shall be sealed with joint sealer.

Preformed joint filler and joint sealer shall also be placed between the concrete pavement slab and the curb construction as shown on the Plans.

The Contractor shall cut the granite curb as required to accommodate treadle frames and curb boxes.

507.04 Measurement.

Granite curb will be measured by the length, in place along the face of curb.

507.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
GRANITE CURB	LINEAR FOOT

Granite curb in toll islands will be paid for as specified in Section 520.

Separate payment will not be made for the excavation and backfill required, but the cost thereof shall be included in the cost of those items to be constructed.

SECTION 508 - CONCRETE MEDIAN BARRIER

508.01 Description.

This work shall consist of construction of Portland cement concrete median barrier of various types, at the designated locations, to the prescribed lines, grades and dimensions.

This work shall also consist of the construction of Variable Message Sign (VMS) Equipment Medians.

508.02 Materials.

Materials shall conform to the following Subsections:

AIR-ENTRAINMENT ADMIXTURE	906.02
CHEMICAL ADMIXTURES	906.03
CLASS A CONCRETE	905.05 (A)
COMMON EMBANKMENT	203.02(A)
CURING MATERIALS	906.07
FENCING	914
JOINT MATERIALS	907.01
LIGHTWEIGHT CONCRETE	905.09
PORTLAND CEMENT CONCRETE	905.05
REINFORCEMENT STEEL, EPOXY COATED	908.01(B)

508.03 Methods of Construction.

Roadway concrete median barrier shall be constructed using extrusion (slip-form) techniques unless otherwise indicated. Concrete median barrier on bridge decks and at protection areas, including transitions, shall be cast-in-place using removable forms. The median barrier shall be constructed so that the top of the barrier will form a smooth line parallel to the grade of the roadway in accordance with the design grades shown on the Plans.

Embedded metalwork placed by the Contractor to support forms shall be either epoxy-coated or galvanized.

Concrete shall be Class A, air entrained, unless otherwise shown. Where lightweight concrete is specified or shown on the Plans, it shall meet the requirements of Subsection 905.09.

Concrete shall be batched, mixed, placed, and cured in accordance with the applicable requirements of Section 401. Concrete shall be placed only during periods when the air temperature at the site is 40°F and expected to rise. Reinforcement steel shall be placed in accordance with the requirements of Subsection 401.09.

The foundation soils and the aggregate base course under the roadway median barrier and the adjacent pavement shall be compacted to a density of not less than 95% of maximum dry density, determined in accordance with AASHTO T180, Method C.

After the median barrier concrete has hardened sufficiently to allow drilling of holes through the concrete barrier without damage to the concrete surfaces, the Contractor shall drill 1-inch diameter holes spaced at approximately 300-foot intervals and located so as to be at least 9 feet clear of all joints. The holes shall be core drilled horizontally and located in accordance with the details shown on the Plans. The holes shall be positioned so as to be at least 2 inches clear of vertical reinforcement steel. The vertical reinforcement steel shall

be located by the use of a pachometer or by other approved means. The holes shall also be spaced to avoid placement in concrete median barrier, bridge and protection segments.

The Contractor shall install a 10 foot minimum length median barrier test section with the equipment and forming methods proposed to be used for the project for acceptance testing by the Engineer. If accepted by the Engineer, the test section may be used as part of the permanent median barrier. Any test section replacements shall be made at no cost to the Authority.

Concrete median barrier, roadway, variable height shall be constructed in accordance with the requirements for concrete median barrier roadway, however, slip-forming or cast in place construction methods may be used.

Construction tolerances shall be in accordance with Paragraph 506.03(A), regardless of method of construction.

Excavation and backfill shall be in accordance with Subsections 202.03 and 203.03.

Variable height concrete median barrier will require site specific forms different than those normally associated with this work. Special extrusion (slip-form) equipment and techniques will be required for molding the variable height median barrier. The narrower than normal median width, in some areas where the proposed variable height barrier is to be constructed, may also restrict the Contractor's choice of equipment.

Shop drawings shall be submitted in accordance with Subsection 104.08 of the Standard Specifications for all components of the VMS Equipment Median.

Where shown on the plans and as directed by the Engineer, the Contractor shall construct VMS Equipment Medians in accordance with the details shown. Median barrier shall be constructed as specified in Paragraph 508.03(A). Conduits, junction boxes, cabinet foundations, power equipment, and wiring shall be provided as shown on the Plans. Install power equipment on the VMS Median as shown on the Plans.

(A) CAST-IN-PLACE CONSTRUCTION USING REMOVABLE FORMS - ROADWAY SECTION.

The forms shall be metal or of plastic-lined material, so as to produce a smooth and dense surface finish. Form ties of any character shall not be used through the barrier. The forms shall be lubricated; the form oil shall not discolor or stain the concrete. Expansion joint filler shall be held in place by nails, waterproof adhesive, or other means approved by the Engineer.

The concrete shall be tamped, spaded, and vibrated, so that the forms are completely filled, the concrete thoroughly compacted, and mortar flushed to the face and top. Where so directed by the Engineer, the Contractor shall employ external vibration to achieve the desired finish result on the face of the dense surface. After the forms have been removed, the concrete shall be given an Ordinary Surface Finish in conformance with the requirements of Paragraph 401.17(A). Edges shall be rounded to the required radius with suitable edging tools. Expansion joints shall be provided as shown on the Plans. Joints shall be filled with preformed joint filler, 1 inch thick which shall be inset 1/4 inch from the top and face. Joints shall be neatly rounded to a 1/4 inch radius.

The barrier shall be cured with clear or translucent liquid compound conforming to Subsection 906.07, which shall be applied as soon as the concrete has been finished. The rate and manner of application shall be as described in Paragraph 401.18(E).

(B) CAST-IN-PLACE CONSTRUCTION USING REMOVABLE FORMS - BRIDGE SECTION.

Concrete median barrier - bridge section shall be constructed as specified under Paragraph 508.03(A) above except as follows:

Forms shall be metal.

The Contractor shall prepare and submit, for approval by the Engineer, shop and working drawings in accordance with requirements of Subsection 104.08.

Embedded metalwork placed by the Contractor to support forms shall be either epoxy-coated or galvanized. All such metalwork shall be positioned, so that it does not encroach within a distance of 2 inches to any surface.

Inaccuracies in the cambers of the bridge's stringers or any failure of the existing deck to form a smooth grade shall be compensated for by variations in the height of the median barrier, but the height of the median barrier above the adjacent gutter lines shall not be less than the height shown on the Plans.

(C) EXTRUSION OR SLIP-FORM CONSTRUCTION - ROADWAY SECTION.

Concrete median barriers, constructed by using an extrusion machine or other similar type of slip-form equipment, shall be constructed using well compacted dense concrete, and the exposed surfaces shall conform to the applicable requirements in Paragraphs 508.03(A) and 508.03(B).

The equipment, methods, and processes, proposed to be used in the construction of the extruded or slip-formed median barrier, shall be submitted to the Engineer for approval prior to use. The Contractor may be required to furnish evidence of successful history and operation of the extrusion machine or other equipment.

The Contractor shall design the concrete mix in accordance with Subsection 905.05. The mix shall also meet the requirements or criteria established therefore by the manufacturer of the slip-form or extrusion machine. The combined aggregate grading for the concrete shall be as necessary to produce concrete of the specified shape and surface texture. Slump shall be 1" $\pm$ 1/2". At the option of the Contractor, concrete may be made with the materials continuously batched by volume and mixed in a continuous mixer, in accordance with the batching and mixing specifications in ASTM C685.

The concrete shall be fed to the extrusion machine at a uniform rate. The machine shall be operated at proper speed to produce a well compacted mass of concrete free from surface pits larger than one inch in diameter and requiring no further finishing other than that conforming to the provisions in Paragraph 401.17(A) "Ordinary Surface Finish".

The proper density and cross section shall be obtained by forcing the approved concrete mix through a mold of the proper cross section. The extrusion machine shall consolidate the freshly placed concrete in one complete pass of the machine. Sufficient internal vibrators shall be provided for consolidating the concrete along the faces of forms and adjacent to joints, in such a manner that a dense and homogeneous barrier free from voids and honeycomb is produced.

The grade for the top of the concrete barrier shall be indicated by an offset guide line set by the Contractor from survey marks established by the Engineer. The forming portion of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine to conform to the predetermined grade line. A grade line gage or pointer shall be attached to the machine in such a manner that a continual comparison can be made between the barrier being placed and the established grade line, as indicated by the offset guide line.

Reinforcement shall be placed and the location of the joints shall be accurately determined, so that, after the joint is sawn, the reinforcement will have the minimum cover shown on the Plans. An anchorage system shall be devised and constructed by the Contractor capable of restraining the reinforcement cage during slip-forming, so that unacceptable displacements will not occur. Material comprising the anchorage system shall be acceptable to the Engineer and shall be either epoxy-coated reinforcement, galvanized steel, or concrete.

Unacceptable displacements shall be those that produce visual cracks in the hardened concrete as determined solely by the Engineer. These displacements may be cause for curb rejection. The Contractor shall incorporate the proposed anchorage system in the curb test section, if required by the Engineer.

At the Contractor's option, contraction joints may be formed or sawed through the barrier section to its full depth. Joint filler will not be required. Sawed joints shall be constructed within 12 hours after concrete placement, or as otherwise directed by the Engineer to permit sawing without excessive ravelling and before uncontrolled cracking occurs.

The variable height barrier may require modifications to the Contractor’s normal method of restraining the reinforcement cage during slip-forming, so that unacceptable displacements will not occur. Should displacement of the reinforcing cage become evident from visual cracking of curb concrete, the Contractor shall stop work and modify the restraining system to the satisfaction of the Engineer

Variable height concrete median barrier will require site specific different forms than those normally associated with this work. Special extrusion (slip-form) equipment and techniques will be required for molding the variable height median barrier. The narrower than normal median width in some areas of the proposed variable height barrier may also restrict the Contractor’s choice of equipment.

(D) CONSTRUCTION TOLERANCES.

All median barrier shall be constructed, so as to present a smooth uniform appearance and in reasonably close conformity to the established shape, line, grade, and dimensions shown on the Plans. The finished

barrier shall be free of lumps, sags, or other irregularities and constructed to the following tolerances as given in Paragraph 506.03(A).

(E) CONCRETE PENETRATING SEALER/WATER REPELLENT TREATMENT.

The concrete penetrating sealer/water repellent treatment shall be in accordance with Subsection 401.19.

508.04 Measurement.

Concrete median barrier of the various types specified to be furnished and installed will be measured by the length in place along the top of the centerline of each type.

Transition section lengths are included in the payment lengths for concrete median barrier, roadway and concrete median barrier, roadway, variable height, as applicable.

VMS Equipment Medians will be measured by the number of each constructed to the limits shown on the plans.

Concrete Median Barrier Removal, Roadway will be measured by the linear foot along the vertical face of the barrier.

508.05 Payment.

Payment will be measured under:

PAY ITEM	*PAY UNIT*
CONCRETE MEDIAN BARRIER, ROADWAY.	LINEAR FOOT
CONCRETE MEDIAN BARRIER, BRIDGE	LINEAR FOOT
CONCRETE MEDIAN BARRIER, PROTECTION	LINEAR FOOT
CONCRETE MEDIAN BARRIER, ROADWAY, VARIABLE HEIGHT	LINEAR FOOT
CONCRETE MEDIAN BARRIER	LINEAR FOOT
CONCRETE MEDIAN BARRIER REMOVAL, ROADWAY	LINEAR FOOT
VMS EQUIPMENT MEDIAN	EACH

Payment adjustments for strength and durability for the various Portland cement concrete items listed above will be made in accordance with the specified Performance Criteria Category within Table 2 of Subsection 905.23.

Separate payment will not be made for the excavation and backfill required, but the cost thereof shall be included in the cost of those items to be constructed.

Payment for reinforcement steel will be made in accordance with Section 401.

Concrete median barrier in protection areas is to be paid for in linear feet based on each side of the protected area. No separate payment will be made for common embankment or 4 inch concrete slab between barrier protection.

Payment for concrete penetrating sealer and concrete core sampling will be made in accordance with Section 401.

Overhead sign structure footings, drilled shafts, anchor bolts and reinforcement steel will be paid for separately as per Division 400.

No separate payment will be made for conduits, junction boxes, foundations, power equipment, and wiring installed within the limits of the VMS Equipment Median. All costs thereof shall be included in the VMS Equipment Median Pay Item. Payment for installation of SCC cabinet within the VMS Equipment Median shall be made as per Division 600.

Conduits, wiring, manholes/junction boxes and cabinets located outside the limits of the VMS Equipment Median will be paid as per Division 600.

SECTION 509 - SIGN PANELS

509.01 Description.

This work shall consist of furnishing, fabricating, and erecting standard sign panels, in accordance with the Plans and Specifications. The work shall also consist of removal of overhead and ground mounted sign panels as shown on contract plans and as directed by the Engineer.

509.02 Materials.

Materials shall conform to the following Sections:

SIGN PANEL FACE 912.01

STIFFENERS AND STRINGERS 912.01

MOUNTING HARDWARE 912.01

REFLECTIVE SHEETING 912.02

U-CHANNEL POST 912.03

509.03 Methods of Construction.

Fabrication of sign panels shall be done in a properly equipped plant established for the production of the type signs specified. The Engineer shall be permitted to enter the plant where signs are fabricated for the purpose of inspection at any time during working hours while the Contract is in effect.

Prior to fabrication of sign panels, the Contractor shall submit to the Engineer shop drawings in accordance with the requirements of Subsection 104.08 with proposed horizontal and vertical seams shown.

If a new sign has been installed, but it is not to be immediately displayed, the Contractor shall securely cover the sign with burlap, canvas or other material as approved by the Engineer to prevent the sign from being read. The Contractor shall be responsible for maintaining the sign covering until directed to remove the material by the Engineer.

(A) ALUMINUM SHEET SIGN PANELS.

All panel fabrication shall be completed prior to surface treatment and painting or application of reflective materials.

Panels shall be cut to proper size and shape in accordance with the dimensions, details, and splice information shown on the Plans.

The number of horizontal stringers to be provided on any panel is dependent on the height of the panel and their numbers and spacing shall be as detailed on the Plans. Sign panels or sections thereof shall have a minimum of two stringers.

Multi-sheet sign panels whose height is greater than the length of available commercial size sheet aluminum may, if approved by the Engineer, have a horizontal seam. Horizontal seams shall be fabricated similar to that detailed for vertical seams and shall be located as shown on the Plans. Sections of panel shall be treated as separate panels in that not less than two stringers shall be the minimum to be used on any section.

Before any copy is attached or applied to the front face of any sign panel, holes shall be drilled for required rivets or bolts and the various components, including stringers, assembled, aligned, and bolted tight.

Sign panel sections shall be free of buckles, warps, dents, burrs, and other defects.

The existing vertical sign hangers and vertical stiffeners will be removed and replaced for all new sign panels.

Sign panels shall have new horizontal stringers and mounting hardware provided where existing sign panels are being replaced.

Before any copy is attached or applied to the front face of any sign panel, holes shall be drilled for required bolts for panel splicing and the various components, including stringers, assembled, aligned and bolted tight.

(B) SIGN SURFACE PREPARATION.

Manufacturer's recommendations for preparation and application of sheeting shall prevail where conflicting with this specification. Prior to the application of reflective sheeting, the sign surface shall be prepared as follows:

(1) Degreasing.

The front face of the sign panel shall be degreased by one of the following methods:

(a) Vapor degreasing by total immersion in a saturated vapor of trichloroethylene or perchloroethylene.

(b) Alkaline degreasing by total immersion in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's Specifications. Immersion time will depend upon the amount of grease or dirt film present and the thickness of metal. Rinse thoroughly with clean running water.

(c) Alkaline degreasing by steam cleaning with alkaline solutions in accordance with the solution manufacturer's instructions. Rinse thoroughly with clean running water.

(2) Etching.

Following degreasing, the front face shall also be etched by one of the following methods:

(a) Acid etching in a 6 to 8 percent phosphoric acid solution at 100°F or proprietary acid etching solution. Rinse thoroughly with cold then hot running water; or

(b) Alkaline etching in an approved alkaline etching material that is controlled by titration. The etching time, temperature, and concentration shall be as specified by the solution manufacturer. Rinse thoroughly with clean running water.

(3) Drying.

After degreasing and etching, the panels shall be dried by the use of forced hot air.

(4) Handling.

Panels shall not be handled except by device or clean canvas gloves from the time degreasing is started to the time of application of paint or reflective sheetings, nor shall any contaminants be permitted to come into contact with the panels during that period.

(C) APPLICATION OF REFLECTIVE SHEETING.

Reflective sheeting for background shall be cut to proper size for the full area of the panel section and shall be cemented to the front face by the vacuum applicator or roller pressure sensitive process. No reflective sheeting shall be applied when the surface or room temperature is below 65°F. No horizontal splices of reflective sheeting will be permitted.

Application of reflective sheeting copy and borders over the reflective sheeting background shall conform to the manufacturer's recommendations.

High intensity grade sheeting must not be subjected to more than one heat cycle. A heat cycle constitutes one full cycle in the heat lamp vacuum applicator or application by the squeeze roller applicator using a heater accessory.

The cleaners used for Engineer grade sheeting may damage other grades of sheeting. The Contractor shall test a small area and determine that the cleaner selected does not damage the sheeting before large scale use.

(D) PAINTED COPY AND BORDER.

Painted copy and border over reflective sheeting shall be produced by the direct screening process using one coat of the stencil paste called for on the Plans, or an approved equal proprietary product. Painted background over reflective sheeting shall be produced by the reverse screening process using one coat of stencil paste or an approved equal.

(E) COATING.

When all reflective sheeting or painted copy and borders have been applied, the entire sign face of all processed high intensity grade sheeting with heat activated adhesive shall receive a full coat of an approved clear coating when recommended by the sheeting manufacturer. Application of the clear coating shall be in accordance with the manufacturer's recommendations. Application by spraying will not be permitted. All reflective sheeting legend and borders applied with pressure sensitive adhesive shall only be edge-sealed with an approved clear coating when recommended by the sheeting manufacturer.

This clear finishing coat shall be air dried at least 24 hours prior to sign erection, and shall be characterized by an even unblemished surface.

(F) FASTENERS.

Nylon washers shall be used between the heads of all twist fasteners (such as screw heads, bolts, or nuts) and the sheeting to protect the sheeting from the twisting action of the fastener heads. Rivets or carriage bolts with square shanks do not require nylon washers.

The exposed heads of rivets or bolts on the face of the sign panels shall be painted to match the background finish prior to erection or, at the Contractor's option and subject to the Engineer's approval, bolts or rivets with prepainted heads may be used.

The exposed heads of rivets or bolts on the face of the sign panels shall be prepainted to match the background finish of the sign prior to installation, as approved by the Engineer.

(G) SHIPPING.

Completed sign panels shall be properly protected and maintained in good condition, free from dirt, scratches, handmarks, or other blemishes. The panels shall be shipped in such a manner as to ensure their arrival on the job site in an undamaged condition.

In order to remove dirt and other foreign matter at the job site, the smooth surface of high intensity grade sheeting may be cleaned by rinsing, then washing the surface with a mild detergent, followed by a final rinse. Steam cleaning will not be permitted.

(H) TIMBER POSTS.

All timber post ground mounted guide signs to be installed on Authority right-of-way shall be mounted on properly sized, pressure treated timber sign supports, in accordance with the sign support details provided in the Contract Plans.

Timber sign posts shall be so erected that the signs to be attached thereto will be at locations, elevations, and spacing called for on the Plans. Any posts damaged, to the extent that they are in the opinion of the Engineer unfit for use in the finished work, shall be removed from the site and replaced at the Contractor's expense. Signs shall be attached after posts are installed.

(I) U-CHANNEL POST.

U-channel posts shall be so erected that the signs to be attached thereto will be at the locations, elevations, and spacing called for on the Plans. Posts shall be driven to the prescribed depth by either hand or mechanical devices using a suitable driving cap, shall be plumb above the ground, and firm in the ground. After driving, the top of the posts shall have substantially the same cross-sectional dimensions as the body of the posts; posts with battered heads will not be accepted. Any posts bent or otherwise damaged, to the extent that they are in the opinion of the Engineer unfit for use in the finished work, shall be removed from the site and replaced by the Contractor at his own expense. Signs shall be attached after posts are driven. Minor damage to galvanized surfaces shall be repaired at the Contractor's expense in accordance with the requirements of Subsection 403.16.

(J) OTHER DETAILS.

All details not specified herein or shown on the Plans shall conform to details and requirements set forth in current edition of AASHTO "Manual for Signing and Pavement Marking of the National System of Interstate and Defense Highways" and the FHWA "Manual of Standard Highway Signs", and all their current references and supplements. Particular attention shall be paid to references to the FHWA "Manual on Uniform Traffic Control Devices", current edition, as amended. All letters and numerals shall conform to the FHWA "Standard Alphabet".

Unless otherwise noted, all message characters shall be modified Series E letter as shown in the Department of Transportation's "New Jersey Standard Sign Manual".

(K) SIGN REMOVALS.

Where shown on the plans and where directed by the Engineer, the Contractor shall remove existing sign panels from overhead sign support structures that are to remain, and completely remove ground-mounted signs and support posts.

All existing sign panels and support posts that are removed shall become the property of the Contractor and shall be disposed of in a satisfactory manner off Authority property by the Contractor. Concrete foundations for ground-mounted signs shall be removed to a depth two (2) feet below finished grade and backfilled. After the removal of ground-mounted signs, the Contractor shall restore the area to a condition similar to the surrounding vicinity as directed by the Engineer.

Removal and salvaging of electronic sign systems from overhead sign structures that are to remain shall be as specified in Division 600.

Removal of ground mounted electronic sign systems and salvaging of materials shall be as specified in Division 600.

(L) SIGN RELOCATIONS.

Where shown on the plans and where directed by the Engineer, the Contractor shall remove, store and reinstall existing sign panels.

Care shall be exercised in handling and storing of the existing sign panel. Existing sign panels broken or damaged during removal or installation because of carelessness or the use of improper methods of work, both during removing and installation, shall be replaced without additional compensation.

(M)SIGN REMOVALS.

The removal of overhead sign panels shall include removing existing sign hangers, stringers, all connection hardware, lighting bracket if any, and disposing of all non-salvageable material outside of Authority property, as determined by the Engineer.

Removal and salvaging of electronic sign systems from overhead sign structures that are to remain shall be as specified in Division 600.

Removal of ground mounted electronic sign systems and salvaging of materials shall be as specified in Division 600.

509.04 Measurement.

Sign panels of the various sizes will be measured by surface area without reduction for rounded corners, actually fabricated, furnished, and erected as prescribed.

U-Channel Posts and timber posts of the various lengths to be furnished and installed will be measured by the length specified.

Material, equipment and the labor necessary to cover and maintain the covering of new signs shall not be measured for payment, but the cost thereof shall be included in the square foot bid price for sign panels.

The removal of existing overhead signs will be measured by the number of signs removed.

The removal of existing ground-mounted signs will be measured by the number of signs removed. No separate payment will be made for the removal of posts and concrete foundations, but the cost thereof shall be considered incidental to the cost for the removal of the sign.

The relocation of existing sign panels will be measured by the number of signs relocated.

509.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SIGN PANELS	SQUARE FOOT
U-CHANNEL POST	LINEAR FOOT
REMOVAL OF EXISTING GROUND-MOUNTED SIGN	EACH

REMOVE SIGNS ..... EACH

RELOCATE EXISTING GROUND-MOUNTED SIGN ASSEMBLY ..... EACH

RELOCATE SIGN PANELS ..... EACH

REMOVAL OF EXISTING OVERHEAD AND GROUND-MOUNTED SIGN PANELS……...EACH

TIMBER POSTS……...LINEAR FEET

Removal of electronic sign systems from overhead sign structures to remain shall be paid for under Division 600.

Removal of ground mounted electronic sign systems, including sign posts and foundations, shall be paid for under Division 600.

No separate payment will be made for removal and disposal of existing sign hangers, stringers, connection hardware, and lighting brackets.

SECTION 510 - GUIDE RAIL

510.01 Description.

Guide Rail shall consist of steel rail elements mounted on steel posts and recycled/synthetic blockouts, with terminal anchorages, end treatments and connections in accordance with the Plans. Work shall include removal, furnishing and installing, realigning, raising, salvaging existing single-face and double-face beam guide rail, and resetting guide rail with salvaged material.

When applicable, this work shall also include the installation of end terminals in accordance with manufacturer's recommendations. The Contractor and Subcontractor (if applicable) will be required to have their foremen and superintendents (at a minimum) attend a mandatory training session presented by the manufacturer, prior to the start of construction.

510.02 Materials.

Materials shall conform to the following Subsections:

RAIL ELEMENT 915.01

POSTS..... 915.02

BLOCKOUTS 915.02

RUB RAIL..... 915.05

MISCELLANEOUS HARDWARE..... 915.03

EXPANSION ANCHORS ..... 909.02 (E)

ADHESIVE ANCHORS..... 909.02 (F)

Portland cement concrete for anchorages and post foundations shall conform to Section 905, Class B.

All metal components along the Turnpike shall be galvanized in accordance with Subsection 909.11. All metal components along the Garden State Parkway shall be weathering steel in accordance with Section 915.

Use the latest non-gating, guide rail end treatments that are NCHRP 350 tested, test level 3 (TL-3) and approved. Ensure that the components of the end treatment comply with the NCHRP 350 approved end treatment details.

510.03 Methods of Construction.

Prior to installing posts, the location of underground electrical conduits and other utilities, which may conflict with the posts, shall be determined. The Contractor must call (800) 272-1000 for a utility markout in accordance with Subsection 106.18. Post spacing may be adjusted by 6 inches or double brackets may be used, as approved, to eliminate such conflicts. The Contractor's attention is directed to Subsection 106.18, pertaining to utilities. Test pits, as directed, shall be made as specified in Section 522.

The rail elements shall be constructed with the top edge in a straight line or smooth curve parallel to or concentric with the roadway. Where a vertical transition is required, the top edge of rail elements shall form the chords of a smooth vertical curve. Attach the beam guide rail element to the blockout at every post.

No punching, drilling, reaming, or cutting of the rail elements will be permitted in the field unless specifically approved by the Engineer. Neither torchcutting nor welding of rail elements will be permitted. All new material shall be furnished, except where resetting, realigning, raising, or salvaging is called for. Damaged galvanized surfaces shall be repaired in accordance with Subsection 403.16.

The installation shall be made in such a manner that no unprotected end is exposed to approaching traffic.

(A) BEAM GUIDE RAIL.

Within the same working day, replace all existing beam guide rail that is removed. Where possible, install new beam guide rail exposed to approaching traffic before the removal of the existing system.

If it is suspected that conduit is present, the Engineer may require tests. Locate and repair damage to the electrical conduit due to construction operations.

Drive beam guide rail posts to the required position. Ensure that posts are driven plumb, properly spaced, and to the line and grade shown.

Install the required bridge attachment type as shown on the Plans. Mount bridge beam guide posts as shown on the Plans.

Repair damage to the galvanized coating, if applicable, according to ASTM A 780.

(B) SAFETY WALK AND PARAPET CONNECTIONS.

Safety Walk and Parapet connections of the types required shall consist of terminal connector, back-up plate(s), rail element(s), posts, and blockouts. Bolt holes through the parapets shall be core drilled through existing parapets or formed through new parapets using non-corrosive sleeves for each bolt.

(C) POST WELDMENTS.

Post Weldments shall consist of a base plate, welded to a modified guide rail post with bracket, and bolted to a concrete anchorage. The Post Weldment shall be set plumb, properly spaced, and to the prescribed line and grade.

The holes for anchor bolts shall be drilled with a masonry drill. Drill bit sizes for anchor bolt holes shall conform to ANSI Standards. Holes shall be properly spaced and located. Anchor bolts shall be as called for in Paragraphs 909.02(E) or (F).

Precautions shall be taken, so that concrete is not damaged during drilling for anchor bolts. Any damage to the existing concrete shall be repaired without additional compensation. Any alternate concrete anchorages shown on the plans may be substituted with the Engineers approval, provided sufficient depth is available.

Welding shall conform to the ANSI/AASHTO/AWS D1.5 Bridge Welding Code, with the exception that the welding of the tubular structures shall be done in accordance with the ANSI/AWS D1.1 Structural Welding Code.

With Post Weldment installations on the Garden State Parkway, the base plate and post shall be painted brown to match the color of the weathering steel beam guide rail element in accordance with Subsection 913.03, Coating System C.

(D) RUB RAIL.

When rub rail is required, bolt rub rail consisting of a steel channel or a bent plate to the beam guide rail posts.

(E) TERMINALS AND ANCHORAGES.

At least 10 days before beginning the work, submit the manufacturer's recommendations to the Engineer. Install terminals and anchorages according to the manufacturer's recommendations.

Excavate for post holes and concrete anchorages as specified in Subsection 206.03. Backfill and compact using the directed method as specified in Subsection 206.03.

(F) RESET BEAM GUIDE RAIL.

Reset Beam Guide Rail consists of using salvaged material to construct the specified item.

The salvaged material shall be carefully loaded at the location specified and transported to the area where it is to be installed. Available salvaged material shall consist of beam guide rail elements, posts, blockouts,

nuts, bolts, washers and plates, unless otherwise specified. Any salvaged material damaged due to carelessness, shall be replaced without additional compensation.

In areas designated on the plans, salvaged beam guide rail shall be reset using recycled/synthetic blockouts in place of the existing steel or wooden blockouts. New hardware shall be supplied, as required. For galvanized steel beam guide rail elements and galvanized posts, the bolt holes for the recycled/synthetic blockouts shall be treated in accordance with Subsection 403.16. Posts damaged during the drilling of bolt holes shall be replaced at the contractor's expense.

(G) Removal of Beam Guide Rail.

Removal of Beam Guide Rail shall consist of dismantling, removing and disposal of guide rail elements, posts, blockouts and hardware. Work shall include cutting existing anchor bolts flush with concrete surfaces and refilling and patching post holes with material similar to that of the adjoining area.

After removing beam guide rail, backfill the post holes and compact the area to the elevation of the adjacent surface. Materials and debris shall be disposed of in accordance with all applicable Federal, State and Local laws.

(H) Raise Beam Guide Rail.

Raise Guide Rail consists of raising existing guide rail and, where post spacing is currently 12'-6", supplying and installing intermediate posts and blockouts. Where additional posts are required for 6'-3" spacing, they shall be carefully set to the required height. The existing posts and rails shall be raised as specified. New hardware shall be supplied where required. Where existing spacing is 6'-3" or closer, every post shall be completely withdrawn and re-driven into virgin ground. All holes left after the post removal shall be backfilled, patched, and the surface repaired.

(I) Beam Guide Rail Element.

Beam Guide Rail Element shall consist of the installation of new rail element on to existing beam guide rail blockouts in accordance with Paragraph 510.03(A).

(J) Beam Guide Rail Blockout.

Beam Guide Rail Blockout shall consist of the installation on new block outs between existing beam guide rail element and beam guide rail posts in accordance with Paragraph 510.03(A).

Where beam guide rail is attached to a structure, attach the blockout to the structure. Reset the beam guide rail, as specified in Paragraph 510.03(F) to provide a smooth transition to the existing structure.

510.04 Measurement.

Beam Guide Rail will be measured by the length in place along the top of rail between centers of end posts, excluding the pay limits for parapet connections, safety walk connections, anchorages and end terminals. Dual-faced rail items will be measured by the linear foot along the face of one rail excluding end terminals.

Beam Guide Rail Element and Rub Rail will be measured by the linear foot along the face of the rail.

Beam Guide Rail Anchorages, Safety Walk Connections, Parapet Connections, Beam Guide Rail Buried End Terminals, Flared Guide Rail Terminals, Tangent Guide Rail Terminals, Telescoping Guide Rail End Terminals, Beam Guide Rail Post Weldments and Beam Guide Rail Blockouts will be measured by the number of each installed.

Beam Guide Rail Posts, that are in addition to those included under the various guide rail items, will be measured by the number installed.

Raise Beam Guide Rail and Reset Beam Guide Rail will be measured as specified above for Beam Guide Rail.

Removal of Beam Guide Rail will be measured by length of existing beam guide rail removed, as shown on the plans, and as directed by the Engineer.

510.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
BEAM GUIDE RAIL	LINEAR FOOT

BEAM GUIDE RAIL, DUAL-FACED ..... LINEAR FOOT

BEAM GUIDE RAIL, BRIDGE ..... LINEAR FOOT

BEAM GUIDE RAIL, DUAL FACED, BRIDGE ..... LINEAR FOOT

BEAM GUIDE RAIL ELEMENT ..... LINEAR FOOT

RAISE BEAM GUIDE RAIL ..... LINEAR FOOT

RAISE BEAM GUIDE RAIL ELEMENT, DUAL FACED ..... LINEAR FOOT

RESET BEAM GUIDE RAIL ..... LINEAR FOOT

RESET BEAM GUIDE RAIL, DUAL FACED ..... LINEAR FOOT

BEAM GUIDE RAIL BLOCKOUT ..... EACH

BEAM GUIDE RAIL ANCHORAGE ..... EACH

SAFETY WALK CONNECTION, TYPE A ..... EACH

SAFETY WALK CONNECTION, TYPE B ..... EACH

PARAPET CONNECTION, TYPE A ..... EACH

PARAPET CONNECTION, TYPE B ..... EACH

BEAM GUIDE RAIL BURIED END TERMINAL ..... EACH

FLARED GUIDE RAIL TERMINAL ..... EACH

TANGENT GUIDE RAIL TERMINAL ..... EACH

BEAM GUIDE RAIL POST ..... EACH

BEAM GUIDE RAIL POST, _____' LONG ..... EACH

BEAM GUIDE RAIL POST WELDMENT ..... EACH

REMOVAL OF BEAM GUIDE RAIL ..... LINEAR FOOT

RUB RAIL ..... LINEAR FOOT

TELESCOPING GUIDE RAIL END TERMINAL ..... EACH

Test Pits will be paid for in accordance with Section 522. Separate payment will not be made for other excavation and backfill.

SECTION 511 – FENCING

511.01 Description.

This work shall consist of the construction of chain link or farm field right-of-way and perimeter fencing, median fencing, and gates.

This work shall also consist of the construction of bridge fencing on structures crossing over Authority ramps and roadways. Bridge fencing, as required, shall be in accordance with the standards of the agency with jurisdiction over the roadway that the bridge is carrying.

511.02 Materials.

Materials shall conform to the following Subsections:

CHAIN LINK FENCE 914.01

CONCRETE 905.05

511.03 Methods of Construction.

Drawings showing details, dimensions, sizes, finishes, locations, and other information necessary for the complete fabrication and installation of the fencing systems, shall be submitted to the Engineer for review, in accordance with the requirements of Subsection 104.08.

(A) RIGHT-OF-WAY AND PERIMETER FENCING.

In general, the fence shall be set parallel to and 1 foot inside the right-of-way line. However, the exact location of the fence is subject to determination in the field by the Engineer. The Contractor shall stake out the line of the fence from the information shown on the Plans, and the fencing fabric shall be set on that line. The side of the fabric on which the posts shall be erected will be determined by the Engineer for each installation.

The term "corner post" shall mean a post occurring at a horizontal angle point in the line of fence together with the required bracing, constructed as indicated on the Plans.

The term "pull post" shall mean a post for maintaining fabric tension together with the required bracing, constructed as indicated on the Plans.

The Contractor's activities and operations for fencing along the right-of-way shall be confined to the area immediately adjacent to the right-of-way lines, and, as far as practicable, within the Authority's right-of-way.

The Contractor shall be responsible for satisfactory arrangements for permits, as required by him from adjacent property owners, in performing the work.

The Contractor shall clear the area one foot on either side of the fence, or as otherwise directed by the Engineer. When the fence is to be constructed through a wooded area and insufficient access is provided by the Project's clearing and grubbing, a swath not to exceed 8 feet may be cleared inside the Authority right-of-way. Trees, having a caliper greater than 4 inches in the swath to be cleared or along the line of the fence, shall not be cut unless approved by the Engineer and when, in the opinion of the Engineer, adjustment of the line of fence is not possible. Trees to be removed shall be cut flush with the finished ground. Stumps, trees, vegetation, and other materials resulting from the erection of the fence shall be disposed of in accordance with the applicable requirements of Subsection 201.03.

When the Plans call for posts to be embedded in concrete, the footings shall be cast-in-place and shall be not less than the dimensions shown on the Plans.

Batching and mixing of concrete and equipment therefore shall conform to the requirements of Section 401, except as otherwise permitted by the Engineer. Hand mixing of concrete will be permitted where small quantities are to be mixed and when done to the satisfaction of the Engineer. No hand-mixed batch shall exceed 1/2 of a cubic yard. All batches exceeding 1/2 of a cubic yard shall be machine-mixed. Consistency shall meet the requirements of Section 401.

When the ground is firm enough to permit excavation of a hole to neat dimensions, the footing concrete may be placed without forms by completely filling the hole. In this case, the earth coming in contact with the concrete must be moistened to a depth of at least 2 inches prior to placing the concrete. Where the ground cannot be satisfactorily excavated to neat dimensions, forms shall be used. In this case, where the soil is not moist, not less than 1 gallon of water shall be placed in the bottom of the hole and as soon as this has been absorbed, the concrete shall be placed.

Prior to setting aluminum or aluminum coated posts in concrete footings, the outside surface of each post, from the bottom of the pipe to a height of 2 inches above the top of footing, shall be dipped in an approved aluminum bituminous paint and allowed to dry thoroughly before setting the post in the footing.

Concrete shall be placed promptly, expeditiously, and without segregation after mixing. Posts and other units shall be approximately centered in their footings. The Contractor shall consolidate and compact the concrete satisfactorily by tamping or vibrating. The top of all footings shall extend slightly above the ground line and shall be steel troweled to a smooth finish with a slope to drain away from the post. Exposed surfaces shall be rounded off.

Where forms are used, they shall be removed not later than 24 hours after placing the concrete and the excavation shall be immediately backfilled with moistened material placed in 4 to 6 inch layers and each layer solidly tamped.

Curing shall be either by placing not less than 4 inches of loosed earth, free from clods or gravel, over the top of the footing immediately after placing the concrete or by spraying all exposed surfaces after concrete has set with white pigmented curing compound. The curing compound and the methods of application shall conform to the requirements of Section 401, except that only one application shall be made.

All excess excavation from footings, including loose material used for curing, shall be disposed of in a manner satisfactory to the Engineer.

Posts, other than those shown on the Plans to be set in concrete footings, shall be driven into the ground to the depths indicated on the Plans. Driving equipment shall be fitted with a suitable protection device (cap or pad) to prevent damage or deformation to the post and damage to the zinc coating (if any) as a result of the driving operation.

When a post is driven to such depth that its top is below the required elevation, it shall be entirely pulled from the ground, the hole completely backfilled and the post redriven to the proper elevation.

After the post has been driven to the proper elevation, it shall be anchored, using drive anchors, in accordance with the details shown on the Plans.

Line posts for farm field fence shall be furnished with an approved anchor plate satisfactorily welded, or riveted with not less than 2 rivets, to the post to hold the post in proper alignment and plumb after driving.

Line posts shall be spaced as shown on the Plans. Spacing of posts shall be as uniform as practicable under local conditions. Additional posts shall be placed at each abrupt change in grade. As far as practical, the finished fence line grade shall be smooth and continuous.

Corner and pull posts for chain link fence shall have a horizontal brace and a tie rod on each side of the posts, extending and connected to the adjacent line posts. For farm field fence diagonal braces shall be anchored into the ground as shown on the Plans.

Each post shall be erected plumb. Posts shall be permanently positioned, anchored, and footing concrete firmly set before the fabric is placed. The tension wire, shall also be placed, stretched tight, and secured at ends and to all posts in a satisfactory manner before chain link fabric is placed. The ends of the fabric shall be secured in accordance with the details shown on the Plans.

The bottom of the fence fabric shall normally be placed a distance of 3 inches above the ground line; however, over irregular ground a minimum clearance of 1 inch and a maximum clearance of 6 inches will be permitted for a distance not to exceed 8 feet. The Contractor shall excavate as necessary to comply with these requirements.

The fabric shall be placed by securing one end and applying sufficient tension, by means of mechanical fence stretchers, to remove all slack before making attachments elsewhere. The fabric shall be fastened to the line posts and to the tension wire with tie wires as called for on the Plans.

Farm field fence fabric shall be placed by securing one end and applying sufficient tension to remove all slack before making permanent attachments elsewhere. The longitudinal wires shall be fastened to end corner and pull posts by wrapping the wires around the posts and tying the wire back on itself with not less than 1-1/2 twists tightly wrapped. Fence fabric shall be fastened to line posts with not less than six tie wires or clamps, except that where the line posts incorporates satisfactory provision for supporting and securing the fabric wire to the posts, the Engineer may approve such use in place of the wires or clamps.

Three strands of barbed wire shall be provided on chain link fence when shown on the Plans, tightly stretched to remove sag and firmly installed in the slots of the extension arms inclined away from Authority property on intermediate posts. Extension arms on end, corner, and gate posts shall be vertical.

The gates shall be carefully aligned with posts fully vertical. Where clamps are used for attaching hardware, they shall be made up tight. The bottom of each gate shall be not less than 3 or more than 5 inches above the ground when closed and shall clear the ground by at least 3 inches at all points in its swing. The Contractor shall modify the existing grade within the area of swing, if necessary, to meet this requirement when directed by the Engineer. Stops with latches or other approved means for holding the gates open, and so placed as to prevent damage to the gate or fence by overswing, shall be provided for all gates. All gate stops shall be of the type shown on the Plans, or an alternate as approved by the Engineer and shall be set as shown on the Plans.

After the fencing installations are completed, the Engineer will inspect all components. Coatings which have been abraded to expose the base metal shall be repaired in accordance with the following:

(1) Damaged zinc-coated (galvanized) surfaces shall be repaired in accordance with the provision of Subsection 403.16.

(2) Aluminum coated surfaces shall be spot painted with a first coat of suitable primer and after this has thoroughly dried, with a second coat of an approved aluminum paint.

(3) PVC coated surfaces shall be repaired, in accordance with the manufacturer's recommendation.

(B) BRIDGE FENCING.

In general, bridge fencing shall be erected on structures crossing over Authority ramps and roadways not carrying Authority traffic. The design, detailing and specifications for the bridge fencing shall follow that of the agency with jurisdiction over the roadway that the bridge is carrying. Vertical fencing shall be erected on bridge parapets that do not have adjacent sidewalks. Curved-top bridge fencing shall be erected on bridge parapets adjacent to sidewalks.

Should the contractor choose to install the anchor bolts using drill and grout methods, the depth and diameter of the drilled holes shall be in accordance with the grout manufacturer's recommendations. Procedures, design and details for drilling and grouting of the anchor bolts shall be provided as part of the bridge fencing shop drawings.

(C) MEDIAN FENCING.

Construction of median fencing shall be in accordance with the applicable requirements specified for bridge fencing.

511.04 Measurement.

Fencing of the various kinds and sizes will be measured by the length, in place, at the bottom of fabric along the line of fence deducting the width of gates.

Gates and wing sections will be measured by the number of each kind and size installed.

511.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
BRIDGE FENCING, ____" HIGH	LINEAR FOOT
MEDIAN FENCING	LINEAR FOOT
PEDESTRIAN GATE, TYPE ____, ____" HIGH, ____' WIDE	EACH
CHAIN LINK FENCE, TYPE _____, ____" HIGH	LINEAR FOOT
VEHICULAR GATE, TYPE ____, ____" HIGH, ____' WIDE	EACH
WING SECTION, TYPE _____, ____" HIGH	EACH

SECTION 512 - CONCRETE MONUMENTS

512.01 Description.

This work shall consist of furnishing and installing concrete monuments with embedded brass markers to mark right-of-way and survey control lines.

512.02 Materials.

Materials shall conform to the following Subsections:

BRASS MARKERS	911.06
CONCRETE	905.05
REINFORCEMENT STEEL	908.01

512.03 Methods of Construction.

Excavation and backfilling shall conform to the requirements of Section 206, except that the equipment may consist of an approved type auger for excavation.

Concrete monuments shall be precast and fabricated in accordance with the applicable requirements of Section 401. Brass markers shall be cast in the concrete with the edge of the top convex surface flush with the top concrete surface of the monument.

Monuments shall be set and backfilled only when the Engineer is present.

When in place, the top surface of the monument shall be horizontal, and the brass marker shall be in exact position at the locations shown on the Plans, or as directed by the Engineer. Exact locations of the concrete monuments shall be staked by the Contractor under the supervision of a licensed land surveyor. Such locations will be subject to check by the Engineer. Monuments delineating the Authority right-of-way shall be set exactly on the property line.

512.04 Measurement.

Concrete monuments will be measured by the number of each.

512.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CONCRETE MONUMENTS	EACH

SECTION 513 - CONCRETE CRIB WALLS

513.01 Description.

This work shall consist of furnishing and installing precast reinforced concrete units to form a crib wall in accordance with the Plans and Specifications.

513.02 Materials.

Materials shall conform to the following Subsections:

CONCRETE	905.05
POROUS FILL	901.01
REINFORCING STEEL	908.01
GRADE B STONE	902.06

513.03 Methods of Construction.

Before commencing work, shop and working drawings shall be submitted, in accordance with the requirements of Subsection 104.08, showing all aspects of the proposed construction.

(A) CRIB UNITS.

Crib units shall be designed to conform to the following requirements: The reinforcing steel shall be of not less than 3/8 inch diameter and shall be arranged symmetrically about the principal axis of the unit. The cross-section area of the reinforcement steel shall be not less than 1 percent of that of crib unit for headers and not less than 0.9 percent for stretchers. Exposed edges of crib units shall be beveled. The total volume of concrete contained in all of the crib units shall represent at least 16 percent of the gross volume of the crib wall with the filling in place.

All units shall be protected against loss of moisture after casting. Live steam shall be employed as a means of applying moisture and controlled heat to freshly cast concrete units. Waterproof covering and framework shall be furnished to enclose crib units, in order that curing temperatures can be controlled.

Live steam shall be introduced into the kiln or enclosure through a series of steam jets which will be evenly spaced. In no case will the steam impinge directly on the concrete or forms.

After the concrete is placed in the forms, live steam may be introduced into the kiln or enclosure provided that the temperature within the kiln or enclosure shall not exceed 100°F for the first 3 hours.

Thereafter, the application of live steam shall be controlled, so that the temperature will not rise faster than 1 degree F per minute, and shall be kept controlled at 130°F for not less than 10 hours. After these curing periods, the steam may be shut off; however, the enclosure shall remain closed for 1 hour before removing members from forms. Recording thermometers shall be provided to record curing temperatures in kiln or enclosure. Plastic or galvanized metal chairs shall be used to provide minimum concrete cover of 1 inch. A tolerance of 1/4 inch, plus or minus, will be allowed in the overall dimensions of crib units.

Any devices cast in the units for handling purposes shall be of a corrosion resistant material, except that aluminum will not be permitted. They shall be located on the rear face of the units, and shall be removed flush with the face after erection.

(B) CRIB WALLS.

The necessary excavation shall be made to prepare a proper foundation for the wall. The wall shall be constructed on a compacted bed of Embankment, Grade A material, to the thickness shown on the Plans or determined by the Engineer, to provide an even bearing. The wall shall have stretchers running parallel to the wall at both the front and the rear of the crib, with headers placed transversely to support the ends of the stretchers and to tie the crib together.

Sill pieces, composed of one or more stretchers, laid at the front and at the back of a starting course, shall have a width (of each of the front or the back sill) in inches not less than the height of the wall in feet except that the width shall not be less than 8 inches. The front face of the finished wall shall have not more than 50 percent openings. The total height of a course of headers plus stretchers shall be not more than 12 inches. Crib members shall be free from cracks, spalls, and depressions. Damaged members shall not be used and shall be replaced at the Contractor's expense. Stretchers shall be formed and arranged so as to retain backfill adequately. Cap stretchers weighing not less than 50 pounds per linear foot shall be used at the top of the front of the wall. The finished face shall be neat and workmanlike.

(C) FILLING CRIB WALLS.

The fill for crib walls shall include a minimum thickness of two feet of Grade B stone behind the front face stretchers. The remainder of the enclosure shall be filled with porous fill material.

The stone fill, porous fill, and embankment behind the wall, shall be placed in lifts as the construction of the crib proceeds upward and shall extend up to the height shown on the Plans. As the filling progresses, bulkheads shall be placed, or other methods approved by the Engineer shall be used, to keep the stone fill and porous fill material within their respective prescribed limits. Each lift of stone fill, porous fill, and embankment immediately adjacent to the porous fill shall be placed in layers not more than 6 inches thick, and each layer shall be thoroughly compacted by flat-faced pneumatic tampers of a type approved by the Engineer.

The progress of fill placement shall be such that compacted fill is never more than three feet below the top of the highest stretcher in place.

513.04 Measurement.

Concrete crib wall will be measured by the volume of crib units in the crib wall constructed within the pay limits shown on the Plans.

Stone fill will be measured by the volume in place.

513.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CONCRETE CRIB WALL	CUBIC FOOT
STONE FILL	CUBIC YARD

Payment for Porous Fill will be made in accordance with Section 203.

SECTION 514 – SIDEWALKS AND ISLANDS

514.01 Description.

Sidewalks shall consist of the construction of asphalt concrete and Portland cement concrete sidewalks.

514.02 Materials.

Materials for asphalt concrete sidewalks shall conform to Subsection 302.02. Material for Portland cement concrete sidewalks and islands shall conform to Subsection 401.02.

514.03 Methods of Construction.

The underlying material shall be shaped and compacted to a firm even surface. All unstable material shall be removed and replaced with acceptable material which shall then be compacted. Excavation shall be in accordance with Subsection 202.03.

(A) Asphalt Concrete Sidewalks.

Asphalt Concrete Sidewalks shall consist of an asphalt concrete surface on a base course.

(1) Base Course.

Either aggregate base or asphalt concrete base may be used, constructed in accordance with the following:

Aggregate base course shall be constructed in accordance with Section 301. Asphalt concrete base and surface course shall be constructed in accordance with Section 302, except that the material may be spread by hand and thoroughly compacted by multiple passes of a roller weighing not less than 1,000 pounds.

(2) Backfilling.

Backfilling shall be in accordance with Subparagraph 514.03(B)(5) below.

(B) Portland Cement Concrete Sidewalks and Islands.

Sidewalks, islands, and slabs shall be constructed in accordance with Section 401 and the following:

(1) Mixing and Placing Concrete.

Immediately before placing the concrete, the subgrade shall be thoroughly dampened, and the forms given a coating of light oil. Where removed and used again, the forms shall be thoroughly cleaned and oiled each time before using.

Mechanical spreaders will not be required.

(2) Finishing.

The concrete shall be struck off with a transverse template resting upon the side forms. After the concrete has been struck off to the required cross section, it shall be finished with floats.

When the surface of the concrete is free from water and just before the concrete obtains its initial set, it shall be gone over and finished with a wooden float and brushed with a wet soft-haired brush. The surface of the concrete shall be so finished as to drain completely at all times. All edges shall be finished and rounded with an edging tool having a radius of 1/4 inch.

The surface shall be divided into blocks by use of a grooving tool. Grooves shall be so placed as to cause expansion joints to be placed at a groove line. The grooves shall be cut to a depth of not less than 1/2 inch. The edges of the grooves shall be edged with an edging tool having a radius of 1/4 inch.

(3) Expansion Joints.

Expansion Joints shall be 1/2 inch wide, placed at intervals of approximately 20 feet, and shall be filled with preformed expansion joint filler. Expansion joints shall be formed around all appurtenances such as manholes and utility poles extending into or through the concrete. Preformed expansion joint filler, 1/4 inch thick, shall be installed in these joints. Expansion joint filler shall be installed between concrete and any fixed structure, such as a building or bridge. This expansion joint material shall extend for the full depth.

The top and ends of expansion joint material shall be cleaned of concrete, and the expansion joint material shall be so trimmed as to be slightly below the surface of the concrete.

(4) Protection and Curing.

Forms may be removed when removal will not damage the concrete. No pressure shall be exerted upon the concrete in removing forms.

Pedestrians will not be allowed upon the concrete sidewalks until 24 hours after finishing concrete, and no vehicles or loads shall be permitted on any sidewalk or slab until the concrete has attained sufficient strength.

Such barricades and protection devices, as are necessary, shall be constructed and placed to keep pedestrians and other traffic off the sidewalk or slab.

Any sidewalk damaged prior to final acceptance shall be repaired by removing concrete within groove limits and replacing it with concrete of the type and finish in the original construction. Damage caused by construction operations shall be repaired without additional compensation.

(5) Backfilling.

Immediately after removing the side forms, the spaces along the edges of sidewalks shall be filled with suitable material. This material shall be placed in layers not exceeding 5 inches in loose thickness, and compacted until firm.

514.04 Measurement.

Sidewalks and islands of the various kinds and thickness will be measured by the surface area.

514.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
ASPHALT CONCRETE SIDEWALK, ____" THICK	SQUARE YARD
CONCRETE SIDEWALK, ___" THICK	SQUARE YARD
CONCRETE SIDEWALK, REINFORCED, ___" THICK	SQUARE YARD
CONCRETE ISLAND, ___" THICK	SQUARE YARD

Payment for excavation will not be made.

SECTION 515 - DELINEATORS

515.01 Description.

This work shall consist of furnishing and installing delineators complete with mounting components.

515.02 Materials.

Materials shall conform to the following Subsections:

U-CHANNEL POST	912.03
MOUNTING BARS, ALUMINUM	911.01
MOUNTING BARS, STEEL	909.01
HARDWARE, ALUMINUM	912.01
HARDWARE, STEEL	909.02
DELINEATORS	923.18
DRIVABLE FLEXIBLE DELINEATORS	923.18

When required by contract documents, drivable flexible delineators shall meet the requirements for materials of construction, performance, installation, and maintenance for glass reinforced composite markers comparable to the FG-300 Ground Mount Delineator Post by Davidson Traffic Control Products, post manufactured by Carsonite. These single sided markers may be used to provide daytime and nighttime delineation for roadways or other marking applications requiring assured long-term durability, lightweight, flexibility, and vehicle impact resistance.

(A) DESIGN.

The delineator shall be a single piece marker capable of simple, permanent installation by one person using a manual driving tool. The marker upon proper installation shall resist displacement from wind and vehicle impact forces. The marker shall be of a sufficient cross sectional design to accept retroreflective sheeting with reinforcing support ribs incorporated longitudinally along each edge, to provide sheeting

protection and structural rigidity. The bottom end of the marker shall be pointed for ease of ground penetration.

(B) MATERIAL.

The marker shall be constructed of a durable, UV resistant, continuous glass fiber and marble reinforced, thermosetting composite material which is resistant to impact, ozone, and hydrocarbons within a service temperature range of -40ºF to +140ºF.

Sheeting and lettering shall be as approved by the Engineer, if not included in Supplementary Specifications.

The marker shall exhibit good workmanship and shall be free of burns, discoloration, cracks, bulges or other objectionable marks which would adversely affect the marker's performance or serviceability.

Each marker shall be permanently identified with the manufacturer's name and the month and year of fabrication. The letters shall be a minimum of 3/8-inch in height, and permanently affixed to the rear of the marker. A black line shall be stamped horizontally across the front of the marker near the bottom to indicate proper burial depth.

(C) PHYSICAL AND MECHANICAL REQUIREMENTS.

The flexible marker shall conform to the shape and overall dimensions as recommended or supplied by the manufacturer.

The nominal marker width shall accommodate a four-inch wide delineator and provide adequate daytime delineation.

The marker shall be of such length to provide the required height above the road surface, as per MUTCD, with a minimum embedment of 24 inches.

The marker shall have the minimum mechanical properties as follows:

Property	ASTM Test Method	Minimum Value
Ultimate Tensile Strength	D 638	50,000 psi
Ultimate Compressive Strength	D 638	45,000 psi
Specific Gravity	D 792	1.7
Weight % Glass Reinforcement	D 2584	50%
Barcol Hardness	D 2583	47

The marker shall be pigmented throughout the entire cross-section so as to produce a uniform color, which is an integral part of the material. Ultraviolet resistant materials shall be incorporated in the construction to inhibit fading or cracking of the delineator upon field exposure.

(D) COLD FLEXIBILITY.

A four foot marker shall be conditioned for a minimum of two hours at -40ºF ± 3ºF. The unit shall then be held at the bottom end in a vertical position and the top end bent 90 degrees such that it parallels the floor. The marker shall return to within 5 degrees of the upright position within 30 seconds. The bend test shall be repeated three times in quick succession, completing the test within 2.5 minutes of post removal from the conditioning temperature.

(E) COLD IMPACT RESISTANCE.

The marker shall be conditioned a minimum of two hours at -40ºF ± 3ºF. A minimum two-pound spherical weight shall be dropped a distance of five feet through a virtually frictionless vertical guide to impact the surface of the marker at mid-section. The surface of the post being struck by the steel ball shall be in a horizontal position with the post supported and held in position at both ends. The post shall be subjected to five impact tests concentrated near the middle of the post within 10 minutes from the removal from the environmental chamber. Fracturing, cracking, or splitting of the posts, shall constitute failure.

Another conditioned marker shall be struck flush against a flat solid surface three times within two minutes after removal from the conditioning chamber. To strike the marker, it should be manually swung through a 90 degree arc, and the marker shall not fracture or shatter upon impact.

(F) VEHICLE IMPACT RESISTANCE.

The Marker shall be capable of self-erecting and remain functional after being subjected to a series of ten head on impacts by a typical passenger sedan at 55 m.p.h. The marker shall retain a minimum of 60% of its sheeting.

(G) INSTALLATION OR REMOVAL.

Follow manufacturer's recommendations.

515.03 Methods of Construction.

Delineator posts shall be so erected that the delineator panels to be attached thereto will be at the locations, elevations, and spacing called for on the Plans.

Posts shall be driven to the prescribed depth by either hand or mechanical devices recommended by the manufacturer using a suitable driving tool, shall be plumb above the ground, and firm in the ground. After driving, the top of the posts shall have substantially the same cross-sectional dimensions as the body of the posts; posts with battered heads will not be accepted. Any posts bent or otherwise damaged to the extent that they are in the opinion of the Engineer unfit for use in the finished work shall be removed from the site and replaced by the Contractor at his own expense. Delineators shall be attached after the posts are driven unless otherwise recommended by the manufacturer.

Mounting bars and brackets shall be properly spaced and firmly attached, as shown on the Plans.

Any minor damage to galvanized surfaces shall be repaired, at the Contractor's expense, in accordance with the requirements of Subsection 403.16.

515.04 Measurement.

Delineators of the various types will be measured by the number installed in accordance with the Plans.

515.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
DELINEATOR, TYPE _____	EACH

SECTION 516 - PAVEMENT STRIPES AND MARKINGS

516.01 Description.

This work shall consist of striping or painting bituminous or concrete surface courses with the following materials, in accordance with the Contract documents: extruded or preformed thermoplastic traffic stripes and markings, epoxy resin traffic stripes or markings, latex traffic paint, pliant polymer rubber preformed traffic stripes or markings, and the application of glass beads when applicable. Unless otherwise indicated in the Contract documents, the type of material for traffic stripes and markings shall follow the table shown on PM-5 of the Standard Drawings.

- **"Traffic stripes"** is defined as the various widths and colors of lines used to designate lanes and shoulders on roadways.
- **"Traffic markings, lines"** is defined as the various types and materials for diagonal gore lines, crosswalks, stop lines, or other pavement lines not covered under "Traffic stripes."
- **"Traffic markings, symbols"** is defined as the various types and materials for words, arrows, or other pavement symbols.

The work also includes the placement and removal of temporary pavement stripes and markings. Temporary pavement stripes and markings may be latex, thermoplastic, epoxy resin, or removable wet weather pavement marking tape as shown on the Contract documents or as directed by the Engineer.

In addition, this work includes the removal of existing traffic stripes and markings consisting of the removal of white or yellow stripes or solid areas, letters, arrows, and other symbols from bituminous concrete and concrete bridge deck surfaces. Removal shall be, in accordance with the contract documents, via mechanical means (grinding or sandblasting) or hydromilling. The work shall also consist of any required placing of removable

black line mask or black paint (only if specifically permitted) to cover existing stripes to be temporarily obliterated.

The work shall also consist of diamond grinding concrete bridge deck surfaces for contrast striping recessing and applying contrast stripes.

516.02 Materials.

Materials shall conform to the following Subsections:

GLASS BEADS 913.04

TRAFFIC PAINT 913.04

REMOVABLE BLACK LINE MASK 920.14

THERMOPLASTIC 913.04

EPOXY RESIN 913.04

PLIANT POLYMER PREFORMED MARKINGS 913.04

BLACK PAINT 913.04

REMOVABLE WET WEATHER PAVEMENT MARKING TAPE 920.10

516.03 Equipment.

(A) EPOXY RESIN STRIPING EQUIPMENT.

The epoxy striping unit shall be so designed, equipped, maintained, and operated that the material is properly applied in variable widths at a consistent temperature. The epoxy striping unit shall include a tachometer and a pressure gauge and calibrated holding vessel for each component. The holding vessels for the epoxy pigments and the hardener shall have thermometers for measuring the temperature of the vessel contents. The striping unit shall be equipped with a separate power unit for the pumps used in the mixing and distribution of the components. The following shall be furnished with each epoxy striping unit:

(1) A calibration sheet that shows the number of the truck body, the capacity thereof, and an outage table in increments of not over ½ inch. This calibration sheet must be certified by the manufacturer or testing agency.

(2) A metal rod for each holding vessel, with accurate divisions marked and consecutively numbered starting at the bottom. The rod shall be not less than 1 foot longer than the depth of the vessel.

(3) Slip-proof steps with handrail to reach ground level.

(4) Slip-proof catwalk with handrail, running along the top of the vessel.

(5) Fire extinguisher in working order.

(B) THERMOPLASTIC STRIPING EQUIPMENT.

The equipment for applying thermoplastic material shall be capable of providing continuous mixing and agitation of the material. The parts of the equipment conveying the material between the main reservoir and the shaping die shall be so constructed to prevent accumulation and clogging. The mixing and conveying parts and the shaping dies or spray gun shall be capable of maintaining the material at optimum plastic temperature. The equipment shall be so constructed to ensure continuous uniformity in the dimensions of the entire stripe or marking. The kettle provided for the melting and heating of the thermoplastic material shall be equipped with an automatic thermostat control device and heated by a controlled heat-transfer liquid rather than by a direct flame. The heating kettle and applicator shall be equipped and arranged to meet the National Board of Fire Underwriters and State and Federal regulations. The parts of the equipment that come in contact with the material shall be easily accessible for cleaning and maintenance.

(C) GENERAL.

All equipment for applying traffic stripes or traffic markings shall be equipped with glass bead dispensers of a type that will mechanically and automatically dispense beads uniformly on wet stripes or markings at the rates specified.

Equipment for removing the various types of traffic stripes or traffic markings shall be designed with a vacuum system to remove all millings from the pavement surface and prevent airborne residue from escaping into the atmosphere.

516.04 Methods of Construction.

Work shall be done in accordance with the following:

(A) New Pavement Striping.

All pavement stripes shall conform to the location, alignment, width, length, size, color and spacing shown on the Plans. The layout for such stripes shall be the responsibility of the Contractor based on guide markers and directions of the Engineer.

At the intersections of white and yellow stripes, the yellow stripe shall be applied first and after the paint has dried, the white stripe applied over the yellow.

The glass beads in proper ratio shall be applied separately onto the traffic paint, following the traffic paint application. The traffic paint shall bind the glass beads in such a manner that it will produce maximum adhesion, refraction, and reflection.

All striping materials, including those required for the three and four-foot wide lines shall be applied by atomizing spray-type striping machines designed for the purpose. The machines shall be so designed as to apply lines of uniform cross sections, clear-cut edges, and even and uniform film thickness of striping materials for the coverages, hereinafter specified to permit easy and accurate adjustment of line width and rate of application and to permit immediate shut off where no striping is required.

The equipment for dispensing the glass beads shall be so designed and constructed as to mechanically and automatically distribute the beads in a uniform pattern and quantity per square foot of stripe, regardless of variation in speed of travel of the distributing equipment. The bead dispensing equipment may be an integral part of the striping machine, or may be a self-contained unit suitably designed for attachment to the striping machines used by the Contractor, so that the glass beads will be applied immediately following the application of the traffic paint. The dispenser shall be so designed and constructed to permit the distribution of beads at the coverage rate specified herein and provided with means of adjusting the coverage rate when and if required.

Striping machines shall be cleaned at the end of each day's work, or more often if necessary, to insure the application of lines of the specified quality and physical requirements.

Surfaces upon which striping materials are to be applied shall be free of moisture, both external and internal. Sufficient time shall elapse after rain, sleet, snow, ice, dew, or frost to permit the surface to become thoroughly dry prior to applying striping materials.

The Contractor shall remove, immediately prior to striping or marking the pavement surface, all dirt, oil, grease, existing types of traffic stripes or traffic markings, and other foreign material, including curing compound on new portland cement concrete, from the surface areas on which the various traffic stripes or traffic markings are to be placed. The pavement shall be cleaned one inch beyond the perimeter of where the stripe or marking is to be placed.

Methods of Construction for contrast striping shall be in accordance with 516.04(I).

The Contractor shall apply a primer-sealer conforming to NJDEP volatile organic content (VOC) requirements to the areas of bituminous concrete surfaces, when recommended by the manufacturer, and to the areas of portland cement concrete surfaces where long-life thermoplastic traffic markings are to be placed.

Striping materials shall be placed only upon surfaces which are dry and free from all dirt, foreign materials, scale, unbonded concrete, or mortar and shall be cleaned to the extent necessary. Existing striping will not require removal where new striping is to be applied over such striping. Striping shall not be applied to any surface until such surface has been inspected by the Engineer and approved as being satisfactory for the application of striping materials. Unsatisfactory lines, resulting from the presence of dirt, scale, or moisture, shall be thoroughly removed by an acceptable method and replaced by the Contractor at his own expense. Striping materials shall not be applied when the air or surface temperature is below 35°F.

Pavement striping erroneously applied, and all striping materials spilled or dripped on the pavement or other Authority property in unauthorized places, shall be removed by the Contractor at his own expense and to the satisfaction of the Engineer. The Contractor will be liable for all damages resulting from the spattering of paint on passing vehicles.

The application of the traffic paint and glass beads, applied separately, including mixing and thinning of traffic paint, equipment pressures and operating speed of equipment, shall be in accordance with the material manufacturer's instructions and recommendations. The application of glass beads shall be uniform and shall immediately follow the application of the traffic paint.

Unless permission is specifically given by the Engineer, beads shall not be applied under a strong wind. When such permission is granted, however, the height of the dispenser above the pavement shall be decreased to insure proper distribution and minimize possible loss of beads and, if so directed, the quantity of beads per gallon of traffic paint shall also be increased to counteract such loss.

The Contractor shall apply latex traffic stripes or traffic markings to thoroughly dry surfaces and during dry weather when the ambient and surface temperatures are as specified for that particular material. Each of these types of traffic paint shall be applied at a maximum temperature of 140°F and at the thicknesses required, as follows:

(1) Latex Traffic Paint.

The Contractor shall apply latex traffic stripes or traffic markings when the ambient and surface temperatures are above 45°F and rising. The latex traffic paint shall be applied in a wet film thickness of 6 ± 1 mil, where traffic stripes are required for 14 days or less. The traffic paint shall be applied in a wet film thickness of 15 ± 1 mil where traffic stripes or traffic markings are to be visible to traffic 15 days and beyond, or when stripes or markings are to be placed on intermediate pavement layers to be opened to traffic due to stage construction.

The Contractor shall apply glass beads, according to the gradation specified for latex traffic paint, to the wet paint in a uniform pattern, and at the rate of 12 pounds per gallon of paint.

When traffic stripes or traffic markings are required to remain visible beyond 14 days, the Contractor shall apply, before Acceptance and when directed, additional applications of latex traffic paint and glass beads. These applications shall be applied at least 15 days after the initial application and after any sawing or sealing of joints in the HMA overlay.

(B) LONG-LIFE THERMOPLASTIC TRAFFIC MARKINGS AND STRIPES.

When used in addition to, or in lieu of painted striping or pliant polymer materials, the Contractor shall apply either preformed or hot extruded thermoplastic traffic markings, using equipment and procedures that produce markings that are straight and have sharp edges; that are the specified color, width, and thickness; that have uniform retroreflectivity; and that are properly bonded to the pavement. The thermoplastic material shall be applied as follows:

(1) Preformed Thermoplastic.

The Contractor shall place preformed thermoplastic traffic marking tape on thoroughly dry surfaces and during anticipated dry weather. The preformed thermoplastic tape shall be melted, using the flame from a propane-type torch, according to the manufacturer's recommendations, to bond the traffic markings permanently in position.

The Contractor shall apply additional glass beads, if required, to the hot-wet material in a uniform pattern, to attain the minimum initial retroreflectance value specified in Subparagraph 516.03(C)(2) for thermoplastic tape.

(2) Extruded Thermoplastic.

Thermoplastic traffic markings and stripes shall not be placed on newly constructed pavement until the pavement is a minimum of twenty-four (24) hours old. Refer to 516.04(G) for temporary striping requirements on pavement less than twenty-four (24) hours old.

The Contractor shall heat the thermoplastic material uniformly and apply the melted material at a temperature between 401 and 428°F; to thoroughly dry surfaces and during anticipated dry weather, when the ambient and surface temperatures are a minimum of 50°F.

The thermoplastic traffic markings shall be extruded on the bituminous or portland cement concrete pavement in a thickness of 0.1 inch.

Immediately after, or in conjunction with the thermoplastic application, the Contractor shall apply, by mechanical means, glass beads to the wet material in a uniform pattern and at a minimum rate of 1 pound per square yard of markings. Hand throwing of the beads will not be allowed.

The equipment for applying thermoplastic material shall be capable of providing continuous mixing and agitation of the material. The parts of the equipment conveying the material between the main reservoir and the shaping die shall be so constructed in order to prevent accumulation and clogging. The mixing and conveying parts and the shaping dies or spray gun shall be capable of maintaining the material at optimum plastic temperature. The equipment shall be so constructed to ensure continuous uniformity in the dimensions of the entire stripe or marking. The kettle, provided for the melting and heating of the thermoplastic material, shall be equipped with an automatic thermostat control device and heated by a controlled heat-transfer liquid rather than by a direct flame. The heating kettle and applicator shall be equipped and arranged to meet the National Board of Fire Underwriters and State and Federal regulations. The parts of the equipment which come in contact with the material shall be easily accessible for cleaning and maintenance.

All equipment for applying traffic stripes or traffic markings shall be equipped with glass bead dispensers of a type that will mechanically and automatically dispense beads uniformly on wet stripes or markings at the rates specified.

Equipment for removing the various types of traffic stripes or traffic markings shall be designed with a vacuum system to remove all millings from the pavement surface and prevent airborne residue from escaping into the atmosphere.

(C) LONG-LIFE EPOXY RESIN TRAFFIC STRIPES.

Methods of Construction for Epoxy Resin Contrast Stripes shall be in accordance with 516.04(I).

The Contractor shall mix epoxy resin material with an automatic proportioning and mixing machine, and hot-spray the compound at a temperature between 100 and 130 ^{o}F onto thoroughly dry surfaces. The material shall only be placed during anticipated dry weather when the ambient temperature is a minimum of 45^{o}F and the surface temperature is a minimum of 50^{o}F. The temperature of the sprayed mixture shall be adjusted as required for prevailing conditions, including the air and pavement surface temperatures, to achieve a no-track drying time of 30 minutes or less. The epoxy resin mixture shall be applied in a wet film thickness of 20 ± 1 mil.

Immediately after, or in conjunction with the epoxy resin application, the Contractor shall apply large glass beads and small glass beads to the wet compound. Each type of bead shall be applied in a uniform pattern and each at a rate of 12 pounds per gallon of epoxy resin material.

The Contractor shall remove all epoxy resin material that has been tracked or spilled in areas outside of the intended placement areas.

(D) PLIANT POLYMER PREFORMED PATTERNED MARKINGS.

Pliant polymer preformed patterned markings shall consist of white or yellow films with ceramic beads incorporated to provide immediate and continuing retroreflection.

The pliant polymer preformed markings shall be capable of being adhered to asphalt concrete and portland cement concrete by a pre-coated pressure sensitive adhesive. The Contractor shall apply a primer to precondition the pavement.

The pavement markings shall be capable of application on new asphalt concrete wearing courses during the paving operation in accordance with the manufacturer's instruction. After application, the marking shall be immediately ready for traffic.

The retroflective pliant polymer pavement markings shall consist of a mixture of high quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, with a reflective layer of ceramic beads bonded to a durable polyurethane topcoat surface.

(E) DEFECTIVE THERMOPLASTIC STRIPES OR MARKINGS.

The Contractor shall replace at no cost to the Authority, long-life thermoplastic traffic stripes or traffic markings determined to be in non-conformance with the Specifications, or not placed at the locations or in the dimensions specified, based on the following:

(1) The entire area of marking determined to be less than the required thickness, to have an incorrect color or width, to have failed to bond to the pavement, or to have chipped or cracked shall be replaced. The minimum replacement area is an individual word or symbol, or entire length of longitudinal line from where the deficiency first occurs to where it no longer exists.

(2) The entire area of marking shall be replaced where the initial retroreflectance value is less than 375 millicandelas per square meter per lux for white or 250 millicandelas per square meter per lux for yellow. Initial retroreflectance will be determined as follows:

Step 1: Visual night inspections will be made to identify traffic markings which appear to be below the specified minimum value.

Step 2: All retroreflectance measurements, taken with a Mirolux-12 Retroreflectometer, will be made on a clean, dry surface.

Step 3: (a) For word markings, three random retroreflectance measurements will be made on each letter.
(b) For symbols, nine random retroreflectance measurements will be made over the symbol.

Step 4: All retroreflectance measurements within an area will be averaged to determine if the minimum retroreflectance requirements are met.

At no cost to the Authority, the Contractor shall remove all traffic paint where the striping or markings will not be directly under long-life material, replace long-life traffic stripes or traffic markings damaged due to any sawing or sealing of joints in the bituminous concrete overlay, and replace all existing pavement reflectors that have been marred by striping or marking material as a result of improperly located traffic stripes or traffic markings.

At the deceleration and acceleration lanes when a portion or all of the right shoulder is used as a traffic lane, the Contractor shall remove the pavement stripes delineating the auxiliary lane. Upon completion of the work, the auxiliary lanes shall be restriped in accordance with the details shown on the Standard Drawings. Removal of existing pavement striping shall be by effective blackout methods to the satisfaction of the Engineer.

(F) REMOVAL OF PAINTED PAVEMENT STRIPES.

The Contractor shall remove all types of traffic stripes or traffic markings by methods that do not damage the integrity of the underlying pavement or adjacent pavement areas, and that do not cause gouging, or create ridges or grooves in the pavement that may result in compromising vehicular control. Obliterating stripes or markings by painting over them with black paint shall not be permitted except where specifically called for in the contract documents or as directed by the Engineer. Obliterating gore area markings with black paint will be permitted only as called for in the Plans or as directed by the Engineer.

Before starting removal operations, the Contractor shall demonstrate the proposed method to accomplish the removal of approximately 100 percent of the stripe or marking without the removal of more than 1/16-inch of pavement thickness. Removal operations will not be permitted until the method of removal has been approved.

The Contractor shall replace all existing pavement reflectors that have been damaged by removal operations, at no cost to the Authority.

Debris from the removal of traffic stripes and markings shall be disposed of as directed by the Engineer.

Pavement markings shall be removed before any change is made in the traffic pattern.

The Contractor shall employ mechanical (grinding or sandblasting), hydromilling, or black line mask for obliterating painted stripes as shown on the Plans. Striping removal operations will not be permitted until the removal method has been tested and approved by the Engineer.

Grinding or Sandblasting shall only be performed on pavement and concrete-wearing surfaces which are scheduled to be replaced.

Hydromilling shall be used in the removal of existing or temporary painted stripes on pavement and concrete-wearing surfaces which are scheduled to remain. This shall be performed by use of a high-pressure water jetting system as specified in Subsection 919.51. Hydromilling of painted striping shall be performed with a truck mounted mobile system and shall not damage the existing pavement. The area of removal includes the area of the stripe plus 1 inch on all sides. Hydromilling shall not be used when the temperature is 35˚F and falling.

When black painting of existing painted lines is permitted, the existing lines shall be kept obliterated for the duration of the work under that stage. Black paint used for obliteration of existing epoxy or latex painted striping shall not be removed and new painted pavement striping will be installed over the black paint.

Black paint shall not be used over existing Thermoplastic traffic striping. If the existing lines reappear, the black paint shall be reapplied.

Striping shall be removed to the fullest extent possible from the pavement by methods that do not damage the surface texture or result in undesirable variations in color. Sand or other material deposited on the pavement shall be removed as the work progresses. Accumulations of sand or other material which might interfere with drainage or might constitute a hazard to traffic will not be permitted.

Where blast cleaning is performed within 10 feet of a lane occupied by public traffic, the residue including dust shall be removed immediately after contact between the sand and the surface being treated. Such removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation, or by other methods acceptable to the Engineer.

Any damage to the pavement or surfacing, caused by removal of the pavement striping, shall be repaired by the Contractor at his expense by methods acceptable to the Engineer.

For construction durations of greater than 7 days, the Contractor shall cover the existing pavement markings by placing a removable black line mask over them. The removable black line mask shall be applied and tamped in accordance with the manufacturer's recommendations and any required primer. It shall completely mask the existing pavement markings being covered, and extend one inch beyond their edges. The black line mask shall provide a neat, durable masking that must be replaced if it flows, distorts, lifts or shrinks during its use, as directed by the Engineer. When directed, the black line mask shall be removed, and the travel lanes shall revert to their original alignment. **Black Line Mask** shall be used for temporary obliteration of existing pavement stripes for staged construction with durations of fifteen (15) days or less. Removable Black Line Mask shall not be overlapped. Only butt splices shall be used. Continuous runs shall be scored at 50 foot intervals.

For lane shifts or traffic detours, when a portion or all of the right shoulder is to be used as a traffic lane, the Contractor shall obliterate existing pavement stripes as called for in the plans or as directed by the Engineer and place temporary striping. At the deceleration and acceleration lanes when a portion or all of the right shoulder is used as a traffic lane, the Contractor shall remove the pavement stripes delineating the auxiliary lane. Allowable hours for striping changes shall be as per the Traffic Manual. Upon completion of the work, the lanes shall be restriped in accordance with the details shown on the Standard Drawings**,** unless shown differently on the contract plans.

(G) TEMPORARY PAVEMENT STRIPING.

Temporary pavement striping shall be provided by the Contractor when required per the Plans, provisions of Paragraph 516.04(G), or when stripes or markings are to be placed on intermediate pavement layers, or on new pavement less than twenty four (24) hours old, to be opened to traffic due to staged construction.

Temporary striping shall be applied in construction work areas, at the locations shown on the Plans, to clean dry surfaces in accordance with the manufacturer's recommendations and the required primer or a method approved by the Engineer.

The following types of temporary pavement striping shall be acceptable, adhering to the below conditions:

(1) Removable Wet Weather Pavement Marking Tape.

This shall be used for applications of seven (7) days or less.

Removable Wet Weather Pavement Marking Tape, meeting the requirements of Subsection 920.10, shall be installed at designated locations under the guidance and in the presence of the manufacturer's representative, in accordance with the manufacturer's recommendations. Primers, if required, shall be used to promote tape adhesion to the wearing surface in accordance with the tape manufacturer's recommendations. The tape shall be white or yellow and shall be installed in single or double lines, as designated.

Removable Wet Weather Pavement Marking Tape shall not be overlapped. Only butt splices shall be used and continuous runs of tape shall be scored at 50 foot intervals.

Tape shall be removed when no longer required for traffic control. Tape shall be removed manually, intact or in large pieces, by scraping if necessary, without the use of solvents, burning, grinding, or sand/shot blasting.

(2) Latex Traffic Paint.

This may be used for applications that will remain in place for longer than seven (7) days.

(3) Thermoplastic Paint.

This may be used in lieu of latex traffic paint, based on temperature constraints, as noted on the plans or as directed by the Engineer.

Temporary thermoplastic traffic stripes shall not be placed on newly constructed concrete decks until the decks are a minimum of 24 hours old. Thermoplastic Paint shall not be placed on top of latex traffic paint.

(4) Epoxy Resin Paint.

This may be used in lieu of latex traffic paint, based on temperature constraints, as noted on the plans or as directed by the Engineer.

Prior to reopening the lanes to traffic, lane lines shall be reestablished with temporary pavement striping on all newly paved areas less than twenty four (24) hours old. Temporary pavement striping must be maintained in a serviceable condition in accordance with the various provisions contained herein and subject to the satisfaction of the Engineer until such time as the permanent traffic striping is constructed.

(H) REMOVAL OF DEFECTIVE TRAFFIC STRIPES.

Remove defective traffic stripes by methods that do not damage the integrity of the underlying pavement or adjacent pavement areas, or cause gouging, or create ridges or grooves in the pavement that may result in compromising vehicular control. Obliterating stripes by painting over them will not be permitted.

Before starting removal operations, the Contractor shall demonstrate to the Engineer, the proposed method to accomplish the removal of approximately 95 percent of the stripe without the removal of more than 1/16 of an inch of pavement. Area of removal includes the area of the stripe plus 1 inch on all sides. Removal operations will not be permitted until the method of removal has been approved.

The Contractor shall replace defective long-life epoxy resin traffic stripes based on the following:

(1) The entire 10 foot broken line if the line to be replaced is determined to have a deficiency.

(2) The entire length of striping determined to have a wet film thickness of less than 19 mils shall be restriped with 20 mils of new epoxy, based upon the calculated and measured yields.

(3) The entire length of striping shall be replaced where improper curing or discoloration has occurred. Discoloration is defined as localized areas or patches of brown or grayish colored epoxy resin material. When improper curing or discoloration occurs intermittently in intervals of 100 feet or less throughout the striping, the entire length of striping shall be replaced from where it first occurs until where it no longer exists plus 5 feet on each end.

(4) The entire length of striping that has failed to bond to the pavement, or has chipped or cracked, shall be replaced from where it first occurs to where it no longer exists. When more than 25 spots (combined or individual) of chipping, cracking or poor bonding has occurred within a 1,000 linear foot distance, the entire 1,000 linear feet shall be replaced.

(5) The entire length of 1 mile of striping shall be replaced where the initial retroreflectance value of two of four readings for that 1 mile of 4-inch wide striping is less than 375 millicandelas per square feet per foot-candle for white or 250 millicandelas per square foot per foot-candle for yellow when taken with a LTL2000 Retrometer.

(6) The entire area of striping shall be replaced where the glass bead coverage or retention is deficient, based on yield determinations made during application and on visual comparisons of the production traffic stripes with those of the test strips.

The contractor must, at all times, have immediately available in his yard an amount of replacement tape equal to the tape applied and be prepared to respond within two hours to close lanes, and repair/replace tape that has become damaged.

Removable Wet Weather Pavement Marking Tape that has become damaged, and is no longer serviceable, in the sole opinion of the Engineer, shall be replaced immediately. Damaged tape that is not replaced immediately may be replaced by the Authority and the costs shall be charged to the Contractor in accordance with Subsection 106.23.

(I) CONTRAST STRIPING.

Diamond grinding shall be performed to prepare the concrete deck surface for the contrast striping. The transverse deck grooving shall be completed before the diamond grinding. Equipment shall include a free-floating cutting or grinding head to provide a consistent recess depth over irregular pavement surfaces. The grinding or cutting head shall be equipped with diamond saw blades. Diamond saw blades shall be used on the cutting head to provide a smooth surface in the bottom of the recess. Immediately prior to the application of the contrast striping, the recess shall be cleaned with high-pressure air to remove debris and dust generated during the cutting operation. The groove must be clean and dry for proper application of the contrast striping. Refer to the manufacturer's technical specifications for recess cleaning and dry time prior to product application.

The recess dimensions are as follows:

(1) Width. The recess shall exceed the width of the marking material by 1 inch.

(2) Depth. 50 mils ± 5 mils.

(3) Position. The edge of the recess shall be constructed a minimum of 2 inches from the edge of concrete joints.

The total stripe width shall be 6 inches.

Existing striping shall be removed prior to application of contrast striping.

The contrast striping system shall be (Epoxy Resin or Preformed Contrast Marking Tape) to be used shall be as noted on the Contract Plans.

Black epoxy resin contrast stripes shall be applied in the recess and applied 12 mil ±2 mils thick. Black aggregate shall be used to remove any sheen. White epoxy resin contrast striping shall be applied in accordance with Paragraph 516.04(C).

Contrast striping materials and application shall conform to the manufacturer's specifications.

The markings shall have crisp distinct edges and clean cutoff at the end of each line.

All applied markings shall be protected from traffic and potential tracking while the epoxy cures. Markings may be saturated with glass beads to help prevent tracking.

The Contractor shall demonstrate to the Engineer the application of the broken white lines for a distance of 150 feet. The Engineer shall approve the test strip before the contractor continues striping operations.

(J) DETERMINATION OF ACCEPTABILITY.

The Contractor shall furnish for approval, 20 calendar days before placement, a complete schedule of operations for applying pavement markings, including the numbers and types of equipment, and procedures for the project.

When long-life epoxy resin traffic stripes are required on the Project, the Contractor shall furnish the manufacturer's written instructions for proper use of the materials, including but not limited to, mixing ratios and application temperatures.

The Contractor shall arrange for and have each long-life material manufacturer's representative on the site for the first full day of applying either long-life traffic stripes or traffic markings to provide technical assistance.

The Contractor shall furnish a Mirolux-12 Retroreflectometer for the Engineer's use in determining the retroreflectance values of the various traffic stripes or traffic markings. This equipment is for the sole use of the Engineer and will become the property of the Contractor after Acceptance.

Before starting all traffic striping operations, the Contractor shall construct one or more test strips. Each test strip shall consist of approximately 500 linear feet of pavement with white and yellow striping (lane and edge lines) or markings similar to that required for the Project. The test strips shall demonstrate the capability of the proposed epoxy resin materials, equipment, and procedures to produce long-life epoxy resin traffic stripes that comply with the Specifications, including dimensions, appearance (stripes with uniform color and crisp, well defined edges), wet film thickness, drying time, and glass beads application and retention. A test strip will be required for each applicator unit used. Additional test strips may be required when major equipment repairs or adjustments are made or when the epoxy resin traffic stripes fail to comply with the Specifications. Permission to proceed with the striping operations will be given when

the test strips are in compliance. Each test strip may remain in place and become part of the finished stripes subject to the requirements of Paragraph 516.04(A).

(K) OPENING TO TRAFFIC.

The striping shall be applied, utilizing lane and/or shoulder closings and be thoroughly dry before opening to traffic. The Contractor shall complete each application of all types of traffic stripes or traffic markings and allow them to thoroughly dry before opening to traffic. In the event a vehicle should cross the molten markings, such markings shall be reapplied and any tracking of the markings made by the moving vehicle shall be removed at no additional cost to the Authority.

Should ambient and surface temperatures be below the minimums specified for various materials, with approval, traffic stripes or traffic markings may be placed at temperatures as low as 35° F in order to open the traveled way to traffic. Placement of long-life epoxy resin or thermoplastic may be delayed for up to seven days after paving. If the application of the traffic stripes will be delayed following the paving operation, temporary traffic stripes shall be applied, so that the paved roadway will be striped according to the striping details, prior to opening it to traffic. Temporary traffic striping and markings shall be applied in accordance with Paragraph 516.04(G) and 920.10. The Engineer will determine when the traveled way is to be opened.

516.05 Measurement.

Thermoplastic, Pliant Polymer, Epoxy Resin or Painted pavement striping of the various widths and colors will be measured by the length of each color and width actually applied or on a lump sum basis.

Temporary Pavement Striping will be measured by the length of Latex Traffic Paint which is applied. Thermoplastic Paint used as temporary pavement striping will be measured and paid under Traffic Stripes, Long Life, and Thermoplastic. Epoxy Resin used as temporary pavement striping will be measured and paid under Traffic Stripes, Long Life, Epoxy Resin. Temporary pavement stripes which are replaced because of damage or excessive wear, as determined by the Engineer, will be measured for payment.

Removable Wet Weather Pavement Marking Tape will be measured by the linear foot based on a 6-inch wide strip.

Striping and Marking Removal, Hydromilling will be measured by the linear foot of permanent or temporary striping removed by hydromilling.

Striping and Marking Removal, Mechanical will be measured and paid by the linear foot of permanent or temporary striping removed by mechanical means (grinding or sandblasting).

Diamond Grinding will be measured by the total length of contrast striping tape or paint within the recess. The distance between the trailing and lead ends of the skip stripes that are not ground will not be measured for payment.

Preformed Contrast Marking Tape will be measured by the length of tape actually installed.

Epoxy Resin Contrast Stripes will be measured by the total length actually applied.

Traffic markings, lines of the various types and materials for diagonal gore lines, crosswalks, or stop lines will be measured by the linear foot for each 6-inch width of actual stripe. Widths not equal to 6 inches will be converted to equivalent linear feet of 6-inch width. Gaps will not be counted.

Traffic markings, symbols of the various types and materials for words, arrows, or other pavement symbols will be measured by the square foot.

The quantity of temporary striping, regardless of the color and width, for which payment will be made, will be measured by the area of striping actually applied and paid for based upon an equivalent 6 inch wide length.

Removable black line mask of the width specified will be measured by the length that is actually applied.

Removable black line mask, which is replaced because of damage through no fault of the Contractor, as determined by the Engineer, will be measured for payment. Any Contractor damaged stripping or black line mask materials shall be replaced at Contractor expense.

Black traffic paint will not be measured for payment; costs for black paint shall be included under Maintenance and Protection of Traffic.

516.06 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
REMOVABLE WET WEATHER PAVEMENT MARKING TAPE	LINEAR FOOT
DIAMOND GRINDING	LINEAR FOOT
PREFORMED CONTRAST MARKING TAPE	LINEAR FOOT
EPOXY RESIN CONTRAST STRIPE	LINEAR FOOT
STRIPING AND MARKING REMOVAL, HYDROMILLING	LINEAR FOOT
STRIPING AND MARKING REMOVAL, MECHANICAL	LINEAR FOOT
TEMPORARY PAVEMENT STRIPING	LINEAR FOOT
TRAFFIC STRIPES, LONG-LIFE, EPOXY RESIN	LINEAR FOOT
TRAFFIC STRIPES, LONG-LIFE, THERMOPLASTIC	LINEAR FOOT
TRAFFIC MARKINGS, LINES, LONG-LIFE, EPOXY RESIN	LINEAR FOOT
TRAFFIC MARKINGS, LINES, LONG-LIFE, THERMOPLASTIC	LINEAR FOOT
TRAFFIC MARKINGS, SYMBOLS, LONG-LIFE, EPOXY RESIN	SQUARE FOOT
TRAFFIC MARKINGS, SYMBOLS, LONG-LIFE, THERMOPLASTIC	SQUARE FOOT

No separate payment will be made for black traffic paint used to temporarily obliterate traffic stripes, but the costs thereof shall be included in the pay item(s) for the removal of striping.

Removable Wet Weather Pavement Marking Tape that has become damaged and is no longer serviceable shall be replaced immediately without additional compensation and will not be measured for payment. Tape that is damaged by construction operations shall also be replaced immediately without additional compensation and will not be measured for payment. Damaged tape, not replaced immediately, may be replaced by the Authority and the costs shall be charged to the Contractor in accordance with Subsection 106.23.

No separate payment will be made for the removal of Removable Wet Weather Pavement Marking Tape or Removable Black Line Mask, 8" Wide, but the costs thereof shall be included in their respective pay items for application.

Temporary pavement striping constructed on new pavement less than twenty four (24) hours old, necessary to re-open a staged work area to traffic, shall not be measured for payment but shall be considered incidental to the placement of pavement.

No separate payment will be made for furnishing and installation of glass beads.

SECTION 517 - FIELD OFFICE

517.01 Description.

This work shall consist of providing a secured, weather-proof building or trailer-type field office for the exclusive use of the Engineer and other representatives of the Authority. The Contractor shall obtain the necessary permits from the New Jersey Department of Community Affairs. The building or trailer furnished for the field office shall be in accordance with all applicable State and local codes and applicable OSHA requirements. The field office shall be complete and ready for use by the Authority, including all utility connections and specified computer systems, office machines, internet service, equipment and supplies, prior to the start of work. The work may be divided among various contracts and includes these pay items:

(A) FURNISH FIELD OFFICE.

"Furnish field office" shall include furnishing, equipping, and site-installing a new building or trailer-type office at a location designated by the Engineer. It shall also include the disconnecting of all utilities, final cleaning, restoration, and if a non-rental trailer, returning the trailer to the Authority's storage yard upon completion of the Contract. If not leased, the trailer and equipment shall become property of the Authority at the completion of the Contract.

(B) MAINTAIN FIELD OFFICE.

"Maintain field office" shall include furnishing all labor and materials and the payment of all expenses necessary to properly maintain the field office for the duration of the Project.

(C) Furnish Office Supplies.

"Furnish office supplies" shall include furnishing all supplies for the Engineer's use as specified under 517.02(F). If not leased, office supplies shall become property of the Engineer at the completion of the Contract.

517.02 Materials.

Ensure that the field office is weatherproof with a minimum ceiling height of 7-1/2 feet and conforms to the requirements specified in Table 517-1. Ensure that 1 of the rooms of the field office has a minimum area of 288 square feet. Ensure that the other rooms have a minimum area of 144 square feet, except for conference rooms, which require a minimum area of 288 square feet. Ensure that the field office doors and windows have locks. Provide the keys to the Engineer. Ensure that the field office has one or more closets of sufficient capacity for the office's size.

(A) Office Size Requirements.

Provide the following, at a minimum, for the field office type specified:

Table 517-1 Office Size Requirements

	Field Office Type					
Description	**A**	**B**	**C**	**D**	**E**	**F**
Total Area (SF)	288	432	576	720	864	1008
Number of Rooms[1]	1	2	3	4	4	5
Conference Room	0	0	0	0	1	1
Desks with Swivel Chairs	2	4	6	8	8	10
Tables and chairs to seat	8	12	16	20	24	28
File Cabinets[2]	2	4	4	4	4	8
Plan Racks[3]	1	2	2	3	3	4
Parking spaces[4]	4	5	6	8	8	10

[1] Including conference room.
[2] Having a UL rating of 350 °F – 1 hour, 4 drawers, legal-size with lock and 2 keys.
[3] Capable of holding 1200 plan sheets.
[4] Free parking on a paved or hard surfaced area adjacent to the building.

Instead of the field office or offices specified above, the Contractor may provide equivalent office space, equipment, and facilities subject to approval of the Engineer.

(B) Utilities and Lighting.

Provide all utility services and connections including water, sewer, gas, electricity, telephone, and broadband internet. Provide a field office with sufficient natural and artificial light.

(C) Lavatory.

Provide a separately enclosed and properly ventilated room with washing and toilet facilities suitable for use by male and female employees. Ensure that the facilities have hot and cold running water. Equip the doors and windows with locks.

(D) Communication Equipment.

Provide the following:

(1) Landline Telephones. Provide a phone system with at least one telephone for each room. At least one telephone shall be cordless, and at least one shall have speaker and conference call capabilities. The phone system shall have the ability to answer all voice lines from each voice line, transfer calls to all voice lines and be equipped with a single, dedicated answering system. A separate line shall also be provided for a fax machine, as requested by the Engineer. The Contractor shall pay all installation charges.

(2) Broadband Internet Service. The field office shall be furnished so as to allow for broadband internet service. If broadband internet service via landline is unavailable, the Contractor shall inform the Engineer of the need to obtain mobile internet service.

Landline communication equipment shall be repaired or replaced by the Contractor within 24 hours of becoming inoperable or defective.

(E) OFFICE FURNITURE.

Provide furniture as requested by the Engineer. At a minimum, provide the following:

(1) Two book cases.

(2) A drafting table and stool.

(3) A supply cabinet.

(4) A water cooler having both hot and cold water dispensers, and bottled water service.

(5) A type ABC fire extinguisher having UL-approval.

(6) A 24-person first-aid kit according to ANSI Z308.1, 1 tick removal tweezers, and 4 aerosol cans of insect repellent containing DEET. Restock first aid supplies and insect repellant as needed.

(7) A wastepaper basket for each room.

(8) Two 3 × 4 foot bulletin boards.

(9) A 1.7 cubic foot refrigerator.

(F) OFFICE SUPPLIES.

Provide office supplies as requested by the Engineer; alternatively, provide an office supply account for the Engineer's use. Office supplies may include, but are not limited to: computer hardware and software, printers, faxes, scanners, cameras, paper shredders, tablets, mobile phones, and all accessories required to operate and maintain such electronic devices; paper products, writing instruments, and desk accessories; and inspection equipment.

517.03 Methods of Construction.

The Contractor shall provide and maintain in good condition one or more construction field offices for the exclusive use of the Engineer at a location or locations approved by the Engineer. The field office or offices shall be ready for use not later than ten days after the date of mailing of the fully executed Contract to the Contractor and before construction operations begin. The field office or offices shall be maintained until no longer required by the Engineer and then removed. It is estimated that the field office or offices is/are required for three months after Completion. Any building scheduled to be demolished under the Contract shall not be used as a field office.

When the trailer is furnished by the Authority, the Contractor shall, shortly after the execution of the Contract, pick up the trailer from the Authority's storage yard where he shall sign an itemized list of the equipment and furnishings prior to transporting it to the construction site. The Engineer must be advised at least forty-eight hours prior to picking up the trailer and must be present when the Contractor picks up the trailer.

The trailer, whether furnished by the Contractor or the Authority, shall be installed at the location and in the position designated by the Engineer. All outside utility connections, including electricity and water, shall be provided by the Contractor. The Contractor shall connect all fixture waste pipes to the existing sewerage disposal system. If there is no sewerage disposal system to connect to, the Contractor shall install a septic tank system, as prescribed on the Plans or as directed by the Engineer.

All deposits required for utility connections shall be paid by the Contractor.

At the completion of the work under the Contract or at such other time as directed, the Contractor shall thoroughly clean and restore and/or repair the trailer and its equipment and furnishings to the condition at the start of the work. The trailer, equipment, and furnishings will be inspected by the Authority, either at the site, if it is to remain there, or at the Authority's storage yard to which it is to be transported, and the Contractor shall secure a written receipt from the Authority for the satisfactory condition of the trailer, equipment and furnishings, and the receipt shall be submitted to the Engineer before final payment under the Contract will be made.

The maintenance of the field office trailer, including utility connections and the security of the trailer and equipment at all times shall be the sole and full responsibility of the Contractor for the duration of the Contract, or as otherwise provided in the Supplementary Specifications or by Change Order. Such maintenance shall include, but is not necessarily limited to:

- Cleaning and maintaining the existing septic tanks (if any) as required.

- Providing janitorial services, such as daily floor sweeping and mopping, daily trash disposal, weekly window cleaning, and monthly floor waxing.
- Furnishing at all times an adequate supply of paper towels, soap, toilet paper, light bulbs, and paper cups.
- Maintaining the refrigerated drinking water facilities in good service, and furnishing adequate and continuous bottled water service when so installed.
- Furnishing necessary bottled propane gas to properly heat the office.
- Maintaining the air conditioning, water pumps, heating units, and lavatory room equipment in perfect operational condition.
- The Contractor shall check out the condition of the furniture, air conditioning, heater, all equipment, and utilities and make all necessary repairs to restore all units for satisfactory operation, as directed by the Engineer. If necessary, unserviceable items shall be replaced.
- Disposing of all sewage, waste, trash, etc., clear of the site to the satisfaction of the Engineer.
- The removal of snow as directed by the Engineer.
- The cost of heating fuel, electricity, water, telephone, internet services, sewage and garbage disposal, supplies, maintenance, and janitorial services shall be paid for by the Contractor.

The Contractor shall submit copies of invoices from the trailer rental (if applicable), utility companies, and receipts for office supply expenses with their monthly application for payment. The Contractor shall be reimbursed for these items as a direct expense without any additional markups for overhead or profit.

When the trailer is to remain on site and responsibility therefore is to be transferred to another Contractor, all utilities and the sewage disposal system shall remain in service. The trailer, including equipment and all utility facilities, shall be put in proper condition as specified above, and the Contractor shall make all necessary arrangements for transferal of billings for utility services and other costs to the Contractor assuming responsibility for the trailer.

When the trailer, whether furnished by the Contractor or by the Authority, is to be removed from the site at the completion of the work under the Contract, utility and sewage services shall be disconnected and terminated in a manner satisfactory to the Engineer, and the trailer shall be put in proper condition as specified above and transported to the designated storage yard of the Authority. Inspection by the Authority and issuance of a written receipt to the Contractor will be made as provided above.

517.04 Measurement.

Furnish Field Office will be measured for payment on a lump sum basis.

Maintain Field Office will be measured for payment by the number of months during which the field office is maintained by the Contractor.

Furnish Office Supplies (No-Bid) provides a dollar value for reimbursement to the Contractor for direct costs associated with furnishing office supplies.

517.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
FURNISH FIELD OFFICE, TYPE___	LUMP SUM
MAINTAIN FIELD OFFICE, TYPE___	MONTH
FURNISH OFFICE SUPPLIES (NO-BID)	USD

If designated in the Contract Documents, picking up and installing a field office furnished by the Authority shall not be measured separately for payment but shall be included in the cost of Furnish Field Office, Type __. The trailer shall remain the property of the Authority.

If designated in the Contract Documents, relocating the field office from one field location to another field location shall not be measured separately for payment but shall be included in the cost of Furnish Field Office, Type __.

SECTION 518 - RAMP GATES

518.01 Description.

This work shall consist of furnishing and installing horizontal ramp gates complete with all necessary excavation and backfill, excavation support, reinforced concrete foundation, electrical connections and other incidental work.

518.02 Materials.

Materials shall conform to the following Subsections:

CONCRETE 905.05

REINFORCING STEEL 908.01

HORIZONTAL RAMP GATE 921.01

518.03 Methods of Construction.

Drawings showing complete and accurate details, design calculations, locations, and other information necessary for the fabrication and installation of the specified ramp gates shall be submitted to the Engineer for review, in accordance with the requirements of Subsection 104.08.

(A) HORIZONTAL RAMP GATE.

The gate shall consist of the following components:

(1) Column

(2) Capstan Assembly

(3) Arm Socket

(4) Arm Adapter

(5) Electrical Cubicle with Flasher and Circuit Protection

(6) Arm, Rectangular Type and Tubular type

(7) Fasteners

(B) INSTALLATION.

Excavation and backfill for gate foundations shall be done in accordance with the applicable provisions of Subsection 205.03. Excavation shall be made in such a manner that the permanent structure may be properly constructed without reduction of the dimensions of the concrete shown on the Plans, without rounded or undercut corners and edges, and to the depths which may be required. Open excavated areas shall be protected in accordance with the applicable provisions of Division 800.

The bottom of the excavation shall be firm, undisturbed earth to provide a suitable bearing area for the foundation. Excavation below the prescribed minimum depth shall be filled with concrete, thus increasing the total thickness of the concrete foundation.

Care shall be taken to minimize damage to surrounding grassed and planted areas.

Placing concrete and reinforcing steel shall conform to the applicable requirements of Section 401.

Anchor bolts shall be set by means of a template held in position during the placing of concrete. Periodic checks of the bolt positions and elevations shall be made during the concreting operations. Care shall be taken to protect the threaded portions of the anchor bolts.

518.04 Measurement.

Ramp Gates will be measured by the number constructed in accordance with the Plans.

518.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
HORIZONTAL RAMP GATE	EACH

SECTION 519 - TOLL BOOTHS AND DATIM ENCLOSURES

519.01 Description.

This work shall consist of furnishing and installing toll booths and DATIM enclosures complete with interior equipment and accessories and internal electrical work, but excluding toll collection equipment.

519.02 Materials.

Materials shall conform to the following Subsections:

BOOTH SHELL	922.02
GENERAL REQUIREMENTS	922.01
INTERIOR EQUIPMENT	922.03
INTERNAL ELECTRICAL WORK	922.04

519.03 Methods of Construction.

Toll booths shall be constructed in accordance with the following.

(A) FABRICATION.

The toll booths fabricated shall be Industrialized Building Commission (IBC) Certified. The certification process shall include the review and approval of the toll booth shop drawings and structural calculations by an IBC certified agent. The Authority will provide the necessary structural calculations which will be signed and sealed by a Professional Engineer registered in the state of New Jersey. The Contractor should anticipate that inspections will be required during the fabrication of the toll booths in accordance with the IBC requirements. All costs associated with the referenced design reviews and construction inspections shall be included in the payment for toll booths.

Provide the Authority six (6) sets of blueprints and one set of reproducible tracings of complete as-built drawings. For each type of toll booth manufactured under the contract, the Contractor shall furnish six (6) bound copies of as-built specifications, indicating actual materials employed for the toll booths' construction. Tracings shall be provided on 22 by 36-inch sheets (3-mil minimum thickness) of polyester film such as Mylar or herculean (sepias will not be accepted). The as-built drawings, specifications and tracings shall be furnished to the Resident Engineer at completion of the Project.

Material specification designations shall be noted on the drawings. All lines and lettering shall be dense in opacity and of sufficient height and width, so as to have residual density to produce microfilm negatives from which legible 11 by 18-inch prints may be made. Certifications of all materials shall be furnished in accordance with Subsection 105.04.

All metal used in the fabrication of the booths shall be free from defects impairing strength, durability, or appearance, and of the best commercial quality for purpose intended. All metal edges shall be free of burrs, sharp corners, roughness, or other conditions which could cause injury to persons or damage to other materials.

All gauges of material shall be standard U.S. Gauge or equal when finished and polished. Unless otherwise specified, no material is to be lighter than #20 Gauge.

Welding shall be done in a thorough manner using welding rods of the same composition as sheets or parts to be welded. Welds shall be strong, ductile, with excess metal ground off joints and finished smooth to match adjoining surfaces. Welds shall be free of imperfections and shall be the same color as adjoining surfaces. Joints may be seamlessly welded by any acceptable process, except that carbon arc welding will not be permitted. Butt welded joints provided with straps shall not be filled with solder.

All welded joints shall be homogeneous with the sheet metal itself. Any form of welding permitting carbon pickup will not be acceptable. Where sheet sizes require a joint, such joint shall be continuously welded. Field joints will not be permitted. Where welds occur on surfaces not finished by grinding or polish, such welds and the accompanying discoloration shall be suitably coated in the shop by means of approved metallic base paint or metallic spray to prevent the possibility of progressive corrosion of such joints.

All workmanship shall be of the best quality by craftsmen skilled in their respective trades.

Toll booths shall be assembled in strict accordance with the Plans in order to allow interchangeability of parts and accessories. Booths shall be provided with appropriate lifting devices securely attached to the frame.

Completed booths shall comply with the applicable requirements of Subsection 918.01, and the National Electrical Code of the National Fire Protection Association (NFPA 70).

(B) INSTALLATION.

The Contractor shall check all governing measurements at the toll islands and the level of surfaces on which each booth is to stand, and shall correct any discrepancies to the satisfaction of the Engineer. No booth shall be installed until all governing measurements and levels have been verified and corrected where necessary.

Prior to the installation of the toll booths, the manufacturer shall be notified and shall make provisions for an authorized representative to be available at the site to assist in the installation of the toll booth if needed. The toll booth manufacturer's representative shall also be present during installation for warranty purposes. The representative will be required to inspect the condition of the booths immediately before and after installation for the purpose of validating preservation of the toll booths' warranties. The manufacturer shall provide acceptable documentation for recording these inspections, which will be cosigned by the Engineer. The forms shall include the contract number; booths manufacturer, serial number, and type; the booths condition including any damaged resulting from the actions of others; and the date of the inspections.

No toll booths may be set until framework, roof and roofing of the canopy are in place, unless adequate protective measures, as approved by the Engineer, are taken to protect the booths.

At all locations where booths are to be installed, it may be necessary to make appropriate modifications to the openings through the tunnel roof in order to accommodate the necessary ducts, etc. by removal of additional concrete and installing new sleeves and grouting them in place.

The booth units shall be installed in their final position on the toll islands utilizing the specified anchor bolts, and all final electrical connections shall be made to the booths by the Contractor, except that treadle connections will be made by the Authority.

All work shall be accomplished in cooperation with others who must also perform work in or around the booths. All work shall be completed fully in a good workmanlike manner, in accordance with the Plans and Specifications and to the satisfaction of the Engineer.

When booths have been set, anchored, electrical systems connected and in operation, and the installation has been inspected by the Engineer, protective coverings and coatings shall be removed from the various surfaces by the Contractor and such materials promptly removed from the Project. All exposed booth surfaces, including windows, shall be cleaned, washed and/or polished, and left in an acceptable condition.

(C) QUALITY ASSURANCE.

Except as otherwise indicated on the drawings or specified herein, all work under this section shall conform to the applicable requirements of BOCA, NEC, NFPA, the State Uniform Construction code and regulations of all governmental authorities having jurisdiction.

Booth assembly will be subject to an independent third party inspection by a certified inspection agency to monitor compliance with contract documents and governing codes and regulations. Each booth shall be furnished with an IBC certification seal and a manufacturer's data plate located in the vicinity of the certification seal. A copy of the IBC certification seal for each toll booth shall be submitted to the Authority.

Contractor shall be responsible for obtaining the services of an independent inspection agency to monitor the compliance assurance program. The inspection agency shall be certified by the IBC to be qualified by reason of facilities, personnel, experience and demonstrated reliability and independence of judgment, to inspect industrialized/modular buildings, building components, building systems or compliance assurance programs.

For each type of toll booth manufactured under this contract, provide the compliance assurance documentation in accordance with the Uniform Construction Code, which shall include 10 copies of the following (6 copies for the Owner and 4 copies for the IBC):

(1) Building System Documents consisting of as-built plans, specifications, calculations, test results and /or other documents that describe in detail the products and manufacturing process employed to assemble the toll booths.

(2) Compliance Assurance Manual consisting of the manufacturer's organizational requirements, material controls, production controls, finished product controls (handling, storage, packaging and shipping).

(3) On-site Installation Instructions consisting of specific installation procedures that specify the materials and procedures required to install the toll booths in conformance with the codes and applicable standards. The installation procedures shall include, but not be limited to, foundation anchoring details, utility system connections, equipment installation requirements, and any other special installation conditions affecting structural, mechanical or electrical elements.

(D) WARRANTIES.

Provide a written warranty for the toll booths' assembly as specified herein. The warranty shall state that the booths furnished shall be free from defects caused by defective workmanship and/or materials for a period of two (2) years from the date of acceptance. The structural steel framing shall have a lifetime warranty against racking and misalignment of components.

Warranty shall be in a form acceptable to the Authority and shall be executed by a principal of the firm issuing the guarantee complete with notarized stamp and date.

Separate warranties for products supplied by other manufacturers shall be forwarded to the Authority.

519.04 Measurement.

Toll booths will be measured by the number installed.

DATIM enclosures will be measured by the number installed.

519.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TOLL BOOTH	EACH
DATIM ENCLOSURE	EACH

SECTION 520 - TOLL ISLANDS

520.01 Description.

This work shall consist of the construction of toll islands and includes concrete bumper and bumper block, granite curb and concrete support, reinforced concrete sub-slab, aluminum railing, grating, stairwell, treadle frame, and other miscellaneous components as detailed on the Plans.

520.02 Materials.

Materials shall conform to the following Subsections:

ANCHOR BOLTS	909.02
CONCRETE	905.05
CONDUIT	918.08
EMBANKMENT, GRADE A	901.01
EPOXY MORTAR	923.09
GALVANIZED STEEL PIPE	923.04
GRANITE CURB	923.13
JOINT SEALER	907.02
PREFORMED JOINT FILLER	907.01
RAILINGS	911.01

REINFORCEMENT STEEL 908.01

SAFETY TREADS 923.19

STRUCTURAL STEEL 909.01

WATER REPELLENT TREATMENT ..... 923.06(F)

WIRE MESH REINFORCEMENT 908.01

GROUT 905.12

Stairwell grating shall be as specified in 922.05(A).

Light fixtures for stairwell lighting shall be as specified in 922.05(B).

Fire extinguishers shall be multipurpose dry chemical (A B C) type portable fire extinguisher as specified in 922.05(C). Extinguishers shall have a capacity of 20 pounds with a U/L rating of 20A:120B:C, a replaceable valve stem seal, pressure gauge, pull pin upright squeeze grip operation.

Provide a mounting bracket for outdoor installation on concrete bumper block at the required toll islands or other Engineer approved locations, as specified in Subsection 922.05(C).

520.03 Methods of Construction.

Toll islands shall be constructed in accordance with the following:

(A) Concrete Components.

The toll islands, bumper blocks, bumpers, stairwell, and sub-slabs shall conform to the applicable requirements specified in Section 401 and in accordance with details, dimensions, lines, and grades shown on the Plans or as directed by the Engineer. Concrete bumper blocks may be either cast-in-place or precast at the Contractor's option. If precast, the Contractor shall submit shop and working drawings to the Engineer for approval.

(B) Concrete Penetrating Sealer.

The concrete penetrating sealer treatment shall be in accordance with Subsection 401.19.

(C) Granite Curbs and Noses.

Granite curbs and noses shall be constructed in conformance with the requirements specified under Section 507.

(D) Railings.

Railings at the stairwell opening shall be fabricated to the dimensions and details shown on the Plans. The fittings shall be flush type for welded assembly. Welds shall be dressed smooth. Posts shall be anchored 4 inches deep in sleeved or formed recesses and caulked between the post and sleeve with quick setting anchor cement or molten lead.

The handrail at the stairs shall be a single rail with suitable wall mounts anchored by means of expansion type anchors or grouted inserts.

(E) Treadle Frame.

Treadle frame, complete with curb box and drain, shall be constructed in accordance with the applicable provisions of Section 403. Installation shall be made during pavement construction.

(F) Stairwell.

Stairwell construction shall include the installation of all associated electrical work for stairwell lighting in accordance with Section 601.

(G) Aluminum Door and Frame.

Aluminum door and frame shall be installed at all tunnel openings to the stairwell as shown.

(H) Water Repellant Treatment.

After the concrete of the toll islands has cured for a minimum period of 28 days, the Contractor shall clean the surfaces of the new concrete and apply the water repellent treatment. All dirt, dust, oil, wax, other

coatings, efflorescence, and other foreign material shall be removed, utilizing high pressure water, sandblasting, or other suitable methods approved by the Engineer.

Application of the water repellent treatment shall be made on dry or damp (not standing water) surfaces. Ambient temperature or surface temperature shall not exceed 100ºF, nor shall the treatment be applied below 40ºF or when ice or frost is covering the substrate. The material shall not be diluted or altered in any way. A one (1) coat application shall be made, using procedures and rate of coverage recommended by the manufacturer.

520.04 Measurement.

Toll Islands and Treadle Frames of the various types will be measured by the number of each, installed and accepted.

Fire Extinguishers will measured by the number installed.

520.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TOLL ISLAND, TYPE (*)	EACH
TOLL ISLAND, TYPE (*) WITH STAIRWELL	EACH
TREADLE FRAME, WITH DRAIN	EACH
FIRE EXTINGUISHER	EACH

*A-Single Booth: B-Two Booths

Payment adjustments for strength and durability for the various Portland cement concrete items listed above will be made in accordance with the specified Performance Criteria Category within Table 2 of Subsection 905.23.

Payment for Toll Island with Stairwell shall include the tunnel door and appurtenances and lighting fixture. Where a pile foundation is required for the stairwell, separate payment for piles will be made in accordance with Section 405.

SECTION 521 - CANOPY

521.01 Description.

This work shall consist of the complete fabrication, erection and installation of all components detailed for the construction of the canopy, except electrical work specified under Section 604.

521.02 Materials.

Materials shall conform to the following Sections or Subsections:

ARCHITECTURAL PANELS	923.01
BOLTS AND BOLTING MATERIALS	909.02
CANOPY DRAINS	923.04
METAL ROOF DECK	923.14
PAINT AND COATINGS	913
STRUCTURAL STEEL	909.01
ZINC COATING	909.11

521.03 Shop and Working Drawings.

Shop, erection, and other drawings, necessary for the fabrication and erection of the canopy, shall be furnished in accordance with Subsection 104.08.

521.04 Standards of Compliance.

All work shall comply with the following:

(A) "Design, Fabrication, and Erection of Structural Steel for Buildings", and the "Code of Standard Practice", latest revisions by A.I.S.C.

(B) "Welding in Building Construction" by the American Welding Society.

(C) "Specification for Structural Joints Using ASTM A325 or A490 Bolts" by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

(D) "Standard Specification for the Design of Light Gauge Cold Formed Steel Structural Members" by A.I.S.I.

521.05 Methods of Construction.

Canopy construction shall be as follows:

(A) FRAMEWORK.

(1) Workmanship and Inspection.

All workmanship shall be equal to the best practice in modern structural shops. All materials shall be free of rust and loose mill scale.

All material will be inspected in the shop for workmanship only and in the field for workmanship and fit after the work has been fitted in place.

All field connections shall be made with high strength bolts, except as indicated on the Plans to be welded.

No shop welding will be permitted unless the Authority representative is in the shop for inspection services, or written instructions are received to the contrary. The Contractor shall give the Engineer a schedule of fabrication at least one week prior to commencing, so that the Engineer may schedule inspections. The Contractor shall afford the inspection agency the maximum cooperation both in the shop and in the field.

(2) Rejected Material.

Any material which is rejected by the inspectors, either at the shop or building site, must be promptly removed from the site and replaced with acceptable material at the Contractor's expense.

The fact that material has been accepted at the shop shall not prevent its rejection at the site or even after it has been erected if it fails to be in proper condition, and the same conditions for replacing this material shall hold as specified above.

(3) Painting.

The support steel shall be shop primed and field painted after erection, as required by the Plans for the selected paint system in accordance with Section 411 and/or applicable Supplementary Specifications.

Machine finished surfaces shall be protected against corrosion by a suitable coating.

(4) Galvanizing.

Galvanizing of any metal part, where called for, shall be by the hot-dip process after fabrication to an average weight of 2 ounces per square foot of actual surface in conformity with ASTM A123. The galvanizing of bolts and similar threaded fasteners shall conform to the requirements of ASTM A153.

(5) Erection.

Particular care shall be taken to have the work perfectly plumb and level before permanent connections are made.

(a) Bracing.

The frame shall be carried up true and plumb and temporary bracing shall be introduced wherever necessary to take care of all loads to which this structure may be subjected, including

wind, erection equipment, and the operation of same. Such bracing shall be left in place as long as may be required for safety.

(b) Bolting Up.

As erection progresses, the work shall be securely bolted up to take care of all dead load, wind and erection stresses. All field connections for canopy construction shall be made with high strength bolts, unless welding is specifically indicated on the Plans.

High strength bolts, nuts and washers shall be governed by "Specifications for Structural Joints using ASTM A325 or A490 Bolts", using the calibrated wrench tightening method with torque controlled impact wrenches.

Compressors, capable of supplying and maintaining a minimum air pressure of 100 pounds per square inch at the impact wrench or suitable electric equipment for proper operation, must be provided.

All holes shall be accurately spaced to allow the insertion of high strength bolts 1/16" smaller than the hole diameter.

Faying surfaces of high strength bolted field joints shall be cleaned but left unpainted.

All high strength bolts shall first be turned up with hand wrenches, followed by impact wrenches, to obtain the required bolt tension which will be indicated by the wrenches' release. Impact wrenches are to be calibrated daily for the size of bolts being currently placed.

No torque wrenches are to be used.

(c) Erection Stresses.

Wherever piles of material, erection equipment, or other loads are carried during erections, proper provision shall be made to take care of stresses resulting therefrom.

(d) Welding.

All steel connections, which are field or shop welded, shall be of the same strength and flexibility as a riveted or bolted connection.

Welding shall be done by the electric arc process and shall comply with the American Welding Society "Standard Code for Welding in Building Construction", latest revision.

All welders employed on the work shall be skilled in the type of welding required by this Contract and shall have been previously qualified by tests. Each welder, when so directed by the Inspector, shall prepare test samples and the Contractor shall supply the materials and facilities necessary to produce these samples.

(e) Drifting.

Light drifting necessary to draw the holes together will be permitted, but drifting to match unfair holes will not be allowed.

Twist drills shall be used to enlarge holes as necessary to make connections. Reaming that weakens the members or makes it impossible to fill the holes properly or to adjust accurately after reaming will not be allowed.

(f) Repairing Damaged Galvanized Surfaces.

Materials or hardware on which the galvanizing has been damaged shall be replaced with new materials having properly galvanized surfaces. Minor damage to galvanized surfaces may be repaired in accordance with Subsection 403.16.

(B) METAL ROOF DECK.

All work shall be done in accordance with the following:

(1) Fabrication.

Metal roof deck shall be fabricated in lengths so that ends of deck rest on steel supports.

Metal roof deck of lengths spanning 3 or more spans shall be fabricated of 22 gauge materials; lengths spanning 2 spans shall be fabricated of 20 gauge materials; single span lengths shall be fabricated of 18 gauge materials. Openings greater than 6" in diameter through metal roof deck will not be permitted.

(2) Installation.

Deck panels shall be attached and welded to the supporting steel framework in accordance with manufacturer's instructions, unless otherwise noted on the Plans. All welds that do not hold must be replaced. Care must be taken to insure that welds fall over supports and do not burn holes in the deck. All welds are to be touched up with rust inhibitive paint. All welding shall be electric arc welding performed by competent welders.

(3) Holes or Openings.

The deck shall be cut by the Contractor to fit openings which are shown on the final approved shop drawings. All openings shall be reinforced.

(4) Roofing, Insulation and Flashing.

All work shall be installed in accordance with the manufacturer's recommendations, and all steps shall be taken to get the maximum length of guarantee available.

Apply over steel roof deck, 1-inch fesco-board insulation as specified in Subsection 922.06(A), mechanically fastened with FM Classification I-90 approved fasteners at a minimum of four feet on center. Include cant strips as required.

Over insulation, apply a smooth surface 4-ply built-up roof such as specified in Subsection 922.06(B), guaranteed for at least 10 years. Contractor shall determine the bitumen used for the existing roofing (either asphalt or coal tar pitch) and shall use bitumen compatible to the existing roof.

Bituminous flashing shall be applied in accordance with the approved manufacturer's flashing system, with preformed expansion joint covers as specified in Subsection 922.06(C).

Gravel stop and fascia at edges of canopy shall be "Colortrim" 16 gauge aluminum. Form gravel stops and fascia of the size and details indicated and in 10 foot lengths. Colortrim aluminum gravel stop and fascia shall be as specified in Subsection 922.06(D), finished with dura color baked enamel of a color as selected by the Engineer.

The roofing shall be formed and pitched to create valleys and crickets, enabling free flow to drains and eliminating any possibility of ponding at ends, joints, or between drains. National Roof Contractors Association (NRCA) details and specifications are to be followed for the "system" being installed, unless otherwise shown on the plans or project specific specifications.

(C) ARCHITECTURAL PANELS.

(1) Fabrication.

All metal panels forming the exterior closure of canopy fascia, soffit, and column facing used in connection with the panels to make them weathertight shall be furnished and erected by the Contractor where so noted on the Plans.

Subgrits shall be roll formed from zinc-coated steel into the required shape to properly receive all panel fasteners and produce the combined action between the face sheet and the liner to meet the designated design loads and deflections.

Hidden clips for fastening exterior face to subgrit shall be coated steel. Clip design shall effectively function to meet all design requirements of the total panel assembly.

(2) Field Erection.

Field erection of the panels shall be in accordance with the approved shop drawings.

(D) CANOPY DRAINS.

Canopy drains shall be provided as shown and shall be flashed with 4 pounds lead extending 10 inches all around the drain. Drains shall be stripped into roofing in accordance with the manufacturer's recommendations.

521.06 Measurement.

Canopy will be measured on a Lump Sum basis.

521.07 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CANOPY	LUMP SUM

SECTION 522 - TEST PITS

522.01 Description.

This work shall consist of excavation by hand methods for the purpose of determining the exact location of existing underground facilities as may be specified or directed by the Engineer.

522.02 Materials.

All surfaces, including pavement, requiring removal for test pits shall be repaired or replaced with like materials as specified in the appropriate Section of the Specifications.

522.03 Methods of Construction.

Excavation shall be by hand methods using the greatest possible care not to damage any existing facility. The excavation shall be made of a lateral size and depth so as to properly identify the facility and its exact location. After establishing means of locating the underground facility from undisturbed surface features, the excavation shall be backfilled and tamped as specified under Subsection 206.03.

Damage to the facility or to the surface area shall be repaired or replaced by the Contractor in a manner satisfactory to the Engineer.

The Contractor should make full use of the latest subsurface utility technology offered by any the following or similar companies that would be applicable to the project;

(1) TBE Services

25 Foxwood Run

Middletown, NJ 07748

Ph. (732) 796-9629

(2) Digital Geographic Technologies, Inc.

374 Congress Street, Suite 403

Boston, MA 02210

Ph. (617) 482-0540

(3) APS, Inc.

4851 Georgia State Hwy 85

Unit 214

Forest Park, GA 30297

Ph. (404) 763-9550

(4) Blackhawk Pipeline Assessment Services

Ph. (864) 322-2614

522.04 Measurement.

Test Pits, regardless of length and width, will be measured by the number of pits excavated to a maximum depth of five feet.

Test Pit Extra Depth will be measured by the depth greater than five feet.

522.05 Payment.

PAY ITEM	*PAY UNIT*
TEST PITS	EACH
TEST PIT EXTRA DEPTH	LINEAR FOOT

SECTION 523 - MISCELLANEOUS DRAINAGE

523.01 Description.

This work shall consist of the cleaning of existing storm drains and cleaning of existing ditches as shown on the plans or as directed by the Engineer.

523.02 Equipment.

Equipment utilized shall be approved by the Engineer.

523.03 Methods of Construction.

Existing storm drains and ditches shall be cleaned of accumulated silt, sand, garbage and other debris. Methods and equipment used by the Contractor in cleaning drainage structures, pipes and ditches shall be subject to the approval of the Engineer. Work shall be performed as follows:

(A) FIELD MEASUREMENT AND INSPECTION.

The Contractor shall verify, by actual field inspection and measurement, the condition of the various components of the drainage systems to be cleaned. In order to determine the condition of the drainage systems, the Contractor shall provide equipment and materials necessary to inspect, in the presence of the Engineer and prior to the cleaning of any part of the drainage system, the entire drainage system. The inspection shall consist of visual inspection and flushing water through inlets. The Engineer will determine which part of the system needs cleaning.

(B) DISPOSAL OF MATERIALS.

All materials resulting from the cleaning operations shall be disposed of in accordance with Subsection 202.03.

(C) CLEAN INLETS ON GRADE.

The Contractor shall thoroughly clean the drainage structures, as determined by the Engineer, of all dirt, debris and foreign matter, to the satisfaction of the Engineer. Care shall be used during the work to prevent damage to any of these structures during the performance of the work. All inlets shall be in clean condition at the time of contract completion.

Except during the actual work of cleaning an inlet no drainage structure shall remain without coverage with a grate at any time.

(D) CLEAN UNDERGROUND PIPE.

The Contractor shall thoroughly clean underground pipes, shown on the plans or ordered by the Engineer, of all dirt, debris and foreign matter to permit free unobstructed flow of the storm drainage system connected thereto. In the event that during or after cleaning the pipe, it is found by the Engineer that the drainage is not free flowing between inlets, due to a break or other defect, then cleaning of such line will cease and payment will be made for the actual length of pipe cleaned by the Contractor. Compensation for any other work ordered by the Engineer in order to permit the free flowing of the storm drainage system, which is not covered by any item of this Contract, shall be made in accordance with the requirements of Subsection 104.04 of the Specifications.

(E) CLEAN EXISTING DITCH.

The Contractor shall thoroughly clean existing ditch, shown on the plans or ordered by the Engineer, of all debris and foreign matter to permit positive flow to the outfall location as shown on the plans.

523.04 Measurement.

The quantity of Clean Existing Storm Drains for which payment will be made will be the total length of drainage pipes actually cleaned in accordance with the Specifications as directed by the Engineer.

Clean Existing Ditch will be measured by the length along the centerline of the ditch.

Cleaning other existing drainage structures will not be measured for payment, but will be considered incidental to the unit price bid for other items.

523.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
CLEAN EXISTING STORM DRAIN, ____" TO ____" DIAMETER	LINEAR FOOT
CLEAN EXISTING STORM DRAIN, ____" DIAMETER	LINEAR FOOT
CLEAN EXISTING DITCH	LINEAR FOOT

SECTION 524 - IMPACT ATTENUATOR

524.01 Description.

This work shall consist of the furnishing, and installing of telescoping, non-gating, re-directive (TNR) impact attenuators. For TNR impact attenuators installed in a construction zone on a temporary basis, work shall also include the maintenance of the attenuator during construction, repair or replacement during construction, relocation to a different area, removal upon completion and the restoration of pavement after removal.

This work shall consist of the furnishing and installation of impact attenuators for Z-Turns, as per the Authority's Standard Drawing, and in accordance with the manufacturer's specifications. Impact attenuators for Z-Turns shall consist of the attenuation system and a tail end section designed for attachment to dual-face beam guide rail.

This work shall also consist of the furnishing and installation of bullnose thrie beam attenuators at wide Z-Turns and other locations shown on the Plans, in accordance with the Authority's Standard Drawing.

524.02 Materials.

Materials shall conform to the following subsections:

TELESCOPING NON-GATING, RE-DIRECTIVE IMPACT ATTENUATOR	920.20

Foundation concrete for the permanent systems shall be at least 4,000 psi. Reinforcement steel shall be epoxy coated. Concrete and reinforcement steel shall conform to Subsection 401.02.

Installation and additional material requirements shall be in accordance with the manufacturer's recommendations.

Reflective sheeting which appears at the blunt end of temporary and permanent impact attenuators shall conform to Subsection 912.02.

524.03 Methods of Construction.

For TNR impact attenuators installed on a temporary basis, the Contractor shall have spare unit parts for repair or replacement on site. If the attenuator is damaged from vehicular impact, the Contractor shall repair/replace any damaged unit within 48 hours of notification from the Authority. Repairs or replacement of TNR impact attenuators due to damage caused by Contractor actions shall be immediately repaired at no additional cost to the Authority. The Contractor shall be certified in accordance with the manufacturer's requirements to perform installation, maintenance, repair and replacement of TNR impact attenuators.

Repair of TNR impact attenuators includes all of the labor and materials necessary to meet the requirements for a working unit in accordance with the manufacturer. This includes but is not limited to replacement of nose units, cartridges, diaphragms, hardware, realignment or total replacement.

524.04 Measurement.

Quadguard Impact Attenuator, ___Bays, ___" Wide are TNR Impact attenuators installed on a permanent basis and shall be measured by the number constructed. Each unit shall consist of a total energy absorbing system composed of the required number of bays and required width.

Impact Attenuator, Type_____ will be measured by the number of each installed.

Bullnose Thrie Beam Attenuator will be measured by the number of each installed.

Furnishing Temporary Impact Attenuator, Quadguard ___Bays, ___"Wide will be measured by the number of each complete unit installed to the maximum number provided in the Proposal that which are installed simultaneously.

Placing and Removing Temporary Impact Attenuator, Quadguard will be measured by the total number of complete units placed in each location as prescribed. Removal of temporary impact attenuators will not be measured for payment.

Repair Temporary Impact Attenuators, Quadguard will be measure by the number of bays to be replaced or repaired to the satisfaction of the Engineer.

524.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
QUADGUARD IMPACT ATTENUATOR, ___BAYS, ___" WIDE	EACH
IMPACT ATTENUATOR, TYPE _____	EACH
BULLNOSE THRIE BEAM ATTENUATOR	EACH
FURNISHING TEMPORARY IMPACT ATTENUATOR, QUADGUARD ___ BAYS, ___" WIDE	EACH
PLACING AND REMOVING TEMPORARY IMPACT ATTENUATOR, QUADGUARD	EACH
REPAIR TEMPORARY IMPACT ATTENUATOR, QUADGUARD	EACH

No separate payment will be made for the restoration of pavement involved with the removal of impact attenuators installed on a temporary basis, but the costs thereof will be included in the lump sum price bid for the pay item "Furnishing Traffic Control Devices" in accordance with Subsection 801.05.

No separate payment will be made for concrete, anchors, concrete foundations, or epoxy coated reinforcement, but the costs thereof will be included in the unit prices bid for the various temporary or permanent impact attenuator pay items in the Contract.

No payment will be made for repair or replacement of permanent or temporary impact attenuators damaged by the Contractor operations.

SECTION 525 – MILE MARKERS

525.01 Description.

The work shall consist of the installation of mile markers where shown on the plans, and on steel posts in lieu of flexible delineator posts as described in Section 515.

525.02 Materials.

Materials shall conform to the following subsections:

MOUNTING BARS, STEEL	909.01
HARDWARE STEEL	909.02
GALVANIZING	909.11
MOUNTING BARS, ALUMINUM	911.01
SIGN MATERIALS	912

HARDWARE, ALUMINUM 912.01

U-CHANNEL POST 912.03

525.03 Methods of Construction.

Methods of construction shall be similar to Subsection 515.03 and as detailed on the Standard Drawings.

525.04 Measurement.

Mile markers will be measured by the number of each type installed.

525.05 Payment.

PAY ITEM ..... *PAY UNIT*

MILE MARKER, TYPE ____. ..... EACH

SECTION 526 - PRESSURE GROUT APPROACH SLAB

526.01 Description.

The work under this section shall include the furnishing of all labor, equipment and materials necessary to fill voids under bridge approach slabs as required in accordance with the Plans and Specifications and as directed by the Engineer.

526.02 Materials.

Portland Cement and water shall conform to the requirements of Section 905.

Sand shall be fine mortar sand having a gradation of at least 30 percent, but not more than 60 percent passing the 200 sieve. Expanding agent shall be as specified in Subsection 923.48.

Grout shall have a minimum compressive strength of 500 psi at 12 hours.

The Contractor shall be responsible for furnishing a current design and testing of the portions of cement, sand, expanding agent and water for the various consistencies of grout to be used. Trial mixes shall be tested for compressive strength by an approved laboratory engaged by the Contractor. A complete mix design with test results shall be furnished to the Engineer for approval a minimum of two (2) weeks before proposed use.

526.03 Methods of Construction.

Removal of Surfacing shall be in accordance with the requirements of Section 305.

Holes shall be drilled with a core drill and shall have a diameter of 2 to 2-1/2 inches. Holes shall be spaced 24 inches from the edges of the slab and 8 feet center to center within the area of the slab to be pressure grouted. Prior to core drill, the Contractor shall locate existing rebars with the use of a pachometer and shall move the hole as required to avoid cutting or damaging existing rebars.

An injection pump equipped with a shut-off valve shall be inserted into each pre-drilled hole prior to receiving grout. The injection pipe shall be set firmly in place in the hole. All remaining holes, except for one hole immediately adjacent to that one receiving the grout, shall be plugged. Plugs shall be an injection pipe with the valve in the closed position, a wooden oak plug or approved equal. The grout pump injection hose shall then be coupled to the injection pipe. Grout is to be seen rising through the adjacent unplugged hole, or to the satisfaction of the Engineer. Repeat the procedure for the remaining predrilled holes.

The grout injection pump shall be capable of sustaining a gauge pressure of 150 psi. A calibrated working pressure gauge shall be located immediately adjacent to the grout hose supply valve and shall be positioned so it can be easily monitored by the Engineer.

The Contractor shall be responsible to repair to the satisfaction of the Engineer any damage to the existing slab to be pressure grouted or to adjacent slabs, pavements, and structures which results from his operations.

No pumping of grout shall be done when the ground is frozen or when the air temperature is below 40°F.

The Contractor shall have sufficient material on hand, including backup equipment, to insure a continuous grouting operation prior to the start of the pumping of any grout.

Two weeks prior to the start of any grouting operation, the Contractor shall submit for review by the Engineer a plan and description specifically detailing the equipment he proposes to use. The proposed locations of holes shall be included in this submission.

526.04 Measurement.

Pressure grout approach slab will be measured by the required quantity of grouting material actually placed for the project. No separate payment will be made for grouting preparations.

526.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
PRESSURE GROUT APPROACH SLAB	CUBIC FOOT

SECTION 527 - UTILITY SUPPORT HANGERS

527.01 Description.

The work under this section shall include the furnishing of all labor, materials and equipment necessary to install new utility support hangers and to remove and properly dispose of all existing utility support rods at locations shown on the plans or as directed by the Engineer.

527.02 Materials.

STRUCTURAL STEEL	909.01(A)
FASTENERS	909.02
HOT-DIP GALVANIZING	909.11(A)&(B)

527.03 Methods of Construction.

The Contractor shall verify all existing conditions and dimensions in the field prior to beginning of work.

The utility supports shall be installed in accordance with the plans and properly adjusted to uniformly support the existing utility lines.

The proposed utility support hangers shall be installed immediately adjacent to the location of the existing hangers as shown on the plans.

The existing utility support rods shall not be relieved of load until a complete installation of the proposed support hangers has been made.

527.04 Measurement.

Utility support hangers will be measured by the number installed.

527.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
UTILITY SUPPORT HANGERS	EACH

The unit cost for this item shall include furnishing, erecting, galvanizing of the proposed system, proper disposal of the existing hanger components and all other appurtenances as may be required including furnishing of all labor and equipment necessary to complete the work.

SECTION 528 - RESETTING OF EXISTING JUNCTION BOXES

528.01 Description.

This work shall consist of removal of portions of the existing reinforced concrete junction boxes and reconstruction of sidewalls of these junction boxes and replacing the existing frames to meet the proposed roadway elevations to a maximum of 6 inch difference from existing conditions.

528.02 Materials.

Materials shall conform to the following subsections:

PORTLAND CEMENT CONCRETE 905.05

REINFORCEMENT STEEL. 908.05

Polyester resin bonding agent to be used for grouting of dowels shall be approved by the Engineer.

528.03 Methods of Construction.

The lateral limits of each wall area to be removed and reconstructed shall be as shown or will be delineated by the Engineer and suitably marked. After removing existing covers and frames and performing necessary excavation to expose the outer faces of the junction box walls, the walls shall be first cut to a depth of one-half inch on both faces along the entire periphery of the junction box using an approved power saw capable of making straight cuts. Then the portions of the walls above the sawcut line shall be removed by hand chipping and/or approved hand operated hammers not exceeding 30 pounds.

The Contractor shall take the necessary precautions to protect the existing electrical connections and to protect the Authority's Electrical and Communication systems.

Care shall be taken so as not to damage or debond the existing reinforcing steel or steel anchorages, or to shatter the concrete walls beyond the removal limits. After concrete removal, surfaces of the remaining concrete and exposed reinforcing steel shall be thoroughly cleaned of all loose and adhering particles. Immediately prior to the placement of new concrete, the top surfaces of the existing walls shall receive a coating of epoxy bonding compound as described in Paragraph 418.03(B).

Backfill shall not be placed against reconstructed junction boxes until the new concrete has been in place for 14 calendar days, or until the concrete has cured 72 hours and concrete strength exceeds 3000 psi. The construction area shall be covered with a metal plate while concrete is curing.

Existing frames and covers shall be reset to new roadway elevations and grouted in place on the reconstructed junction boxes as shown on plans.

528.04 Measurement.

Resetting of junction boxes, with existing frames and covers, of various kinds and types will be measured by the number reset.

528.05 Payment.

Payment will be made under:

PAY ITEM ..... ***PAY UNIT***

RESET JUNCTION BOX ..... EACH

SECTION 529 - LIGHTWEIGHT FILL

529.01 Description.

This work shall consist of the furnishing and placement of lightweight aggregate manufactured from dredged sediment at the locations shown on the plans or as directed by the Engineer. No lightweight fill shall be used for Crib, Modular or MSE walls.

529.02 Materials.

MANUFACTURED LIGHTWEIGHT AGGREGATE ..... 902.05(F)

SEE PARAGRAPH 902.05(F) FOR REQUIRED MATERIALS TEST SUBMITTALS.

529.03 Equipment.

Equipment utilized shall be approved by the Engineer.

529.04 Methods of Construction.

Lightweight fill can be placed in approximately uniform layers not to exceed 12 inches loose thickness. Each layer shall be compacted using vibratory compaction equipment weighing not more than 12 tons static weight. The actual lift thickness, exact number of passes, and need for vibrating the roller will be determined by the Engineer, depending on the project requirements (i.e., strength, compressibility, unit weight) and equipment used. The Contractor shall take all necessary precautions during construction activities in operations on or adjacent to the lightweight fill to ensure that the material is not over-compacted. Construction equipment, other than for compaction, shall not operate on the exposed lightweight fill.

529.05 Measurement.

Lightweight Fill shall be measured by the cubic yard complete in place. Measurement for payment shall occur following completion of all excavation as approved by the Engineer but prior to placement of Lightweight Fill.

529.06 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
LIGHTWEIGHT FILL	CUBIC YARD

The Contractor is apprised that manufactured lightweight aggregate is sold by the supplier by the ton, but payment will be made per cubic yard and shall be full compensation for all labor, materials and equipment required to complete the work.

SECTION 530 - RAISED PAVEMENT MARKERS

530.01 Description.

This work shall consist of furnishing and installing raised pavement markers in accordance with the details shown on the Plans or as directed by the Engineer.

530.02 Materials.

The raised pavement markers shall be as specified in Subsection 923.46.

The raised pavement marker is an iron casting to which is attached a replaceable prismatic reflective element. The raised pavement markers shall be able to withstand snow plowing in two opposing directions without sustaining any damage.

The adhesive used to bond the raised pavement markers to the pavement shall be a two-component standard set type epoxy as specified in Subsection 923.46.

530.03 Method of Construction.

(A) PAVEMENT PREPARATION.

The Contractor shall be responsible for cleaning and preparing the pavement grooves in which the raised pavement marker is to be bonded, to the satisfaction of the Engineer, such that at the time of raised pavement marker installation, the grooves shall be free of dirt, dust, oil, grease, moisture, curing compound, loose or unsound layers or any other material which would interfere with proper bonding of the raised pavement marker to the pavement. The pavement grooves shall be blown out with compressed air just prior to the application of the epoxy compound.

(B) INSTALLATION OF RAISED PAVEMENT MARKERS.

At the time of installation, the raised pavement markers shall be free of dirt, dust, oil, grease, rust, moisture or any foreign matter which will impair adhesion to the pavement. It shall be the Contractor's responsibility to clean each contaminated casting by sand blasting or other acceptable procedure to remove all such foreign matter prior to installation.

Before beginning the raised pavement marker installation, the Contractor shall accurately and adequately layout, by reference points, the locations of all raised pavement markers to assure their proper placement, as shown on the Plans or as directed by the Engineer.

Raised pavement markers shall not be placed on pavement surfaces that show visible evidence of cracking, checking, spalling or failure of underlying base material.

If, during the pre-installation lay-cut operation, it is determined that a raised pavement marker would be placed at a point with one of the above pavement surface defects or at a pavement construction joint as the result of typical spacing, the affected raised pavement marker shall be relocated longitudinally a sufficient distance to a suitable point, with the approval of the Engineer. The distance the raised pavement marker may be relocated shall not exceed 10 percent of the typical raised pavement marker spacing. Where it would be necessary to relocate the raised pavement markers a distance greater than 10 percent of the typical raised pavement marker spacing, the affected raised pavement marker shall be deleted.

The pavement surface temperature and the ambient air temperature shall not be less than 40 degrees F at the time of application. No raised pavement marker shall be installed if the pavement surface is not dry.

Raised pavement markers shall be installed by inserting the two keels on the casting into saw cuts in the pavement in accordance with the details on the Plans. Within two (2) working days after the slots are saw cut into the pavement, the marker castings shall be hand placed into the slots in such a manner as to assure that the tip of the markers's snowplow deflecting surface(s) are below the pavement surface.

The recessed attachment area shall then be painted with adhesive primer as specified in Subsection 923.46 in accordance with the manufacturer's instructions. After allowing the primer to dry thoroughly, the release paper shall then be peeled from the butyl adhesive bottom of the reflector and the reflector shall be inserted into the recessed attachment area and pressed into place until a firm bond has been made with the casting. The Contractor shall press the reflector into place by the application of a 1500 to 2500 pound load for six (6) seconds minimum or another procedure acceptable to the Engineer.

In addition to compliance with the details of installation, the installed raised pavement markers shall show careful finished workmanship in all particulars. The installed raised pavement markers which show defective workmanship, shall be rejected unless repaired to the satisfaction of the Engineer. The following defects are specified as constituting poor workmanship and the presence of any or all of them in any individual raised pavement marker or in general in any shipment shall constitute sufficient cause for rejection unless repaired.

(1) Improper adhesion of the reflector to the metal casing.

(2) Leading edge of casting above the road surface.

(3) Epoxy on the reflective surface.

530.04 Measurement.

The quantity of raised pavement markers for which payment will be made will be the actual number of each furnished and installed in accordance with the Plans and Specifications or as directed by the Engineer.

530.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
RAISED PAVEMENT MARKERS	EACH

SECTION 531 - FORCE ACCOUNT FOR SNOW REMOVAL

531.01 Description

This work shall include the removal of accumulated snow adjacent to temporary construction barrier and existing barrier parapet throughout the limits of the project, resulting from the snow plowing operations of the Authority's maintenance forces or its agents during all stages of construction. The snow removal shall include disposal of the snow by the Contractor at areas clear from active traffic lanes approved by the Engineer.

531.02 Methods of Construction

The Contractor shall utilize snow removal equipment that can remove the plowed snow deposits from the edges of the roadways without restricting the use of adjacent lanes. The snow deposits shall be displaced into hauling equipment or into the work areas of the roadways. The snow removal equipment shall only travel in the direction of traffic. The Contractor may be directed to perform snow removal at any time while the Contract is in force. The Contractor shall initiate snow removal operations within four hours after notification by the

Authority. The failure to commence work within a 4-hour notification timeframe will result in back charges for all costs incurred by the Authority to remove snow from travel lanes within work limits. In addition the Contractor will be charged a $1,000.00 per hour penalty for each hour over the above 4-hour notification timeframe up to $4,000.00 for each event.

All lane closings for the snow removal work under force account item shall be performed by the Contractor's forces. The Contractor shall place temporary barrier mounted sign supports prior to the storm as directed by the Engineer.

The Contractor shall submit his plan for snow removal to the Engineer for review and approval within 30 days after Contract is awarded. The plan shall detail the Contractor's methods for removal of plowed snow deposits, including the work force and number and type of equipment to be used. A meeting with NJTA Maintenance will be required to review the plan regarding manpower, equipment, response time, etc.

The removal of snow deposited in the Contractor's work areas by Authority plowing operations or the Contractor's snow removal operations shall not be eligible for payment.

531.03 Measurement

Force Account for Snow Removal provides for a value of reimbursement to the Contractor for costs measured on a Cost Plus basis for the time and material used in accordance with Subsection 108.04.

531.04 Payment

Payment will be made under:

PAY ITEM ..... ***PAY UNIT***

FORCE ACCOUNT FOR SNOW REMOVAL (NO-BID) ..... USD

Payment for Force Account for Snow Removal excluding lane closings will be made on a Cost Plus basis in accordance with Subsection 108.04.

Payment for lane closings, if required for snow removal, will be paid for under the item "Installation, Maintenance and Removal of Lane Closings".

SECTION 532 – FORCE ACCOUNT FOR EMERGENCY AND ROUTINE ROADWAY AND BRIDGE REPAIRS

532.01 Description

This work shall consist of Force Account for Emergency and Routine Roadway and Bridge Repairs that will be required to be performed by the Contractor on an emergency or routine basis during the duration of the Contract, as directed by the Engineer within the limits of the Contract.

The Contractor may be directed to perform emergency or routine repair work under the Force Account item during scheduled or non-scheduled daytime, nighttime or weekend lane closings throughout the limits of the project.

Force Account for Emergency and Routine Roadway and Bridge Repairs work shall include the following items as described in the Specification Section noted for each item.

Emergency and Routine Roadway and Bridge Repairs	Specification Section
HMA Surface Course	302
Temporary Surfacing	302
Emergency Temporary Surfacing	302
Sealing Cracks	302
Furnishing and Placement of High Performance Cold Patch Material	302
Pavement Removal, Variable Depth	305
Emergency Pavement Removal, Variable Depth	305
Concrete Deck Replacement with Catches	417
Emergency Concrete Deck Replacement	417
Headblock Repairs, Type 1, 2, and 3	417
Emergency Headblock Repairs, Types 1, 2, and 3	417
Spall Repairs, Types 1, 4, 5, 5A, 5B, and 6	417
Emergency Spall Repair, Types 5, and 6	417

Emergency and Routine Roadway and Bridge Repairs	Specification Section
Joint Reconstruction, Type 1A	417
Emergency Joint Reconstruction, Type 1A	417
Joint Reconstruction, Type 1P	417
Emergency Joint Reconstruction, Type 1P	417
Joint Replacement, Type 1P	417
Emergency Joint Replacement, Type 1P	417
Vertical Spall Repair	417
Repair Inlet	503
Reset Frames	503
Reset Beam Guide Rail	510
Beam Guide Rail Element	510
Beam Guide Rail Post	510

When directed to perform any of the above described items of work or any other work deemed necessary on an emergency basis under the Force Account item, the Contractor shall begin the work immediately after the necessary lane closings have been installed or when directed by the Engineer, and shall perform and complete all work required and have the lane available for opening to traffic within the time frame stipulated hereafter or determined by the Engineer.

The Contractor shall prepare a plan describing the availability of the necessary labor, equipment and material to perform the emergency repair work within the time frames stipulated for the various repairs. The Plan shall be submitted to the Engineer for review and approval within two weeks of receiving Notice To Proceed.

For allowable daytime, nighttime and weekend closing hours see Division 800 and the Manual for Traffic Control. All lane closings for the repair work under the Force Account pay item shall be performed by the Contractor's forces or the Authority's Maintenance forces as directed by the Engineer.

The Contractor shall supply Concrete Repair Materials as specified for the performance of the various emergency repairs as described herein and as directed by the Engineer.

The Contractor shall furnish and deliver the repair materials within one month of Notice to Proceed as follows:

(A) MATERIALS TO BE STOCK PILED IN CONTRACTOR'S STAGING AREA.

The Contractor shall furnish and deliver to his yard the following materials for the performance of the various emergency repairs as described herein and as directed by the Engineer:

Material	Quantity
High Early Strength Cement Patch Mix (as specified in Subsection 923.47) with at least one year shelf life, to yield 1.5 C.Y. Each	4 Each
Epoxy tie wire	1 Case
#5 Epoxy Coated Reinforcement Bars (25 ft. Length)	100 Each
#6 Epoxy Coated Reinforcement Bars (20 ft. Length)	50 Each
High Performance Permanent Cold Patch	10 Tons

At the end of the project all unused materials with remaining shelf life of 1 year or more shall be delivered to the Authority's Maintenance Yard at the Herbertsville Maintenance Facility, (MP 94) as directed and after review and acceptance by the Engineer. Materials not accepted will be disposed of by the Contractor.

All materials to be removed as part of the Emergency and Routine Roadway and Bridge Repairs work shall become the property of the Contractor and shall be properly disposed of by him off Authority property unless otherwise authorized in writing by the Engineer or otherwise directed to be salvaged.

532.02 Materials

Materials to be used shall be as specified in Subsections 302.02, 417.02, 503.02 and 510.02 or as directed by the Engineer.

532.03 Methods of Construction

Methods of Construction to be used shall be as specified in Sections 302, 305, 417, 503, and 510 or as directed by the Engineer.

532.04 Measurement

Force Account for Emergency and Routine Roadway and Bridge Repairs provides for a value of reimbursement to the Contractor for costs measured on a Cost Plus basis for the time and material used in accordance with Subsection 108.04.

Measurement for Lane Closings for the performance of Emergency and Routine Roadway and Bridge Repairs, installed by the Contractor's forces will be made on a Cost Plus basis for the time and material used in accordance with Subsection 108.04.

Measurement for Concrete Repair Material will be made on a Cost Plus basis for the material furnished and delivered to the designated locations identified in Paragraphs 532.01 (A).

532.05 Payment

Payment will be made under:

PAY ITEM ..... ***PAY UNIT***

FORCE ACCOUNT FOR EMERGENCY AND ROUTINE ROADWAY AND BRIDGE REPAIRS (NO BID)..... USD

The Cost Plus payment shall include Emergency and Routine Roadway and Bridge Repairs, Lane Closings for emergency and routine repairs, and Concrete Repair Material delivered to the Contractor's staging area as specified above.

Payment for work under Force Account for Emergency and Routine Roadway and Bridge Repairs will be made on a Cost Plus basis in accordance with Subsection 108.04.

SECTION 533 – THERMOPLASTIC RUMBLE STRIPS

533.01 Description

This work shall consist of the installation of four (4) inch wide white rumble strips using thermoplastic material.

533.02 Materials

The material shall conform to the physical and chemical requirements of AASHTO M 249.

533.03 Equipment

The equipment shall be capable of providing continuous mixing and agitation of the material. The parts of the equipment conveying the material between the main reservoir and the shaping die shall be constructed to prevent accumulation and clogging. The parts of the equipment which come in contact with the material shall be easily accessible for cleaning and maintenance. The mixing and conveying parts and the shaping dies or spray gun shall be capable of maintaining the material at optimum plastic temperature. The equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. When applied by either method, the thickness of the material on the roadway surface shall be 1/8 to 3/16 inch maximum per pass. Multiple passes will be required to achieve the desired 1/4 inch plan thickness.

The kettle provided for melting and heating the thermoplastic material shall be equipped with an automatic thermostatic control device and heated by a controlled heat-transfer liquid rather than direct flame.

The heating kettle and applicator shall be equipped and arranged to meet the National Board of Fire Underwriters and State and Federal regulations.

The equipment shall be arranged to permit preheating of the roadway surface immediately prior to application of the thermoplastic material if preheating is recommended by the material manufacturer. The applicator shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

The applicator shall have the capacity to contain a minimum of 125 pounds of molten material. The use of a drag box is prohibited.

533.04 Method of Construction

Thermoplastic rumble strips shall be applied only on clean, dry surfaces having a surface temperature above 50 degrees F. Dirt, debris, loose particles and heavy oil residues shall be removed from surface areas immediately prior to the application of the markings as recommend by the manufacturer.

The marking material shall be heated uniformly and applied at a temperature, between 412.5 and 425 degrees F, that will provide best adhesion to the roadway surface. Binder and pigment shall be dispersed uniformly when applied to roadway surfaces.

533.05 Measurement

Thermoplastic rumble strips will be measured by the linear foot based on a four (4) inch width of stripe at a thickness of 1/4 inch. Separate measurement will not be made for multiple passes.

533.06 Payment

Payment will be made under:

PAY ITEM	*PAY UNIT*
THERMOPLASTIC RUMBLE STRIPS	LINEAR FOOT

SECTION 534 – TRENCHLESS INSTALLATION OF UNDERGROUND FACILITIES

534.01 Description

This work shall include furnishing all labor, equipment, tools, materials, and design services necessary to install the underground facilities shown on the plans, covered in this specification, or as otherwise required to construct a fully functional watertight facility to the limits shown on the Plans.

This work shall also include where applicable, installing driving shafts, intermediate shafts and receiving shafts, advancing casing, excavation, dewatering, placement of embankment, Vibration and Displacement Monitoring, Contact Grouting, Backfill Grouting, and all other labor, equipment, or materials required to complete the work detailed in accordance with the Plans and Specifications, or as directed by the Engineer.

The design and installation of facilities owned by entities other than the Authority shall be solely the responsibility of the Contractor and shall be in accordance with the current editions of the AASHTO LRFD Bridge Design and Construction Specifications with Interims, except as noted otherwise herein. The design, including all Shop Drawings and calculations, shall be in accordance with the current Authority Design Manual, and shall be signed and sealed by a Professional Engineer licensed in the State of New Jersey.

One of the following methods, Auger Boring, Pipe Jacking, Microtunneling, Horizontal Directional Drilling, Pipe Ramming, or Utility Tunneling shall be proposed in the submittals required herein. Alternative methods, including, but not limited to slurry boring, and soil compaction, will not be allowed.

534.02 Definitions

For the purposes of allocation of responsibilities only within this specification, the following definitions shall apply:

Auger Boring	shall refer to a technique where a horizontal bore hole is created by means of a rotating cutting head. Spoils are transported by helical-wound auger flights rotating inside a steel casing that is being installed by the Principal of Pipe Jacking.
Backfill Grouting	shall be defined as placing grout to fill the annular space between the Casing Pipe and the Carrier Pipe.
Casing Pipe or Casing	shall be defined as a pipe which is installed for the purpose of stabilizing an excavation.
Carrier Pipe	is defined as pipe which is installed inside of casing pipe to house the utility.
Closed Shield	shall be a shield which incorporates a closed pressure chamber and does not allow direct access to the face.
Contact Grouting	shall be defined as injecting grout to fill the annular space between the Casing Pipe and the excavated ground to ensure contact between the Casing Pipe and the ground.
Driving Shaft	shall be an excavation constructed for initiating the advancement of a casing as part of a trenchless technology operation.
Engineer	shall be defined in paragraph 101.02B.
Engineer of Record	shall be defined as the Professional Engineer licensed in New Jersey, responsible for the preparation of the Contract Documents or License to Cross.

Horizontal Directional Drilling	shall be defined as a multi-stage process that consists of drilling a small diameter pilot hole along a predetermined path. The pilot hole is then developed into a suitable bore hole that will accommodate the desired facility which is ultimately pulled back through the developed alignment. Horizontal Directional Drilling is sub classified into mini-HDD (Carrier Pipe Diameter 2 – 10 inches), midi-HDD (Carrier Pipe Diameter 10 – 24 inches), and maxi-HDD (Carrier Pipe Diameter 24 to 48 inches).
Intermediate Shaft	shall be defined as a shaft constructed between the driving shaft and receiving shaft to overcome resistance associated with longer length trenchless installations or to accommodate changes in direction along the alignment.
License to Cross	shall be defined as a legal document that grants permission to outside parties (i.e. utility owners) to impact Authority property.
Microtunneling	shall be defined as a remote controlled guided Pipe Jacking process that provides continuous support to the excavation face.
Open Shield	shall be a shield which allows direct access to the face or a point immediately behind the cutters. It does not include provisions for a pressure-balance of the heading.
Pipe Jacking	shall be defined as pipe that is advanced using the Principals of Pipe Jacking, horizontally through the ground.
Pipe Ramming	shall be defined as a non-steerable system of forming a bore by driving an open-ended steel casing using a percussion hammer from a driving shaft to a receiving shaft. The soil may be removed from the casing by auguring, jet-cutting, or compressed air. In some instances a closed end pipe may be used.
Principle of Pipe Jacking	shall be defined as the use of hydraulic rams to push pipe sections along a controlled excavated alignment formed by a cutting head or shield. The principle of pipe jacking applies to Auger Boring, Microtunneling, and to the Pipe Jacking method itself.
Receiving Shaft	shall be an excavation constructed at the termination point of a trenchless installation.
Shop Drawings	shall refer to the plans submitted by the Contractor.
Trenchless Methods or Trenchless Installations	shall be defined herein as Auger Boring, Pipe Jacking, Microtunneling, Horizontal Directional Drilling, Pipe Ramming, and Utility Tunneling.
Utility Tunneling	shall be defined as a process in which an access excavation is installed to allow workers located at the face of the tunnel to remove the encountered material while inside a protective shield such as liner plates are installed. As the workers continue to dig, the shield is hydraulically thrust forward from the liner plates behind it. When the shield is completely advanced, the hydraulic cylinders are retracted and additional liner plates are installed. The excavation can be accomplished manually or mechanically.

534.03 Materials

(A) General

All materials and appurtenances shall, at a minimum, be selected and sized to accommodate installation forces, drilling fluid pressures, hydrostatic and earth pressures, surcharge loads, permanent loads, facility type, and site specific conditions.

Materials shall be suitably wrapped, packaged, or covered at the factory or shop for protection against dirt, water, oil, grease, and damage. Materials stored at the site shall be placed above ground on a well-supported platform and covered.

(B) Materials

Materials shall conform to the following Sections and Subsections:

Temporary Sheeting 415

Casing Pipes 924.01

Carrier Pipes 924.02

FILLER MATERIALS.....924.03

All pipeline casing shall be furnished with standoffs which center and adequately support the carrier pipeline within the casing, and with link seals and casing end seals manufactured specifically for this purpose.

534.04 Methods Of Construction.

(A) CONTRACTOR'S RESPONSIBILITY.

The Contractor shall bear full responsibility for the methods employed and for any damage incurred while performing the work. Under no circumstances shall the flow of traffic be disturbed during the performance of work. Should the performance of the work result in any damages that impede the regular flow of traffic, the Contractor shall incur a "traffic disruption penalty" by the Authority, charged by the hour until the damages are repaired and regular traffic flow is restored. The "traffic disruption penalty" shall be charged at a predetermined amount specified in the Contract Documents, which shall be in addition to the cost of repairing the damages.

(B) SAFETY.

Safety shall be the sole responsibility of the Contractor. Prior to the commencement of work, the Contractor shall provide a Health and Safety Plan (HASP) and place and/or install safety, precautionary, and protective devices and services required to safely perform the work. The Contractor shall work continuously, as permitted in the HASP, whenever there is a condition which is likely to endanger the excavation or surrounding structures until the hazardous condition is eliminated and the safety of the work is restored.

(C) MAINTENANCE AND PROTECTION OF TRAFFIC.

If shoulder closings are required by the Shop Drawings or Contract Drawings, such closings shall be installed in accordance with the Authority's *Manual for Traffic Control in Work Zones,* the Standard Drawings, and the Standard Specifications Division 800.

(D) PROTECTION OF ADJACENT STRUCTURES AND UTILITIES.

The Contractor shall take protective measures as detailed in the Site Specific Workplan (SSWP) to ensure adjacent bridges, roadway, and appurtenances, including all below grade utilities are protected at all times during construction. Any items damaged in the course of work shall be corrected to the satisfaction of the Engineer and at no additional cost to the Authority.

Displacement and Vibration Monitoring shall be performed in accordance with Section 214.

(E) QUALIFICATIONS.

The Contractor shall provide a statement of qualifications for proposed personnel and/or subcontractors regularly engaged in trenchless installations who have successfully installed casing pipe on at least four projects in the past ten (10) years, of similar length, diameter, and complexity to those shown on the Contract Drawing, via the Contractor's proposed trenchless method. Experience shall be relevant to the anticipated subsurface materials, groundwater conditions, and any special construction techniques required. The statement of qualifications shall clearly list completed projects with details of the types of installations, names of personnel directly performing the work, owner contact names, and telephone numbers.

The Contractor shall provide details of experience of the supervisory personnel in charge of daily operations indicating a minimum of five (5) years of work experience on at least five (5) projects in the execution of similar work. The supervisor shall be present at the site during performance of all Work.

The Contractor shall provide details of experience of the operator(s) of the tunneling equipment, with a minimum of five (5) years of work experience on at least three (3) projects in the execution of similar work.

The Contractor's specialist performing Ground Penetrating Radar (GPR) or other approved geophysical methods shall have minimum of five (5) years of work experience on at least three (3) projects in the execution of similar work.

(F) SUBMITTALS.

The Contractor shall submit a minimum of 30 calendar days prior to the start of trenchless installation, Shop Drawings and a Site Specific Work Plan (SSWP) describing, in detail and with supporting

calculations, the proposed means and method for the installation, for the review of the Engineer. The submittal shall be signed and sealed by a registered Professional Engineer licensed in New Jersey routinely engaged in the design of trenchless installations. The submittal shall include, but is not limited to, the following:

Item	Description
Geotechnical Data	Boring location plan
	Soil boring logs for a minimum three borings along the facility alignment. If the trenchless installation is greater than 150', one additional boring for every 50' of length greater than 150' is required.
	Subsurface profiles and/or cross sections with groundwater levels indicated
	Laboratory and in-situ testing results
Calculations and Analysis	Relevant loads including earth pressure, water pressure, thrust, drag, live load surcharge
	Sacrificial steel thickness, corrosion resistant coating type and thickness, and abrasion loss assumptions for casing materials
	Complete structural and geotechnical design computations
	Assessment of drilling fluid migration.
	Anticipated heave or subsidence and mitigation proposed if necessary.
Shop Drawings	Diameter and Material Properties of Casing and/or Pipe
	Horizontal and vertical alignment depicting all existing features.
	Type of shaft (i.e. steel sheeting, solider pile and lagging, sloped)
	Tip elevations of shaft walls
	Staging areas, storage areas, cuttings and pit spoil-handling areas
	The layout and design of the driving shaft and receiving shaft, including construction method of the shafts.
	Details of muck removal system.
	Details of bentonite injection system (if applicable).
	Details of intermediate jacking system (if applicable).
	Details of the Contractor's experience as required herein.
	A detailed description of means and methods of installation with trenchless technologies, including equipment model numbers and manufacturer's specifications, access and preconstruction activities.
	The steering and tracking capabilities method for checking the alignment and grade and provide documentation from the manufacturer that these capabilities can install the casing to the design line and grade within the specified tolerance.
	Method to detect over-excavation at the heading and action plans to control over-excavation.
SSWP	Description of mixing, introducing, managing, and disposing of bentonite or polymer slurry as a lubricant, if applicable.
	Dewatering details and procedures, anticipated volumes of water to be dewatered, zone of influence of dewatering, the anticipated settlement caused by dewatering, and methods for surface subsidence or heave mitigation.
	Contingencies for obstruction removal or penetration.
	A description of casing and carrier pipe connections/joints. Also include a method to maintain the carrier pipe centered in the casing pipe and if grouting of the annular space will be required.
	Shaft construction details and procedures and sequence of construction.
	Soil stabilization methods to create entry and exit blocks at the portal walls of the shafts, to stabilize the base of the shaft excavations, and to support pipe runs. QA/QC methods to confirm that soil stabilization was effective.
	A description of the proposed equipment and procedures for mixing and placing grout and/or CLSM
	Manufactures' specifications of all materials to be installed for the approval of the Engineer, at least 7 days prior to the placement of the material. Materials Safety Data Sheets (MSDS) for all materials must also be provided.
	Construction schedule showing each activity name, date, and duration.
	List safety procedures to be followed as required by the Health and Safety Plan. List emergency telephone numbers for local police and fire department, rescue squads, and additional telephone numbers that may be required by the Engineer.
	Required construction permits
	Soil and water storage and disposal plan

Item	Description
	Submittals as described in Section 214.
	Void Remediation Plan including means, methods, equipment, materials and MPT Plans
	Methods for Contact Grouting and Backfill Grouting if required, including mix design, grouting pressure, equipment

If modifications to the pipe installation method are required during construction to accommodate field conditions, the Contractor shall submit revisions to the above listed documents delineating the modifications and including the reasons for the changes.

Work shall not commence until the Engineer approves the above listed submittals.

Upon successful completion of the work, the Contractor shall submit As-Built Drawings and or Installation Records.

(G) Additional Subsurface Investigation.

The Contractor shall interpret the available geotechnical data for adequacy and applicability and perform additional investigation at their own expense if deemed necessary.

(H) Cover Depth Requirements.

A minimum cover of the greater of 6 feet or two casing diameters below the bottom of asphalt at the lowest elevation along the facilities alignment shall be provided for all methods except for Horizontal Directional Drilling, which shall require a minimum cover of 10 feet or five casing diameters for midi-HDD and maxi-HDD and a minimum cover of 6 feet or eight casing diameters for mini-HDD, whichever is greater.

(I) Tolerances.

The Contractor shall maintain the line and grade of the Casing Pipe in accordance with the Shop Drawings. The final position of the Casing Pipe shall not vary from line and grade by more than 1 inch in 40 feet with the exception that the pipe shall be free draining in the direction of flow shown on the plans and be without any reverse sloping where water can collect.

The Contractor shall install Carrier Pipe within the Casing Pipe to the tolerance specified on the Shop Drawings.

(J) Schedule.

After trenchless installation begins, the operation must proceed continuously until completed, unless otherwise approved by the Authority.

(K) Preparation for Work.

The Contractor shall implement, when applicable, the site dewatering procedures, as specified in the certified SSWP. Dewatering activities shall not impose settlement in excess of that accounted for in the Contractor's approved submittals. Delays, additional equipment, or additional labor resulting from the presence of water, snow, ice, or the pumping of water shall not be considered for additional compensation or extension of time.

Ground Improvement required to stabilize ground or required to perform the work, including delays, additional equipment, materials, and labor associated with ground improvement shall take place in accordance with the SSWP and at no additional cost to the Authority.

(L) Driving, Intermediate, and Receiving Shafts.

Temporary sheeting used to construct driving, intermediate or receiving shafts shall conform to Section 415. Driven Piles or Drilled Shafts used to construct solider pile lagging wall shall be in accordance with Division 400. Driving, intermediate, or receiving shafts shall be offset from the edge of pavement a minimum distance equal to 1.5 times the depth of the shaft. All excavated areas are to be illuminated and fenced to provide fall protection.

Surplus and waste materials are to be disposed of off Authority property in accordance with Section 202. Excavation and backfilling of the shafts shall conform to Division 200. Embankment material and compaction criteria shall be as specified on the Contract Drawings. Unless otherwise specified on the Contract Plans, Embankment Grade A shall be used and shall be compacted to meet the requirements provided in Section 203.

(M)EQUIPMENT.

The equipment used shall be as proposed in the Shop Drawings and SSWP.

(1) Tunnel Shield.

Tunnel Shields shall include means to secure the heading in event of unstable ground or a work stoppage, include means to accommodate obstructions at the heading (e.g., rubble backfill from original construction, etc.), and shall be compatible with anticipated ground and groundwater conditions.

(2) Guidance and Control System.

The Contractor shall continually monitor the alignment and grade of the Casing Pipe. Necessary controls shall be provided to ensure proper horizontal and vertical alignment. The alignment shall be verified at any time at the request of the Engineer.

The guidance system shall be capable of generating a plot of the borehole survey showing depths of the installed piping along its entire length and proposed pipe depth. Depths shown on the plot of the borehole survey shall be accurate to 1/10 of a foot. The guidance system shall have an inclination accuracy of 0.01 % of grade, a range of 1/10 of a foot, an azimuth repeatability of 0.1 % of grade and a range of 1/10 of a foot. The Contractor shall measure the repeatability of the inclination/azimuth before drilling commences.

Survey and measurement of alignment and grade shall be the sole responsibility of the Contractor and at no additional cost to the Authority.

(3) Spoil Removal System.

Spoil removal equipment shall be as proposed in the certified SSWP, and be based on ground and groundwater conditions.

(4) Bentonite Injection System.

The use of bentonite or polymer slurry to lubricate the outside of the casing to reduce driving forces will only be allowed upon approval by the Engineer. Bentonite injection system equipment shall be as proposed in the certified SSWP.

(N) JACKING OPERATION.

After approval of the Shop Drawings and written procedures, the Contractor shall notify the Engineer a minimum of 7 working days prior to the start of the installation of the pipe by a trenchless method.

The use of hand-mining ahead of the pipe shall be evaluated on a project specific basis depending on the soil conditions and shall require approval by the Authority. Should hand-mining be permitted, the excavation shall not extend more than 18 inches beyond the end of the pipe or as specified by the Authority.

Bracing and backstops shall be designed and jacks of sufficient rating shall be used so that the jacking can be progressed without stoppage (except for adding lengths of pipe) until the leading edge of the pipe has reached the receiving shaft.

The operation shall provide means to control the face throughout the entire installation process, including stoppage to remove obstruction, and to prevent any raveling of the ground within the jacked pipe or casing. Grout and/or dewater the soil as required to mitigate against instability. Grouting shall not unduly hinder subsequent excavation and/or jacking operations.

(O) HORIZONTAL DIRECTIONAL DRILLING METHOD.

Throughout the insertion process, the Contractor shall constantly measure and record axial tension force readings on the pipe material, the insertion velocity, the mud flow circulation, the exit rates, and the length of pipe installed.

Drilling fluid shall be a mixture of water and Bentonite clay, or other approved mixture. Disposal of excess drilling fluid and spoils shall be the responsibility of the Contractor. Excess drilling fluid and spoils shall be disposed at a location approved by the Engineer.

Drilling fluid returns caused by fracturing of formations at locations other than the entry and exit points shall not be permitted unless approved by the Engineer. The Contractor shall immediately clean up any drilling fluid that is exposed through fractures.

The Contractor must provide a detailed Fracture Mitigation (frac-out) plan, including method of monitoring quantity and capturing return of drilling fluids with particular attention to variation from proposed plan.

The sizing of the pilot hole reamed to facilitate the insertion of the specified casing pipe shall be minimized to maximize support for the pipe. The casing pipe sleeve being pulled into the pilot tunnel shall be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation.

(P) PIPE RAMMING.

The use of Pipe Ramming shall be evaluated on a project specific basis and shall only be allowed when approved by the Authority.

The use of pipe ramming shall only be permitted on drives of 100 feet or less. Drives shall always begin from the upstream side of the crossing to ensure the flow line of the pipe is in the correct flow direction as shown on the Contract Drawings since gravitational forces will force the pipe to drift downward slightly during the pipe ramming process. Closed face pipe ramming shall not be permitted.

The type of casing and conduit shall be limited to steel pipe. A drivability analysis of the pipe shall be performed to ensure that the steel grade and pipe wall thickness is adequate to overcome driving stresses and that a large enough hammer is supplied to advance the pipe the entire length of the drive.

Vibration and displacement monitoring shall be performed on any existing or proposed structures, pavements, railroads, earth slopes, utilities, phased construction elements, etc., or any other potential vulnerabilities within the project limits in accordance with Section 214 during the pipe ramming process.

If Pipe Ramming is approved for an individual project, the Contractor shall submit Shop Drawings, driveability analysis, vibration and displacement monitoring plan, and written procedures to the Engineer a minimum of 30 calendar days prior to the start of the installation of the pipe by a trenchless method.

(Q) UTILITY TUNNELING.

The use of Utility Tunneling shall be evaluated on a project specific basis and shall only be allowed when approved by the Authority.

A laser monitoring system shall be utilized to achieve steering control during tunnel advancement. A theodolite shall be utilized in conjunction with the laser monitoring system to provide redundancy of the measurements. For curved tunneling applications, a gyroscope shall be utilized.

As the cutting face is excavated and the tunneling shield is advanced, a tunnel lining system shall be installed immediately behind the cutting face or the tail of the tunnel shield. The tunnel lining system shall be comprised of prefabricated steel or reinforced concrete plates/segments. The plates/segments shall be provided with flanged edges and precast holes such that they may be bolted together to form an integrated liner system. The use of steel rib and wood lagging systems shall not be permitted

The plates/segments shall be provided with prefabricated grout application holes such that the annular space between the ground and the outside of the plate/segment can be grouted. The Contractor shall grout the first 10 feet of tunnel liner immediately after placement and allow a minimum of 24 hours before continuing the excavation such that there is a sufficient amount of partially cured plates/segments grouted in place to jack against as the cutting face is advanced. The subsequent plates/segments shall be grouted in place no later than 24 hours from their time of placement or when they are a minimum of 10 feet from the leading edge of the newly placed plates/segments where the tunnel shield jacks are applied, whichever is earlier.

(R) CONNECTIONS.

All welding shall be performed in accordance with Subsection 403.06 of the Standard Specifications.

Ends of pipes shall be sealed with a flexible material prior to grouting of the annular space between the casing pipe and the carrier pipe to prevent grout loss.

For instances where multiple utilities are to be installed in the casing, the Carrier Pipes shall be placed within the casing such that they are electrically insulated from each other.

All other connections shall satisfy the requirements of Subsection 923.46 and be performed in accordance with the certified SSWP.

(S) OBSTRUCTIONS.

In the event that an obstruction is encountered, the approved contingency plan included in the SSWP shall be implemented to remove it. In the event that an obstruction or other condition prevents the completed installation, the casing shall be abandoned, a concrete plug shall be installed at the leading end of the Casing Pipe and the remaining void shall be filled with Backfill Grout using tremie methods or as approved by the Engineer. Removal of the casing shall not be permitted. No additional payment will be made for abandonment of the casing or for additional attempts.

(T) SETTLEMENT AND HEAVE.

If during work an uncontrolled cutting face or unacceptable settlement or heave is experienced, trenchless installation work shall be stopped immediately. The Contractor shall notify the Engineer immediately and proceed with the contingency plan provided in the SSWP if applicable, or propose a new contingency plan if necessary for review and approval by the Engineer. The magnitude of settlement or heave deemed unacceptable shall be stated in the SSWP and accepted by the Engineer. Final values shall be at the sole discretion of the Engineer.

(U) BACKFILL GROUTING.

Backfill Grouting or placing of CLSM in the annular space between casing pipe and carrier pipe shall be required, unless the annular distance between the casing pipe and carrier pipe is less than 2 inches, or unless the casing is seamless. CLSM shall be tremied in place or pressure grouted in place, and shall extend from the driving shaft to the receiving shaft, for the entire annular space. CLSM shall be pumped continuously until full return of CLSM has occurred.

In the event that the drill hole must be abandoned before completion of the installation, fill the abandoned drill hole with CLSM to prevent subsidence. The abandonment and subsequent attempts of trenchless installation shall be performed at no additional cost to the Authority.

(V) CONTACT GROUTING.

Contact Grouting shall be performed if at any point around the outside of the Casing Pipe a void greater than 3 inches. The Contractor shall inject grout to fill the annular space between the pipe and the excavated ground to ensure contact between the Casing Pipe and the excavated ground.

(W) INVESTIGATION AND REMEDIATION OF VOIDS.

To assess whether the installation of the subject facility compromised the integrity of the subgrade and to determine if voids were created outside of the casing by the operation, Ground Penetrating Radar (GPR) or other approved geophysical methods shall be performed below facilities as the Engineer deems necessary. Any voids created outside of the casing pipe shall be filled in accordance with a method approved by the Engineer submitted in the SSWP for void remediation.

If voids are identified, void remediation shall be performed as described herein. The effectiveness of the remediation shall be confirmed through post remediation investigation of voids to confirm the condition identified has been repaired. If the voids have not been filled a revised Void Remediation Plan shall be submitted and approved by the Engineer, void remediation shall be performed, and investigation of voids shall be re-performed until the voids have been filled. This work shall be done at no additional cost and shall be performed with minimized impact to traffic.

(X) SITE RESTORATION.

The work area shall be restored to its original condition upon completion of the installation subject to inspection and acceptance by the Engineer. Adjacent trees and shrubs shall be protected from damage during the progression of work unless explicitly denoted as to be removed in the certified SSWP.

Driving, Intermediate, and Receiving Shafts shall be dismantled and backfilled in accordance with approved submittals. The site shall be repaired and restored to its condition before being disturbed by construction activities at no additional cost.

534.05 Measurement.

Trenchless Installation of Underground Facilities, including furnishing of approved personnel, methods, materials, and equipment shall be measured on a linear feet basis for the total length of installed casing pipe, measured to the nearest foot.

Driving, Intermediate, and Receiving shafts shall not be measured for payment.

534.06 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
_____ INCH TRENCHLESS INSTALLATION	LINEAR FOOT

Payment shall be made in accordance with the following schedule:

10% Paid Upon Approval of the SSWP.

30% Paid Upon Completion of Installation of Driving, Intermediate, and Receiving Shafts

40% Paid Upon Completion of Trenchless Installation.

20% Retained until GPR is Performed without Voids.

Payment for Installation of Facilities with Trenchless Technologies will be made at the contract unit price bid per linear foot for pipe satisfactorily installed, and shall include, but is not limited to, compensation for providing all materials, equipment, operators, mechanics, laborers, and other personnel, tools, and incidental items necessary to complete the installation of driving, intermediate, and receiving shafts, the utility, and decommissioning/backfilling of launching and receiving shafts.

No separate payment shall be made for design services, mobilization, excavation, backfill, restoration of existing work area, construction and restoration of the jacking and receiving shafts, disposal of spoil and fluids, dewatering, obstruction drilling, contact grouting, backfill grouting, GPR, maintenance and protection of traffic, grouting to limit groundwater inflows into the shafts and to prevent basal instability, or demobilization. These items will be considered incidental to the Trenchless Installation of Underground Facilities, and shall be included in the unit price for Trenchless Installation of Underground Facilities. The bid price and payment made shall include all wear and tear, maintenance repair and replacement and all tools required in connection with each installation.

DIVISION - 600 ELECTRICAL

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SECTION 601 - COMMON ELECTRICAL PROVISIONS

601.01 Description.

Work under this Section covers general electrical equipment, installations, and electrical construction methods common to all Authority facilities. Included are conduits, boxes, manholes, bases, foundations, cables and terminations, grounding, testing, and other associated work for the above. Also included are removing existing electrical equipment and providing connections to new utility services and utility coordination.

Work under this Section also includes providing temporary facilities as required to maintain continuity of illumination, power, and/or communications systems. Included are furnishing and installing temporary cables and ground wire, reinstalling existing cables and ground wire, reconstruction of junction boxes, and resetting junction box frames and cover.

The nature and extent of electrical work within and adjacent to each work area, as indicated on the Plans are based on the best available information. However, no guarantees are made as to the accuracy or completeness of this information. The Contractor is hereby advised that it shall be his responsibility to verify such information and obtain the approval of the Engineer before proceeding with the work in each work area.

601.02 Materials.

Materials shall conform to the following Sections and Subsections:

ALUMINUM HARDWARE	911.01
ANCHOR BOLTS	909.02
BONDING AND GROUNDING DEVICES	918.02
CABLE CONNECTORS	918.04
CABLE DUCTS	918.05
CABLE RACKS	918.06
CABLE AND WIRE	918.07
COARSE AGGREGATE	902.05
CONCRETE FOR DUCT BANK ENCASEMENT	905 (CLASS C)
CONDUIT AND FITTINGS	918.08
DIRECTIONAL DRILLED PIPE SLEEVES	918.36
ELECTRICAL TAPES	918.10
HDPE CONDUITS AND INNERDUCTS	918.35
JUNCTION BOX FRAMES AND COVERS	909.04; 918.17
METALLIC JUNCTION BOXES	918.17
POLYMER CONCRETE JUNCTION BOX	918.47
RODENT BLOCKING	918.46

Portland cement concrete in boxes, bases, manholes, and foundations shall be Class C, meeting the requirements of Section 401.

601.03 General Conditions.

The following shall apply:

(A) CODES AND STANDARDS.

Electrical materials, construction, and installation shall conform to the requirements of the National Electrical Code (National Fire Protection Association Publication 70, latest version adopted by the New Jersey Department of Community Affairs, Division of Codes and Standards), and shall also conform to the requirements of all Federal and State laws and regulations governing such installations. Where these

requirements do not govern and where not otherwise specified, electrical equipment shall conform to the standardization rules of the Institute of Electrical and Electronics Engineers.

The Contractor shall obtain a Certificate of Inspection from the Department of Community Affairs, or a Certified Electrical Inspector, in accordance with the State Uniform Construction Code for all electrical installations which, require service connections by the Utility Company or other work which, may be required by the Engineer, a minimum of fifteen days in advance of the actual service connections to be made by the utility company.

(B) UNIFORMITY AND QUALITY OF COMPONENTS.

All new major items of electrical equipment throughout shall be the product of the same manufacturer, in order to obtain single responsibility and satisfactory service.

Materials, equipment, and workmanship shall be of the best quality and free from all defects. Any material not specifically covered in these specifications shall be in accordance with accepted standards, such as NEMA, UL and NEC. During the progress of the work, any materials, equipment, or installations which are deemed unsatisfactory by the Engineer shall be removed and replaced at no cost to the Authority.

(C) COMPLIANCE WITH PLANS.

Diagrammatic drawings shall be followed as closely as actual conditions at the site and the work of the other contractors and trades will permit. As the work progresses, these drawings may be revised or supplemented by the Engineer to further illustrate the work.

Approximate locations of various existing and newly installed underground facilities, within the vicinity of the Contractor's work are generally shown on the Plans. However, no guarantees are made to the accuracy or completeness of such information. The Contractor shall be responsible for locating all such facilities before proceeding with the work. When excavating or trenching in these areas, the Contractor shall employ hand excavation to avoid damaging these facilities. Any damage caused by the Contractor to existing facilities shall be repaired to the satisfaction of the Engineer by the Contractor at no cost to the Authority.

(D) CONTINUITY OF ILLUMINATION, COMMUNICATION, AND POWER .

In areas that are currently illuminated, or scheduled for illumination as a part of the Project, it is essential that all roadways, toll plazas and service areas, which are open to vehicular traffic, and illuminated signs required to guide that vehicular traffic, have illumination at all times during the hours of darkness and fog conditions by means of existing or new permanent or temporary roadway lighting facilities as indicated on the Plans or as directed.

The Contractor shall provide temporary power distribution equipment, including conduits and wires, as required to re-feed existing services, from the new/upgraded services. Where the proposed service Voltage differs from the existing, the Contractor shall provide transformers or other means to keep the existing system operational during construction of the proposed ITS power systems.

In areas that contain power distribution systems serving, area lighting, ITS or other devices, it is essential that these power distribution remain operational at all times, unless approved in advance by the Authority.

In areas that contain communications or networking systems, it is essential that these communications and networking circuits remain operational at all times, unless approved in advance by the Authority. If generators are provided, they shall have a fuel capacity that is capable of providing power for the maximum connected load for a minimum of 24 hours. The Contractor shall be responsible for refueling all portable generators in order to maintain generators in continuous operation. Portable generators shall not be utilized at any location for more than 20 consecutive days. Maintenance of service during construction is a sole responsibility of the Contractor at all times and shall be performed at no additional cost to the Authority.

Traffic signals required to control vehicular traffic shall remain operable at all times unless otherwise specified.

The Contractor shall schedule and coordinate his work with other Contractors to enable the above mentioned electrical facilities to be in full operation.

(E) SHOP DRAWINGS.

Shop drawings in the form of working drawings, catalog cuts and specifications for all electrical materials and equipment shall be submitted by the Contractor in accordance with the requirements in Subsection 104.08 and approved by the Engineer before the order is issued for their purchase or manufacture.

Items for which shop drawings and catalog cuts shall be submitted shall include but not be limited to the following:

- Conduits (all types), fittings, support devices and hardware
- Multiple Lightingcable, service wire, fiber-optic cable, and other cables and wire
- Cable and wire splicing, termination and identification materials
- Ground wire and grounding devices.
- Cable Connector Kits
- Bonding Devices
- Grounding and Termination Devices
- Temporary Support Systems where required
- Metallic and Nonmetallic Junction Boxes and Pull Boxes
- Temporary Electrical Provisions
- Power Distribution Equipment (i.e. panelboards, contactors, wireways, etc.)
- Electrical Cabinets and Mounting hardware
- Switches, photocells, and other wiring devices
- Structural Modifications to Mount Electrical Equipment
- Scaled drawings of each cabinet with equipment shown inside
- Wiring and connection diagrams
- Engineering Calculations and design
- Cabinet and Electrical Equipment Foundations showing conduit locations, mounting bolt locations, reinforcement, concrete class, and other materials
- Scaled working drawings of electrical installations cast within concrete showing all conduits, boxes, fittings, grounding, and hardware
- Luminaires
- Lighting Standards and other Structural hardware to mount lighting standards and luminaires.
- Should deviations from the details shown on the Plans be required, the Contractor shall make all necessary design modifications and obtain the approval of the Engineer prior to construction through the Shop Drawing process.

(F) CONNECTION WITH UTILITY SERVICES.

Underground conduits and electric service cables shall be extended from a building, meter cabinet, manhole or junction box to the service point designated on the Plans. Sufficient lengths of cable for extension to the utility service shall be supplied in accordance with the requirements of the utility company and subject to its approval. The installation from this point to the utility service and connections thereof will be made by the utility company.

The utility company shall be notified and all required applications for inspection shall be completed. The location of the service conduit and meter within the meter cabinet shall be verified with the utility company.

The meter socket will be provided by the utility company or shall be supplied as required by the utility company's regulations. The dimensions of the socket and meter shall be verified to assure proper installation in the cabinet and conformance with utility company requirements.

The service conduit shall be located and installed in accordance with the utility company requirements. The Contractor shall comply with all utility company requirements for service installations, including electric meter, disconnect, and current transformer and cabinet, where required. The Contractor shall perform coordination with the Authority, obtain all utility and third-party inspections and approvals, and perform work as shown on the Plans to obtain connection by the utility. It shall be the Contractor's responsibility to obtain utility service connections in a timely manner in accordance with the required construction schedule. Any delay(s) in obtaining the approval(s) shall not be considered as the basis for additional compensation. Rather, the Contractor shall factor into his bid the necessary work to complete utility coordination at the appropriate stage during construction.

(G) REMOVAL OF EXISTING ELECTRICAL FACILITIES.

Various electrical facilities and associated installations, which are no longer in service or are not required to be relocated and reused, shall be removed, abandoned in place, demolished, or salvaged as required, as delineated on the Plans. Removal of all equipment, materials, and installations shall be as outlined below:

(1) All underground installations which are no longer in service shall be demolished or removed and disposed of from the site. On a case-by-case basis (as approved by the Engineer) or where explicitly shown on the Plans as "abandon in place", underground electrical installations may be abandoned in place, if they do not interfere with the new construction..

(2) Where portions of underground conduits are required to remain in service and be connected to new facilities, the existing cables shall be removed and reinstalled in the revised conduits if called for on the Plans, otherwise they shall be removed and disposed of from the site.

(3) Existing foundations, concrete bases and junction boxes, which are approved to be abandoned in place, shall be removed to a depth of one foot below finished grade. Should any of these items interfere with the installation of a new facility, it shall be completely removed, as specified in Section 202.

(4) All items to be removed and salvaged for the Authority, as delineated on the Plans or as prescribed elsewhere, shall be carefully removed, stockpiled, and transported to the Authority's designated storage yard, unloaded and stored as directed by the Engineer.

Items shall be removed in a manner satisfactory to the Engineer to obtain the items in the best possible condition, and all such items so removed shall be delivered to the Authority as prescribed. Any items to be salvaged, but damaged by the Contractor during the removal or transporting operations, shall be replaced with new and equivalent items at the expense of the Contractor.

The Contractor shall obtain fully itemized receipts from The Authority. The receipts shall be cosigned by the Engineer.

(5) Where items are to be removed and relocated, damaged items shall be replaced in accordance with (4) above.

Unless otherwise indicated on the Plans, lighting standard assemblies shall be relocated complete with lighting standard shaft, bracket arm(s), transformer base or shoe base, luminaire(s), parapet mounting brackets for bridge mounted units, and remote ballast(s) for series lighting system. New mounting hardware shall be provided.

The precast boxes, manholes, foundations, and bases for lighting standards shall be removed complete with frame and cover, cable rack assemblies, pulling irons, embedded conduits and anchor bolt assemblies, as applicable, and shall be reinstalled as prescribed for new similar items, including new grounding devices.

Cabinets and items of equipment shall be removed and modified where called for on the Plans. Reinstallation shall be as prescribed for new items.

(6) The Contractor shall perform all work related to the revisions to various circuitry, including disconnecting and reconnecting cables, revising phase connections, and all required identification.

(7) Where luminaire numbers are revised due to relocation of existing lighting standard assemblies, provide new pole tags at no additional cost.

(H) LOCATION OF EXISTING UNDERGROUND CABLES AND WIRES.

The Contractor shall locate all existing underground electrical and communications cables, including fiber optic cables, and wires within the limits of the Contract in accordance with Subsection 106.18.

In the event electrical or communications cables are damaged by the Contractor, and the damage is discovered during the day, the Contractor will be notified and given the opportunity to repair the damaged cable with his workforce and/or subcontractor. The Contractor will be given up to four hours to respond to damaged communications facilities, and any damaged electrical cable must be repaired prior to nightfall. If the Contractor chooses not to respond, or is unable to make the repair within this timeframe, the Authority's Maintenance Department will be called out and the Contractor will be billed a $1,000 call-out charge, as well as all labor, material, equipment and overhead expenses incurred by the Authority's Maintenance Department to make the necessary repairs.

If cable damage is discovered during non-working hours or after the Contractor has left the site, the Authority's Maintenance Department will be called immediately to make all repairs and to bring all circuits back in service. If the Engineer determines that the Contractor has caused this damage, the Contractor will be billed for a $1,000 call-out charge, as well as all labor, materials, equipment and overhead costs incurred by the Authority's Maintenance Department to make the necessary repairs. In the case of cable damage being discovered after the Contractor's work hours, the Contractor will not be given the opportunity to make repairs and in these cases, all repairs will be made by the Authority and costs will be reimbursed by the Contractor, where appropriate.

(I) ELECTRICAL SHUT DOWN PROCEDURES.

Shutdown of Authority electrical power will be performed by the Authority's electricians.

To arrange for a shutdown, the Contractor shall obtain approval from the Authority's Electrical Maintenance Department, through the Engineer, to disconnect the electric service for the required circuits, prior to the commencement of any work, either directly related to or within the close proximity of the existing electrical facilities. The Contractor is responsible for "Tagging-Out" all circuits he will be working with, and following all safety codes adopted by the Authority or other agencies having jurisdiction. At the end of the outage, the Contractor is to remove his tag and restore the circuit. The Authority will not remove a Contractor's "Tag". The Contractor will be responsible to restore service. In the case of lighting circuits, the circuit restoration shall be performed prior to darkness. In the case of other power circuits, the circuit restoration shall be performed at least one hour in advance of the scheduled end of shutdown.

Shutdowns are available Monday through Friday, excluding holidays from 9:00 AM to 3:00 PM with 24-hour advance notice to the appropriate Electrical Foreman. For safety purposes, the Contractor or Engineer shall witness each shutdown. Arrangements between the Contractor, Engineer and Electrical Foreman shall be coordinated to re-energize the shutdown circuits, all circuits should be re-energized as soon as possible after 3:00 PM, such that they can be tested for proper operation prior to darkness. If circuits are energized late, Authority overtime may be incurred. Shutdowns outside this time frame will be performed solely at the Authority's discretion, and shall be arranged on a case-by-case basis through Contractor coordination with the Engineer.

In the event a scheduled shutdown is canceled, the appropriate Electrical Foreman must be notified immediately.

(J) EXISTING SYSTEMS.

Existing power distribution systems, where present within the limits of the Contract, operate at various Voltages and configurations (single- and three-phase), as shown on the Plans. The roadway, power distribution, and sign lighting systems are typically of 2400V Class for series lighting circuits and/or 120V, 208V, 240V, 277V, 480V, or 600V Class for the multiple circuits, although other system types may be as shown on the Plans. All required electrical work must be performed in an approved manner and in accordance with the standard procedure for the class of Voltage.

601.04 Excavation and Backfill.

Excavation and backfill for foundations, boxes, manholes, bases, conduits, cable ducts, and other appurtenances, shall be constructed in accordance with Section 206 and the following.

Hand excavation shall be employed in areas where underground conduits or other subsurface structures are to be installed adjacent to existing underground facilities which are to remain. Prior to commencing any excavation operation, the Contractor shall obtain all available as-built data from the Engineer pertaining to such location. Any damage caused by the Contractor to these facilities shall be repaired, or the facility replaced at his own expense, to the satisfaction of the Engineer.

The excavation for precast units shall be carefully made no larger than necessary. The bottom of excavation shall be thoroughly tamped, and the units shall bed evenly on the bottom of excavation. Precast units shall be

placed at the same time as the conduit is laid. Fill adjacent to drains shall consist of not less than two cubic feet of approved gravel or crushed stone.

Careful attention shall be given to the grading and leveling of the bottom of the trench and to the selection and placing of backfill material. If muck material should be encountered at the bottom of the trench, the Contractor shall remove such material to the depth ordered by the Engineer and backfill with suitable material as specified below. Underground nonmetallic conduits and/or cable ducts shall not be covered prior to the inspection and approval of the Engineer.

Backfill placed around directly buried nonmetallic conduits or cable ducts shall be clean moist sand or soil, free of stones, rocks, or other foreign material to a point twelve inches above the top of the raceway and shall be carefully hand-tamped to a compacted condition in layers of four inch thickness. Backfilling in grassed areas shall also include fertilizing and seeding, as required.

Directly buried nonmetallic conduits or cable ducts shall rest upon a compacted cushion four inches thick of the same material, as specified for backfilling in the preceding paragraph.

Unless otherwise directed by the Engineer, suitable excavated material shall be used for backfilling trenches of metallic conduits.

Trenching for conduit will be permitted only for such daily distances for which the Contractor can install the conduit and backfill on the same day. Should a conduit installation not extend from one terminus point to the next at the end of the workday, the conduit shall be capped.

Where conduits are to be placed beneath existing pavement, they shall be installed by directional drill or jacking unless open trench operations are called for on the Plans.

Where directional drill or jacking is called for, excavations for pits shall be kept a minimum of four feet from the edge of pavement. The Contractor shall submit details of his proposed equipment and procedures for review and work shall not commence until said submission is acceptable to the Engineer.

Where open trench operations are called for, the initial cut in the pavement shall be made by means of saw-cutting to a depth of not less than two inches. The trench width shall be kept to a minimum. Upon completion of the conduit installation, the trench shall be backfilled, compacted, and the pavement patched and restored to its original condition, as indicated on the Plans and as approved by the Engineer. The Contractor shall use extreme care in cutting and excavating the existing pavement to avoid damaging pavement to remain.

Where directional drilled methods are used for installation of conduits/sleeves, follow the additional requirements noted below in Subsection 601.05.

601.05 Conduit.

Conduit shall be of the following types:

- Flexible Metallic
- Rigid Metallic (Hot-Dipped Galvanized Steel or Aluminum)
- Rigid Non-metallic
- PVC-Coated Galvanized Steel
- HDPE Conduits (installed using directional drilling methods only)

All underground conduits shall be installed at the prescribed locations, as shown on the Plans or as directed by the Engineer, after the grading has been completed and preferably prior to the placing of berm surfacing or topsoil, seeding, landscaping, and guard rail installations.

Underground conduit shall be laid with its centerline not less than thirty (30) inches below the finished grade unless specified otherwise on the Plans, or directed by the Engineer. Where installed under concrete slabs or pavements, this distance shall be permitted to be reduced to twenty-four (24) inches. Conduit runs shall be pitched 1/8 inch to the foot to drain to boxes or manholes; if this is not practical, then pitched to drainage tees which shall be provided at low points of conduit runs. Two cubic feet of crushed stone or gravel shall be placed around all drains for underground conduits. Openings for conduit entering boxes or manholes shall be completely sealed around the conduit with Portland cement mortar.

Where more than one conduit is required to be installed in the same location, the conduits shall be placed in a common trench.

All rigid conduits shall be supplied in lengths of ten feet or longer.

A nylon cord with at least five hundred pound tensile strength shall be furnished and installed in all empty conduits installed as spares or for future use.

When underground conduits are dead-ended for future use, the Contractor shall terminate the conduit with a cap and identify the location in a manner as shown on the Plans or as directed by the Engineer if a method is not called out in the Plans..

Conduit bends and offsets shall be avoided wherever possible; where necessary, they shall be made by cold bending by approved methods and equipment. The use of a pipe tee or vise for bending conduit will not be permitted. Conduit which has been crushed or in any way deformed shall be discarded. Bends made in the field shall be of long radius, free from kinks, and of such curvature as to permit pulling conductors without damage to the conductors, jacket, or insulation. The sum of all bends between any two outlets shall not exceed two hundred-seventy degrees. The radius of curvature of a field bend shall be not less than ten times the inside diameter of the conduit, unless otherwise shown on the Plans or approved by the Engineer. Bends made in the field shall not be installed unless approved by the Engineer.

Where existing cast-in-place conduit is to remain and be reconnected to new conduit, the end of the existing conduit at the face of concrete removal shall be cut square and smooth. Enough concrete around the conduit to remain shall be carefully hand chiseled to permit the installation of a coupling-adaptor to connect the existing conduit to the new conduit. During work, the Contractor shall exercise utmost care so as not to damage any existing conduit(s) embedded in concrete.

Conduits shall be maintained free of dirt or other foreign or objectionable material. Ends of conduits shall be closed with caps, plugs, or discs placed under the bushings until the cables and/or wires are installed.

All conduits entering signs and cabinets shall be sealed with rodent blocking material after installation of all wires and cabling.

(A) INSTALLATION METHODS.

In order to eliminate adverse effects created by dissimilar metal connections, the following installation methods shall be used:

(1) Apply an approved anti-oxidant compound on threads and between dissimilar metals to provide electrical continuity and prevent corrosion.

(2) Connection between aluminum and steel conduits shall be made with a stainless steel coupling.

(3) Where aluminum conduit is to be connected to a steel or cast iron junction box, enclosure or conduit fitting, a stainless steel coupling and a short galvanized steel nipple shall be used.

(4) Where steel conduit is to be connected to an aluminum junction box, enclosure or conduit fitting, a stainless steel coupling and a short aluminum nipple shall be used.

Where nonmetallic duct bank or conduits are placed but no metallic cables are shown on the Plans for installation (i.e. duct bank is for fiber optic cable or future use), a tracer wire shall be installed inside one conduit of each set of parallel conduits to aid in future conduit location. The tracer wire shall be fourteen (14) gauge minimum solid THWN copper with thermoplastic insulation. At least four (4) feet of slack tracer wire, properly labeled shall be present at every junction box location where the conduit is accessible.

The Contractor shall provide expansion/deflection fittings at points of potential movement between conduits, at lengths of long conduit runs in accordance with conduit-manufacturer instructions, and where shown on Plans. Installation of the expansion/deflection fittings shall be made in accordance with the manufacturer's installation instructions and the Authority`s standard electrical drawings, and in all cases the fittings provided shall be able to accommodate the maximum potential movement between the two conduit sections. The Contractor shall ensure that the conduit entering the fitting at the expansion-contraction end is completely free of any concrete or other obstruction within the open joint which may otherwise prevent the fittings from performing properly. Where existing expansion/deflection fittings are shown to remain, but are judged to be nonfunctional (in the opinion of the Engineer) the Contractor shall replace such expansion couplings with new fittings as part of the work.

(B) DAMAGE CREDITS.

Should any conduits be damaged during work or any deteriorated conduits found (as determined by the Engineer) the damaged or deteriorated portion of the conduit(s) shall be replaced as follows.

(1) Existing cables and ground wire in the conduit shall be disconnected at both ends, removed, reinstalled, and connected in order to provide temporary service as prescribed in Subsection 601.07.

(2) The damaged or deteriorated section of the conduit shall be removed and replaced.

(3) New cables shall be pulled into the conduit, and terminations made.

Conduit(s) damaged by the Contractor's operation during work shall be repaired by replacement of the damaged section(s) of the conduits to the satisfaction of the Engineer. Upon completion of the conduit repair work, each conduit run shall be rodded throughout its entire length with a mandrel in conformance with Subsection 601.07, and new cables and ground wire shall be installed between the junction boxes connected by the repaired conduit run(s). All costs for the prescribed conduit repairs and new cable and ground wire installation shall be borne by the Contractor at no additional cost to the Authority.

(C) FLEXIBLE METALLIC CONDUIT.

Flexible metallic conduit shall be used only in exposed locations and only where specifically called for on the Plans. Flexible metallic conduit shall not be installed in any location where a rigid conduit can be installed.

Length of flexible metallic conduit sections, where approved for use or shown in Plans, shall be no longer than 6 feet. Two sections of flexible metallic conduit shall not be connected together.

If connected to PVC coated galvanized conduit, the color of flexible metallic conduit shall match that of the connecting coated conduit. Color shall be integral to the flexible metallic conduit, and shall not be applied in the field by use of paint or other methods.

(D) RIGID METALLIC CONDUIT.

Rigid metallic conduits (hot-dipped galvanized steel and aluminum) shall be used in all exposed above ground installations, except where flexible and PVC coated galvanized conduits are called for, and as further prescribed hereinafter.

Galvanized steel conduit shall be used for exposed conduit installation where the conduit is fastened to either steel structural members or concrete surfaces (pay item noted as “on structures”); unless otherwise noted where the conduit is encased in or embedded in concrete; for short underground runs where specifically called for on the Plans; and for the conduit installations by means of jacking operations.

Aluminum conduit shall be used only for exposed conduit installations where the conduit is fastened to aluminum tubular or other structural members. The aluminum conduit shall be transitioned to a conduit of another type once no longer required. Aluminum conduit shall not be attached to concrete surfaces.

The ends of each length of conduit shall be reamed to ensure that the interior is free of obstructions and burrs prior to installation in couplings or threaded fittings. When exposed metallic conduits cannot be joined with standard couplings, union type couplings shall be used. Conduit shall be installed so as to be continuous and watertight between outlets.

Where conduit is cut and field threaded, apply an approved cold-galvanizing zinc compound to prevent corrosion prior to installation of coupling fitting.

Conduit runs shall have a minimum of couplings permitted by standard conduit lengths. Conduit sections shall be connected to each other with threaded couplings and ends abutting each other squarely inside the couplings or fittings. Running threads will not be permitted.

Rigid metallic conduits less than ten feet long encased in concrete shall be of continuous lengths with bends having the prescribed radius. Conduit bends shall be inspected and approved by the Engineer before being used. Ends of conduit bends shall be threaded, cleaned, capped, and shall remain capped until placed in service.

Metallic conduits entering sheet metal boxes or enclosures, unless otherwise approved by the Engineer, shall be connected thereto with Myers-type waterproof conduit hubs. Conduit shall be installed so as to preclude water draining from the conduit from damaging the electrical components. Conduit penetrations shall not be installed on the top side of the panels or junction boxes for boxes located where they can be potentially exposed to inclement weather or water. Metallic conduits terminating in concrete boxes or manholes shall extend two inches beyond the inside face of the box or manhole wall, and shall be terminated with a grounding bushing.

Expansion fittings, complete with copper bonding strap, shall be installed at all open expansion joints.

Exposed conduits shall be fastened to concrete surfaces and structural members by means of conduit clamps and clamp-backs or conduit supports and U-bolts, as shown on the Plans or directed by the Engineer, spaced not more than five feet apart, and shall be installed parallel or perpendicular to structural

members, walls, or intersections of vertical planes with right angle turns of cast metal fittings of symmetrical bends, except as approved or shown otherwise by design details.

Attachment of supports or clamp and clamp-backs for conduits, fittings, and equipment to concrete surfaces shall be made by the installation of an expansion type anchor. Conduits shall be fastened to concrete surfaces by means of approved clamps and clamp-backs.

Conduits shall be fastened to the structural members by means of conduit supports and U-bolts, as detailed on the Plans, spaced not more than five feet apart.

Extension of existing metallic conduits, where noted on the Plans, shall be installed by removing the designated sections of conduits from the nearest coupling points or upon removal of the boxes or manholes, as approved by the Engineer.

(E) RIGID NONMETALLIC CONDUIT.

Rigid Nonmetallic Conduit shall be used for all underground installations unless rigid metallic conduit is called for on the Plans. Unless otherwise specifically called for, Schedule 80 PVC conduit shall be used for installation under pavements, and Schedule 40 PVC conduit shall be used in all other locations.

Where noted on the Plans, Rigid Nonmetallic Conduit shall be permitted to be encased in or embedded in concrete (pay item noted as "on structures"). Where encased in concrete, PVC conduit shall be Schedule 80.

Generally, bends in rigid nonmetallic conduits shall be made with manufactured fittings. Field bends, where required and approved by the Engineer, shall be made with an approved flameless heater.

No repairs will be permitted to any rigid nonmetallic conduit or fitting. All broken, chipped, cracked, or impaired length or fittings shall be removed and replaced with approved new material.

Where rigid nonmetallic conduit is to be joined to an existing installation or to rigid metallic conduit, a suitable and approved type adaptor shall be used.

Conduits shall be laid up to a uniform grade and invert with each length brought home to a full even bearing in the socket before the next length is laid.

Nonmetallic conduit sections shall be connected by means of bell ends or socket type couplings made up tightly with conduit ends abutting and sealed with a solvent cement recommended by the conduit manufacturer. End of conduits cut in the field shall be deburred properly and all sharp edges removed, before they are installed in couplings or fittings.

Termination of conduits at each box or manhole shall be made by means of standard end bell fittings. End bell fittings shall be installed flush with the inside face of the boxes or manholes and sealed around the fittings with neat cement mortar.

(F) PVC COATED GALVANIZED STEEL CONDUIT.

PVC coated galvanized steel conduit shall be used for exposed conduit installation as noted on the Plans. Toll Plaza Tunnel ceiling slab, gasoline/Diesel dispensing islands, navigation lighting; etc., are samples of required applications.

Installations of PVC Coated Galvanized Steel Conduit shall conform to the construction methods detailed in Paragraph 601.05(B) for Rigid Metallic Conduit. In addition to these requirements, the Contractor shall be certified by the manufacturer of the particular PVC Coated Galvanized Steel conduit being used on the project. Submit proof of certification as a shop drawing prior to performing any conduit work. The Contractor shall use all special tools, materials, and methods prescribed by the manufacturer. Conduit sections with damage to the PVC coating shall be removed and replaced at no cost to the Authority. It will not be acceptable to use a paint-on repair coating in lieu of replacing damaged conduit.

Where PVC Coated Galvanized Steel Conduit is provided, all couplings, fittings, and boxes attached shall be PVC Coated malleable iron, made by the same manufacturer of the conduit. The only exception to this requirement is boxes larger than 6"x6", which will be permitted to be fabricated of stainless steel.

PVC coated galvanized steel conduit shall be provided where underground conduits of other types sweep up to connect to above-ground cabinets or equipment. Transition from the underground conduit material to PVC-coated galvanized steel conduit at a location that is a minimum of 30 inches below grade. All conduit sections located closer to grade than 30 inches, including the portion that exits grade and becomes exposed, shall be PVC-coated galvanized steel.

(G) DUCT BANK, SOIL AND CONCRETE ENCASED.

Duct banks shall be installed underground at the locations shown on the Plans. Duct banks shall either be encased in concrete or directly buried, as shown on the details. Materials and installation methods for the conduits shall be as prescribed in this Subsection for the type of conduit used.

Duct spacers shall be provided as shown on the Plans to maintain an even spacing of the conduits during concrete encasement or backfilling operations. Duct spacers shall be prefabricated out of high impact Polystyrene.

Ducts with concrete encasement shall have concrete around the ducts as shown on the Plans. Ducts with no concrete envelope shall be backfilled in accordance with Division 200.

(H) DUCT BANK, HDPE CONDUITS - DIRECTIONAL DRILLED.

This work shall consist of the installation of HDPE conduits under existing embankments or paved roadways using the horizontal directional drilled (HDD) method. Duct banks, installed using the Horizontal Directional Drilled (HDD) method, shall be utilized to install conduits under active roadways and pavements to minimize damage and downtime to Authority facilities. Duct banks may include a combination of sleeves, conduits, and inner-ducts.

The work shall include installation of:

- HDPE pipe sleeves (size as per Plans) for runs of multiple parallel conduits
- HDPE conduits within pipe sleeves and
- HDPE innerducts within the communications conduits, where specified and/or shown on the Plans.

See Plans for cross-sectional views and installation details for the various types of directional-drilled duct banks.

Directional Drilled Duct Banks shall be installed according to the following:

(1) Alternate Methods.

Approval for an alternate method, other than directional drilling, may be sought by the Contractor at no additional cost, provided it provides no additional impacts to the surface, pavements, etc. The Contractor shall submit a detailed construction plan for the alternate method to the Engineer for review and approval. If such approval is granted (at the sole discretion of the Authority) and the alternate method does not provide the desired results, use of such alternate method shall be discontinued and installation shall be completed by the directional drilled method at no additional cost to the Authority.

(2) Experience Requirements.

Prior to the submission of bids, the Contractor or his subcontractor shall have completed the installation of at least 5,000 feet of directional-drilled piping on similar projects. Field supervisory personnel employed by the Contractor or his subcontractor shall have both the necessary experience and manufacturer training in the operation of the directional drilling equipment proposed to be used in the performance of the work.

The Contractor shall submit documentation showing conformance with the experience requirements. Information shall include, but not be limited to, date and duration of work, location, project information, (i.e., name, address, telephone number, contact person).

The Contractor shall also submit a list of field supervisory personnel and their experience with directional drilling operations for review and approval. At least one approved field supervisor listed must be at the site and be responsible for all work at all times when directional drilling operations are in progress.

(3) Shop Drawing Submittals.

Before directional drilling work may commence, the Contractor shall submit for approval, the specific details of the sleeve pipe, conduit, innerducts, and separators proposed for installation. This will include, but not be limited to, size, capacity and setup requirements of equipment, location and site of drilling and receiving points or pits, if necessary, and method of monitoring and controlling line and grade. If the Contractor determines that modifications to the method and equipment as stated in the

original submittals are necessary, the Contractor will submit details of and reasons for such modifications.

Also, the Contractor shall submit information pertaining to the following drilling materials: Material Safety Data Sheets (MSDS) sheets, any necessary safety precautions or procedures, and proposed methods of removing spoils.

Drilling operations shall not interfere with, interrupt or endanger either surface or subsurface developments. The Contractor shall comply with all applicable jurisdictional codes and OSHA requirements.

In the event the Contractor deems it necessary to obtain additional information to proceed with the work, they shall obtain additional subsurface information as needed. Costs associated with this effort shall be the exclusive responsibility of the Contractor. Furthermore, the Contractor shall not make any claims for additional compensation for additional work made necessary as a result of existing subsurface conditions.

When available, the Authority will provide soil-boring logs near the location of the proposed work. If available, these logs are included as an appendix to these specifications. In the event the Contractor deems it necessary to obtain additional information to proceed with the work, they shall obtain additional subsurface information as needed. Costs associated with this effort shall be the exclusive responsibility of the Contractor. Furthermore, the Contractor shall not make any claims for additional compensation for additional work made necessary as a result of existing subsurface conditions.

The Contractor shall submit a "frac-out" contingency plan which provides specific procedures and steps to contain the inadvertent release of drilling mud ("frac-out") used during installation of sleeve pipe utilizing HDD.

(4) Drilling Equipment.

The drilling equipment shall be specifically designed to create a bore hole then ream the hole to the diameter necessary for the simultaneous insertion of the sleeve pipe. Sleeve pipes and/or conduits shall be installed at the locations and grades as designated on the Plans.

The drilling equipment shall be capable of placing the specified sleeve/conduit at the planned line and grade without inverted slopes or deflection in accordance with these Specifications. The equipment must be capable of pulling the sleeve/conduit from either the downstream or upstream pull box location. The number of pits shall be kept to a minimum. The equipment must be capable of boring the specified lengths, from pull box to pull box, in a single bore.

Since sleeve/conduit wall thickness and type selection is dependent upon equipment pullback force, the proposal and approval of the use of equipment with a pullback rating greater than the maximum pullback force specified may invalidate the proposed piping. The Contractor shall be responsible to monitor the force and ensure the approved pulling tensions, as submitted in the Shop Drawings, are not exceeded. Any sleeves/conduits installed using methods that exceed the pulling tension shall be filled and abandoned in place. New sleeves/conduits shall be installed at no cost to the Authority.

Throughout the insertion process, the Contractor shall constantly measure and record axial tension force readings on the pipe material, the insertion velocity, the mud flow circulation and exit rates and the length of pipe installed. Furthermore, the equipment shall have a guidance system that has the capability of measuring inclination and azimuth. The guidance system shall have an independent means of ensuring the accuracy of the installation. The Contractor shall demonstrate a viable method to eliminate accumulated error due to the inclinometer (pitch or accelerometer). The guidance system shall be capable of generating a plot of the borehole survey showing depths of the installed piping along its entire length. The scale of the plot of the borehole survey shall be the same as that shown on the project profile sheets. Depths shown on the plot of the borehole survey shall be accurate to 1/10 of a foot. The guidance system shall have an inclination accuracy of 0.01 % of grade, a range of 1/10 of a foot, an azimuth repeatability of 0.1 % of grade and a range of 1/10 of a foot.

The Contractor shall measure the repeatability of the inclination/azimuth before drilling commences.

(5) Drilling Fluid.

Drilling fluid shall be a mixture of water and Bentonite clay. Information regarding use of any other proposed drilling fluids shall be submitted to the Engineer for approval at least two (2) weeks before beginning drilling operations.

Disposal of excess drilling fluid and spoils shall be the responsibility of the Contractor. Excess drilling fluid and spoils shall be disposed at a location approved by the Engineer.

Drilling fluid returns caused by fracturing of formations at locations other than the entry and exit points shall be minimized. The Contractor shall immediately clean up any drilling fluid that is exposed through fractures.

The Contractor shall be responsible for making provisions for a clean water supply for the mixing of drilling fluid.

(6) Site Set-up.

Equipment set-up shall be determined by the Contractor and submitted to the Engineer per the requirements as stated in this Section. The entry angle of the pilot hole and the boring process shall maintain a curvature that does not exceed the allowable bending radii of the product pipe per the piping manufacturer. The set-up shall account for pipe bending in the vertical and horizontal directions, as well as the set-up and spacing needed for the butt-fusion process.

(7) Safety.

At the location of the work, the Contractor shall be solely responsible for the safety of all parties.

The drilling equipment shall have an alarm system capable of detecting electrical current.

(8) Directional Drilling Methods.

Directional drilling shall conform to the following methods and submittal requirements pertaining to the installation of sleeves/conduits under existing embankments and paved roadways of the New Jersey Turnpike Authority:

(a) The minimum allowable cover under roadways is 6 feet at the center of the roadway measured between the top of sleeves/conduits to top of pavement. Minimum cover under ditches is 3 feet measured from top of sleeve or conduit to invert of ditch. Pretreatment of soils or other soil stabilization techniques intended to reduce the minimum cover shall be approved by the Engineer.

(b) Sending and receiving pits will not be allowed closer than 10 feet from the outer edge of the paved shoulder. Pits located between 10 to 30 feet from the outer edge of the paved shoulder shall be sheeted, braced, and shored in accordance to calculations and drawings provided by the Contractor. . Sending and receiving pits located beyond 30 feet from the outer edge of paved shoulders may have un-sheeted sides provided a 1 to 1 slope can be maintained in accordance with the latest OSHA standards. In this case, the front face of the pit must be sheeted. In all cases, the pit shall be designed to maintain the stability of the embankment and to provide for proper operation of the drilling equipment. End sections of sleeves or pipes which are damaged during installation shall be replaced without additional compensation. Excavated material shall be placed on the side of the pit facing traffic to provide additional protection. Surplus and waste materials are to be disposed off Authority property in accordance with Section 206.

(c) When pits are located between 10 and 30 feet from the outer edge of paved shoulder, a standard shoulder closing shall be required for the duration of the operation. In addition, a minimum of 30 feet of temporary concrete barrier is required in accordance with Turnpike standard drawings and in accordance with Division 800 of the Specifications. If the pit is constructed behind existing guard rail which meets current standards, temporary concrete barrier curb is not required. Pits located beyond 30 feet from the roadway require neither a shoulder closing nor temporary concrete barrier.

(d) It is the Contractor's responsibility to continually monitor the line and grade of the sleeve or pipe to detect abnormal horizontal and/or vertical movements. Necessary controls shall be provided to ensure proper horizontal and vertical alignment. The alignment shall be verified at any time at the request of the Engineer.

(e) Entry or exit points shall not be installed in roadway medians unless shown on the Plans.

(f) Detailed drilling operations and equipment shall be submitted to the Authority or their authorized representative for approval. Work is not to start before receipt of required approval.

(g) All work areas must be enclosed with orange security fencing to maintain security and safety of the work site.

(h) Strapping shall be stainless steel.

(i) Show cross section along proposed bore within Authority ROW.

(j) Detail means and methods to be used to ensure line and grade of pipe sleeve.

(k) Once pipe sleeve is advanced from the point of entry and is within 10' of roadway edge of pavement all work shall be continuous until sleeve/conduit is advanced to at least 10' beyond the roadway far edge of pavement.

(l) During boring operations, roadway shall be monitored for settlement and /or heave along the line of bore.

(m) Excavation and backfilling of the sending and receiving pits shall conform to Section 206.

(n) In the event an obstruction or other condition prevents the completed installation, a concrete plug shall be installed at the end of the pipe or sleeve and the remaining void shall be filled in a manner approved by the Engineer. Removal or withdrawal of a drilled pipe, sleeve or casing will not be permitted.

(o) Delays and/or inconvenience resulting from the presence of water or the pumping of water shall not be considered for additional compensation or extension of time but shall be considered incidental to the pipe or sleeve being installed.

(p) All welding (for steel pipe sleeves) must be performed by a certified welder.

(q) The work area shall be restored to its original condition upon completion of the installation subject to inspection and acceptance by the Authority. Care should be taken to protect adjacent trees and shrubs from injury during the progression of work.

(r) Extend the sleeve at least 10 feet beyond the limits of roadway pavement.

(s) Provide a method to seal the ends of the sleeve after installation of conduits within the sleeve. The method used shall provide a watertight seal. Provide shop drawings detailing the methods prior to commencement of any directional drilling operations.

(9) Insertion of Sleeve/Conduit.

The Contractor shall follow the sleeve/conduit alignment as shown on the drawings and in accordance with the Specifications.

In the event of difficulties encountered during boring operations that require the withdrawal of the directional-drilling equipment from the pilot hole, the Contractor shall be allowed to withdraw and abandon the boring and begin a second attempt. With the approval of the Engineer, the Contractor may excavate at the point of the difficulty to correct problems. Unless otherwise directed by the Engineer, any unsuccessful attempts at performing the specified directional drill, including any sleeve/conduit installation, and any excavations performed by the Contractor to remove obstructions to the drilling process shall be made part of the Contract amount and shall not serve as basis for claims for additional compensation. The sleeve/conduit provided may vary by drilling location, and shall be designed specifically for each installation based on grades, soil type, drilled length, access limitations, and other site-specific constraints.

The Engineer shall be notified immediately if any obstruction is encountered that stops the forward progress of drilling operations. The Engineer shall review both the situation and the Contractor's assessment thereof and then determine the feasibility of continuing drilling operations. When it is determined that it is impossible to continue drilling operations, the Contractor will be allowed to abandon the completed portion in place, unless otherwise directed by the Engineer. Abandonment of installed sleeves and conduits shall be to the satisfaction of the Engineer. The Engineer shall determine the necessity of ordering an alternative construction method in place of horizontal directional drilling.

The sizing of the pilot hole reamed to facilitate the insertion of the specified sleeve/conduit shall be minimized to maximize support for the pipe. Reaming diameter shall not exceed 120% of the outside diameter of the sleeve/conduit being installed. The sleeve/conduit being pulled into the pilot tunnel shall be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation.

(10) Installation of Conduits.

Where the Plans show installation of conduits within sleeves, the Contractor shall install HDPE conduits within the pipe sleeve as shown on the Plans after the pipe sleeve has been installed and accepted by the Engineer. The conduits shall be continuous from one end of the pipe sleeve to the other.

The Contractor shall install three (3) 1¼" HDPE innerducts in each conduit noted on the Plans for communications use. Innerducts shall be supplied only in communications conduits within directional-drilled duct bank, and shall be supplied within the duct banks regardless of whether or not the conduits or innerducts are slated for use under this Contract.

The Contractor will allow sufficient lengths of HDPE conduit to extend past the sleeve termination point to allow for contraction. Pulled HDPE conduit shall be allowed forty-eight (48) hours of stabilization prior to making final terminations or connections.

601.06 Foundations, Boxes, Manholes and Bases.

Concrete junction boxes, junction box foundations, manholes (except incoming electric and telephone service manholes, which may be of cast-in-place construction), and lighting standard bases (except those units to be constructed integrally with bridge parapet or median barrier) shall be precast monolithically. Forms shall not be removed for twenty-four hours after the concrete is placed, and the box shall be kept moist for seven days after casting. Construction shall be in accordance with Section 401, using Class C concrete.

Two cubic feet of crushed stone or gravel shall be placed around all in-ground junction boxes for drainage.

Anchorages for lighting standards and junction boxes on bridge structures shall be constructed as a part of the structure, in accordance with Section 401.

Handling loops of 3/4 inch diameter steel rod shall be installed for all precast units. Units shall not be shipped to the job site, until the Engineer's approval has been obtained. Junction boxes and foundations shall not be lifted by using conduits or other holes in the precast unit that have not been specifically designed for lifting.

Size and location of conduit entrance holes for boxes and manholes, which are to be connected to existing conduits, may have to be modified in order to suit the field conditions. Prior to construction of these units, the Contractor shall survey and determine the exact termination of all such existing conduits and make the necessary provisions. The size and location of these modified conduit entrance holes, supplemented with the existing field conditions, shall be incorporated in the shop drawings and be subject to the Engineer's approval. If such modifications are required and not done prior to construction of precast units, it shall be the Contractor's responsibility to meet all field conditions.

All exposed outdoor junction boxes shall conform to NEMA Type 4x, 16 gauge Type 304 stainless steel, unless otherwise noted. Size shall be as shown on the Plans.

Where anchor bolt couplings are called for, threaded bolt studs shall be inserted in the couplings before concrete is placed in the forms. Threads of studs shall be cleaned and lubricated before insertion in the couplings.

Type C junction boxes shall be installed with the top (on the roadway side) flush with finished grade elevation. Whenever applicable, junction boxes shall be set to effect a straight line connection with runs of conduit raceways.

Junction box foundations and lighting standard bases shall be set, so that the centerline of the lighting standard will be located as called for on the Plans. Special attention shall be given to eliminate any interference with existing or proposed guard rail installations. Junction boxes and junction foundations are to be installed with a maximum pulling distance of 250 feet. Field exception must be approved by the Engineer.

For junction boxes that are cast as part of structures, place the frame and cover such that the cover will be flush with the final concrete surface upon removal of the concrete pour. Use temporary blocking material to maintain a void behind/under the frame and cover that will serve as the ultimate junction box. After stripping of concrete forms, remove temporary blocking material, and grind all surfaces of the concrete smooth to remove sharp edges that may damage wires installed within the box.

Where existing cast-in-place boxes and frames and covers are to be reconstructed, remove the frame and cover. Install a new frame and cover to meet the proposed elevation of the new concrete surface, where shown on the Plans and in conformance with the details shown on Standard Drawings and/or as directed by the Engineer.

Where approved by the Engineer or shown on the Plans, the existing frames and covers shall be salvaged and reused, with the following provisions.

(A) The bolt holes in the frame, which is to be reused, shall be retapped.

(B) The existing screws for covers shall be replaced with new matching stainless steel flat head screws.

(C) The existing gaskets between the frame and cover shall be replaced with new ⅛" thick neoprene gaskets.

The Contractor shall clean all existing boxes to remain and all boxes that have been reconstructed/reset prior to installation of new cables. All debris therein shall be removed to assure that the drain holes or pipes are thoroughly clear and free of any obstruction. This work shall be performed at no additional cost to the Authority.

Existing concrete junction boxes, junction box foundations and manholes requiring a greater than 6 inch adjustment to final grade shall be replaced.

Unless shown otherwise on the Plans, all composite junction boxes shall have a concrete apron installed. Installation of concrete aprons will be performed as part of the junction box work.

601.07 Cables and Wires.

Prior to the installation of cables, all new or existing conduits shall be rodded throughout their entire lengths with a mandrel which is 1/4 inch smaller in diameter than the conduit and two inches in length, and with a wire brush of the same diameter as the conduit. Any conduits installed under this Contract that fail the mandrel test (i.e. the mandrel will not pass through) shall be replaced at no cost to the Authority. Where existing conduits fail the mandrel test and as approved by the Engineer, the conduit shall be replaced prior to installation of cables.

The Contractor shall provide adequate equipment, satisfactory to the Engineer, for installation of cables and shall pull all cables through conduits in a manner which will not overstress or stretch any cable, and shall use precautions so as not to score, cut, twist, or damage the protective covering of the cable insulation. In the pulling of cables through conduits, where the strain on the cables is likely to prove excessive, the Contractor shall use an approved type lubricant recommended by the cable manufacturer for such application. Without exception, all cables in all boxes, transformer bases, and manholes shall be provided with a full loop of slack and shall be arranged in a neat and orderly manner.

Cable slack to be provided in various units shall be as follows:

TRANSFORMER BASES	4 FEET
UNDERGROUND JUNCTION BOXES	9 FEET
BRIDGE JUNCTION BOXES	6 FEET
ROADWAY LIGHTING MANHOLES	17 FEET
METALLIC BOXES AND EQUIPMENT ENCLOSURES	ONE FULL LOOP

Cables in junction boxes, junction box foundations, and manholes shall be neatly arranged and laced with nylon cable ties. Cables shall be supported on cable rack assemblies in all junction boxes, manholes, and junction box foundations.

Where two or more cables are to occupy the same conduit, they shall be drawn in together and kept parallel to each other by the use of a pulling head. Phase legs shall be arranged circumferentially and in sequence around the neutral cables.

(A) TEMPORARY CABLES.

In order to accommodate the temporary service requirements during construction, provide temporary cables as required and/or as shown on the Plans. The design of the temporary system, including selection of materials, conduits, mountings, and routings shall be the responsibility of the Contractor. All temporary systems shall be submitted as Shop Drawings and approved in advance of construction.

Where proposed cables tie into existing cables to remain, the length of existing cables between junction boxes which are located outside the limits of work shall be removed from the existing conduit. The cables and ground wire then shall be cut and spliced into new temporary cables in sufficient length to permit placement within the temporary conduit support system detailed in the Plans.

Where shown in the Plans, temporary cables may be installed outside bridge parapets during bridge reconstruction work. The cables shall be suspended outside the parapet alongside of the bridge within Schedule 40 PVC conduits. The Contractor shall secure, by methods approved by the Engineer, the PVC conduits containing the wires to the bridge, so as not to represent any hazard to the public or workmen or cause damage to the cables.

Upon completion of the conduit replacement operations, the Contractor shall install new power and ground cables. Use of existing cables shall be permitted for temporary power circuits only.

New cables and ground wire shall be installed in all replaced conduits, between junction boxes, as a result of damage caused by the Contractor's operations.

(B) INSTALLATION WITH EXISTING CABLE.

Where cable is required to be installed in existing conduits with existing cables therein, as indicated on the Plans, one or both of the following two installation methods shall be used at the option of the Contractor, unless otherwise directed by the Engineer.

(1) Alternate Method One.

(a) Existing cables shall be disconnected at both ends of each conduit run, and the insulation resistance of each cable shall be measured by means of an approved type megohm meter (megger). The megger readings shall be taken by the Contractor in the presence of the Engineer and shall be recorded. Any existing cable, measuring less than fifteen megohms, shall be replaced with a new cable of the same type and size, concurrently with the removal and reinstallation process. Payment will be made under the appropriate new cable item scheduled in the Proposal.

(b) The existing cables shall be test capped and pulled back to the adjoining junction box, manhole, or lighting standard transformer base and the existing conduit cleaned, using an approved device attached to the ends of existing cables and drawn through the conduit during the cable removal procedure. New and existing cables shall be installed together, as required, using an approved pulling head.

(c) All cables shall be re-meggered in the presence of the Engineer and recorded. Any existing cable measuring less than fifteen megohms and new cable, measuring less than one hundred fifty megohms after installation, shall be removed independent of others and replaced with a new cable, utilizing the existing cable as a drag wire, at no additional cost to the Authority. Existing cable connector kits shall be reused, unless otherwise directed by the Engineer. New screw-type terminal blocks shall be installed within existing cable connector kits, where necessary, to replace non-reusable crimp-type terminals. New cables shall be installed without splices for a minimum of two conduit lengths (alternate junction boxes, manholes or transformer bases). The Contractor may, at his option, install as many lengths without splices as is practical; but in all cases, a full loop of slack cable shall be provided and installed, as required at all junction points.

(2) Alternate Method Two.

(a) Same procedure as step (1) in Alternate Method One.

(b) The Contractor shall then utilize one of the existing cables as a drag wire to install an equal replacement cable together with new cables, as required. The cable designated for this purpose shall be selected by the Contractor in the presence of the Engineer, but in all cases, any existing cable with the lowest megohm reading shall be considered the primary candidate for replacement. An approved pulling head shall be utilized to install the cables, as prescribed. The existing cable used as a drag wire shall be disposed of by the Contractor.

(c) No separate payment will be made for furnishing and installing new cable for replacement of the existing cable used as a drag wire.

(d) Same procedure as step (c) in Alternate Method One.

The Contractor will be permitted, at his own option and expense to remove a lighting standard assembly to facilitate cable removal and reinstallation operations and reinstall the same immediately after completion of the required cable work.

601.08 Grounding.

All metal parts of the electrical system in the proximity of current-carrying conductors or equipment shall be adequately grounded and bonded in accordance with NEC, and as may be required by the utility company and as prescribed hereinafter.

Unless otherwise called for, all grounding shall be made with wires of the sizes indicated on the Plans.

A continuous equipment grounding conductor (ground cable) shall be provided in every conduit that contains power circuits. It will not be permissible to rely on metallic conduits to provide an effective path to ground. In the case of underground circuits, the ground cable shall connect to all ground rods installed in junction boxes, foundations, and manholes in order to provide a continuous bonded grounding system.

Ground wire terminal connections, except where otherwise specified, shall be made by means of tap bolts or through bolts with nuts, lock washers or locknuts, and approved types of ground lugs. Paint, rust, and scale shall be removed over the contact area and the contact face of the ground lug shall be thoroughly tinned or lead coated. The connection shall be made up as tightly as possible and any bare metal or paint undercoat remaining exposed shall be spot-painted to restore the surface with the same coating and number of coats, as applied to the adjacent metal.

In all precast boxes, foundations, and manholes, a ground rod shall be furnished and installed. The grounding bushings of metallic conduits terminating in these units, the metal frame of these units, and the metallic cable racks shall be bonded to the ground rod by means of ground wires.

In junction boxes on structures, all grounding bushings of metallic conduits terminating in these boxes, and the metal frames of these boxes, shall be bonded together by means of ground wires.

In addition, a positive grounding system throughout the bridge structures shall be achieved by installation of a continuous individual ground wire through each bridge conduit and junction box system, which shall be extended to the precast box or manhole beyond each end of the structure and connected to the ground rod therein. The continuous ground wire shall be a single piece between the ground rod connections for structures of nominal length. For long structures, the ground wire may be installed in sections, not less than one thousand feet each, unless otherwise approved or directed by the Engineer. Metallic conduits shall be bonded to all bridge structural steel that is capable of being energized by the electrical installations on the bridge.

Bridge mounted lighting standards shall be grounded as shown on the drawings.

For lighting standards adjacent to precast junction boxes or manholes or installed on junction box foundations, the ground wires shall be soldered to a grounding terminal bolted through the base plate of the transformer base, extended through the conduit and connected to the ground rod in the junction box, manhole, or junction box foundation as hereinafter described. For lighting standards installed on concrete bases, grounding shall be similar to that described above, except that an individual ground rod shall be provided for such lighting standards. Ground connection between the ground rod and grounding terminal shall be by means of a ground wire through the drainage grooves of the concrete lighting standard bases. All rigid metallic conduits, terminating with grounding bushings at the top of concrete bases, shall be bonded to the lighting standard grounding terminals.

All sign structures, roadway ramp gates, ITS equipment, cabinets, and other electrical devices, shall be properly grounded. Grounding shall be accomplished by extending a ground wire in the electric service conduit from the ground rod in the adjacent junction box to the grounding stud within the device, and making all necessary bonding connections thereto, unless otherwise indicated.

On sign structures that hold ITS and VMS installations, install exothermic (UFER-type) ground as shown on the Plans and bond to the sign structure and incoming ground wire.

The Contractor shall, in connecting sockets, enclosures, ballasts, and other equipment, connect the most accessible bare parts of each piece of equipment to the ground and/or grounded neutral. In order to ensure that this has been done, each piece of equipment shall be tested after installation, under the direction of the Engineer, with a test lamp, one leg of which has been connected to a definite ground, or by other approved means of testing.

At new services, install ground rods and bond other potential grounding electrodes (i.e. water pipes, building framing) as required by the National Electrical Code. Perform ground resistance testing as described below.

Impedance between ITS Devices (i.e. Variable Message Signs, Changeable Message Signs) and ground shall be no more than 10 Ohms when measured between the device and ground. Furnish and install additional ground rods/ground electrodes, add additional grounding equipment, and/or modify the system in order to obtain a

ground reading that is less than or equal to 10 Ohms when measured from the device. Ground resistance for services shall be no greater than 20 Ohms as measured at the primary ground rod. Furnish/install additional ground rods/ground electrodes, add additional grounding equipment, and/or modify the system to obtain a ground reading that is less than or equal to 20 Ohms at the service. No separate payment will be made for this work.

601.09 Testing.

Upon the completion of each wiring system and before any connection is made to operating equipment, it shall be the responsibility of the Contractor to perform, in the presence of the Engineer, the following tests of each new or revised circuit to determine whether the installations are in acceptable working order:

- Tests for continuity
- Tests for grounds
- Tests for insulation resistance between circuit conductors and from circuit conductors to ground.
- Tests for source and load Voltages
- Tests for fiber optic signal strength and reflections

Four copies of the above prescribed test results shall be submitted to the Engineer identifying the observed readings with respective circuits. The test results will be identified with the Project title, the date of the test, and the atmospheric conditions.

Separate payment will not be made for testing, repair, or replacement required under this Subsection.

(A) CONTINUITY TESTING.

Each circuit shall be tested for electrical continuity as per the manufacturer recommendation. Test results shall be submitted to the Engineer for approval prior to final termination.

(B) GROUND RESISTANCE TESTING.

Upon completion of the electrical system, the complete grounding system shall be tested for ground resistance with an earth test megger to ensure that the ground resistance, without chemical treatment or other artificial means, does not exceed twenty (20) Ohms unless otherwise specified. If the grounding system test does not show the required ground resistance, the Contractor shall notify the Engineer of the results and provide additional ground rods and conductors as per the code requirements to achieve the required resistance to ground. Testing equipment must be calibrated to the manufacturer`s requirements. Upon request, the Contractor shall provide documentation of the testing equipment`s most recent calibration.

(C) INSULATION RESISTANCE TESTING.

Upon completion of the electrical system with fuses removed and before energizing, the insulation shall be tested with an approved device for a period of five minutes, after which the insulation resistance shall not be less than one hundred fifty (150) megohms. Any cables that fail this test shall be replaced at no cost to the Authority.

The tests shall be performed on each system as a whole. The circuits will be complete, including all splicing and cable connections from the service equipment, to all the devices that it services.

(D) FUNCTIONAL TESTING.

With all equipment connected to the wiring system, a functional test shall be performed by the Contractor, in the presence of the Engineer at least five days in advance of its intended acceptance, to demonstrate that the system as a whole, and all parts thereof, function as specified or intended herein. Any defective materials or faulty or improper installation shall be permanently corrected by repairs or replacements, to be made by the Contractor to the satisfaction of the Engineer, and at the Contractor's own expense.

Lighting circuits shall be subjected to such other tests as may be required by the Engineer. All tests shall be performed at the expense of the Contractor in the presence of the Engineer.

601.10 Guarantee.

The Contractor shall be responsible for the proper performance in service, in whole and in part, to the satisfaction of the Authority, of the various electrical and incidental installations furnished and/or installed

(with the exceptions noted below for defective lamps) for a period of one year after the date of final acceptance of the work, to the extent that he shall correct at his own expense any difficulties with the operation which may arise during this period. Responsibility for such correction shall include the repair, readjustment, and replacement not only of defective parts, but of other parts, whether existing or installed by the Contractor which may be damaged thereby.

The Authority reserves the right to correct any such defect by its own means, and the Contractor hereby agrees to pay all the costs incurred by the Authority in correcting these defects. Notwithstanding the foregoing, the Contractor's responsibility for defective lamps shall be limited to the responsibility for damage to other components, which may be caused by such defective lamps furnished and installed by the Contractor, and shall not include the replacement of such lamps after final acceptance of the entire work under the Contract.

For each item furnished and/or installed that is provided with a manufacturer warranty that exceeds the 1-year guarantee period (109.03), the Contractor shall assign the warranty to the Authority. The Contractor shall provide a written warranty statement denoting the manufacturer information, model number, warranty terms, and starting and ending coverage dates.

Where work is required to repair electrical or ITS systems in accordance with the guarantee/maintenance bond, the following additional requirement shall apply:

(A) The Contractor shall be available for 24-hour service and support throughout the 1-year guarantee term. The Contractor shall be on site ready to make the necessary repairs within 2 hours of a service call. The repairs shall be made and service shall be restored within 24 hours of when the service call was placed.

(B) The Contractor shall provide a bucket truck if required for on-site repairs and shall provide lane or shoulder closings as required.

(C) The Contractor may request to utilize the Authority`s spare parts to make the necessary field repairs, but is responsible for replacing the spare parts and returning working spares to the Authority after repairs are completed.

(D) Should the Contractor default in his obligation to provide emergency services within the time frame as described herein, the Authority reserves the right to make emergency repairs at the expense of the Contractor.

(E) Any spare parts used in repairs made by the Authority shall be reimbursed by the Contractor or Surety.

601.11 Measurement.

Conduit will be measured by the length, in place, along its centerline. Conduit embedded in bases and foundations, and conduit connections between lighting standard bases and junction boxes or manholes that are less than three feet in length, will not be measured for payment.

Duct Banks of the various types will be measured by the length, in place, along the duct bank centerline.
The lengths of conduit abandoned in place, after all attempts to bypass obstructions using approved jacking methods have failed, will be measured for payment.

Cable Duct, Cable and Ground Wire (installed in conduit) will be measured by the length, in place, including slack, as specified.

Removal and Reinstallation of Existing Cables will be measured by the linear foot length of the conduit run from which the cables are being removed and reinstalled, regardless of the number of cables or ground wire in the conduit.

Junction Boxes, Junction Box Foundations, Lighting Standard Bases, Manholes, Foundations, and Relocations of these units will be measured by the number installed or relocated.

Junction Box Reconstruction will be measured by the number actually reconstructed as determined by the Engineer.

Electrical equipment to be removed, as designated on the Plans, will be measured as per 201.03 ..

Electrical equipment to be salvaged, as designated on the Plans, will not be measured individually..

Temporary service facilities, as prescribed, will not be measured for separate payment, but the cost thereof shall be incidental to the other items in the Contract.

Retapping and replacement of the bolts for existing junction box frames and covers and cleaning of existing junction boxes to remain will not be measured for separate payment, but the cost thereof shall be incidental to the other items in the Contract.

Installation of concrete-encased and soil-encased duct bank will be measured by linear foot along its centerline. Installation of directional drilled duct bank will measured longitudinally along the centerline of the sleeve (where a sleeve is installed) or as an average of the linear foot lengths of the individual conduits (where a sleeve is not installed). Where installed in a duct bank, conduit will not be measured separately.

601.12 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
REMOVE AND SALVAGE EXISTING FACILITIES	LUMP SUM
FOUNDATION, TYPE _____	EACH
JUNCTION BOX, TYPE _____	EACH
JUNCTION BOX FOUNDATION, TYPE _____	EACH
JUNCTION BOX RECONSTRUCTION	EACH
__(ITEM DESCRIPTION)__ MANHOLE	EACH
CONCRETE BASE, TYPE ____	EACH
__" RIGID METALLIC CONDUIT, UNDERGROUND	LINEAR FOOT
__" RIGID METALLIC CONDUIT, EXPOSED	LINEAR FOOT
__" RIGID METALLIC CONDUIT, JACKED	LINEAR FOOT
__" RIGID METALLIC CONDUIT ON STRUCTURES	LINEAR FOOT
__" RIGID NONMETALLIC CONDUIT, PVC - __(GRADE)__	LINEAR FOOT
__" RIGID NONMETALLIC CONDUIT ON STRUCTURES	LINEAR FOOT
_____- WAY DUCT BANK, ___" HDPE CONDUITS DIRECTIONAL DRILLED	LINEAR FOOT
_____- WAY DUCT BANK, ___" PVC SOIL ENCASED	LINEAR FOOT
_____- WAY DUCT BANK, ___" PVC CONCRETE ENCASED	LINEAR FOOT
#___ A.W.G. POWER CABLE	LINEAR FOOT
#___ A.W.G. SERIES LIGHTING CABLE	LINEAR FOOT
#___ A.W.G. GROUND WIRE	LINEAR FOOT
REMOVAL AND REINSTALLATION OF EXISTING CABLES	LINEAR FOOT
RELOCATE __(ITEM DESCRIPTION)	EACH

No separate payment will be made for installation of tracer wires or installation of conduit fittings and couplings. All costs thereof shall be incidental to the various conduit and duct bank items in the Contract.

No separate payment will be made for locating and maintenance of existing underground electrical and communications cables and wires; test pits to determine the location of existing Authority underground facilities; excavation and backfill for installation and removal of electrical items; work necessary to return the site back to the existing condition; or other similar work. All costs thereof shall be included in the various items in the Contract.

No separate payment will be made for terminations, splices, or other work to connect installed cables. All costs thereof shall be included in the various cable items in the Contract.

No separate payment will be made for equipment necessary to mount electrical cabinets, conduits, or equipment, including furnishing and installing structural steel and hardware. All costs thereof shall be incidental to the various items in the Contract.

No separate payment will be made for Flexible Metallic conduit installations. Such lengths of conduit shall be measured and paid under the items of the conduits to which they are connected.

No separate payment will be made for grounding system work, including grounding system equipment not specifically shown on the Plans but required to be installed to achieve the minimum impedance between the devices and ground as described herein. All costs for this work shall be included in the various pay items bid.

No separate payment will be made for installation of innerduct in communications conduits. All costs thereof shall be incidental to the various conduit and duct bank items in the Contract.

Payment for Duct Bank, HDPE Conduits Directional Drilled includes excavating, dewatering, permanent sheeting at test pit locations and sheeting at jacking or boring pits including sheeting left in place; furnishing and installing pipe sleeve; disposal of spoil materials; all else incidental to complete the work.

No separate payment will be made for the furnishing, installation, removal, or modification or any equipment necessary to maintain power and communications to existing signs as required by these specifications. No separate payment will be made for incidental and temporary electrical work, such as removing the existing cables and ground wire for reuse, installing the same for temporary service including the furnishing and installation of the necessary new cable and ground wire lengths for this purpose, and the temporary cable and conduit support system. All costs thereof shall be incidental to the various items in the Contract.

No separate payment will be made for excavating, dewatering, test pits, sheeting required for pits whether temporary or left in place, pipe sleeve, conduits and innerducts within the sleeve, disposal of spoil materials.. All costs thereof shall be included in the cost of installation of Duct Bank, Directional Drilled.

Except for Junction Boxes on Structures, reinforcement steel will not be paid for separately.

No separate payment will be made for ground wire and ground rod installations in junction boxes, manholes, lighting standards, equipment enclosures, cabinets, sign structures and ramp gates, or for cable connector kits. All costs thereof shall be incidental to the various items in the Contract.

The disposal of muck material shall be paid for as specified in Subsection 202.05. Temporary Sheeting required for the removal of the muck material during trenching operations shall be paid for, as specified in Subsection 415.06.

No separate payment will be made for utility coordination, All costs thereof shall be incidental to the various items in the Contract.

For payment of the removal of electrical items that are not shown on the Plans to be salvaged, See Subsection 201.03.

SECTION 602 - POWER DISTRIBUTION

602.01 Description.

The work shall consist of furnishing and installing power distribution systems.

The power distribution work shall include power and control equipment, meter cabinets, load centers,, medium-Voltage equipment, power distribution systems, and other equipment and appurtenances required to provide power to the Authority-owned electrical devices.

Installation of transformers, conduits, wiring, and maintenance platforms for ITS Stations shall be constructed as described in Section 605.

602.02 Materials.

Materials shall conform to Section 601 and the following Subsections:

CABINETS 918.03

CABLE CONNECTORS..... 918.04

PANELBOARDS AND CIRCUIT BREAKERS ..... 918.20 (A)

POWER DISTRIBUTION AND CONTROL EQUIPMENT 918.20

602.03 Power.

The circuit characteristics and utilized Voltage for the various types of lighting facilities shall be as follows:

(A) ROADWAY, TOLL PLAZA AND SERVICE AREA LIGHTING.

Generally, these facilities shall utilize one of the following types of distribution systems, as indicated on the Plans.

(1) Turnpike Lighting Systems.

3-Phase, 4-wire, 277/480 Volt, 60 Hertz alternating current. Power shall be obtained from one of the Turnpike's toll plaza utility buildings, Service Area restaurant buildings, transformer stations, or dedicated electrical meter cabinet as indicated on the Plans.

(2) Parkway Lighting Systems.

Voltage varies by location. Typical Voltages include 3-Phase, 4-wire, 277/480 Volt or 120/208 Volt, or 1-Phase, 3-wire, 120/240 Volt or 240/480 Volt, 60 Hertz alternating current. Power shall be obtained from one of the Parkway's toll plaza utility buildings, Service Area restaurant buildings, or dedicated electrical meter cabinet as indicated on the Plans.

(3) Series Distribution System.

6.6 Ampere, 2400 Volt or 7200 Volt primary, 60 Hertz alternating current. This obsolete system, present in certain areas of the Turnpike, shall be used only in those areas where the existing series lighting facilities are to be modified under the Contract. Power for the existing series lighting facilities are originated from the existing transformer stations, as indicated on the Plans.

(B) ROADWAY LIGHTING POWER DISTRIBUTION.

Power distribution to non-lighting facilities, such as ITS devices or ramp gates, shall be serviced as follows:

(1) All power distribution facilities within the general limits of an interchange or service area, including all ramp connections, shall be fed from the roadway lighting circuitry where feasible given load requirements.

(2) All other power distribution facilities at remote locations shall utilize single phase, 3-wire, 120/240, single phase, 3-wire, 240/480 Volt, or 3-phase 277/480 Volt, 60 Hertz, alternating current obtained locally from the utility company's facilities and distributed, as shown on the Plans.

(3) In many cases, the Voltage obtained from the utility company is not sufficient to feed the load required. In this case, Authority-owned step-up transformers may be provided to increase the Voltage, and therefore distance, of the area served by the power distribution circuit.

(C) SIGN LIGHTING POWER DISTRIBUTION.

Electric service for sign lighting systems shall be provided as follows:

(1) All sign lighting systems within the general limits of an interchange, service area, or bridge structure with roadway lighting facilities shall be fed from the roadway lighting circuitry.

(2) All sign lighting systems at remote locations shall utilize single phase, 3-wire, 120/240 Volt, 60 Hertz alternating current obtained locally from the utility company's facilities and distributed as shown on the Plans.

(D) ITS POWER INFRASTRUCTURE.

(1) ITS Power Equipment, Pedestal-Mounted.

Furnish and install the power distribution equipment mounted to the sign structure pedestal. Furnish and install conduits between the power distribution equipment and the conduit stubs provided under the ITS Equipment Platform item.

Terminate the incoming power cables (installed under Section 601) at the main disconnect. Furnish, install, and connect power wiring on the load side of the main disconnect, as shown on the Plans, as necessary to provide a complete and operational power distribution system. Provide grounding as shown on the Plans and/or as required by the National Electric Code.

(2) ITS Power Equipment Cabinet.

Furnish and install the power equipment cabinet on the cabinet foundation provided under the ITS Equipment Platform item. Install power distribution devices and conduit as shown on the Plans.

Terminate the incoming power cables (installed under Section 601) at the main disconnect. Furnish, install, and connect power wiring on the load side of the main disconnect, as shown on the Plans, as necessary to provide a complete and operational power distribution system. Provide grounding as shown on the Plans and/or as required by the National Electric Code.

(3) Transformers.

Install transformers as specified and shown on the Plans. All transformers provided of each type shall be manufactured by the same manufacturer, and shall have the same dimensions. Orient the transformer to facilitate maintenance without having one's back to active traffic. Terminate the primary and secondary cables, and provide ground for separately derived systems as per the requirements of the National Electrical Code.

(4) ITS Equipment Platform.

Work under this item includes construction and installation of the common electrical infrastructure serving ITS System Control Cabinets and Power Cabinets.

Furnish and install, as shown on Plans:

(a) concrete or steel work platform

(b) foundations for Systems Control Cabinets, ITS Power Equipment Cabinets (where required), and Transformers (where required)

(c) conduits within the limits of the platform

(d) conduits between the platform and adjacent Type C Junction Boxes

(e) conduits between the sign structure foundations and junction boxes/cabinet foundations as shown on the Plans and Standard Drawings

(f) bollards, handrails, and protective devices (where required)

Install conduit using the methods described in Section 601. Where conduits extend past the platform, provide a minimum 24 inch stub beyond the platform. Where conduits extend from underground to exposed mounting, provide 3" minimum extension above the platform for future connection.

Cap all conduits not used in the final system under this Contract.

(E) POWER CABLES.

After cables have been installed and pending permanent connection or splicing, the end of each section of cable shall be carefully sealed, using rubber tape, and painted with a sealing type of waterproof compound. All wiring shall be done in a workmanlike manner and shall be finished to give a neat and orderly appearance.

All cable splicing for temporary and permanent facilities, shall be made by means of new cable connector kits. Installation of the cable connector kits shall conform to the manufacturer's installation instructions and as per the Authority's standard drawings. All cable connector kits, upon completion of installation, shall be wrapped with several layers of half-lapped jacket tape to insure positive water-moisture proof and submersible type connections.

Ends of cable not connected to any device shall be insulated and sealed, as designated by test capping on the Plans, in a manner similar to a standard splice. All cable ends not terminating at circuit breakers, switches, terminal blocks, etc., shall be equipped with solderless type mechanical lugs.

All cables and wires shall be factory color coded. For cable provided in total Contract quantities less than 500 feet, use of color taping may be granted at the sole discretion of the Authority. Where approved, color taping shall be accomplished by spiral application of 3/4 inch wide, colored pressure sensitive plastic tape, half lapped for a minimum distance of 18 inches. The last three wraps of tape shall be applied with no tension. The tape shall be applied so as not to obliterate identification markings of the cable, as approved by the Engineer.

All cables in junction boxes, junction box foundations, cabinets, pull boxes, and at equipment terminal connections shall be tested for circuit connections, which shall be in conformity with those indicated on the Plans. After verification of circuit connections, these cables shall be provided with individual identification tags, as per Authority`s standard drawings, with circuit and phase designations, such as 1-A, 1-B, 1-C, N, etc. for multiple lighting circuits and A, B, C, D, etc. for series lighting circuits. The tags shall be securely attached to the cables with nylon ties.

Cable connections, including the splices, shall be made by means of connector kits, as indicated on the Plans. Installations of these kits shall be done in accordance with the manufacturer's instructions. All cable connector kits in concrete junction boxes, junction box foundations and manholes, upon completion of

installation, shall be wrapped with several layers of half-lapped jacket tape to insure positive water-moisture proof and submersible type connections. All cable connector kits shall be placed on cable racks and fastened thereto by means of nylon cable ties.

Where these connector kits cannot be used, as verified by the Engineer, connections on cables in boxes or manholes shall be made by standard splicing. Splices shall be mechanically and electrically secure by means of a stranded tinned copper pressure-type connector. It shall then be wrapped with half-lapped layers of insulating tape and in opposite directions. Over the insulating tape, apply several layers of half-lapped jacket tape. Apply two coats of waterproofing paint over the complete splice. The insulating tape shall be wrapped to a wall thickness equal to 1-1/2 times the wall thickness of the cable insulation. The jacket tape shall be wrapped to a thickness equal to 1-1/2 times the thickness of the cable jacket.

602.04 Power Distribution and Control Equipment.

A roadway lighting distribution and control panel may be required for each new roadway, toll plaza, ITS and service area multiple lighting facilities. These panels shall be complete with indoor or outdoor type enclosures, as required, and all power and control equipment such as circuit breakers, contactors, relays, distribution panelboards, switches, terminal blocks, transformers, and metering facilities where required, etc., all in conformance with the details on the Plans.

All circuit breakers for area lighting circuits, in the panel board, shall be of the single pole bolt on type. Circuits with a connected load up to 25 Amps shall be placed on a 50 Amps breaker, and those circuits over 25 Amps connected load shall be on a 70 Amps breaker**.**

Load center and/or meter cabinet installations, which may be required for underbridge lighting installations or other lighting facilities at remote locations, shall be as shown on the Plans.

Furnish and Install the power distribution equipment mounted to the sign structure pedestal. Furnish and install conduits between the power distribution equipment and the conduit stubs provided under the ITS Equipment Platform item. Terminate the incoming power cables (installed under Section 601) at the main disconnect. Furnish, install, and connect power wiring on the load side of the main disconnect, as shown on the Plans, and as necessary to provide a complete and operational power distribution system.

The work shall also include furnishing and installing the ITS power Equipment Cabinet on the cabinet foundation provided under the ITS Equipment Platform or VMS Equipment Median item. Install power distribution devices and conduit as shown on the Plans.

Terminate the incoming power cables (installed under Section 601) at the main disconnect. Furnish, install, and connect power wiring on the load side of the main disconnect, as shown on the Plans, and as necessary to provide a complete and operational power distribution system.

Contractor to perform current readings and balance the current between the phase legs as described on the Plans. Submit the method to be used for balancing of loads for review and approval.

Install Load Center Cabinets and Meter Cabinets at locations as shown on the Plans. The work shall consist of furnishing and installing the cabinets, appurtenances, mounting hardware, and all internal and attached external components as shown on the Plans including but not limited to circuit breakers, meter pans, contactors, transformers, panelboards, photocells, thermostats, heaters, receptacles, and surge protectors. Furnish and install wiring between devices within the cabinet and terminate all wiring to field devices. Perform grounding work as required by the National Electric Code. For Meter Cabinets, coordinate with local utility to ensure that details used comply with local requirements. Perform all coordination and work, and obtain inspections necessary to provide a complete, connected power service, including any temporary work necessary to keep existing electrical systems operational.

Install concrete sidewalks adjacent to meter cabinets and load center cabinets, as shown on the Plans. Concrete shall be poured such that water cannot flow into/under the cabinet. Grade the area around the cabinet to remove tripping hazards and the potential for damage due to lawn mowing equipment.

602.05 Measurement.

Load Center Cabinet and Meter Cabinets of each type will be measured by the number in place.

ITS Power Equipment Cabinets and ITS Power Equipment, Pedestal-Mounted; will be measured by each system completely installed, regardless of the arrangement and extent of associated system components.

602.06 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
LOAD CENTER CABINET, TYPE _____,	EACH
METER CABINET, TYPE _____,	EACH
ITS POWER EQUIPMENT CABINET	EACH
ITS POWER EQUIPMENT , PEDESTAL MOUNTED	EACH

Payment for boxes, manholes, foundations, bases, conduits, cables, and grounding devices will be made in accordance with Section 601.

All secondary wiring with cable connector kits, including fuses, shall be included under the appropriate Luminaire items or Underbridge Lighting Installation.

Utility company coordination shall be as specified in Section 601.

No separate payment will be made for concrete sidewalks installed adjacent to Load Center Cabinets and Meter Cabinets. All costs for this work shall be included in the cost of Load Center Cabinet and Meter Cabinet installation.

SECTION 603 - LIGHTING

603.01 Description.

The work shall consist of furnishing and installing roadway and sign lighting systems complete with luminaires, ballasts, driver, conduits, fittings, mounting hardware, metallic junction boxes, wires, power and control equipment, and other items and appurtenances required to provide complete operational lighting systems for overhead sign structures, bridge mounted signs, and certain ground mounted signs, as indicated on the Plans. Dynamic message signs are not included in this Section..

The lighting equipment shall consist of lighting standards, High Intensity Discharge (HID) and Light-Emitting Diode (LED) luminaires, lamps, ballasts, and other items and appurtenances including fixture hardware and wiring required to provide illumination for Authority facilities.

603.02 Materials.

Materials shall conform to the following Subsections:

LAMPS	918.13
SIGN LIGHTING LUMINAIRES	918.22
BALLASTS	918.21(2 C)
CABINETS	918.03
CABLE CONNECTORS	918.04
LIGHTING STANDARDS	918.16
PARAPET MOUNTING BRACKETS	918.16
ROADWAY LIGHTING LUMINAIRES	918.21
SHOE BASES	918.16
TRANSFORMER BASES	918.16
UNDERBRIDGE LUMINAIRES	918.23

603.03 Installations.

(A) LIGHTING STANDARDS.

The lighting standards shall be of aluminum alloy or steel construction, complete with pole shaft, bracket arm(s), luminaire mounting assembly(ies), pole cap(s), dampers, transformer base, shoe base, base plate, parapet mounting brackets, and hardware as required and as shown on the Plans. Various types of

lighting standards, as listed on the Plans, identify the mounting height and type of mounting of each lighting standard, as well as defining the type of base and length and number of bracket arms to be provided with each assembly.

Lighting standards shall be provided with the equipment required, in conformance with the details shown on the Plans.

(B) LIGHTING STANDARD DESIGN.

All lighting standard assemblies, complete with pole shafts, bracket arms, cast bases and parapet mounting brackets, shall conform in all respects to the requirements described in the Standard Drawings and shall be certified to support the required load per AASHTO requirements.

All transformer bases shall be of an approved breakaway design, in conformance with the breakaway requirements of the latest AASHTO Specifications.

(C) LIGHTING STANDARD INSTALLATIONS.

All lighting standards shall be securely bolted in a vertical position to concrete bases, junction box foundations, lighting blisters, or lower mounting brackets on bridge parapets. They shall be plumbed with bracket arms at right angles to (or with offset luminaire mounting brackets parallel to) the centerline of the roadway by means of stainless steel shims between the transformer bases and concrete bases or junction box foundations or between the base plates and lighting blister/lower mounting brackets.

The Contractor shall verify and determine by accurate field measurements all dimensions which will in any way affect fabrication and installation of the lighting standard, especially where modifying existing lighting standards to remain. All dimensions shall be shown on the shop drawings and noted as to which were determined by field measurements. Field dimensions and data shall be submitted with the shop drawings. Discrepancies between field dimensions and Plan or reference drawing dimensions shall immediately be brought to the attention of the Engineer and noted as such on the submission of field measurement data. The Contractor shall submit shop drawings and Methods of Construction in accordance with Subsection 104.08.

(D) IDENTIFICATION PLATES.

Each lighting standard, whether new or relocated, shall be identified by means of aluminum identification plate(s), which shall bear the lighting standard and circuit numbers and phase designation for multiple circuits and the lighting standard number, circuit (loop) and origin designations for series circuits, as well as the lamp Wattage (non-LED type fixtures only), utilized Voltage for multiple circuits and Amperage for series circuits, lighting standard and luminaire types, all as shown on the Plans. A separate identification plate shall be provided for each luminaire supported by the lighting standard. Lighting standards with floodlighting or emergency lighting luminaires shall be provided with additional identification plate(s). Existing identification plates on relocated lighting standards shall be replaced, where required.

The identification plates shall be installed on the roadway side of the lighting standard shafts, 4'-6" above concrete bases or junction box foundations, or one foot above the top of parapets, unless otherwise directed by the Engineer. The identification plate designations shall be as shown on the Plans.

Where revisions to existing circuitry are made, the Contractor shall install new identification plates where required for proper identification. No separate payment will be made for installation of new identification plates.

(E) LUMINAIRE INSTALLATIONS.

Work shall include installation of the luminaire, lamp (where required), remote ballast (where required), secondary wiring, cable connector kits, Luminaire Headframe ring assembly, luminaire lowering device and fuses for all lighting systems.

Various types of luminaries, to be used on the Project, shall be as listed on Plans. Prior to installation of each luminaire, the Contractor shall check and verify the type, wattage and Voltage(HID), current setting (LED), and the proper lamp socket position (if applicable) to produce the specified light distribution.

All cutoff luminaires shall be installed truly parallel to the roadway surface in conformance with the luminaire manufacturer's installation manual, unless a tilt angle is shown in the Plans. In order to achieve this requirement, the Contractor shall use a leveling eye and other supplementary equipment resting on the top flat section of each luminaire, and level it both parallel and perpendicular to the roadway.

Offset and pole-top luminaires shall be installed on luminaire mounting assemblies, as shown on the Plans.

Upon completion of the luminaire installation, the secondary wiring shall be connected to the luminaire line terminals and extended to the cable connector kits in the transformer base for ground mounted lighting standards, and to the adjacent junction box for bridge mounted, and for certain ground mounted lighting standards with remote ballast type luminaires.

Before installation of each lamp, the Contractor shall neatly mark the lamp base with the lamp installation date code (2 digit numbers indicating the month and the year of installation) by means of scratching the lamp base.

Unless otherwise called for, all secondary wiring between the cable connector kits and luminaires for all lighting standards shall be single conductor, No. 10 A.W.G. wire as specified elsewhere herein.

Where a new luminaire is installed on an existing lighting standard, work shall also include removal of the existing luminaire, including secondary wiring back to the fuses and cable connector kits in the transformer base, handhole, or junction box. New secondary wiring, cable connector kits, and fuses shall be provided and installed.

(F) UNDERBRIDGE LIGHTING INSTALLATIONS.

Underbridge lighting luminaires shall be installed beneath structures to illuminate and/or supplement the illuminations thereof over those portions of the roadways beneath these structures.

The luminaires shall be installed on bridge piers, abutments, or walls and fastened to concrete surfaces, or shall be installed on mounting plates and steel members connected to stringers, all as shown on the Plans.

The service wiring shall be extended in conduit to a nearby precast junction box or junction box foundation or to an adjacent bridge junction box (as shown on Plans), and connected therein to the distribution circuit cables by means of cable connector kits with fuses, where required. The identification plates for underbridge luminaires shall be installed on a stainless steel plate fastened to the face of pier, abutment, or wall, as directed by the Engineer.

These facilities shall be serviced as follows:

(1) All underbridge lighting facilities within the general limits of an interchange or service area, including all ramp connections, shall be fed from the roadway lighting circuitry.

(2) All other underbridge lighting facilities at remote locations shall utilize single phase, 3-wire, 120/240 Volt, 60 Hertz, alternating current obtained locally from the utility company's facilities and distributed, as shown on the Plans.

Installations shall conform to applicable portions of Sections 601 and 602.

(G) SIGN LIGHTING.

Sign luminaires shall be placed and securely fastened with stainless steel hardware, in conformance with the details shown.

All sign lighting systems, being fed from roadway lighting facilities, shall be provided with an enclosed circuit breaker for circuit protection. All sign lighting systems, which either utilize local utility company service or other non-controlled service, shall be provided with a service cabinet and a photoelectric control unit as shown on the Plans.

Metallic junction boxes, conduits and conduit fittings shall be furnished and installed where required to facilitate the pulling, splicing, and connecting of wires and cables. These materials shall be aluminum when fastened to aluminum structural members, and galvanized steel or galvanized cast iron when installed on concrete surfaces or steel structural members.

Each conduit entering metallic boxes, except boxes equipped with threaded holes or bosses, shall be securely fastened as specified in Section 601 Grounding bushings shall be the insulated type. Bushing caps shall be furnished and shall remain in place until just before conductors are installed. Continuous grounding shall be provided by installing a bare grounding conductor.

The exposed conduits to be installed on the sign structures shall be fastened to structural members by means of U-bolts and backup plates in conformance with the details shown on the Plans. All components of these conduit supports, including hardware, shall be stainless steel. Drilling and tapping of any structural member for conduit installation will not be permitted.

Sufficient length of service cables shall be furnished and installed in the service conduit to the nearest junction box or meter cabinet, and all cable connections therein shall be made.

Service cabinet and/or meter cabinet installations required for sign lighting systems at remote locations shall be as shown on the Plans.

603.04 Measurement.

Lighting Standards and Luminaire Installations or Relocations of each Type will be measured by the number in place.

Underbridge Lighting Installations for each structure will be measured as a unit, which will include all exposed work and connections to the nearest junction box or meter cabinet, on a Lump Sum basis.

Sign lighting systems for illumination of each sign structure and bridge mounted sign, including the enclosed circuit breaker or service cabinet, will each be measured on a lump sum basis.

603.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
LIGHTING STANDARD, TYPE _____	EACH
(TYPE) (ITEM DESCRIPTION) LUMINAIRE, __(DESCRIPTION)___	EACH
UNDERBRIDGE LIGHTING INSTALLATION, STR. NO. _____	LUMP SUM
ILLUMINATION FOR SIGN STRUCTURE __*__	LUMP SUM

* Designation

All secondary wiring with cable connector kits, including fuses, shall be included under the appropriate Luminaire items or Underbridge Lighting Installation.

Bridge mounted lighting standards shall include the cost of parapet mounting brackets.

No separate payment will be made for removal of existing luminaires and wiring when installing a new luminaire on an existing lighting standard. All costs thereof shall be incidental to the respective luminaire items.

No separate payment will be made for mounting hardware and required accessories for installation and testing. All costs thereof shall be incidental to the items requiring testing.

SECTION 604 - COMMUNICATIONS

604.01 Description.

All ITS devices installed under this Contract will be controlled by the central ITS software systems installed at the Authority's TMC. Communications between the TMC and the System Control Cabinets (SCC`s) or Pole Mounted ITS Cabinets at each field location will be either via Wireless Radio Communication System, cellular communications or fiber optic cable. The Radio Communications System is a separate system that is owned, operated, maintained by and licensed to the Authority.

604.02 Materials.

Materials shall conform to the following Sections and Subsections:

BONDING AND GROUNDING DEVICES	918.02
CABLE AND WIRE	918.07
CONDUIT AND FITTINGS	918.08
END NODE RADIO	918.58
FIBER TERMINATION PANEL	918.45
FIBER OPTIC CABLE – SINGLE MODE	918.07 (D)
FIBER OPTIC CABLE – MULTIMODE	918.07 (E)
FIBER OPTIC CABLE – TERMINATION CONNECTOR	918.07 (F)
MEDIA CONVERTER	918.43

METALLIC JUNCTION BOXES 918.17
NETWORK SWITCH 918.48
NETWORK SWITCH TX EXPANSION MODULE 918.48
NETWORK SWITCH FX EXPANSION MODULE 918.48
POE SURGE PROTECTOR 918.50
POLE MOUNTED ITS CABINET 918.33
POWER INJECTOR 918.41
RADIO ANTENNA 918.57
RADIO COAXIAL CABLE 918.11

604.03 Installations.

(A) COMMUNICATION SYSTEM.

The Contractor shall furnish a wireless End Node Radio, Radio Antenna and Radio Coaxial Cable (between radio and antenna) for each designated node in the Contract. The installation and alignment of the End Node Radio Antenna shall be performed by the Contractor. Installation of the antenna (including furnishing of mounting hardware as required), alignment of the antenna, and coordination with the Engineer for the Authority to test and commission the radio communications link shall be performed by the Contractor. Each ITSS structure shall have its own radio cabled back to the SCC. The Contractor shall provide and install the outdoor rated network cable and surge protector between the radio and SCC.

The Contractor shall also furnish and install Radio Antenna Mounts as delineated elsewhere in the Specifications.

(B) COMMUNICATIONS AND FIBER OPTIC CABLES.

All communication cables including fiber optic cables shall be furnished and installed complete with termination connectors and all necessary hardware and fittings as shown on the Plans. No splicing of communications or control cable shall be allowed, except for splicing of long length cables. These shall be located only in specified junction boxes with specified splicing materials and methods. All splice points shall be located and identified on the as-built plans with reference locator dimensions. All terminations shall occur above ground in cabinets or equipment.

Fiber optic cable shall consist of a number of single-mode or multi-mode fiber strands as shown on the Plans and as directed by the Engineer. Final fiber optic cable termination locations shall be coordinated with the Engineer.

(C) NETWORK SWITCH.

Networking equipment (including Network Switch) within the Systems Control Cabinets, as defined in Materials, shall be furnished and installed by the Contractor. The Authority will be responsible for configuring and testing the network switches, and for providing a complete and functional communication system between each field location and the TMC. It shall be the Contractor's responsibility to configure and test all Contractor furnished ITS devices for integration into this communication system once the Authority has provided notice that the communications system is functional and operational.

IP addresses for the various ITS devices will be provided by the Authority for configuration by the Contractor or manufacturer's representative. The Contractor shall request IP addresses from the Authority with a minimum of 10 business days' notice.

The Contractor shall also provide and install a Network Switch Expansion Module, in accordance with the manufacturer's instructions, if and where indicated on the Contract Plans.

(D) RADIO ANTENNA.

The work shall be to furnish and install the Radio Antenna, Mount, surge protector, and Radio Coaxial Cable (between radio and antenna), cabling, connectors and patch cords for connection between the radio and surge protector, surge protector and antenna with all necessary hardware and fittings as defined in Materials and shown on the Plans. The mount shall consist of an aluminum pipe mounted in a stainless steel sleeve. The sleeve shall be mounted to the sign structure as shown on the Plans and as directed by the Engineer.

The Contractor shall be responsible for the installation and alignment of the Radio Antenna. The Authority shall test, configure and commission the radio communications link. furnishing and installing the radio antenna mounts as shown on ITS Standard Drawings. Final location of the mount and the mounting height shall be coordinated with the Engineer.

(E) END NODE RADIO.

The work is to furnish and install a Wireless End Node Radio, End Node Radio Antenna and Cabling between the Radio and SCC (or equivalent) at the locations as defined in Materials and shown on the Plans.

See Subsection 604.02 for Materials. Each ITSS structure shall have its own radio cabled back to the SCC. The Contractor shall furnish and install the outdoor rated network cable and surge protector between the radio and SCC and CAT-5 patch cords between the surge protector, power injector and network switch.

Radio antenna installation, alignment, and coordination with the Engineer for the Authority to test and commission the radio communications link shall be performed by the Contractor. The Contractor shall also provide and install Radio Antenna Mounts as delineated elsewhere in the Specifications.

The Contractor shall furnish and install all cabling, connectors and patch cords for connection between the radio and surge protector, surge protector and power injector, and between the power injector and network switch in the SCC. The Contractor shall coil sufficient slack cable inside the structure chord to allow installation or relocation of the End Node Radio to any location between the sign structure End Frames.

Radio antenna installation, alignment, and coordination with the Engineer for the Authority to test and commission the radio communications link shall be performed by the Contractor. The Contractor shall also provide and install the Radio Antenna Mount as shown on Standard Drawings.

Install the End Node Radio Antenna and Wireless Radio on the Radio Antenna Mounts as shown on Standard Drawings. Install the radio at an elevation such that it is accessible from the overhead structure walkway using a 8′ step ladder. Connect the Antenna and Radio with Radio Coaxial Cable, and fasten it to the Mount as directed by the Engineer.

Connect the Outdoor Network Cable to the Wireless Radio, and route the cable back to the SCC through the sign structure chords and conduits as shown on the Plans. Install a Power Injector in the SCC, furnish and install a PoE surge protector, and make the connections as required to provide connectivity between the radio and the Network Switch, including CAT5e patch cords.

As part of this work, perform coordination with the Engineer and the Authority to determine the location and methods of radio system equipment installation. Final location of the equipment and the mounting height of the antenna shall be coordinated with the Engineer. Upon request, the Contractor will be provided a list of tower antenna locations broken down by sign milepost for his use in aiming the antennas. The Contractor shall request mounting details, dimensions, locations, and aiming details at least 60 days in advance of his intended work at each location. The Authority will provide mounting locations within 30 days upon receipt of notice.

It shall be the Contractor's responsibility to achieve a functional communications link (as determined by the Engineer) between the Radio Antenna and the tower serving the system. Perform alignment of the antenna as directed by the Engineer/Authority. Installation and alignment of radio components shall be performed after the sign structure is erected. The Contractor shall provide a bucket truck, lane/shoulder closings and traffic protection as required to aim the antenna in order to achieve an acceptable communications link at no additional cost to the Authority.

After installation and aiming work is complete, the Authority will test, configure and commission the radio communications link. Payment will not be made until the Authority has accepted the installation and provided the Engineer notice that either:

(1) The antenna has been successfully aimed and a communications link has been established to the serving tower, or

(2) The antenna has been installed according to plan and aimed as directed, but that the location does not allow for a direct communications link with the serving tower.

(F) END NODE RADIO RELOCATION.

In certain circumstances, the Engineer may direct the relocation of the Radio Antena Mount and End Node Radio Antenna equipment to another location on the sign structure.

When directed, perform the following work:

(1) Disconnect the antenna and radio from the network cable.

(2) Remove the Radio Antenna Mount and reinstall in the new location (as directed by the Engineer)

(3) Pull the slack cable provided under the original End Node Radio Installation item through the sign structure chords to the new location.

(4) Provide new outdoor network cable between the SCC and the End Node Radio if the existing cable does not reach the new location. Remove the existing cable.

(5) Reinstall the End Node Radio equipment and connect to the network cable.

(6) Perform aiming operations as described under "End Node Radio Installation" above.

The work under this item shall include the maintenance and protection of traffic to perform all removal, installation, and aiming operations required to establish a functional communications link (as determined by the Engineer) between the Radio Antenna in its new location and the tower serving the system.

(G) LABELING.

Provide identification tags on all proposed cables and equipment within all junction boxes and cabinets. The Contractor shall label all power line cords, fiber optic patch cords, copper patch cords, power injectors and power supplies installed in the Systems Control Cabinet and pole mounted ITS Enclosure. Patch cords shall be labeled at both ends. Line cords shall be labeled near the receptacle plug. Labels shall consist of water resistant adhesive-back flexible tape securely fastened to the cable or device and machine printed with large black text indicating the associated device and roadway (e.g. CCTV-NS, TDS-SNO, etc.). Provide a minimum of one identification tag on each cable within each junction box.

(H) FIBER OPTIC TESTING (OTDR).

Test each individual fiber after completion of all splicing and connections. Perform the testing at 850 and 1300 nanometers (multi-mode cable) or 1310 and 1550 nanometers *(single-mode cable) in both directions. Ensure that the maximum decibel loss for any single event is not greater than 0.3 dB/km decibels; however, ensure that the OTDR machine threshold is set to record all events greater than or equal in absolute value to 0.05 decibels along the positive and negative axes. Events revealed by the OTDR machine bi-directional trace average to exceed 0.3 decibels are cause for the rejection of the cable. If directed, remove and replace the cable.

Ensure that the net result of the bi-directional trace average across a splice event is not greater than 0.15 decibels. Redo splices revealed by the OTDR machine to be greater than 0.15 decibels as many times as required in order to achieve 0.15 decibels or less.

Ensure that reflectance at each connector is better than -55 decibels.

Ensure the fiber loss across each fiber segment is not greater than 0.4 decibels per kilometer when tested at 1300/1310 nanometers.

Also test, and include in the report, the dark fiber segments that are not being utilized by the signal transmission equipment. Provide connectors as necessary to test un-terminated fibers.

Provide 2 paper copies and 1 electronic copy of the results immediately to the Engineer for review and approval. Clearly identify each fiber on the report. Provide Engineer with certification from the equipment manufacturer that the OTDR was calibrated within three (3) months of its use on the Contract. OTDR equipment shall be recalibrated at 6-month intervals.

(I) POWER METER TESTING.

Measure and record all fiber segment optical budgets, including each end connector, according to the meter manufacturer instructions. Perform power meter tests at 850 and 1300 nanometers (multi-mode) or 1310 and 1550 nanometer (single-mode) in both directions after completion of all cable and connector splicing. Ensure that the maximum connector loss tested is 0.8 decibels with the average of all connectors in the tested fiber segment being 0.5 decibels. Compile the test results in a binder and submit 2 copies with the final documentation. Provide 2 paper copies and 1 electronic copy of the results immediately to the Engineer for review and approval. Clearly identify each fiber on the report and the work site location of the end points. Provide the Engineer with a certification from the equipment manufacturer that the power meters were calibrated within 3 months of their use on the Contract. Recalibrate at 6-month intervals.

604.04 Measurement.

Single Mode and Multi-Mode Fiber Optic Cable, Coaxial Cable, Outdoor Network Cable and Twisted Pair Communication Cable will be measured by the Linear Foot for all cable installed under the Contract including cable loops required at pull boxes and splice cases. Costs for incidentals including patch panels, jumpers, termination connectors, etc. which will be included in the Linear Foot bid cost.

Network Switch will be measured as a unit of Each, which will include internal work, exposed work and communications connections.

Radio Coaxial Cable will be measured by the Linear Foot for all cable installed under the Contract including termination connectors, etc. which will be included in the Linear Foot bid cost.

Radio Antenna will be measured as the number of Each, which will include internal work, exposed work and communications connections, fully installed, connected, and aimed.

End Node Radio will be measured as a unit of Each, which will include internal work, exposed work and communications connections.

End Node Radio Relocation will be measured by the number of Radio Antenna Mounts and sets of End Node Radio equipment relocated, including installation, connection, and testing.

Labeling will not be measured but will be included in the Linear Foot cost for cables.

604.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
END NODE RADIO	EACH
END NODE RADIO RELOCATION	EACH
MULTI-MODE FIBER OPTIC CABLE, ____ FIBERS	LINEAR FOOT
NETWORK SWITCH	EACH
OUTDOOR NETWORK CABLE	LINEAR FOOT
RADIO ANTENNA.	EACH
RADIO COAXIAL CABLE	LINEAR FOOT
SINGLE-MODE FIBER OPTIC CABLE, ____FIBERS	LINEAR FOOT
TWISTED PAIR COMMUNICATION CABLE	LINEAR FOOT

No separate payment will be made for the installation and coordination of End Node Radio Antenna and Wireless Radio, including furnishing and installing the communication cable, surge protector and coordination with system integrator and the Authority. All costs for this work shall be included in the End Node Radio Installation pay items.

The bid price for End Node Radio Relocation shall include all necessary work, Maintenance and Protection of Traffic, materials, cables, and other items required to remove a Radio Antenna Mount/End Node Radio Antenna assembly from one location on a sign structure, and reinstall it at any other location on the same sign structure.

SECTION 605 - INTELLIGENT TRANSPORTATION SYSTEMS

605.01 Description.

The following sections detail the requirements that are common to the various types of ITS installations.

(A) DEFINITIONS.

The following definitions are used throughout this Section:

Closed Circuit Television (CCTV)	A system of cameras and video distribution equipment that allows for the monitoring of video images taken across the Authority's facilities from a connection on the Authority's network.

Changeable Message Sign (CMS)	In the context of these specifications, a CMS is a type of Dynamic Message sign with a limited changeable message set displayed with rotating drums.
Dynamic Message Sign (DMS)	Electronic sign that is capable of displaying more than one message through use of an LED matrix, rotating drum, or similar technology. In the context of these specifications, refers to any combination of Variable Message Signs (VMS), Variable Speed Limit Signs (VSLS) and Hybrid Changeable Message Signs (HCMS).
Hybrid Changeable Message Sign (HCMS)	An electronic sign that is the combination of a VMS and/or fixed panel with a rotating drum sign.
Intelligent Transportation Systems (ITS)	Technologies and engineering concepts to develop and improve transportation systems of all kinds.
Intelligent Transportation System Station (ITSS)	A single installation to colocate several ITS technologies. In the context of these specifications, refers to any combination of DMS and Traffic Detection Station (TDS), Power Distribution Panels, System Control Cabinet (SCC) or CCTV cameras.
Remote Power Unit (RPU)	Enclosure housing DC Power Distribution to the Camera.
Pan, Tilt & Zoom (PTZ)	Motorized Camera with Pan, Tilt and Zoom capability.
Sign Manufacturer	There will be one or more Sign Manufacturers for the Dynamic Message Signs installed under the Contract. References made to the Sign Manufacturer(s) for the VMS/VSLS signs shall be interpreted as one of the approved Sign Manufacturers under separate agreement with the Authority to provide, HCMS, VMS, VSLS, and System Control Cabinets for the project.
Systems Control Cabinet (SCC)	NEMA 3R outdoor cabinet housing sign control electronics and power distribution equipment for ITS equipment.
Traffic Detection Station (TDS)	Electronic devices for the detection, measurement and reporting of vehicular traffic.
Traffic Management Center (TMC)	The Authority's building located on Route 184 in Woodbridge, New Jersey, where roadway operations are supervised.
Variable Message Sign (VMS)	In the context of these specifications, a VMS is a type of Dynamic Message Sign with changeable message content that is only restricted by the sign display size and density.
Variable Speed Limit Sign (VSLS)	An electronically changeable speed limit sign.
Traffic Sensor Wireless Access Point (TS-WAP)	An electronic device for wireless communications with in-pavement traffic sensors used in a Traffic Detection Station.
Traffic Sensor Wireless Repeater (TS-WR)	An electronic device for extending the wireless range of a TS-WAP.

(B) SCHEDULING, COORDINATION, AND COMMON WORK.

Maintenance of Existing ITS installations:

Unless otherwise noted, the Contractor shall maintain all existing ITS installations, including Variable Message signs, Highway Advisory Radio equipment Cameras, and Weather Stations in operation continually for the duration of the Contract. Existing equipment may be decommissioned and removed only after either the proposed equipment has been placed into operation or if an alternate interim arrangement has been placed into operation as specified on the Plans.

Shutdown of electrical circuits for the purposes of performing Contract work shall be performed in accordance with Paragraph 601.03(I).

(C) CONSTRUCTION SCHEDULING.

The Contractor shall submit his schedule for anticipated installation of Dynamic Message Signs and ITS Devices at the start of the Contract. The Contractor shall keep the Engineer informed of any schedule changes during the course of construction.

The proposed delineation of work and sequence of procurement and installation for each ITSS shall be as follows:

(1) The Contractor orders, schedules delivery and receives the shipment for sign(s) and associated SCC(s) and is responsible for unloading signs at his designated location(s).

(2) The Contractor completes all proposed underground power and communications infrastructure installations, including permanent power utility service, ITS Power Equipment and ITS Equipment Platforms.

(3) The Contractor installs SCC on foundations within the Equipment Platform.

(4) The Contractor transports (if required) and installs signs on the sign structures. The Contractor installs all components of other ITS systems (i.e. CCTV and Traffic Detection) that can be feasibly installed while the structure is not over live traffic. The Contractor installs power and communications cabling where feasible.

(5) The Contractor erects the sign structures.

(6) The Contractor furnishes and installs power and communications cabling from SCCs to the signs and other ITS equipment.

(7) Where Radio Communication is required on the Plans, the Contractor shall furnish and install the End Node Radio and Antenna. The Contractor shall also furnish and install communication cable between the SCC, Radio, and other devices required on the sign structure and within the SCC.

(8) The Contractor shall furnish and install a Network Switch in the SCC, unless otherwise noted on the Plans. The Authority will configure the network switches and radio communications equipment. The Authority will test and provide a functional communications link between the SCC and the Traffic Management Center.

(9) The Sign Manufacturer, under agreement and in coordination with the Contractor, performs all interconnection, startup, configuration, and integration testing for the Dynamic Message Signs.

(10) The Contractor arranges with the providers of other ITS equipment for all interconnection, startup, configuration and integration testing of the ITS equipment by the equipment providers.

(11) The Authority inspects sign installation and witnesses a Preliminary Acceptance Test for the sign system control from the local SCC and local control of all ITS equipment.

(12) The Authority witnesses a Final Acceptance Test for all Dynamic Message Sign system and other ITS equipment functionality, including remote functionality from the Traffic Management Center.

Prior to erection of each sign structure or installation of ITS equipment at each location, the Contractor shall coordinate the schedule of networking equipment and radio communications equipment (where required) with the Engineer and the Authority. The schedule shall be developed such that the maximum downtime of existing systems (specified as 5 Calendar Days) is not exceeded before the proposed Dynamic Message Sign system is made operational. For all other locations where downtime would be greater than 5 Calendar days, a Temporary Portable VMS and/or VSLS as described in Materials shall be implemented by the Contractor at no additional cost unless otherwise shown on the Plans.

The Contractor shall perform all scheduling with the Authority and the Sign Manufacturer to ensure that the specified allowable equipment downtimes are not exceeded. Delays due to scheduling or inadequate coordination will not be considered as grounds for additional compensation or waiver of liquidated damages.

(D) DYNAMIC MESSAGE SIGN INSTALLATION.

The work shall consist of connecting and testing of Dynamic Message Signs (DMS) at the locations as designated on the Plans.

The work shall also include installing and connecting System Control Cabinets (SCCs), furnishing and installing of power and communications wiring serving the Dynamic Message Signs, and performing partial and final acceptance testing of the signs and their controllers after installation.

Included in this work is a fixed lump sum allowance for the Contractor to secure the services of the sign manufacturer for final testing and commissioning of the DMS.

(E) CLOSED CIRCUIT TELEVISION (CCTV) CAMERAS.

The work shall consist of furnishing and installing CCTV cameras complete with encoders, camera mounting brackets, power transformers, power and communications cabling, surge protectors, communications equipment and other items and appurtenances required to provide working systems either for Intelligent Transportation System Station (ITSS) mounted or pole mounted configurations.

Video Encoders shall be supplied with the CCTV camera both for ITSS-mounted and for Pole mounted configuration.

(F) Traffic Detection Stations (TDS).

The work shall consist of furnishing, installing, configuring, and testing a wireless, battery-powered magnetometer Traffic Detection Station system consisting of in-pavement wireless sensors, Wireless Access Points, Wireless Repeaters, and miscellaneous electronic equipment for monitoring traffic at the designated locations as shown on the Plans.

(G) Removal of Variable Message Sign Systems.

The work shall consist of furnishing all labor and equipment necessary to disconnect, remove and dispose of existing electronic sign systems at locations as shown on the Plans.

Removal work includes, but is not limited to, disconnecting incoming power and communication feeds, removing signs, cabinets, foundations, wiring, conduits, junction boxes, antennas, power equipment, communications equipment, luminaires, bridge walkways, maintenance platforms and railings, and other system components as shown on the Plans. The work also includes removal of existing structural items such as sign mounting hangers, bridge mounted sign supports, and ground-mounted sign posts and foundations.

Concrete foundations for ground-mounted electronic sign systems shall be removed to a depth two (2) feet below finished grade and backfilled. After the removal of ground mounted electronic sign system, the Contractor shall restore the area to a condition similar to the surrounding vicinity as directed by the Engineer.

The Contractor shall give 4 week notice to the Authority prior to decommissioning a sign system and shall obtain approval from the Authority's Electrical Maintenance Department to disconnect the service. After approval is given, the Contractor shall disconnect, carefully remove the signs, and temporarily place them on the ground at the construction site.

All components deemed salvageable by the Engineer, or as noted herein or on the Plans, shall be loaded, transported and off-loaded by the Contractor to the Authority's storage yard as directed by the Engineer. Any non-salvageable items shall be disposed of in a satisfactory manner off Turnpike property by the Contractor after notification is given that material salvaging by the Authority has been completed. The Contractor shall give the Engineer a minimum of one (1) week notice to schedule for material salvaging.

For Variable Message Signs and Changeable Message Signs, salvage work shall include sign enclosures complete with all internal components, controllers, and other cabinets as directed.

The item for Removal of Electronic Signs, Bridge Mounted, shall include removal of maintenance walkways, sign hangers, and structural support components in accordance with Section 210. For bridge structures to remain, this item shall also include spot repainting of steel surfaces in accordance with Section 411. In removing the sign, the Contractor shall take all necessary precautions to prevent damage to the existing structure to remain. Empty bolt holes remaining in the structural steel after removal of the Electronic Sign System structural supports shall be filled with fully-tightened bolts with washers on each side. These bolts shall conform to Paragraph 909.02(B). Holes remaining in the concrete bridge parapet after removal of the bridge-mounted structural supports shall be filled with a non-metallic, non-shrink grout conforming to Subsection 905.13.

(H) Spare Parts.

The work shall consist of furnishing and delivering to the Authority spare parts for ITS systems as specified herein.

605.02 Materials.

Materials shall conform to the following Sections and Subsections:

Aluminum Pipe 911.01

Bonding and Grounding Devices 918.02

Cable and Wire 918.07

Camera Lowering Device ..... 918.32(C)

CCTV Camera 918.31

CCTV Camera Mount 918.32
CCTV Remote Power Unit 918.44
CCTV Surge Protector 918.51
Coaxial Cable 918.49
Conduit and Fittings 918.08
Electrical Tape 918.10
Epoxy 918.42
Hybrid Changeable Message Sign (HCMS) 918.54
In-pavement Wireless Sensor 918.40
Lighting Standards 918.16
Media Converter 918.43
Metallic Junction Boxes 918.17
Pole Mounted ITS Enclosure 918.33
PoE Surge Protector 918.50
Portable Variable Message Sign (PVMS) 918.55
Portable Variable Speed Limit Sign (PVSLS) 918.56
System Control Cabinet (SCC) 918.19
Traffic Sensor Wireless Access Point 918.38
Traffic Sensor Wireless Repeater 918.39
Variable Message Signs (VMS) 918.52
Variable Speed Limit Signs (VSLS) 918.53

All materials used in the TDS and CCTV system shall be provided with standard manufacturer warranties. If these standard warranties extend beyond the duration of the one-year Maintenance Bond (see Section 109), provide documentation to the Authority indicating warranty duration and method of making a warranty claim for each item provided.

Where required, the pole used for cameras or remote TS-WAPs/TS-WRs shall be a lighting standard provided in accordance with the requirements of Section 602. The type of lighting standards shall be as shown on the Plans. The lighting standard shall be provided with all hardware, fittings, and accessories necessary to attach the complete assembly to the specified foundation.

The Contractor shall be responsible for any required licensing fee or related expense for the addition of the new wireless access points or wireless sensors into the existing Authority traffic detection system. The cost for this shall be included in various pay items for TDS installation and shall not be paid separately.

Materials for spare parts shall conform to all stated requirements for equipment installed under this Contract. All spare parts provided shall be of the identical make and model as those installed under this Contract.

605.03 Methods of Construction.

(A) Dynamic Message Signs (DMS).

At least eight (8) weeks prior to anticipated erection of each VMS/VSLS and twelve (12) weeks prior to anticipated erection of each HCMS sign structure, the Contractor shall notify the Engineer and Sign Manufacturer for the request of sign equipment delivery. Sign equipment shall not reside uninstalled on Authority property any longer than 30 days from the date of delivery by the manufacturer. The Contractor shall protect the signs and equipment during this period. Any damage to the equipment during this period will be at the Contractor's expense.

The DMS and SCC equipment will be delivered by the Sign Manufacturer directly to the Contractor's designated location. The signs and controllers will be tested at the sign manufacturer's facility before shipment. The Contractor, at his discretion, may choose to power up the sign and test upon delivery to verify operation prior to erection, but must do so at no additional cost to the Authority. The Contractor

shall secure the services of the sign manufacturer to perform on-site startup, interconnections and testing after the signs have been erected and connected.

Fiber optic communication cables between the signs and the sign controller shall be furnished by the sign vender and shall be installed by the Contractor; however power cables between the sign and SCC shall be furnished and installed by the Contractor. Cable terminations at the SCC and within the Dynamic Message Signs and controllers shall be performed by the Contractor and under the supervision of the Sign Manufacturer representative. Sign Manufacturer contact information will be provided to the Contractor in advance of this work for coordination and scheduling.

Erection of the Dynamic Message Signs on the sign structure shall be performed under Division 400 prior to erection.

(B) VARIABLE MESSAGE SIGN (VMS).

The work shall consist of performing all necessary work to furnish, install and prepare the VMS for integration and testing.

Furnish and install conduits and perform work as shown on the Plans to provide continuous communications and power raceway paths between the SCC and the VMS. Pull and terminate power and communications cables between the SCC and the Variable Message Sign as shown on the Plans.

Power cable type, size and quantity of conductors shall be furnished and installed as shown on the Standard Drawings.

(C) VARIABLE SPEED LIMIT SIGN (VSLS).

The work shall consist of performing all work necessary to furnish, install and prepare the VSLS for integration and testing.

Furnish and install conduits and perform work as shown on the Plans to provide continuous communications and power raceway paths between the SCC and the VSLS. Pull and terminate power and communications cables between the SCC and the VSLS as shown on the Plans.

Power cable type, size and quantity of conductors shall be furnished and installed as shown on the Standard Drawings.

(D) HYBRID CHANGEABLE MESSAGE SIGN (HCMS).

The work shall consist of performing all work necessary to furnish, install and prepare the HCMS for integration and testing.

Furnish and install conduits and cables and perform work as shown on the Plans to provide continuous communications and power raceway paths between the SCC and the HCMS. Pull and terminate power cables between the SCC and the HCMS as shown on the Plans.

Power cable type, size and quantity of conductors shall be furnished and installed as shown in the Standard Drawings.

(E) SYSTEM MANUFACTURER INSTALLATION AND TESTING.

The Contractor shall secure the services of the Sign Manufacturer to perform configuration, integration, and acceptance testing for each sign. The Sign Manufacturer will perform this work as a sub-contractor to the Contractor. The sign will have previously been tested, inspected and certified by the Sign Manufacturer to be free from manufacturing problems and defects prior to pick up by / delivery to the Contractor. Final testing shall be designed to uncover wiring errors, installation damage of all types, and any remaining manufacturing defects. The Contractor shall provide test equipment and supplies needed for testing after installation.

If the Engineer determines that repairs are required to the signs after installation, it shall be assumed that such damage or lack of operation was due to work performed by this Contract or by manufacturer's defect. Any repairs shall be made, or arranged for under the manufacturer's warranty, by the Contractor at no cost to the Authority.

The Contractor shall ensure that a representative of the Sign Manufacturer oversees the installation and testing. Connection to any active communication system shall be performed or directly supervised by Authority personnel.

The Contractor shall submit a comprehensive testing plan, at least 30 days in advance of the anticipated testing for the first sign location.

Testing shall be performed as follows:

(1) Preliminary Acceptance Testing.

The Preliminary Acceptance Test shall include the following, and shall be completed prior to connection to the communications system:

(a) All diagnostic routines provided by the manufacturer.

(b) Proper operation of every pixel, including uniform brightness at all brightness levels and proper current consumption.

(c) Proper wiring of the display modules, checked by displaying a test message that identifies the modules' proper row and column positions.

(d) Appropriate brightness for day and night conditions. If the sign is on a portion of the road that runs approximately east-west, the brightness when the sun is directly in front of or behind the sign shall also be checked.

(e) Proper operation from the auxiliary controller

(f) Absence of leaks

(g) Proper entry of default messages

(h) Proper operation of the interfaces to all sign subsystems

(i) Proper operation of the temperature sensors, blowers, etc.

(j) Proper grounding.

(k) Correct wiring of sensors and alarms as sensed at the controller.

(l) Visual inspection for any structural or cosmetic damage.

(m) Visual inspection for any missing electrical components or component damage.

(2) Final Acceptance Testing.

The final acceptance testing shall be performed after connection of the communication system. Among the aspects that shall be included in final testing are the following:

(a) All items included in the Preliminary Acceptance Testing

(b) Fully functional control of the sign by the central computer at the TMC.

(c) A 10-day operational test from the TMC.

The Final Acceptance Test results shall be documented, signed system manufacturer's representative and submitted to the Engineer.

(F) CLOSED CIRCUIT TELEVISION (CCTV) CAMERA.

The locations of CCTV cameras shown on the Plans shall be considered schematic in nature. The exact location of each CCTV camera shall be as directed by the Engineer through coordination with the Authority. All installations shall be performed in accordance with the camera manufacturer's recommendations.

For overhead sign structures with no view of the adjacent roadway (e.g. The northbound and southbound median is obscured by trees), the preferred locations is near the middle of the structure and within reach of a wiring hand-hole. For overhead sign structures where the adjacent roadway is visible, the preferred location is the left side of the structure and within reach of a wiring hand-hole. For cantilever structures, the preferred location is over the right or left shoulder (depending on structure orientation). The Resident Engineer will verify site specific conditions and notify the Authority of any visual obstructions that may warrant further consideration. The Resident Engineer will provide the Contractor with final camera mounting locations.

The Contractor shall have the camera manufacturer's representative perform system activation and system testing. The system shall be configured and tested by the camera manufacturer's representative to prove

compatible operation from the existing CCTV computer hardware and software in the Authority's Traffic Management Center.

(1) The Contractor shall submit a written Final Acceptance Test Plan for approval prior to scheduling a Final Acceptance Test. The Final Acceptance Test shall include the following, and shall be completed after all components have been installed, configured, and integration-tested:

(a) All diagnostic routines provided by the manufacturer

(b) Proper wiring, grounding, and attachment to pole or ITSS

(c) Proper operation of the camera, including focus and clarity of picture

(d) Adequate picture visibility under direct sunlight and nighttime conditions

(e) Demonstration of real-time live-motion video received at the TMC

(f) Demonstration of proper control of pan, tilt, and zoom capabilities

(g) A 10-day operational test of all functionality from the TMC

The Final Acceptance Test results shall be documented, signed system manufacturer's representative and submitted to the Engineer.

(2) CCTV Camera, Pole Mounted.

For pole mounted CCTV cameras, provide all equipment as shown on the Plans. Install the Pole Mounted ITS Enclosure on the pole, and provide equipment within the enclosure as shown on the Plans. Furnish and install video encoders and/or media converters in the Pole Mounted ITS Enclosures and Systems Control Cabinets as shown on the Plans. Terminate power and communications wiring at the camera and Pole Mounted ITS Enclosure as per the camera manufacturer's directions. Install power wiring from the Pole-Mounted ITS Enclosure to the nearest junction box or junction box foundation and connect to the power wiring.

(3) CCTV Camera, ITSS Mounted.

For ITSS-mounted CCTV cameras, provide all equipment as shown on the Plans. Install the Camera Mount at the location shown on the Plans, ensuring that the camera can be maintained from the sign structure walkway where present or from a right-lane closure where a walkway is not present. Install the Remote Power Unit on the sign structure, and provide equipment within the enclosure as shown on the Plans. Furnish and install camera encoders in the Systems Control Cabinets as shown on the Plans. Terminate power and communications wiring at the camera and Remote Power Unit as per the camera manufacturer's directions. Install power wiring from the Remote Power Unit to the specified power panel located in the Systems Control Cabinet.

(4) CCTV Camera, Pole Mounted with Lowering Device.

For Pole Mounted CCTV camera with a lowering device, provide all equipment as shown on the Plans complete with Pole and the Camera Lowering device. Install the Pole Mounted ITS Enclosure on the pole, and provide equipment within the enclosure as shown on the Plans. Furnish and install video encoders and/or media converters in the Pole Mounted ITS Enclosures and Systems Control Cabinets as shown on the Plans. Terminate power and communications wiring at the camera and Pole Mounted ITS Enclosure as per the camera manufacturer's directions. Install power wiring from the Pole-Mounted Enclosure to the nearest junction box or junction box foundation and connect to the power wiring.

(5) Power Wiring (included in above items).

(a) The Remote Power Unit (RPU) may be mounted directly to a sign structure member using drilled and tapped holes and stainless steel hardware, or it may be mounted using stainless steel C-channels (e.g. Unistrut) and stainless steel hardware. Shop drawing submittals shall indicate the intended mounting method and materials.

(b) Wires for the 120 VAC feed to the RPU shall be routed through flexible conduit in the manner shown in the Standard Drawings.

(c) The specified flexible conduit between the RPU and the camera mount shall be eliminated. Low Voltage power from the RPU shall be supplied to the camera by way of a 5 or 6 conductor 18 AWG (stranded) cable with a direct sunlight rated outer jacket. The cable shall exit the RPU

through a compression type cord fitting and be exposed before entering the bottom of the camera mounting arm. One 16" diameter loop of slack cable shall be bundled and secured between the RPU and the camera mounting arm.

(d) The low Voltage power cable shall terminate at a terminal block in the RPU and at a terminal block on the Pipe Interface Board provided with the specified camera equipment in accordance with the camera manufacturer`s instructions. Secure the power cable to the Pipe Interface Board with a nylon cable tie or electrical tape to provide strain relief.

(6) Communication Cabling for Analog Cameras (included in above items).

(a) Video and PTZ communication cables shall exit the structure through separate compression type cord fittings and be exposed before entering the camera arm. One 16" loop of slack cable shall be bundled and secured between the RPU and the camera mounting arm.

(b) Video coaxial cable shall be terminated at both ends with a crimped or compression type BNC connector properly sized to match the provided cable dimensions and installed in accordance with the connector manufacturer`s instructions. The crimping tool die shall be properly sized to match the provided connector, or the cable connection will be rejected.

(c) The camera end of the video coaxial cable shall connect to a mating BNC connector located on the Pipe Interface Board provided with the specified camera equipment in accordance with the camera manufacturer`s instructions.

(d) The coaxial cable shall connect to the line side of a PTZ camera surge protector in the SCC. The surge protector shall be mounted to an inside wall of the SCC using Velcro strips. The equipment side of the surge protector shall be connected to the video encoder by way of a short coaxial cable. The surge protector and short coaxial cable shall be furnished by the Contractor.

(e) The camera PTZ cable shall meet the Contract specification requirements for Outdoor Network Cable except as noted herein. Permissible exceptions to these specifications are; single jacket construction, no shielding, all else as specified. Where double jacket is furnished, the outer jacket and shield shall be stripped back at least 16 inches at each end to increase flexibility. The end of the outer jacket shall be sealed with heat shrink tubing or electrical tape.

(f) The camera end of the PTZ cable shall terminate at a terminal block located on the Pipe Interface Board provided with the specified camera equipment in accordance with the camera manufacturer`s instructions. Secure the PTZ cable to the Pipe Interface Board with a nylon cable tie or electrical tape to provide strain relief.

(g) Terminate the SCC end of the PTZ cable with an RJ45 cable with an RJ45 modular plug properly rated and sized for the provided cable. The plug shall be wired in accordance with ITA/IEA 568B and crimped onto the inner jacket of the cable to provide proper strain relief. The connectorized cable shall connect to the Line side of a PTZ camera surge protector. The surge protector shall be mounted to an inside wall of the SCC using Velcro strips. The Equipment side of the surge protector shall be mounted to an inside wall of the SCC using Velcro strips. The Equipment side of the surge protector shall be connected to the Video Encoder by way of a CAT5e Ethernet patch cord. The Authority will furnish a pair of CAT5e jacks with a short cable for connection of the PTZ cable plug and patch cord to the PTZ camera surge protector terminal blocks. The video encoder shall be connected to the Network Switch with a second CAT5e patch cord. For Contracts that do not specify a video surge protector, the surge protector Velcro strips and one patch cord will be furnished by the Authority.

(G) TRAFFIC DETECTION STATIONS (TDS).

The Contractor shall ensure that a representative of the system's manufacturer oversees the installation, system configuration, and testing. Testing shall include verification of proper sensor operation, access point operation, communications to the Traffic Management Center, and integration with the existing traffic detection system software. Software services shall include configuration of the wireless access point and the Authority's existing traffic detection system central server as it pertains to the traffic detection stations installed under this Contract

The Contractor shall submit a written Final Acceptance Test Plan for approval prior to scheduling a Final Acceptance Test. The Final Acceptance Test shall include the following, and shall be completed after all components have been installed, configured, and integration-tested:

- All diagnostic routines provided by the manufacturer

- Proper wiring, grounding, and attachment to pole or ITSS
- Proper operation of the detection system, provided over a one-hour period comparing system counts to counts obtained by observation of live traffic
- Accurate reporting of traffic speed
- Demonstration of real-time traffic detection data received at TMC
- A 10-day operational test of all functionality from the TMC

The Final Acceptance Test results shall be documented, signed system manufacturer's representative and submitted to the Engineer.

Where the Plans call for installation of Wireless Access Points and Wireless Repeaters without the corresponding installation of In-Pavement Wireless Sensors that they serve, perform Final Acceptance Testing according to the following requirements:

- Provide a temporary In-Pavement Wireless Sensor for use in testing. No additional payment will be made for the furnishing of this sensor.
- Place the Sensor on the shoulder pavement (without disturbing live traffic), in a location that is even with line of sensors furthest from the Wireless Access Point or Wireless Repeater. The sensor need not be installed within the pavement for this test, but can be temporarily paced on the surface, protected from live traffic with a shoulder closing.
- Demonstrate proper communications and that the TMC software recognizes the sensor by driving a vehicle multiple times over the sensor.

Repeat the test in the opposite roadway shoulder.

The traffic detection station shall be installed according to the specifications described below:

(1) Traffic Sensor Wireless Access Point.

The wireless access point shall be located as close to the in-pavement wireless sensors as possible as shown on the Plans. The wireless access point shall be mounted either to the ITSS or to a pole as indicated on the Plans.

When mounted on the ITSS, the TS-WAP shall be positioned as shown on the Plans to provide line of site to the in-pavement sensors. The TS-WAP shall be mounted to the top chord of the structure with no obstructions and shall not compromise the integrity of the sign structure. Mounting of the TS-WAP shall be as shown in the details on the Plans. The Contractor shall install a network cable between the TS-WAP and the SCC.

When mounted on the pole, the TS-WAP shall be installed on a lighting standard as shown on the Plans. Install the Pole Mounted ITS Enclosure on the pole, and provide equipment within the enclosure as shown on the Plans. The Work includes furnishing and installing media converters in the enclosure and/or in the Systems Control Cabinets as shown on the Plans. Terminate power and communications wiring at the ITS enclosure as per the manufacturer's directions. Install wiring from the ITS enclosure to the nearest junction box or junction box foundation for a fully operational system.

The Contractor shall install a Power Injector in the Systems Control Cabinet for an ITSS mounted configuration and in the ITS Enclosure for a Pole mounted configuration, and shall connect it to the network cable feeding the TS-WAP in accordance with the manufacturer's directions. The Power Injector line cord shall be neatly labeled with the inscription "TDS-POE" near the receptacle plug using printed adhesive backed flexible tape.

(2) Traffic Sensor Wireless Repeater.

A TS-WR shall be installed where the TS-WAP is out of the coverage range of the In-Pavement Wireless Sensors. The Wireless repeater shall be provided complete with mounting hardware and appurtenances as recommended by the Wireless Repeater manufacturer.

The TS-WR shall be positioned as shown on the Plans to provide clear line of site to the in-pavement sensors. The TS-WR shall be mounted on the pole with no obstructions to the In-Pavement Sensors and to the corresponding TS-WAP. Mounting of the TS-WR shall be as shown on the Plans.

The TS-WR shall be a battery powered unit with an expected battery life of eight (8) years. The TS-WR will be used to provide a two-way relay between out-of-range sensors and the access point. Since the TS-WR is battery-powered, it requires no wires or cabling.

(3) In-pavement Wireless Sensor.

Each in-pavement wireless sensor shall be installed in the roadway by core drilling to provide a 4″ diameter hole, 2.25″ to 2.50″ deep. A thin layer of epoxy sufficient to cover the bottom of the hole shall be applied. The wireless sensor shall be placed on top of this layer of epoxy in the correct orientation as clearly marked on the sensor. The sensor shall be fully encapsulated with the epoxy to the lip of the cored hole with a minimum cover of .25″ and no more than .50″ of epoxy.

Each installation of the TDS shall consist at a minimum of three (3) sensors installed in the center of each monitored traffic lane, as shown on the Plans within ± 2″. The distances between installed sensors shall be measured to the nearest 1/16″, recorded and submitted to the Engineer.

The Contractor shall test all the sensors and record their serial numbers before they are epoxied in the road. The Contractor shall keep accurate records of where each individual sensor (by serial number) is installed. Pre-epoxy testing shall be performed with the sensor at the final depth in the lane hole and shall verify proper communications with adequate signal strength at the wireless access point and the ability to detect vehicles after it is epoxied in place. The Contractor shall be required to remove and install new sensors or relocate sensors as required to achieve proper sensor to access point communications and vehicle detection without additional compensation.

Installation of the in-pavement sensors shall occur only after the final pavement overlay has been constructed. The Contractor and Engineer shall field coordinate the schedule to determine the timeline of wireless access point equipment and in-pavement sensor installations.

(H) SYSTEM CONTROL CABINET (SCC).

The work shall consist of performing all work necessary to furnish and install the SCC.

Each ITSS installation shall have its own SCC along with other ITS equipment at its base. The Authority has made arrangements with the Sign Manufacturer to fabricate SCCs with the required electronics for each VMS/VSLS/HCMS location. The Contractor is required to install each SCC. SCCs for some ITSS Contracts will be provided to the Contractor (unless otherwise noted on the Contract Plans) with all the required equipment at a particular location and as shown on the Standard drawing except the Network Switch and Fiber Termination Panel (where fiber optic cable is required) which shall be furnished and installed by the Contractor.

There are incidental items not shown on the ITS Standard Drawings that shall be furnished and installed by the Contractor. This includes but is not limited to: video encoders, patch cords, power line cords, POE injectors, and surge protectors in the SCC as shown on ITS Standard Drawings.

Install the SCC on the foundation or platform provided under Section 602. Perform bonding and grounding of the cabinet. Pull and terminate power cables between the SCC and the upstream power disconnect as shown on the Plans. The Contractor shall furnish and install all required ground wires and connectors to properly ground all shielded cables and surge protectors in accordance with the equipment manufacturer`s instructions. All slack wires and cables entering the SCC shall be neatly bundled, secured and labeled in the base of the cabinet.

The Contractor shall furnish and install a 12 terminal (minimum) equipment ground bar in the SCC as shown on standard drawing. All surge protectors, cable shields and other devices requiring grounding shall be bonded to the ground bar with neatly arranged ground wires kept as short and straight as practical.

Power cable type, size and quantity of conductors shall be furnished and installed as shown on the Standard Drawings.

A bead of silicone caulk shall be applied around the base of the cabinet where it meets the concrete pad.

(I) SPARE PARTS.

Provide a complete package of spare parts as indicated below. The provisions of this section shall not be construed to limit the delivery of spare parts referenced or required by other sections of this Specification or as shown on the Plans.

Provide spare parts of the following equipment. The quantities provided of each part shall be equal to the greater of a) 10% of the installed quantity, or b) 4 units, except as noted below:

(1) CCTV Camera, ITSS mount

(2) CCTV Camera, pole mount

(3) Camera Remote Power Unit

(4) Video Encoder

(5) Video Encoder Power Supply

(6) Media Converter

(7) Media Converter Power Supply

(8) Power-over-Ethernet Injector (each type if more than one)

(9) Traffic Sensor Wireless Access Point

(10) Traffic Sensor Wireless Repeater

(11) In-Pavement Wireless Sensor (provide a quantity of __)

(12) Surge Protector (each type if more than one)

(13) Fiber Termination Panel

(14) Pole-Mounted Enclosure (enclosure only, internal components to be provided separately)

Deliver the spare parts as a complete package to the Authority at a location as specified by the Engineer. The Authority will issue a written receipt for the Spare Parts.

605.04 Measurement.

System Control Cabinet Installations will be measured by the number of Each, which will include internal work, exposed work and connections to the nearest junction box or meter cabinet. When the Contractor is required to furnish the System Control Cabinet, this item will include that aspect of the Work.

Pole Mounted ITS Cabinet will be measured by the number of Each, which will include internal work, exposed work and connections to the nearest junction box or meter cabinet.

Variable Message Signs, Variable Speed Limit Signs, Hybrid Changeable Message Signs, System Controller Cabinets will be measured by the number of each installed, tested, and accepted.

FX and TX expansion modules at the Network Switch will not be measured separately but are designated to be part of the Network Switch.

System Manufacturer Installation and Testing (No-Bid) provides a value for reimbursement to the Contractor for costs paid by the Contractor to the Sign Manufacturer which shall be equal to $5,000 multiplied by the number of each set of VMS & VSL signs installed and having passed final acceptance testing in accordance with Subparagraph 605.03 (A) (4) above.

CCTV Cameras, ITSS Mounted will be measured by the number in place, fully installed and tested with all components, including camera mounting post, camera Remote Power Unit with all appurtenances as shown on the Plans, and power and communications cabling between the CCTV camera and Systems Control Cabinet.

CCTV Cameras, Pole Mounted and Pole Mounted with Lowering Device, will be measured by the number in place, fully installed and tested with all components, including the mounting of the camera on the pole, Pole Mounted ITS Enclosure, and with all appurtenances as shown on the Plans, and all power and communications wiring between the camera and the nearest junction box or junction box foundation.

Conduits embedded in concrete platform and in sign structure foundations serving ITS devices will not be measured for payment.

Wireless Access Points, ITSS Mounted, will be measured by the number in place, fully installed, tested and accepted. Power Injectors and all other accessories shall not be measured separately and shall be considered incidental to the other items for Traffic Detection Stations.

Wireless Access Point and Wireless Repeaters, Pole Mounted, will be measured by the number in place, fully installed, tested and accepted with all components, including mounting on the pole, batteries, ITS Enclosures

with all interior components and cables and all power and communications wiring between the TS-WAP and the nearest junction box or junction box foundation.

In-Pavement Wireless Sensors will be measured by the quantity of each installed.

ITS Equipment Platforms will be measured by the quantity of each installed.

Removal of common electrical and communication components that serve multiple sign systems will not be measured; the costs for removal of these common components shall be distributed among the various sign system removal items.

Spare Parts will be on a lump sum basis, for all parts delivered as a complete package. Payment will not be made until preliminary acceptance of all signs and ITS devices has been completed, and the Engineer has received a copy of the receipt issued by the Authority indicating that the Spare Parts have been delivered.

605.05 Payment.

Payment will be made under:

PAY ITEM	PAY UNIT
VARIABLE MESSAGE SIGN INSTALLATION	EACH
VARIABLE SPEED LIMIT SIGN INSTALLATION	EACH
HYBRID CHANGEABLE MESSAGE SIGN INSTALLATION	EACH
SYSTEM CONTROL CABINET INSTALLATION	EACH
SYSTEM MANUFACTURER INSTALLATION AND TESTING (NO BID)	USD
EXPANSION MODULE, TYPE_____	EACH
CCTV CAMERA, ITSS MOUNTED	EACH
CCTV CAMERA, POLE MOUNTED	EACH
CCTV CAMERA, POLE MOUNTED WITH LOWERING DEVICE	EACH
TRAFFIC SENSOR WIRELESS ACCESS POINT, ITSS MOUNTED	EACH
TRAFFIC SENSOR WIRELESS ACCESS POINT, POLE MOUNTED	EACH
TRAFFIC SENSOR WIRELESS REPEATER, POLE MOUNTED	EACH
IN-PAVEMENT WIRELESS SENSOR	EACH
REMOVAL OF _____ SIGN SYSTEM, BRIDGE MOUNTED	EACH
REMOVAL OF _____ SIGN SYSTEM, GROUND MOUNTED	EACH
REMOVAL OF _____ SIGN SYSTEM, OVERHEAD SIGN STRUCTURE MOUNTED	EACH
ITS EQUIPMENT PLATFORM, TYPE _____	EACH
POLE MOUNTED ITS CABINET	EACH
SYSTEM CONTROL CABINET (SCC)	EACH
SPARE PARTS	LUMP SUM

Payment for Variable Message Sign Installation, Variable Speed Limit Sign Installation, Hybrid Changeable Message Sign Installation and System Control Cabinet Installation shall be made after successful completion of the Partial Acceptance Testing for each connected system.

Payment for furnishing and installing the Network Switch core unit includes two (2) AC input power supplies, all necessary SFP communication interface modules and a 19-inch rack mounting kit.

No separate payment will be made for furnishing and installing power and communications cables between the DMS sign on the structure and the controllers in the SCC cabinet, but all cost thereof shall be included in the various sign installation pay items.

No separate payment will be made for furnishing and installing conduits within the ITS equipment platform, but all cost thereof shall be included in the price bid for ITS Equipment Platform pay item.

No separate payment will be made for furnishing and installing power cable between outer and inner SCC cabinet, but all cost thereof shall be included in the inner sign installation pay item.

Payment for CCTV Cameras, Wireless Access Points, Wireless Repeaters, and In-Pavement Wireless Sensors shall be made after successful completion of the Final Acceptance Testing for each connected system.

Payment for lighting standards, pole with lowering device and foundations used for pole mounted devices shall be paid for separately in accordance with Section 602.

Payment for the removal of sign mounting hangers, bridge mounted sign supports, and ground-mounted sign posts and foundations associated with the removal of Electronic Sign Systems shall be included under "Removal of _____ Sign System, _____".

Removal of Overhead Sign Structures shall be paid as specified in Section 406.

Foundations for pole-mounted CCTV cameras, Wireless Access Points, and Radio Antennas will be paid separately as per Section 601.

Furnishing and installation of all conduits, wiring, foundations, and other electrical work within the VMS Equipment Median shall be as specified in Section 508.

No separate payment will be made for the Contractor's work under the System Manufacturer Installation and Testing pay item. All payment made to the Contractor under this item shall be passed through by the Contractor to the Sign Manufacturer. Payment for Contractor's work under this item, including but not limited to coordination with the Sign Manufacturer, and provision of labor and materials to execute acceptance testing for the Dynamic Sign Systems shall be included in the various Dynamic Message Sign installation pay items.

No separate payment will be made for the testing, integration, and configuration of CCTV and Traffic Detection equipment, including equipment manufacturer services, travel, and other work. All costs for this work shall be included among the various CCTV and Traffic Detection Systems pay items.

No separate payment will be made for furnishing and installing the video encoder, fiber termination panel , power supply, cables and other appurtenances within the ITS Enclosure, but all costs thereof shall be included in the CCTV camera item

Communications cable and surge protector between the Wireless Radio and SCC will not be measured or paid separately.

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SECTION 701 - TREE CARE

701.01 Description.

Tree care shall include selective thinning, trimming, and renovation of existing trees in the areas shown on the Plans, or designated by the Engineer.

Selective thinning shall include the removal of live and dead trees, both standing and fallen, shrubs, and other vegetation and debris outside the limits of clearing and grubbing.

Trimming existing trees shall include the complete removal of all defective or undesirable limbs and the repair of all injuries or wounds on existing trees as directed by the Engineer.

Tree renovation shall consist of pruning and straightening existing trees; weeding, fertilizing, watering and mulching existing trees; spraying insecticide and rodent repellent, as required, and other incidental renovation work, as shown on the Plans or as directed by the Engineer.

701.02 Materials.

Materials shall conform to the following Subsections:

TREE PAINT 919.01
PESTICIDE 919.18
PLANTING PACKETS 919.19
WOOD CHIPS 919.31
WATER 905.04

701.03 Methods of Construction.

All diseased, dead, broken, and seriously injured branches shall be trimmed. Healthy low branches shall not be removed, except as otherwise directed by the Engineer. All wounds over one inch diameter shall be painted with tree paint. The bark around all wounds and other injuries shall be traced and treated in accordance with approved arboricultural practice as outlined by the local Cooperative Extension Service. All pruning tools and methods employed shall also be in accordance with arboricultural practice, as outlined by the local Cooperative Extension Service and shall be subject to the approval of the Engineer.

All tree trimming work shall be supervised by an arborist certified with the International Society of Arboriculture or licensed in the jurisdiction where the project is located, as determined by the Engineer.

Burning will not be permitted. The removal and disposal of elm trees shall be as specified in Subsection 201.03(A). No materials, except tree stumps, shall be buried within the right-of-way. Burial areas shall be satisfactory to the Engineer. All wood materials shall be chipped and either stockpiled or spread in areas to be reforested where shown on the Plans, or as designated by the Engineer. All other materials shall be disposed of by the Contractor at sites to be provided by the Contractor outside and out of sight of the Turnpike right-of-way in a manner satisfactory to the Engineer and to the owner or agency having jurisdiction over the disposal site(s).

Any damage caused by the Contractor's operations to other vegetation, or to structures or property shall be repaired by the Contractor without additional compensation. Damage to existing trees shall be repaired as specified herein. Damage to existing grass areas shall be repaired and restored by the Contractor to the condition of surrounding areas.

(A) SELECTIVE THINNING.

Remove trees, shrubs, and other vegetation as directed by the Engineer. Trees shall be carefully felled to prevent damage to adjacent vegetation, structures, and property. Trees, stumps, and all debris shall be removed in a manner that will not compact or disturb the soil adjacent to trees and shrubs to remain.

In open areas, stumps shall be completely removed. The stump hole shall be backfilled to the adjacent ground surface. In wooded areas, stumps shall be cut off at the existing ground surface.

All trees to remain within the areas designated for selective thinning shall be trimmed to remove all dead and undesirable limbs up to a height of 16 feet above ground. The Engineer will determine which live limbs are undesirable.

Within the areas of selective thinning, any and all trees that may have died between the time of selective thinning, and prior to the time of acceptance of the Contract, shall be removed by the Contractor. Such tree removal shall be considered a part of the work of selective thinning.

(B) TREE RENOVATION.

Unless otherwise directed, existing trees to be straightened shall be carefully dug to the depth required to properly align each tree and staked or guyed, in accordance with typical details shown on the Plans for new plantings.

The trunk, branches and foliage of all renovated trees shall be sprayed with an approved rodent repellent, insecticide and/or fungicide, as directed by the Engineer.

Weeding and cultivating shall consist of removing by hand all wood and grass plant material, including roots from the tree planting beds and raking the areas to an even surface. The limits of planting beds shall be defined as a point two feet in any direction from a renovated tree. As an alternate, herbicide conforming to Subsection 919.18, when approved by the Engineer, shall be used to kill existing weeds and grass in the area of the planting beds.

Fertilizer planting packets shall be placed at each existing tree. The method of placement shall be as specified in Subsection 705.03(H). Wood chip mulch shall be evenly spread over each existing tree bed. The minimum layer thickness of wood chip mulch to be applied shall be four inches. Wood chip mulch shall be placed around renovated trees within the area of the planting bed.

701.04 Measurement.

The quantity of Selective Thinning will be measured by the areas thinned.

The quantity of Trimming Existing Trees will be measured by the number of trees in each caliper range completely trimmed and treated. The diameter measured at 4-1/2 feet above the ground shall determine the caliper of the trees.

Tree Renovation will be measured by lump sum.

Any tree measured for payment under tree renovation will not be measured for payment under the item trimming existing trees.

701.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SELECTIVE THINNING	ACRE
TRIMMING EXISTING TREES, __" TO __" CALIPER	EACH
TREE RENOVATION	L.S.

Payment for wood chip mulching will be made in accordance with Section 705.

SECTION 702 - TREE WELLS AND TREE WALLS

702.01 Description.

Tree wells and tree walls shall include the construction of rubble, modular retaining wall or concrete block walls, as shown on the Plans, or as directed by the Engineer. Excavation and filling in the vicinity of trees which are to be provided with tree well or tree wall protection shall be delayed until the work under this Section has progressed to an acceptable stage.

Tree walls shall be constructed to protect trees where the existing grade is being lowered in the vicinity of the trees.

Tree wells shall be constructed to protect trees where the existing grade is being raised in the vicinity of the trees.

702.02 Materials.

Materials shall conform to the following:

TREE PAINT	919.01
CEMENT FOR MORTAR	919.02
AGGREGATES	919.03
SUBSURFACE DRAIN	919.04
RUBBLE STONE	919.05
CONCRETE BLOCK	916.01

RETAINING WALL SYSTEM 919.47

702.03 Methods of Construction.

Rubble and concrete block tree wells and tree walls shall be constructed, as shown on the Plans.

The masonry pattern shall be rubble or course squared stone with joints not more than 1-1/2 inches wide. Horizontal surfaces shall slope downward to the rear at the rate of 1-1/2 inches per horizontal foot. Spaces between stones shall be filled with spalls, neatly fitted into place, except that no spalls shall be used in the exposed face. Concrete block walls for tree wells and tree walls shall be constructed with 1/2 inch wide mortar joints throughout, except that every third vertical joint in the bottom course shall be left open for drainage.

The minimum number of roots shall be cut to accommodate tree wall construction. Roots which are cut shall be cleanly cut and root cuts over one (1) inch in diameter shall be painted with tree paint. Roots exposed to air before backfilling shall be kept moist by the use of wet burlap or other suitable material.

An aeration layer consisting of coarse gravel or broken stone ranging in size from one-half inch to five inches, covered with a layer of hay shall be placed outside the tree well as shown on the Plans. Where shown on the Plans, subsurface drain shall be placed before the aeration layer and fill is placed.

702.04 Measurement.

Rubble Tree Wells, Rubble Tree Walls, Concrete Block Tree Wells, and Concrete Block Tree Walls will be measured by the volume of rubble stone or concrete block constructed.

Retaining Wall System will be measured by the total number of square feet of exposed wall face area. No quantity other than the exposed wall area will be measured for payment.

702.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
RUBBLE TREE WELLS	CUBIC YARD
RUBBLE TREE WALLS	CUBIC YARD
CONCRETE BLOCK TREE WELLS	CUBIC YARD
CONCRETE BLOCK TREE WALLS	CUBIC YARD
RETAINING WALL SYSTEM	SQUARE FOOT

No separate payment will be made for the retaining wall system gravel leveling pad, excavation, backfill, drainage pipe, adhesive or other incidentals.

SECTION 703 - TOPSOILING

703.01 Description.

Topsoiling shall include the work of furnishing all topsoil material, preparing for use as topsoil any material obtained from stripping described in Section 202, shaping and dressing preparatory to topsoiling and placing topsoil to a compacted thickness of 4 inches.

703.02 Materials.

Materials shall conform to the following subsection:

TOPSOIL 919.07

703.03 Methods of Construction.

Storage of topsoil shall conform to Subsection 202.03. The storage piles of topsoil and the areas from which stored topsoil has been removed, within the right-of-way limits of the Project, shall be limed, fertilized, and seeded, in accordance with Section 704.

Topsoil shall not be placed until the area to be topsoiled has been shaped and dressed. Shaping and dressing shall include grading to required lines and elevations, tilling to a depth of 3 inches, removal of stones two (2) inches or larger in any dimension, and the removal of all other debris such as wires, cables, loose tree roots, pieces of concrete, clods, lumps and other unsuitable material.

The topsoil shall be spread on the shaped and dressed surface in a uniform layer that will produce a compacted thickness of four (4) inches. All surfaces shall then be raked and compacted to a smooth even surface, free from any depressions that would collect water, conforming to the prescribed lines and grades. After shaping and grading, all trucks and other equipment shall be excluded from the topsoiled areas.

The Contractor shall coordinate topsoiling and finishing operations with the seeding and sodding work so as to minimize erosion. Where any topsoil area becomes eroded before final acceptance of the Contract, the Contractor, at his own expense, shall make repairs as directed by the Engineer.

Topsoil in excess of the quantity required for the Project shall be stored in neatly graded storage piles for future use by the Authority, or disposed of as directed by the Engineer. All waste material and debris, resulting from the topsoiling operation, shall be disposed of in accordance with the applicable provisions of Subsection 203.03.

703.04 Measurement.

The quantity of Topsoil will be measured by the surface area of topsoil placed, regardless of source.

703.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TOPSOIL	SQUARE YARD

SECTION 704 - SEEDING AND SODDING

704.01 Description.

Seeding shall include furnishing and placing seed, fertilizer, lime, mulch and other materials as specified and performing related work.

Sodding shall include finished hand raking, furnishing and placing sod, fertilizer and performing related work.

704.02 Materials.

Materials shall conform to the following Subsections:

LIME	919.08
FERTILIZER	919.09
SEED	919.10
SOD	919.12
MULCH	919.13
EMULSIFIED ASPHALT	919.15
EMULSIONS & GELS	919.16
FIBER MULCH	919.14
WATER	905.04

704.03 Methods of Construction.

Seeding and sodding shall be performed in accordance with the following:

(A) SEEDING AND MULCHING.

When the item Seeding is scheduled in the Proposal, the area(s) designated on the Plans for seeding shall be prepared by raking the previously placed topsoil, or existing ground to be seeded, to remove any debris and compacting the soil to a smooth even surface. Immediately following topsoiling operations or ground preparation, fertilizing, liming, and seeding shall commence.

When the soil to be seeded has a pH value of less than 5.8, sufficient lime shall be evenly spread to increase the soil pH value to 6.5. The pounds of lime per acre required to raise the pH of a 4 inch layer of different soil textural classes to approximately 6.5 are as follows:

Soil (pH)	Loamy Sand	Sandy Loam	Loam	Silty Loam
5.7	750	1500	2250	3000
5.3-5.6	1500	2600	3750	4500
4.9-5.2	2250	3750	5250	6000
4.5-4.8	3000	4500	6750	7500

Soil (pH)	Loamy Sand	Sandy Loam	Loam	Silty Loam
4.1-4.4	3750	5250	8250	9000

The quantity of lime required may be reduced proportionally, if the magnesium and calcium oxide content is greater than 40%.

Fertilizer for establishing turf shall be limited to one commercial ratio selection throughout the Project. Fertilizer shall be applied in accordance with Subsection 919.09.

(1) Soil Preparation.

All areas to be seeded shall be cultivated to provide a reasonably firm, but friable seedbed. The depth of cultivation shall be 3 to 4 inches. On slopes steeper than 3:1, the Engineer may direct the depth of cultivation to be reduced. All areas to be seeded shall meet the specified finish grades and shall be free of any weed or plant growth, stones of 2 inches in any dimension or larger, or other debris.

(2) Seeding Seasons.

Seeding shall be completed from March 1 to May 15, and from August 15 to October 15. The Engineer may permit seeding at other times when weather and soil conditions are suitable. The Engineer shall be notified at least seventy-two (72) hours in advance of where and when the seeding is to be done.

(3) Application.

All seed mixtures shall be uniformly sown at a minimum rate of 125 pounds per acre. Seed and fertilizer may be placed by either of the following methods, except that Type L seeding shall be placed by the dry method:

(a) Hydraulic Method.

The seed and fertilizer shall be mixed in water and then applied under pressure at the specified rates. Any area inadequately covered shall be retreated.

(b) Dry Method.

Mechanical seeders, seed drills, landscape seeders, cultipaker seeders, and fertilizer spreaders may be used when seed and fertilizer are applied in dry form. Fertilizer shall be spread separately.

Hand operated seeding devices may be used when seed and fertilizer are applied in dry form on areas which are inaccessible to mechanical seeders.

Finished seeded areas shall be smooth and shall conform to the prescribed lines and elevations. All seeded areas shall be mulched.

(4) Mulching.

Mulch materials shall be spread evenly over all seeded areas within twenty-four (24) hours after seeding is done.

The straw or salt hay mulch shall be placed to a depth, measured immediately after application, of one to two (1-2) inches, and bound in place with one application of binder material applied the same day as mulch. Binder material shall not be applied during rain or in freezing weather.

Synthetic plastic emulsion shall be applied by hydraulic pressure equipment at a rate of 30 gallons (264 lbs.) of undiluted material per acre. The synthetic binder shall be diluted in water at a ratio of 1:15.

Vegetable based gels shall be mixed with water and applied by hydraulic pressure equipment. The vegetable gels shall be used as recommended by the manufacturer except that no less than 40 pounds of the dry material shall be thoroughly mixed in 750 gallons of water per acre.

In areas where pedestrian traffic would make the use of asphaltic binder objectionable, a small quantity of topsoil shall be spread on the mulch to secure it in place.

Fiber mulch may be used only with the approval of the Engineer, and shall be mixed with water and applied by hydraulic equipment. The fiber mulch shall be used as recommended by the manufacturer, except that no less than 400 pounds of the dry product shall be used per acre. Fiber mulch shall not be applied with the seed/lime/fertilizer mixture.

No mulch shall be placed in areas designated on the Plans to receive soil stabilization matting. All mulch shall be left in place and allowed to disintegrate, except that excessive amounts of salt hay or straw shall be removed when directed by the Engineer.

(5) Care During Construction.

The Contractor shall be responsible for a satisfactory growth of grass on all areas seeded under the Contract until final acceptance of the Contract. Any seeded area which, in the opinion of the Engineer, does not show a satisfactory growth of the type of grass specified in the seed mixtures and/or has excessive weeds, and/or has washouts or gullies, shall be reseeded by the Contractor, as directed and approved by the Engineer. Reseeding shall include the removal of mulch previously placed and the placing of mulch after the new seed has been sown. The Contractor shall also remove any slide material which has been deposited on seeded areas.

(B) SODDING.

Sod shall be placed immediately after the areas to be sodded have been topsoiled as specified in Subsection 703.03; limed as specified in Subsection 704.03; and fertilized in accordance with Subsection 919.09. Sod shall be harvested, and within 36 hours delivered and placed. Sod shall be laid with staggered joints and pressed closely together. The ends of sod strips shall be matched, so that the ends and sides always lie flush with each other. Sod shall be pressed into the underlying soil by hand tamping and rolling. Then the sodded areas shall be thoroughly watered.

Watering shall be performed as necessary until firm root mass is established. Each watering shall be performed until water infiltrates through the root zone and into the topsoil zone. Watering shall be performed in a manner that provides equal distribution and coverage to all areas sodded. Sod shall not be transplanted when the moisture content (excessively wet or dry) may adversely affect its survival. If the upper half (1/2) inch of topsoil is dry, the soil shall be lightly moistened immediately prior to laying the sod.

The finished surface shall be smooth, even, and to the prescribed lines and contour. Dead, dying, or unhealthy sod, as determined by engineer, shall be replaced immediately without additional compensation.

On slopes, sod placement shall start at the bottom of slope. At the top of slopes, the upper edge of the sod strips shall be turned into the soil and covered with topsoil. On slopes steeper than three horizontal and one vertical, sod shall be held in place with pegs driven flush with the surface of the sod. The pegs shall be not more than one (1) foot apart. No less than two pegs shall be used for each strip of sod.

After a firm root mass is established and before the turf reaches the height of three (3) inches, the area shall be mowed with a machine that will not produce ruts, contribute to soil compaction, or in any way damage the sod. Mowing shall be performed as directed until the time of acceptance of the sod.

Where sod is to adjoin seeding, the sod shall be placed immediately before seeding. Where rain intervenes before or during the placement of sod, the areas shall be repaired before the placement of sod is resumed.

The Contractor shall be responsible for the satisfactory growth of grass on all sodded areas under the Contract until final acceptance of the Contract. Any sodded area which, in the opinion of the Engineer, does not show a satisfactory growth and/or has washouts or gullies, shall be resodded by the Contractor as directed and approved by the Engineer. The Contractor shall also remove any slide material which has been deposited on sodded areas.

(C) WATERING.

Seeding and sodded areas shall be watered as necessary to promote growth.

Water shall be delivered to the site in watertight tanks or tank trucks equipped with a pump and distributor bar or hose and nozzle, capable of distributing the water throughout the entire area to be watered. Water shall be applied uniformly and in such a manner that washing or eroding of the surface does not occur. All equipment shall be operated, so that no damage occurs to any part of the work. Should any damage occur, it shall be promptly repaired at the expense of the Contractor to the satisfaction of the Engineer.

The Contractor may, if permitted by authorities having jurisdiction, obtain water from streams or rivers. The Contractor may also obtain water from hydrants, if permitted to do so by the local authorities having jurisdiction. Approval of the Engineer will be required if water is to be obtained from Turnpike facilities.

(D) MOWING.

For areas which have been seeded or sodded in the Spring season, the Contractor shall mow the grass at such times as the Engineer may designate. Grass shall be mowed to a height of not more than 5 inches or to

a height designated by the Engineer. Unless specifically ordered by the Engineer, grass on slopes 2 horizontal and 1 vertical or steeper shall not be mowed.

Mowing equipment or mowing operations which the Engineer may consider dangerous or injurious to the completed work or work under construction shall not be used. Excessive cuttings shall be removed, as directed by the Engineer.

704.04 Measurement.

The quantity of Seeding will be measured by the surface area seeded, limed, fertilized and mulched as prescribed for each type of seeding.

Sodding will be measured by the area sodded, fertilized, and limed.

Watering will be measured in units of 1,000 gallons (MG). Water may be measured by means of meters, by actual measurement in tanks, tank trucks or other containers, or by computation based on weight.

704.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
SEEDING, TYPE ___	SQUARE YARD
SODDING	SQUARE FOOT
WATERING FOR SEEDING OR SODDING	MG

No separate payment will be made for mowing.

No separate payment will be made for fertilizing, liming, or mulching.

SECTION 705 - PLANTING

705.01 Description.

Planting shall consist of furnishing, delivering, and planting specified trees, shrubs, vines, perennials and other plant material at the prescribed locations. It shall also include a one-year warranty from the date of final acceptance.

705.02 Materials.

Materials shall conform to the following Subsections:

ANTIDESICCANT	919.22
BARK MULCHING	919.39
BROKEN STONE	919.34
FERTILIZER	919.09
FILTER FABRIC	923.21
GUY POSTS	919.23
GUY STAKES	919.24
GUY WIRE	919.25
POLYPROPYLENE STRAP	919.27
LOG OR TIMBER DEADMEN	919.26
PEAT HUMUS	919.32
PEAT MOSS	919.33
PESTICIDE	919.18
PLANT MATERIALS	919.17
PLANTING PACKETS	919.19
MYCHORRIZAL INNOCULANT	919.21
PLASTIC CHAINLOCK TREE TIE	919.20
TOPSOIL	919.07
TREE PAINT	919.01
TREE PROTECTORS	919.11

TWINE 919.28
WATER 919.43
WIRE ROPE 919.29
WOOD CHIPS 919.31
WRAPPING MATERIAL 919.30
COMPOSTED SEWERAGE SLUDGE 919.45
RETAINING WALL SYSTEM 919.47

705.03 Methods of Construction.

All plant material shall be carefully handled and packed in accordance with good nursery practice to prevent injuries during transit. Plant deliveries made on open trucks shall have the entire load completely covered with a well secured tarp. The roots of all bare-root plants shall be properly protected with wet straw, moss, or other suitable material until planted. If not planted on the day of delivery, all bare root material shall be heeled in and well watered, and the plants shall be kept shaded or covered, in a manner acceptable to the Engineer, until planted.

Bare root material shall be given a liquid mud bath 24 hours before planting. This bath should consist of half a 55 gallon drum filled with water and soil and mixed to a consistency, as that of extremely muddy water. This mud bath should be agitated each day before plant material is placed in the drum. The Contractor shall coordinate his work to prevent delays in planting that may expose the roots of plant materials to the air, sun, or freezing conditions.

Plant material shall be stored at the job site for a minimal period of time and in a shaded, protected area. If this storage period is to exceed 5 calendar days, the plants are to be placed ball to ball, mulched with wood chips and thoroughly and routinely watered until planting. The Contractor shall perform all planting in accordance with approved nursery practice as designated by the American Nursery and Landscape Association (ANLA).

(A) TIME OF PLANTING.

Broad leaf and coniferous evergreen trees, shrubs, vines, and ground covers shall be planted between August 15 and October 30 and between March 15 and June 15. Deciduous trees, shrubs, vines, and perennials shall be planted between October 15 and December 1 and between March 15 and June 15. These planting seasons may be extended or shortened by the Engineer if, in his opinion, prevailing weather and soil conditions permit.

During an extension of the spring planting season, plant materials shall be moved with roots balled; the trunk, branches and foliage shall be sprayed with an anti-desiccant, approved by the Engineer, mixed and applied according to the directions of the manufacturer. Trees and shrubs shall be trimmed and thinned to reduce the amount of foliage and help balance the loss of roots due to transplanting.

(B) INSPECTION.

All plant materials will first be inspected by the Engineer at the site where they are growing prior to their removal. The Contractor shall give the Engineer 7 days written notice prior to the removal of plant materials. Trees and shrubs approved will be marked by the Engineer with the Authority's seal. The plant materials will again be inspected upon arrival on the Project.

All plant materials shall be obtained from growing nurseries located within a 150 mile radius or three (3) hour driving time of New Brunswick, New Jersey. The Authority may allow exceptions, in its sole discretion, upon written request to the Engineer prior to the bid opening date. All exceptions granted shall be in writing. In all cases in which the Authority grants an exception, the Contractor shall bear, at its sole cost and expense, any and all costs(including, but not limited to transportation, hotel, meals and incidentals) incurred by the Authority in the inspection of plants at the site where they are growing.

The Contractor shall advise the Engineer not less than twenty-four (24) hours before the arrival of any plant material to the Project. Material arriving with broken seals or broken or loose balls or with shriveled, dry, or insufficiently developed roots, or which are weak thin, damaged, or defective, or which do not comply with the Specifications, will be rejected. The Contractor shall give the Engineer all necessary assistance when inspections are made.

(C) LAYING OUT AND STARTING WORK.

The Contractor and Engineer shall jointly stake out the locations of all plant pits and the outlines of all plant beds and planting areas. If the Contractor stakes out the work, no excavation or cultivation shall be started until the locations and outlines have been approved by the Engineer.

Attention is directed to Subsection 106.17, Utilities. When utility lines are encountered or other subsurface conditions in plant pits are otherwise unsuitable for the particular varieties of plants to be planted, the Engineer at his discretion, will direct the Contractor to plant certain trees or shrubs in raised pits at a grade

higher than the adjacent ground as detailed, or to relocate the plants to be planted in other satisfactory locations.

All trees and deciduous shrubs shall be planted in individual pits.

(D) PLANTING BEDS.

All weeds, grass, as well as more substantial vegetation such as small trees and shrubs, shall be removed and the surface raked and neatly edged, as directed by the Engineer. Planting beds in areas flatter than 4:1 shall, in addition to the above, be cultivated to a depth of 6 inches.

(E) PIT SIZES.

Minimum planting pit sizes for bare root (B.R.) plant materials shall be as follows:

	Height of Plant (Feet)						
	1-4	4-5	5-6	6-8	8-10	10-12	12-14
Diameter of pit, inches	25	27	28	30	33	36	44
Depth of pit, inches	16	17	18	19	20	22	26

Planting pits shall be circular with sides sloped inward. The bottom of the pit shall include a 6 inches high platform of undisturbed soil in the center of the excavation to support root ball, prevent settlement, and assist with drainage, as shown in drawings. Scarify sides of plant pits smeared or smoothed during excavation.

Planting pits for balled and burlapped (B&B) plant materials shall provide a space for not less than twice the size of the root balls. Planting pits for plant material shall provide space for not less than 6 inches of backfill below and around the root-earth clump. Soil from the excavation of planting pits is to be saved and reused as part of the backfill mix unless otherwise directed by the Engineer.

Topsoil from the excavation of planting may be saved and re-used as part of the backfill mix, unless otherwise directed by the Engineer.

All sod, weeds, roots, and other objectionable material unsuitable for back-fill shall be immediately removed and disposed of off the site.

Planting pits for vines, ground covers, and perennials shall be not less than 12 inches in diameter and twelve (12) inches deep.

Planting pits shall not remain open more than 10 days in advance of planting on slopes steeper than 4:1.

In medians or other areas close to the roadway where a hazardous condition may result as determined by the Engineer, planting pits shall not remain open beyond the close of the working day unless adequate precautions are taken to warn of their presence and protect the public from injury.

(F) SUBDRAINAGE.

Subdrainage in pits, when shown on the Plans or ordered by the Engineer, shall consist of excavating planting pits to an additional depth of six (6) inches, disposing of the excavated material, furnishing and backfilling the six (6) inch extra excavation with broken stone, and covering the broken stone with a two (2) inch layer of salt hay.

Subdrainage in trenches, when shown on the Plans or ordered by the Engineer, shall consist of constructing 2 foot average depth "French" drains as follows: topsoil shall be stripped and piled separately; the trench shall be excavated to a width of 12 inches; the trench depth shall equal the depth of the pit at its junction therewith and the bottom shall slope down at a rate of 1/2 per cent to outlet at grade, or to connect with existing drainage systems, as shown on the Plans or directed by the Engineer.

The trench shall be backfilled to a compacted depth of one (1) foot with broken stone and the stone shall be covered with filter fabric. The remainder of the trench shall be backfilled in well compacted, eight (8) inch layers of suitable soil obtained from the excavation and finished by respreading and compacting the stripped topsoil to finished grade; surplus soil shall be disposed of. The disturbed area shall then be prepared and seeded as specified under Subsection 704.03.

(G) ABANDONED PLANTING PITS.

The Contractor shall, when directed by the Engineer, abandon any planting pit after it is partially or fully excavated. Abandoned pits shall be backfilled with the excavated soil placed in eight (8) inch deep, well compacted layers and finished by respreading and compacting the stipped topsoil to finished grade. All

excess material shall be disposed of off-site. The Contractor shall prepare and seed the disturbed area as specified under Subsection 704.03.

(H) BACKFILL.

The contractor has the option of using peat humus and topsoil or composted sewerage sludge and topsoil/subsoil. Composted sewerage sludge from a previously approved source will be delivered to the site, dumped and stored in area(s) previously approved by the Engineer. As planting pits are hand or machine dug, excavated topsoil and subsoil will be thoroughly mixed to a uniform blend. This blend will then be thoroughly mixed with the composted sewerage sludge at a 2 to 1 ratio to create an amended backfill alongside each planting pit. When the pit has been excavated to specified size, the backfill mixture will be placed as described below. Excess backfill will be used to create saucers or watering berms around individual plant pits.

Planting packets shall be placed at a depth of three to four (3- 4) inches, in a circle evenly distributed around each tree, as the backfill is placed. Each tree shall be provided with 1 packet per full caliper inch, or as otherwise directed by the Engineer.

Mycorrhizal Inoculant shall be placed at the rate of one (1) packet per inch of tree caliper. The contents of the appropriate number of packets are to be broadcast on the outside of the rootball, all the way around it, thoroughly mixed into the top 10 inches of the backfill soil prior to backfilling planting pit.

All plants shall be set plumb and straight. Set all planting material at 2 inches above finish grade such that, after settlement, a normal or natural relationship of the crown of the plant with the ground surface will be established.

The roots of bare root plant materials shall be placed in their natural arrangement and the backfilling shall be carefully performed to prevent damage to the plant's root system. Broken or bruised roots shall be pruned immediately with a clean cut. The backfill materials shall be placed in the bottom of the planting pit and shall be worked around the roots and thoroughly compacted as the backfilling proceeds.

For balled materials, the backfill mixture shall be around the balls once the planting material has been set in the pit. Once the planting pits are backfilled, the burlap shall be cut away from the upper half of the root ball and the remainder adjusted to prevent the formation of air pockets. Once complete, remainder of pit should be backfilled and tamped firm.

Immediately prior to planting containerized plant materials, the plant shall be carefully removed from the container and the root mass shall receive three vertical cuts, spaced equally about the perimeter. Each cut, about 1/2 inch deep, shall begin at the top of the root mass and continue to the bottom. The plants shall be set on undisturbed subgrade. Backfill mixture shall be placed around the roots in a manner that will not damage the root-earth clumps.

Earth saucers or water basins at least four (4) inches in depth shall be formed around individual plants, with a diameter equal to that of the plant pit. Material from the planting pit excavation may be used to form the sides of the saucer or berm.

Where the ground is level or on a slight slope, a four (4) inch deep basin with a diameter equal to that of the tree's crown shall be left around each plant. On steeper slopes, the backfill shall be formed into a dam that will catch and hold water around the plant. All plants shall be thoroughly watered the day they are planted. For the purpose of these specifications, the crown is defined as the maximum circumference delineated by the plant's branches at the time of planting.

(I) MULCHING OF PLANT MATERIALS.

Ground cover plants and trees and shrubs within ground cover planting areas shall be mulched with peat moss within 1 day after planting. The peat moss shall completely cover the area of the planting bed, or planting pit when not contained in a bed, to a depth of 2 inches, loose measurement.

Planting pits of individual trees or shrubs, and the entire area where material is planted in beds, shall be mulched within 10 days after planting with either wood chips or bark mulching, spread in a 3-3/4 to 4-1/2 inch thick round layer. Mulch shall extend to the outside diameter of the earth saucers. Mulch displaced prior to the final acceptance of the Project shall be replaced without additional compensation.

(J) PRUNING.

Deciduous trees and shrubs shall be pruned after they are firmly in place to remove one-third to one-half of the previous season's growth, or more as may be directed by the Engineer. The plants shall be carefully pruned to preserve their natural appearance. Pruning shall only be performed by an experienced landscape worker. All cuts shall be made flush, leaving no stubs. Cuts over 1" shall be coated with tree paint.

(K) WRAPPING TREES.

Deciduous trees more than 1-1/2 inches in caliper shall be wrapped except when otherwise designated. Wrapping material shall be wound from the ground line to 6 inches above the lowest main branches. The wrapping shall be tied with twine at the bottom and at the top and at maximum 24 inch intervals between. The trees shall be wrapped within 4 days after planting, but not before the condition of the trunks of the trees has been inspected and approved by the Engineer.

(L) TREE PROTECTORS.

Tree Protectors shall be installed to a height of 2 feet above the ground surface on all newly planted Malus Prunus and Crataegus species to prevent damage from bark consuming rodents.

(M) SUPPORTING TREES.

All trees one (1) inch or more in caliper or more than three (3) feet high shall be staked or guyed immediately after planting. Multi-stemmed, shrub-like trees need not be staked unless otherwise directed by the Engineer. All staking and guying must be removed after two (2) growing seasons. Trees staked for longer than two (2) seasons fail to develop strong roots, have poor trunk taper, and become weakened.

Deciduous trees one to three (1 - 3) inches caliper and evergreen trees, three to eight (3- 8) feet high shall be staked with two guy posts placed on opposite sides of the tree and set not less than twenty-four (24) inches in the ground and twelve (12) inches from the tree trunk.

Deciduous trees three to four (3-4) inches caliper, and evergreen trees over eight (8) feet in height and under four (4) inches caliper, shall be guyed with three guys arranged evenly about each tree and attached securely to guy stakes driven firmly into the ground. The stakes shall be notched to receive the guy wire and shall extend not more than eight (8) inches out of the ground. Stakes shall be driven with the point toward the tree trunk at an angle of 45^{o} with the ground. Each guy shall be made of two strands of wire twisted together.

Deciduous and evergreen trees of four to eight (4 -8) inches caliper shall be guyed with three wire rope guys spaced around the tree and each guy, anchored to a log or timber dead man buried not less than two (2) feet in the ground.

Guys shall be attached to the trees above the lowest branches and shall slope at an angle of approximately 45 degree with the tree trunk. Wire rope guys shall be clearly marked as directed by the Engineer.

The wire or wire rope for staking and guying shall be attached to a polypropylene strap with brass grommets a minimum of 1" wide with an approximate break of 1000 lbs. nominal. Plastic tree tie shall be an acceptable alternate to wire and hose, providing the size and quality of that material is sufficient in the opinion of the Engineer to adequately hold the plants to be braced.

(N) WATERING.

All plants shall be watered thoroughly on the day they are planted. The initial watering at the time of planting shall be at the rate of 10 gallons per square yard of plant pit area. All plants shall be watered once a week thereafter until the work is accepted unless otherwise directed by the Engineer. Each watering, after the first, shall provide 5 gallons of water per square yard in the plant pit area.

More than one watering per week may be required by the Engineer during planting operations or during periods of excessive dryness. If the basin constructed around each plant, as specified elsewhere herein, does not function properly, it shall be repaired by the Contractor. All damage to grass, plants, stakes, guys, mulch or watering basins resulting from the Contractor's operations shall be repaired by the Contractor.

All plants that are not alive and healthy at the end of one year after the date of final acceptance of the completed landscape planting, shall be replaced by the Contractor with material as originally specified, in accordance with the requirements of this Section. The Engineer shall determine which plants are not acceptable. The Engineer may permit substitute varieties of plants to be used.

Replacement of evergreen materials shall be made from March 15 to May 15 and from August 15 to October 30. Replacement of deciduous material shall be made from March 15 to May 15, and from October 15 to December 1.

(O) MAINTENANCE AND REPLACEMENT PLANTING.

At the time of acceptance of the contract, all planting areas shall be free from weeds and properly mulched The Contractor shall properly care for all planting until expiration of the one year warranty period. Contractor shall water, weed, spray with insecticide, fungicide, or herbicide, cultivate, and perform other ordinary maintenance work as may be necessary to keep the plants in a live and healthy condition. Maintenance work necessary to keep the plants in a live and healthy condition shall be performed after 48 hours notice, subject to the traffic provisions as directed by the Engineer.

705.04 Measurement.

Planting of trees or vines of the various species of plants, of each designated height, caliper, or spread, will be measured by the number of each planted.

Bark Mulching and Wood Chip Mulching will be measured by the area actually mulched.

Subdrainage in Pits will be measured by the surface area of additional six (6) inch excavation made and back-filled.

Subdrainage in Trenches will be measured by the surface area of trenches (regardless of depth) excavated and backfilled.

Abandoned Plant Pits will be measured by the volume of plant pits abandoned.

Watering will be measured in units of 1,000 gallons (MG). Water may be measured by means of meters, by actual measurement in tanks, tank trucks or other containers, or by computation based on weight.

705.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
PLANTING, _____	EACH
WOOD CHIP MULCHING	SQUARE YARD
BARK MULCHING	SQUARE YARD
SUBDRAINAGE IN PITS	SQUARE FOOT
SUBDRAINAGE IN TRENCHES	LINEAR FOOT
ABANDONED PLANT PITS	CUBIC FOOT
WATERING FOR PLANTING	MG

No separate payment will be made for topsoil used for planting.

SECTION 706 - SOIL STABILIZATION MATTING

706.01 Description.

Soil stabilization matting shall include furnishing, placing, anchoring, securing and stapling matting for temporary and permanent erosion control on prepared and seeded surfaces as designated on the plans or as directed by the Engineer..

706.02 Materials.

Materials shall conform to the following Subsections:

MATTING	919.35
STAPLES	919.36

706.03 Methods of Construction.

Before the matting is placed in position, the soil shall be smooth, soft and free of depressions, clods, mounds, stones, or other debris which will prevent the matting from making complete contact with the soil. After the soil has been properly, fertilized and the seed mixture(s) have been broadcast as specified in Subsection 704.03, the matting shall be laid in the appropriate positions over seeded areas of steep slopes, waterways, around drop inlets, along the top of berms, or other areas as shown on the Plans, or designated by the Engineer.

When jute mesh is being laid, the upper end or edge of each strip shall be anchored by burying it in a slot six (6) inches deep. Joints between strips shall be made by lapping the edge of the upper strip approximately six (6) inches over the anchored edge of the lower strip to form a shingle like effect. When laid parallel, the matting shall overlap from three to six (3- 6) inches.

Jute matting placed as ditch lining shall have joints made with a twelve (12) inch minimum lap and transverse check slots shall be provided, at fifty (50) feet intervals in the direction of flow, by folding the matting into a transverse slot six (6) inches deep. Check slots shall also be provided around inlets and other critical locations subject to undercutting. The bottom end or edge of each complete run shall be anchored as specified for the upper edge of each strip. The soil shall be tamped into all slots.

When excelsior matting is being laid, the material shall be unrolled in the direction of the flow of water. Where laid end to end, the adjoining ends shall be butted snugly. When laid parallel, the matting shall be butted snugly.

For Permanent Soil Stabilization Matting, the contractor shall submit an installation plan for review and approval. The installation procedures shall be based on soil conditions, Manufacturer's recommendations, and procedures and the Guidelines for Installing Rolled Erosion Control Products published by the Erosion Control Council. The installation plan shall include the specifications for the C-TRM, staples and stakes. For the initial 1,000 square feet of placement, a representative from the C-TRM shall be on site to supervise and to assist the Contractor to ensure that proper installation procedures are being followed.

The Contractor shall lightly roll the matting into the soil surface to insure complete contact with the soil at all points. The edges of every matting strip shall be stapled so as to anchor the matting flush with the ground. Staples shall be spaced approximately twenty four to thirty-six (24-36) inches on center except along overlapping edges where they shall be approximately twelve (12) inches on center. Staples shall be driven at an angle of approximately 30 degrees from the perpendicular to grade and shall be driven flush with the surface of the matting. Care shall be taken so as not to form depressions or bulges in the surface of the matting. Edges of slots shall be secured by stapling ten (10) inches on center. The edges of matting strips, at channel intersections, where concentrated water flow is apt to enter from the sides shall be protected by laying a short length of matting at the foot of the entering waterway, abutting the main channel, and anchoring the ends in slots six (6) inches deep.

After laying the matting, the covered areas shall be given a second application of the seed type specified for that location at the rate of 1/2 of that specified in Subsection 704.03(A)(3). The matting shall be left in place after the stand of grass is established.

If any staples become loosened or raised, or if any matting becomes loose, torn, or undermined, satisfactory repairs shall be made immediately. Areas damaged by the Contractor's vehicles, by erosion or other causes, shall be repaired to the required grade and condition as directed by the Engineer.

706.04 Measurement.

Soil Stabilization Matting of the various types will be measured by the surface area covered with matting.

706.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TEMPORARY SOIL STABILIZATION MATTING	SQUARE YARD
PERMANENT SOIL STABILIZATION MATTING	SQUARE YARD

No separate payment will be made for the second application of seed.

SECTION 707 - TIMBER PLANTER CONSTRUCTION

707.01 Description.

Timber planter construction shall include furnishing and placing timber planter. This item may include the construction of timber planters, timber walls and timber curbs. The timber walls are to contain bracing perpendicular to the wall face called deadmen every third course or as directed by the Engineer.

The size and number of timbers required shall be as shown on the plans.

707.02 Materials.

Materials shall conform to the following Subsections:

TIMBER	919.37
TOPSOIL	919.07
PEAT HUMUS	919.32

707.03 Methods of Construction.

All timber shall be accurately cut and framed to a close fit in such a manner that the joints will have even bearing over the entire contact surface. No blocking or shimming will be allowed in joints. Timbers shall be neatly cut with a chain or circular saw. Corner joints shall overlap and all linear joints shall be staggered from previous courses. Twelve-inch galvanized spikes shall be used at all joints.

Cuts, abrasions, and other surface breaks shall be trimmed carefully.

The Contractor shall place specified backfill in timber planters to an elevation of ± four (4) inches below top of planter.

707.04 Measurement.

Timber Planter construction will be measured on a lump sum basis.

707.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
TIMBER PLANTER CONSTRUCTION AT _____	LUMP SUM

SECTION 708 - STEEL EDGING

708.01 Description.

Steel edging shall be furnished and installed as a divider and edge for various areas.

708.02 Materials.

Steel edging shall conform to Subsection 919.38.

708.03 Methods of Construction.

Steel edging shall be installed as shown on the Plans prior to installing the various paved areas, lawns, and mulches. Setting and anchoring the steel edging shall be in accordance with the manufacturer's recommendations.

708.04 Measurement.

Steel Edging will be measured by the length installed.

708.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
STEEL EDGING	LINEAR FOOT

SECTION 709 - LANDSCAPE PAVING

709.01 Description.

Landscape paving shall consist of furnishing and placing block pavers, brick, or gravel on a prepared base.

709.02 Materials.

Materials shall conform to the following Subsections:

BRICK PAVERS	919.44
BLOCK EDGING	919.46
CEMENT FOR MORTAR	919.02
BLOCK PAVERS	919.40
GRAVEL	919.43
SAND	919.41
WEED BARRIER	919.06

709.03 Methods of Construction.

Areas where block pavers are to be installed shall be excavated to a depth of ± eight (8) inches below the bottom of block. The subgrade shall be compacted with an approved mechanical vibrator to provide a firm base. The Contractor shall then provide a six (6) inch compacted stone layer; a two (2) inch layer of sand or stone dust shall be screeded over the stone base. The blocks shall be hand-laid with care to insure proper alignment with the top of the block three quarters (3/4)of an inch above final grade. The block shall be vibrated to lower the block to the final grade. Dry sand or stone dust shall be swept into the joints so that all voids are filled. Excess sand shall be removed.

Where gravel is to be placed, the finished grade shall be established by hand raking of the planting bed. Weed barrier shall be installed to cover the entire bed. All edges shall overlap a minimum of three inches. Gravel shall then be spread evenly to a three-inch minimum depth. No weed barrier shall be visible through the gravel or at the edge of the gravel area.

Brick shall be dry laid on a four (4) inch base of sand in the pattern(s) shown on the Plans. The soil subgrade shall be established four (4) inches below the bottom of the brick walk, and shall be covered with a weed barrier prior to the sand base being placed so that the top of the brick is equal to the top of the adjacent sidewalk, curb or edging. The brick is to be butted tightly as it is installed and is to fit between timber planters, block edging, sidewalk and curb so as not to move. A 4:1 sand-cement mixture shall be swept across the top of the butted brick to fill all small voids which may exist. The brick shall be gently sprayed with water and more of the mixture added as needed.

709.04 Measurement.

Block Paving, Gravel Paving and Brick Paving will be measured by the surface area of the various types of paving installed.

709.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
BLOCK PAVING	SQUARE YARD
GRAVEL PAVING	SQUARE YARD
BRICK PAVING	SQUARE YARD

Unless specified in the Contract Documents, no separate payment will be made for the furnished and prepared sub-base, edging or any incidentals.

SECTION 710 - BLOCK WALL

710.01 Description.

Block Wall shall consist of furnishing, delivering, and installation of the specified modular, concrete wall system.

710.02 Materials.

RETAINING WALL SYSTEM 919.47

710.03 Methods of Construction.

Block Wall shall be laid out as shown on plans and gravel leveling pad installed. Wall units shall then be laid up with pinning units installed at each course. Drainage pipe and gravel shall be installed at the lower portion of each wall. More gravel is to be installed behind the wall until it reaches the maximum number of courses as shown on the plans. Cap units shall then be installed using the specified concrete block adhesive. Additional topsoil fill shall be added behind the wall to create a consistent grade from the bottom of the cap unit to the top of the existing grade along the building face. All courses to be level in both directions with tops of blocks forming in a straight line throughout the wall.

710.04 Measurement.

The quantity of Block Wall will be measured by the area of block wall constructed measured along the front face of the block wall.

710.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
BLOCK WALL	SQUARE FEET

No separate payment will be made for the gravel leveling pad, excavation, backfill, drainage pipe, adhesive or other incidentals.

SECTION 711 - IRRIGATION SYSTEM

711.01 Description.

The work shall consist of furnishing and installing a complete and workable irrigation system in accordance with the Plans and Specifications.

Work includes excavating and backfilling, layout for construction, furnishing and installing underground pipe and fittings; Controller, electrical conduit and conductors; all necessary connection needed in plumbing and electrical work; and, testing and programming entire system.

711.02 Materials.

All exterior piping shall be PVC pressure pipe at working pressure of 160 psi in accordance with ASTM Designation D2241.

Fittings shall be PVC socket-type, conforming to ASTM Designation D2467, Schedule 80 or ASTM Designation D2644, Schedule 40.

Manual shut-off valve to be a copper sweat ball valve, Apollo #70-208-01, 2 inches or smaller, or approved equal.

All water piping within the building, from the house connection to the first valve box outside the building, shall be type "L" seamless hard drawn copper, conforming to standard dimensions, weights and tolerances of ASTM Designation B43. Fittings shall be soldered with 95 percent tin – 5 percent antimony solder. No lead solder to be used.

The spray heads, drains and solenoid valves and controller shall be as specified in 919.48. The quantities are as shown on the plans.

Plastic valve boxes and covers shall be as specified in 919.49.

All wiring conductors shall be single strand, soft drawn or annealed copper conductors having insulation that shall be flame retardant, moisture resistant, corrosion resistant, and suitable for direct burial in earth such as Underwriters' Laboratories approved UF. The insulated conductors shall be #14 AWG rated for 600 volts use. The Contractor shall install conductors in a continuous run. Splicing will not be permitted.

711.03 Methods of Construction.

The Contractor shall supply and install the automatic controller for the irrigation system at the location designated by the Engineer. The Contractor shall install controller, as shown on the Plans and as directed by the Engineer. The Controller shall be mounted near existing duplex electrical outlet to be supplied by the Authority.

Water service to be obtained from mechanical rooms in the utility buildings or other sources. Irrigation system to be connected to the cold water supply as directed by the Engineer.

The Contractor shall provide layout for the construction of the entire irrigation system and receive approval of the locations from the Engineer prior to any trenching.

Furnish and install all sleeves for piping passing through outside building walls below grade. Sleeves to be properly sealed and watertight as is piping which passes through the sleeve. Method to be previously approved by the Engineer.

All interior plumbing work shall be performed in accordance with applicable plumbing codes and insulated as follows:

(A) Insulate the new cold water pipe within the building with 1" thick fiberglass, one-piece insulation having a factory applied all service vapor barrier jacket (ASJ). Insulation shall be as specified in 919.50.

(B) All insulation shall be applied over clean dry surfaces, butting all sections or surfaces firmly together and finishing as specified. Adhesives shall be as specified in 919.50.

(C) Piping shall be tested before insulation is applied or joints shall be left uncovered until tests have been performed.

(D) Contractor shall be required to remove and replace all insulation not applied in strict accordance with manufacturer's specifications or not presenting a neat appearance.

(E) All insulation on indoor work shall have composite fire and smoke hazard ratings, as tested by Procedure ASTM E-84, NFPA 255 and UL 73, not exceeding flame spread of 25, fuel contributed of 50 and smoke developed of 50. Accessories, such as adhesives, mastics, cements, tapes and cloth for fittings shall have component ratings as listed above.

(F) Specified mastics, adhesives and coatings shall be applied in strict accordance with manufacturer's instructions, including recommended coverages.

(G) Adhere the factory applied vapor barrier jacket lap smoothly and securely at the longitudinal laps, with 3 inches wide butt joint strips over all end joints with EPLUX CADALAG 336 adhesive or similar to insure a continuous vapor barrier.

(H) SETON "SETMARK"

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Pipe shall be run neat and square and shall not obstruct other valve handles, motor operators, access doors, smoke detectors, etc.

Trenching shall be done to a depth as shown on the Plans and maximum width of 12 inches. All foreign materials such as stone, vegetation or inorganic materials shall be removed before placing any pipe. Trenching operations shall be carried out in a manner that will minimize damage to surrounding lawn, shrubs and trees.

Pipe, conduit and wires shall be placed at the depth and location as shown on the Plans.

Where a sleeve for PVC piping is to be installed under pavement, installation shall be done by jacking. The method of jacking shall be submitted to the Engineer for approval before installation.

Sprinkler heads shall be installed at the location shown on the Plans or as otherwise located by the Engineer. Installation of sprinkler heads and valves shall be in accordance with the manufacturer's installation procedure.

All solenoid valves shall be enclosed within a valve box as specified.

All wiring to the controller shall be factory color coded plugs and sockets.

Install a #12 AWG tracer wire adjacent to all long runs of PVC buried piping. Pigtail the end of the tracer wire above grade for tracing equipment connection.

All electrical work shall conform to the requirements of the National Electrical Code. Allowance for expansion and contraction shall be made by the contractor. Provide a minimum of two feet of slack at each splice. All splices shall be totally waterproof.

Upon completion of all work, the entire system shall be tested in the presence of the Engineer to assure proper operation. The system shall then be programmed by the Contractor, as directed by the Engineer.

711.04 Measurement.

Irrigation system installation will be measured on a lump sum basis and will include all trenching and backfilling. Topsoil and seeding will be paid for separately.

711.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
IRRIGATION SYSTEM	LUMP SUM

SECTION 712 - BLOCK EDGING

712.01 Description.

Block edging shall be furnished and installed as a divider and edge for various areas.

712.02 Materials.

Block edging shall conform to Subsection 919.46.

712.03 Methods of Construction.

Block edging shall be installed as shown on the Plans prior to installing the various paved areas, lawns, and mulches. Setting and anchoring the block edging shall be in accordance with the manufacturer's recommendations.

712.04 Measurement.

Block Edging will be measured by the length installed.

712.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
BLOCK EDGING	LINEAR FOOT

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SECTION 801 – TRAFFIC CONTROL ON AUTHORITY ROADWAYS

801.01 Description.

The work includes furnishing and/or placing traffic protection devices for short-term and long-term work zone and high-intensity construction cycle (HICC) closings which include ramp (half-width), mainline lane and shoulder closings; furnishing personnel immediately and solely employed for the maintenance of the devices and protection of the traveling public; the transportation of devices to and from the site of the Project; moving devices from one position to another as required; and the continual maintenance and subsequent removal of all devices. Work shall also include providing flaggers at ramp gates for Authority-installed Roadway Closings and providing, maintaining and replacing truck-mounted, temporary and quad-guard attenuators. Unless otherwise noted, all traffic protection devices shall be furnished, installed, maintained and removed by the Contractor.

The work shall also include furnishing, placing/installing, removing and maintaining traffic protection devices at locations not shown on the Plans that may be required for completion of "If and Where Directed by the Engineer", "Force Account", and "Emergency" work as determined by the Engineer.

801.02 Materials.

Materials shall conform to the following subsections:

ALUMINUM ALLOYS 911.01

ARROW BOARD 920.11

BATTERIES 920.05

CONCRETE BARRIER 920.08

FLAGS 920.09

FLASHING LIGHTS 920.04

FOLDING SIGN STANDS 920.07

IMPACT ATTENUATORS (QUADGUARD) 524

MODULAR GLARE SCREEN SYSTEM 920.17

PORTABLE VARIABLE MESSAGE SIGNS 920.19

REFLECTORS 923.18

SAFETY VESTS 920.03

SIGNS AND OVERLAY PANELS 920.06

TEMPORARY PAVEMENT STRIPING 920.10

TRAFFIC CONES 920.01

TEMPORARY IMPACT ATTENUATOR 920.15

TRUCK MOUNTED ATTENUATOR 920.18

VEHICLE LIGHTS 920.13

Sign Stand (Type III) for mounting on concrete median barrier or guide rail shall conform to the associated Standard Drawing.

801.03 Methods Of Construction.

(A) GENERAL PROVISIONS.

The attention of the Contractor is specifically directed to the provisions of the Traffic Manual. In case of conflicting requirements among contract documents, refer to Subsection 104.03 for the order of precedence.

Requests for lane, roadway or ramp closures, escorts or slowdowns, and State Police supplemental patrols shall be submitted to the Engineer for approval. Instructions for submitting these requests may be found on the Authority's Web Site or as directed by the Engineer.

The Authority's roadways are in continuous operation 24 hours a day, 7 days a week. The work under this Contract has been planned to cause as little interference to Authority traffic as possible. The Contractor shall, therefore, plan his operations to permit the continuous flow of traffic along the roadways, ramps, toll plazas, and service areas.

It is the intent of the Contract to limit lane and shoulder closings to an absolute minimum and that work requiring closings is to be carried out in an expeditious manner.

No signs except traffic protection signs and traffic direction signs specified herein, on the Plans or as directed by the Engineer shall be erected by the Contractor or his subcontractors on or near Authority right-of-way.

The Contractor will be issued a copy of the "Lane Closure and Construction Safety Video" at the Preconstruction meeting. The Contractor will not be permitted to engage in lane and shoulder closing operations on Authority roadways and ramps until the "Lane Closure and Construction Safety Video" has been viewed and acknowledged by all employees, Subcontractors, suppliers and vendors as noted on the attendance sheet, a copy of which is found on the Authority's Web Site. The completed Attendance sheet shall be submitted to the Engineer prior to the first lane closing request submission. The Engineer shall provide the attendance sheet to the Authority's Operations Department with the first lane closing request submission. The Contractor shall submit additional attendance sheets as necessary throughout the course of the project to account for change in personnel. Any exceptions to the specified personnel viewing the "Lane Closing and Construction Safety Video" will be only as approved by the Engineer.

The safety measures outlined and prescribed shall be considered basic and in certain instances additional safety measures may be appropriate and required. Compliance with the safety measures and precautions prescribed in the Specifications and on the Plans shall not relieve the Contractor of responsibility for taking all additional and appropriate safety measures for all persons and property. Full responsibility for adequate safety measures for the protection of all persons and property on and adjacent to the work site shall rest with the Contractor.

(1) **State Police Authority.**

Traffic on Authority roadways is under the direct supervision and control of the New Jersey State Police who will enforce all statutory laws including the Authority's established Regulations under the Subchapter titled "Traffic Control on New Jersey Turnpike", as they pertain to the Contractor as well as to the traveling public. The regulations can be found on the Authority's Web Site http://www.state.nj.us/turnpike/policies-rules-and-regulations.html. The Contractor shall familiarize himself with and adhere strictly to the requirements of these Regulations.

The State Police have the authority to advise the Contractor of hazardous conditions or violations connected with the Contractor's operations and to order immediate remedial action. Upon such notification, the Contractor shall immediately discontinue work as required and correct the hazardous condition or violation. The Contractor shall then advise the Engineer of the State Police directive and the remedial action taken.

If the Authority or State Police declare that an emergency condition exists, the Contractor shall immediately respond with the required manpower and equipment to remove a closing in the shortest possible time, day or night, including weekends and holidays. This requirement shall not be considered as a basis for claim against the Authority.

All communication from the Contractor to the State Police shall be directed via the Engineer or Liaison Engineer.

(2) **Traffic Permit.**

The Contractor shall apply for a Traffic Permit at least ten (10) working days prior to the time the Contractor intends to start any operations at the Project site. The Contractor shall complete the applicable portion of the Traffic Permit application form as described in the Manual, and return the completed application to the Engineer. A Traffic Permit Application can be found on the Authority's Web Site http://www.state.nj.us/turnpike/professional-services.html. The Traffic Permit will be issued only to the Prime Contractor, but will be deemed to apply to all suppliers and Subcontractors engaged in the prosecution of this work. It is the responsibility of the Prime Contractor to inform all such suppliers and Subcontractors of the provisions of the Traffic Permit and to take all necessary measures to assure that they abide by its provisions. Copies of transmittals that furnish the Subcontractors with the Traffic Permit and its provisions shall be submitted to the Engineer. All applicants for Traffic Permits shall adhere to the requirements set forth in the Manual.

The Contractor's Traffic Permit application shall include complete information, data and/or sketches covering the following:

(a) The nature and location of the work.

(b) The proposed obstructions or other hazards to traffic, including all operations across the roadway cross-section.

(c) The length of time during which it is anticipated that hazards or obstructions to traffic will exist.

(d) The means proposed by the Contractor for the protection of the public and his own personnel and equipment, including layouts and schedules showing the anticipated lane and shoulder closings, truck access points, guide rail openings, locations of all devices for lane and shoulder closings and for protection of traffic, and anticipated dates and rates of work.

(e) The names, and day and night telephone numbers of the Contractor's Superintendents.

(f) Anticipated impacts to railways, if any.

(g) Other information as requested by the Engineer.

The information will be reviewed by the Engineer and when satisfactory, approved and advanced to the Authority. Upon approval by the Authority's Traffic Engineer or Operations Department a Traffic Permit will be issued to the Contractor through the Engineer.

An Addendum to the Traffic Permit will be required each time any of the above items (a) thru (g) are revised or when insurance certificates require renewal during the Contract Period.

The Contractor shall furnish a schedule each week outlining all requested closings, as approved by the Engineer, and other traffic protection activity required during the following week. Said schedule shall be available to the Engineer on the time and date as directed. The Contractor shall provide the Engineer 48 hours notice of any proposed changes in this schedule.

If the approved methods of operation are not strictly adhered to by the Contractor, the Engineer has the right to direct that any work which, in the Engineer's opinion is not approved under the Traffic Permit, be immediately discontinued. Such work shall not be resumed until the Engineer is assured and determines that the work will be performed in conformity with the approved methods of operation. The Contractor shall have no claim against the Authority for losses or delays caused by such stoppage of work, including but not limited to stoppages caused by inclement weather.

(3) **Movement of Contractor's Vehicles, Equipment and Personnel.**

The Contractor's employees shall not walk across or along, nor occupy any active Authority roadway except within areas coned off or otherwise closed to the traveling public, or as specified herein for traffic control purposes.

The Contractor's personnel in any work area shall wear a vest at all times as specified in Subsection 920.03.

Personal vehicles will not be permitted to park anywhere within Authority right-of-way except in areas designated by the Engineer.

The Contractor shall be responsible for transporting all his personnel to and from enclosed or closed off work areas in accordance with NJSA 39:4-69, Riding on Part Not Intended for Passengers Prohibited. Personal vehicles will not be permitted anywhere within Authority right-of-way or private properties, except in areas designated by the Engineer.

Contractor vehicles operating on any Authority roadway or shoulder which is open to traffic shall travel with, and not across or against, the direction of traffic. Vehicles shall not park or stop on roadways or shoulders except within areas coned off or otherwise closed to traffic. Unless otherwise specified, or permitted by the Authority's Engineer or Operations Department, the Contractor's vehicles shall not travel via Z-turns, U-turns, or at the point at which the roadway is coned off. Any vehicle making any illegal movement will be subject to a summons by the State Police.

Authorized locations for the use of U-turns and Z-turns will be as shown on the Plans.

Contractor vehicles shall enter and exit the work area via the nearest Interchange.

Whenever the Contractor intends to transport oversize or slow moving equipment on active Authority roadways, he may do so only under State Police escort and must follow the requirements of Subparagraph 801.03(B)(7).

Contractor vehicles and equipment operating in a closed roadway shall always stay to the right in the direction of travel and observe a speed limit of 35 miles per hour. Conspicuous, overhead, amber flashing lights in accordance with Subsection 920.13, visible from a 360 degree viewing angle shall be required and activated for all vehicles traveling or operating in a closed roadway.

For major traffic shifts as determined by the Engineer, and for structure erections or demolitions, a 2-week notice is required for the Operations Department and the State Police.

(4) **Vehicle Access to Work Areas.**

Contractor's vehicles entering or leaving a work area via Authority roadways shall be operated in a safe manner. They shall leave and enter the Authority roadway traffic stream only at designated points. Delivery of materials or personnel, and movement of vehicles and equipment into and out of a work area via Authority roadways shall be made only after lane or shoulder closings are in place, or with the use of an escort and/or approved slowdowns.

The use of emergency access gates by the Contractor's vehicles is prohibited unless otherwise specified, or permitted by the Authority's Engineer or Operations Department. Where an operation of the Contractor would permit unauthorized entry or exit from Authority property, the Contractor shall take immediate measures to restore the security of the Authority right-of-way. Toll evasion is subject to a summons by the State Police.

The Contractor shall, through the Engineer, coordinate his access points with those of the adjacent contracts to ensure proper spacing. Points for leaving and re-entering Authority roadway traffic flow shall be, in general, at the respective beginning and end of a closing.

Uniformed flagmen or "Flaggers" shall be provided by the Contractor for protection within the work zones at appropriate locations and as directed by the Engineer. Each flagger shall be properly trained, instructed, and experienced in flagger duties, and shall be uniformed as specified in Subsection 920.12. Flaggers must be English-speaking. Any flagger not satisfactory in the opinion of the Engineer shall be immediately replaced by an approved flagger. Flags shall be provided by the Contractor for each flagger as specified in Subsection 920.09.

It shall be the responsibility of the flagger to assist and direct construction vehicles into and out of the work area. He shall observe approaching traffic and warn Contractor personnel of vehicles entering the work site. He shall observe the flow of traffic and direct vehicles leaving the work site so that they may safely merge into active lanes of Authority roadways. Under no circumstances shall the flagger attempt to slow or otherwise direct Authority roadway traffic.

During permissible times for lane or shoulder closings when a flagger is not on duty, automobiles operated solely for the transportation of supervisory personnel, flaggers, or approved inspectors will be allowed access to the work site provided such vehicles are operated in a safe manner.

When the Contractor is granted permission to work within closed roadways, access to closed roadways shall be solely by ramp gates, either at the time the ramp is closed or if continuous access is required with flagger control. Unattended ramp gates must remain locked. The Contractor's flagger is responsible to secure the ramp gate in the closed position, upon completion of their flagging work, to maintain a secure roadway for the remainder of the scheduled roadway closing.

Whenever vehicular access to a work area requires the removal of existing guide rail, the guide rail shall be reinstalled during all times when a shoulder closing with vehicle access points is not allowed and during non-working hours. The opening shall be closed using an approved barrier immediately in front of the line of the guide rail and extending at least five feet beyond the opening in each direction. The blunt end of the guide rail shall be protected at all times by a Truck Mounted Attenuator, approved end treatment, or a Temporary Impact Attenuator. The guide rail shall be properly lapped and attached to the barrier using a terminal connector.

During non-working hours and/or on any day when an access point is not in use, the access signs associated with that location shall be left in place and covered, or removed and stored in a manner which will not soil the face. If covers are used they shall be securely fastened, top and bottom, to prevent the cover being blown aside by the wind.

Equipment delivery on lowboys or other similar equipment carrying vehicles that are not overweight or oversized are not permitted to access an interior lane shift without an escort. An escort is required for the delivery of materials or equipment on lowboys or similar transport vehicles to access an interior lane shift when an interior lane shift is determined to be necessary or called for on the Contract Plans.

(5) **Maintenance of Existing Traffic Control Devices.**

All existing guide, warning, and regulatory signs for the control of Authority roadway traffic must be maintained erect and unobstructed until such time as their use may be discontinued by direction of the Engineer. Existing panels and legends which become damaged as a result of the Contractor's operations shall be restored or repaired at the Contractor's own expense. In order to permit construction at the present location of these signs, the panels may be mounted on such temporary supports and at such locations as approved by the Engineer.

Existing directional and regulatory signs which cannot be maintained in place or temporarily mounted on channels are to be supported by temporary supports. Electrical service, power, and other incidental work for such temporary-mounted signs shall be as specified, and shop drawings shall be submitted in accordance with Subsection 104.08.

Existing roadway delineators are to be maintained unless directed by the Engineer to discontinue their use.

The Contractor shall temporarily mount any existing mile marker that will be removed because of construction, on the top of construction barrier or post-mount at the outside edge of the shoulder as may be necessary. The relocated mile markers shall be mounted in accordance with the associated Standard Drawing, and as approved by the Engineer. The Contractor will be responsible for maintaining and, if necessary, replacing all mile markers within the limits of work during the course of construction.

Sign covers, for the purpose of obscuring installed but inactive temporary and permanent signs, shall be large enough to obscure the entirety of the sign, be non-reflective, opaque, and easy to install and remove. The use of plastic bags with duct tape, or similar method, is prohibited.

(6) **Traffic Control Coordinator.**

The Contractor shall assign a supervisory level employee to be the Traffic Control Coordinator (TCC). The name and telephone number(s) of the TCC shall be submitted to the Engineer with the Traffic Permit Application. The Engineer shall be notified as to the name and telephone number(s) of the TCC on a 24 hour basis. The TCC shall have a "TCC Designation Card" as issued by Rutgers' Center for Advanced Infrastructure and Transportation (CAIT), and have the ability to communicate fluently in English. Information on CAIT's "Traffic Control Coordinator Program" may be found on the web at http://cait.rutgers.edu/cait/tcc-program.

The Traffic Control Coordinator shall perform daily inspections, including weekends and holidays, and inspections at night as required, and take all corrective action to ensure compliance with the Traffic Control Plan and other approved standards. The Engineer shall be advised of the schedule of these inspections and be given the opportunity to join in the inspection. In addition, the duties of the Traffic Control Coordinator shall include, but shall not be limited to, the responsibility for ensuring the following:

- Setup and removal of all traffic control devices in accordance with the Contract Documents.
- Correction of deficiencies of traffic control devices within 2 hours of discovery or notification by the Engineer.
- Repositioning traffic control devices displaced by traffic or construction equipment.
- Covering or uncovering signs as appropriate.
- Repairing and/or replacing damaged traffic control devices.
- Replacing batteries, light bulbs, control panels and other electrical components.
- Keeping all traffic control devices clean.
- Adding fuel and oil to power units for traffic control devices.
- That all Contractor equipment and vehicles are properly stored and parked so as not to create a traffic hazard.

- Properly store traffic control devices when not in use.
- That all excavations or drop-offs greater than 2 inches deep are protected in accordance with the Manual.

(7) **Traffic Protection Patrol.**

The purpose of this patrol is to guarantee that traffic protection devices remain functional during the periods when the Contractor's personnel are not actively engaged at the site. When work is active at a site, the responsibilities for guaranteeing that traffic protection devices remain functional is then covered under the pay item "Installation, Maintenance, and Removal of Lane Closing". Traffic protection patrol may be full-time, part-time, or may not be required. The Traffic Control Coordinator may fulfill some or all of the duties of the patroller(s).

The Contractor will be required to provide a traffic protection patrol at all times when lane, ramp, or partial ramp closings are in place.

The type of patrol (full-time or part-time) and amount of Man Hours shall be as given in the Scheduled Items of Work.

a) Full-time Patrol.

The Contractor shall provide a traffic protection patroller for the entire work area and maintain in-place devices as necessary, during all times and hours when no workmen are actively engaged at the site. The Contractor shall also provide a minimum of three (3), twenty-four (24) hour emergency contact names and telephone numbers to the Engineer. One of the three (3) emergency contact names shall be the Traffic Control Coordinator.

The Contractor shall provide the patroller with a suitable vehicle for patrolling the work area. The vehicle shall be equipped with approved vehicle lights as specified in Subsection 920.13.

Patrols shall be made at least once per hour during the patroller's tour of duty. In reversing direction at each end of his patrol, the patroller shall exit at an interchange beyond the limits of the Project and then re-enter.

The traffic protection patroller shall be an employee of the Contractor and not of a subcontractor, Authority, or other transportation agency. The patroller shall be thoroughly familiar with all of the provisions of these Specifications for Maintenance and Protection of Traffic. The traffic protection patroller shall be English speaking and equipped with a cell phone capable of direct contact at all times.

The patroller's duties in regard to maintenance of devices shall include maintaining the proper position and alignment of all devices, washing sign faces and the lenses of flashing lights, replacing dead batteries and defective bulbs and lights, aligning lights properly, and any other maintenance of devices deemed essential by the Engineer to sustain the full effectiveness of all in-place devices.

In addition to providing a traffic protection patrol for periods when directed by the Engineer, the Contractor shall provide traffic protection patrol in the event of any incident occurring during hours when the Contractor's personnel are not engaged at the site and an incident occurs which causes damage or relocation to traffic protection and control devices. During these incidents, the Authority, State Police, or the Engineer will call the Contractor's supervisor who shall respond within one hour and correct any deficiencies or damage within three hours. A non-response by the Contractor within the stipulated time frames will result in a one thousand dollars ($1,000) assessment for each occurrence as determined by the Engineer, and be deducted from the Contractor's partial payments.

In the event of an incident causing damage to the in-place traffic protection and control devices beyond the repair capability of the patroller, he shall immediately call the superintendent and/or the Traffic Control Coordinator who shall make himself available at the site of the work within four (4) hours of being requested, and with such additional workmen as may be required to make the necessary repairs. If damaged traffic control devices are within tapers, State Police assistance shall be required for the resetting of the devices.

Should an incident occur which causes damage to in-place devices and the Contractor's patroller is unable or otherwise fails to perform the specified duties, the Engineer will call the Contractor's superintendent and/or the Traffic Control Coordinator who shall make himself available at the

site and effect repairs as specified in the preceding paragraph.

The patroller shall maintain the cone line of an entire work area, particularly in the area of the pavement removal, resurfacing and line striping operations. When a cone or cones are struck by a vehicle, they must be picked up and placed in proper alignment immediately. Once the operation proceeds through an area, the cone line must be brought back to the proper configuration to reduce the re-occurrence of cones being struck by passing vehicles.

Lengths of closings and complexities of both the operation of paving and proximity to interchanges require a 2-person patrol for all paving operations.

b) Part-time Patrol.

Part-time patrol shall be as specified above for full time patrol except that the patrol shall be made during the time periods specified (such as weekends, certain Holiday periods, etc.) or as otherwise directed or ordered by the Engineer. The Engineer reserves the right, however, to require the Contractor to provide the services of such patroller more frequently than specified and/or at such other times when the devices are in-place and none of the Contractor's workmen are engaged at the site (such as long periods of inclement weather).

c) No Patrol Required.

In the event of an incident occurring during hours when no workmen are engaged at the site and causing damage to traffic protection and control devices that are in-place, the Engineer will call the Contractor's superintendent and/or Traffic Control Coordinator who shall make himself available at the site of the work within a reasonable length of time, as determined by the Engineer, and with such additional workmen as may be required to make the necessary repairs.

(B) CLOSINGS, SLOWDOWNS, AND ESCORTS.

All lane, ramp and shoulder closings (including traffic shifts) required for the construction of the work for this Contract shall be installed, maintained and removed by the Contractor unless specifically called for on the Plans. It is the Contractor's responsibility to become familiar with the location and use of the devices described in these Specifications and on the Plans. All roadway closings (if permitted) shall be installed and removed by the Authority.

When the work under the Contract requires that a ramp (half-width), mainline lane, shoulder of an Authority roadway be closed, such closings shall be made only at such times, to such limits, and in such a manner that the movement of traffic on the roadway will be maintained. Restrictions to movement of traffic by lane closings shall be minimized. All traffic moving on lanes not closed shall be able to flow smoothly, and shall be protected from all hazards pertaining to the Contractor's operations and because of the lane closings. A lane closing is defined as a reduction in the number of lanes. A half-width ramp closing of a single lane ramp is considered as a shoulder closing or a lane shift. Closing a lane on a ramp with two or more lanes is considered as a lane closing. A lane shift is defined as the lateral movement of traffic without a reduction in the number of lanes.

The Contractor is advised that the time required to install and remove a lane closing may be substantial. Approved lane closing hours are inclusive of the time for installation and removal of traffic protection devices; removal of existing striping, placement and removal of temporary striping and construction barrier, placement of permanent striping and all else necessary either to properly close or reopen lane(s) and shoulders to traffic. The Contractor will be assessed a penalty as defined in Subsection 107.12 for each fifteen (15) minute delay in reopening of a closing.

Permissible lane and shoulder closing hours for Authority roadways are noted in tabular form in the Manual. Where the limits of a proposed lane or shoulder closing extend beyond the limits of a single closing table, the more restrictive hours shall govern. Because of heavy traffic during morning and evening commuter rush hours, on weekends, over holidays, and during the summer vacation period (between Memorial Day and Labor Day), the times or hours when a road, lane or lanes may be closed and work requiring such closings may be performed are limited. Lanes may be closed and work requiring lanes to be closed may be performed only during the times prescribed. Additional restrictions for closings, if applicable, will be listed in the Supplementary Specifications. When a proposed closing extends within 1,000 feet of an interchange or service area ramp, measured from the physical nose of the ramp in either direction to any part of the closing (cone or barrier segment, including tapers), additional restrictions may be imposed by the Operations Department.

All requests for lane, shoulder or roadway closings, or State Police escorts or slowdowns shall be scheduled

by submitting the proper form(s) to the Engineer no later than 12:00 p.m. on the 2nd Monday prior to the requested escort, slowdown, closing or opening. If the Contractor fails to submit the appropriate form(s) to the Engineer in advance as stipulated above, it may result in the denial of the requested lane closing, escort or slowdown for the week. Notwithstanding, because of adjacent construction, a roadway, lane, or shoulder closing, or escort or slowdown may be denied even if properly requested. In any event, the denial of lane, shoulder or roadway closing or delay of the closing or opening of up to two hours from the scheduled times shall not be considered as a basis for a claim of delay against the Authority. The Contractor is advised that closings or openings installed by the Authority will be initiated within two hours of the time scheduled for such closings or openings. The Contractor shall establish his priorities for closings and openings and request such closings and openings at one hour intervals, minimum.

If a prescheduled lane or roadway closing operation which has been approved by the Authority will not be utilized for any reason by the Contractor, the Contractor shall notify the Engineer at least forty-eight (48) hours in advance to cancel the scheduled closing. If the forty-eight (48) hour period falls on a Saturday or Sunday, the notice for cancellation must be submitted on the preceding Thursday. The Contractor will be permitted one (1) occasion where the proper advance notification to cancel any scheduled closing operation is not given. If the Contractor fails to properly cancel a prescheduled lane or roadway closing a second time, within six (6) months of the first occurrence, the Contractor will be assessed $2,500 and an additional $2,500 for each subsequent occurrence within six (6) months of the previous occurrence. If the Contractor is unable to utilize the lane or roadway closing at the scheduled time due to weather conditions, as determined by the Engineer, it shall not count as a failure to notify the Engineer.

Where the Contractor finishes a work operation using a prescheduled lane closing earlier than scheduled, such that the lane closing operation is not needed on a scheduled day or days, he shall notify the Engineer as soon as the change in schedule is known, even if within the forty-eight (48) hour notification period. This case shall not constitute a failure to properly notify the Engineer.

It shall be the responsibility of the Contractor, for the work covered by these Specifications, to coordinate with the Engineer and other contractors affected by the Authority closings and to schedule his work accordingly with the approved progress schedules of the other contractors and the current status of each project, as described in Subsection 104.07.

The traffic protection devices for closing of a lane or shoulder shall always be set up progressively in the direction of traffic from the cone and traffic control trucks traveling in the lane or shoulder being closed. The protection devices shall always be removed in the reverse order by the truck backing up on the closed lane or shoulder. Proper flashing yellow lights shall be installed on all construction vehicles in accordance with Subsection 920.13. The Engineer will coordinate the procedures for closing or opening a lane or shoulder.

Once a lane closing is in place, work shall commence immediately and shall progress on a continuous basis to completion.

The Contractor's personnel, vehicles, equipment, or materials shall not occupy any area within thirty (30) feet from the edge of pavement where there is no guide rail or other physical barrier unless the shoulder has been closed. The storage of materials and equipment will be permitted within Authority right-of-way only at specific locations to be designated by the Engineer. Materials or equipment shall not be stored in a closed lane or shoulder unless protected by a barrier.

Precast concrete construction barrier shall be installed only after the lane or shoulder has been closed.

During all periods when traffic lanes are not closed, the roadways shall be clear of all obstructions.

All traffic control devices within the Contractor’s work area which have been moved or displaced for whatever reason shall be immediately restored to their proper position by the Contractor. Cones or other traffic control devices which have been moved or displaced during such times when the Contractor is not actively engaged at the site, it shall be restored by the Contractor’s Traffic Protection Patrol in accordance with Subparagraph 801.03(A)(7).

The Operations Department or State Police may determine that a scheduled half-ramp, mainline lane, shoulder or roadway closing must be cancelled, postponed, or delayed in opening or opened earlier than originally planned. This change in available work hours shall not be considered as a basis for a claim against the Authority. Lane closings may be cancelled or may be reopened earlier than scheduled, as required by weather conditions or other incidents.

The Contractor shall install, maintain and remove lane closings in accordance with staged work requirements during the allowed times specified in the Manual, and in accordance with the Plans and

Specifications.

Refer to the Tables provided in the Manual and/or the Plans for allowable lane closing hours.

(1) **Lane Closings.**

Unless otherwise specified by the Authority, the maximum length of any lane closing, i.e., length between first and last cones, shall be five (5) miles. The minimum clear distance between two separate lane closings, i.e., from the last traffic cone of the first closing to the first cone of the second closing, in the same roadway, shall be three (3) miles.

Lane closings shall be installed, maintained and removed, by the Contractor, in accordance with these Specifications, maintenance and protection of traffic details included in the Plans, and Authority-issued Standard Drawings unless otherwise approved by the Operations Department. No work shall begin until traffic protection devices, including Precast Concrete Construction Barrier (if called for), are completely set in place in accordance with the limits and details shown in the Plans and to the satisfaction of the Engineer.

During permissible lane closing hours, not more than one lane in a roadway may be closed at any one time in any one work area unless multiple lane closings are specifically permitted.

The Contractor may request a Supplemental State Police Traffic Patrol for each mainline lane closing when work is to be performed at roadway level within six (6) feet of the traveled way and no precast concrete construction barrier is specified. The Supplemental State Police Traffic Patrol may also be requested for half width or partial ramp closings with posted speed limits of 40 mph or higher and where no concrete construction barrier is specified, within the project limits. The Contractor shall prepare a schedule for a State Police Supplemental Patrol and review the schedule with the Engineer prior to submittal to the Authority; instructions for submitting the request may be found on the Authority's Web Site or as directed by the Engineer. Supplemental State Police Traffic Patrols will be made available only during Contractor working hours.

The Contractor shall submit the request for Supplemental State Police Traffic Patrol at the same time as the roadway, lane or shoulder closing, escort or slowdown request. Time required for pavement striping changes shall be included in the requested Supplemental State Police Traffic Patrol schedule.

In stages where multiple lanes are closed and inclement weather or other circumstances may impact the stipulated lane closing pick-up time, the Contractor shall concentrate his work effort on the lane adjacent to the active traffic lane or other lane or shoulder as directed by the Engineer. He shall be prepared to complete work in this lane ahead of work in the remaining area in order to allow this lane to be opened to traffic as soon as possible. This approach may require a non-continuous paving operation requiring additional mobilization of the paving train and crew.

(2) **Emergency Lane Closings.**

When in the opinion of the Chief Engineer it becomes necessary to close lanes to make prompt repairs to work in progress or to other facilities that are damaged, the Contractor shall provide all the materials and manpower necessary, and shall work continuously on a 24 hour per day basis to complete the emergency repairs and again make all lanes available to use by public traffic. Compensation for emergency repairs of damage beyond the Contractor's control will be paid under the established pay item in the Contract or on a cost-plus basis as specified in Subsection 108.04 or on such other basis as agreed upon by the Contractor and the Engineer. All costs incurred as a result of emergency repairs of damage caused solely by the Contractor's procedures shall be borne entirely by the Contractor.

(3) **Shoulder Closings.**

Shoulder closings may be permitted between the hours as specified in the Plans, Supplementary Specifications, or within the Appendices of the Manual. Refer to 801.03(A) for Contract documents' order of precedence.

Unless a shoulder is closed long term with Precast Concrete Construction Barrier, once a shoulder closing is in place, work shall commence immediately and shall progress on a continuous basis to completion. Shoulders shall not be kept closed when no work is scheduled to be performed.

Simultaneous closing of both the right and left shoulder of a roadway will not be permitted. All shoulder closings shall be of the shortest overall length and duration necessary to protect traffic and shall provide as much shoulder as possible for use by disabled vehicles and/or emergency vehicles.

Shoulder closings shall be installed, maintained and removed by the Contractor in accordance with these Specifications, maintenance and protection of traffic details included in the Plans, and Authority issued Standard Drawings. No work shall begin until traffic protection devices, including precast concrete construction barrier, are completely set in place in accordance with the limits and details shown in the Plans in accordance with the Traffic Protection Standard Drawings and to the satisfaction of the Engineer.

Additional shoulder closings or an extension in the shoulder closings shown may be required to perform "If and Where Directed" work, Force Account work, Change Order work and/or Emergency Repair work. The additional closings may be of partial day, full day or multi-day durations. Shoulder closings for punchlist work and correction of defective work shall be at the Contractor's expense. The number and duration of the shoulder closing installation for punchlist work shall be that necessary to complete all punchlist work as directed by the Engineer.

The shifting of traffic from a single lane ramp to the shoulder of a single lane ramp shall be performed during the same time as lane closings in the Manual.

(4) **Supplementary Lane Closings.**

Supplementary lane closings will be permitted as specified on the Plans and, if not indicated on the Plans, will be permissible during the times prescribed in the Appendices of the Manual. All lane, ramp, shoulder and supplementary closings shall be installed, maintained and removed by the Contractor. The installation, maintenance and removal of supplementary lane closings include the furnishing, placing and removing arrow boards, placing and removing traffic cones, placing and removing additional signs, and the changing of sign panels and/or overlays.

(5) **Authority Roadway Closing.**

THE CONTRACTOR IS ADVISED THAT ROADWAY CLOSINGS MAY NOT BE AVAILABLE FOR WORK ON THIS PROJECT. However, the Contractor may utilize any roadway closing installed/scheduled by others for work on other Contracts or for Authority maintenance. The Contractor shall not interfere or conflict with the work for which the closing was installed. If the Contractor performs work within a roadway closing by others, he is responsible for vacating the closing within the scheduled hours of the closing.

The hours when one roadway of a single direction dual roadway may be closed are limited. A roadway may be closed, and work requiring roadways to be closed, may be performed only during the times prescribed in this Contract (if permitted), in other Contracts or if roadway closings are in place for NJTA maintenance work.

The initial closing and final re-opening of ramp gates (where applicable) will be performed only by employees of the Authority and under the direction of the State Police. The Contractor of this or other Contracts will arrange for such assistance through the Engineer.

Unless otherwise specified, the Contractor shall not position his vehicles and equipment to block all lanes and shoulders of the closed roadway. At least one lane of emergency access is to be maintained at all times.

The Contractor shall be permitted to undertake only as much work as can be completed within the time prescribed. Extension of roadway closing hours will not be granted under any circumstances. The Contractor is reminded that the time required to close an entire roadway may be substantial and that the roadway closing hours prescribed are inclusive of closing and reopening times.

Roadway closings may be cancelled or roadways may be reopened earlier than scheduled, as required by weather conditions or incidents in the open same-direction roadway. The Contractor shall immediately vacate the closed roadway if so instructed by the State Police or the Operations Department. The cancellation or curtailment of a roadway closing shall not be considered as a basis for a claim of delay against the Authority.

(6) **Ramp Closings.**

Unless otherwise approved on the Contract Plans, the Contractor is advised that Ramp Closings are not permitted for work on this project unless prior authorization is obtained from the Authority or as directed by the State Police in the event of an emergency. However, the Contractor may utilize any Ramp Closing installed/scheduled by others for work on other Contracts or for Authority Maintenance where permitted by the Engineer of the installed/scheduled Ramp Closing. The contractor shall not interfere or conflict with the work for which the closing was installed. If the

Contractor performs work within a Ramp Closing by others, he is responsible for vacating the closing within the scheduled hours of the closing.

Where a Ramp Closing is otherwise approved by the Authority or the State Police whereas the closing was not originally detailed in Contract Plans, the Ramp Closing shall be in substantial conformance with the Authority's Standard Drawings. A Detour Route with appropriate signing shall be provided except in the case of installation due to emergency whereas the Contractor will provide the Detour Route and signing within a practical time frame which includes fabrication, installation, and mobilization.

Unless otherwise specified, the Contractor shall not position its vehicles and equipment to block all through lanes and shoulders on the ramp. At least one lane or one shoulder for emergency access is to be maintained at all times.

The Contractor shall be permitted to undertake only as much work as can be completed within the time prescribed. Extension of ramp closing hours will not be granted under any circumstances. The Contractor is reminded that the total time required to open and close a ramp may be substantial due to the deployment of necessary detour signing (to close) and the removal and proper covering or removal of detour signing (to open) that the closing hours prescribed are inclusive of closing and reopening times.

Ramp closings may be cancelled or ramps may be opened earlier than scheduled, as required by weather conditions or incidents. The Contractor shall immediately vacate the closed ramp if so instructed by the Authority or the State Police. The cancellation or curtailment of a ramp closing shall not be considered as a basis for a claim of delay against the Authority.

(7) **Slowdowns.**

Certain elements of work which cannot be accomplished with lane closings will be required to be accomplished during the simultaneous slowing of traffic in all lanes. This work may include but is not limited to the movement of heavy equipment across a roadway, the erection or removal of bridge elements or sign structures; installation of bridge deck joints, milling and resurfacing operations; placement, removal or relocation of precast concrete construction barriers; installation of traffic tapers; removal of traffic closings; realigning displaced traffic control devices; and striping changes. The Contractor shall confirm with the Engineer a minimum of twenty-four (24) hours (48 hours preferred) prior notice of the time he wishes traffic to be slowed. Slowdowns will not be granted for such work elements as installation or removal of any line striping or sweeping.

All requests for slowdowns should be scheduled by submitting the proper Escort, Slowdown Request to the Engineer ; instructions for submitting the request may be found on the Authority's Web Site or as directed by the Engineer. Emergency slowdowns for the purpose of maintaining traffic protection devices can be requested by the Contractor's Traffic Control Coordinator. The Contractor shall submit the request for State Police Traffic Patrol at the same time as the Escort, Slowdown Request.

Traffic shall be slowed down only by the direction of the State Police. The Engineer will arrange State Police assistance for these operations through the Operations Department.

Slowdowns for the movement of equipment, requiring one minute or less, may be scheduled any time except during the hours of 6:00 AM to 9:00 AM and 4:00 PM to 7:00 PM, Monday through Friday. Slowdowns requiring more than one minute but less than five minutes may be scheduled from 10:00 AM to 2:00 PM Monday through Friday. Slowdowns of more than five minutes and less than ten minutes must be scheduled during the allowable roadway or two-lane closing hours as specified in the Manual. Slowdowns of more than ten minutes will generally not be permitted.

The method of accomplishing work which would require lengthy slowdowns will be determined by the Engineer after consultation with the Operations Department and may involve extremely limited working hours and traffic control provisions beyond those called for in the Plans and Specifications.

When more than one slowdown is scheduled for the same work area, the flow of traffic must return to normal before traffic is slowed again.

Slowdowns will not be permitted during the Holiday and Heavy Traffic Day Restrictions as specified in the Appendices of the Manual.

(8) **Escorts.**

Whenever the Contractor intends to transport oversize or slow moving equipment on active Authority roadways, he may do so only under State Police escort.

All requests for escorts should be scheduled by submitting the proper Escort Request Form to the Engineer on the Monday of the week preceding the requested escort. In no case, however, will a slowdown be granted after 12:00 PM the day prior. If escort is needed on a Saturday or Sunday, request must be submitted by 12:00 PM on Thursday.

The Engineer will determine the time and the route of the escort. Escorts will not be scheduled during the hours of 6:00 AM to 9:00 AM and 4:00 PM to 7:00 PM Monday through Friday. Escorts are generally permitted only to and from the nearest Interchange.

A minimum of two flashing amber lights as specified in Subsection 920.13 shall be mounted on all slow moving vehicles. Tracked vehicles are not permitted to drive on open roadways.

(C) TRAFFIC CONTROL DEVICES.

The Contractor is responsible for installing, maintaining, and removing all traffic control devices, including but not limited to, concrete construction barriers, construction signs and sign stands, portable variable message signs, arrow boards, trucks, attenuators, and all other traffic protection devices furnished and/or handled by him. The Contractor is also required to fabricate, furnish, install and remove mainline sign overlay panels and coverings when shown in the Plans and in accordance with MUTCD. Overlays and coverings shall be installed and removed during the installation and removal of traffic closings and shifts.

The Contractor shall furnish materials, such as bolts, nuts, washers, adhesive anchors and polyester resin bonding agent, fasteners, paint, equipment and all labor required for the construction, placement, replacement, and maintenance of all traffic protection devices furnished and/or installed by him.

The Contractor or the assigned Traffic Control Coordinator shall maintain all traffic protection devices for the duration of the project, ensuring their operation, visibility, and overall effectiveness whenever they are in place at a work site. Maintenance shall include repairing, replacing, and washing devices as necessary, properly realigning devices, and any other work deemed necessary by the Engineer. Traffic protection devices, including but not limited to aluminum sign stands, sign panels, TMAs, cones and arrow board trailers that become damaged shall be repaired or replaced immediately upon notification of damage. The Contractor shall have on the project, an adequate number of spare parts to repair any damaged devices.

When traffic protection devices are to remain in-place overnight, during weekends, holidays, periods of inclement weather, or any other time that work will not be in progress, the Contractor or the assigned Traffic Control Coordinator shall ensure the full effectiveness of the devices prior to the cessation of work.

Cones or other protective devices moved by the Contractor for his own convenience in conducting his work operations may be done only with the approval of the Engineer and at no expense to the Authority. Upon completion of operations necessitating such moves, the Contractor shall immediately replace the protective devices to their original positions.

The Contractor shall furnish all supports, including guide rail and concrete median mounts as shown on the associated Standard Drawing, as required by each sign location to support the sign panels (except those furnished by the Authority – see Part 801.03(C)(11)). The Contractor is responsible to install and maintain all sign stands as directed by the Engineer. Sign stands carrying signs shall be in full extended position and the sign shall provide five (5) feet of clearance to the top of grade on Authority roadways. The use of clamps will not be permitted for attaching the sign stand to the median barrier. The sign base shall be properly tensioned to ensure the sign is stable and visible during passing truck traffic. After completion of the Contract, the sign stands shall remain the Contractor's property, except those furnished by the Authority, which shall be returned to the Authority in accordance with Part 801.03(C)(11).

(1) **Traffic Cones.**

The Contractor shall use 36" or 28" traffic cones. The Contractor shall not combine 28" and 36" cones in a single closing. All cones per closing shall be the same height. See Subsection 920.01.

(2) **Precast Concrete Construction Barrier.**

Precast concrete construction barrier delivered to the job site shall be in new condition and maintained throughout the duration of the Project. The Engineer shall be the sole judge of the acceptability of the

precast concrete barrier. Precast concrete barrier deemed unsatisfactory by the Engineer shall be replaced at no cost to the Authority.

Where different joint classifications are required within a section of barrier, the controlling joint class shall extend a minimum of one complete barrier length before and after the work area. For example, where A and D are required, Joint Class D shall extend a minimum of one complete barrier length before and after the work area before changing to Joint Class A.

The concrete construction barrier may be installed after the removal of existing surfacing and removed prior to paving, unless otherwise shown on Plans, if site conditions and construction sequence require doing so.

The Contractor shall furnish all hardware, concrete barrier interlock devices, anchors and all else necessary for the complete installation and subsequent removal and/or relocation of the concrete barrier.

The Contractor shall be required to maintain the concrete barrier units in their correct alignment at all times. The Contractor shall promptly furnish (any time of the day or night upon notification from the Authority, State Police or the Engineer) all labor, materials and equipment as necessary to repair, reset and/or realign any portion of concrete barrier units damaged or displaced by traffic incidents or otherwise. All contractor-furnished devices shall remain the property of the Contractor and shall be removed by the contractor upon completion of the work.

All precast concrete construction barrier that does not meet the following criteria, as determined by the Engineer prior to placement on the roadway, shall be rejected for use:

- No more than three cracks in the middle 6 feet of the barrier.
- All cracks must be less than ⅛ inch wide.
- No gouges in the lower half of the face exposed to traffic.
- No reinforcing steel shall be exposed.
- The key way must be intact.
- Lifting devices shall be intact.
- Face exposed to traffic must be clean of all road dirt.
- Reflectors shall be in place.
- Interlock must accept key full depth without projection of key cap above barrier.
- The full key way must be available.

Precast concrete construction barrier that becomes damaged shall be replaced within 24-hours, as directed by the Engineer.

The Contractor shall clean and maintain the drainage slots at the bottom of the concrete construction barrier at all times as directed by the Engineer.

(3) **Modular Glare Screen System.**

Within isolated deck replacement areas and at parapet replacement areas, a Modular Glare Screen System with screening shall be installed on top of the precast concrete construction barrier at locations shown on the Plans. The Modular Glare Screen System is required at isolated deck replacement areas scheduled for a Stage that is permitted for a period of four (4) days or greater and at all parapet replacement areas.

The Modular Glare Screen System shall be installed prior to beginning any deck removal and shall remain in place until the new deck has been constructed. The Modular Glare Screen System and screening may be temporarily removed for placing, relocating or moving the precast construction barrier. The removal of the Modular Glare Screen System is subject to the approval of the Engineer.

The Modular Glare Screen System shall extend for the full length of the precast concrete construction barrier (except on taper sections) adjacent to deck breakouts as shown on the Plans.

The screening shall be in accordance with the debris shield mesh netting material requirements in Subsection 920.17. Screening shall be located along the top of the barrier and extend to a height above the top of the barrier equal to the top of the Modular Glare Screen System; it shall be attached through

small holes drilled through the Modular Glare Screen System panel and secured with plastic ties to every other panel in accordance with the manufacturer's recommendations.

(4) **Temporary Impact Attenuators.**

Temporary impact attenuators refer to non-directive sand-filled polyethylene plastic frangible modules. Temporary impact attenuator devices which are lost, stolen, damaged, destroyed or determined by the Engineer to be unacceptable shall be replaced without additional compensation.

The Contractor shall notify the Engineer immediately upon discovery of any damaged temporary impact attenuator and shall immediately replace or repair all damaged portions. The Contractor shall have on the Project an adequate number of spare parts to repair any damaged attenuator unit. Any modules of a unit or sand which are damaged due to the Contractor's carelessness while placing, or due to the operation of the Contractor's equipment or personnel after such placement, shall be replaced at no additional cost to the Authority.

(5) **Impact Attenuators (Quadguard).**

Impact attenuators (Quadguard) refer to crushable, energy absorbing systems. Refer to Section 524 for requirements.

(6) **Truck with Mounted Attenuator (TMA).**

This item shall also include placing, moving and removing the TMA unit as necessary when the Contractor is working within a closed shoulder or lane. The TMA shall be removed from the closed shoulder or lane when no work is in progress or they shall be stored behind precast concrete construction barrier.

The truck shall be in excellent operating condition and have a minimum gross weight (11 Tons) in accordance with the TMA manufacturer's recommendation. The truck shall be equipped with a rear-mounted attenuator, including a crushable energy absorption module, cartridge support cables, lightweight steel backup plate, corner jacks, hydraulic tilting system and the hardware necessary for attachment. The truck mounted attenuator shall be attached to the truck in accordance with the manufacturer's specifications and recommendations.

The Contractor shall provide a heavy truck with mounted attenuator (TMA) as a barrier vehicle in the closed lane or closed shoulder preceding each work location where personnel are engaged in construction activities and no concrete barrier is called for.

The appropriate numbers of TMA's, as shown on the Plans, are to be provided for work on this Contract. The TMA's shall remain the Contractor's property upon Contract completion. If the Contractor elects to work at more than one location requiring a TMA, he shall furnish additional TMAs at no additional cost to the Authority.

The TMA layout (positioning) shall conform to the requirements set forth in the section on Truck Mounted Attenuators in the most recent Edition of the AASHTO Roadside Design Guide.

Any units or parts of the truck mounted attenuator which are damaged or become inoperable during construction shall be repaired or replaced. A complete replacement module and the required components for restoration shall be available at all times on the project without additional compensation.

The truck shall be equipped with two (2) conspicuous overhead flashing lights in accordance with Subsection 920.13 and the appropriate generator to power the lights. The lights shall be mounted so that they are visible when the attenuator is in a raised position and the flashing lights shall run continuously whenever the truck is performing lane and shoulder closing and opening operations.

In the event that the traffic control truck is hit during the process of the work and the crash cushions become damaged or inoperable, the Contractor shall have a replacement cartridge on the site at all times, and shall immediately repair the truck mounted crash cushions. The replacement cartridge shall be compatible with the original unit so that the repair can be accomplished in a minimal amount of time.

The Contractor shall have a truck mounted attenuator with a driver available at the request of the Engineer for the purpose of inspection, condition assessment, layout of "If and Where Directed" work, "Change Order" and/or "Emergency Work" and for the Final Inspection. It is anticipated that the truck mounted attenuator with the driver will be needed a minimum of four (4) hours and no more than eight (8) hours per request with a twelve (12) hour advance notice by the Engineer. Payment for

costs associated with this work shall be in accordance with "Furnishing Truck Mounted Attenuator for Engineer's Use", or shall be included in the unit costs of the various pay items within Division 800.

(7) **Cone and TMA Trucks.**

All lane and shoulder closing operations shall be performed with a minimum of two (2) vehicles consisting of a cone truck and a TMA truck. Both vehicles shall be equipped with approved conspicuous overhead flashing amber warning lights per Subsection 920.13. The warning lights shall be mounted so that they are visible when the attenuator is in a raised position. The warning lights shall run continuously whenever the vehicles are performing lane and shoulder closing or opening operations.

The cone truck shall be equipped with an approved carrier to hold personnel placing cones. Cone trucks with side-mounted carrier baskets may only be used for lane closing installations. Cone trucks with rear-mounted carrier baskets may be used for all types of closing installations.

The shoulder/lane closing crew shall be augmented by a traffic observer, who shall be equipped with an air horn. The traffic observer shall ride on the cone truck and watch oncoming traffic and this person shall sound the air horn as a warning if an out-of-control or other errant vehicles pose a threat to the crew.

The use of a TMA truck and the use of an approved cone truck and a traffic observer during the lane and shoulder closing or opening operations are mandatory and no exception shall be made.

Under no circumstances shall a TMA truck or cone truck remain in a closed lane or shoulder during non-working hours or a period of inactivity.

(8) **Portable Variable Message Signs.**

The portable variable message signs shall be physically located off of the traveled way, within a closed lane or shoulder, behind guide rail, behind approved closing devices, as shown on the Plans or Standard Drawings, or as directed by the Engineer. The portable variable message signs shall be positioned prior to the start of any work.

The Contractor is responsible for ensuring that the sign and generator runs continuously until sign and generator is no longer required.

Malfunctioning portable variable message signs shall be repaired or replaced within two (2) hours. The Contractor shall retain a spare portable variable message sign unit for use in the Contract.

Whilst deactivated, the portable variable message signs shall completely be removed from the worksite, or be stored behind precast concrete construction barriers.

(9) **Real Time Work Zone Traffic Information System.**

If called for on the Plans, the contractor is to provide a Real Time Work Zone Traffic Information System during all stages of maintenance and protection of traffic. The system shall detect traffic conditions in advance of and/or through the work zone and provide real time traffic information to the Authority's Traffic Management and Technology Center (TMTC) and the traveling public. It will also serve as a temporary replacement for existing Emergency Speed Warning and Variable Speed Limit signs that may be removed during the project. The JamLogic or ASTI system shall be used. The software will be hosted by the provider (JamLogic or ASTI). The provider will make the system accessible to Authority-designated personnel via a password-protected website.

(10) **Arrow Boards.**

Arrow boards shall be in accordance with Subsection 920.11.

(11) **Devices Furnished by the Authority.**

All devices furnished by the Authority to the Contractor shall remain the property of the Authority. All devices furnished for the project by the Contractor shall become the property of the Authority, with the exception of those items so designated.

Upon completion of the project, the Contractor shall repair or replace as necessary all devices used on the project, whether furnished by him or the Authority. The devices shall be restored to a condition

suitable for further use. The Contractor shall transport all restored or replaced devices to the location designated and shall unload and store them as directed by the Engineer.

The Engineer shall be notified of the proposed delivery date of the devices at least 48 hours in advance so that he can be present upon their delivery. The Contractor shall obtain a written receipt upon the satisfactory return of the devices. Adjustments for any shortage or deficiencies will be made before final payment.

Adjustment in a form of credit to the Authority will be assessed for any deficiencies or shortages of traffic protection devices returned to the Authority in accordance with the requirements of the Contract. The adjustments for this credit will be based on the replacement costs at the time of final completion and not at the time of issue. These adjustments will be made before final payment to the Contractor is recommended. All items furnished by the Contractor shall remain his.

The State Police have the authority to advise the Contractor of hazardous conditions or violations connected with the Contractor's operations and to order immediate remedial action. Upon such notification, the Contractor shall immediately discontinue work as required and correct the hazardous condition or violation. The Contractor shall then advise the Engineer of the State Police directive and the remedial action taken.

If the Authority or State Police declare that an emergency condition exists, the Contractor shall immediately respond with the required manpower and equipment to remove a closing in the shortest possible time, day or night, including weekends and holidays. This requirement shall not be considered as a basis for claim against the Authority.

All communication from the Contractor to the State Police shall be directed via the Engineer or Liaison Engineer.

801.04 Measurement.

Furnishing Traffic Control Devices for maintenance and protection of traffic will be measured on a lump sum basis. Furnishing construction signs of various sizes required, complete with messages on the specified supports; overlay panels; traffic protection signs and aluminum sign supports; traffic control vehicles; flashing warning lights; batteries; cones with bases; stabilizers; flashing arrow boards; furnishing traffic control devices for installation of roadway, lane and shoulder closings at the locations shown on the Plans or as directed by the Engineer; replacing defective devices as directed, replacing lost, stolen, destroyed or unacceptable devices; and all equipment and material necessary therefore and incidental thereto, unless otherwise noted will not be measured separately for payment. Shimming, leveling, and/or construction of bituminous pavement strips necessary for the proper installation and maintenance of the traffic control devices will not be measured separately for payment.

Furnishing Precast Concrete Construction Barrier will be measured by the linear foot along the front vertical face of the barrier, including tangent and taper runs, as it is used on the project, and the quantity will be limited to the maximum linear footage that is installed simultaneously on the project. Provisions for joint interlocking devices; reflectors; shimming and leveling; blockouts; grouting joints; anchorages into pavement; restoring roadway surfaces per the details following barrier removal; lifting devices; flashing lights; the labor, materials and equipment for transportation and delivery to the project site; furnishing test results or service history for approval by the Engineer, and any incidentals required in supplying the required quantity of precast concrete construction barrier to the Project will not be measured separately for payment.

Placing and Removing Precast Concrete Construction Barrier will be measured by the linear foot along the front vertical face of the barrier, including tangent and taper runs, as it is installed in its properly assembled final alignment and subsequently removed. The barrier shall not be measured twice to account for subsequent removal. Labor for loading and unloading of units; trucks; all trailers; all heavy machinery and other equipment required to place and remove the barrier as prescribed will not be measured separately for payment. Relocating precast concrete construction barrier as a result of accidents will be paid under the established pay item in the Contract or on a cost-plus basis as specified in Subsection 108.04 or on such other basis as agreed upon by the Contractor and the Engineer. Relocating precast concrete construction barrier to gain access to a work area will not be measured separately for payment.

Resetting Precast Concrete Construction Barrier will be measured by the linear foot along front vertical face of the barrier, including tangent and taper runs, actually shifted when an existing barrier alignment is to be modified as shown on the Staging Plans, or as directed by the Engineer or for staged construction. Resetting Precast Concrete Construction Barrier will only apply to barrier that had been previously installed on the Project and must be relocated to a new location a minimum of seven (7) feet adjacent to the previous location for staged construction. Resetting of barrier to a location less than seven (7) feet will not be measured separately for

payment. Resetting of barrier that requires the loading of units onto a truck and unloading of same shall be measured under the item "Placing and Removing Precast Concrete Construction Barrier". Resetting precast concrete construction barrier as a result of accidents or to gain access to a work area will not be measured separately for payment.

Modular Glare Screen System along the top of concrete barrier as directed by the Engineer will be measured for payment by the linear foot of system furnished, installed and maintained along the tangent section of barrier in each location as prescribed. Removal and subsequent installation of the modular guidance system and screening for the purpose of placing, relocating or removing the precast concrete construction barrier will not be measured separately for payment. Furnishing, installing and maintaining of the screening will not be measured separately for payment.

Traffic Protection Patrol will be measured by the man-hours that the patroller is actively engaged at the site for the purpose of making patrols, correcting any deficiencies to maintenance and protection devices and reporting as required, including any waiting periods between patrols. The measurement of man-hours shall begin at the time the patroller (or TCC or other Contractor Representative) arrives on site as directed by the Engineer for scheduled patrols, plus response time when addressing an incident, and shall end at the time the Engineer has deemed that the patroller (TCC or other Contractor representative) is no longer required on the site. Traffic Protection Patrol and the maintenance of traffic protection devices that may be required while the Contractor is actively engaged at the site(s) will not be measured separately for payment, but it will be included under the associated traffic protection pay items under this contract. Additional personnel required for correction of deficiencies will not be measured separately for payment. Duties of any Contractor personnel engaged in the aforementioned will not be measured separately for payment.

Flaggers will be measured by the sum total of man-hours for each flagger that is actively engaged in flagging services at the designated location(s).

Furnishing Portable Variable Message Sign will be measured by the number of each and will be limited to the maximum number provided in the Proposal which is installed simultaneously, plus one spare sign which must be retained by the Contractor for use in this Contract. Sign placement, removal and maintenance will not be measured separately for payment.

Furnishing Temporary Impact Attenuator will be measured by the number of complete units (barrel configuration) and shall include the number of complete units installed simultaneously, limited to the maximum number provided for in the Proposal that are installed simultaneously.

Placing and Removing Temporary Impact Attenuator will be measured by the total number of complete units placed in each location as prescribed. Removal, relocating or resetting of temporary impact attenuators will not be measured separately for payment.

Repair Temporary Impact Attenuators will be measured by the total number of barrels requiring replacement or repairs in each barrier system, either damaged or destroyed by the traveling public and as directed by the Engineer. Barrels damaged by Contractors operations will not be measured for payment.

Furnishing Truck with Mounted Attenuator will be measured by the number of each as they are used on the roadway and will be limited to the maximum number provided for in the Proposal, which are used simultaneously.

Furnishing Truck with Mounted Attenuator for Engineer's Use will be measured by man-hours and shall include the time the Truck Mounted Attenuator is actively engaged in service at the request of and for the use of the Engineer. The hours measured shall exclude travel time prior to picking up the Engineer and travel time after dropping off the Engineer at the requested locations. The cost of the truck, the operation and maintenance thereof, and the rate of the driver will not be measured separately for payment. The minimum number of hours measured for payment will be four (4).

Repair Truck Mounted Impact Attenuators will be measured by the total number of units repaired or requiring replacement that are either damaged or destroyed by the traveling public and as directed by the Engineer. Attenuators damaged by Contractors operations will not be measured for payment.

Picking Up and Returning Authority's Traffic Protection Devices will be measured on a lump sum basis.

Any work or expense, including traffic protection required for the closing of lanes or shoulders in connection with the correction of defective work; for the convenience of the Contractor which are not specified in the Contract or ordered by the Engineer; for "punch list" work; or for the Final Inspection will not be measured for payment.

Cone trucks and traffic observers required for lane and shoulder closing operations or for observers that may be engaged at the site to ride the cone truck will not be measured separately for payment.

The relocation and if necessary the replacement of existing mile markers during construction and the covering and uncovering of overhead sign panels (or the installation or removal of overlay panels) during lane closings will not be measured separately for payment.

Impact Attenuators (Quadguard) will be measured separately for payment in accordance with Subsection 524.04.

Temporary Striping will be measured separately for payment in accordance with Subsection 516.05.

801.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
FURNISHING TRAFFIC CONTROL DEVICES	LUMP SUM
FURNISHING PRECAST CONCRETE CONSTRUCTION BARRIER	LINEAR FOOT
PLACING AND REMOVING PRECAST CONCRETE CONSTRUCTION BARRIER	LINEAR FOOT
RESETTING PRECAST CONCRETE CONSTRUCTION BARRIER	LINEAR FOOT
MODULAR GLARE SCREEN SYSTEM	LINEAR FOOT
TRAFFIC PROTECTION PATROL, FULL-TIME	MAN HOURS
TRAFFIC PROTECTION PATROL, PART-TIME	MAN HOURS
FLAGGERS	MAN HOURS
FURNISHING PORTABLE VARIABLE MESSAGE SIGN	EACH
FURNISHING TEMPORARY IMPACT ATTENUATOR	EACH
PLACING AND REMOVING TEMPORARY IMPACT ATTENUATOR	EACH
REPAIR TEMPORARY IMPACT ATTENUATORS	BARREL
FURNISHING TRUCK WITH MOUNTED ATTENUATOR	EACH
FURNISHING TRUCK WITH MOUNTED ATTENUATOR FOR ENGINEER'S USE	MAN HOURS
REPAIR TRUCK MOUNTED IMPACT ATTENUATORS	EACH
PICKING UP AND RETURNING AUTHORITY'S TRAFFIC PROTECTION DEVICES	LUMP SUM

Except for the items listed in the Proposal, no separate payment will be made for any costs incurred by the Contractor in complying with the requirements specified under the various articles of this Section, unless otherwise specifically prescribed elsewhere in these Specifications, including all tools, equipment, transportation, labor, services and materials as may be required for maintaining traffic protection devices when the Contractor is actively engaged at the site; providing lane and shoulder closings; placing, removing and maintaining flashing arrow board trailer and variable message sign, covering and uncovering overhead sign panels (or the installation or removal of overlay panels) for lane closings and any other work or expense in connection with the maintenance and protection of traffic, during various stages of construction and as may be required by the Engineer.

No separate payment will be made for furnishing a schedule of operations for each stage of construction and attending review meetings related to staging of construction; placing, maintaining or removing variable message signs; furnishing, installing and maintaining arrow boards; maintaining temporary impact attenuator; furnishing, installing and maintaining temporary fencing at deck replacement areas; installing, maintaining and removing signs, traffic cones or sign supports; removing temporary striping; traffic observers required for lane and shoulder closing or opening operations; all tools, equipment, transportation, labor, services and materials as may be necessary for installation, maintenance and removal of lane and shoulder closings; cone trucks and traffic observers required for lane and shoulder closing operations; relocation and if necessary the replacement of existing mile markers; the covering and uncovering of overhead sign panels (or the installation or removal of overlay panels); installing, maintaining and removing lane closings for the purposes of obtaining field measurements; extending the lane closings for the purposes of performing "If and Where Directed by the Engineer" work, "Force Account" work, Change Orders and/or Emergency Work; placing, removing and

maintaining flashing arrow board trailer; furnishing and installing any spare parts for repairing or replacing damaged or missing traffic protection devices; furnishing, installing, maintaining and removal of closings of service area access locations and closing of U-turn access locations; and all else therefore and other work associated with and incidental to maintaining and protecting traffic.

No separate payment will be made for furnishing construction signs of various sizes required, complete with messages on the specified supports; overlay panels; traffic protection signs and aluminum sign supports; breakaway barricades; traffic control vehicles; flashing warning lights; batteries; cones with bases; stabilizers; flashing arrow boards; furnishing traffic control devices for installation of roadway, lane and shoulder closings at the locations shown on the Plans or as directed by the Engineer; replacing defective devices as directed, replacing lost, stolen, destroyed or unacceptable devices; and all equipment and material necessary therefore and incidental thereto, unless otherwise noted**.** No separate payment will be made for shimming, leveling, and/or construction of bituminous pavement strips necessary for the proper installation and maintenance of the traffic control devices.

No separate payment will be made for furnishing provisions for joint interlocking devices; reflectors; shimming and leveling; blockouts; grouting joints; anchorages into pavement; restoring roadway surfaces per the details following barrier removal; lifting devices; flashing lights; the labor, materials and equipment for transportation and delivery to the project site; furnishing test results or service history for approval by the Engineer, and any incidentals required in supplying the required quantity of precast concrete construction barrier to the Project. Reflectors shall be replaced when lost or damaged at no cost to the Authority.

No separate payment will be made for labor involved with loading and unloading of units; trucks; all trailers; all heavy machinery; and other equipment required to place and remove the barrier as prescribed; relocating temporary impact attenuators associated with resetting precast concrete construction barrier; relocating precast concrete construction barrier to gain access to a work area; and subsequent removal of the barrier.

No separate payment will be made for resetting of the precast concrete construction barrier less than a seven (7) foot difference to the previous location for staged construction, or for resetting of barrier due to the result of an accident or to gain access to a work area.

No separate payment will be made for furnishing, removing and reinstallation associated with Contractors operations, maintenance, and final removal of the Modular Glare Screen System (including screening) for the precast concrete construction barrier.

No separate payment will be made for correcting deficiencies to maintenance and protection devices, reporting to NJTA Traffic Operations, waiting periods between patrols, personnel required to perform Traffic Protection Patrol and correcting deficiencies (regardless is TCC or other Contractor personnel), for Traffic Protection Patrol duties when the Contractor is actively engaged at the site(s), or for Traffic Protection Patrol duties for deficiencies of maintenance and protection devices due to Contractor's operations.

No separate payment will be made for repairing impact attenuator barrels damaged by Contractor operations.

Payment for **"Furnishing Traffic Control Devices"** shall be made as follows:

- 50% at start of Contract
- 25% at midpoint
- 25% at completion of Contract.

No separate payment will be made for any work or expense, including traffic protection required for the closing of lanes or shoulders in connection with the correction of defective work; for the convenience of the Contractor which are not specified in the Contract or ordered by the Engineer; for "punch list" work; or for the Final Inspection, but the costs thereof will be included in the unit costs for the various maintenance and protection of traffic items in the Contract.

Payment for the various items related to **Temporary Impact Attenuators (Quadguard)** shall be in accordance with Subsection 524.05.

Payment for **Temporary Striping** shall be in accordance with Subsection 516.06.

SECTION 802 - STANDBY WRECKER SERVICE

802.01 Description.

The provision of standby wrecker service consists of providing a wrecker and driver (light duty and heavy duty), as hereinafter specified, to immediately remove from the construction area any vehicles that become disabled during construction.

The provision of standby wrecker service consists of providing an authorized flatbed tow truck (also called a Rollback or a Slide) that can be hydraulically inclined and moved to ground level, allowing a patron's vehicle to be placed on it under its own power or pulled by a winch, and licensed driver, as hereinafter specified, to immediately remove from the construction area any vehicles, within its capacity, which become disabled in the travel lanes when no shoulders are available.

802.02 Materials.

No materials supplied by the Contractor are involved in this work.

802.03 Methods of Construction.

Standby wrecker service is intended only to move disabled patron vehicles, including light duty trucks, from the construction zone to an authorized location within the Authority right-of-way. This service will be performed at no cost to the Authority patron. Removal of the disabled patron vehicle from the respective Authority right-of-way will be paid under another contract in accordance with Authority policies and regulations without need to "re-hook" the patron's vehicle.

The Contractor shall coordinate with the Authority, through the Engineer, areas of the project construction area to be served by the Authority's qualified towing firms.

Standby wrecker service shall be provided by a heavy duty tow truck in good working order. It shall be equipped with approved amber light bar and a Turnpike patron services radio or other approved means of communications with the Authority's Traffic Management and Technology Center in Woodbridge. The driver shall possess a valid New Jersey driver's license, shall have a good command of the English Language and be experienced in towing operations on the New Jersey Turnpike.

Extended hours during certain periods or inclement weather may be required by the Engineer after consultation with the Operations Department.

If the wrecker is called into service, the Authorized Towing Company shall dispatch another Wrecker to the staging area to act as the designated Stand-by. The service provider shall keep the Engineer informed as to the time of departure and the time the replacement truck is on station.

The service provider shall provide acceptable verbal notice to the Engineer when stationed within the Authority ROW at the start of a shift and at the end of a shift. Additionally, the service provider shall provide weekly invoices which reflect the daily name of the driver on duty, the truck identification number, time of arrival and time of departure and total hours for which payment is sought.

802.04 Measurement.

Standby Wrecker Service, Light Duty and Standby Wrecker Service, Heavy Duty provides a value for reimbursement to the Contractor for costs associated with having the wrecker on duty on Authority roadways. The only reimbursable costs permitted will be those charges approved by the Engineer for cost related to standby wrecker service related to this Contract.

802.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
STANDBY WRECKER SERVICE, LIGHT DUTY (NO-BID)	USD
STANDBY WRECKER SERVICE, HEAVY DUTY (NO-BID)	USD

No additional payment will be made for the time needed to travel to and from the designated AM and PM staging areas from the towing company's facilities.

No additional payment will be made to the Contractor for the management and payment of the Wrecker Service provider, but the costs thereof will be included in the unit cost for the pay items **"Standby Wrecker Service, Light Duty"** or **"Standby Wrecker Service, Heavy Duty".**

SECTION 803 - STATE, COUNTY, AND LOCAL ROADWAYS

803.01 Description.

The Contractor shall be responsible for protecting and maintaining vehicular and pedestrian traffic on State and Local Highways. Traffic shall be maintained in accordance with the requirements of the agency having jurisdiction and of the current edition of the Manual on Uniform Traffic Control Devices for Streets & Highway published by U.S. Department of Transportation, Federal Highway Administration, and as directed by the Engineer.

803.02 Materials.

Materials shall conform to the requirements of the agency having jurisdiction. All traffic control devices will be furnished by the Contractor and will remain the property of the Contractor.

803.03 Methods Of Construction.

The Contractor shall give written notice and a schematic layout of traffic protection devices to the appropriate State, County and/or local officials not less than ten days before he will start work on the road.

Before beginning work on any phase of the Project, the Contractor shall install all traffic protection devices required and necessary to protect the public during that phase of construction. Staging of work shall be as shown on the Plans unless otherwise approved by the Engineer.

Closing of lanes, and work requiring the closings of lanes, will be permitted only during the hours called for. The number of lanes for traffic to be maintained shall be as called for unless otherwise approved by the Engineer.

Except as necessary during actual working hours and then only with the specific approval of the Engineer, the Contractor shall not occupy with his equipment, materials, or personnel, any roadway or sidewalk area within or adjacent to the Project that is open to traffic.

The Contractor's operations shall be performed in such manner and sequence that interference with the traveling public and fire, police, and other emergency service will be kept to an absolute minimum.

The local roadways affected by construction under this Contract are under the jurisdiction of the agencies noted in the Contract documents. The Contractor shall prepare and submit a traffic control plan including methods, operations, and a layout plan indicating signing and traffic control protection devices and obtain approval prior to the closing of any lanes, shoulders or sidewalks under the jurisdiction of local agencies. The Contractor shall comply with all regulations, including permissible hours for closings and obtaining permits imposed by local agencies regarding the maintenance and protection of traffic. The Contractor shall give proper written notice as required by the local agencies prior to any closings.

Vehicular traffic on local roadways shall be maintained and protected in accordance with current NJDOT and MUTCD Standards. The Contractor is responsible for obtaining the most current NJDOT Standards from the NJDOT.

The Contractor shall secure permission from NJDOT, comply with all regulations, pay any charges imposed and furnish, place, maintain and remove the required traffic protection devices, including the necessary labor and services when impacting State roadways.

The Contractor is responsible for furnishing, installing, maintaining, and removing all traffic protection devices necessary to properly close lanes, shoulders, roadways and sidewalks as shown on the Plans for each of the local streets or on roadways under the jurisdiction of agencies other than the Authority.

The Contractor will not be permitted to occupy any section of roadway or sidewalk that is open to traffic with equipment, materials or personnel.

The Contractor shall coordinate all local traffic control with the agencies having jurisdiction and local police as applicable. Municipal Police Traffic Directors shall be off duty police officers from within the applicable municipality. Police Traffic Directors shall be provided where required by the municipality or at specific locations directed by the Engineer during construction. The townships and/or counties identified in the contract shall be contacted in order to obtain the services of police traffic directors and the name, address and

telephone number of their local representative. Police Traffic Directors shall not be considered to be Flaggers. Flaggers are as defined in the Manual.

The Contractor shall comply with all regulations imposed by these agencies regarding the maintenance and protection of traffic and shall pay for and obtain all necessary permits as required by them or local agencies having relevant jurisdiction.

Flaggers shall be properly trained, instructed, and experienced in flagman duties, and shall be uniformed as specified in Subsection 920.12. Any flaggers not satisfactory in the opinion of the Engineer shall be immediately replaced by an approved flagman. All flaggers shall be English speaking. Equipment and devices to be used by the flaggers are to be furnished by the Contractor.

The flagger stations shall be adequately protected and illuminated for nighttime operations. Refer to the MUTCD for further information and requirements of uniformed flagmen or flaggers at flagman stations.

If deemed necessary, the agency having jurisdiction may furnish or assign inspectors or other personnel who will be assigned to the Project during the time the Contractor or any subcontractor is performing work under this Contract. The cost of these personnel shall be paid directly by the Contractor to that agency having jurisdiction.

The Contractor shall submit evidence of payment of all charges made to each agency having jurisdiction in the form of copies of receipted bills, to the Engineer prior to final payment of the Contract by the Authority.

The traffic control plan shall provide for the treatment of conditions caused by or encountered during the work on the Project. The traffic control plan shall be based on the requirements provided in the MUTCD. The Contractor shall work in accordance with the MUTCD, and shall only deviate from the traffic control plan after receiving written approval.

Prior to the start of construction, the Engineer shall be notified of the single supervisory level individual, trained in the principles of safe traffic control, who will be assigned the responsibility and authority for the implementation and maintenance of the traffic control plan.

803.04 Measurement.

"Maintenance and Protection of Traffic on Location No. < > (Local Road Name)" will be measured on a Lump Sum basis. Flaggers will be measured in accordance with Section 801.

Traffic Protection Patrol or Traffic Control Coordinator efforts of local roadways will not be measured separately for payment.

Police Traffic Directors (No Bid) provides a value for reimbursement to the Contractor for costs associated with local police providing maintenance and protection of traffic on local roads. The only reimbursable costs permitted will be those charges approved by the Engineer and by the impacted municipality or county for cost related to maintenance and protection of local road traffic affected by this Contract.

Furnishing Traffic Control Devices for State, County, and Local Roadways for maintenance and protection of traffic will be measured on a lump sum basis. Furnishing construction signs of various sizes required, complete with messages on the specified supports; overlay panels; traffic protection signs and aluminum sign supports; traffic control vehicles; flashing warning lights; batteries; cones with bases; stabilizers; flashing arrow boards; furnishing traffic control devices for installation of roadway, lane and shoulder closings at the locations shown on the Plans or as directed by the Engineer; replacing defective devices as directed, replacing lost, stolen, destroyed or unacceptable devices; and all equipment and material necessary therefore and incidental thereto, unless otherwise noted will not be measured separately for payment. Shimming, leveling, and/or construction of bituminous pavement strips necessary for the proper installation and maintenance of the traffic control devices will not be measured separately for payment.

803.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
MAINTENANCE AND PROTECTION OF TRAFFIC ON LOCATION NO. < > LOCAL ROAD NAME)	LUMP SUM
FURNISHING TRAFFIC CONTROL DEVICES FOR STATE, COUNTY, AND LOCAL ROADWAYS	LUMP SUM
POLICE TRAFFIC DIRECTORS (NO-BID)	USD

No separate payment will be made for preparation of maintenance and protection of traffic plans; obtaining local agency approval and permits; Contractor's traffic protection patrol; furnishing, placing, maintaining or removing variable message signs; furnishing, installing, maintaining and removing temporary impact attenuators required for the detour; furnishing, installing and maintaining construction fencing; furnishing, placing, maintaining and removing signs, sign support posts, and connecting hardware; placing, maintaining and removing traffic cones, barrels or concrete barrier; all tools, equipment, transportation, training, labor, services and materials as may be necessary for maintenance and protection of local roadway traffic or as may be required by the Engineer or outside agencies; and all else necessary therefore and other work associated with and incidental to, but the costs thereof will be included in the unit prices bid for the lump sum items specified in this Section.

Payment for Police Traffic Directors will be made on a lump sum basis based on the total costs incurred by the Contractor (this amount may be higher or lower than that stipulated in the Proposal). The Contractor shall provide detailed billings prepared by the local municipalities identifying the actual maintenance and protection of traffic costs incurred. Final payment to the Contractor will not be made until the Authority obtains a release stating that all local municipality costs have been reimbursed from each municipality affected by the Contract.

SECTION 804 - RAILROADS

804.01 Description.

The Contractor is responsible for the maintenance and protection of rail traffic and appurtances passing over, under, or adjacent to work areas. The Contractor shall secure permission from, and comply with the regulations of, the agency having jurisdiction over the rail line. The Contractor shall pay all charges imposed by such agency and shall furnish, place, and remove such traffic protection devices which may be required.

804.02 Materials.

Materials used in the maintenance and protection of railroad traffic and appurtances shall be as specified by the appropriate rail agency. All traffic control devices shall be furnished by the Contractor and will remain the property of the Contractor.

804.03 Methods of Construction.

The Contractor shall conduct his work within the railroad limits in such a manner as to safeguard the tracks, traffic, and appurtenances of the railroad(s). He shall comply with the regulations of each railroad relative to the work.

The Contractor is advised that the proposed work may involve construction operations on, over, or adjacent to electrified tracks of the railroad and in the vicinity of high voltage lines of the railroad. In working near these lines great care must be exercised and the railroad's rules detailing requirements for clearance to be maintained between equipment and energized wires and other instructions in regard to working in the vicinity of their electric operations must be strictly observed.

The Contractor will obtain verification of the time and schedule of track occupancy from the railroad(s) before proceeding with any construction or demolition work over, under, within, or adjacent to the railroad right-of-way. The Contractor shall submit for the approval of each railroad, plans and a detailed description of the methods which will be followed for work within these areas. The work in the field shall not proceed until the plans and method of procedure have been approved by each railroad.

Before proceeding with any construction or demolition work on, over, or adjacent to the railroad's property, a pre-construction meeting may be required.

The Contractor shall give not less than twenty-one days advance written notice to the official designated by each railroad to receive such notice, prior to the commencement of any work or any portion of the work by the Contractor or his subcontractors over or adjacent to the railroad's right-of-way.

If deemed necessary, the railroad(s) may furnish or assign inspectors or other personnel who will be assigned to the project during the time the Contractor or any subcontractor is performing work under the Contract on railroad property. The cost of these personnel will be paid directly by the Contractor to the railroad(s).

When railroad employees are assigned to protection duties during the time work is being performed on or adjacent to railroad right-of-way or facilities, the wages of said employees will include the base rate, warranted overtime, and labor surcharges in accordance with 23 CFR 140, Subpart I.

The Contractor for this project is ultimately responsible for assuring that its agents, consultants, contractors and sub-contractors fully comply with the specifications contained herein. The term "sponsor" used throughout the specifications shall mean the Contractor, its agents, consultants, contractors, sub-contractors, etc.

The Contractor shall pay directly to the Railroad charges by the Railroad for protective services performed to insure safe operations of trains when the work required by the Contractor under this Contract would, in the Railroad's opinion, be a hazard to Railroad operations. No separate measurement nor payment will be made to the Contractor, by the Turnpike Authority for such charges paid directly to the Railroad; these and any costs imposed by the Railroad shall be included in the price bid for the pay item Mobilization. To insure Contractor payment of all charges made by the Railroad, the Contractor shall submit evidence of payment in the form of copies of receipts with proof of payment, to the Engineer prior to final payment of the Contract by the Authority.

(A) CONSOLIDATED RAIL CORPORATION (CONRAIL).

The Contractor shall give written notice to the Chief Engineer Design and Construction, Consolidated Rail Corporation, 1000 Howard Blvd, 4th Floor, Mt. Laurel, NJ 08054, telephone 1-856-231-2021, not less than twenty-one (21) days in advance of the date he expects to start work on, over or adjacent to the railroad property.

With respect to CONRAIL's facilities, the Contractor shall conduct his work in conformance with the applicable requirements detailed in the CONRAIL guidelines entitled "SPECIFIC REQUIREMENTS OF CONSOLIDATED RAIL CORPORATION FOR WORK ON ITS RIGHT OF WAY", as provided in the Supplementary Specifications, if applicable.

(B) NJ TRANSIT RAIL OPERATIONS (NJTRO).

The Contractor shall give written notice to the R.O.W. Engineering, NJ Transit Rail Operations, Penn Plaza, Newark, NJ, telephone 1-973-491-8086, not less than 21 days prior to commencement of any work which may affect railroad property.

With respect to NJTRO facilities, the Contractor shall conduct his work in conformance with the applicable requirements detailed in the NJTRO guidelines entitled "SPECIFICATIONS FOR PIPELINE OCCUPANCY ON NEW JERSEY TRANSIT PROPERTY", as provided in the Supplementary Specifications, if applicable.

(C) PORT AUTHORITY TRANS-HUDSON CORPORATION (PATH).

The Contractor shall give written notice to the Port Authority of NY & NJ, 1 PATH Plaza, 3rd Floor, Jersey City, NJ 07306, not less than thirty days prior to commencement of any work on, over or adjacent to the Railroad's right-of-way.

The Contractor is advised that PATH will require approval of any temporary shielding, scaffolding or other temporary devices constructed over PATH tracks and right-of-ways. Plans and procedures, including calculations, for all catches or shielding to be installed, shall be prepared, signed and stamped by a Registered Professional Engineer licensed in the State of New Jersey. Five copies of the procedures are to be sent to Project Manager, Technical Services of the Port Authority Interstate Transportation Department, One PATH Plaza, 3rd Floor, Jersey City, NJ 07306-2905, Telephone (201) 216-6313. The Contractor is advised that a minimum 30-day review will be required.

PATH representatives shall be contacted by the Contractor prior to the start of work. The Contractor shall hold a pre-construction meeting with PATH prior to starting work on PATH Right-of-Way (ROW).

The Contractor shall provide PATH with his proposed access and construction methodology procedure within the PATH ROW at least three (3) weeks prior to his scheduled operations. No work will be permitted within the ROW until the proposed access and construction methodology procedure is approved by PATH in writing. Such approval shall not be considered as releasing the Contractor from any responsibility or liability for any damage which PATH may suffer, or for which it may be held liable, by the acts of the Contractor or to those of his subcontractors, or his or their employees.

The Contractor shall at all times protect and safeguard the PATH track and power-rail during any work activity which might cause debris to fall onto or in the vicinity of these tracks. If, in PATH's opinion, the work is at any time being performed in a manner which may endanger its' operations, PATH may order work stopped until all dangerous conditions are remedied.

The Contractor shall daily clean up all refuse, rubbish, scrap materials and debris caused by his operations. When a deck panel is removed for rehabilitation and repairs have to be done in stages due to restricted work hours, Contractor shall protect any unauthorized access to PATH ROW by erecting temporary

closure of any opening and, in addition, install barricades. Before a Certificate of Final Completion of Work may be issued by New Jersey Turnpike Authority to its Contractor, all surplus materials, false work, temporary fences and other temporary structures, plant of any description and debris of any nature resulting from his operations shall be removed from PATH ROW and the construction site shall be put in a neat, orderly condition.

Due to projected work loads, PATH will not make flat cars/work trains available for the work of this contract. Additionally, no storage of material or equipment is permitted on PATH property or within the right-of-way unless specifically granted in writing by PATH.

The Contractor will be responsible for scheduling track availability with PATH's Resident Engineer. Requests by the Contractor to PATH for track availability for installing work platform under the bridge, must be made in writing by Tuesday before the week of anticipated operations. The Contractor shall be advised that the desired track might not always be available, being subject to the priority of PATH requirements, timing, and other ongoing PATH contracts.

For work performed within PATH right-of-way, the Contractor's attention is directed to the fact that there will be high voltage electrical lines, rails and collector shoes for PATH traction power at or adjacent to the areas of work and no representation is made that such lines and rails will be de-energized during performance of the work of the contract. The Contractor shall take necessary precautions to protect personnel and equipment from such high voltage lines and rails. Such lines and rails will remain energized for PATH operations except where shutoff is approved by the PATH Resident Engineer.

With respect to PATH facilities, the Contractor shall conduct his work in conformance with the requirements specified above and shall obtain all necessary permit(s) required by PATH.

(D) NATIONAL RAILROAD PASSENGER CORP. (AMTRAK).

The Contractor shall give written notice to the National Railroad Passenger Corp., 30th Station, Box 64, Philadelphia, PA 19104 telephone (215) 349-4971, not less than 21 days prior to commencement of any work which may affect railroad property.

With respect to AMTRAK facilities, the Contractor shall obtain specific requirements and necessary permit(s) from AMTRAK and conduct his work in conformance with applicable requirements and permit(s).

(E) NEW YORK, SUSQUEHANNA AND WESTERN RAILWAY CORP. (NYS&W).

The Contractor shall give written notice to the Vice President of Engineering, New York, Susquehanna and Western Railway, One Railroad Ave., Cooperstown, NY 13326, telephone 1-607-547-2555 ext. 264, not less than twenty-one (21) days in advance of the date he expects to start work on, over or adjacent to the railroad property.

With respect to NYS&W 's facilities, the Contractor shall conduct his work in conformance with the applicable requirements detailed in the NYS&W guidelines entitled "INFORMATION REQUIRED FOR WORK ON NYS&W'S RIGHT-OF-WAY", as provided in the Supplementary Specifications, if applicable .

(F) C.S.X. TRANSPORTATION (CSXT).

The Contractor shall give written notice C.S.X. Transportation, 4901 Belfort Road, Suite 130, Jacksonville, FL 32256, telephone 1-904-245-1036, not less than twenty-one (21) days in advance of the date he expects to start work on, over or adjacent to the railroad property.

With respect to CSXT's facilities, the Contractor shall conduct his work in conformance with the applicable requirements detailed in the CSXT guidelines entitled "CSXT SPECIAL PROVISIONS", as provided in the Supplementary Specifications, if applicable.

(G) NORFOLK SOUTHERN CORP. (NS).

The Contractor shall give written notice to the Office of the Chief Engineer Bridges & Structures, Norfolk Southern Corp., 99 Spring Street, SW, Atlanta, GA 30303, telephone 1-404-529-1362, not less than twenty-one (21) days in advance of the date he expects to start work on, over or adjacent to the railroad property.

With respect to NS's facilities, the Contractor shall conduct his work in conformance with the applicable requirements detailed in the NS guidelines entitled "SPECIAL PROVISIONS FOR PROTECTION OF RAILWAY INTEREST", as provided in the Supplementary Specifications, if applicable.

All work to be done under, upon, or over the railroad right-of-way shall be performed by the Contractor in

a manner satisfactory to the railroad, and at such times and in such manner as not to interfere with the approved procedure for movement of trains or traffic upon the tracks of the railroad. The Contractor shall use all necessary care and precaution in order to avoid accidents, damage, delay, or interference with the railroad's trains or other property.

During demolition operations, the Contractor shall provide an approved shield to prevent any debris from falling onto railroad right-of-way.

The Contractor shall conduct his work and handle his equipment and materials so that no part of any equipment shall foul an operating track or wire line without the written permission of the railroad. An operating track is fouled when any object is brought closer than 10 feet horizontally from the near rail of the tracks. Cranes, trucks, motor shovels, or any other equipment shall be considered as fouling the tracks when working in such a position that failure of the same, with or without load, will obstruct the track.

Materials and equipment belonging to the Contractor shall not be stored on railroad property without first having obtained permission from the railroad.

The Contractor shall keep the tracks adjacent to the site clear of all refuse and debris that may accumulate from his operations, and shall leave the railroad property in the condition existing before the start of his operations.

Upon completion of the work and before final payment is made, the Contractor shall remove from within the limits of the railroad's right-of-way, all machinery, equipment, surplus materials, falsework, rubbish and temporary buildings, and other property of the Contractor or any subcontractor and shall leave the right-of-way in a condition satisfactory to the railroad(s).

804.04 Measurements.

Maintenance and Protection of Railroad Traffic will not be measured for payment.

804.05 Payment.

No separate payment will be made for costs incurred for maintenance and protection of railroad traffic or for any costs as a result of compliance with Railroad regulations, but the costs thereof shall be included in the price bid for the pay item Mobilization. Final payment to the Contractor will not be made until the Authority obtains a release stating that all railroad costs have been reimbursed from each railroad affected by the Contract.

SECTION 805 - MARINE

805.01 Description.

The Contractor shall carry on his work in, over, adjacent, or contiguous to navigable waters in such fashion as not to interfere with navigation or pose a threat to marine traffic. He shall obtain Permits, comply with all laws and regulations applicable thereto, and such instructions or directions as issued by the U.S. Coast Guard, the U.S. Army Corps of Engineers, and any other authority having jurisdiction over waterways.

805.02 Materials.

Materials used in the maintenance and protection of marine traffic shall be as specified by the appropriate agency having jurisdiction over the waterway(s). All traffic control devices will be furnished by the Contractor and will remain the property of the Contractor.

805.03 Methods of Construction.

The Contractor shall conduct his work so as not to improperly interfere with navigation in the various rivers and streams, infringe upon the navigable clearances, or impair existing navigable depths without proper permits. He shall comply with all laws and regulations applicable thereto and with such further instructions as may be issued by the U.S. Coast Guard District Commander or other governmental agencies regulating use of these waters.

The Contractor shall submit his plan and schedule of operations to the Engineer, the U.S. Army Corps of Engineers and/or the United States Coast Guard at least 14 days (unless otherwise required by the agency) prior to commencement of any work for their approval. The information shall include a sketch of the waterway, the structure, location of any restrictions to be placed in the waterway, locations of scaffolding or netting, and a projected schedule of dates and length of time each operation will take, including hours of operation and whether or not the equipment will be removed at night. No deviation from the approved plan

and schedule will be permitted unless the modification has been previously submitted and approved by the appropriate agency.

The navigable depths of the waterways may be unknown. The Contractor shall therefore investigate, by soundings or otherwise, the actual navigable depths at all locations where he plans to use barges or marine equipment to satisfy himself as to the navigable conditions in relation to his operations.

Before commencing any work requiring occupation of any waterway, the Contract shall notify:

Commander (AOWB)
USCG Atlantic Area
4th Floor Federal Building
431 Crawford Street
Portsmouth, VA 23704-5004

The Contractor shall comply with the following:

(1) Two copies of the Contractor's plan, schedule and sequence of operations approved by the NJTA, shall be submitted to the above office and approval obtained by such office prior to mobilization or work requiring the occupation of areas over or in the waterway. In addition, a NJTA approved sketch of the project area shall be submitted to the above office for the structure showing the following: (1) the waterway, (2) the structure, (3) the location of any restrictions that will be placed in the waterway, such as barges, anchors and anchor lines. And (4) the location, height above mean high water and detailed description of any scaffolding or netting to be used. The schedule should also include the daily hours of operation and whether or not waterborne equipment will remain in the waterway at night. The Contractor will be required to comply with all provisions of the Navigation Rules International – Inland, copies of which are available from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Refer to Stock No. 022-003-92759-0. One copy of each plan, schedule, sequence of operations and sketch of the project areas, approved by the above office and appropriately stamped by the Coast Guard shall be promptly submitted to the Engineer for his records or comments as appropriate. No deviation from the Coast Guard approved plan, sequence, schedule of operations or any Contractor restrictions to navigation shall be made unless modifications have previously been submitted to the Coast Guard and approved by them.

(2) Positive means shall be taken to prevent any debris or construction material from entering the waterway.

(3) Floating equipment shall have a radio telephone capable of operation from its main control station in accordance with Part 26 of Title 33, Code of Federal Regulations and shall be monitored during all periods the floating equipment is on station.

(4) Repairs shall be made in such manner so as not to present any metal surfaces on the face of the fender system. All spike, bolts or other metal fastening devices shall be countersunk.

(5) At no time during the repairs will any waterway be closed to navigation without approval of the above office.

(6) There shall be no change in the horizontal and vertical clearances as a result of subject repairs.

(7) If permanent lighting cannot be maintained operable, identical, temporary battery or power-operated lights shall be installed at the same general locations. These temporary lights shall be visible for a distance of 2,000 yards on 90 percent of the nights of the year. Generally, a lamp of 20 candlepower will meet these requirements. The temporary lights shall be in place until the repairs have been completed and permanent navigational lighting has been reinstalled and determined to be operating satisfactorily. Written approval of temporary lighting to be used during periods of construction is required. Deviations from the prescribed temporary lighting shall only be permitted upon written approval of the above office.

(8) All anchor lines must be marked by anchor buoys which shall be lighted.

(9) During the progress of work should any material, machinery or equipment be lost, dumped, thrown overboard or sunk so as to obstruct, interfere with or hazard navigation, immediate notice shall be given to the Coast Guard and the object removed immediately. Until removal can be effected, the obstruction shall be properly marked in order to protect navigation. Notice to the Coast Guard shall give a description and location of any such object and the action taken or being taken to protect navigation.

(10) Spillage of oil and hazardous substances is specifically prohibited by Section 311 of the Federal Water Pollution Act of 1972, as amended. Measures should be taken including: 1) proper maintenance of construction equipment, 2) arrangement of fuel/hazardous substances handling areas so as to ensure that any spills are contained before reaching navigable waterways or their adjoining shorelines, 3) instructions to personnel not to dispose of oil hazardous substances into drains or the navigable waterways directly or onto adjoining shorelines and 4) any other procedures to prohibit spillage. If in spite of such planning oil/hazardous substances are spilled into a navigable waterway or adjoining shoreline, the US Coast Guard is to be notified immediately at (800) 424-8802. A supply of an absorbent material should be retained so that it may be rapidly deployed to soak up any possible spillage, pending Coast Guard arrival on scene. The use of chemical dispersing agents and emulsifiers is not authorized without prior, specific, federal approval.

(11) The above office shall be notified immediately upon completion of the repairs and certification shall be provided in writing by a licensed engineer or licensed surveyor that the waterway has not been impaired and all debris has been cleared from the waterway. The Coast Guard suggests that a wire drag and/or before and after soundings be conducted to make this verification.

(12) The Contractor must notify the Coast Guard 30 days in advance of construction and of any work or structures placed in the water, which may be obstructions to navigation so that the Coast Guard can publish the information in the Local Notice to Mariners. Advise the Coast Guard of the location and type of construction plant that will be used in this activity. Construction plans showing this information, as well as the sequence of operations should be provided to the Coast Guard at the time of the 30-day advance notification. Notify the Coast Guard when construction is completed.

(13) At no time during the work shall the waterway be closed to navigation without prior notification and approval from the Coast Guard.

(14) The Contractor is required to maintain close and regular contact with Coast Guard Marine Safety Office/Group Philadelphia throughout the repair period to keep them informed of activities in the river (telephone (215) 271-4835).

The Contractor is responsible for compliance with the requirements of any Federal, State or local agency who may have jurisdiction over any aspect of the project.

(A) Lighting Requirements For Barges And Structures Not Part Of A Bridge Or Approach Structure.

Lights on barges at bank or dock:

(1) The following barges shall display at night and, if practicable, in periods of restricted visibility the lights described in paragraph (B) of this section.

(a) Every barge projecting into a buoyed or restricted channel.

(b) Every barge so moored that it reduces the available navigable width of any channel to less than 80 meters.

(c) Barges moored in groups more than two barges wide or to a maximum width of over 25 meters.

(d) Every barge not moored parallel to the bank or dock.

(2) Barges described in paragraph (A) shall carry two unobstructed white lights of an intensity to be visible for at least one mile on a clear dark night and arranged as follows:

(a) On a single moored barge, lights shall be placed on the two corners farthest from the bank or dock.

(b) On barges moored in group formation, a light shall be placed on each of the upstream and downstream ends of the group on the corners farthest from the bank or dock.

(3) Any barge in a group, projecting from the main body of the group toward the channel, shall be lighted as a single barge.

(4) Barges moored in any slip or slough, which is used primarily for mooring purposes are exempt from the lighting requirements of this section.

(B) Lights On Structures Not Part Of A Bridge Or Approach Structure.

Lights on sheer booms, isolated piers, obstructions and other structures not part of a bridge or approach structure must meet the requirements for aids to navigation in (A) below.

(1) The characteristics of a private aid to navigation shall conform to the United States Aids to Navigation System except that only tungsten-incandescent light sources will be approved for electric lights.

Therefore, in accordance with 33 CFR 66.01-10(a) the above lights shall be marked with slow flashing yellow lights visible for two miles on a clear dark night. Lights similar to the Tideland ML-120 Barge Light may be used.

Should the Contractor during the progress of the work lose, dump, throw overboard, sink, or misplace any material, plant, machinery, or appliance which may be dangerous to or obstruct navigation, the Contractor shall recover and remove the same with utmost dispatch. The Contractor shall give immediate notice, with description and location of such obstructions and the action taken or to be taken to protect navigation, to the U.S. Coast Guard and, if required, shall mark or bouy the obstructions and comply with any directions issued by the U.S. Coast Guard.

The Contractor shall provide temporary signal lights and signals in accordance with the requirements of the Coast Guard and shall also be responsible for the proper performance and maintenance of all temporary signal lights during the life of the Contract.

Should the Contractor refuse, neglect, or delay his responsibility for the proper maintenance of the temporary signal lights and signals or for the removal of obstructions to navigation, the Authority reserves the right to correct any defect resulting from such refusal, neglect, or delay by its own means and the cost of same may be deducted from any money due or to become due to the Contractor.

The Contractor shall protect the construction work from damages caused by marine craft, as well as providing necessary devices to warn and protect all marine craft utilizing the channel from damage caused by collision with the construction work. The Contractor shall repair at his own expense, any damage to the work caused by marine craft until the work is substantially completed as verified in writing by the Engineer upon the request of the Contractor.

The Contractor will be required to comply with all provisions of the Navigation Rules International - Inland, copies of which are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Refer to Stock No. 022-003-92759-0.

Positive means shall be taken to prevent any debris or construction material from entering waterways.

Spillage of oil and hazardous substances is specifically prohibited by Section 311 of the Federal Water Pollution Control Act of 1972, as amended. Measures should be taken including: (1) proper maintenance of construction equipment, (2) arrangement of fuel/hazardous substances handling areas so as to ensure that any spills are contained before reaching navigable waterways or their adjoining shorelines, (3) instructions to personnel not to dispose of oil/hazardous substances into drains or the navigable waterways directly or onto adjoining shorelines and (4) any other procedures to prevent spillage. A supply of an absorbent material should be retained so that it may be rapidly deployed to soak up any possible spillage.

It shall be the responsibility of the Contractor to insure that channel depths are not affected by the work. Should it be suspected that channel depths have been impaired or that an obstruction resulting from the work may exist, the Contractor shall, upon request of the Coast Guard or Corps of Engineers, provide the necessary equipment and personnel to undertake a survey to determine the presence of such impairment or obstruction.

805.04 Measurement.

Maintenance and Protection of Marine Traffic will be paid for on a lump sum basis.

805.05 Payment.

Payment will be made under:

PAY ITEM	*PAY UNIT*
MAINTENANCE AND PROTECTION OF MARINE TRAFFIC	LUMP SUM

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SECTION 901 - EMBANKMENT

901.01 Embankment, Grade A.

Embankment, Grade A shall be a free-draining* frost-resistant** material. The material shall have a Plasticity Index of not more than 3, and shall meet the following gradation requirements when tested in accordance with AASHTO T27 and T11.

Sieve Size	Total Percent Passing (by Weight)
2"	100
1"	60-100
3/8"	35-100
No. 4	25-100
No. 10	20-100
No. 200	0-6

When tested for bearing capacity, Embankment, Grade A shall have a California Bearing Ratio (CBR) of not less than 20% when compacted to 100% of maximum density.

901.02 Embankment, Grade B.

Embankment, Grade B shall be free-draining*, frost-resistant** material. The material shall have a Plasticity Index of not more than 6, and shall meet the following gradation requirements when tested in accordance with AASHTO T27 and T11.

Sieve Size	Total Percent Passing (by Weight)
3"	100
No. 50	8-65
No. 200	0-10

When tested for bearing capacity, Embankment, Grade B shall have a California Bearing Ratio (CBR) of not less than 15% when compacted to 100% of maximum density.

* Free draining shall be defined as a material having a coefficient of permeability of not less than 1×10^{-3} cm/sec.

** Frost resistant material is defined as being a material meeting the following grading requirements: not more than 10% shall pass a 200 mesh sieve and not more than 5% of its particles shall be less than 0.02 millimeters in size.

SECTION 902 - AGGREGATES

902.01 General.

Sampling and testing of aggregates shall conform to the requirements of ASTM C33.

Geologic classifications from which broken stone aggregates are manufactured shall be defined as follows:

(A) TRAP ROCK.

Trap Rock shall mean a basic igneous rock consisting principally of augite and plagioclase. It shall be either basalt or diabase rock. It shall be of medium or fine grain texture with even distribution of constituent minerals and uniform quality and color.

(B) ARGILLITE.

Argillite shall mean a hard, uniformly dense, fine-grained, metasedimentary rock devoid of fissile partings. It shall be uniform in quality and color and have blocky cleavage.

(C) QUARTZITE.

Quartzite shall mean a metamorphic rock composed principally of quartz. It shall be quarried so that only the nonarkosic, uniformly compacted quartzites are included in the graded products, and shall not be schistose in structure.

(D) CARBONATE ROCK.

Carbonate Rock shall mean a rock consisting primarily of calcium and magnesium carbonates. It shall contain not less than 75 percent by weight total of combined calcium and magnesium carbonates, nor more than 20 percent of elements which are insoluble in hot, dilute, hydrochloric acid.

(E) GRANITE.

Granite shall mean an equigranular or porphyritic igneous rock consisting principally of quartz and feldspar. It shall be of medium or fine grain texture, shall have an even distribution of the constituent materials, and shall be uniform in quality and structure.

(F) GNEISS.

Gneiss shall mean a metamorphic rock consisting principally of quartz and feldspar. It shall have a dense structure, shall not break in thin pieces at lines of stratification, and shall have a uniform distribution of minerals.

All stockpiles shall meet the following:

The area for each stockpile shall be of adequate size, reasonably uniform in cross-section, well drained, and cleared of foreign materials.

Stockpiles at Portland cement concrete and HMA mixing plants shall be of sufficient size to provide for a minimum of one day's operations. The aggregate stockpiles shall be placed on a firm, hard surface such as a compacted aggregate or stabilized base, HMA or concrete surface, and shall be constructed by placing the aggregates in layers not more than 3 feet thick.

Aggregates from the haul away areas shall not be used. The piles shall be located so that there is no contamination by foreign material and no intermingling of aggregates from adjacent piles.

Aggregates from different sources, geological classifications, or of different gradings shall not be stockpiled near each other unless a bulkhead is placed between the different materials. Aggregates of different gradings and from different sources for use in blends shall be blended by proportion through the weigh hoppers. Aggregates found segregated or contaminated will be rejected for use. A rejected stockpile may be reconstructed for further evaluation. Aggregates shall be removed from stockpiles in a manner such as to prevent segregation.

Aggregates that require washing shall not be used sooner than 24 hours after washing, or until the surplus water has drained out and the material has a uniform moisture content.

Reclaimed Asphalt Pavement (RAP) stockpiles shall consist of RAP from an approved NJDOT, NJHA, NJTA HMA or Superpave mixture only. When tested the coarse aggregate in this RAP shall be broken stone only in conformance with Subsection 902.02 and the fine aggregate shall conform to Subsection 902.02. All RAP shall be processed prior to testing by crushing to where all RAP shall pass the ½" or smaller screen and shall contain only coarse aggregate, fine aggregate and asphalt binder, free of solvents or other contaminating substances. Stockpiles of RAP to be used in HMA mixes shall not exceed 15 feet in height. Stockpiles shall be covered or otherwise protected to prevent buildup of moisture in the stockpile.

Steel-tracked equipment will not be permitted on the stockpiles.

902.02 Broken Stone.

Broken stone for concrete shall be either trap rock, argillite, quartzite carbonate rock, granite, limestone or gneiss. Only one of these classifications shall be used in any one structure, unless otherwise approved by the Engineer. The percentage of wear for coarse aggregates 1-1/2 inches and larger shall be determined by AASHTO T3. The maximum allowable percentage of wear will be 4.5 for all types of stone. The percentage of wear for coarse aggregates small than 1 ½ inches, when tested by means of the Los Angeles Machine using AASHTO T96, shall not exceed 40 percent. The broken stone shall be uniform in texture and quality and free from pieces coated with clay, caked stone dust, and other foreign materials. It shall contain not more than 5 percent of weathered or decomposed rock; not more than 5 percent of stone of a classification other than that approved for use; not more than 5 percent, by weight, of flat or elongated pieces; and the total of all of the above shall not exceed 8 percent. Absorption in cold water shall be not more than 1.2 percent as determined by AASHTO T85. A flat piece shall be one in which the ratio of the width to thickness of its circumscribing rectangular prism is greater than 4 to 1 and an elongated piece shall be one in which the ratio of the length to width of its circumscribing rectangular prism is greater than 4 to 1. It shall not lose more than 10 percent when testing ledge rock or more than 8 percent when testing graded sizes according to the sodium sulfate method by

AASHTO T104.

Broken stone for asphalt concrete shall have a percentage of wear (Los Angeles) for surface course of no more than 25 percent and for intermediate course and base course of more than 25 percent and for intermediate course and base course of no more than 35 percent as determined by AASHTO T96.

Only broken stone shall be used in the pavement surface and intermediate courses, or in the bridge surfacing course. The stone shall be either argillite, gneiss, granite, quartzite or trap rock. Carbonates stone shall not be used in these courses.

902.03 Gravel.

Gravel for concrete and other specified purposes shall be either crushed or uncrushed, containing not more than 2 percent of soft fragments not more than a total of 0.5 percent of clay lumps, coal, organic and other foreign matter; not more than 3 percent of thin, elongated pieces as defined above and shall be practically free from sea salt and other deleterious matter. Absorption in cold water shall be not more than 2.5 percent as determined by AASHTO T85. Before being loaded for shipment, it shall be washed so that the surfaces are clean and free from coatings of foreign matter. The percentage of wear shall not be more than 35 when determined in accordance with AASHTO T96.

902.04 Fine Aggregate.

Fine aggregate for concrete and mortar shall be particles of quartz or other hard durable rock, moderately sharp and free from soft particles, clay, shale, loam, cemented particles, mica, salt and organic and other foreign matter. The surface of the particles shall be clean, and the aggregate, including grading, shall be in accordance with the requirements for fine aggregates in ASTM C33.

When the aggregate is mixed with cement and water, the resulting mortar shall have compressive and tensile strengths at the age of 7 and 28 days which are not less than those of mortar similarly prepared with standard Ottawa sand. When for testing purposes, Ottawa sand is called for and not available, a similar quartz sand which the Laboratory has compared for strength results with standard Ottawa sand may be used, but all test results shall be reported on the basis of percentage of Ottawa sand strength as computed.

Fine aggregate (passing the No. 8 sieve) for asphalt paving mixtures shall be stone sand, natural sand, or combinations thereof. Stone sand shall be produced from broken stone conforming to the quality requirements specified above for broken stone. Natural sand shall consist of particles of quartz or other hard durable rock and shall be predominately angular in shape. Quality requirements for fine aggregates shall consist of a maximum absorption in cold water of 2 percent by weight, when subjected to five cycles of the soundness test shall have a weighted loss of not more than 5 percent using sodium sulfate and shall not contain more than 2 percent by weight of soft particles, clay, loam, foreign and deleterious matter.

Fine aggregate for concrete decks shall contain a miximum of 0.06 percent chloride content.

Fine aggregate for asphalt concrete bridge surfacing shall only be stone sand.

Fine aggregate for sand bedding shall be a coarse sand of quality approved by the Engineer.

Fine aggregate used in the manufacture of concrete blocks or concrete bricks shall not contain calcite rock or dolomite rock.

Sand for rolling into the top surface of the asphalt concrete bridge surfacing shall be clean, hard angular silica sand conforming to the following gradation.

Sieve Size	Total Percent Passing
No. 4	100
No. 8	65-85
No. 16	40-62
No. 30	22-45
No. 50	10-35
No. 100	0-10

902.05 Coarse Aggregate.

Coarse aggregate shall be graded to conform with Table 2, Grading Requirements for Coarse Aggregate, in ASTM C33.

(A) Coarse aggregate for concrete, except for bridge slabs and bridge slab overlays, shall be broken stone, gravel, or blast furnace slag. Coarse aggregate for bridge slabs and slab overlays shall be broken stone only, containing no carbonate rock. Coarse aggregate shall conform to the requirements which follow and shall be graded as specified.

The maximum size of the coarse aggregate shall not exceed three-quarters of the clear distance between the reinforcing bars, or between the bars and the face of the concrete, whichever is the lesser of the two. The size number used shall conform to the restrictions on maximum size as specified above.

Blast furnace slag shall be the air-cooled residue resulting from the production of pig iron and shall consist of tough, durable, angular fragments uniform in density, absorption, quality, and shall be free from flux stone, dirt, or other objectionable material. The slag shall conform to the following quality requirements:

Weight per cubic yard(loose measure), pounds	330 minimum
Percentage of wear (Los Angeles Test)	50 maximum
Sulfur, percentage by weight	2 maximum

(B) Lightweight aggregates for structural concrete shall conform to ASTM C330.

Certified test reports for ASTM C330 on newly manufactured lightweight aggregate including, but not limited to, the test items listed herein shall be verified by an independent testing laboratory within 2 years and shall be submitted to the Engineer within 60 days prior to the start of the project.

(1) Water Absorption.

(2) Bulk Specific Gravity and Dry Rodded Unit Weight per ASTM C29.

(3) Soundness loss per AASHTO T104 - shall be less than 10% after 5 immersion and drying cycles using the sodium sulfate method.

(4) Freeze/Thaw for the aggregate per AASHTO T103 Procedure A.

(5) Density Tests per ASTM D4253 AND D4254

(6) Abrasion Loss when tested in accordance with AASHTO T 96 shall not exceed 40%.

(7) The maximum chloride content (CAL DOT Test 422) shall be 100 ppm.

Manufactured aggregate from dredged sediment shall be a rotary kiln expanded shale and shall meet all United States EPA Toxicity Characteristic Leaching procedure regulatory limits. The maximum size shall be 3/4 inch with gradation requirements per ASTM C330.

The unit weight of the dry loose aggregate shall conform to those values given in Table II of ASTM C330.

Two possible sources of manufactured lightweight aggregate from dredged sediment that may be used when approved by the Engineer are lightweight aggregate as supplied by Solite Corporation, P.O. Box K-28, Richmond, VA 23288 Ph. (888)854-9634; Norlite Corporation, 628 S. Saratoga Street, Cohoes, NY 12047, Ph. (518)235-0030, or other comparable source.

(C) Coarse aggregate for asphalt concrete shall conform to the requirements of Subsection 902.02.

(D) Aggregate for filter blanket shall be Size No. 8 washed gravel.

(E) Aggregate for underdrains shall be Size No. 8 washed gravel or broken stone.

(F) Lightweight aggregate manufactured from dredged sediment required or allowed to be used as structural fill shall be SOLITE, NORLITE or an approved rotary kiln substitute meeting the requirements of ASTM C330.

Certified test reports for ASTM C330 on newly manufactured lightweight aggregate including, but not limited to, the test items listed herein shall be verified by an independent testing laboratory within 2 years and shall be submitted to the Engineer within 60 days prior to the start of the project.

(1) Water Absorption.

(2) Bulk Specific Gravity and Dry Rodded Unit Weight per ASTM C29.

(3) Soundness loss per AASHTO T104 - shall be less than 10% after 5 immersion and drying cycles using the sodium sulfate method.

(4) Freeze/Thaw for the aggregate per AASHTO T103 Procedure A.

(5) Bulk Density Tests per ASTM D4253 and D4254

(6) Abrasion Loss when tested in accordance with AASHTO T 96 shall not exceed 40%.

(7) Direct Shear Test per ASTM D3080

(8) Consolidated Triaxial Test per Corps of Engineers EM-1110-2-1906, Appendix X

(9) Gradings shall be tested per ASTM A136.

(10) Resistivity, ohm-cm, shall be greater than 3,000, per AASHTO T 288.

No by-product slags, cinders or by-products of coal combustion shall be permitted. Lightweight aggregate shall have a proven record of durability, as determined by ASTM C88 and ASTM C131, and be non-corrosive, as determined by CAL DOT Test 422 with the following physical properties:

Sieve Size	Delivered Gradation: % Passing
1"	100
3/4"	90-100
3/8"	10-50
No. 4	0-15

The dry loose density shall be less than 50 pcf.

The maximum in situ density (moist, surface dry) shall be less than 60 pcf. The minimum compacted dry density shall be equal to 65% relative density as determined by ASTM D4253 and D4254, or as otherwise specified by the Engineer.

The maximum soundness loss when tested with 5 cycles of magnesium sulfate shall be 10% (ASTM C88).

The maximum chloride content (CAL DOT Test 422) shall be 100 ppm.

The minimum strength of loosely placed material, as determined from drained triaxial tests, shall equal that of cohesionless soil with an angle of internal friction of 36^{o}. Minimum strength of material compacted to 65% relative density shall equal that of a cohesionless soil with an angle of internal friction of 40^{o}.

902.06 Stone.

Stone shall be sound, durable, angular rock, free from spoil, shale, and organic material and shall be subject to approval by the Engineer.

Grade A stone shall be riprap weighing not less than 50 nor more than 150 pounds each, and shall be reasonably graded. Not more than 40% shall weigh more than 100 pounds each. An allowance of 10% by weight of quarry spalls (weighing less than 50 pounds each) will be permitted.

(A) Grade B stone shall be crushed stone conforming to Size No. 2, ASTM C33 of either trap rock, dolomite, granite, limestone, or gneiss. Unless otherwise approved, only one kind shall be used.

(B) Grade C stone shall be riprap weighing not less than 10 or more than 25 pounds each, and shall be reasonably graded. Not more than 35 percent shall weigh more than 15 pounds each. An allowance of 15 percent by weight of quarry spalls (weighting less than 5 pounds each) will be permitted.

(C) Grade D stone shall be riprap weighing not less than 15 nor more than 35 pounds each, and shall be reasonably graded. Not more than 35 percent shall weigh more than 25 pounds each. An allowance of 15 percent by weight of quarry spalls (weighing less than 7 pounds each) will be permitted.

(D) Grade E stone shall be riprap weighing not less than 75 nor more than 200 pounds each, and shall be reasonably graded. Not more than 35 percent shall weigh more than 130 pounds each. An allowance of 15 percent by weight of quarry spalls (weighing less than 35 pounds each) will be permitted.

Riprap stones shall consist of a uniformly graded mixture of rock conforming to one or more of the Grades A, C, D or E above as required by the Contract Documents such that 50 percent of the mixture by weight shall be equal to or larger than the designated median stone (d_{50}) size. The well-graded mixture shall be

composed primarily of the larger stone sizes, but with a sufficient mixture of other sizes to fill the progressively smaller voids between the stones. The diameter of the largest stone size in such a mixture shall be 1.5 times the d_{50} size.

Riprap stone material shall not contain disintegrated granite or shale and shall meet the following limits when tested as specified. The Contractor shall be responsible for all sampling and testing specified herein.

The following tests shall be performed on samples of stone riprap material obtained for use as riprap stone protection when required by the Engineer.

(1) Soundness – Freezing and Thawing. Maximum loss of 10% when tested in accordance with ASTM D5312.

(2) Bulk Specific Gravity. Minimum specific gravity of stone shall be 2.50 when tested in accordance with ASTM C127.

Except for specific gravity and freeze thaw testing, acceptance of quality and size of riprap material will be made by visual inspection at the job site unless required otherwise by the Engineer.

902.07 Aggregate Base.

Aggregate base shall conform to all the requirements of the "New Jersey Interagency Engineering Committee - Standard for Dense Graded Aggregate Base Course", with the exceptions that the material shall be quarry processed, quality controlled, crushed dolomitic limestone, gneiss or traprock and the provision for material passing the No. 4 sieve to be entirely or in part natural processed sand is deleted. No blast furnace slag or stone consisting of shale, mica schist, slate, or sandstone will be permitted except as allowed herein.

Manufactured lightweight aggregate from dredged sediment meeting the requirements of Subsection 902.05(F) may be used as aggregate base and provided it meets requirements of the "Standard for Dense Graded Aggregate Base Course".

This material shall meet the material and gradation requirements of Subsection 905.09(A) for manufactured lightweight concrete aggregate.

All other aggregate base material requirements specified herein not conflicting with the above requirements for manufactured lightweight aggregate shall also apply to the manufactured lightweight aggregate unless waived by the Engineer.

The moisture content of the aggregate base material shall be 6 percent plus or minus 2 percent based on dry weight immediately prior to placement.

No aggregate from any source shall be used that does not conform to the approved sample from that source.

Gradation shall be as follows, determined in accordance with AASHTO T27.

Sieve Size	Total Per Cent Passing
1-1/2"	100
3/4"	55-90
No. 4	25-60
No. 50	5-25
No. 200	3-12

The portion passing the No. 40 sieve shall be nonplastic when tested in accordance with AASHTO T90.

Loss limitation shall not exceed 10% loss by weight per ASTM C88, using sodium sulfate for 5 cycle test period, or 15% using magnesium sulfate for 5 cycle test period.

Aggregate base may consist of broken stone conforming to Subsection 902.02, crushed gravel conforming to Subsection 902.03, except that at least 90 percent of all fragments shall contain at least one face resulting from fracture, and shall conform to the above requirements and gradation.

Aggregate base may be produced from recycled concrete aggregate that shall conform to the gradation and plasticity requirements above and to the following:

(A) COMPOSITION.

	Percent by Weight	
	Minimum	Maximum
Portland cement concrete	90 (Note 1)	
HMA		10 (Note 2)
Brick, mica, schist, and other friable material		4 (Note 2)
Reactive material		0
Wood		0.1 (Note 2)

Note 1: To meet the minimum requirement, broken stone, crushed gravel, or crushed vitreous china may be added. Broken stone shall conform to Subsection 902.02. Crushed gravel shall conform to Subsection 902.03, except that it need not be washed. Crushed vitreous china shall conform to the requirements for resistance to abrasion and soundness listed in this Subsection.

Note 2: The percent shall be determined by separating the material retained on the No. 4 sieve and expressing that amount as a percentage of the total weight of material retained on the No. 4 sieve.

(B) RESISTANCE TO ABRASION.

The loss shall not exceed 50 percent when tested according to AASHTO T 96 (Los Angeles Machine).

(C) SOUNDNESS. .

The loss shall not exceed 15.0 percent when tested according to AASHTO T 104 by the use of sodium sulfate.

(D) BEFORE USE.

Before use, test results certifying compliance to the above requirements shall be submitted to and verified by the Authority Laboratory.

(E) A QUALITY CONTROL PLAN.

A quality control plan shall also be submitted for approval and shall include the following:

(1) The assignment of quality control responsibility to specifically named individuals.

(2) Performance of regularly scheduled inspection procedures including inspection of the source concrete for the recycled concrete aggregate.

(3) Provisions for the prompt implementation of control and corrective measures.

(4) Provisions for liaison with the Engineer at all times.

(5) Performance of necessary quality control tests. The quality control procedure shall include performance of the following tests while stockpiles of recycled concrete aggregate are being produced:

(a) Gradation.

Testing according to AASHTO T 27 and T 11 shall be performed at least once a day.

(b) Composition.

Continuous visual inspection and removal of objectionable material to ensure compliance.

(c) Soundness of aggregate.

Soundness of aggregate according to AASHTO T 104 and resistance to degradation according to AASHTO T 96 shall be performed a minimum of once every two weeks.

(F) REPORTING OF RECYCLED MATERIALS USAGE.

The Contractor shall report to the Solid Waste Management District of origin, according to NJAC 7:26A, the tonnage of concrete aggregate being recycled. A copy of the reported information shall be provided to the Resident Engineer.

902.08 Soil Aggregate.

Soil aggregate shall be natural or prepared mixtures consisting predominately of hard durable particles or fragments of stone, slag, gravel, or sand, and containing some silt-clay or stone dust or remediated ID-27 petroleum contaminated soil aggregate (RPCSA) produced by a New Jersey Department of Environmental Protection (NJDEP) approved "Class B" recycling center operating pursuant to NJAC 7:26A.

A list of recycling centers, which have been approved as a source of RPCSA for NJDOT projects is available from the Department's Bureau of Materials.

Soil aggregate obtained from subaqueous sources and placed by methods other than hydraulically shall first be placed in a stockpile and drained, and shall not be placed in its final location until the Engineer has determined that the moisture content is not excessive.

Soil aggregate shall conform to the following:

(A) Definitions of Constituent Materials.

Stone shall be crushed or naturally angular particles of rock, a natural solid mineral matter occurring in large masses or fragments, which shall pass a 2-inch sieve and be retained on a No. 8 sieve. The stone shall conform to Subsection 902.02.

Blast furnace slag shall be the air-cooled residue resulting from the production of pig iron and shall consist of tough, durable, angular fragments uniform in density, absorption, quality, and shall be free from flux stone, dirt, or other objectionable material. The slag shall conform to Subsections 902.01 and 902.02, and to the following quality requirements:

Weight per cubic foot (loose measure), pound	60 minimum
Percentage of wear (Los Angeles Test)	50 maximum
Sulfur, percentage by weight	2 maximum

Gravel shall be rounded particles of rock that shall pass a 4-inch sieve and be retained on No. 8 sieve.

Sand shall be granular material resulting from weathering processes, grinding or crushing of rock and shall pass a No. 8 sieve and be retained on the No. 200 sieve.

Stone dust shall be fine soil or mineral particles, or both, which shall pass the No. 200 sieve. Silt-clay shall be fine soil particles that shall pass the No. 200 sieve.

(B) Composition of Soil Aggregate.

The composite mixture of any type of soil aggregate specified herein shall be free from elements or chemicals which, in the presence of water, would produce detrimental effects to pavements, structures, or utility lines, and be free from organic matter, wood, garbage, metal, debris, or lumps of clay.

Designations I-1, I-2, I-3, I-4, I-9, I-10, I-11, I-12, and I-13 shall consist of bank-run sand and gravel, commercial sand and gravel combined, blast furnace slag, or stone, except blast furnace slag will not be permitted when in contact with concrete. Designation I-5 shall be hard, durable gravel or stone mixed with sand, stone dust, or silt-clay so that it can be compacted into a hard, dense mass. The composite mixture shall contain, by weight, a total of not more than 25 percent of shale, slate, schist, or soft and decomposed aggregate as determined by lithologic analysis.

Designation I-5 may be produced from recycled concrete aggregate conforming to the composition and quality requirements specified for recycled concrete aggregate in Subsection 902.07, except that the crushed surface requirement shall not apply, and to the gradation requirements of Subsection 902.09, Table 902-1. When designation I-5 is produced from recycled concrete aggregate, the Contractor shall report to the solid waste management district of origin, according to NJAC 7:26A, the tonnage of concrete aggregate being recycled. A copy of the reported information shall be provided to the Resident Engineer.

Designations I-6, I-7, and I-8 shall consist of clean, free-draining sand, gravel or stone.

Designations I-1, I-2, I-3, I-4, I-5, I-9, and I-10 shall comply with the gradation requirements specified in Subsection 902.09, Table 902-1 after being tested for materials which break down as determined according to Section 990, A-7.

(C) GRADATION.

Soil aggregate shall be graded as shown in Subsection 902.09, Table 902-1 for the various designations. The gradation requirements shall apply to the material after it has been placed and compacted on the Project. Where compaction is not prescribed, the requirements for any given type shall apply to the material at the time it is placed.

(D) COMBINING AND MIXING.

If bank-run or other materials conforming to the requirements specified hereinabove are not available, materials that conform thereto may be produced by combining and mixing, and by washing if necessary. Materials may be combined and mixed on the grade only with approval. The blending on the grade shall be performed by a traveling high-speed rotor mixer capable of cutting and thoroughly mixing to a minimum depth of 6 inches.

902.09 Table.

Table 902-1 Standard Soil Aggregate Gradations
New Jersey Interagency Engineering Committee

Sieve	Gradation Designations, percentage by weight passing square mesh sieves												
Size	I-1	I-2	I-3	I-4	I-5	I-6	I-7	I-8	I-9	I-10	I-11	I-12	I-13
4"	100		100						100	100	100	100	100
2"	70-100	100		100	100				80-100	80-100	80-100		
1"				60-100		100	100						
¾"	50-95	65-100	60-100		70-100				60-100	60-100	60-100	70-100	
½"				40-100		80-100	80-100	100					
No. 4	30-60	40-75	30-100	25-100	30-80			95-100	40-100	40-100	40-100		30-100
No. 8				20-100		45-100	35-100						
No. 16				15-85		30-90	25-90	45-70	20-70	20-70			
No. 50	5-25	5-30	5-35	8-45	10-35	0-20	5-50	5-25	5-35	5-40	0-75	0-75	
No. 100						0-3	0-8		0-20	0-30			
No. 200	0-7	0-7	0-8	5-10	5-12		0-2	0-5	0-8	0-20	0-9	0-5	0-12

SECTION 903 –HOT MIX ASPHALT (HMA)

903.01 Composition.

The composition of the mixture for HMA surface courses shall be coarse aggregate, fine aggregate, and asphalt binder and may also include mineral filler and up to 10 percent RAP. RAP will not be permitted in surface course mixes used for Bridge Deck Resurfacing. The composition of the mixture for base or intermediate courses shall be coarse aggregate, fine aggregate, and asphalt binder and may also include mineral filler and up to maximum of 30 percent by weight of RAP. The RAP shall be the product resulting from the cold milling or crushing of an existing hot mix asphalt pavement and shall be so processed so that 100 percent will pass the maximum aggregate size for the mixture being produced. RAP shall not exceed 30 percent of mass (weight) of the total mixture.

The use of "open system" RAP sources will be permitted for use in the proposed mix.

The grade of asphalt binder shall be determined by the Contractor, and submitted for approval by the Authority, for those projects that include the use of 11 to 30 percent of RAP.

When RAP is used, the supplier shall have in operation an ongoing daily quality control program to evaluate the RAP. As a minimum this program shall consist of the following:

(A) An evaluation performed to ensure that the material complies with Section 902, and compares favorably with the design submittal.

(B) An evaluation of the RAP material performed using a solvent or an ignition oven to qualitatively evaluate the aggregate components to determine compliance with Section 902. Quality control reports shall be made available to the Engineer.

Materials shall conform to the following Subsections:

AGGREGATES.....902

ASPHALT BINDER.....904

Mineral filler shall meet the requirements of AASHTO M17.

The several mineral constituents shall be combined in such proportions that the resulting mixture meets the grading requirements in Subsection 903.04. In calculating the percentage of aggregates of the various sizes, the asphalt binder is excluded.

Aggregates shall conform to the requirements in Subsection 902 and the following:

The combined coarse aggregate in the mixture shall comply with the requirements in Table 903-5 and the combined fine aggregate in the mixture shall comply with the requirements in Table 903-6. Only broken stone shall be used in the pavement surface and intermediate courses, or in the bridge surfacing course. The stone shall be either argillite, gneiss, granite, quartzite or trap rock. Carbonate stone shall not be used in these courses. Only one of the geologic classifications shall be used in a mixture unless otherwise authorized. RAP for HMA shall be processed through screening and crushing operations and meet the requirements of Subsection 902.01.

Nominal maximum size of aggregates and asphalt binder for mixes shall be as follows:

	Asphalt Binder	Aggregate Size
Base Course	PG 64-22	1-1/2"(37.5 mm)
Intermediate Course*	PG 64-22	1-1/2"(37.5 mm) or 1" (25.0 mm)
Surface Course	PG-64-22	3/4"(19 mm)
Surface Course	PG-76-22	3/4"(19 mm)

* Where permitted by the Contract Documents the nominal aggregate size for intermediate courses may be adjusted to 3/4", 1/2", or 3/8" mixes as necessary to accommodate the lift thickness of material to be placed. Lift thickness shall be a minimum of 2 times the nominal maximum aggregate size unless otherwise permitted by the Engineer.

903.02 Job Mix Formula.

A job mix formula for each mixture shall be submitted on forms acceptable to the Authority, which shall include a statement naming the source of each component and a report showing the results meet the criteria specified in Subsection 903.04 Table 903-2 and Table 903-3.

The job mix formula for each mixture shall establish the percentage of dry weight of aggregate passing each required sieve size and an optimum percentage of asphalt binder based upon the weight of the total mix. The optimum percentage of asphalt binder shall be determined according to AASHTO MP2 and PP28. The job mix formula shall be within the master range specified in Subsection 903.04, Table 903-1.

For each mix design, three gyratory specimens and one loose sample corresponding to the composition of the job mix formula, including the design asphalt content, shall be submitted with the mix design forms. These will be used for verification of the properties of the job mix formula. The specimens shall be compacted to the design number of gyrations (N_{des}). To be acceptable all three gyratory specimens must comply with all of the requirements in Table 903-1 and 903-4. The Engineer reserves the right to be present at the time of molding the

gyratory specimens.

At the discretion of the Engineer, the submission of gyratory specimens for verification of the properties of the job mix formula will not be required if the previous year's approved design for a particular mix is submitted with written certification that the same source and character of materials are to be used. When a previous year's design is approved for use, the initial lot provision of Subsection 903.03 shall not apply and the first lot of the particular mix shall not be a reduced size lot.

The job mix formula shall provide a mixture that meets a minimum Tensile Strength Ratio (TSR) of 80% when tested according to AASHTO T 283.

The job mix formula for each mixture shall be in effect until modification is approved.

The job mix formula which includes RAP shall also include the following based on the weight of the total mixture:

(A) Percentage of RAP

(B) Percentage of asphalt binder in the RAP.

(C) Percentage of new asphalt binder.

(D) Total percentage of asphalt binder.

(E) Percentage of each type of new aggregate.

For mixes containing RAP, the job mix formula shall also establish the target percentage of dry weight of aggregate passing each required sieve size and the target percentage of recoverable bitumen to be present in the recycled HMA mixture when discharged from the plant and when tested according to Section 990, B-3 or AASHTO T 308.

The job mix formula containing up to 10 percent of RAP may be established by modifying a previously approved mix design to allow for the introduction of reclaimed asphalt pavement.

When unsatisfactory results for any specified characteristic of the work make it necessary, a new job mix formula may be established for approval. In such instances, if corrective action is not taken, the Engineer reserves the right to require an appropriate adjustment.

Should a change in sources or properties of new materials be made or significant changes in the properties of the RAP occur, the Engineer may require that a new job mix formula be established and approved before production can continue.

The Contractor may submit to the Engineer for approval job-mix formulas of the type specified in the contract documents which have been previously approved for use by the NJDOT. Such job-mix formulas shall include the NJDOT Laboratory Serial Number. Submission of pre-approved job-mix formulas on NJDOT Producers Analysis of Materials and Job Mix Formulas form are acceptable.

The Contractor is advised that NJTA Standard Supplementary Specifications allow 10% RAP content in dense graded surface course mixes. RAP is not permitted in OGFC and bridge deck surface mixes. As such, a NJDOT approved job-mix formula with a RAP content of greater than 10% will not be permitted unless specifically approved by the Engineer.

903.03 Sampling and Testing.

(A) General Sampling and Testing Requirements.

Acceptance testing of HMA will be performed in a timely manner. Sampling will be performed according to AASHTO T 168, Section 990, B-2, and/or ASTM D 3665.

The producer's quality control technician shall be present during periods of mix production for the sole purpose of quality control testing and to assist the Authority's representative in order to ensure compliance. The Authority will not perform the quality control testing or other routine test functions in the absence of or instead of the plant laboratory technician.

Acceptance testing does not preclude the Engineer from requiring disposal of any batch or shipment without further testing which is rendered unfit for its intended use due to contamination, segregation, improper temperature, or incomplete coating of the aggregate. For other than improper temperature, visual inspection of the material by the Engineer is considered sufficient grounds for such rejection.

When materials are rejected for any of the above reasons, except for improper temperature, samples will be

taken for testing. Should such testing indicate that the material was erroneously rejected, payment will be made for the rejected material.

HMA mixtures processed through a surge or storage system will be inspected visually to ensure that they are essentially free of lumps of cold material. Any batch or shipment of material found to be so contaminated will be rejected and shall be disposed of.

(B) DRUM MIX PLANTS.

Five stratified random samples for acceptance will be taken from each lot of approximately 3, 000 tons of each type of mix. When a lot of HMA is necessarily less than 3,000 tons, samples will be taken at random for each type of mix at the rate of one sample for each 600 tons or fraction thereof and will be treated as a short lot.

To determine the quantity of binder and the gradation of the aggregate to determine volumetric properties for quality control testing purposes, extractions or ignition testing at the sampling rate specified shall be performed each day for each type mixture according to Section 990, B-3 or AASHTO T 308.

(C) FULLY AUTOMATED BATCH PLANTS.

When using bin analysis, five stratified random samples shall be taken from each lot, under the supervision of the Engineer, otherwise sampling is done according to the requirements for drum mix plants. A lot is approximately 3,000 tons of each type of mix. When a lot of HMA is necessarily less than 3,000 tons, samples shall be taken at random for each type of mix at the rate of one sample for each 600 tons or fraction thereof and will be treated as a short lot.

Quality control testing for gradation and volumetric properties shall be performed using bin samples and printed weigh tickets according to Section 990, B-5 or according to the requirements for drum mix plants.

(D) QUALITY CONTROL AND ACCEPTANCE REQUIREMENTS.

The quality control technician at the asphalt plant shall perform sampling and testing according to the approved quality control plan for the plant, to keep the mix within the limits specified in Tables 903-1 and 903-4. Volumetric properties, dust to binder ratio, and compaction requirements (N_{ini}, N_{des}, N_{max}) for quality control samples shall be determined on the basis of extraction, ignition oven, or hot bin analysis, and air voids as determined by bulk specific gravity according to AASHTO T 166 and maximum specific gravity according to AASHTO T 209. The quality control technician shall use the results to control production.

Coarse aggregate, fine aggregate, mineral filler and RAP shall be sampled and tested according to the approved quality control plan for the plant.

Volumetric properties at N_{des}, dust to binder ratio and compaction at N_{ini} will be determined for acceptance from samples taken, compacted and tested at the mixing plant. The number of sublots tested for N_{max} is at the Engineer's discretion. The material will be compacted to the number of design gyrations (N_{des}) as required in Table 903-2, using equipment according to AASHTO T 312.

The bulk specific gravity of the compacted sample will be determined according to AASHTO T 166.

Maximum specific gravity shall be tested as needed to control production and at least once per day's production by the producer's quality control technician on loose material, according to AASHTO T 209.

The HMA mixture shall conform to all of the requirements listed in Subsection 903.04 Table 903-4, and to the gradation requirements in Table 903-1. If two samples in a lot do not conform to these requirements, corrective action shall be initiated immediately.

The temperature of the mixture at discharge from the plant or surge and storage bins shall be maintained at a minimum of 15°F above the minimum laydown temperature required to deliver material to the project to achieve optimum compaction. In no case shall the mixture temperature exceed 325 °F for unmodified asphalt binders or exceed the mixing range specified by the manufacturer for modified binders.

The moisture content of the mixture at discharge from the plant shall not exceed 1.0 percent. Moisture determinations are based on the weight loss on heating for one hour in an oven at 280 ± 5°F of an approximately 3.5 lb. sample of mixture. A minimum of one sample per lot will be tested for moisture. Samples for moisture determinations will be obtained according to Section 990, B-2 or ASTM D 3665.

The total mineral aggregate and asphalt binder material shall be so combined and mixed that at least 95 percent of the coarse aggregate particles are entirely coated with asphalt binder as determined by AASHTO T 195. At the option of the Engineer, random samples will be obtained from each of five trucks, and the

adequacy of the mixing will be determined on the average of particle counts made on these five test portions. If the above requirement is not fully met plant operations shall be modified as necessary to obtain the required degree of coating.

(E) Initial Production Lot.

The initial lot each year is defined as the plant's first day's production, or a minimum of 1,200 tons, in a calendar year. In the event the first day's production does not reach 1,200 tons, the initial lot is to be extended until the 1,200-ton level is reached or the Project is completed. Every truck will be visually checked before the first sample being taken. The first sample shall be taken in the first 100 to 200 tons. The remaining samples shall be taken at a rate of one sample every 600 tons, starting at 600 tons.

(F) Plants Producing for Multiple Projects.

When a plant is producing HMA mixtures for two or more Authority Projects at the same time, only one common set of lots will be established and the samples taken for each lot shall apply to each Project on which a part of that lot was used.

(G) Testing of Cores for Air Voids Acceptance.

HMA cores shall meet the air voids requirements of Subsection 302.07. Acceptance of cores will be determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix will be determined according to Section 990, B-9 and AASHTO T 209 except that minimum sample size may be waived in order to use a 6-inch diameter core sample. Bulk specific gravity of the compacted mixture will be performed on each core and determined according to AASHTO T166.

903.04 Tables.

Tables referenced in the Specifications are as follows:

Table 903-1 HMA Mixtures
Nominal Maximum Size of Aggregate - Grading Of Total Aggregate

Sieve Size	Nominal Maximum Aggregate Size – Control Point (Percent Passing)									
	37.5 mm		25 mm		19 mm		12.5 mm		9.5 mm	
	Min.	Max	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2"	100	--	--	--	--	--	--	--	--	--
1½"	90	100	100	--	--	--	--	--	--	--
1"	--	90	90	100	100	--	--	--	--	--
¾"	--	--	--	90	90	100	100	--	--	--
½"	--	--	--	--	--	90	90	100	100	--
3/8"	--	--	--	--	--	--	--	90	90	100
No. 4	--	--	--	--	--	--	--	--	--	90
No. 8	15	41	19	45	23	49	28	58	32	67
No. 200	0	6	1	7	2	8	2	10	2	10

Material passing the 200 sieve may consist of fine particles of the aggregate or mineral filler, or both. Material passing the No. 40 sieve shall be non-plastic when tested according to AASHTO T 90.

Aggregate size requirements: Layer thickness should be greater than or equal to three times the nominal maximum aggregate size for the mixture. (For example, the minimum proposed lift thickness for a 12.5-millimeter mix should be 1½.")

Table 903-2 Gyratory Compaction Effort for e HMA Mixtures

Compaction Level	ESALs[(1)] (millions)	N_{ini}	N_{des}	N_{max}
L	<0.3	6	50	75
M	0.3 to < 3	7	75	115
H	3 to < 30	8	100	160

Design ESALs (Design Equivalent (80kN) Single-Axle Loads) are anticipated project traffic level expected on the

design lane over a 20-year period.

Table 903-3 HMA Requirements for Design										
Compac-tion Levels	Required Density (% of Theoretical Max. Specific Gravity)			Voids in Mineral Aggregate (VMA), % (minimum) Nominal Max. Aggregate Size, mm					Voids Filled With Asphalt (VFA) %	Dust-to-Binder Ratio
	N_{ini}	N_{des}	N_{max}	37.5	25.0	19.0	12.5	9.5		
L	≤91.5	96.0[2]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	70 – 80	0.6 - 1.2
M	≤ 90.5	96.0[2]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	65 – 78	0.6 – 1.2
H	≤ 89.0	96.0[2]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	65 –75[1]	0.6 - 1.2

Note 1: For 37.5 mm nominal maximum size mixtures the specified lower limit of the VFA shall be 64 percent for all design traffic levels.

Note 2: As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix will be determined according to AASHTO T 209. Bulk specific gravity of the compacted mixture shall be determined according to AASHTO T 166.

Table 903-4 Hot Mix Asphalt Requirements for Control									
Compaction Levels	Required Density (% of Theoretical Max. Specific Gravity)			Voids in Mineral Aggregate (VMA), % (minimum) Nominal Max. Aggregate Size, mm					Ratio Dust-to-Binder
	N_{ini}	N_{des}	N_{max}	37.5	25.0	19.0	12.5	9.5	
L	≤91.5	95.0 – 97.0[1]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	0.6 - 1.3
M	≤ 90.5	95.0 – 97.0[1]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	0.6 – 1.3
H	≤ 89.0	95.0 – 97.0[1]	≤ 98.0	11.0	12.0	13.0	14.0	15.0	0.6 - 1.3

Note 1: As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix will be determined according to AASHTO T 209. Bulk specific gravity of the compacted mixture shall be determined according to AASHTO T 166.

Note 2: For 37.5 mm nominal maximum size mixtures the specified lower limit of the VFA shall be 64 percent for all design traffic levels.

Table 903-5 Additional Coarse Aggregate Requirements			
Mix Compaction Level	Coarse Aggregate Angularity % (minimum)		Flat & Elongated[2] % (maximum)
	Surface/Intermediate	Base	
L	95/90[1]	80/75	10
M,H	95/90	80/75	10

Note 1: 95/90 denotes that 95 percent of the coarse aggregate has one or more fractured faces and 90 percent has two or more fractured faces, according to ASTM D 5821.

Note 2: Criterion based upon a 5:1 maximum to minimum ratio according to ASTM D 4791.

Table 903-6 Additional Fine Aggregate Requirements			
Mix Compaction Level	Fine Aggregate Angularity % Air Voids (minimum)[1]		Clay Content Sand Equivalent[2] % (minimum)
	Surface/Intermediate	Base	
L	40	40	45
M,H	45	40	45

Note 1: According to AASHTO T 304, Method A.

Note 2: According to AASHTO T 176

SECTION 904 - BITUMINOUS MATERIALS

904.01 Asphalt Cement.

Asphalt binder shall conform to AASHTO MP-1, "Standard Specifications for Performance Graded Asphalt Binder." Grade 76-22 shall be used except that an asphalt of softer grade may be permitted when the mixture contains RAP and except where otherwise specified.

PG 76-22 asphalt binder shall be storage-stable, pre-blended, homogeneous, polymer modified asphalt binder using Styrene-Butadiene (SB) or Styrene-Butadiene-Styrene (SBS) formulations with the rolling thin film oven test (RTFOT) residue having a minimum Elastic Recovery (ASTM D 6084) of 50 percent when tested for 60 minutes at 77 ^{o}F and 2 inches/minute elongation. A written certification of compliance shall be furnished for the polymer modified asphalt binder and shall be submitted according to Subsection 105.04.

904.02 Tack Coat.

Tack coat material shall be undiluted Grade RS-1 or Grade SS-1 emulsified asphalt, conforming to the requirements of AASHTO M140 or grade PG 64-22 conforming to the requirements of AASHTO MP1. Asphalt material grade RC-70 or RC-250 conforming to the requirements of AASHTO M81 may only be used when so directed by the Engineer.

904.03 Crack Sealant.

Asphalt vulcanized rubber crack sealant shall be from an approved supplier as listed on the QPL All materials shall be used in strict accordance with the manufacturer's instructions.

904.04 Liquid Asphalt.

Liquid asphalt for erosion control shall be SS-1 as per AASHTO M140 mixed with an equal part of water conforming to Subsection 905.04.

904.05 Asphalt Additive.

Asphalt additive for asphalt bridge surfacing mixture shall be from an approved supplier as listed on the QPL.

904.06 Sealing Materials.

The material for coating the exposed vertical face of existing asphalt concrete surfacing or concrete surfaces shall be asphalt cement, Viscosity Grade AC-20.

Material for sealing the horizontal joint between new and existing asphalt concrete surfacing or concrete surfaces shall be asphalt cement, Viscosity AC-20.

Material for sealing the transverse and longitudinal joints in the new asphalt concrete pavement shall be asphalt cement Viscosity Grade AC-20.

(A) HOT POURED JOINT SEALANT.

Hot poured joint sealers shall be from an approved supplier listed on the QPL, and shall conform to the requirements of ASTM Designation D3405 for joints in concrete and asphalt pavements.

904.07 Latex-Modified Bitumen.

Latex-modified shall be a blend of 5 percent latex as specified in 904.08 and 95 percent blended bitumen. The blended bitumen shall be a blend of 75 percent asphalt cement as specified in 904.01 and 25 percent natural asphalt as specified in 904.09.

904.08 Latex Additive Tack Coat.

Latex additive shall be from an approved supplier as listed on the QPL.

904.09 Natural Asphalt.

Natural asphalt shall be refined Trinidad Lake Asphalt and shall be blended with asphalt cement prior to introducing the bitumen into the asphalt plant.

Natural asphalt shall be from an approved supplier as listed on the QPL and blending shall be done by an

approved supplier as listed on the QPL.

SECTION 905 - CONCRETE, MORTAR AND GROUT

905.01 Portland Cement.

Portland Cement shall conform to ASTM C150, Type I, II or III except as follows:

Type I and III White Portland Cement shall not contain more than 0.55% by weight of ferric oxide ($Fe_2 0_3$).

The autoclave expansion for Type II cement shall not exceed 0.5%.

Type III or IIIA cement may only be used when specifically approved by the Engineer and when high early strength is desired.

At the Contractor's option, either Type I or II may be used unless otherwise specified. The cement shall be of a standard brand and at the place of manufacture shall be taken from storage bins containing cement which has been inspected and approved by the Engineer.

Different brands of cement, the same brand of cement from different mills, or different types of cement shall not be mixed.

Subject to conformity with all other specification requirements, the use of the cement in the Project may begin when the cement has satisfactorily passed the specified 7-day compression test; however, the cement may still be rejected if the 28-day test is unsatisfactory.

Each unit of a structure shall be constructed with cement of one brand and with aggregates from the same sources. In the event it is deemed necessary, the Contractor, with the approval of the Engineer, may use more than one brand of cement in a structure provided that any resulting differences in coloration are not objectionable. Cement may be shipped in bulk or in 94 pound bags. Railroad cars or trucks in which cement is shipped shall be loaded, sealed, and certified to the Engineer. Cars or trucks with broken seals may be unloaded, but the cement shall not be used until retested and reapproved.

The cement shall be stored in an approved weatherproof building, silo, or bin with the floor raised over the ground. Small quantities left at the site shall be stored on suitable platforms and protected with waterproof covering to the satisfaction of the Engineer. Each shipment of cement shall be stored separately to provide for ready identification and inspection. Cement which for any reason has become partially set or containing lumps of hardened cement or which has been stored for more than 6 months shall not be used. The temperature of the cement when delivered to the mixing site shall not exceed 150°F. Standard cement stored at the site of the Project for more than 30 days, and high early strength cement stored for more than 10 days, shall not be used until retested and reapproved by the Engineer. The Contractor or concrete supplier shall keep suitable daily records of cement received and used. The records shall show, in such details as the Engineer may require, the quantity used for each part of the Project during the day, and copies of the records shall be furnished the Engineer upon request.

905.02 Aggregates.

Fine aggregates, coarse aggregates, and lightweight aggregates shall conform to the requirements of Section 902.

905.03 Admixtures and Curing Compounds.

Air entraining admixtures, water reducing admixtures, water-reducing and retarding admixtures, superplastizers, silica fume admixtures, corrosion inhibiting admixtures, curing compounds and miscellaneous curing materials shall conform to the requirements of Section 906.

905.04 Water.

Water used in mixing and curing shall be clean, fresh, and free from oil, salts, acid, injurious alkali, and vegetable matter. It shall be tested in accordance with AASHTO T26 if from an unknown source. If the test indicates that mortar made with the water being tested is unsound or slow setting, or of less strength than mortar made with potable water, the water shall not be used for concrete mixtures. Water known to be of potable quality may be used without test. Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass, or other foreign materials.

905.05 Portland Cement Concrete.

Portland cement concrete shall be composed of Portland cement, coarse and fine aggregates, admixtures, and water, conforming to Subsections 905.01 through 905.04 and Section 906.

The concrete design mix and coarse aggregate size, slump, and entrained air for shall be as specified herein. Any of the coarse aggregate sizes may be used for a particular type of construction. Conformance to gradation will be determined on the basis of separate tests on the component sizes before proportioning. If the size selected creates a clearance problem with reinforcement steel, a smaller size aggregate shall be used.

(A) Composition of Mix.

The proportions of all components for the various classes of concrete shall be based on the following minimum cement content and minimum compressive strength at twenty-eight (28) days:

Class of Concrete	Minimum Cement Content(bags per cu.yd. of concrete, 94#/bag)	Maximum Water-Cement Ratio (lb./lb.)	Minimum Compressive Strength (psi at 28 days)
A	7.0	0.45	4,500
B	6.5	0.50	4,000
C	6.0	0.53	3,500
D	5.0	0.53	2,500
P	7.0	-	As Specified on Plans
S (Tremie)	7.0	0.577	2,000

The concrete mixture for Class S Concrete shall be based on a slump of 7" $\pm$ 2".

An air-entraining agent shall be added as required to provide air contents as follows:

Concrete made with Coarse Aggregate of Maximum Size	Air Content
3/8", 1/2"	7% $\pm$ 1½ %
3/4", 1"	6% $\pm$ 1½ %
1-1/2", 2", 2-1/2"	5% $\pm$ 1½ %

The concrete mixture shall be based on a slump of 2" $\pm$ 1" for deck slabs and Class P concrete, and 3" $\pm$ 1" for all other concrete unless otherwise specified. Slump may be increased with the use of approved superplasticizers. Slip formed concrete may require a slump of from 0" to 1".

Concrete delivered on the site which fails to meet the above requirements for slump and air content will be rejected by the Engineer except as specified in Subsection 401.06.

The cement and aggregates for the corresponding concrete mixes shall be proportioned in accordance with ACI 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete" and ACI 211.2, "Standard Practice for Selecting Proportions for Structural Lightweight Concrete", as appropriate, except as modified below.

A water-reducing admixture may be used when the ambient temperature is 75°F or below. A water-reducing and retarding admixture or a water-reducing admixture and retarding admixture may be used when the ambient temperature is above 75°F. The Contractor may also use a water-reducing admixture, or a water-reducing and retarding admixture, in order to obtain a more workable concrete.

Chlorides and admixtures containing chlorides shall not be used.

(B) Mix Design.

The Contractor shall be responsible for designing the mixtures and determining the proportions and type of cement, fine aggregate, coarse aggregate, water, air-entraining admixture and corrosion inhibiting, water-reducing or water-reducing and retarding admixture (when used) and superplasticizer (when used), which will produce a workable concrete mix meeting the above criteria for the classes of concrete or special design mix specified. Consideration shall be given to the amount of an air-entrainment that may be incidentally afforded by the use of water-reducing or water-reducing and retarding admixture or

superplasticizer.

Whenever admixtures are used, or any proportion of an approved mix is changed, trial mixtures shall be made and submitted to the Engineer for approval in order that the compatibility of the admixtures with the materials and the effect of the admixture on the properties of the fresh and hardened concrete can be determined.

Since the cement content necessary for a given mix to produce certain strength requirements is also dependent on the type and gradation of the aggregates actually used, the Authority does not guarantee that the desired strengths will be obtained with the minimum cement content given above. The Contractor shall use whatever greater amount of cement is required to meet the specified minimum compressive strength.

The design of the concrete mix shall be established using standard forms furnished by the Authority, and approved ingredients which the Contractor intends to use for the Project. Computer generated forms may be used if approved by the Engineer. All trial batches shall be made using such materials. The mix design shall be tested for complete conformance to these Specifications by either the Contractor's laboratory or an Authority approved laboratory engaged by the Contractor.

At least 45 days before the start of concrete placement, trial batches of concrete shall be prepared of the same materials and proportions proposed for use on the Project.

Authority personnel shall be present at the time of verification batching to confirm that the proportions and ingredients batched are according to the proposed mix designs. Testing will be performed in accordance with Subsection 401.16.

The use of chemical admixtures shall be according to the admixture manufacturer’s recommendation for the given design mix and anticipated field conditions, including the admixture dosage rate(s) and the location (plant or placement site) where it is to be introduced into the mixture. The admixture manufacturer’s technical representative shall be on the Project site for the first full day’s production of mix containing a chemical admixture to recommend methods and operations based on prevailing climatic and job conditions.

At least one trial mix shall be designed to equal or exceed the required performance criteria verification strengths listed herein or that required by Supplementary Specifications for each class or mix of concrete included on the Project. A single mix design may satisfy the requirements for more than one class or mix of concrete, and any mix design failing to meet a specific verification requirement may later be approved for use on the Project if the field strengths and degree of quality control warrant.

At the Authority's option, verification may be done on an annual basis for a concrete plant rather than on a project-to-project basis provided the properties and proportions of the materials do not change. If the job is the continuation of Work in progress during the previous construction season and written verification is submitted that the same source and character of materials are to be used, the Engineer may waive the requirement for the design and verification of previously approved mixes.

Concrete furnished on the Project shall conform to the approved mix design. If another previously approved mix design is to be used, the Engineer shall be notified at least one day before such change.

Change in the sources, types, or proportions of materials shall not be made until approved and the requirements for verification specified herein have been satisfied. The Engineer may waive this requirement if the materials, other than Portland cement, or proportions are not appreciably different from those used with a previously approved mix design.

The requirement to verify a new design as a result of a change in the source of Portland cement may be waived only by the Engineer.

Class A concrete may be designed to achieve early strength requirements by increasing the cement content. Additional verification tests to that specified for high-early-strength mixes are not required but shall be performed if requested by Engineer. Before actual loading is applied in the field, the requirements of Subsections 401.17 and 401.21 shall be met.

If fly ash is added, its weight shall not exceed 15 percent of the minimum cement content and shall not be greater than 125 percent of the weight of cement replaced.

If fly ash is added to control alkali-silica reactivity, the minimum amount required shall not be less than 15 percent of the total cementitious material. If AASHTO T 303 Standard Test Method results in an expansion greater than 0.40 percent, the minimum addition of fly ash shall be 20 percent. Fly ash may replace no more than 15 percent of the Portland cement; the remaining fly ash will replace fine aggregate.

If ground granulated blast furnace slag is used to control alkali-silica reactivity, the amount required shall not be less than 25 percent of the total cementitious material.

The combined weight of fly ash, ground granulated blast furnace slag, and cement content shall be used to determine compliance with the cement factor and water-cement ratio requirements listed herein for the various classes of concrete.

If it is the opinion of the Engineer that the mix properties are such that concrete of unacceptable quality is likely to be produced, the Work may be ordered stopped until the cause has been determined and the necessary corrective action has been taken. The corrective action may range from a minor adjustment of proportions to the establishment of a new mix design.

If the concrete producer has satisfactorily met applicable design, control, and acceptance testing requirements at the batch plant and has provided automatic recordation of the various batched weights which comply with specified design criteria, slump, and air content, the concrete will be presumed to be in compliance with Authority standards at the time of delivery. This presumption shall not waive or alter any other requirements.

If a low-alkali cement is used to control alkali-silica reactivity, use cement with equivalent alkali of less than 0.60 percent.

(C) Testing and Acceptance of the Design Mix.

After the Contractor has designed a project special mix or mix for a particular class of concrete, and his laboratory has tested for compressive strength at least six concrete cylinders from each of three separate trial batches using that mix (two cylinders for 7 days, two for 14 days and two for 28 days), and the Contractor and his laboratory have concluded that the design mix so tested is a satisfactory mix meeting the requirements specified in Subsection 905.05(A), the Contractor shall furnish the Engineer with the mix data, the results of the cylinder tests, the yield as determined by ASTM C138, for producing one cubic yard of concrete for each type of mix. For special design high early strength mixes, 2 additional cylinders shall be tested in addition to the above for the required early design strength and verification of the needed time frame to reach it. In establishing the amount of each ingredient to be used in the design mix, the cement and aggregate proportions shall be by weight for measuring and batching purposes; water and admixture shall be by weight or volume as applicable. The Engineer will then check the mix design for conformance to the Specifications.

If any of the specified requirements are not met, the mix design will be rejected and the Contractor shall revise the design and furnish the Engineer with data until a satisfactory mix is established. The revised design mix will be checked by the Engineer as described in the preceding paragraph. Whenever the source of coarse aggregate, fine aggregate or any other ingredient changes, the Contractor shall revise the design of the mix or establish a new design mix as necessary, all in the same manner and following the same procedures.

Upon acceptance of a design mix found satisfactory to the Engineer, the mix proportions shall be used without change for all concrete of that class, unless necessary modifications are subsequently approved by the Engineer. Corrections necessitated by variations in the moisture content of the aggregates shall be made by the Contractor.

No separate payment will be made for the cost of the laboratory engaged by the Contractor; or for the materials furnished and used for trial batches; or for the preparation and testing of trial batches either by the Contractor or his laboratory; or for furnishing the Engineer with the mix data, the results of the cylinder tests.

All check testing by the Engineer will be done at the Authority's expense.

905.06 Not in Use.

This heading is not currently in use.

905.07 Low-Slump, High-Density Concrete.

Low-slump, high-density concrete shall be composed of Portland cement, fine and coarse aggregate, water, and admixtures.

Coarse aggregate shall be ASTM C33, size No. 7.

(A) Design Mix.

Concrete shall meet the following requirements:

Basic Absolute Volumes per Unit Volume of Concrete.

Coarse Aggregate	0.312
Fine Aggregate	0.312
Air	0.060
Water	0.160
Cement	0.156
Total	1.000

Approximate cement content will be 8.75 bags per cubic yard.

A water-reducing admixture for improving workability shall be required. The specific admixture shall be subject to approval by the Engineer.

The slump, measured in accordance with ASTM C143, shall be 3/4 inch with a tolerance of plus or minus 1/4 inch.

The intended air entrainment of the finished concrete is 6 percent, but the air content of fresh, unvibrated concrete at the time of placement, as determined by ASTM C231, shall be 6.5 percent with a maximum variation of plus or minus 1.0 percent.

Following sampling of the discharged, normally mixed concrete from a continuous mixer, the commencement of tests shall be delayed from 4 to 4-1/2 minutes.

905.08 Not in Use.

This heading is not currently in use.

905.09 Lightweight Concrete.

Lightweight concrete shall be composed of Portland cement, fine and lightweight coarse aggregates, water, and admixtures and shall meet all the requirements of Subsection 905.07 and the following:

Lightweight concrete shall meet the following requirements:

Compressive strength at 28 days, psi, min.	5,000
Slump	3" ± 1"
Cement contents, bags/cu. yd., min	7
Air content	6% ± 1%
Air dry unit weight at 28 days, lbs./cu. ft.	115

Lightweight concrete shall be proportioned by weight in accordance with the applicable requirements of ACI 213R.

The lightweight concrete mix shall be designed by a testing laboratory, retained by and at the Contractor's expense, and approved by the Engineer.

The design mix, along with all the test results and enough materials to produce 10 cubic feet of lightweight concrete, shall be submitted to the Engineer for approval of the mix design.

All lightweight concrete shall have good workability and other properties such that proper placement, consolidation, and finishing is obtained.

Lightweight coarse aggregates and normal weight fine aggregates shall be batched by weight.

The Contractor shall provide, at his expense, during the initial placement of the lightweight concrete, the services of a technical representative of the producer of the lightweight coarse aggregate.

(A) Manufactured Lightweight Aggregate Concrete.

When lightweight aggregate manufactured from dredged sediment is used, the concrete materials, mix and test requirements herein shall prevail if in conflict with lightweight concrete mix requirements specified

above or elsewhere and shall be in accordance with the following:

(1) Cement.

The cement shall be Portland cement, Type I or II conforming to ASTM C150. When deemed necessary and approved in writing by the Engineer, Type III, Portland cement conforming to ASTM C150 may be used.

(2) Aggregate.

All lightweight aggregate shall be a rotary kiln expanded shale. The aggregate shall be SOLITE, NORLITE or equal as approved by the Engineer and shall conform to ASTM C330. The maximum size of the coarse aggregate shall be 3/4 inch and the gradation requirements shall conform to ASTM C330 and the unit weight of the dry loose aggregate shall conform to those values given in Table II, ASTM C330.

(3) Water.

Mixing water shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials or other deleterious substances, such as would render it unfit for drinking and shall be in accordance with Subsection 905.04.

(4) Admixtures.

An approved type of air-entraining agent consisting of neutralized visol resin or a commercial AE agent conforming to ASTM C260, and an option for the use of a water reducing admixture, conforming with the requirements of ASTM C494. No corrosion inhibiting admixtures shall be used unless approved by the Engineer.

Materials shall be proportioned in such a manner as to produce a concrete meeting the 28 day strength and dry unit weight specified above.

Concrete shall be mixed with the minimum slump necessary to afford proper consistency for efficient mixing, handling, placing and finishing. The maximum slump shall be as specified above, with a tolerance of 1 1/2 in. ± 1.

The air content shall be 5% ± 1% as determined by ASTM C173, "Standard Method of Test for Air/Content of Freshly Mixed Concrete by the Volumetric Method"

The control of the concrete shall be under the supervision of a competent representative of the Engineer.

The unit weight of the wet concrete and the slump shall be measured at frequent intervals - 50 yards or fraction thereof.

Samples of the concrete shall be taken in accordance with ASTM C172 and compression test cylinders made and cured according to ASTM C31. Test specimens are to be tested in an Authority approved testing laboratory, and are to be cured in accordance with Section 7 (b), ASTM C31. Two of the cylinders are to be tested at an age of 7 days and two at 28 days.

Concrete made from the aggregate with a cement content of 564 lb/cu yd and approximately 6% air content shall have a minimum durability factor of 85% when tested in accordance with ASTM C666.

905.10 Grout.

Grout shall consist of equal parts by weight of Portland cement and sand, mixed with sufficient water to form a stiff slurry. The consistency of this slurry shall be such that it can be applied with a stiff brush or broom to the previously placed concrete in a thin, even coating that will not run or puddle in low spots.

For sealing vertical joints between adjacent lanes and at the curbs, this grout shall be thinned to paint consistency.

Grout shall not be retempered or used after it has begun to set.

905.11 Mortar.

Mortar shall consist of one part Portland cement to two parts sand. Water shall be added to form the proper consistency. Mortar shall not be retempered or used after it has begun to set.

905.12 Non-Shrink, High Strength Mortar.

Non-shrink, high-strength mortar (for use on paved concrete decks) shall be a material packaged and ready for mixing just prior to use in accordance with the manufacturer's instructions. The Contractor shall cure the material immediately after finishing with a 30% solids, acrylic cure and seal material.

All materials for this work shall be from an approved supplier as listed on the QPL.

905.13 Non-Metallic, Non-Shrink Mortar or Grout.

A product from an approved supplier as listed on the QPL shall be used for spalls that cannot be easily accessed and formed. Use shall be in accordance with the manufacturer's instruction.

The material shall show no shrinkage and a maximum 4.0% expansion when tested in accordance with ASTM C827. It shall have a minimum 28 day compressive strength of 5,000 psi when tested in accordance with ASTM C109 and a minimum initial set time of 60 minutes when tested in accordance with ASTM C191.

905.14 Non-Shrink, High-Strength Mortar.

Non-shrink, high-strength mortar (For use on bare concrete decks) shall be a material packaged and ready for mixing just prior to use in accordance with the manufacturer's instructions. The Contractor shall cure the material immediately after finishing with a 30% solids, acrylics cure and seal material.

All materials for this work shall be from an approved supplier as listed on the QPL.

905.15 Non-Shrink, High Early Strength Mortar.

Non-shrink, high early strength mortar shall be a material packaged and ready for mixing.

Immediately prior to use in accordance with the manufacturer's instructions. Acceptable non-shrink high early strength mortar products shall be from an approved supplier as listed on the QPL

905.16 Elastomeric Concrete.

Elastomeric concretes shall consist of aggregate binder proportioned by the manufacturer. The aggregate shall consist of predetermined portions of graded clean sands and shall be delivered to the project site dry and in the manufacturer's original containers.

The binder, consisting of resin and harder supplied as two liquid components, will be a factory blend of rubber producing ingredients which will be mixed in accordance with the recommendations of the manufacturer at the job site after being heat conditioned using specialized equipment.

All materials for this work shall be from an approved supplier as listed on the QPL.

905.18 Epoxy Bonding Coat.

Epoxy bonding coat shall be a two-component, epoxy-resin, bonding system for application to Portland cement concrete. The coating shall conform to ASTM C881. The system type, grade, and class shall depend on the condition of intended use. Color shall be clear or gray to match the color of the adjacent concrete.

905.19 Ground, Granulated Blast-Furnace Slag.

Ground, granulated blast furnace slag for use as a cementitious material in Portland cement concrete shall conform to the requirements of AASHTO M 302, Grade 120. Grade 100 shall be used only with the written permission of the Engineer.

Ground, granulated blast furnace slag may be used as a replacement for Portland cement conforming to ASTM C150 or white Portland cement as specified in Subsection 905.01 up to a maximum replacement level of 30 percent by weight. Replacement of Portland cement greater than 30 percent will not be allowed.

Certification will be required indicating that the ground, granulated blast furnace slag meets the requirements AASHTO M302, Grade 120 at seven days, and the results for 28 days shall be provided within the time requirements of this standard.

905.20 Epoxy Injection Systems.

Epoxy injection systems with recommended materials shall be from an approved supplier as listed on the QPL

SECTION 906 - CONCRETE ADMIXTURES CURING MATERIALS, AND FILM EVAPORATORS

906.01 Restrictions.

Admixtures and curing materials containing chloride salts, urea, and materials which allow the formation of chloride ions shall not be used.

906.02 Air-Entrainment Admixtures.

Air-entrainment shall be produced by the addition of an approved air-entrainment admixture to the concrete mix. The admixture shall conform to the requirements of ASTM C260 with the following modifications:

(A) The air content shall be determined in accordance with ASTM C231 using the same proportions and the same cement, water, and aggregates to be used in the work.

(B) The compressive and flexural strength and resistance to freezing and thawing tests shall be made at the 7-day and 28-day curing periods.

906.03 Chemical Admixtures.

Chemical admixtures for Portland cement concrete shall conform to ASTM C494 except that the use of such admixtures shall not introduce more than 1 percent of air entrainment. The chemical admixtures shall conform to the following:

(A) WATER-REDUCING ADMIXTURES AND WATER-REDUCING AND RETARDING ADMIXTURES.

A water-reducing admixture or water reducing and retarding admixture may be added to the concrete mixes for the purposes of reducing the water content and shrinkage in the concrete, improving its workability, retarding the initial set of the concrete, and/or reducing the rate of internal heat development in concrete pours without sacrificing quality or strength.

Water-reducing and retarding admixtures shall be the product of combinations of hydroxylated carboxylic acids and lignosulfonic acids and their salts conforming to the applicable requirements of ACI Standard 212.3R. It shall be designed to reduce the water content and achieve a retardation in the rate of hardening.

The use of chemical admixtures shall be in accordance with the admixture manufacturer's recommendation for the given design mix and anticipated field conditions, including the admixture dosage rate(s) and the location (plant or placement site) where it is to be introduced into the mixture. When required by the Engineer, the admixture manufacturer's technical representative shall be on the Project site for the first full day's production of mix containing a chemical admixture in order to recommend methods and operations based on prevailing climatic and job conditions.

Concrete containing this admixture is hereafter referred to as the "test concrete"; concrete with the same materials but without the admixture is hereafter referred to as the "reference concrete." Both test and reference concretes shall be prepared at an ambient temperature of 70°F. and an entrained air content between 5% and 5-1/2% (ASTM C231). The cement and aggregates for the test and reference concretes shall be the same as those to be used in the Project.

Test concrete containing the admixture in an amount sufficient to cause an increase of 50% and 60% in the initial setting time (ASTM C403) over the initial setting time of the reference concrete at an ambient temperature of 70°F., and having the same cement content and slump (ASTM C143) as the reference concrete, shall meet the requirements established in Table 1 in ASTM C494 for Type D admixtures and the following properties when compared to such reference concrete:

(1) The longitudinal linear measurement of the drying shrinkage (ASTM C157) of the test concrete at the age of 28 days, after 14 days of initial moist curing, shall be decreased by at least 5% from that of the reference concrete.

(2) The durability factor of the test concrete as determined by the freezing and thawing test (ASTM C666) shall not be less than 96% of the durability factor of the reference concrete.

Concrete strengths shall be calculated on the average results of at least five 6" diameter by 12" high cylinders for compressive tests and at least five 6" wide by 6" high by 21" long beams for flexural tests, at each age of tests, prepared in accordance with ASTM C192. Drying shrinkage shall be calculated on the average results of at least three 3" x 3" x 16" specimens prepared in accordance with ASTM C157.

The Contractor shall submit to the Engineer actual test data from a recognized laboratory evidencing that the above requirements have been met. A recognized laboratory shall be understood to mean any State Highway, Federal Highway Administration, or cement and concrete laboratory regularly inspected by the Cement and Concrete Reference Laboratory of the ASTM. The samples of the admixture necessary for the acceptance tests shall be selected at random from stockpiled supplies.

Unless otherwise specified, the amount of admixture to be introduced into each concrete batch shall be such as to cause an increase of at least two (2) hours in the initial setting time of the concrete for the particular ambient temperature at the time of placing concrete. This admixture shall be used in addition to, and shall not be considered as replacing any portion of, the cement content specified for the appropriate class. The admixture shall be introduced into the mix at the same time the water is added, or shall be mixed only with the aggregates prior to the addition of water. In addition, whenever this admixture is used, the air-entraining admixture must be adjusted to compensate for entrained air variations due to the use of the water-reducing and retarding admixture.

(B) HYDROXYLATED CARBOXCYLIC ACIDS.

Water-Reducing Admixture shall be the product of hydroxylated carboxylic acids and their salts, conforming to the applicable requirements of ACI Standard 212.3R and meeting the requirements established in Table 1 in ASTM C494 for the Type A admixture and conforming to the applicable requirements specified above for water-reducing and retarding admixtures.

(C) SUPERPLASTICIZERS.

Superplasticizers shall be Type "F" or Type "G" conforming to the requirements of ASTM C494 and shall be a product and type approved by the Engineer.

The superplasticizer, when compared to a standard air entrained mix, shall:

(1) reduce the required water by a minimum of 20%, either alone or in conjunction with a water reducing and retarding admixture.

(2) retard the set sufficiently, either alone or in conjunction with a water reducing and retarding admixture, so as to allow delivery, proper placement, and finish of the concrete.

(3) contain no air entraining agents.

(4) be either a sulphonated melamine/formaldehyde condensate or a sulphonated naphthalene /formaldehyde condensate.

(5) increase the slump specified in Subsection 905.05(A) to 6" ± 2".

906.04 Not In Use.

906.05 Silica Fume Admixtures.

Prior to submitting a mix design in accordance with Subsection 905.05(B), a sample of the silica fume admixture shall be submitted to the Engineer and tested for conformity against the requirements of the latest AASHTO M 307 or ASTM C1240 and shall be accompanied by a copy of manufacturer's recommendations.

Silica fume admixtures shall be approved by the Engineer prior to its use on the Project. Only one brand of silica fume admixture shall be used for the entire duration of the project. Silica fume admixtures may be supplied either in dry or in slurry form. If the slurry form is used, it shall be homogeneous and agitated to prevent separation. Silica fume concrete shall consist of a homogeneous mixture of Portland cement, silica fume admixture, fine aggregate, coarse aggregate, concrete admixtures (Type "F" or Type "G" high range water reducing admixture and air entraining admixture), and water.

Admixtures shall be from an approved supplier as listed on the QPL.

906.06 Corrosion Inhibiting Admixtures.

Corrosion inhibiting admixtures shall be defined as materials that when added to concrete have the ability to reduce the potential of corrosion of embedded steel. The calcium nitrite based corrosion inhibitor when mixed into the concrete will become an integral part of the concrete matrix and promote a corrosion barrier around the embedded steel. The following guidelines shall be followed in the use of calcium nitrite:

Precautions shall be taken to ensure that the calcium nitrite does not contact other admixtures before entering the concrete mix. Air entraining, water reducing and/or retarding admixtures, as per the manufacturers'

recommendations, shall be compatible with the calcium nitrite solution. The calcium nitrite solution shall be added immediately after all other admixtures have been incorporated into the concrete mix. However, the calcium nitrite shall be thoroughly mixed before the addition of the other admixtures.

The Contractor shall strictly adhere to the manufacturer's written recommendations regarding the use of the admixture including storage, transportation and method of mixing. The manufacturer of the calcium nitrite solution shall provide a representative to assist the Contractor and the Engineer on the first full days of production of members and to be available on request during subsequent construction.

Testing for the presence of the calcium nitrite admixture in the concrete shall conform to Paragraph 906.06(C) for plastic concrete testing and Paragraph 906.06(D) for hardened concrete testing. The test kit that is required to perform the plastic test shall be provided to the Authority Laboratory by the Contractor if so required.

(A) Design Mix.

At least 45 calendar days prior to the start of the concrete placement, a mix design, containing the corrosion inhibitor admixture, shall be submitted for approval and verification. Approval of the design mix shall be based on completed applicable product testing as stated below and results of a Trial Concrete Mix Program.

(1) The design mix shall incorporate the following conditions:

(a) The concrete, containing the corrosion inhibitor admixture, shall have a maximum water to cement ratio of 0.40.

(b) Design, control and acceptance testing shall conform to the requirements of Section 401.

(c) Mix design requirements shall conform to Section 401. In accordance with the manufacturer's product specifications, chemical admixtures, in accordance with Subsection 906.06, may be added to the concrete mix. The corrosion inhibitor admixture shall be thoroughly mixed before chemical admixtures are added.

(2) The Trial Concrete Mix Program shall incorporate the following conditions:

(a) To demonstrate the workability of the concrete containing the corrosion inhibitor admixture, a minimum of 6 cubic yards of the concrete mix shall be placed at the Project site in a location that is acceptable to the Engineer. This location shall not be a structural element that is to remain in place.

(b) The provisions of Section 401 or Section 402 concerning placement, curing and finishing of the concrete shall be followed.

(c) The corrosion inhibiting calcium nitrite admixture shall be added to the concrete at the concrete plant.

(B) Production.

Actual production of the corrosion inhibitor concrete mix that is to be used in the Project shall not begin until the design mix and trial concrete mix program are accepted by the Engineer. A representative from the admixture supplier shall be present during the initiation of the trial concrete mix program and during the actual initial placement of the concrete.

The use of the calcium nitrite admixture shall conform to the following quality control conditions.

(1) 30 +/- 2 percent of calcium nitrite shall be contained in the admixture. A high range water reducing chemical admixture shall be included in the design mix.

(2) The calcium nitrite shall be added at a rate of 3 gallons per cubic yard unless specified otherwise in the Supplementary Specifications or in accordance with written recommendations by the manufacturer for the project involved.

(3) As part of the design mix approval, completed results of the testing outlined in test requirements Subsection 906.06(C) and 906.06(D) shall be submitted.

(C) Calcium Nitrite Presence in Plastic Concrete.

This Method of Test is used to determine the presence of calcium nitrite in the plastic concrete state. A freshly mixed concrete sample shall be tested. Testing materials shall be from an approved supplier as listed on the QPL. The equipment to perform this test shall be provided to the State by the Contractor. This will include provision of such equipment for the field laboratory testing operation.

For each day's production, a minimum of one test shall be performed unless directed otherwise.

(1) Apparatus.

The following equipment shall be provided:

(a) Test Strips for high range nitrite from an approved supplier as listed on the QPL.

(b) 10cc disposable syringes from an approved supplier as listed on the QPL.

(c) Disposable filters 25mm/0.45 micron from an approved supplier as listed on the QPL.

(d) Wide-mouth Container.

(e) Clean Measuring Cup.

(2) Procedure.

(a) Using the apparatus list above, add field concrete to pre-measured 2 liters of water in a wide mouth container. Use the water in the container to rinse out the measuring cup.

(b) Shake the container 2-5 minutes until contents are well mixed. As indicated in Column 2 of the following Table, the stated quantity of concrete, in millimeters, should be obtained in the container.

(c) Using the syringe, uptake approximately 10 ml of extraction water from the container. Attach a disposable filter to the end of the syringe.

(d) Filter the extraction water into a clean cup.

(e) Dip the test strip into the clear, filtered extraction water and compare the color to the chart on the side of the test strip container.

Use the following chart to determine amount of concrete to be extracted, and expected readings on test strips:

Amount of Calcium Nitrite Added, liters/cu. Meters	Volume of Concrete to be Extracted, milliliters	Expected Reading on Test Strip
9.9	225	0.3
12.4	180	0.3
14.8	150	0.3
17.3	130	0.3
19.8	225	0.6
22.3	200	0.6
24.8	180	0.6

(D) CALCIUM NITRITE PRESENCE IN HARDENED CONCRETE.

This test shall be used, at the direction of the Authority, only as a retest provision.

This method of test is used to determine the concentration of calcium nitrite in the hardened concrete. A concrete sample shall be pulverized, and a representative portion shall be extracted with water.

Note: An alternative to the following procedure is specified by the Environmental Protection Agency (EPA Method No. 353.3 -Storet No. Total 00630 - Spectrophotometric, Cadmium Reduction). The sample shall be filtered and the filtrate diluted to a known volume, an aliquot is treated with sulfanilic acid which is diazotized by the nitrite. The diazotized sulfanilic acid is then coupled with N-(1-naphthyl) ethylenediamine to produce a purple color which is measured by a spectrophotometer from 520 to 530 nanometer.

(1) The following equipment shall be provided to facilitate the testing.

(a) Analytical Balance, accurate to +/- 0.1 milligram.

(b) U.S. Standard Sieve Series, 50 mesh.

(c) Magnetic Stirrer and Stirring Bars.

(d) Erlenmeyer Flask, 500 milliliter.

(e) Pipets, 2.00 milliliter, 5.00 milliliter, 10.00 milliliter, 20.00 milliliter, and 50.00 milliliter.

(f) Volumetric Flasks 100 milliliter, 500 milliliter, 1000 milliliter.

(g) Graduated Cylinders, 50 milliliter, 200 milliliter.

(h) Funnels.

(i) Weighing Paper Grade B-2 from an approved supplier as listed on the QPL.

(j) Filter Paper, Grade 44 from an approved supplier as listed on the QPL.

(k) Spectrophotometer with scanning capability.

(2) Reagents.

(a) Sulfanilic Acid, 0.6% Solution, ACS Reagent Grade.

Dissolve 2.27 liters of sulfanilic acid in 70 milliliter of hot distilled water, cool the solution, add 20 milliliter of concentrated hydrochloride acid, and dilute to 100 milliliter with distilled water and mix.

(b) Hydrochloric Acid, 1N, Concentrated, ACS Reagent Grade.

Dilute 8.6 milliliter of Conc. HC1 to 100 milliliter and mix.

(c) N-(1-Naphthyl)-Ethylenediamine Hydrochloride Solution.

Dissolve 0.60 g of this reagent in 50 milliliter of distilled water acidified with 1.0 milliliter of Conc. HC1. Dilute to 100 milliliter and mix. Keep solution in a refrigerator and prepare freshly every week.

(d) Sodium Nitrite, Crystals, ACS Reagent Grade.

(1) Primary Standard Solution.

Dissolve approximately, but accurately 10.6 liters of sodium nitrite in distilled water and dilute to one liter using a volumetric flask.

(2) Secondary Standard Solution.

Dilute the primary standard solution 50/500 using a 50 milliliter pipet and 500 milliliter volumetric flask.

(e) Phenolphthalein Indicator Solution, 1%, ACS Reagent Grade.

Dissolve 1 gram of phenolphthalein in 100 milliliter (Graduate) of 95% ethyl alcohol.

(f) Ethyl Alcohol, ACS Reagent Grade.

(3) Procedure.

(a) Preparation of Standard Calibration Curve for Nitrite Ion.

Using the appropriate pipets and three 500 milliliter volumetric flasks, dilute the secondary sodium nitrite standard solution 5/500, 10/500, and 20/500. Pipe 10 milliliter of each of the above solutions into separate 100 milliliter volumetric flasks. Add approximately 50 mils. of distilled water to each volumetric flask. To a fourth 100 milliliter volumetric flask labelled "Blank" add 60 mils of water. To each 100 milliliter flask:

(1) Pipet 2.00 milliliter of sulfanilic acid reagent, mix and allow to stand for 5 minutes.

(2) Pipet 2.00 milliliter of N-(1-Naphthyl) ethylenediamine dichloride reagent, dilute to volume, mix, and allow to stand for 10 minutes. Using the spectrophotometer, measure the absorbance of the three standard solutions as follows:

(a) Zero the spectrophotometer over the range of 600 to 500 nanometer using the reagent blank in the sample cell.

(b) Measure the absorbance of the nitrite standard solutions by placing each solution in the sample cell and scanning the UV spectra from 600 to 500 nm. Record the absorbance at the apex of the UV curve between 520 and 530 nanometer.

Using regular graph paper, plot ug/milliliter nitrate vs. Absorbance.

(4) Sample Extraction and Nitrite Determination.

Pulverize the whole concrete sample in order to obtain a homogeneous and representative sample. Pass the powder through a 50-mesh screen. Using weighing paper (S&S, No. B-2) and the analytical balance, weigh a 2 gram sample to the nearest milligram.

Quantitatively transfer the sample to a 500 milliliter Erlenmeyer flask. Add (graduate) 200 milliliter of distilled water an a magnetic stirring bar. Place the Erlenmeyer flask on a magnetic stirring base and stir for 30 minutes. Stop stirring and allow to settle. Filter through Whatman #44 paper. Collect the filtrate in a 500 milliliter volumetric flask. To the Erlenmeyer flask containing the residual sample, add 200 milliliter of distilled water and re-extract by stirring 10 minutes. Stop stirring and allow to settle. Refilter using the same filter as in Step 5. Collect the filtrate in the same 500 milliliter volumetric flask. Repeat extraction and filtration using 100 milliliter of distilled water. Dilute to volume (500 milliliter), if necessary, and mix. From the 500 milliliter volumetric flask transfer (pipet) a 10.00 milliliter aliquot into a 100 milliliter volumetric flask. Add 50 milliliter of distilled water. Add a few drops of phenolphthalein indicator and neutralize by dropwise addition of hydrochloric acid. Pipet 2.00 milliliter of sulfanilic acid reagent, mix, and allow solution to stand 5 minutes. Pipet 2.00 milliliter of N(-1naphthyl) ethylenediamine dihydrochloride reagent. Dilute to volume, mix and allow solution to stand 10 minutes. Scan an aliquot of the sample solution from 600 to 500 nm and record the maximum absorbance between 520 to 530 nanometer.

(5) Calculations.

Read the ug/milliliter nitrite equivalent to the absorbance from the standard calibration curve. Calculate the % NO 2 - in the sample as follows:

(µg/milliliter NO2 - ,Sample Dilution

From Standard Curve X Aliquot X 500) X 100%= _____ % NO2

(Sample Wt., Grams)X (10^6)

Note: The aliquots pipeted from the 500 milliliter extraction filtrate should be adjusted such that the absorbance is within the range of 0.10 to 0.80.

Note: The % NO2 - as calculated above does not take into account the % recovery factor of the nitrite. For a particular set of lab concrete standards containing 390 kilograms per cubic meter(629.6 lb/cubic yard) cement with 2% s/s Ca(NO2)2 96% recovery of the theoretical nitrite was obtained.

(6) Report.

The following data and certification for the corrosion inhibitor admixture shall be submitted. Test results shall meet or exceed the Physical Requirements (Table 1) of ASTM C494 Standard Specification for Chemical Admixtures for Concrete for any type of admixture.

(F) Sources.

Admixtures shall be from an approved supplier as listed on the QPL.

906.07 Curing Materials.

Curing materials for Portland cement concrete shall conform to the following:

(A) Curing Compound.

Curing Compound shall be a non-bituminous liquid membrane forming curing material and shall comply with the requirements of ASTM C309, Type 1-D or Type 2, as directed by the Engineer. The curing compound shall not be tacky nor track off the concrete when walked upon nor impart a slippery condition to the surface. The coloring agent shall be of a color an approved by the Engineer.

The Contractor shall furnish the manufacturer's certified statement giving the results of tests conducted by the manufacturer, pursuant to the ASTM requirements.

(B) Burlap.

Burlap shall conform to the requirements of AASHTO M182, Class 4. Weights per linear yard shown in Table 1 shall be the weight of dry burlap. Burlap shall have a length, after shrinkage, of not less than the

width of the surface. Clean burlap reclaimed from previous use may be used again if it is not torn and meets the foregoing requirements.

(C) WATERPROOF PAPER.

Waterproof Paper for curing shall conform to ASTM C171.

(D) POLYETHYLENE SHEETS.

White for curing shall conform to ASTM C171.

The sheets shall be in one piece for lengths up to 300 feet and a width of not less than 14 feet, unless otherwise specified.

The Contractor shall furnish with each shipment the manufacturer's certificate of analysis giving the results of tests required by the ASTM specifications and in accordance with the requirements of Subsection 105.04.

(E) SALT HAY.

Salt Hay shall be salt meadow grasses, free from decayed matter and organic matter soluble in water, and shall be approved by the Engineer. When salt hay is used for insulation in cold weather, it shall be dry and shall not be reused.

(F) EVAPORATION RETARDERS.

Evaporation Retarders shall be from an approved supplier as listed on the QPL.

SECTION 907 - JOINTS

907.01 Preformed Expansion Joint Filler.

Preformed expansion joint filler shall conform to the requirements of AASHTO M33. Where required, holes shall be punched in the joint filler to admit dowels. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened securely, and held accurately for stapling or other positive fastening.

907.02 Joint Sealers.

Joint sealers for pavement joints, structural expansion joints, pipe joints and other joints where sealing is required shall be as follows:

(A) HOT-POURED JOINT SEALANT FOR PAVEMENT.

Hot-poured Joint Sealant for pavement shall be from an approved supplier as listed on the QPL, and shall conform to ASTM D6690.

(B) COLD-APPLIED CONCRETE JOINT SEALER.

Cold-applied Concrete Joint Sealer shall be silicone type conforming to Federal Specification TT-S-1543A, Class A. The sealant shall be a one-part, low-modulus silicone rubber type with an ultimate elongation of 1200 percent.

The use of low-modulus silicon rubber or polyethylene base sealers shall be limited to vertical applications and shall conform to Federal Specifications TT-S-1543A, Class A, TT-S-227E, Type II, Class A, or TT-S-230C, Type II, Class A with a minimum ultimate elongation of 600 percent. A primer shall be used in the application when recommended by the manufacturer.

(C) JOINT SEALER.

Joint Sealer for waterproofed expansion joints in walls shall be an elastomeric cold poured type, conforming to Federal Specification TT-S-00227, Class A, and shall be Type I for horizontal joints and Type II for vertical joints. The color of the joint sealer shall match the color of adjacent surfaces.

(D) PREFORMED JOINT SEALER (EVA).

Preformed Joint Sealer (EVA) for use at expansion joints shall consist of a closed cell, cross linked, ethylene vinyl acetate, low density polyethylene copolymer, nitrogen blown material, with UV stabilizer, from an approved supplier as listed on the QPL.

(E) Silicone Joint Seal.

The joint sealer shall be from an approved supplier listed on the QPL.

907.03 Preformed Elastomeric Joint Sealer.

Preformed elastomeric joint sealer and the lubricant-adhesive used in its installation shall conform to the requirements of AASHTO M220 and shall be resistant to abrasion, oxidation and to salts, oil, gasoline or similar materials that may be found or spilled on the roadways. The material shall have a minimum effective life of 15 years. The shape of the preformed elastic joint sealer shall not develop appreciable permanent set after full compression for its full effective lift. The preformed elastic joint sealer shall be such that it will repel the intrusion of stones, dirt and other materials into the joint or into the material itself.

(A) Sealer For Joint Seal Replacement, Type W.

The joint sealer shall be from an approved supplier listed on the QPL.

The adhesive shall be a double-component, epoxy-based adhesive, which is mixed at the job site. It shall be double component thixotropic paste having the following properties:

Tensile strength	4000PSI
Axial compression	8000 PSI
Pot life	40 minutes at 77° F
Flash point	Greater than 200° F
Initial Cure	24 hours
Final Cure	7days at 77° F

907.04 Expanded Polystyrene Joint Filler.

Expanded polystyrene joint filler shall be a commercially available polystyrene board. Expanded polystyrene shall have a flexural strength of 35 pounds per square inch, minimum, determined in accordance with ASTM C203, and a compressive yield strength of between 16 and 40 pounds per square inch, at 5 percent compression.

907.05 Rubber Gasket Joint.

Rubber gasket joint for concrete pipes shall conform to the requirements of ASTM C443.

907.06 Joint-Sealing Compound.

Joint-sealing compound used in filling pipe joints shall be a mastic watertight joint sealing compound approved by the Engineer. The joint-sealing compound shall have a history of not less than 5 years of successful performance as a watertight pipe joint sealer.

907.07 Strip Seal Expansion Joints.

The strip seal expansion joint system shall comprise a continuous preformed elastomeric joint seal gland within steel extrusions.

(A) Metals.

Steel extrusions shall be manufactured from structural carbon steel or high-strength low alloy structural steel meeting the requirements of ASTM A36 or A709, respectively, and shall be hot dip galvanized in accordance with ASTM A123.

Steel plates shall meet the requirements of Subsection 909.01(A) or (B).

Steel bar anchors shall be fabricated from weldable reinforcing steel bars meeting the requirements of ASTM A706.

Fabricating and welding shall meet the requirements of Subsection 403.06. Groove welds shall be partial penetration butt welds extending the full height of the extrusions and across the full width of the flats of the extrusion. Welds shall be 3/8″ deep and made from the back side of the extrusion.

(B) Preformed Elastomeric Joint Seal Gland.

Sealers shall be preformed and manufactured from vulcanized elastomeric compound using

polychloroprene as the only base polymer and meeting the following requirements:

Properties	Astm test procedures	Physical requirements
Tensile Strength, min psi	D 412	2000
Elongation at break, min %	D 412	250
Hardness, Type A durometer (Test made with durometer in durometer stand)	D 2240	55±
Compression set 70 hrs at 212 ° F, max %	D 395 Method B	40
Permanent set at break, max %	D 412	10
Oven or head aging, 70 hrs at 212 ° F Tensile strength, change max % Elongation, change max % Hardness, Type A, points change	D 573	+10 to –20 -20 0 to +10
Ozone resistance 20% strain, 300 pphm in air, 70 hrs/104 ° F (Wipe with solvent to remove surface contamination)	D 1149	No cracks
Oil swell, ASTM oil #3, 70 hrs at 212 ° F, Weight change, max %	D 471	+45
Low temperature recovery, 72 hr. @ 14 ° F 50% deflection, min	D 2628	88%
Low temperature recovery, 22 hr. @ -20 ° F, 50% deflection, min.	D 2628	83%
High temperature recovery, 70 hr. @ 212 ° F 50% deflection, min	D 2628	85%

The preformed elastomeric joint sealer shall be furnished in one piece for the full width of the roadway deck. Field splicing is strictly prohibited.

The manufacturer shall provide marks on the top surface of the seal at one foot intervals +/-1/16 inch. The manufacturer's name or trademark shall appear on the seal at intervals of not more than five feet. The date of manufacture shall be stated on containers in which the seals are shipped or otherwise affixed to the seals in each shipment.

(C) LUBRICANT ADHESIVE FOR INSTALLATION OF THE PREFORMED ELASTOMER JOINT SEAL GLANDS.

The lubricant shall be one-component polychloroprene compound containing only soluble phenolic resins blended together with anti-oxidants and acid acceptors in an aromatic hydrocarbon solvent mixture, meeting the requirements of ASTM D4070 and the following physical requirements:

Average net weight per gallon:	8.00 ± 10% (Fed Test Method Std 41a(404.1)
Solid content:	22-28% by weight
Film strength (ASTM D 412):	2,000 psi minimum tensile strength
Elongation at Break (ASTM D 412), % min:	750
Flash Point (seta close cup):	Over 100°F

The lubricant shall remain fluid from 5°F to 120°F; the viscosity shall be such that the lubricant shall perform suitably with the installation equipment, and shall be recommended for such use by the manufacturer of the elastomeric joint sealer glands.

Each lot of the lubricant shall be delivered in containers plainly marked with the manufacturer's name and trademark, lot number and date of manufacture and shall be accompanied by the manufacturer's certification and shall conform to these specifications.

Lubricants shall be stored at a temperature of 50°F to 80°F. Any lubricant not used within 180 days of its manufacture will be rejected.

(D) Sampling and Certification.

Samples shall be furnished for testing in such size and number as directed by the Engineer.

The manufacturer shall furnish to the Engineer, six certified copies of his test reports for each lot of elastomeric sealers and lubricants furnished to each project.

These reports shall indicate the results of test required by these specifications. They shall include a certification that the material conforms with this specification, and shall be identified by project number, and manufacturer's batch number.

The Authority reserves the right to perform tests on random samples taken from each lot furnished.

Prior to final acceptance of an expansion joint, the Contractor shall submit manufacturer certifications attesting that the entire expansion joint assembly including all accessories meet the requirements of the Plan, Specifications, and the approved shop drawings.

(E) Fabrication.

The Contractor shall, before fabricating the strip seal expansion joints, submit shop drawings, in accordance with Subsection 104.08.

Specific items to be included with the Contractor's submissions are as follows:

(1) Manufacturer's brochures concerning the proposed joint which shall include all physical dimensions of components, installations procedures, material certifications, and a table of variable temperatures and dimensions.

(2) Drawings detailing the installation of the joint indicating length of component members, treatment of an directional changes, fabrication of metal components including configurations at barriers, curbs and parapets.

(F) Acceptable Suppliers.

Products shall be from an approved supplier as listed on the QPL and in accordance with the foregoing provisions and plan details.

907.08 Rubber Asphalt Concrete.

Rubber asphalt concrete shall consist of aggregate and binder proportional by the manufacturer.

(A) Binder.

Binder shall be a thermoplastic polymeric modified asphalt and shall meet the standards set forth by the manufacturer of the joint system.

(B) Aggregate.

Aggregate_shall consist of trap rock such as granite, basalt, gabbro, porphyry, or grit stones. Such aggregate shall meet the standards set forth by the manufacturer of the joint system.

The joint system shall be supplied and installed by approved suppliers as listed on the QPL.

907.09 Sampling and Testing Methods.

Sampling and testing will be performed as specified herein and in accordance with Subsections 907.01 thru 907.08 and the following:

Preformed Expansion Joint Filler:	1 yard length from each lot
Joint Sealers	
Hot Poured Joint Sealant	10 pounds from each lot
Cold poured Joint Sealant	1 quart from each lot
Joint Sealer for waterproofed expansion joints	1 quart from each lot
Preformed Joint Sealer (EVA)	1 yard length from each lot
Preformed Elastomeric Joint Sealer	1 yard length from each lot
Expanded Polystyrene Joint Filler	1 yard length from each lot

Preformed Expansion Joint Filler:	1 yard length from each lot
Joint Sealers	
Joint Sealing Compound	1 quart from each lot
Strip Seal Expansion Joint	Subsection 907.07
Rubber Asphalt Concrete Binder and Aggregate	10 pounds from each lot
Thorma Joint and BJS Joint Systems.....	1 yard length from each lot
Elastomeric Concrete	Sample size as approved by the Engineer
Jeene Structural Joint Systems	Sample size as approved by the Engineer

The above lengths shall be supplied for each of the sizes used.

The Engineer shall reserve the right to change the sample sizes required above.

A lot shall consist of a quantity represented by not more than one day's production of each cross-section and size of sealer.

Samples will be taken at random from each lot at least three weeks in advance of the product's delivery to the project.

In instances of stockpiling, samples will be taken at random from every lot. The minimum lengths of samples for testing purposes shall be in accordance with the above. In all tests, the material to be tested shall be furnished from standard production. The supplier may elect to have the sealer sampled and inspected in accordance with one of the following:

(A) Sampling of Stockpiles.

The supplier will be permitted to stockpile only upon receipt of written approval. A representative from the Authority will sample each lot and size for acceptance testing and the sample will be marked for identification with the representative's seal. Shipment to the Project will be permitted only after approval. The Authority shall be notified by the supplier of the lot number and quantity shipped to the project so that an inventory can be maintained.

(B) At the Project Site.

The Contractor shall notify the Engineer when the sealer has arrived at the Project. Shipment shall be made to allow at least three weeks for sampling and testing prior to the sealer being incorporated into the Project. The supplier shall ensure that each lot and size shipped includes sufficient length for testing in accordance with the above.

(C) Manufacturer's Submission.

The manufacturer shall submit, for each lot and size of material, the required length, plus an extra 4 inches, for testing as specified herein. The sealer from which the sample is taken shall be marked to indicate from which end the test piece was cut. The extra 4 inches of the submitted sample is to be cut from the marked end of the sample and, after approval by the Authority, will be taken to the project site and matched to the end of the length sent to the project. Upon verification that the cut ends match, the material will be approved for use.

907.10 Acceptance of Joint Sealers.

The acceptance of joint sealers is subject to the following:

(A) Sealer materials shall not be installed prior to Engineer approval.

(B) In new construction, field splicing of preformed sealers shall not be permitted. For reconstruction projects, field splices may be permitted. In such case, splicing shall be accomplished through vulcanization or as specified below for factory bonding. All splicing of extrusion steel armor shall be kept to a minimum.

(C) If shop splicing of preformed sealer is unavoidable, splicing shall be accomplished either through factory vulcanization or through cold-cured factory bonding using a high-strength rapid-bonding adhesive.

(D) Conformance with applicable portions of Sections 401, 417 and 907 as determined by the Engineer.

907.11 Certification of Compliance..

Manufacturer's certification for all joint materials shall be submitted in accordance with Subsection 105.04. Manufacturer's certification for Strip Seal Expansion Joints with associated materials shall be submitted in accordance with Subsection 907.07.

SECTION 908 - REINFORCEMENT STEEL

908.01 Reinforcement Steel for Structures.

Metal chairs, supports and bolsters for use with all reinforcement steel shall be galvanized, electrostatically coated with epoxy or plastic coated by a dipping operation, and shall be acceptable to the Engineer. The plastic coating shall be not less than 1/16 inch thick at joints of contact with the forms. The plastic coating shall not chip, crack, or peel under ordinary job conditions, it will not deform permanently when subjected to a temperature of 170°F so that metal is exposed at points of contact and it shall not shatter or severely crack under impact loading when subjected to a temperature of 5°F.

Certification, sampling, and testing shall conform to Subsection 908.03.

(A) DEFORMED BARS.

Reinforcement steel shall be deformed bars meeting the requirements of ASTM A615, Grade 60. Detailing dimensions for hooks and bends shall be in accordance with the Manual of Standard Practice For Detailing Reinforced Concrete Structures (ACI 315) for Grade 60. Production bending of Grade 60 bars shall be by the cold method, motive power machine, in an approved fabrication shop.

Low-alloy, low-carbon steel conforming to the requirements of ASTM Designation A706, Grade 60, may be substituted in situations where welding of cross bars is employed to expedite the assembly of reinforcement cages. All welding shall conform to the most current edition of the AWS D1.4 Structural Welding Code for Reinforcing Steel. Tack welding shall only be performed under continuous and competent control by an approved and qualified fabrication shop. Field welding of the reinforcement cage assembly shall not be permitted. Additionally, welding of intersecting bars shall not be permitted in deck slabs.

Certification, sampling and testing of the tack welded cage assembly shall be submitted in accordance with Subsection 105.04.

(B) DEFORMED BARS, EPOXY COATED.

Epoxy coated reinforcement steel shall be deformed bars meeting the requirements of 908.01 (A) and shall be in accordance with the requirements of ASTM 775 and ASTM D3963.

Repairs to damaged epoxy coating on reinforcement steel shall be in accordance with ASTM 775 and ASTM D3963 using a patching material, inert in concrete and compatible with the epoxy coating to be repaired.

(C) WELDED WIRE FABRIC.

Welded Wire Fabric for concrete reinforcement shall be cold drawn from new open hearth or electric furnace process steel conforming to ASTM A185.

(D) WELDED DEFORMED STEEL WIRE FABRIC REINFORCEMENT.

Welded Deformed Steel Wire Fabric Reinforcement shall conform to the requirements of ASTM A497.

(E) DEFORMED BAR AND PLAIN BAR MATS.

Deformed Bar and Plain Bar Mats for use in reinforced concrete pavement shall conform to the requirements of ASTM A184, using bars rolled from new billet steel conforming to ASTM A615, Grade 60. Deformed bar mats shall be assembled with approved clips. Plain bar mats shall be assembled by welding.

(F) ZINC COATING ON REINFORCEMENT STEEL.

Zinc Coating on Reinforcement Steel shall be performed in accordance with the requirements of Subsection 909.11(D).

(G) MANUFACTURING AND SAMPLING.

Steel reinforcement shall be sampled and inspected at the place where fabricated or at a dealer's warehouse and shall not be shipped to the Project until approved. If permitted by the Engineer, the bars will be

inspected and tested after delivery. Steel reinforcement showing injurious defects when received, will be rejected.

(H) Tolerances.

Fabricating tolerances for deformed reinforcement steel bars shall be in accordance with Figures 3 and 4, of the CRSI Manual of Standard Practices, unless otherwise specified or shown on the Plans.

(I) Packaging and Shipping.

Wire fabric shall be not less than 5 feet in width and shall be shipped in sheets and not in rolls. Fabric for slope protection, gutters, and miscellaneous items may be shipped in rolls. Sheets shall be bent in the shop.

(J) Welding of Reinforcement Steel.

Welding of Reinforcement Steel shall be performed in accordance with the requirements of the most current edition of AWS D1.4.

(K) Support Bars.

Support bars for reinforcement bars on stringers shall conform to the requirements of ASTM A36 and shall not be epoxy coated.

(L) Reinforcement Bar Couplers.

Reinforcement bar couplers shall be from an approved supplier listed on the QPL.

Reinforcement bar couplers shall be epoxy coated and capable of developing 125% of the yield strength of the ASTM A615, Grade 60 reinforcement bars.

908.02 Prestressing Reinforcement.

Certification, sampling, and testing shall conform to Subsection 908.03. Prestressing reinforcement shall meet the following requirements:

(A) High-Tensile-Strength Steel Wire.

High-Tensile-Strength Steel Wire shall be uncoated stress relieved steel wire meeting the requirements of ASTM A421.

(B) High-Tensile-Strength Steel Strand.

High-Tensile-Strength Steel Strand shall be uncoated stress relieved steel strand meeting the requirements of ASTM A416, Grade 270.

(C) Strand or Wire.

Strand or Wire not specifically itemized in ASTM A416 or A421 may be used (subject to the Engineer's approval), provided they conform to or exceed the minimum requirements of these Specifications and have no properties which make them less satisfactory than those listed in ASTM A416 or A421.

(D) Packaging.

The shipping package or form shall be clearly marked with a statement that the package contains high-strength prestressing tendons; the care to be used in handling; type, kind and amount of corrosion inhibitor used, including the date when placed and safety orders and instructions for use.

Tendons shall be packaged in containers or shipping forms for the protection of the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor which prevents rust or other results of corrosion shall be placed in the package or form or shall be incorporated in a corrosion inhibitor carrier type packaging material or, when permitted by the Engineer, may be applied directly to the tendons. The corrosion inhibitor shall have no deleterious effect on the tendon or concrete or bond strength of tendons to concrete. Packaging or forms damaged from any cause shall be immediately replaced or restored to original condition.

908.03 Certification, Sampling and Testing.

Certification, sampling and testing of the various types of reinforcement shall conform to the following requirements:

(A) Certification of Compliance.

Certifications are required for reinforcement bars, pretensioning bars, welded wire fabric and tendons and shall be submitted in accordance with Subsection 105.04.

Prior to shipment of tendons from the manufacturer's plant, the Contractor shall also submit for approval by the Engineer typical stress-strain curves obtained from mill (or an approved independent laboratory) test performance on the tendons proposed for use.

(B) Sampling and Testing.

Samples and the rate of sampling will be in accordance with the following:

Plain and deformed bars	Three 30-inch pieces from each heat
Post-tensioning:	
Bars (threaded)	One 6-foot piece (between threads) from each lot
Cable with fittings	One 6-foot piece (between fittings) from each reel
Pretensioning:	
Cable	One 6-foot piece from each reel
Welded wire fabric	One 2 square feet piece from each source
Anchorages	2 assemblies (complete with plates) of each size or type

(C) Testing Prestressing Reinforcement.

All wire or strand to be shipped to the site shall be assigned a lot number and tagged for identification purposes.

All samples submitted shall be representative of the lot to be furnished and shall be taken from the same master roll of the wire or strand. The manufacturer shall furnish samples selected from each lot. If ordered, the selection of samples shall be made at the manufacturer's plant.

908.04 Reinforcement Steel for Concrete Pavement.

Reinforcement steel may be either deformed steel bars or cold-drawn steel wire.

(A) Tolerances.

Fabricating tolerances for deformed reinforcement steel bars shall be in accordance with Figures 3 and 4 of the CRSI Manual of Standard Practices, unless otherwise specified.

(B) Bar Mats.

Bar Mats shall be rolled cold-drawn steel wire or deformed steel bars from new billet steel conforming to ASTM A615. The bars shall be size No. 3. All bars shall have the tensile requirement of Grade 60. The bar mats shall be fabricated in accordance with ASTM A184.

Deformed bar mats shall be assembled by clipping the bars.

(C) Welded Steel Wire Fabric.

Welded Steel Wire Fabric shall conform to ASTM A185.

(D) Joint Tie Bolt Assembly.

The bar used shall conform to Subsection 908.01(A) except that it shall be of the plain type. The tensile strength of the assembly shall be not less than 15,000 pounds. The tie bolt assemblies shall be equipped with an approved fastener for installation of the assembly in the steel pavement form. The fastener shall hold the assembly in the designated position during the placing and finishing of the concrete and subsequent removal of the forms without damage to the concrete or the tie bolt assembly.

(E) Dowels.

Dowels for transverse joints shall be carbon steel dowels, part of the length of which shall be encased in stainless steel or monel metal tubing or infused with chromium or shall be solid stainless steel dowels. The carbon steel dowels may be of any grade of carbon steel.

Dowel bars shall be plain round bars. They shall be free from burring or other deformation restricting

slippage in the concrete. Dowel bars shall be coated with asphaltic oil.

The sleeve-type end caps for dowel bars shall be metal of approved design covering 4 inches of the dowel, with a closed end containing a cork plug to hold the end of the sleeve at least 1 inch from the end of the dowel bar.

(F) TIE BARS.

Tie Bars shall conform to Subsection 908.01(A).

908.05 Stone Anchors.

Anchors for granite curb shall be reinforcing steel conforming to Subsection 908.01(A), galvanized in accordance with Subsection 909.11(D).

SECTION 909 - STRUCTURAL STEEL AND OTHER FERROUS METALS

909.01 Structural Steel.

Structural steel for various structural applications shall conform to the following requirements and in accordance with the Plans or Supplementary Specifications.

(A) CARBON STRUCTURAL STEEL.

Carbon Structural Steel shall conform to the requirements of AASHTO M183 (ASTM A36). Supplementary requirement S3 is mandatory for materials designated as main load carrying member components subject to tensile stress; Zone 2 of Table S1 shall govern the toughness requirements.

(B) HIGH-STRENGTH LOW-ALLOY STRUCTURAL STEEL.

High strength low alloy steel for bridges of 4 inches thickness or less shall conform to the requirements of AASHTO M270, Grade 50 (ASTM A709, Grade 50) unless specified otherwise in the Plans. Supplemental requirement S83 for non-fracture critical material or S84 for fracture critical material is mandatory for material designated as main load carrying member components subject to tensile stresses.

909.02 Fasteners.

Fastener for structural connections anchorages and other similar connections shall conform to the following requirements:

(A) HIGH-TENSILE-STRENGTH BOLTS, NUTS AND WASHERS.

High-strength bolts, nuts, and washers shall conform to Section 11.3.2 of the AASHTO LRFD Bridge Construction Specifications. When high-strength bolts are used with weathering grades of steel, the bolts, nuts, and washers shall be Type 3.

(B) UNFINISHED BOLTS, NUTS, WASHERS AND CAP SCREWS.

Unfinished Bolts, Nuts, Washers and Cap Screws shall conform to the requirements of ASTM A307, Grade A. Circular washers of steel conforming to ASTM A36 shall be flat and smooth and shall conform to the requirements of ASME B18.21.1.

(C) STAINLESS STEEL BOLTS, U-BOLTS, J-BOLTS, NUTS, AND WASHERS.

Stainless steel headed bolts, U-bolts, J-bolts and nuts shall be fabricated from material conforming to the requirements of ASTM A276, Type 304, Condition A, hot finished. Bolt heads and nuts shall conform to the dimensional requirements of ASME B18.2.1 and B18.2.2, as applicable. Washers shall be fabricated from stainless steel conforming to the requirements of ASTM A167, Type 304 with a No. 4 finish, and shall conform to the dimensional requirements of ASME B18.21.1. Bolt heads and nuts, unless otherwise noted on the Plans, shall be finished hexagon. Threads of bolts and nuts shall be Class 2, 2A, or 2B.

All stainless steel bolts, nuts and washers shall be passivated in accordance with the requirements of ASTM A967.

(D) EXPANSION ANCHORS.

Expansion Anchors shall be shield type meeting the requirements of Federal Specifications A-A-1922A, A-A-1923A, A-A-1924, A-A-1925, A-A-55614 and A-A-55615, of the size shown on the Plans and subject to the Engineer's approval. Certified manufacturer's affidavit shall be furnished attesting to the pull and shear

strength of the various types and sizes of the expansion anchors proposed to be used.

(E) Adhesive and Cast-in-Place Anchors.

Unless otherwise specified, Adhesive and Cast-in-Place Anchors shall be fully galvanized high strength steel anchor bolts meeting the requirements of ASTM F1554, Grade 105. Adhesive Anchors shall be set in drilled holes with an approved epoxy or polyester resin bonding agent. Where removable anchors are specified, the anchor bolt shall be Teflon coated prior to installation. Certified manufacturer's affidavit shall be furnished attesting to the pullout strength by proof loading to 90% of the yield of materials, of the various sizes and types of anchor bolts to be used.

909.03 Pins and Rollers.

Pins and rollers 9 inches or less in diameter may be either forged and annealed steel or cold-finished carbon-steel shafting. If the cold-finished carbon-steel shafting process is desired, the pins and rollers shall conform to the requirements of ASTM A108, Grades 1020 to 1035, inclusive. Pins and rollers more than 9 inches in diameter shall be steel forgings, and pins and rollers 12-inch and larger in diameter shall be alloy steel forgings meeting the requirements of 909.04(B).

Pintles (rocker plate dowels) shall be of stainless steel conforming to the requirements of ASTM A276, Type 302, Condition A. The surface finish shall be as specified on the Plans.

909.04 Castings and Forgings.

Castings and forgings as designated on the Plans or specified in the Supplementary Specifications shall conform to the following requirements:

(A) Steel Castings.

Steel castings shall be true to pattern and of workmanlike finish and shall be free of injurious defects. Minor defects which do not impair the strength of the castings may, with permission of the Engineer, be welded by an approved process. The defects shall first be cleaned out to solid metal and after welding, unless otherwise permitted, the castings shall be re-annealed and refinished. Castings which have been welded without the Engineer's permission will not be accepted. Castings shall be properly cleaned and all fins, seams, and other irregularities shall be removed so that they shall have clean smooth surfaces.

Steel castings shall be Grade 65-35, fully annealed and mechanically tested conforming to ASTM A27, then galvanized in accordance with ASTM A123.

Castings specified as alloy steel castings shall be Grade 80-50 conforming to ASTM A148 and galvanized in accordance with ASTM A123. All castings shall be fully annealed and a tension test made from each melt in each heat treatment charge. The Contractor shall submit for approval the content of the steel he proposes to use to meet the physical requirements and shall make an analysis of each melt to determine the percentage of all elements present in the steel.

It shall be the responsibility of the Contractor to determine the chemical composition which will produce steel castings meeting the requirements of these Specifications. The Contractor shall submit satisfactory evidence to the Engineer to substantiate the fact that the chemical composition proposed will produce steel castings conforming to these requirements.

(B) Steel Forgings.

Steel forgings not otherwise specified shall be Class D annealed conforming to ASTM A668, and galvanized in accordance with ASTM A123.

Forgings specified as alloy steel forgings shall be Class G annealed conforming to ASTM A668, and galvanized in accordance with ASTM A123.

It shall be the responsibility of the Contractor to determine the chemical composition which will produce steel forgings meeting the requirements of these Specifications. The Contractor shall submit satisfactory evidence to the Engineer to substantiate the fact that the chemical composition proposed will produce steel forgings conforming to these requirements.

(C) Iron, Malleable and Ductile Castings.

All castings shall be boldly filleted and the arrises shall be sharp and perfect. The castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blowholes, and other defects affecting their strength and value for the service intended. All castings shall be sandblasted or otherwise

effectively cleaned of scale and sand so as to present a smooth, clean, and uniform surface.

Gray iron castings shall conform to ASTM A48 and shall be Class No. 30B unless otherwise specified.

Ductile iron castings shall conform to the requirements of ASTM A536, Grade 65-45-12.

Malleable iron castings shall conform to ASTM A47, Grade 35018.

Each casting shall be identified by either casting or stamping, using G (Gray Iron), M (Malleable iron) or D (Ductile iron).

909.05 Steel Piles.

Steel piles of structural sections, pipe or sheet as designated on the Plans or in the Supplementary Specifications shall conform to the following requirements:

(A) Steel H-Piles.

Steel H-Piles and plates for splices and joints shall be of carbon steel conforming to the requirements of ASTM A36, A572 Grade 50, or ASTM A709 Grade 50 with the exception that steel H-piles for use in a marine environment shall conform to ASTM A690.

(B) Steel Pipe Piles and Pipe Shells.

Steel Pipe Piles and Pipe Shells shall conform to the requirements of ASTM A252, Grade 2. Pipe piling designated as ASTM Designation A252, which has a yield strength of less than or equal to 65 ksi shall be treated as ASTM Designation A572/A572M, Grade 50 material for the purposes of welding and prequalification of base metal, in conformance with the requirements in AWS D1.1. The type, size and wall thickness shall be as shown or specified on the Plans. Steel shells shall be cylindrical, uniformly tapered, step tapered, or a combination thereof. When used in a marine environment as an Engineer approved alternative protection system to that specified elsewhere, pipe piles shall be coated from 12" below the finished ground or mud line unless noted otherwise on the Plans with an approved petrolatum based tape system from an approved supplier as listed on the QPL.

(C) Steel Sheet Piles.

Steel Sheet Piles shall conform to the requirements of ASTM A572, with the exception that steel sheet piles for use in a marine environment shall conform to ASTM A690.

909.06 Automatic End Welded Studs.

Automatic end welded studs and welding thereof shall conform to the requirements of Section 7 of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code.

909.07 Permanent Metal Bridge Deck Forms.

Permanent metal bridge deck forms shall be fabricated from galvanized steel sheets conforming to the requirements of ASTM A653, Grade 50 or 60; coating designation shall be A924.

Permanent metal bridge deck forms shall meet the following requirements:

(A) Fabrication.

Shop drawings for fabricated permanent metal bridge deck forms, which shall also show related deck reinforcement placement, shall be submitted to the Engineer for review. Drawings shall clearly indicate locations where forms are supported by beam flanges subject to tensile stresses.

(B) Design.

Forms shall be designed to support the combined dead loads of forms, reinforcement steel, plastic concrete, and a construction load of 50 lbs. per square foot.

The allowable stress in the steel sheet shall not exceed 0.725 of the minimum yield strength of the material furnished, but in no case more than 36,000 lbs. per square inch.

The maximum permissible deflection of the forms under the load of plastic concrete, reinforcement, and forms shall not exceed 1/180 of the form span or 1/2 inch, whichever is less. (If more, the forms shall be cambered.) Maximum deflection under 60 pounds per square foot of live load shall not exceed 1/360 of the form span or 1/4 inch, whichever is less.

The form span for deflection and design shall be taken as the clear distance between flanges of supporting beams less two inches, measured parallel to corrugations.

Physical properties of the forms shall be computed in accordance with the American Iron and Steel Specification for the Design of Cold-Formed Steel Structure Members, current edition.

909.08 Transverse Tie Rods.

Transverse tie rods shall be high-tensile strength alloy bars conforming to the requirements of ASTM A722. They shall be stress relieved by heat treatment and then cold stretched (proof stressed) to minimum yield strength as specified below.

After cold stretching, the physical properties shall conform to the following:

Minimum ultimate tensile strength as certified by the manufacturer	145,000 psi
Minimum yield strength measured by the 0.7% extension under load method shall not be less than 87% of ultimate minimum modulus of elasticity	25,000,000 psi
Minimum elongation in 20 bar diameters Length after rupture	4.0 %
Minimum reduction of area after rupture	20.0 %
Diameter tolerance	+0.03, -0.01 inch

All physical properties shall be calculated on nominal bar area.

Transverse tie rods shall be commercial blast cleaned in accordance with the requirements of SSPC-SP-6 and shall be coated with a two-component, self-priming, chemically cured, catalyzed coal tar epoxy coating conforming to SSPC-Paint 16.

Nuts and washers shall conform to Subsection 909.02 and shall be galvanized.

909.09 Steel Pipe for Bridge Drainage.

Steel pipe for bridge drainage shall be hot-dipped galvanized steel pipe, schedule 40, meeting the requirements of ASTM A53, Grade B, Type E or S.

Metal drainage fittings, including bends, sweeps, elbows, fabricated fittings, and couplings shall be of pipe conforming to the above requirements and shall be hot-dip galvanized after all fabrication and welding is completed.

909.10 Steel Pipes for Sign Support Structures.

Steel pipes for sign support structures shall be of pipe, tube or fabricated plate conforming to the following requirements:

(A) High-Strength, Low-Alloy Steel Pipe.

High-Strength, Low-Alloy Steel Pipe conforming to the requirements of ASTM A714, Class 4, Grade V, VI, VII OR VIII, Type E or S except that the hydrostatic pressure test will not be required. The nominal diameters and schedules of pipe members shall be as shown on the Plans.

(B) Cylindrical Tubes.

Cylindrical Tubes produced by forming and longitudinal welding of structural steel plate shall conform to the requirements of ASTM A588, ASTM A242, ASTM A709, or ASTM A847. Diameters and thickness of finished cylindrical tubes shall be as shown on the Plans.

(C) Tapered Structural Steel Tubes.

Tapered Structural Steel Tubes conforming to the requirements of ASTM A595, Grade C.

(D) Galvanized Seamless Steel Pipe.

Galvanized Seamless Steel Pipe construction shall be of pipe conforming to ASTM A53, Type S, Grade B.

909.11 Zinc Coating on Steel.

Zinc coating on steel products shall be performed in accordance with the following requirements:

(A) HOT-DIP GALVANIZING – IRON AND STEEL PRODUCTS.

Hot-dip galvanizing applied on products fabricated from rolled, pressed and forged steel strips, plates, and bars shall conform to the requirements of ASTM A123.

(B) HOT-DIP GALVANIZING – IRON AND STEEL HARDWARE.

Hot-dip galvanizing applied on iron and steel hardware shall conform to the requirements of ASTM A153.

(C) HOT-DIP GALVANIZING - WIRE.

Hot-dip galvanizing applied on wire, wire fabric reinforcement and welded steel wire fabric shall be performed after welding and fabrication is completed, in accordance with the requirements of ASTM A641, Class 2 coating.

(D) HOT-DIP GALVANIZING - REINFORCEMENT.

Hot-dip galvanizing applied on reinforcement steel bars shall be performed after all bending is completed, in accordance with the requirements of ASTM A767, Class I. Bending bars after galvanizing will not be acceptable.

909.12 Steel Handrail.

Steel handrail shall conform to ASTM A53 Type E or S Grade A, six-inch diameter steel pipe, Standard Weight with plain ends. Handrail pipe shall be furnished without splices for lengths less than twenty-one feet.

909.13 Steel Posts and Plates.

Steel Posts and Plates shall conform to ASTM Designation A709 Grade 36.

909.14 Jacks for Bearing Replacement.

Jacks for bearing replacement shall be from an approved supplier as listed on the QPL and in accordance with Subsection 432.02.

SECTION 910 - TIMBER AND TIMBER PRESERVATIVES

910.01 Timber for Structures.

Timber for structures shall conform to AASHTO M168 with the following modifications:

Timber shall be Douglas Fir or Southern Pine of structural grade. The timber shall be stress graded, conforming to Standard Grading Rules of the Southern Pine Inspection Bureau. Materials for Southern Pine shall be designated and graded as No. 2 dense if less than 5 inches thick and as No. 2 Dense SR if 5 inches or thicker. Douglas Fir shall be designated as Dense No. 1, except timber for sheet piling shall be Southern Pine or Douglas Fir No. 2 or better.

Timber for decking subject to vehicle traffic shall be graded as Dense Commercial for Southern Pine and Select if Douglas Fir. Timber for decking subject to exclusively pedestrian traffic shall be Commercial grade. Timber decking shall not be preserved with creosote.

Sheet piling and structural timber for use above ground, in soil or fresh water contact shall be Southern Pine or Douglas Fir and shall be treated with waterborne preservatives in accordance with the below tables. Sheet piling and structural timber for use in a marine environment shall be Southern Pine or Douglas Fir and shall be treated with waterborne preservatives in accordance with the below tables.

Glued-laminated structural timber for use above ground and in soil contact shall be Southern Pine or Douglas Fir and shall be treated with waterborne preservatives in accordance with the below tables. Glued-laminated timber shall be treated prior to gluing. Glued-laminated timber shall not be used in fresh water contact, marine environments or in salt water splash zones.

Application	American Wood Protection Association Standard		
	Standard	Service Condition	Commodity Specification
Timber Sheet Piling and Structural Timber/Usage			
(1) Above ground, soil contact, and fresh water contact	U1	UC4C	A
(2) Marine environment (salt water contact or salt water splash)	U1	UC5B	G
Glued-Laminated Structural Timber/Usage			
(1) Above ground and soil contact	U1	UC4C	F

Preservatives for Timber for structures outside of the above published applications shall be submitted to the Engineer for review and approval prior to use.

910.02 Timber Piles.

Timber piles shall be Southern Pine or Douglas Fir and shall conform to ASTM D25.

Timber piles shall be treated with a preservative in accordance with the American Wood Protection Association (AWPA) Standard U1, Commodity Specification E, to the requirements of Use Category 5B (UC5B)

910.03 Timber Connectors.

Timber connectors shall conform to Division II, Section 16 of the AASHTO Standard Specifications for Highway Bridges.

910.04 Timber Preservative.

Timber preservative shall be water-borne preservatives conforming to AWPA Standards as specified elsewhere herein.

910.05 Timber Posts and Timber Brackets for Breakaway Terminals and Routed Timber Brackets for Guardrail.

Timber posts and timber brackets for breakaway terminals and routed timber brackets for guardrail shall be structural grade Southern Pine timber or Douglas Fir with a stress grade of 1,200 psi or greater as tested in accordance with Southern Pine Inspection Bureau and shall be sound, square-edge, saw-finished, with no heartwood requirements, conforming to AASHTO M168.

All timber posts and timber brackets for breakaway terminals and routed timber brackets for guardrail shall be treated with a preservative in accordance with the American Wood Protection Association (AWPA) Standard U1, Commodity Specification A, to the requirements of Use Category 4C (UC4C)

910.06 Timber Planks.

Timber planks and stakes for backing hand-laid Asphalt Concrete Lip Curb may be either new or used lumber of any type suitable for the purpose. Timber shall be conditioned and treated in accordance with AWPA Standards with timber preservative as specified in 910.04 to a minimum net retention of 8 pounds per cubic foot.

910.07 Timber Sheet Piles.

Timber sheet piles shall conform to Subsection 910.01, dressed on 4 sides, and shall be tongue and grooved or grooved for splines.

910.08 Hardware.

Machine bolts, anchor bolts, drift bolts, dowel, lag screws, rods, spikes, nails, staples, and plate washers shall be medium steel for all construction including fender and marine construction. All hardware shall be hot dipped galvanized (G185 coating thickness). Galvanization shall be performed in accordance with ASTM A153 or A653, as appropriate.

910.09 Pile Top Protection.

Pile top protection shall consist of the following:

Copper in accordance with ASTM B248 shall be 0.032 "thick cut to dimension" as shown on the Plans.

910.10 Protective Coating.

Protective Coatings shall be in accordance with the requirements of AWPA M4

910.11 Plastic Lumber Sheeting.

The sheeting will be 3x10 nominal size and shall conform to the following Mechanical Properties as per ASTM D198-99.

Specific Gravity	0.75
Modulus of Rupture	2800 psi
Modulus of Elasticity	0.27 million - psi
Work to Maximum Load	1.91 lbs. per cubic inch
Physical Properties:	
Moisture Content	Negligible
Shrinkage/swelling due to moisture	Negligible
Coefficient of Thermal Expansion	15.–50 x 106 in/in/ºC
Density	44 lbs.– 50 lbs. per cubic foot

Insect resistance to marine borer and shipworms teredinidae.

Plastic Lumber shall be from an approved supplier as listed on the QPL.

SECTION 911 - NON-FERROUS METALS

911.01 Aluminum Alloys.

Aluminum alloys shall conform to the following:

Component	ASTM	ASTM Alloy and Temper
Castings, Sand	B 26	356-T6
Die Castings, Permanent Mold	B 108	356-T6
Extruded Bars, Rods, Shapes and Pipe	B 221	6061-T6
Luminaire Support Channels	B 221	6063-T6
Pipe	B 241	6061-T6
Plates and Sheets	B 209	6061-T6
Rolled Shapes, Rods and Bars	B 211	6061-T6
Shim Material made of Sheet or Plate	B 209	1100-O
Tube, Drawn	B 210	6061-T6
Tube, Extruded	B 221	6061-T6
Washers, made of Sheet, Alloy Clad	B 209	2024-T3
Ladder Rungs on Sign Structures	B 241	6061-T6

Aluminum bolts, nuts, set screws and pins shall be made from rods conforming to the requirements of ASTM

B211, Alloy 2024 T4 with No. 205 Alumilite Finish. Bolt heads and nuts shall be American Standard, Regular Series, hexagonal, semi-finished, conforming to the requirements of ANSI/ASME B18.2.1 and B18.2.2, respectively. Threads shall be American Standard, Coarse Series, Class 2 Fit, conforming to the requirements of ANSI/ASME B1.1. The finished bolts and nuts shall be heat treated to a T4 temper and given an anodic coating of not less than 0.0002 inch thickness and shall be chromate sealed.

Electrodes for welding aluminum shall conform to the requirements of AWS Specification A5.10 for Electrode ER5556 OR ER5356.

911.02 Flashing for Construction and Expansion Joints.

Copper for flashing shall weigh 16 ounces per square foot and shall conform to the requirements of ASTM B152, type UNS No. C11000.

Nickel-copper alloy sheeting for flashing shall conform to the requirements of ASTM B127. It shall be cold-rolled deep-drawing and spinning quality.

911.03 Lead.

Lead shall conform to the requirements of ASTM B29 for common lead.

911.04 Zinc.

Zinc shall conform to the requirements of ASTM B69.

911.05 Brass Markers.

Brass markers shall be fabricated from copper alloy UNS No. C21000, half-hard, conforming to the requirements of ASTM B36, or any other copper alloy as approved by the Engineer.

911.06 Zinc Wire.

(A) Zinc wire shall meet the following parameters.

Diameter:	1/8 inch
Tolerance:	-0.002 inch
Melting Point:	788°F
Density:	0.258 lb/in^3
Tensile Strength:	13-19 ksi
Chemical Composition:	99.00 percent zinc

(B) Finish and Appearance.

The wire is clean and of uniform composition and quality, free of seams, cracks, nicks or burrs. The wire is capable of uncoiling readily from a precision wound spool, and is free of bends, kinks, or slivers that would prevent its passage through a metalizing gun. The use of diamond dies in finishing the wire is required.

(C) Packaging Requirements.

Precision wound onto 22 lb. or 50 lb. plastic spools for use with a metalizing gun.

All zinc shall conform to the requirements of ASTM B69 and ASTM B833. A certification of compliance (Subsection 105.04) is required for acceptance of the zinc wire.

Section 912 - Sign Materials

912.01 Aluminum Sheet Sign Panels and Incidental Hardware.

(A) Flat Sheet Sign Face Panels, Backup Plates, Clips, Shims and Spacers.

Flat Sheet Sign Face Panels, Backup Plates, Clips, Shims and Spacers shall be fabricated from flat aluminum sheet and plate conforming to the requirements of ASTM B209, Alloy 6061-T6.

Aluminum thickness shall be 0.080" for flat panel signs measuring less than 8 square feet in area.

Aluminum thickness shall be 0.100" to 0.125" for flat panel signs measuring 8 square feet or greater in area.

(B) Extruded Sign Panels, Stringers, Stiffeners, Backing Strips, U-Bolt Clips, Bars and Post Clamp Brackets.

Extruded Sign Panels, Stringers, Stiffeners, Backing Strips, U-Bolt Clips, Bars and Post Clamp Brackets shall be fabricated from aluminum extrusions conforming to the requirements of ASTM B221, Alloy 6061-T6. Post clamp brackets for use on small aluminum extrusions shall conform to the requirements of ASTM B221, Alloy 6062-T6.

(C) Aluminum Rivets.

Aluminum Rivets for connecting delineators to concrete barrier shall be structural, self-plugging type with sleeve of aluminum Alloy 5056 and mandrel of aluminum Alloy 7178 from an approved supplier as listed on the QPL.

(D) Stainless Steel Bolts, U-Bolts, J-Bolts, Nuts, and Washers.

Stainless Steel Bolts, U-Bolts, J-Bolts, Nuts, and Washers shall be as specified in Subsection 909.02(C). Where stop nuts are specified, they shall be from an approved supplier as listed on the QPL.

(E) Nylon Washers.

Nylon Washers shall be as specified in Subsection 923.16.

(F) Stainless Steel Rivets.

Stainless Steel Rivets when used for sign panels shall be type CCPQ-08-02 and from an approved supplier as listed on the QPL. Aluminum rivets are not acceptable for sign panels.

912.02 Sign Copy and Background.

(A) Classification and Conformance.

The sheeting specified herein is intended for shop production of stationary traffic control signs or objects, exclusive of those used for construction and maintenance work zones.

Reflective sheeting background for sign panels shall be super-high efficiency, full cube retroreflective sheeting with full cube prismatic lens elements with a distinctive interlocking diamond seal pattern visible from the face of a smooth surface. The sheeting shall have a precoated adhesive protected by an easily removable liner and shall be from an approved supplier as listed on the QPL.

The sheeting shall conform to ASTM D4956 as modified by this specification.

(B) Process Colors.

The manufacturer of the sheeting shall manufacture and offer process colors in standard traffic colors, clears and thinners recommended for the sheeting to meet the performance requirements of this specification.

The process colors shall be a single line of traffic colors which may be applied before and after sheeting is applied to a substrate; which require no component premixing; which will air dry for packing in 3 hours or less and requires no clear coating.

(C) Overlay Films.

The sheeting manufacturer shall also manufacture colored acrylic imaging films and clear protective overlays when required, which are compatible with the sheetings, and when used in accordance with the sheeting manufacturer's instructions, shall not lessen the warranty term as described herein.

(D) Test Panels and Test Conditions.

Unless specified otherwise herein or in the Contract Documents, sheeting shall be supplied to test panels in accordance with ASTM D4956, Section 7.2 and test conditions shall conform to ASTM D4956, Section 7.1.

(E) Color Requirements.

Colors shall be as specified and shall conform to the Daytime and Nighttime Color Specification Limits requirements of Tables 912-1 and 912-2 and as found in ASTM D4956. Daytime luminance factors shall conform to Table 912-3 and as found in ASTM D4956.

Table 912-1 Color Specification Limits (Daytime)[A]								
Color	1		2		3		4	
	x	y	x	y	x	y	x	y
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404
Green[B]	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346
Blue[B]	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216
Brown	0.430	0.340	0.610	0.390	0.550	0.450	0.430	0.390

[A] The four pairs of chromatically coordinates determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with CIE Standard Illuminant D65.

[B] The saturation limit of green and blue may extend to the border of the CIE chromatically locus for spectral colors.

Table 912-2 Color Specification Limits (Nighttime)[A]								
Color	1		2		3		4	
	x	y	x	y	x	y	x	y
White (no requirement)								
Yellow	0.513	0.487	0.500	0.470	0.545	0.425	0.572	0.425
Orange	0.595	0.405	0.565	0.405	0.613	0.355	0.643	0.355
Green	0.007	0.570	0.200	0.500	0.322	0.590	0.193	0.782
Red	0.650	0.348	0.620	0.348	0.712	0.255	0.735	0.265
Blue	0.033	0.370	0.180	0.370	0.230	0.240	0.091	0.133
Brown	0.595	0.405	0.540	0.405	0.570	0.365	0.643	0.355

[A] The four pairs of chromatically coordinates determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with CIE Standard Illuminant A.

Table 912-3 Daytime Luminance Factor (Y%)		
Color	Min.	Max.
White	27	-
Yellow	15	45
Orange	10	30
Green	3.0	12
Red	2.5	15
Blue	1.0	10
Brown	1.0	9.0

(1) Ordinary Colors.

Conformance to standard chromaticity (x, y) and luminance factor (Y%) requirements shall be determined by instrumental method in accordance with ASTM E1164 on sheeting applied to smooth aluminum test panels cut from Alloy 6061-T6. The values shall be determined with a 45/0 spectrophotometer. Computations shall be done for CIE Illuminant D_{65} and the 2^{o} standard observer.

(F) COEFFICIENT OF RETROREFLECTION.

Conformance to minimum requirements for Retroreflectance is determined as follows:

(1) Three 8 inch x 8 inch samples spaced evenly across and down a representative piece of sheeting shall be taken. The Coefficient of Retroreflection (R_A) shall be determined for each of the three samples per ASTM E810. The average of the three values shall comply with the stated minimum table value and no single sample shall be less than 80% of the table value.

(2) The observation angles shall be 0.2°, 0.5°, 1.0°.

(3) The entrance angles shall be -4° and 30°.

(4) For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficients of retroreflection shall not be less than 70% of the values for corresponding color in Table 912-4 of this specification.

Table 912-4
Type XI Minimum Coefficient of Retroreflection (R_A)
(candelas per foot- candle per square foot - cd/fc/ft^2)

- 4º Entrance Angle[A]	**Observation Angle[B]**			
Color	0.1º[C]	0.2º	0.5º	1.0º
White	830	580	420	120
Yellow	620	435	315	90
Orange	290	200	150	42
Green	83	58	42	12
Red	125	87	63	18
Blue	37	26	19	5.0
Brown	25	17	13	4.0
+30º Entrance Angle[A]	**Observation Angle[B]**			
Color	0.1º[C]	0.2º	0.5º	1.0º
White	325	220	150	45
Yellow	245	165	110	34
Orange	115	77	53	16
Green	33	22	15	5.0
Red	50	33	23	7.0
Blue	15	10	7.0	2.0
Brown	10	7.0	5.0	1.0

[A] Entrance (Incidence) Angle – The angle from the illumination axis to the retroreflector axis. The retroflector axis is the axis perpendicular to the retroreflective surface.

[B] Observation (Divergence) Angle - The angle between the illumination axis and the observation axis.

[C] Note that 0.1º Observation angle is a "supplemental requirement" in ASTM D4956. It represents long highway viewing distances of about 900 ft and greater.

(G) FRACTIONAL RETROREFLECTANCE.

The optical design of the sheeting shall be such that when measured at an entrance angle of –4° the fractional retroreflectance within a 2° observation angle cone, as defined in ASTM E808 as R_T with α_{max} = 2°, is at least 55%.

(H) COLOR PROCESSING.

The retroreflective sheeting shall be designed to work with recommended imaging systems. Color processing with compatible transparent and opaque process colors shall be possible in accordance with the sheeting manufacturer's recommendation at temperatures of 60° to 100° F and relative humidity of 20% to 80%. The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures recommended by the sheeting manufacturer.

(I) SHRINKAGE.

The retroreflective sheeting shall comply with the shrinkage requirements contained in ASTM D4956, Section 6.6.

(J) ADHESIVE.

The retroreflective sheeting shall comply with the liner removal and adhesion requirement contained in ASTM D4956, Sections 6.8 and 6.9 respectively.

(K) OPTICAL STABILITY.

Three pieces of retroreflective sheeting applied to test panels and conditioned as in ASTM D4956, Section 7.1 shall each first have their photometric properties characterized by measuring the coefficients of retroreflection according to the provisions in Subsection 912.02(I) and all test geometries in Table II. These panels shall then be exposed in an air circulating oven at 170+/-5°F for a period of 24 hours. After exposure the panels shall be allowed to condition according to the provisions of ASTM D4956, Section 7.6.2. These panels will again be characterized for photometrics by measuring the coefficients of retroreflection according to the provisions of 912.02(F) at all test geometries measured before exposure.

The coefficients of retroreflection measured after exposure shall be between 85% and 115% of the values measured before exposure for each of the three samples.

(L) FUNGUS RESISTANCE.

The retroreflective sheeting shall comply with the supplementary requirements contained in Section S1 of ASTM D4956.

(M)GENERAL CHARACTERISTICS AND PACKAGING.

The retroreflective sheeting as supplied shall be of good appearance, free from ragged edges, cracks and extraneous materials and shall be furnished in either rolls or sheets.

When furnished in continuous rolls, the number of splices shall not be more than two per 50 yards of material, with a maximum of three pieces in any 50 yard length. Splices shall be butted and shall be suitable for continuous application as furnished.

The sheeting shall be packaged in accordance with commercially accepted standards. Each carton shall clearly stipulate the brand, quantity, size, lot or run number, and color. Stored under normal conditions the retroreflective sheeting as furnished shall be suitable for use for a minimum period of one year.

(N) PERFORMANCE REQUIREMENTS AND OBLIGATIONS.

The sheeting manufacturer shall submit a certification that states the material supplied will meet all the requirements listed herein.

Sheeting processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendations, shall perform effectively for the number of years stated below of this specification. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retroreflection is less than the minimum specified for that sheeting during that period listed.

Type XI – 80% of values listed in Table 912-4 after 7 years and

70% of values listed in Table 912-4 after 12 years.

Failure to process colors or overlay films provided and/or sold for use on recommended sheeting shall constitute a failure of the entire sign and shall be replaced under the Subsection 912.02(O) Sheeting Manufacturer's Replacement Obligations.

For screen printed transparent colored areas or transparent colored overlay films on white sheeting, the coefficients of retroreflection shall not be less than 70% of the values for the corresponding integral color.

All measurements shall be made after sign cleaning according to the sheeting manufacturer’s recommendations.

(O) SHEETING MANUFACTURER'S REPLACEMENT OBLIGATIONS.

Where it can be shown that retroreflective signs, supplied and used according to the sheeting

manufacturer's recommendations, have not met the performance requirements of Subsection 912.02(P), the sheeting manufacturer shall cover restoration costs as follows for sheetings shown to be unsatisfactory during:

The entire 12 years (Type XI): The sheeting manufacturer will replace the sheeting required to restore the sign surface to its original effectiveness.

In addition, during the first 7 years, the sheeting manufacturer will cover the cost of restoration of the sign surface to its original effectiveness at no cost to the Authority for materials and labor.

The Contractor shall be responsible for requiring the dating of all signs at the time of application and shall submit dates to the Engineer. That date constitutes the start of field performance obligation period.

(P) PREQUALIFICATION AND PERFORMANCE HISTORY.

Materials will be considered for use only when, in the opinion of the Authority, sufficient evidence exists to ensure that the materials and services offered can reliably conform to this specification. The sheeting manufacturer shall provide evidence of performance and suitability for use in accordance with Section 105.

912.03 U-Channel Post.

U-Channel post for mounting signs and delineators shall be NCHRP Report 350 compliant and shall be from an approved supplier as listed on the QPL. Installation shall be in accordance with manufacturer's recommendations. For repair or replacement of sign posts that are damaged, components made by other manufacturers shall not be used for replacement parts.

SECTION 913 - PAINTS AND COATINGS

913.01 Paint System A.

The VOS Compliant System shall consist of a two component aluminum epoxy mastic primer and two component medium to high gloss aliphatic polyurethane finish coating. The system shall be from an approved supplier as listed on the QPL. To insure compatibility, the primer, intermediate coat and finish cost including thinners shall be supplied by the same manufacturer. All coating shall conform to the requirements of Subchapter 23 Volatile Organic Substances (VOS) in Consumer Products of the New Jersey Administrative Code (NJAC) 7:27. The manufacturer of the aluminum epoxy mastic spot primer and intermediate coat selected for use on this Project shall provide proof of satisfactory adhesion of such primer and intermediate coat over the pre-existing paint system.

All paint systems are subject to change in availability or recommendation by the manufacturer.

Drying time between coats shall be per the manufacturer's recommendations and the following:

Spot Primer, Intermediate Coat and Finish Coat: 24 Hours

The following samples and information along with the current published technical product data and material safety data sheets for the system selected shall be submitted to the engineer at least on month before application of the paint system is anticipated by the Contractor.

A 1 gallon sample for each coat of paint in the system.

Infrared curves (2.5 to 15 microns) for the primer and finish coat to include curves for the dry film of the vehicle (binder) of each component and for the mixed paint.

Weight per gallon, at 77°F, for primer and finish coat. Variance shall be within +/0.4 pounds of the nominal weight per gallon of the sample that was approved.

Viscosity in krebs units, at 77°F, for primer and finish coat paints. Variance shall be with ±5 krebs units or equivalent units of another viscometer of the viscosity of the sample that was approved.

Percent solids by weight of the primer vehicle and finish coat paints.

Finish coat color chips for specified color and gloss.

VOS Content, lbs. per gallon.

Specific application instructions for all coats. In the event of a conflict between the instruction sheets and these specifications, with the approval of the engineer, the manufacturer's requirements shall govern. Work shall not be allowed to proceed until the information is received and approved.

Mixing and thinning directions.

Submit the manufacturer's recommended repair procedures to correct damage such as that caused in handling and shipping, deficient or excessive coating thickness, removal of contaminants that may be detrimental to succeeding coats and procedure for surface preparation and painting of rust spots.

Provide the services of a paint or a painting technical representative from the paint manufacturer at the beginning of operations and whenever required during operations.

(A) DRY FILM THICKNESS.

The minimum dry film thickness shall be as described in Subsection 411.03.

The Contractor shall perform inspections to assure compliance with Subsection 411.03 of the Specifications. The Engineer may perform dry film thickness measurements and evaluation of measurement results as specified under Subsection 411.03 of the Specification

(B) PAINT COLOR.

The prime coat and intermediate coat shall be different colors. The finish cost shall match the color of the existing paint system, unless otherwise specified, and shall be subject to approval by the Engineer. The finish coats shall be as follows:

(1) New Jersey Turnpike.

Green: Federal Standard 595B, Color Chip No. 14159.

Brown: Federal Standard 595B, Color Chip No. 20062.

(2) Garden State Parkway.

Green (Exterior Surfaces/Fascias): Federal Standard 595B, Color Chip No. 14090.

Green (Interior Surfaces): Federal Standard 595B, Color Chip No. 14672.

Brown: Federal Standard 595B, Color Chip No. 20062.

(C) PACKAGING AND LABELING.

Container shall be new containers of such strength, durability, design, fabrication, and material that the paint will be suitable protected in transit and in storage against any change in characteristics. Each container shall bear a label displaying the name of the manufacture, kind of paint, brand name, lot number, date of manufacture, date of expiration of usable storage life, net weight and volume of contents including volatile organic substance content, and complete instructions and precautions for its use. Each container shall be labeled in accordance with the code of Federal regulations for Federal regulations for flammables and shall contain all information necessary to comply with N.J.S.A. 34:5A-1 N.J. Worker and Community Right to Know Act (see Subsection 106.02). Each container shall be sealed by the manufacturer at the place of manufacture.

The Contractor shall provide the Authority with a copy of the manufacturer's most recent material safety data sheets (MSDS) for each and every item which, upon delivery/pick-up, is in the form of a single chemical substance or a mixture containing two or more chemical substances. All MSDS must meet or exceed the format requirements prescribed by OSHA's Hazard Communication Standard, 29 CFR 1910.1200 (g). In addition, in order for the Authority to be able to comply with the container labeling provision of the New Jersey Worker and Community Right to Know Act (N.J.S.A. 34:5A-1 et seq.), the Authority must account for 100 percent of the ingredients in each container, (1) by percentage of volume and (2) by chemical name and chemical abstract service number of all hazardous substances in each container, and all other substances (or the trade secret registry number assigned to the substance) which are among the five most predominant substances in the container. To the extent that any MSDS does not include sufficient information to enable the Authority to prepare a container label, as specified herein, the Contractor shall provide the Authority with supplemental documentation from the manufacturer detailing the missing required ingredient information.

913.02 Coating System B.

The VOS Compliant System shall consist of a two component epoxy polyamide zinc-rich primer, a two component high build epoxy polyamide intermediate and a two component medium to high gloss aliphatic polyurethane finish coating. The system shall be from an approved supplier as listed on the QPL. To insure compatibility, the primer, intermediate coat and finish coat including thinners shall be supplied by the same

manufacturer. All coatings shall conform to the requirements of Subchapter 23 Volatile Organic Substances (VOS) in Consumer Products of the New Jersey Administrative Code (NJAC) 7:27.

All paint systems are subject to change in availability or recommendation by the manufacturer.

Drying time between coats shall be per the manufacturer's recommendations and the following:

Primer, Intermediate Coat and Finish Coat: 24 Hours

The following samples and information along with the current published technical product data and material safety data sheets for the system selected shall be submitted to the Engineer at least on month before application of the paint system is anticipated by the Contractor.

A one-gallon sample for each coat of paint in the system.

Infrared curves (2.5 to 15 microns) for the primer and finish coat to include curves for the dry film of the vehicle (binder) of each component and for the mixed paint.

Weight per gallon, at 77 °F, for primer and finish coat. Variance shall be within +/0.4 pounds of the nominal weight per gallon of the sample that was approved.

Viscosity in krebs units, at 77 °F, for primer and finish coat paints. Variance shall be with ±5 krebs units or equivalent units of another viscometer of the viscosity of the sample that was approved.

Percent solids by weight of the primer vehicle and finish coat paints.

Finish coat color chips for specified color and gloss.

VOS Content, lbs. per gallon.

Specific application instructions for all coats. In the event of a conflict between the instruction sheets and these specifications, with the approval of the Engineer, the manufacturer's requirements shall govern. Work shall not be allowed to proceed until the information is received and approved.

Mixing and thinning directions.

Submit the manufacturer's recommended repair procedures to correct damage such as that caused in handling and shipping, deficient or excessive coating thickness, removal of contaminants that may be detrimental to succeeding coats and procedure for surface preparation and painting of rust spots.

Provide the services of a paint or a painting technical representative from the paint manufacturer at the beginning of operations and whenever required during operations.

(A) Dry Film Thickness.

The minimum dry film thickness shall be as described in Subsection 411.03.

The Contractor shall perform inspections to assure compliance with Subsection 411.03 of the Specifications. The Engineer may perform dry film thickness measurements and evaluation of measurement results as specified under Subsection 411.03 of the Specifications. The Contractor is notified that due to the roughness and irregular surface of weathering steel, a higher volume of primer will be required to achieve the minimum dry film thickness as compared to carbon steel, and shall bid the contract accordingly.

(B) Paint Color.

The prime coat and intermediate coat shall be different colors. The finish cost shall match the color of the existing paint system, unless otherwise specified, and shall be subject to approval by the Engineer. The finish coats shall be as follows:

(1) New Jersey Turnpike.

Green: Federal Standard 595B, Color Chip No. 14159.

Brown: Federal Standard 595B, Color Chip No. 20062.

(2) Garden State Parkway.

Green (Exterior Surfaces/Fascias): Federal Standard 595B, Color Chip No. 14090.

Green (Interior Surfaces): Federal Standard 595B, Color Chip No. 14672.

Brown: Federal Standard 595B, Color Chip No. 20062.

(C) PACKAGING AND LABELING.

Container shall be new containers of such strength, durability, design, fabrication, and material that the paint will be suitable protected in transit and in storage against any change in characteristics. Each container shall bear a label displaying the name of the manufacture, kind of paint, brand name, lot number, date of manufacture, date of expiration of usable storage life, net weight and volume of contents including volatile organic substance content, and complete instructions and precautions for its use. Each container shall be labeled in accordance with the code of Federal regulations for flammables and shall contain all information necessary to comply with N.J.S.A. 34:5A-1 N.J. Worker and Community Right to Know Act (see Subsection 106.02). Each container shall be sealed by the manufacturer at the place of manufacture.

The Contractor shall provide the Authority with a copy of the manufacturer's most recent material safety data sheets (MSDS) for each and every item which, upon delivery/pick-up, is in the form of a single chemical substance or a mixture containing two or more chemical substances. All MSDS must meet or exceed the format requirements prescribed by OSHA's Hazard Communication Standard, 29 CFR 1910.1200 (g). In addition, in order for the Authority to be able to comply with the container labeling provision of the New Jersey Worker and Community Right to Know Act (N.J.S.A. 34:5A-1 et seq.), the Authority must account for 100 percent of the ingredients in each container, (1) by percentage of volume and (2) by chemical name and chemical abstract service number of all hazardous substances in each container, and all other substances (or the trade secret registry number assigned to the substance) which are among the five most predominant substances in the container. To the extent that any MSDS does not include sufficient information to enable the Authority to prepare a container label, as specified herein, the Contractor shall provide the Authority with supplemental documentation from the manufacturer detailing the missing required ingredient information.

913.03 Coating System C.

The VOS Compliant System shall consist of inorganic zinc-rich primer, high-build epoxy intermediate coat and a urethane finish coat coating. The system shall be from an approved supplier as listed on the QPL. To insure compatibility, the primer, intermediate coat and finish coat including thinners shall be supplied by the same manufacturer. All coatings shall conform to the requirements of Subchapter 23 Volatile Organic Substances (VOS) in Consumer Products of the New Jersey Administrative Code (NJAC) 7:27.

All paint systems are subject to change in availability or recommendation by the manufacturer.

Drying time between coats shall be per the manufacturer's recommendations and the following:

Primer, Intermediate Coat and Finish Coat: 24 Hours

The following samples and information along with the current published technical product data and material safety data sheets for the system selected shall be submitted to the Engineer at least on month before application of the paint system is anticipated by the Contractor.

A one-gallon sample for each coat of paint in the system.

Infrared curves (2.5 to 15 microns) for the primer and finish coat to include curves for the dry film of the vehicle (binder) of each component and for the mixed paint.

Weight per gallon, at 77 ^{o}F, for primer and finish coat. Variance shall be within +/0.4 pounds of the nominal weight per gallon of the sample that was approved.

Viscosity in krebs units, at 77 ^{o}F, for primer and finish coat paints. Variance shall be with ±5 krebs units or equivalent units of another viscometer of the viscosity of the sample that was approved.

Percent solids by weight of the primer vehicle and finish coat paints.

Finish coat color chips for specified color and gloss.

VOS Content, lbs. per gallon.

Specific application instructions for all coats. In the event of a conflict between the instruction sheets and these specifications, with the approval of the Engineer, the manufacturer's requirements shall govern. Work shall not be allowed to proceed until the information is received and approved.

Mixing and thinning directions.

Submit the manufacturer's recommended repair procedures to correct damage such as that caused in handling and shipping, deficient or excessive coating thickness, removal of contaminants that may be detrimental to succeeding coats and procedure for surface preparation and painting of rust spots.

Provide the services of a paint or a painting technical representative from the paint manufacturer at the beginning of operations and whenever required during operations.

(A) Dry Film Thickness.

The minimum dry film thickness range shall be as described in Subsection 411.06(F).

The Contractor shall perform inspections to assure compliance with Subsection 411.03 of the Specifications. The Engineer may perform dry film thickness measurements and evaluation of measurement results as specified under Subsection 411.03 of the Specifications. The Contractor is notified that due to the roughness and irregular surface of weathering steel, a higher volume of primer will be required to achieve the minimum dry film thickness as compared to carbon steel, and shall bid the contract accordingly.

(B) Paint Color.

The prime coat and intermediate coat shall be different colors. The finish cost shall match the color of the existing paint system, unless otherwise specified, and shall be subject to approval by the Engineer. The finish coats shall be as follows:

(1) New Jersey Turnpike.

Green: Federal Standard 595B, Color Chip No. 14159.

Brown: Federal Standard 595B, Color Chip No. 20062.

(2) Garden State Parkway.

Green (Exterior Surfaces/Fascias): Federal Standard 595B, Color Chip No. 14090.

Green (Interior Surfaces): Federal Standard 595B, Color Chip No. 14672.

Brown: Federal Standard 595B, Color Chip No. 20062.

(C) Packaging and Labeling.

Container shall be new containers of such strength, durability, design, fabrication, and material that the paint will be suitable protected in transit and in storage against any change in characteristics. Each container shall bear a label displaying the name of the manufacture, kind of paint, brand name, lot number, date of manufacture, date of expiration of usable storage life, net weight and volume of contents including volatile organic substance content, and complete instructions and precautions for its use. Each container shall be labeled in accordance with the code of Federal regulations for flammables and shall contain all information necessary to comply with N.J.S.A. 34:5A-1 N.J. Worker and Community Right to Know Act (see Subsection 106.02). Each container shall be sealed by the manufacturer at the place of manufacture.

The Contractor shall provide the Authority with a copy of the manufacturer's most recent material safety data sheets (MSDS) for each and every item which, upon delivery/pick-up, is in the form of a single chemical substance or a mixture containing two or more chemical substances. All MSDS must meet or exceed the format requirements prescribed by OSHA's Hazard Communication Standard, 29 CFR 1910.1200 (g). In addition, in order for the Authority to be able to comply with the container labeling provision of the New Jersey Worker and Community Right to Know Act (N.J.S.A. 34:5A-1 et seq.), the Authority must account for 100 percent of the ingredients in each container, (1) by percentage of volume and (2) by chemical name and chemical abstract service number of all hazardous substances in each container, and all other substances (or the trade secret registry number assigned to the substance) which are among the five most predominant substances in the container. To the extent that any MSDS does not include sufficient information to enable the Authority to prepare a container label, as specified herein, the Contractor shall provide the Authority with supplemental documentation from the manufacturer detailing the missing required ingredient information.

913.04 Traffic Paint and Marking.

(A) Latex Pavement Striping Paint.

Latex paints shall be as specified herein and shall be suitable for application by spray equipment and shall be capable of receiving and securely holding glass beads when applied by the drop-on method for producing reflectorized traffic markings on hard surface pavement of all types.

The pigment and vehicle shall be so prepared and blended that the resulting paint shall be uniform in composition and of the required consistency. The paint at the time of use shall comply with all the provisions specified herein.

In addition to the methods of tests and inspection set forth below, the Engineer reserves the right to make any and all additional tests he may deem necessary to determine compliance with these Specifications and the suitability of the paint for its intended use. The Engineer further reserves the right to require the manufacturer of the paint to certify to the use of specific materials and components in the quantities specified herein where such materials or components are not readily identifiable in the finished paint.

All paint furnished must be shipped in strong, substantial containers, plainly marked with the name, weight and volume of the content, together with the color, formula and name and address of the manufacturer.

Latex traffic paint for traffic stripes or traffic markings shall be a white or a yellow ready-mixed pigmented binder that is emulsified in water and capable of anchoring reflective glass beads that are separately applied. In addition, the paint shall not contain any of the materials listed in the EPA Code of Regulations (CFR) 40, Section 261.24, Table 1.

Manufacturers of latex paint shall have produced, to the satisfaction of the Authority, a fast-drying traffic paint that meets the following requirements:

(1) Composition.

The exact composition of the latex paint shall be left to the discretion of the manufacturer, provided that the finished product meets the requirements as stipulated hereinafter.

(2) Pigment.

The pigment portion shall be a combination of prime and extender pigments as required to produce either a white or yellow traffic paint meeting the color and other requirements of the finished product for white or yellow, as specified elsewhere in this specification.

The prime pigment for white paint shall be titanium dioxide conforming to ASTM D 476, Type IV, with a minimum titanium dioxide content of 94 percent and shall be used at a minimum rate of 1 pound per gallon.

The prime pigment for yellow paint shall be a non-toxic organic pigment yellow, No. 75 or equal pre-approved by the Authority laboratory, with excellent exterior and color permanence. The prime pigment shall also contain a minimum 0.2 pounds per gallon of titanium dioxide conforming to ASTM D 476, Type IV, 94 percent purity.

The percent pigment by weight of the finished product shall not be less than 60 nor more than 62 percent.

(3) Vehicle.

The non-volatile vehicle shall not be less than 42 percent by weight, and shall be pre-approved by the Authority Laboratory and meet the dry through (early washout) requirements specified hereinafter.

(4) Physical Properties.

(a) Color.

The color shall match FED-STD-595B, No. 33538 for yellow and No. 37886 for white.

(b) Organic Volatiles.

The volatile organic content (VOC) of the finished paint shall contain less than 2 pounds per gallon of volatile organic matter of total non-volatile paint material as required by NJSA 7:27-23.

(c) Volume of Solids.

The finished paint shall not be less than 61 percent solids by volume.

(d) Total Solids.

The finished paint shall not be less than 77.5 percent total non-volatiles by weight, when tested according to ASTM D 2369.

(e) Weight.

The weight of the finished paint shall be 14 ± 0.2 pounds per gallon for each color.

(f) Grind.

The grind shall not be less than 2 Hegman when tested in accordance with ASTM D 1210.

(g) Field No-Tracking Time.

The paint shall dry to a no-tracking condition under traffic in 120 seconds maximum when the ambient temperature is 77 °F, and when applied in a wet film thickness of 15 ± 1 mil, at 140 °F, and with 12 pounds per gallon of glass beads for latex traffic paint conforming to Subsection 913.05(D).

(h) Viscosity.

The consistency of the paint shall be not less than 70 nor more than 95 Krebs Units at 77 °F, when tested according to ASTM D 562.

(i) Flexibility.

The paint shall show no cracking or flaking when tested according to ASTM D 522.

(j) Dry Opacity.

The minimum contrast ratio shall be 0.95 when tested according to ASTM D 2805.

(k) Daylight Reflectance.

The daylight directional reflectance shall not be less than 85 percent for the white paint and not less than 54 percent for the yellow (relative to magnesium oxide), when tested according to ASTM E 1347.

(l) Abrasion Resistance.

The abrasion resistance shall be such that no less than 55 gallons of sand shall be required for removal of the paint film when tested according to ASTM D 968.

(m) Dilution Test.

The paint shall be capable of dilution with water at all levels without curdling or precipitation such that the wet paint can be readily cleaned up with only water.

(n) Dry Through (Early Washout).

The "dry through" time of a 15 mil wet film placed immediately in a humidity chamber maintained at 72.5 ± 2.5 °F and 90 ± 5 percent relative humidity shall be less than or equal to the Authority Laboratory reference film when tested according to ASTM D 1640, except that the pressure exerted shall be the minimum needed to maintain contact with the thumb and film.

(o) Shelf Life.

All paint furnished shall have a minimum shelf life of nine months at temperatures above 35 °F. When tested, the paint shall conform to the physical requirements specified herein. In addition, the paint shall show no skinning, gelling or hardening on the surface, nor hard settling upon storage in the sealed containers, that will affect the performance of the product.

(p) Packaging.

The paint shall be packaged in 5-gallon kits or 55-gallon drums, complying with the Code of Federal Regulations, Revised 1-70. The 5-gallon kits shall be new metal, 37A80, "Single Trip Container" Lug Type, 24 gauge thick steel for both body and head sheet. The 55-gallon drums shall be new metal, 17H, 18 gauge thick metal for body and bottom head sheet, and have welded side seams. The drums shall be of the open end type. All containers, after being filled, shall be closed with tight fitting covers that will ensure leak-proof seals. The removable top head sheet thickness shall be 14 gauge; 16 gauge is authorized provided there are one or more corrugations in the cover near the periphery.

The 5-gallon kits and the 55-gallon drums shall be coated on the inside of the body and head sheets with a lacquer type rust inhibiting coating, free of pin holes, scratches, or other defects that may allow contamination of the paint from corrosion of the container.

The label or stencil shall show the name of the manufacturer, a designation of the contents, the lot or batch number, the date of manufacture, and the volumetric contents in liters. All containers

shall be labeled according to the current code of Federal Regulations and shall contain all information necessary to comply with NJSA 34:5A-1, NJ Worker and Community Right to Know Act.

(5) Inspection and Testing.

The manufacturer shall provide access for the representative of the Authority's independent testing laboratory to obtain two one-quart production samples of the paint for each production batch. Each sample shall be accompanied by an analysis report showing compliance with specification requirements for the following physical tests:

(a) Viscosity.

(b) Weight per gallon.

(c) Grind.

Testing shall be performed on production batches by the manufacturer and witnessed by the representative of the laboratory or Authority. Compliance with the above requirements must be met before batches are sampled for testing by the Authority Laboratory.

The Authority also reserves the right to randomly sample raw materials during the manufacturing process.

Only Authority approved material conforming to all the requirements of this specification shall be shipped. Any specification deviation will result in rejection of the entire batch. Paint not approved, but shipped, shall be picked up entirely at the manufacturer's expense.

(B) EPOXY RESIN.

Epoxy resin compound shall be specifically formulated for use as a long-life pavement striping material and for hot-spray application at elevated temperatures. The types and amounts of epoxy resins and curing agents shall be at the discretion of the manufacturer, provided that the physical properties and composition specified in this Subsection are satisfied.

Long-life epoxy resin traffic stripes placed on the Project with material that fails to comply with the following requirements shall be removed and replaced according to Subsection 516.03(G).

(1) Physical Properties of the Mixed Compound.

(a) Samples.

All samples shall be mixed at the ratio specified by the manufacturer and tested at an ambient temperature of 73 ± 5 °F unless otherwise specified.

(b) Color.

The white and yellow epoxy resin compound, when applied in a wet film thickness of 20 ± 1 mil and allowed to cure, shall meet the following initial color requirements:

Color	1		2		3		4		Reflectance Limits Y (%)	
	x	y	x	y	x	y	x	y	Min.	Max.
White	0.302	0.344	0.325	0.344	0.302	0.320	0.325	0.320	80.0	
Yellow	0.5425	0.4718	0.4752	0.4718	0.5425	0.4245	0.4752	0.4245	50.0	60.0

The black epoxy resin compound, when applied in a wet film thickness of 20 ± 1 mils and allowed to cure, shall match color chip No. 37038 of FED-STD-595B.

(c) Yellowness Index.

When tested according to ASTM D 1925-95 (with glass beads), the white epoxy resin should exhibit the following color stability:

Maximum Yellowness Index before QUV: 10.00

Maximum Yellowness Index after 72 hours QUV: 20.00

(d) Directional Reflectance.

The white epoxy resin compound (without glass beads) shall have a daylight directional reflectance of not less than 80 percent relative to a magnesium oxide standard when tested according to ASTM E 1347.

The yellow epoxy resin compound (without glass beads) shall have a daylight directional reflectance of not less than 50 percent relative to a magnesium oxide standard when tested according to ASTM E 1347.

(e) Drying Time.

The epoxy resin compounds, when mixed in the proper ratio and applied according to the thickness requirements specified above and immediately dressed with glass beads at the rates specified in Subsection 516.04(C), shall exhibit a no-track drying time of 15 minutes or less when tested according to ASTM D 711.

(f) Abrasion Resistance.

When the epoxy resin material is tested according to ASTM C 501 with a CS-17 wheel under a load of 1,000 grams for 1,000 cycles, the abrasive wear index shall be no greater than 80. The abrasive wear index is the weight in milligrams that is abraded from the sample under the specified test conditions.

(g) Hardness.

After the epoxy resin material has cured for not less than 72 hours and not more than 96 hours at 70 °F, Shore D hardness of the material shall be not less than 75 nor more than 100 when tested according to ASTM D 2240.

(2) Epoxy Composition.

Black epoxy resin is to be applied with black aggregate to remove any sheen.

The epoxy resin material shall be a two-component (Component A and Component B), 100 percent solids type system formulated and designed to provide a simple volumetric mixing ratio (e.g., two volumes of Component A to one volume of Component B) according to the following:

Pigment Composition	Percent By Weight	
	Minimum	Maximum
White:		
Titanium Dioxide Rustile (94% minimum purity) (ASTM D 476, Type III)	18.0	25.0
Epoxy Resin	75.0	82.0
Yellow:		
Organic Non-Lead Yellow	7.0	8.0
Epoxy Resin	77.0	79.0
Titanium Dioxide (ASTM D 476, Type III)	14.0	17.0
Black:		
Epoxy Resin	79%	
Black Pigment	21%	

The entire pigment composition shall consist of titanium dioxide. No extender pigments shall be permitted, except in non-lead formula.

The epoxy resin shall be as follows:

(a) Epoxy Content (Component A).

The epoxy content of the epoxy resin shall be tested according to ASTM D 1652 and calculated as the weight per epoxy equivalent (WPE) for white, yellow and black. The epoxy content shall be determined on a pigment free basis and shall meet the target value provided by the

manufacturer's certification and approved by the Authority. A tolerance of plus or minus 50 will be applied to the target value to establish the acceptance range.

(b) Amine Value (Component B).

The amine value of the curing agent shall be determined according to ASTM D 2074. The total amine value shall meet a target value provided by the manufacturer and approved by the Authority. A tolerance of plus or minus 50 will be applied to the target value to establish the acceptance range. If the manufacturer specifies an alternate test method for determining the amine value, the alternate shall be subject to approval by the Authority's Bureau of Materials.

(c) Toxicity.

Upon heating to application temperature, the material shall not exude fumes that are toxic or injurious to persons or property.

(3) Sampling and Certified Analysis.

The epoxy manufacturer shall furnish certified test results that each batch of epoxy resin material used on the Project complies with these specifications. In addition, all epoxy components shall be pre-approved for use on the Project. Samples of the epoxy components shall be submitted to the Authority Laboratory at least 30 days before the needed approval date.

To verify that the epoxy resin material subsequently used on the Project is of an identical formulation as those pre-approved, epoxy components shall be sampled at the Project and submitted to the Authority Laboratory. These sample components shall match their respective infrared spectrums in the pre-approved file in the Authority Laboratory.

(4) Containers and Shipment.

The epoxy resin material shall be shipped in appropriate containers supplied by the Contractor and shall be plainly marked with the following information:

Manufacturer's Name and Address.

(a) Name of Product.

(b) Lot/Batch Number.

(c) Color.

(d) Net Weight and Volume of Contents.

(e) Date of Manufacture.

(f) Date of Expiration.

(g) Statement of Contents (As Appropriate):

Component A - Pigment and Epoxy Resin.

Component B - Catalyst.

(h) Mixing Proportions and Instructions.

(i) Safety Information.

(C) THERMOPLASTIC.

Thermoplastic for long-life traffic markings shall be of either preformed or hot extruded material. The thermoplastic shall conform to the requirements of AASHTO M 249, except as follows:

(1) Preformed material shall be 90 mils thick and conform to only those portions of AASHTO M 249 not associated with material in a liquid state.

(2) For white, the composition of the mixture shall be as follows:

Component	Percent by weight
Resin/Binder	22-26 percent minimum
Glass Beads (pre-mix)	30 percent minimum
White Pigment	10 percent minimum

Component	Percent by weight
Calcium Carbonate and Inert Fillers (shall not contain silica other than as glass beads)	34-38 percent maximum

(3) For yellow non-lead formulas, the composition of the mixture shall be as follows:

Component	Percent by weight
Resin/Binder	22-26 percent minimum
Glass Beads (pre-mix)	30 percent minimum
Yellow Pigment	2 percent minimum
Calcium Carbonate and Inert Fillers (shall not contain silica other than as glass beads)	42-46 percent maximum

The yellow material's combined totals of lead, cadmium, mercury, and hexavalent chromium shall not exceed 100 parts per million.

The thermoplastic manufacturer shall certify, according to Subsection 105.04, that the material will meet the requirements specified.

(D) GLASS BEADS.

Glass beads for Epoxy Resin Contrast Stripes shall meet the following requirements:

The large glass beads shall be from an approved supplier as listed on the QPL. Drop rates to be 8 lbs. per gallon or as directed by the manufacturer.

The small glass beads shall conform to the AASHTO M-247 Type 1 Specification. Drop rates to be 8 lbs. per gallon or as directed by the manufacturer.

Glass beads required for other uses shall be as listed in the remaining portions of this subparagraph.

All glass beads shall be transparent, clean, colorless glass which are smooth and spherically shaped and free of milkiness, pits, or air bubbles. All glass beads shall conform to the following when tested according to Subsection 990.10 and with other appropriate methods:

(1) Spherical Particles (Rounds).

Glass beads shall contain a minimum of 80 percent rounds per screen for the two highest sieve quantities. There shall be no more than 3 percent sharp angular particles per screen. The remaining sieve fractions shall contain not less than 75 percent rounds.

(a) Gradation.

The beads shall meet the specified grading requirements for the following pavement stripe or marking materials when tested according to ASTM D 1214:

(1) Traffic Paint.

6 mil Thickness	
Sieve Size	**Percent Retained by weight**
No. 16	0
No. 20	0 - 2
No. 30	5 - 28
No. 50	35 – 65
No. 100	15 - 40
Pan	0 - 5

6 mil Thickness	
Sieve Size	**Percent Retained by weight**
No. 12	0
No. 14	0 - 5

6 mil Thickness	
Sieve Size	**Percent Retained by weight**
No. 16	5 - 20
No. 18	40-80
No. 20	10-40
No. 25	0 - 5
Pan	0-2

(2) Epoxy Resin.

Large Beads	
Sieve Size	**Percent Retained by weight**
No. 10	0
No. 12	0 - 5
No. 14	5 - 20
No. 16	40-80
No. 18	10-40
No. 20	0 - 5
Pan	0-2

Small Beads	
Sieve Size	**Percent Retained by weight**
No. 20	0 - 5
No. 30	5 - 20
No. 50	30 - 75
No. 80	9-32
No. 100	0 - 5
Pan	0-2

(3) Thermoplastic.

Sieve Size	Percent Retained by weight
No. 20	0 - 5
No. 30	5 - 20
No. 50	30 - 75
No. 80	9-32
No. 100	0 - 5
Pan	0-2

(4) Coating.

The beads shall be coated with a silane adherence coating meeting the requirements of Subsection 990.06, except that pre-mix beads for thermoplastic shall be uncoated and conform to AASHTO M 247, Type 1. Drop-on beads for thermoplastic shall also be moisture resistant coated.

(5) Index of Refraction.

The beads, when tested by the liquid immersion method, shall show an index of refraction within the range of 1.50 to 1.52.

(6) Chemical Stability.

Beads that show any tendency toward decomposition, including surface etching, when exposed to atmospheric conditions, moisture, dilute acids or alkalines, or paint film constituents, shall be rejected.

(7) Packaging.

The beads shall be packaged in 50-pound moisture-resistant bags conforming to the packaging and marking requirements of AASHTO M 247.

(E) Pliant, Polymer Rubber Marking Materials.

Pliant, Polymer Rubber Marking Materials, when used, shall be from an approved supplier as listed on the QPL.

(F) Black Paint.

Black Paint for obscuring striping shall be from an approved supplier as listed on the QPL and shall be non-reflective and abrasion and weather resistant

913.05 Aluminum-Pigmented Alkaline-Resistant Bituminous Paint.

Aluminum-pigmented alkaline-resistant bituminous paint shall conform to Military Specification MIL-P-6883.

913.06 Coal Tar Epoxy Coating.

Coal tar epoxy coating shall be a two-component, coal tar epoxy-polyamide paint (black) conforming to SSPC-Paint 16 and the requirements of Federal Specification FS QPL 24441.

913.07 Bituminous Paint.

Bituminous paint shall consist of a final color coating for bituminous treated surfaces. The green paint shall be formulated with 100% pure acrylic vehicle, pigmented with chromium oxide, for the express purpose of applying a tough, durable, weather resistant coating to bituminous surfaces.

913.08 Concrete Coloring.

Coloring for precast concrete noise barriers shall be from an approved supplier as listed on the QPL and in accordance with the specifications as set forth in Subsection 425.02.

913.09 Penetrating Stain.

Penetrating stain for precast concrete noise barriers shall be from an approved supplier as listed on the QPL and in accordance with the specifications as set forth in Subsection 425.02.

SECTION 914 - FENCE

914.01 Chain Link Fence.

Chain link fence and gates shall be fabricated in accordance with the requirements of AASHTO M181 with the following additions or modifications:

(A) Fence Fabric.

Fence Fabric shall be composed of either aluminum coated steel wire, Type II or polyvinyl chloride (PVC) coated steel wire, Type IV, woven into a 2-inch mesh and the wire shall be No. 9 gage (0.148 inch) before coating.

PVC coated steel wire shall be dark green in color and the shade shall be subject to the approval of the Engineer.

(B) Line and End/Corner Fence Post Sections.

Line and End /Corner Fence Posts shall be galvanized steel shapes conforming to the requirements of ASTM F1043. Line posts shall be either Group IC with a minimum yield strength of 50,000 psi, 2 ⅜ inch diameter standard "Round Steel Pipe" posts, 3.12 lb/ft ; or Group II with a minimum yield strength of 50,000 psi, 1 ⅞ inch standard "C"-shaped posts, 2.4 lb/ft; or Group III with a minimum yield strength of 50,000 psi; or 2 ¼ inch standard "H"- shaped posts, 3.26 lb/ft. End/Corner posts shall be Group IA with a

minimum yield strength of 83,000 psi, 2 ⅞ inch diameter standard "Round Steel Pipe" posts, 5.80 lb/ft.

(C) Brace Rail Sections.

Brace Rail Sections shall be galvanized (1.8 oz./ft² – zinc coating, per ASTM F1083) steel pipe conforming to the requirements of ASTM F1043, Group 1A. Brace rail posts shall be 1 ⅝ inch outside diameter round pipe, 2.27 lbs/ft.

(D) Tension Wire.

Tension Wire shall be aluminum-coated steel wire with a minimum tensile strength of 80,000 psi. The aluminum coating shall be an aluminum alloy applied at the rate of not less than 0.40 oz. per square foot of uncoated wire surface.

(E) Wire Fabric Ties.

Wire Fabric Ties shall be aluminum-coated ductile steel wire. The aluminum coating shall be an aluminum alloy applied at the rate of not less than 0.40 oz. per square foot of uncoated wire surface.

(F) Wire Fabric Ties.

Barbed Wire shall be Type I, aluminum-coated steel barbed wire conforming to the requirements of ASTM A585.

(G) Caps.

Caps shall be provided at the tops of all circular posts and shall be made to provide a drive fit over the outside of the section to exclude moisture. Caps shall not be furnished for H-shaped sections. When barbed wire is required to be installed along the top of fence, extension arms shall be provided with means for passing the barbed wire strands.

(H) Nuts.

Nuts upon installation shall be made vandal-resistant by burring the exposed bolt threads.

(I) Drive Anchors.

Drive Anchors for H-beam line posts shall be fabricated from steel bars and pressed steel, of the type and size shown on the Plans, and shall be hot dip galvanized in accordance with the requirements of ASTM A123.

(J) Gates.

Gates shall be equipped with approved latches, stops, suitable locking devices, and satisfactory provision for padlocking. Means shall be provided for securing and supporting the free ends of vehicular gates in the open position. Fabric used in the fabrication of the gates shall be of the same type and height as that of the fence within which the gate is installed. Hinges shall be of the pivot type, heavy and strong, with large bearing surfaces for clamping onto the posts, or equal. Hinges shall not twist or turn under the action of the gate, and shall be so arranged that a closed gate cannot be lifted off its hinges to obtain entry. Vehicular gates shall be capable of being operated easily by one person and shall be full 180-degree-opening swing type.

(K) Locks.

Locks for both vehicular and pedestrian gates shall be an approved padlock type suitable for outdoor use.

(L) Concrete.

Concrete for footings shall be Class D.

914.02 Farm Field Fence.

Farm field fence shall be in accordance with the following:

(A) Fabric.

Fabric for farm fence shall be of No. 9 gage (0.148 inch) galvanized steel wire, conforming to ASTM A116, for No. 9 Farm Fence, Design No. 1155-12-9, Class 3 zinc coating. Wire spacings shall be as shown on the Plans. Vertical stays at each horizontal wire shall be joined by the Hinge-Joint method consisting of not less than 1-1/2 twists tightly wrapped.

(B) Posts, Braces and Gate Frames.

Posts, Braces and Gate Frames shall be hot-dipped galvanized standard weight steel pipe, Schedule No. 40, of the sizes called for on the Plans, conforming to the requirements of ASTM A53. Line posts and anchor plates and diagonal braces for gates shall be of good commercial quality steel, hot-dipped galvanized as specified above for pipe posts and braces, and shall be of the weights called for on the Plans. Pipe posts shall have heavy malleable iron caps made to provide a drive fit over the outside of the pipe to exclude moisture.

(C) Fastenings.

Fastenings to secure the fabric to the posts shall be either No. 9 gage galvanized tie wire complying with the requirements for wire for the fencing, or galvanized steel clamps of the manufacturer's standard design.

(D) Fittings and Hardware.

Fittings and Hardware necessary to make a complete installation shall be rolled steel, pressed steel, forged steel, cast steel, malleable iron, or aluminum.

Drive anchors shall conform to the requirements of 914.01.

(E) Galvanizing.

All ferrous materials composing the complete fence installation shall be hot-dipped galvanized in accordance with ASTM A53 or A123, as applicable. Wherever possible, galvanizing shall take place after fabrication.

(F) Concrete Footings.

Concrete for footings shall be Class D.

Section 915 – Beam Guide Rail

915.01 Rail Element.

Rail elements shall be 12 gauge steel.

For galvanized beam guide rail, fabricate the rail element, including rounded end sections and buffer end sections, according to AASHTO M 180, Class A, Type I in Table 2. Ensure that the weight of the zinc coating conforms to AASHTO M 180, Type I in Table 1.

For weathering steel beam guide rail, fabricate the rail element, including rounded end sections and buffer end sections, shall be high strength, low-alloy weathering steel conforming to the requirements of ASTM A 709, Grade 50W and AASHTO M 180, Type IV, Class A.

915.02 Posts and Recycled/Synthetic Blockouts.

For galvanized steel posts, use structural steel conforming to ASTM A 709, Grade 36, that is galvanized according to ASTM A 123.

For weathering steel posts shall be fabricated of high strength, low-alloy structural, weathering steel conforming to the requirements of current ASTM A 709, Grade 50W. The bottom 4'-2" of the six (6) foot guide rail posts and bottom 6'-2" of the eight (8) foot guide rail posts shall be galvanized in accordance with AASHTO M 111.

Timber posts for end terminals shall conform to Subsection 910.05.

Use recycled/synthetic routed blockouts that are NCHRP 350 tested, test level 3 (TL-3), approved. Ensure that the name of the manufacturer and model number are stamped on each blockout and that the blockouts are of the same material and dimensions as the spacers that were NCHRP tested.

915.03 Miscellaneous Hardware.

(A) For galvanized beam guide rail, ensure that connections or splices, nuts, bolts, washers, and plates conform to AASHTO M 180, except as follows:

(1) If high-strength bolts are shown on the Plans for bridge guide rail, use high-strength bolts, nuts, and washers conforming to ASTM A 325, Type I, and galvanized according to ASTM A 153.

(2) For base plate assemblies on bridge guide rail, use an adhesive anchor system with galvanized bolts as specified in 909.02(F) or galvanized anchor bolts, nuts, and washers as specified in 909.02(E).

(3) Use plates for beam guide rail on bridges conforming to ASTM A 36 and galvanized according to ASTM A 123.

(B) For weathering steel beam guide rail, ensure that connections or splices, nuts, bolts, washers, and plates conform to AASHTO M 180, except as follows:

(1) Nuts for beam guide rail end treatment shall conform to ASTM A 563, Grade A.

(2) Plates and rods for guide rail end treatment shall be structural steel conforming to ASTM A 36 and galvanized according to AASHTO M 111.

(3) Bolts, nuts, and washers for bridge guide rail, excluding base plate anchor bolts, shall conform to or exceed the requirements of ASTM A 307 unless otherwise designated as high-strength on the Plans. High-strength bolts, nuts, and washers shall conform to AASHTO M 164, Type I (ASTM A/325/ 325M, Type I) or ASTM A 449/A 449M. Anchor bolts, nuts, and washers for base plate assemblies on bridge guide rail shall conform to or exceed the requirements of AASHTO M 164, Type I (ASTM A/325/ 325M, Type I). Structural steel plates for guide rail on bridges shall conform to AASHTO M 183/M 183M (ASTM A/36/ A36M).

(4) Bolts and nuts may be mechanically galvanized according to AASHTO M 298, Class 50, Type 1.

915.04 Sampling and Testing.

Samples and rate of sampling taken by the Engineer will be in accordance with AASHTO M180.

915.05 Rub Rail.

For galvanized beam guide rail, rub rail shall be steel channels or bent plate of structural steel conforming to ASTM A 36 and galvanized according to ASTM A 123.

For weathering steel beam guide rail, rub rail shall be steel channels or bent plate fabricated of high strength, low-alloy weathering structural steel conforming to the requirements of current ASTM A 709, Grade 50W.

SECTION 916 - MASONRY UNITS

916.01 Concrete Blocks.

Concrete blocks for inlets and manholes shall meet the following requirements:

Each block shall have a compressive strength of not less than 4,500 pounds per square inch (PSI) when tested in accordance with the ASTM-C140.

The water absorption after 24 hours immersion in water shall not exceed 5.0% for each block when tested in accordance with ASTM-C 67.

The resistance to freeze thaw shall meet the requirements of ASTM-C666 after 300 cycles for each block. After 300 cycles of freeze/thaw, specimens shall have no breakage, and no greater than 1.0% loss in dry weight of any individual unit.

The rapid chloride permeability shall not exceed 1000 coulombs for each block when tested in accordance with AASHTO T277.

The total air content shall be 4% to 6% when tested in accordance with ASTM-C 642.

Pozzalains, in amounts not to exceed 5% by weight of the cement, may be used to meet the above requirements.

Prior to start of manufacture for the block, a design mix which names the source of each component shall be submitted to the Engineer for approval. The mix design shall include test results, performed by a laboratory employed by the contractor, of a trial batch meeting the requirements stated herein. The laboratory used by the contractor shall be AASHTO Accredited for performing concrete testing and shall be approved in advance by the Engineer. Whenever a component in the mix or a supplier of an ingredient changes, a new mix design, with test results shall be submitted to the Engineer for approval prior to the start of manufacture.

Certification shall be submitted, in accordance with Subsection 105.04, verifying that the concrete blocks meet the requirements stated herein.

The following is added to the beginning of the second paragraph:

The blocks shall be solid precast segmental concrete masonry units. Portland cement Type I conforming to ASTM-C 150 shall be used. Other materials shall conform to the following subsections:

AGGREGATES FOR PORTLAND CEMENT, MORTAR, AND GROUT 905.02

WATER 905.04

916.02 Brick Masonry Units.

Brick masonry units shall conform to the following:

Clay or Shale Brick shall be solid conforming to the requirements of ASTM C32, Grade SM, and shall be new, whole, of best quality and of a standard brand and manufacturer.

916.03 Precast Reinforced Concrete Manhole Sections.

Precast reinforced concrete manhole sections shall conform to the requirements of ASTM C478.

916.04 Precast Concrete Underground Utility Structures.

Precast concrete underground utility structures shall conform to the requirements of ASTM C858.

916.05 Ladder Rungs.

Ladder rungs for manholes and inlets shall conform to ASTM C478 and shall be of a skid resistant design and skid resistant surface. Ladder rungs shall be steel or steel encased in accordance with the following.

Steel ladder rungs shall be galvanized in accordance with ASTM A123. Ladder rungs may also be composed of a steel reinforcing bar encased in plastic or rubber, pressure-molded to the steel with a cross sectional dimension of at least one inch. The reinforcing shall be continuous through the entire length of the legs and tread.

Plastic encasement shall be a copolymer polypropylene meeting the requirements of ASTM D4101.

Rubber compound shall meet the physical requirements of ASTM C443 except the durometer, Shore A, hardness shall be 70, $\pm$5.

Plastic or rubber coated steel ladder rungs shall be from an approved supplier as listed on the QPL.

SECTION 917 - PIPE

917.01 General.

Pipes shall be of the kinds and sizes shown on the Plans. The prescribed sizes of pipes are inside diameters. The pipe shall be inspected and approved before being shipped. Culls, damaged or defective pipe shall not be placed in the Project. Used pipe shall not be placed in the Project except where the Plans, Specifications, or the Engineer may require the relaying of existing drains.

917.02 Reinforced Concrete Pipe.

(A) CIRCULAR PIPE.

Circular Pipe shall conform to the requirements of ASTM C76. Except where Class IV or Class V pipe is specifically called for, all circular reinforced concrete pipe shall be Class III. At the Contractor's option, Type B or Type C wall may be used.

The Contractor will be permitted, subject to the approval of the Engineer, to submit modified or special designs of pipes in accordance with the requirements of ASTM C76.

(B) ELLIPTICAL PIPE.

Elliptical Pipe shall conform to the applicable provisions of ASTM C507, of the Class designated on the Plans.

(C) ARCH PIPE.

Arch Pipe shall conform to the requirements of ASTM C506, of the Class designated on the Plans.

(D) Lifting Holes.

Lifting holes will not be permitted in reinforced concrete pipe having a diameter less than 36 inches.

(E) Flared End Sections.

Flared End Sections for reinforced concrete pipe shall conform to the requirements of ASTM C76 for the class and wall type of the connecting circular reinforced concrete pipe and shall be of the dimensions shown on the Plans.

917.03 Ductile Iron Pipe.

Ductile iron pipe for culverts shall conform to ANSI A21.51 with push-on joints. Thickness class will be as shown on the Plans.

917.04 Underdrains.

Unless otherwise specified, pipe for underdrain shall be either perforated non-reinforced concrete pipe, semi-circular metal pipe with top corrugated metal shield, perforated corrugated metal pipe, or high density polyethylene (HDPE) pipe at the Contractor's option.

(A) Perforated Non-Reinforced Concrete Pipe.

Perforated Non-Reinforced Concrete Pipe shall conform to the requirements of AASHTO M175, Type 1, and all applicable requirements of AASHTO M86 for standard strength pipe (Table 1).

(B) Semi-Circular Metal Pipe.

Semi-Circular Metal Pipe (with top corrugated metal shield) shall be from an approved supplier as listed on the QPL. Pipe and shield shall be hot-dip galvanized and conform with the requirements of AASHTO M36, Type IIIA.

(C) Perforated Corrugated Metal Pipe.

Perforated Corrugated Metal Pipe shall conform to the requirements of AASHTO M36, Type III.

(D) Not Used.

(E) High Density Polyethylene (HDPE) Pipe.

Perforated High Density Polyethylene (HDPE) Pipe shall conform to the requirements of AASHTO M294, Type S.

(F) Outlet Pipe.

Outlet pipe for all types of underdrains shall be corrugated metal pipe conforming to the requirements of AASHTO M36, Type I.

(G) Elbows or Tees.

Elbows or tees for connecting underdrains to drainage structures shall be of the same type as the respective underdrain pipe and the joint shall meet with the Engineer's approval.

917.05 Corrugated Metal Pipe.

(A) Circular Pipe.

Circular Pipe shall conform to the requirements of AASHTO M36 for Type I and shall be joined with 12 inch connecting bands.

Unless otherwise prescribed in the Supplementary Specifications, the minimum sheet thickness for the various pipe diameters shall be as follows:

Nominal Diameter of Pipe	Sheet Thickness
8" through 24" inclusive	16 gage (.064")
30" and 36"	14 gage (.079")
42" through 54" inclusive	12 gage (.109")

Nominal Diameter of Pipe	Sheet Thickness
60" and 72"	10 gage (.138")
84"	8 gage (.168")

(B) Pipe Arch.

Pipe Arch shall conform to the requirements of AASHTO M36 for Type II.

The minimum sheet thickness for the various pipe arch sizes shall be as follows:

Pipe Arch Size		Pipe Arch Size	
Span x Rise (inches)	Sheet Thickness	Span x Rise (inches)	Sheet Thickness
18 x 11	16 gage	50 x 31	12 gage
22 x 13	16 gage	58 x 36	12 gage
25 x 16	16 gage	65 x 40	12 gage
29 x 18	14 gage	72 x 44	10 gage
36 x 22	14 gage	79 x 49	8 gage
43 x 27	14 gage	85 x 54	8 gage

(C) Flared End Sections.

Flared End Sections for corrugated metal pipe shall be fabricated from materials conforming to the requirements of AASHTO M36 for base metal, galvanized coating, rivets, riveting, sampling, sheet manufacturer's certified analysis and guarantee. Sheet thickness shall be the same as for the pipe to which it is connected. They shall be suitable for connecting to corresponding diameters of corrugated metal pipe and shall be of a shape similar to corresponding diameters of corrugated metal pipe as detailed on the Plans. Each completed unit shall show careful, finished workmanship, free of all irregularities.

(D) Circular Pipe Half Sections.

Circular Pipe Half Sections shall be fabricated from corrugated steel culvert pipe galvanized, conforming to AASHTO M36 for Type I, 12 gauge (.109 inch) thick.

917.06 Fiberglass Pipe.

Fiberglass pipe will conform to ASTM D2996 Designation Code RTRP-12EA1-2122. Fiberglass fittings conform to ASTM D3840. Fiberglass pipe and fittings will be pigmented resin 100% throughout the wall and UV stabilized resin. Exterior paint or coatings are not permitted. The finished color shall be concrete gray unless otherwise specified on the plans or as directed by the Engineer. The color shall be a Federal Standard 5985C Color designation.

917.07 Plastic Drainage Pipe.

Plastic drainage pipe for underdrains shall be corrugated polyethylene drainage tubing conforming to AASHTO M252.

Polyvinyl chloride (PVC) drainage pipe shall conform to ASTM D2729.

917.08 High Density Polyethylene (HDPE) Pipe.

Corrugated HDPE drainage pipe shall conform to AASHTO M 294, and is Type S (smooth interior with annular corrugations), with gasketed silt-tight joints. Submit a certification of compliance, as specified in 105.04 for HDPE pipe.

917.09 Pipe Joint Patch Material.

Pipe joint patch material shall be from an approved supplier as listed on the QPL and in accordance with Subsection 502.02.

SECTION 918 - ELECTRICAL MATERIALS

918.01 General.

Materials, equipment, appliances, and workmanship shall be of the best quality and free from all defects. Any materials not specifically covered in these Specifications shall be in accordance with the accepted standards, and as directed by the Engineer. During the progress of the work, any materials, appliances, or installations which may be deemed defective, damaged, or otherwise unsatisfactory by the Engineer shall be removed and replaced or repaired in an approved manner at no additional cost to the Authority.

Equipment specified in the Plans by manufacturer name and model or catalog number shall, in addition to the specific requirements stated therein, also meet the specifications published by the stated manufacturer to the extent the manufacturer's specifications expand upon or exceed these Plans and Specifications.

All electrical materials and equipment for which there are established Underwriters' Laboratories, Inc. (UL) standards shall bear the UL label.

All materials and equipment forming part of any assembly shall be new and subject to the approval of the Engineer. Materials, components and equipment approved by the Engineer which appear defective when received or which may have become damaged in any manner, shall not be used until retested and re-approved. Manufacturer's certifications or certified copies of reports of tests shall be furnished as directed by the Engineer.

The sources of supply of each of the equipment items to be incorporated into an assembly shall be subject to approval by the Engineer. Work performed and materials, components, and equipment furnished which do not conform to the requirements of these Specifications will be rejected and shall be removed and replaced, as the Engineer may direct, at the Contractor's expense.

All Electrical Materials shall be selected from those listed on the Qualified Products List (QPL) and must be compatible with the installation as shown on the Standard Drawings.

918.02 Bonding and Grounding Devices.

Bonding and grounding devices shall include the following materials:

(A) GROUND RODS.

Ground Rods shall be 3/4 inch in diameter and 10 feet long, composed of steel core with copper covering inseparably molten welded so that an interlocking crystalline union is secured between the two materials. The minimum thickness of the copper covering on the cylindrical portion of the rod shall average not less than 0.015 inch.

Each ground rod shall be equipped with a cast or extruded ground clamp consisting of high copper content or bronze body and silicon bronze hex head bolt.

(B) GROUND WIRE.

All grounding and bonding wires shall be green insulated conductors, unless bare are specified.

All ground wires, bare or insulated, shall be soft drawn or annealed and stranded copper conductors conforming to the requirements of ASTM B8. Concentric stranding shall be Class B.

Insulated ground wire shall be of uncoated copper conductor conforming to the requirements of ASTM B3 and shall be covered with an insulation that meets or exceeds the requirements of UL Type THW. Color coding shall be green.

Bare ground wire shall be of coated copper conductor conforming to the requirements of ASTM B33 for tin coated conductors.

(C) GROUNDING BUSHINGS.

Grounding Bushings for rigid metallic conduits shall be cast bronze and cast aluminum when used in conjunction with galvanized steel and aluminum conduit, respectively. All grounding bushings shall be insulated type utilizing a high quality Bakelite or other type of heat resistant plastic, with a minimum UL temperature rating of 150°C., molded and locked into the bushing. Grounding lugs shall be of the same material as the bushings. The set screws, lug mounting, and binding screws shall be silicon bronze or stainless steel.

(D) Grounding Hardware.

Ground wire terminal connections at the equipment shall be made by means of grounding studs or through bolts with nuts, lockwashers or locknuts, and approved type of ground lugs.

Where UFER grounding is shown on the plans, it shall be performed through exothermic weld.

918.03 Cabinets.

Cabinets for electrical equipment shall be of the types and sizes as indicated on the Plans and shall be fabricated as follows:

(A) Cast Construction.

Cast aluminum cabinets to be used for electric metering and/or distribution equipment shall be watertight and dust-tight cast aluminum in conformance with NEMA Type 3R construction.

The cabinets, conforming to the details shown on the Plans, shall be aluminum alloy permanent mold castings in accordance with ASTM B108 for alloy 356.0 and shall be provided with a single piece neoprene gasketed hinged door with cylinder tumbler lock and stainless steel key hole cover. The lock shall be Corbin Lock No. 0357SGS and shall be provided with three (3) keys. All hardware for the cabinets shall be stainless steel.

The meter cabinets shall be a minimum of 40" high, 15" wide and 16" deep. The electrical distribution cabinets shall be a minimum of 43" high, 29" wide, 15" deep and furnished with a 6" high cast aluminum base. All cabinets shall be provided with a 3/4" thick exterior plywood backboard. The backboards shall be for the full height and width of the cabinets and shall be painted with one coat of asphaltic paint on all sides.

The meter cabinets, where specified, shall be provided with an 8" high and 6" wide gasketed safety glass window to accommodate the meter reading without the need of opening for the door.

The electric distribution cabinets, where specified, shall be equipped with the required number and size louvers with insect screen backing.

(B) Sheet Metal Construction.

Sheet metal cabinets shall be fabricated from sheet steel (hot dipped galvanized, where specified), aluminum or stainless steel, painted where required, and shall conform to the specified NEMA type constructions, all as prescribed herein.

All sheet metal cabinets shall be fabricated in accordance with the details and dimensions shown on the Plans. The cabinet enclosures shall be constructed with continuously welded seams, reinforced with steel angles, channels or stiffener plates, as required, and shall be provided with hinged and gasketed door(s). A rolled or flanged lip shall be provided all around the door(s) and the enclosure opening, in order to increase strength of the cabinet and accommodate the installation of single piece neoprene door gasket(s). The door hinges shall be a set of heavy duty units or heavy gauge continuous hinges, brass or stainless steel, as approved. The door(s) shall be equipped with a three point vault type handle and a cylinder tumbler type lock, unless otherwise specified. Outdoor cabinets shall be provided with stainless steel key-hole covers. The lock shall be Corbin No. 0357SGS for electrical distribution equipment cabinets and locks for communications equipment cabinets will be a Corbin series as called for in the Supplementary Specifications. Each shall be provided with three (3) keys.

The electric distribution cabinets, where specified, shall be equipped with the required number and size louvers with insect screen backing.

The cabinets shall be provided with wall mounting bars welded to the back wall for mounting on concrete surfaces or structural members.

The roadway lighting control and distribution panels to be installed in the Utility Buildings shall be a minimum of 6'-9" high, 4'-0" wide, 1'-6", deep floor mounted and free standing cabinets fabricated from 10 gauge sheet steel, reinforced with steel angles, and divided into two sections for wiring and control/distribution compartments.

The wiring compartment of the panel shall have a screw on front cover for the access to wiring in the lower section of the cabinet. The screws shall be stainless steel and captive type.

The control and distribution panel compartment shall be dust-tight with framed overlapping gasketed doors for access to the equipment therein. The doors shall be hung on a substantial set of hinges and

equipped with a three point vault type handle and a cylinder tumbler type lock with a key, all as specified hereinbefore. Two removable 12 gauge flat steel inner plates attached to the cabinet with adjustable stainless steel rotating trim clamps shall be installed inside the control and distribution compartment with cutouts providing easy access to the circuit breaker and by-pass switch handles, all as approved by the Engineer. The removable inner plates shall provide access to the wiring and all equipment in the compartment. No electrical equipment shall be fastened to the removable inner cover plates.

The devices within the control and distribution panel enclosure shall be mounted on sheet steel or angle iron frames fastened to the back of the enclosures neatly arranged and located as shown on the Plans.

The roadway lighting control and distribution panel, including the removable inner cover plates, shall be painted inside and out in conformance with the following requirements.

(C) Painting Requirements.

Where shown on plans, the indoor cabinets fabricated from non-galvanized sheet steel and all outdoor cabinets fabricated from galvanized sheet steel shall be painted inside and out in accordance with System A as specified in Paragraph 913.01(B).

All indoor cabinets fabricated from sheet aluminum shall be painted inside and out in a similar manner as the galvanized sheet steel cabinets, as specified above. Degreasing and etching of aluminum surfaces, prior to painting, shall be in accordance with Paragraph 509.03(B).

(D) NEMA Construction Types.

The sheet steel or aluminum cabinets to be installed in indoor damp locations and for all outdoor installations shall be watertight and dust-tight, NEMA Type 3R.

The sheet steel or aluminum cabinets to be installed in indoor dry locations shall be general purpose, NEMA Type 1.

The stainless steel cabinets for indoor and outdoor applications shall be watertight, dust-tight and corrosion resistant, NEMA Type 3R or 4X as indicated on plans

(1) Anchorage.

The Contractor shall be responsible for the coordination of required anchorage layouts, as may be necessary to accommodate variations in proposed cabinets. Anchor bolt size, type and characteristics shall be as shown on the plans.

918.04 Cable Connectors.

Cable connectors shall be fused or non-fused, in-line, wye or through splice type with break-away or non-breakaway features as prescribed herein, and shall be furnished in a kit form complete with all required components.

The cable connectors shall be of watertight and submersible design with two or three piece housing units, each made of high dielectric EPDM rubber. Each end housing unit shall be provided with an appropriately sized or a universal size (cut-off type) cable entry to form a seal around the cable. The interior of the cable connector housing assembly shall be of sufficient size to accommodate the fuse holders, contacts, links or terminal blocks, as required.

(A) In-Line Connectors.

In-Line Connectors to be used on multiple lighting systems shall be of break-away type units rated at 600 Volts; fused type for use on phase cables and non-fused type on neutral cables.

The connector assemblies shall be composed of two piece housing units; line side and load side, both permanently marked. The interior arrangement of the housing shall receive and retain the copper fuse holders, links and contacts, as required.

The fuse holders and contacts shall be rated for a maximum current of 30 Amperes at 600 Volts and shall have a high conductivity. The fuse holders and contacts shall be suitable for safely gripping a cartridge type midget fuse in such manner that when the connector is opened the fuse will remain on the load side of the connector. The fuse shall be a non-glass type, 13/32 inch in diameter and 1-1/2 inches in length. The fuse ratings shall be as indicated on the Plans.

The in-line connectors to be used in conjunction with series lighting systems shall be of break-away type non-fused units rated at 5000 Volts and 100 Amperes. The connector units shall be composed of a line side

housing (receptacle), a load side housing (plug) and a copper female socket contact and male pin contact assembly. The cable connector shall conform to FAA Specification L-823.

(B) WYE CONNECTORS.

Wye Connectors to be used on multiple lighting systems shall be of break-away or non-breakaway type units rated at 600 Volts. The break-away connectors on phase cables shall be fused type. The break-away connector on neutral cables and all non-breakaway connectors shall be of non-fused type.

The breakaway type wye connector assemblies shall be composed of three piece housing units; line side, line side insert and load side. Construction of the connectors shall be similar to the in-line connectors except that the line side housings shall be equipped with two cable entries and the units shall be furnished with a tin plated terminal block with corrosion resistant terminal screws.

The non-breakaway type wye connector assemblies shall be composed of two piece housing units, line side and load side. Construction of the connector shall be similar to the break-away type wye connectors, except that the break-away components and fuse holders shall be omitted.

(C) THROUGH SPLICE CONNECTORS.

Through Splice Connectors to be used on multiple lighting and power distribution systems, 600 Volts maximum, shall be composed of two or three piece housing units, each equipped with a copper or tin plated terminal block or mechanical connector with corrosion resistant screws.

The through splice connectors shall be in-line, 3-wire tap or 4-wire tap types, as required.

918.05 Cable Ducts.

The ducts for the preassembled duct and multiple lighting cable assembly shall be made from medium density polyethylene compound with tensile strength 2500 psi (min.), conforming to the requirements of ASTM D1248. The ducts shall be flexible enough for easy coiling and uncoiling at -10°C., but sturdy enough to maintain its cross section and shall be suitable for direct burial installations without additional protection. The ducts shall conform to NEMA Specification TC-7. Unless otherwise specified on the Plans, all ducts shall be 3 inch diameter.

The ducts shall be constructed by means of extruding the duct over the preassembled cables, conforming to the number and sizes as indicated on the Plans. The multiple lighting cables, including neutrals, shall be single conductor, stranded copper, insulated and jacketed cables in conformance with Subsection 918.07.

918.06 Cable Racks.

Cable racks may be of metallic or nonmetallic construction.

(A) METALLIC CABLE RACK.

Metallic Cable Rack shall consist of a steel channel, welded steel supports, a locking clip, and porcelain insulator(s) on each support. All steel components shall be hot-dipped galvanized in accordance with Subsection 909.11. The cable rack shall be approximately 13-1/2 inches long with support holes spaced approximately 1-1/2 inch on centers. The cable rack supports shall be approximately 4 inches and 7-1/2 inches long for concrete junction box and manhole installations, respectively, and shall be designed with an interlocking feature at the rear of the support to prevent tilting when installed. The porcelain insulator(s) required on each support shall be constructed with a hook bottom groove to prevent slipping. One and two insulators shall be provided for each support installed in concrete junction boxes and manholes, respectively.

(B) NONMETALLIC CABLE RACKS.

Nonmetallic Cable Racks shall be a molded polycarbonate unit. The cable racks shall have a dielectric strength of less than 2 micro-Amps at 100,000 Volts. The polycarbonate used in the construction of the racks shall be fire retardant with an SE-1 rating. The cable racks shall be 3 inches wide and approximately 22 inches long, and shall be equipped with two 2 inch and two 3 inch capacity saddle arms for concrete junction box and manhole applications, respectively. Each saddle arm shall be provided with a saddle arm lock unit.

918.07 Cable and Wire.

Cable and wire types and sizes to be used for various lighting and associated electrical facilities shall be as indicated on the Plans, and shall conform to the following.

The Contractor shall submit for review all necessary catalog cuts and specification sheets along with the typical test data of the cable and wire he intends to furnish in conformance with the appropriate ICEA/NEMA Publication's physical, aging, electrical and accelerated water-absorption test requirements prior to either ordering for manufacturing or purchasing these materials.

Six certified copies of the test reports of all factory tests, including insulation resistance test, performed on each reel of cable being supplied in quantities above 1,000 feet, shall be submitted to the Engineer in conformance with the Specification requirements. Said test reports must be approved by the Engineer prior to installation of the cable.

For cable being supplied in quantities less than 1,000 feet, a certificate of compliance by the cable manufacturer, in lieu of the above requirements, will be acceptable.

Cable which has been manufactured more than two years prior to purchase will not be acceptable unless written approval of the Engineer is obtained.

The manufacturer shall furnish to the Engineer and the Contractor all splicing or terminating information necessary for proper installation of the cable and wire.

The Contractor shall furnish 2 foot samples of all types and sizes of the cable and wire being supplied to show conformance with the Specifications.

(A) CCTV CAMERA LOW VOLTAGE POWER CABLE.

The CCTV camera low voltage power cable shall consist of no less than five (5) and no more than eight (8) 18 AWG stranded copper conductors, unshielded. Conductor insulation shall be solid colored conforming to the color code listed below. The cable construction and outer jacket shall be suitable for direct exposure to weather and sunlight, rated for a minimum of 300 Vrms, have a maximum outside diameter of 0.36 inches and a maximum rated bending radius of no more than ten times the cable diameter. The cable jacket shall be printed with the wire gauge, number of conductors, manufacturer and part number.

The conductor color code shall be as follows:

(1) Black

(2) Red

(3) White

(4) Green

(5) Orange

(6) Blue (* optional)

(7) Brown (* optional)

(8) Yellow (* optional)

(B) MULTIPLE LIGHTING AND POWER CABLE.

All cable and wire to be used for multiple lighting and power distribution (600V. maximum) systems, including neutrals, shall be single, stranded, soft drawn, or annealed copper conductors (coated conductors where specified), insulated for 600 Volt, covered with a jacket material, and shall be of the type specified herein.

All multiple lighting and power cable and wire shall be factory color coded, except as prescribed herein, for phase identification in conformance with Part 5 of the appropriate IPCE/NEMA Publications as specified hereinafter. Color coding shall be accomplished by use of color compounds, surface color coatings, or neutral/single color compound with surface printing of number and color designations.

Color coding requirement for different Voltage characteristics shall be as follows:

Cable or Wire	265/460 V. Or 277/480 V.	120/208V.	120/240 V.
Phase A	Brown	Black	Red
Phase B	Yellow	Red	Black
Phase C	Orange	Blue	--

Cable or Wire	265/460 V. Or 277/480 V.	120/208V.	120/240 V.
Neutral	Grey	White	White

Where limited quantities of cable or wire are involved, the Engineer may permit the use of colored taping in lieu of the factory color coding in each junction box, manhole or equipment enclosure and each terminal point, as specified in Subsection 601.07.

(1) Type I.

Cable and wire shall be manufactured in conformance with ICEA/NEMA Publication No. S-95-658/NEMA WC70, and shall meet the following requirements:

(a) Stranded copper conductor shall conform to the requirements of the above noted Publication - Part 2, and the concentric stranding shall be Class B, in accordance with Table 2-2.

(b) Insulation shall be ethylene-propylene-rubber (EPR) with flame retardant characteristics, heat and moisture resistant at a temperature of 90 °C for wet and dry locations, conforming to the requirements of the above noted Publication - Part 3, and Table 3-1 (Column B).

(c) The jacket, over the insulation, shall be heavy-duty chlorosulfonated polyethylene (CSPE) conforming to the requirements of the above noted Publication - Part 4, Paragraph 4.4.10 and Table 4-2.

Nominal composite insulation/jacket thickness of the cable and wire shall be as follows:

Conductor Size (AWG OR MCM)	Insulation/Jacket Thickness (Mils)
14-10	45(30/15)
8	60(45/15)
6-2	75(45/30)
1-4/0	100(55/45)
250-500	130(65/65)
600-1000	145(80/65)

(C) SERIES LIGHTING CABLE.

Series Lighting Cable shall be single conductor, No. 8 AWG, 5KV insulation, non-shielded and shall be in conformance with ICEA/NEMA Publication No. S-96-659/WC71, conforming to FAA Specification L-824, Type C (5000 Volts) and the following requirements:

(1) Conductors shall be stranded, soft drawn, or annealed copper conforming to the requirements of the ICEA/NEMA Publication - Part 2, Paragraph 2.3, and the concentric stranding shall be Class B, in accordance with ASTM B8.

(2) Insulation shall be cross-linked polyethylene (XLP) with thermosetting characteristics, heat and moisture resistant at a temperature of 90 °C for wet and dry locations, conforming to the requirements of the ICEA/NEMA Publication - Part 3, Paragraph 3.7. The insulation thickness shall be in accordance with Table 7-31 for 5000 Volt.

(3) Cable identification shall be accomplished by ink printing on the insulation "#8AWG, 5000V., (Manufacturer), FAA L-824 Type C".

(D) OUTDOOR NETWORK CABLE.

Outdoor network cable shall consist of 24 AWG solid bare copper conductors, Category 5e or better rated twisted pairs, polyolefin insulation, inner LLPE jacket, overall shield (100% coverage), 24 AWG stranded TC drain wire, industrial grade sunlight- and oil-resistant LLPE jacket and be model 7937A DATATUFF by Belden or approved equal.

Specifications for the cable shall be as follows:

Number of Conductor Pairs:	4
Total Number of Conductors:	8 # 24 AWG
Conductor Stranding:	Solid
Conductor Material:	Bare Copper
Insulation Material:	Polyolefin
Waterblocking Material:	Polymer Gel
Conductor Color Code:	1 - White/Blue Stripe & Blue 2 - White/Orange Stripe & Orange 3 - White/Green Stripe & Green 4 - White/Brown Stripe & Brown
Inner Jacket Material:	Linear Low Density Polyethylene
Inner Jacket Diameter:	0.230 inches
Outer Shield Type:	Tape
Outer Shield Material:	Aluminum Foil-Polyester Tape
Outer Shield %Coverage:	100 %
Outer Shield Drain Wire AWG:	24
Outer Shield Drain Wire Stranding:	7x32
Outer Shield Drain Wire Conductor Material:	Tinned Copper
Outer Jacket Material:	Linear Low Density Polyethylene
Outer Jacket Ripcord:	No
Overall Nominal Diameter:	0.276 inches
Operating Temperature Range:	-40°C To +75°C
Installation Temperature Range:	-25°C To +75°C
Bulk Cable Weight:	33 lbs/1000 feet
Max. Recommended Pulling Tension:	40 lbs.
Min. Bend Radius (Install):	2.75 inches
IEC Specification:	11801 Category 5
EU RoHS Compliant (Y/N):	Yes
EU RoHS Compliance Date	01/01/2004
TIA/EIA Specification:	568-B.2 Category 5e
Other Specification:	NEMA WC-63.1 Category 5e
Suitability – Outdoor:	Yes
Suitability – Burial:	Yes
Sunlight Resistance:	Yes
Oil Resistance:	Yes
Non-halogenated:	Yes
Plenum:	No
Nom. Mutual Capacitance @ 1 KHz:	15 pF/ft
Maximum Capacitance Unbalance (pF/100m):	330 pF/100 m
Nominal Velocity of Propagation:	70 %
Maximum Delay (ns/100 m):	538 @ 100MHz ns/100 m
Maximum Delay Skew (ns/100m):	45 ns/100 m
Maximum Conductor DC Resistance @ 20 Deg. C:	9.38 Ohms/100 m
Maximum DCR Unbalance @ 20 Deg. C:	3 %
Max. Operating Voltage – UL:	300 V RMS

(E) FIBER OPTIC CABLE – SINGLE MODE.

Fiber Optic Cable - Single Mode shall be tight buffered breakout type cable from an approved supplier as listed on the QPL. No splices are permitted, except as required for terminations, unless shown on the Plans.

The fiber optic communications cable shall be of six fiber configuration or as called on the plans, each fiber with a color coded Polyvinyl Chloride inner sub-cable jacket, containing Aramid strength fibers all surrounded by a yellow Fluoropolymer outer jacket with rip cord.. (If exposed to sunlight, the outer jacket shall be black.) The single mode fibers shall be structured with 9/125/900 micron diameter. Optical fibers shall be protected in individual color coded, breakout buffer tubes. The buffer tubes shall be cabled around a central dielectric strength element with a gel-less water blocking system to inhibit water migration. The cable shall be suitable for use in cable tray, direct burial, underground duct and aerial installations. The optical and physical characteristics of the cable shall be as listed in the table below:

Single Mode Fiber Type:	Low Water Peak
Core Diameter:	9 +/- 1 Microns (single mode)
Cladding:	125 +/- 2 Microns
Coating:	245+/- 15 Microns
Buffer:	900+/- 25 Microns
Color Coded Breakout Tube	2 mm or 2.5 mm
Attenuation @ 1310nm: @ 1550nm:	0.5 dB/Km Maximum 0.5 dB/Km Maximum
Proof Test:	100KPSI
Cable Type:	Breakout; Tight Buffer; Indoor/Outdoor
Operating Temperature:	-40°C to +85°C
Storage Temperature:	-40°C to +85°C
Installation Temperature:	0°C to +60°C (actual temperature of cable)
Fiber Count:	6
Outer Jacket Color:	Yellow (Black if exposed to sunlight)
Weight:	56 lbs/kft
Maximum Load for Installation:	670 lbs
Max Load for Long Term Apps:	270 lbs
Min Bend Radius for Installation:	5.7”
Min Radius for Long Term Apps:	3.8”
Crush Resistance:	High
Flame Resistance:	UL 1666 (OFNR); IEEE383
Solar Radiation Resistance:	High
Sub-cable Tube Color Code:	1. Blue, 2. Orange, 3. Green, 4. Brown, 5. Slate, 6. White

(F) FIBER OPTIC CABLE – MULTI-MODE.

Fiber Optic Cable - Multimode shall be tight buffered breakout type cable as manufactured by Optical Cable Corporation BX006KWLS9OP or approved equal (OAE). No splices are permitted, except as required for terminations, unless shown on the Plans.

The fiber optic communications cable shall be of configuration as shown on the plans, each fiber with a color coded Polyvinyl Chloride inner sub-cable jacket, containing Aramid strength fibers all surrounded by an orange Fluoropolymer outer jacket with rip cord. (If exposed to sunlight, the outer jacket shall be black.) The multimode fibers shall be structured with 62.5/125/900 micron diameter. Optical fibers shall be protected in individual color coded, breakout buffer tubes. The buffer tubes shall be cabled around a central dielectric strength element with a gel-less water blocking system to inhibit water migration. The cable shall be suitable for use in cable tray, direct burial, underground duct and aerial installations. The optical and physical characteristics of the cable shall be as listed in the table below:

Multimode Fiber Type:	Graded Index
Core Diameter:	62.5 +/- 3 Microns (multi-mode)
Cladding:	125 +/- 2 Microns
Coating:	245+/- 15 Microns
Buffer:	900+/- 25 Microns
Color Coded Breakout Tube	2 mm or 2.5 mm
Attenuation @ 850nm: @ 1310nm:	3.5 dB/km Maximum 1.5 dB/km Maximum
Bandwidth @ 850nm: @ 1310nm:	200 MHz/Km Minimum 500 MHz/Km Minimum
Numerical Aperture:	0.275 Nominal
Proof Test:	100KPSI
Cable Type:	Breakout; Tight Buffer; Indoor/Outdoor
Operating Temperature:	-40°C to +85°C
Storage Temperature:	-40°C to +85°C
Installation Temperature:	0°C to +60°C (actual temperature of cable)
Fiber Count:	6
Outer Jacket Color:	Orange (Black if exposed to sunlight)
Weight:	56 lbs/kft
Maximum Load for Installation:	670 lbs
Max Load for Long Term Apps:	270 lbs
Minimum Bending Radius:	5.7”
Min Radius for Long Term Apps:	3.8”
Crush Resistance:	750 lbs./inch Minimum
Impact Resistance:	25 Impacts Minimum @ 3.3Ft.-Lbs
Solar Resistance:	High
Flame Resistance:	UL 1666 (OFNR); IEEE383
Sub-cable Tube Color Code:	1. Blue, 2. Orange, 3. Green, 4. Brown, 5. Slate, 6. White

(G) FIBER OPTIC CABLE – TERMINATION CONNECTOR.

Fiber Optic Cable – Termination Connector shall be a pigtail consisting of a three foot (one meter) length of tight buffered type cable with a factory installed and terminated connector. The pigtail shall be fusion spliced to each strand at each end of every Fiber Optic Cable described in 918.07(H) and 918.07(I) furnished and installed by the Contractor. The pigtail fiber optic strand type shall match the strand type of the installed cable and shall be applied to each cable strand with a fusion splice. The fusion splice shall have a measured attenuation of less than 0.2 dB or it shall be remade until the quality of the splice meets this requirement.

Each pigtail shall be furnished with a factory made connector of the type indicated on the Plans. The connector shall be manufactured to have an average insertion loss equal to or less than 0.2 dB.

(H) TWISTED PAIR COMMUNICATION CABLE.

Twisted Pair Communication Cable shall consist of 4 pairs of #24AWG stranded copper conductors, each pair individually shielded, covered by a PVC jacket. The cable shall be Belden Model 8164 or approved equal.

Specifications for the cable shall be as follows:

Number of Conductor Pairs:	4
Total Number of Conductors:	8 # 24 AWG
Conductor Stranding:	7x32

Conductor Material:	Tinned Copper
Insulation Material:	Foam Polyethylene
Inner Shield Material:	Aluminum Foil-Polyester Tape
Inner Shield Coverage:	100%
Inner Shield Drain:	24 AWG, 7x32 Tinned Copper
Conductor Color Code (by pair):	1 - Black & Red 2 - Black & White 3 - Black & Green 4 - Black & Blue
Outer Shield Material:	Aluminum Foil-Polyester Tape
Outer Shield Coverage:	100 %
Outer Shield Drain:	Tinned Copper Braid
Outer Jacket Material:	Polyvinyl Chloride
Outer Jacket Ripcord:	No
Overall Nominal Diameter:	0.276 inches
Operating Temperature Range:	-40°C To +60°C
Installation Temperature Range:	-25°C To +60°C
Bulk Cable Weight:	75 lbs/1000 feet
Max. Recommended Pulling Tension:	100 lbs.
Min. Bend Radius (Install):	4 inches
EU RoHS Compliant (Y/N):	Yes
EU RoHS Compliance Date (mm/dd/yyyy):	01/01/2004
NEC/(UL) Specification:	CM
Suitability – Outdoor:	Yes
Suitability – Burial:	Yes
Sunlight Resistance:	Yes
Oil Resistance:	Yes
Non-halogenated:	Yes
Nom. Mutual Capacitance @ 1 KHz:	12.5 pF/ft
Nominal Velocity of Propagation:	70 %
Max. Operating Voltage – UL:	300 V RMS

Unless otherwise noted, all twisted paid communication cables not carrying Ethernet signals shall conform to this specification. Cables carrying Ethernet signals shall conform to Specifications in Section 918.07 (F).

(I) SOOW MULTI CONDUCTOR POWER CABLE.

The SOOW multi-conductor portable cable shall be minimum of #10AWG cable, number as shown on the Contract Plans or as applicable, soft drawn or annealed, stranded copper individually insulated (color coded in accordance with ICEA Method 1), with oil and water resistant rubber jacket (EPDM), and overall black heavy duty CPE rubber jacket, rated 600V and with operating temperature range of -40°C to +90°C.

Cable and wire shall be manufactured in conformance with ICEA S-68-516, UL 62, CSA Flexible cords C22.2-49, MSHA, and UL listed for indoor and outdoor use.

The cable shall be General Cable Part No. 02727, or Custom Cable Corp. Catalog Number 9026, or approved equal.

Provide cord grip connectors at each cable entry/exit point of the luminaire, model CGA771750 /CGA771850 as manufactured by Bridgeport Fittings or approved equal.

918.08 Conduit and Fittings.

Conduit and fittings shall be of types and sizes as indicated on the Plans, and shall conform to the following specifications:

(A) Rigid Nonmetallic Conduit.

Rigid Nonmetallic Conduit shall be of the following three types:

(1) PVC Conduit - Schedule 80.

Conduit and fittings shall be made from virgin polyvinyl chloride compound with virgin resin conforming to the requirements of ASTM D1784, and shall be furnished with plain (non-threaded) ends. The conduits and couplings shall meet the requirements of NEMA TC-2, for Type EPC-80-PVC- Electrical Plastic Conduits and Fittings for Type IV Application.

(2) PVC Conduit - Schedule 40.

Conduit and fittings shall be made from virgin polyvinyl chloride compound with virgin resin conforming to the requirements of ASTM D1784. The conduit and couplings shall be as specified in UL 651 and NEMA TC2 for EPC-40-PVC-Electrical Plastic Conduits and Fittings for Type II and III Applications. The physical dimensions of the conduit shall conform to the requirements for Schedule 40 steel pipe. The conduit shall be furnished with plain end (non-threaded) and socket type couplings.

(3) PVC Conduit - Utility Grade.

Conduit and fittings shall be made from virgin polyvinyl chloride compound with virgin resin conforming to the requirements of ASTM D1784 and filler compounds. The conduit and fittings shall be as specified for Type DB conduit in the NEMA TC6. The conduit shall be furnished with bell ends and socket type couplings and shall be suitable for direct burial installations.

(B) Rigid Metallic Conduit.

Rigid Metallic Conduit and fittings shall be galvanized steel or aluminum as specified herein.

(1) Galvanized Steel Conduit.

Galvanized Steel Conduit shall be manufactured from milled steel tubing with wall thickness conforming to Schedule 40 pipe. The conduit shall be hot-dipped galvanized inside and out throughout its entire length including the threads, and the couplings shall conform to the requirements of UL 6, ANSI C-80.1 and Federal Specification WW-C-581.

(2) Aluminum Conduit and Fittings.

Aluminum Conduit and Fittings shall be fabricated of copper-free, corrosion resistant aluminum alloy, conforming to Federal Specification WW-C-540.

(C) Flexible Metallic Conduit.

Flexible Metallic Conduit shall consist of a spirally wound metallic core covered with a polyvinyl chloride or neoprene jacket. It shall be manufactured in accordance with Federal Specification WW-C-566, and shall comply with the provisions of the National Electrical Code dealing with liquid tight flexible metallic conduit. The metallic core shall be steel or aluminum in conjunction with galvanized steel and aluminum conduits, respectively.

(D) PVC Coated Galvanized Conduit.

PVC Coated Galvanized Conduit prior to coating shall conform to Federal Spec. WW-C-581E, ANSI Spec. C80.1 and UL 6. The conduit shall be hot dipped galvanized inside and out throughout its entire length including the threads. The interior of the conduit shall have a urethane coating of a nominal thickness of .002" (2 mils). The exterior of the conduit shall have PVC coating of a minimum thickness of .040" (40 mils) applied by dipping in liquid plastisol. All coated conduit shall conform to NEMA Standard no. RN-1. The conduit shall be bendable without damage to either interior or exterior coating. A .002" (2 mils) nominal thickness coating of blue urethane shall be applied to the exterior, the interior and the threads of all fittings and coupling. A .040" (40 mils) minimum thickness of coating of PVC shall be applied to the exterior of all fittings. All hub fittings and couplings shall have a PVC sleeve extending one pipe diameter or 2" whichever is less. The ID of the sleeve to be equal to the OD of the uncoated pipe. The bond between the coating and the metal shall be greater than the tensile strength of the coatings. A loose coupling shall be

supplied with each length of conduit and the coupling shall have longitudinal ribs to enhance installation. Special tools as recommended by the coated conduit manufacturer shall be utilized during installation. Any coated damage shall be repaired.

(E) CONDUIT FITTINGS.

Fittings for PVC conduit shall be manufactured from high impact strength polyvinyl chloride conforming to the requirements of NEMA TC-3. They shall be of the socket type and joined to the conduit using PVC solvent cement.

Solvent cement used for joining PVC conduits shall be a heavy bodied cement complying with ASTM D2564 and shall be applied with a natural bristle or nylon brush.

Fittings in connection with rigid aluminum conduit shall be of cast aluminum. All other rigid metallic conduit fittings shall be galvanized malleable iron conforming to the requirements of ASTM A338. Manufactured rigid metallic elbows shall conform to UL 6.

Grounding bushings for metallic conduit shall conform to Subsection 918.02.

Non-grounding type insulated bushings for rigid metallic conduit shall be galvanized malleable iron and cast aluminum when used in conjunction with galvanized steel and aluminum conduit, respectively, and shall be insulated in a similar manner as prescribed for the grounding type bushings.

Fittings to be used for connecting rigid metallic conduit to enclosures without bosses or drilled and tapped holes, at outdoor or damp locations, shall be approved waterproof fittings.

Fittings for flexible metallic conduit shall be the same material as the conduit and shall provide positive grounding and/or liquid tight seal between the conduit and the fitting.

Conduit expansion fittings to be installed at all structural expansion joints shall be manufactured units of weatherproof construction allowing for a maximum of 4 inches total (2 inches in either direction) linear movement of rigid metallic conduit, as follows:

(1) Fittings shall consist of hot-dip galvanized cast iron expansion head and body. Suitable packing and a pressure ring shall be provided in the expansion head to insure a weatherproof fitting. A copper grounding braid shall also be provided with the expansion head to produce an internally bonded assembly.

(2) Fittings shall be UL listed for use without bonding jumpers for indoor applications and each unit shall be furnished with a 24 inch long tinned copper braid (equivalent to the resistance of No. 3 AWG tinned copper conductor) and two (2) hot-dip galvanized U-bolt and saddle clamp assemblies for use in outdoor locations.

(3) Fittings shall be of the same size as the conduit to which they are connected. After the expansion head is fitted over the conduit, the insulating bushing shall be installed on the conduit end to prevent abrasion to wiring.

(4) Fittings to be used, where required, in conjunction with nonmetallic conduits shall be manufactured from polyvinyl chloride with a design which utilizes rubber O-ring(s). Detailed information of this coupling including the size of O-rings, tolerances, amount of movement, and all other data shall be submitted for approval.

(F) DUCT BANK SPACERS.

Spacers shall be prefabricated and made out of high impact Polystyrene. Spacers shall be manufactured by Underground Devices Inc., Model No. 4W30-2, or an approved equal.

918.09 Conduit End Bells.

Conduit End Bells for rigid non-metallic conduit (PVC Type) and rigid metallic conduit shall be made of malleable or ductile iron hot dip galvanized and shall have a smooth surface to prevent damage to cable sheath or insulation. It shall be of the type 'TNS' as manufactured by O-Z/Gedney.

918.10 Electrical Tapes.

Electrical tapes shall be as follows:

(A) INSULATING TAPE.

Insulating Tape shall be of self-bonding type and compatible with insulation of the cables to which it is

applied. When installed, it shall provide a permanent electrical and watertight seal.

(B) JACKET TAPE.

Jacket Tape shall be conformable vinyl, plastic electrical tape which is flame retardant, water resistant and cold weather pliable. It shall be heavy duty with a minimum tensile strength of 20 pounds per inch, a minimum adhesion of 20 ounces per inch, and a minimum thickness of 8.5 mils.

918.11 Radio Coaxial Cable.

Coaxial Cable, copper conductors with foam polyethylene insulation, Model 9913 Coaxial Cable – 50 Ohm as manufactured by Belden or approved equal (Unless otherwise noted in the Contract Plans.)

Specifications for the cable shall be as follows:

Number of Coax Conductors:	1
Conductor Stranding:	Solid
Conductor Material:	Bare Copper
Insulation Material:	Foam Polyethylene
Outer Jacket Material:	PE- Polyethylene
Outer Shield %Coverage:	100 %
Overall Nominal Diameter:	0.405 inches
Operating Temperature Range:	-40°C To +80°C
Bulk Cable Weight:	68lbs/1000 feet
Min. Bend Radius (Install):	2 inches
EU RoHS Compliant (Y/N):	Yes
Suitability – Outdoor:	Yes
Suitability – Indoor:	Yes
Characteristic Impedance:	50 Ohm
Oil Resistance:	Yes

918.12 Fixture Support Boxes.

Fixture support boxes to be used in conjunction with canopy lane lighting fixtures, where required, shall be of weatherproof construction, fabricated from 1/8 inch thick steel sheet with continuously welded seams and equipped with mounting studs, holes for attachment to supporting structural members, conduit holes and all mounting hardware, conforming to the details shown on the Plans.

The fixture boxes shall be hot-dip galvanized, after fabrication, in accordance with ASTM 123.

918.13 Lamps.

Various types and sizes of lamps to be used in the project shall conform to ANSI standards, and shall meet the following requirements:

(A) HIGH PRESSURE SODIUM LAMPS.

The electrical, physical, and photometric characteristics of high pressure sodium lamps shall be as follows:

	50W	70W	100W	150W	200W	250W	310W	400W
ANSI Lamp Designation	S68	S62	S54	S55	S66	S50	S67	S51
Base Designation	Mogul Screw							
Bulb Type	Clear, Lead Borosilicate Glass							
Nominal Lamp Volts	52	52	55	55	100	100	100	100
Lamp Burning Position	Universal							
(*)Rated Average Life (Hrs.)	24,000							

	50W	70W	100W	150W	200W	250W	310W	400W
(*)Percent Survival Rate								
@ 4,000 Hrs.	98%							
@ 8,000 Hrs.	95%							
@ 12,000 Hrs.	89%							
@ 16,000 Hrs.	80%							
@ 20,000 Hrs.	68%							
@ 24,000 Hrs.	50%							
(*)Rated Initial Lumens, Horizontal & Vertical	3,300	5,800	9,500	16,000	22,000	27,500	37,000	50,000

(1) For All Wattages:

(*)Lumen Maintenance, Percent of Initial	
@ 4,000 Hrs.	98%
@ 8,000 Hrs.	95%
@ 12,000 Hrs.	90%
@ 16,000 Hrs.	84%
@ 20,000 Hrs.	79%
@ 24,000 Hrs.	73%
Correlated Color Temperature	1,900ºK - 2,100ºK
Warm-up Time	3-4 minutes
Restart Time	1 minute
(*)Figures are based on a minimum of 10 hours operation per start.	

918.14 Lane Lighting Fixtures.

Lane lighting fixtures shall be of ruggedly constructed, with a die-cast aluminum housing with heavy wall construction, resistance to corrosion, vandal resistant, fully gasketed with IP66 rating.

The refractor shall have perfectly smooth exterior for ease of maintenance. The refractor shall be fitted into the housing by means of stainless steel captive screws and over a one-piece heavy duty gasket.

The integral driver assembly shall be of a high power factor auto transformer type, rated for 120 to 277 Volts (unless otherwise specified) operation and shall provide the following characteristics:

The rated operating temperature range shall be -40 ºC (-22 ºF) to +40 ºC (104 ºF).

Minimum power factor over 90% for lamp life.

Lamp Wattage regulation of ± 5% at ± 10% of the line Voltage fluctuation.

Photometry must be compliant with IESNA LM-79 and shall have been conducted at 25°C (75°F) ambient temperature.

Luminaire shall be constructed such that LED modules may be replaced or repaired without replacement of whole luminaire.

Housing and door frame shall be aluminum with a minimum 2.5 mil thick paint baked finish able to withstand a 3,000 hour salt spray test as specified in ASTM Designation: B117

Light Color/Quality: The luminaire shall have a correlated color temperature (CCT) shall be between 4,000K to 5,000K. The color rendition index (CRI) shall be 65 minimum

The luminaire shall operate from a 60 HZ ±3 HZ AC line with a multi tap Voltage ranging from 108 VAC to 305 VAC. The fluctuations of line Voltage shall have no visible effect on the luminous output.

Non-PCB dielectric capacitor shall be rated at 90 ºC.

The unit shall produce a IES Type V, semi-direct light distribution with a minimum of 50% total lumen output.

The exposed surfaces of the fixture housing shall be treated and finished with black oven-cured paint. The complete lighting fixture shall be UL listed for outdoor application and labeled "Suitable for Wet Locations".

External glare shields, also finished with black paint, shall be provided for the designated units

The photometric data to be submitted, as part of the shop drawing submittal, shall conform to applicable requirements set forth in Subsection 918.20.

918.15 Lane Traffic Signal Units.

Lane traffic signal units shall be furnished complete with housing signal lights, terminal block, gasketed door with glass lenses, and aluminum visors, all in conformance with details shown on the Plans and as prescribed herein.

Both housing and the door shall be of 1/8 inch thick one-piece sheet aluminum construction. The door shall be sealed with a 3/16 inch thick sponge neoprene gasket for weather proof and dust-tight construction and hinged to the top of the housing with a continuous internal stainless steel hinge and stainless steel hinge pin.

The integral driver assembly shall have integrated solid state power supply, rated for 120 to 277 Volts (unless otherwise specified).

The signal housing shall have a minimum dimensions of 20″ H x 20″ W and shall not exceed 30″ H x 30″ W , hall be mounted horizontally in the door assembly. The glass lenses shall conform to ITE Specifications for light transmission, distribution and chromaticity.

The cabinet shall be constructed with a corrosion resistant aluminum housing. The fixture shall be 5 stroke LED sign designed with energy-saving LED direct-view illumination and shall features two superimposed messages that display separately. The sign face shall be black. The “X” arrow symbol shall be displayed in red LEDs and the “↓”down arrow symbol shall be displayed in green LEDs with an 18" high character. Both messages shall blank-out when power is off. The sign shall be manufactured with a solid-state circuit board and integrated power supply that are enclosed in a corrosion-resistant aluminum extruded cabinet.

The door shall be equipped with an aluminum lock bar to hold it in the open position during installation and maintenance. The door shall be opened and closed without the use of any tools. This will be accomplished by means of three stainless steel wing head captive screws located at the lower part of the door.

The visors shall be aluminum cutaway type with four slotted mounting tabs for easy attachment to the face of the door. The four screws used for attachment shall be stainless steel.

The entire aluminum housing complete with door and visors, including the screws, shall be painted flat black. All welds shall be ground smooth prior to painting.

The paint to be used shall be baked epoxy powder paint and applied by electrostatic powder spray equipment. Thickness of paint coating shall be a minimum of 2 mils. The finish shall be smooth, hard, free from runs and drips, and highly resistant to salt spray abrasion and ultra violet light. The tough mar resistant coating shall withstand high impact without chipping or cracking.

The unit shall be pre-wired to the terminal block by means of quick-disconnect lugs for ease of maintenance. The terminal block shall be three point molded phenolic type.

918.16 Lighting Standards.

(A) Aluminum.

Lighting standards shall be of aluminum alloy and shall be fabricated in conformance with the design criteria set forth in Subsection 602.04 and must meet all requirements shown in the Standard Drawings for Aluminum Lighting Standards.

Transformer bases shall be cast from permanent mold castings. All castings shall have a smooth satin finish and color to match the lighting standards.

Pole shafts and bracket arms shall be fabricated and welded in the mill temper and then precipitation heat treated (artificially aged) to the specified temper in accordance with ASTM B597.

All welds shall be made by welders certified as prescribed in Section IX of the ASME Boiler and Pressure Vessel Code. Copies of the certifications shall be presented upon request. The items shall be manufactured under a quality control program conforming to the General Requirements for a Quality Program of American Society for Quality Control.

Electrodes used for welding the aluminum structural members shall conform to ASTM B285 for electrode ER5556 or ER5356.

(B) Steel.

Lighting standards shall meet all requirements shown in the Standard Drawings for Steel Lighting Standards.

All hardware, except anchor bolt assemblies, shall be stainless steel conforming to Paragraph 909.02(C), except that the socket head cap screws in the upper parapet mounting bracket castings shall be ASTM A276, Type 304, Condition B, cold finished.

All ground mounted lighting standards shall be furnished with a shoe base and a separate transformer base.

Where the secondary wiring passes through a hole or runs along a surface, such holes or surfaces shall be deburred to avoid any sharp edges or protuberances that may damage the wiring. Rubber grommets shall be installed in the wiring entrance holes in the pole shafts.

All lighting standards shall be furnished with an internal vibration damper mounted at a height recommended by the manufacturer.

Lighting standard pole shafts and bracket arms shall have a rotary sand polish finish and shall be factory wrapped to protect them during shipment.

Lighting standard assemblies complete with bracket arms or luminaire mounting brackets, cast bases and parapet mounting brackets shall be tested by the manufacturer to assure compliance with specified material and strength requirements as per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. A certification by the manufacturer, including test results, stipulating that the items meet these requirements shall be submitted.

918.17 Metallic Junction Boxes.

Metallic junction boxes shall be of the types and sizes as indicated on the Plans.

All boxes shall be provided with mounting such that the box can be mounted without drilling through the NEMA-rated compartment. Under no circumstances will drilling through the box be permitted except for connection of conduits or as otherwise shown on the plans. The boxes shall be fabricated as follows:

(A) Cast Construction.

Cast boxes shall be of iron or aluminum and shall be watertight – dust-tight NEMA Type 4 construction.

Cast iron boxes and covers shall conform to Subsection 909.04. All surfaces of cast iron boxes and covers shall be hot-dip galvanized in accordance with ASTM A123.

Aluminum boxes and covers shall conform to Subsection 911.01.

Cast junction boxes shall be surface mounting type and shall be provided with mounting lugs, screw on cover with neoprene gasket and stainless steel screws, and threaded bosses or drilled and tapped holes for conduit with a minimum of five full threads.

For cast boxes, conduit connections shall be allowed only to nipples that are cast as an integral part of the box. Drilling through cast iron boxes will not be allowed.

Where required by the Plans and Specifications, cast boxes shall be PVC coated with materials using a process that conforms to Section 918.08(D)

(B) Sheet Metal Construction.

Sheet metal boxes shall be fabricated from aluminum and shall be watertight – dust-tight NEMA Type 4 construction. Stainless steel, where used, shall be Type 316.

All boxes shall be surface mounting type, fabricated with continuously welded seams, and shall be provided with screw on cover with neoprene gasket and stainless steel screws, conduit holes, and mounting bars, where specified.

Provide continuous piano hinges for box covers, and orient covers as shown on the Plans and as directed by the Engineer to facilitate maintenance access. Provide box closures that can be unlatched without complete removal of the closure device. Boxes with loose covers or screws will not be accepted.

Steel junction boxes, including covers, shall be hot-dip galvanized after fabrication in accordance with ASTM A123.

918.18 Mounting Devices.

The equipment mounting devices shall be of galvanized steel or aluminum conforming to the types, arrangements, and the details shown on the Plans.

Conduit fastening devices to be used for various installations shall be as indicated on the Plans and as prescribed below:

(A) Galvanized cast steel clamps and clamp-backs shall be used on all concrete surfaces, unless otherwise shown on the Plans. The fastening hardware shall be galvanized 2-unit expansion bolts.

(B) Galvanized steel conduit support assemblies including U-channel strut system with galvanized steel hardware conforming to the details shown on the Plans shall be used for all conduit installations along bridge stringers or other structural members. Manufactured beam clamps will not be permitted, unless usage of such clamps for a particular installation is approved by the Engineer.

(C) Stainless steel U-bolts or J-bolts with back up plates and stainless steel hardware shall be used for conduit installations on aluminum sign structures.

(D) A 3/4 inch PVC conduit or a stainless steel spacer shall be added behind the under-deck luminaire mounting bolts offsetting the fixture from the face of the pier.

918.19 System Control Cabinet (SCC).

Systems Control Cabinet (SCC) – NEMA 3R outdoor cabinet housing sign control electronics and power distribution equipment for ITS equipment

The Authority has made arrangements with the approved Sign Manufacturers to furnish SCCs with the required electronics for each VMS/VSLS/HCMS location. Each ITS Sign site will have its own SCC along with other ITS equipment within its base. Each SCC shall contain all the required equipment for each site. Typical SCC equipment is shown in the Standard Drawings. There are other incidental items not shown on the SCC Standard Drawings to be furnished and installed by the Contractor. These include but are not limited to: Network Switch and Fiber Termination Panel (where fiber optic cable is required), video encoders, patch cords, power line cords, POE injectors, and surge protectors to be installed within the SCC as may be required at the various Contract locations.

918.20 Power Distribution and Control Equipment.

Power distribution and control equipment to be used in conjunction with various lighting systems shall be as specified herein and shall conform to the types, capacities, model, and catalogue numbers indicated on the Plans or in the Supplementary Specifications.

(A) Panelboards and Circuit Breakers.

Panel boards for 600V and below systems shall be single phase 3 wire or 3-phase 4-wire system, and each shall be equipped with a solid neutral, a main circuit breaker or main with lugs as specified. Panelboards shall be UL listed, comply with NEMA standards and conform to Federal Specification W-P-115A.

The neutral bars and main busses shall be equipped with solderless lugs suitable for copper conductors, and of such rating and size as to accommodate the required Ampacities and conductors. The panel boards shall be mounted in enclosures of NEMA types as specified.

The main and branch circuit breakers for panelboards shall be molded case units with quick-make, quick-break and trip-free mechanism, bolted type unless otherwise specified, and with a minimum interrupting capacity of 10,000A (RMS Symmetrical). The Voltage, number of poles, frame and trip sizes of circuit breakers shall be as indicated on the Plans. Circuit breakers shall be UL listed, comply with NEMA standards and conform to latest Federal Specification W-C-375 requirements..

The circuit breakers shall be of fixed trip type, unless adjustable trip type units are specifically called for on the Plans or in the Supplementary Specifications.

(B) Enclosed Circuit Breakers.

Circuit breaker units of enclosed circuit breakers shall conform to applicable requirements set forth in Subparagraph 918.20(A).

All enclosures shall be surface mounted type, NEMA Type 4 or 4X (stainless steel) when installed in damp indoor locations, and in all outdoor applications. Enclosures shall be NEMA Type 1 when installed in dry indoor areas and within NEMA Type 4 or 4X cabinets located outdoors.

Where specified, the enclosed circuit breakers shall be equipped with padlock provisions for the breaker handle to remain in "OFF" position.

(C) SAFETY OR DISCONNECT SWITCHES.

Safety switches shall be of heavy duty, quick-make and quick-break type with terminals suitable for copper conductors, and equipped with an insulated groundable neutral. The Voltage and Ampacity ratings, number of poles, and fuse sizes shall be as indicated on the Plans. Fuses shall be cartridge type, unless otherwise specified. Safety switches shall be UL listed, comply with NEMA Standards and conform to Federal Specification WS-865C.

Disconnect switches shall be the same as safety switches except that the fuses shall be replaced with solid links.

Enclosures and locking provisions for safety or disconnect switches shall conform to applicable requirements set forth in Subparagraph 918.20(B).

(D) DISTRIBUTION TRANSFORMERS.

Distribution transformers shall be totally enclosed and dry type, designed for indoor/outdoor applications, suitable for wall or floor mounting as required, and shall meet the phase, KVA, primary and secondary Voltage and tap requirements indicated on the Plans and in the Special Provisions.

The insulation material shall be Class H which will not permit a temperature rise of 115 ^{o}C above the 40 ^{o}C ambient, when tested in accordance with ANSI and NEMA standards.

The core and coil assemblies of transformers below 600V class for up to 37.5 KVA, single phase and 15 KVA, three phase shall be epoxy encapsulated.

The transformers shall be designed to maximize energy efficiency requirement as per NEMA TP1-2002 and tested in accordance with Harmonic Mitigation requirements of NEMA-ST20NEMA-TR27 AND UL-506and shall bear the UL label.

The transformer enclosures shall be degreased, primed, and finished with a coat of outdoor enamel paint and shall be stored in accordance to manufacturer`s recommendations in a climate controlled facility. Transformer core and internals shall have Solid-Based Varnish.

(E) CONSTANT CURRENT TRANSFORMERS.

Constant current transformers for series lighting systems shall be of moving coil type (not static type), oil-filled, suitable for floor mounting, rated at 6.6A, 2400V or 7200V primary Voltage as required, and with 120V control Voltage.

All constant current transformers shall be equipped with two pole mounting lugs and with two primary and two secondary high Voltage bushings with De-Ion type lightning arrestors on both primary and secondary sides to protect the units against lightning surges which might develop between primary and tank, primary and secondary, or secondary and tank.

(F) CAPACITOR ASSEMBLIES.

The capacitor assemblies to be installed on constant current transformers shall consist of the following components:

(1) Capacitor Units.

Capacitor Units shall be single phase, 60 hertz, 2400V or 7200V primary Voltage, outdoor type, equipped with non-PCB type dielectric materials, two bushings and mounting ears, and shall be of the required KVAR sizes.

The bushings shall be equipped with solderless connectors to accommodate #8 AWG stranded copper conductor. The capacitor housing, including the mounting ears, shall be factory painted for corrosion protections, except that bottom of the mounting ears shall remain unpainted for grounding connection.

In order to achieve a uniform installation throughout, thereby enabling the utilization of the same type of capacitor mounting bracket at all locations, the cross section (width and depth) of the capacitor housing for all sizes and two Voltage classifications shall be the same.

(2) Capacitor Mounting Brackets.

Capacitor Mounting Brackets, conforming to the details shown on the Plans, shall be manufactured from 10 gauge sheet steel conforming to the requirements of ASTM A36 and shall be hot-dipped galvanized after fabrication in accordance with ASTM A123.

In addition, the mounting brackets shall be shop painted as specified below.

The primer shall be composed of a pigment containing zinc dust, silicates and titanium dioxide and an alkyd-resin vehicle, suitable for use on galvanized surfaces.

The finish coat shall be a long-oil alkyd-resin type enamel of a color to match the coating of the constant current transformers.

The stainless steel bolts, nuts, and washers to be used for fastening the capacitor mounting brackets to lower pole mounting lugs of the constant current transformers shall be of stainless steel.

(G) PHOTOELECTRIC CONTROL UNITS.

The photoelectric control units shall be outdoor type, single pole-single throw, 105-277VAC, 50/60 hertz, and shall be rated for a minimum of 1800 Volt-Ampere and 5000 on-off operations. Operating levels shall be 1 $\pm$ 0.2 FC (nominal) for turn-on and 3 FC (average) for turn-off conditions. Average power consumption of the unit shall be less than 1.6 Watts. The unit shall be rated for ambient temperature range of -65ºF to + 158ºF, and shall be moisture resistant for 100% relative humidity.

Chassis of the units shall be molded phenolic with three twist lock type blades and removable neoprene gasket, all in conformance with NEMA standards.

The photoelectric control units shall be equipped with encapsulated surge protection devices and hermetically sealed photocell, and shall be furnished with receptacle units and necessary mounting devices.

(H) MISCELLANEOUS EQUIPMENT.

All other electrical equipment such as remote control switches, contactors, relays, toggle or push button switches, receptacles, etc. shall be as specified on the Plans and/or in the Special Provisions.

918.21 Roadway Lighting Luminaires.

Luminaire Types and sizes shall be as indicated on the Plans and shall be as per the QPL.

(A) LED LUMINAIRES.

LED Roadway lighting luminaires shall be various types of units as prescribed herein below.

The floodlighting, high mast lighting, and offset type luminaires to be used for illumination of designated toll plazas and other large areas shall be as specified on the Plans or in the Special Provisions.

LED luminaires to be used for general roadway, toll plaza and parking area illumination shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply). Each luminaire shall be rated for a minimum operational life of 50,000 hours at an average operating time of 11.5 hours per night at 40ºC (104ºF) while maintaining greater than 70% of its initial lumen output (L70).

The individual LEDs shall be constructed such that a loss or the failure of one LED will not result in the loss of the entire luminaire. Luminaire shall be constructed such that LED modules may be replaced or repaired without replacement of whole luminaire. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires, or an approved equivalent standard from a nationally recognized testing laboratory, and shall have a certification label.

All luminaires of the same type and Wattage to be installed under the same Contract shall be physically identical unless otherwise approved by the Engineer.

(1) Construction.

The LED luminaire housings shall be die cast aluminum frame, extruded aluminum heat sinks to an independent electrical compartment. Housing and door frame shall be aluminum with a nominal 2.5mil thick paint finish able to withstand a 3000 hour salt spray test as specified in ASTM designation,

B117. Access to the electrical compartment shall be tool-less. The die cast aluminum housing shall be designed to prevent the buildup of water on the top of the housing. Exposed heat sink fins shall be oriented so that water can freely run off the luminaire to carry dust and other accumulated debris away from the unit. Housing shall have cast in pipe, leveling steps and mounting system capable of accommodating 2 3/8" OD.

The maximum effective projected area shall not exceed 1.31. The housing shall be grey in color with a flat or semi-gloss sheen. Luminaire options to include a NEMA photo-control receptacle and the fixture shall be furnished with a shorting cap.

The assembly and manufacturing process for the LED luminaire shall withstand vibration, meeting ANSI C136.31 American Standard for Roadway and Area Lighting Equipment-Luminaire Vibration for both normal and bridge operation.

The optical assembly of the luminaire shall be protected against dust and moisture intrusion per the requirements of IP-66 to protect all optical components. The electronics/power supply enclosure shall meet the requirements for NEMA/UL we location.

The luminaires shall be equipped with a universal slip fitter mounting device capable of adapting to 1-1/4 inch through 2 inch pipe size bracket arms without the need of separate mounting parts. Leveling and clamping of the luminaires to the bracket arm shall be accomplished by tightening of four bolts. The mounting end of luminaires shall be provided with an appropriate means of covering the opening to prevent bird infiltration into the luminaire housings.

The optical assemblies shall consist of highly polished and anodic or chemically bonded glass surfaced aluminum reflector to achieve the required photometrics and impact resistant flat tempered glass refractor equipped with a high temperature gasket to provide a completely sealed optical assembly. The gasket shall be a single piece polyester fiber attached around the full perimeter of the reflector to prevent contaminants from entering the optical system. Breathing action of the sealed optical assembly shall be accomplished by means of the reflector gasket, unless otherwise specified.

The luminaires shall have adequate provisions for the dissipation of heat radiated from the electronic driver. All luminaires shall have a durable baked-on acrylic gray finish, inside and out, and shall be furnished with corrosion-resistant hardware.

(2) Electrical Requirements.

(a) The luminaire shall operate from a 60HZ + 3HZ AC line over a Voltage ranging from 108 VAC to 305VAC. The fluctuations of line Voltage shall have no visible effect on the luminous output. The luminaire shall have a minimum efficacy of 87 lumens per Watt and shall not consume power in the off state.

(b) Total Harmonic Distortion (THD) induced into an AC power line by a luminaire shall not exceed 20 percent.

(c) The luminaire on-board circuitry shall include surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD protects the luminaire from damage and failure for common and differential mode transient peak currents up to 10 KA (minimum). SPD conforms to UL 1449. SPD performance shall be tested per procedures in ANSI/IEEE C62.41-2:2002 category C high exposure and ANSI C136.2 10kV BIL. The SPD shall fail in such a way as the Luminaire will no longer operate. The SPD shall be field replaceable. All LED fixtures shall come standard with a 10kV module for transient line surge protection.

(d) LED Drivers must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B.

(e) Drivers shall be an IP66 rated UL class 2 power unit as per UL1310 with a Class A sound rating and shall comply with FCC rules and regulations as per Title 47 CFR part 15.

(3) Photometric Requirements.

The luminaires shall produce Type II or Type III light distributions in conformance with the current ANSI/IES classification and shall meet the photometric requirements shown on the Plans. Additional distributions for glare control shall be utilized when direct source must be mitigated. Mitigation must take place without external shielding elements. Optical assemblies shall have a minimum efficiency of 85% regardless of distribution type.

The photometric data to be submitted for each type of luminaire, as part of the shop drawings submittal, shall be as follows:

(a) Isofootcandle curve shall indicate the horizontal footcandles based on the specified mounting height as indicated on the Plans. The curve shall indicate, as a minimum, the isofootcandle lines in an area two mounting heights transversely on the house side, four mounting heights transversely on the street side, and seven mounting heights longitudinally on each side of the luminaire.

(b) Coefficient of utilization curve shall indicate the coefficient of utilization in percent for a transverse distance of a minimum of four mounting heights.

(c) Light flux values shall be given in lumens and percent of lamp lumens, for the output of the luminaire upward and downward, on the street side and house side.

(B) HID LUMINAIRES.

Roadway lighting luminaires shall be various types of high pressure sodium units as prescribed herein below.

The floodlighting, high mast lighting, and offset type luminaires to be used for illumination of designated toll plazas and other large areas shall be as specified on the Plans or in the Special Provisions.

The conventional luminaires to be used for general roadway, toll plaza and parking illumination shall be of integral or remote ballast type high pressure sodium units with die-cast aluminum cobra-head construction and equipped with a precision optical assembly that will produce a fully cutoff and glare-free light distribution

The integral and remote ballast types of luminaires shall be used on lighting standards operating on multiple and series lighting distribution systems, respectively. Remote ballast type luminaires for series lighting systems shall be equipped with starter units within the luminaire housings and prewired to the terminal blocks therein.

All luminaires of the same type and Wattage to be installed under the same Contract shall be physically identical unless otherwise approved by the Engineer.

(1) Construction.

The luminaire housings shall be of two different physical sizes to accommodate the horizontally mounted high pressure sodium lamps and associated ballasts of 50W thru 400W sizes.

The small housing which is to accommodate the lamp/ballast sizes 50W-150W, shall be of ruggedly constructed three section die-cast aluminum consisting of an upper housing, an optical assembly access door, and a ballast assembly and/or starter unit access door. Each access door shall be attached to the upper housing by means of a heavy duty and integrally cast hinge at one end and a substantial positive latch at the other end to prevent the accidental opening or disengagement of the door assembly under normal vibration conditions.

The large housing, which is to accommodate the lamp/ballast sizes 200W-400W, shall be constructed in a similar manner as prescribed above, for the small housing.

The luminaires shall be equipped with a universal slip fitter mounting device capable of adapting to 1/14 inch through 2 inch pipe size bracket arms without the need of separate mounting parts. Leveling and clamping of the luminaires to the bracket arm shall be accomplished by tightening of four bolts. The mounting end of luminaires shall be provided with an appropriate means of covering the opening to prevent bird infiltration into the luminaire housings.

The optical assemblies of both small and large size luminaires shall be of specially engineered true cutoff design for use with a high pressure sodium light source that will produce an efficient light distribution with low viewing luminance, and at the same time will totally eliminate any upward lumen output above 90°.

The optical assemblies shall consist of highly polished and anodic or chemically bonded glass surfaced aluminum reflector to achieve the required photometrics, a heavy-duty porcelain mogul base lamp socket with sealing provisions, and a heat proof and impact resistant flat tempered glass refractor equipped with a high temperature gasket to provide a completely sealed optical assembly. The gasket shall be a single piece polyester fiber attached around the full perimeter of the reflector to prevent contaminants from entering the optical system. Breathing action of the sealed optical assembly shall be accomplished by means of the reflector gasket, unless otherwise specified. The lamp socket mounting

bracket shall be of a heavy-duty design to withstand structural vibration conditions without any failure or adverse effect on the lamp life, and shall be provided with adjustable socket positions to permit filed changes for different light distribution patterns.

The lamp socket and integral ballast assembly shall be prewired to the terminal block. Compression screw type pressure terminals shall be provided on the terminal block to accept #10 AWG secondary wiring.

The luminaires shall have adequate provisions for the dissipation of heat radiated from the integral ballast coil and the lamp. All luminaires shall have a durable backed-on acrylic gray finish, inside and out, and shall be furnished with corrosion-resistant hardware and without a photoelectric control receptacle.

(2) Photometric Requirements.

The luminaires shall produce medium-cutoff, Type II or Type III light distributions in conformance with the current ANSI/IES classification and shall meet the photometric requirements shown on the Plans.

The photometric data to be submitted for each type of luminaire, as part of the shop drawings submittal, shall be as follows:

(a) Isofootcandle curve shall indicate the horizontal footcandles based on the specified mounting height as indicated on the Plans. The curve shall indicate, as a minimum, the isofootcandle lines in an area two mounting heights transversely on the house side, four mounting heights transversely on the street side, and seven mounting heights longitudinally on each side of the luminaire.

(b) Coefficient of utilization curve shall indicate the coefficient of utilization in percent for a transverse distance of a minimum of four mounting heights.

(c) Light flux values shall be given in lumens and percent of lamp lumens, for the output of the luminaire upward and downward, on the street side and house side.

(C) BALLAST ASSEMBLIES.

Ballast Assemblies shall conform to ANSI requirements and shall be of integral and remote types.

All components of both integral and remote ballast assemblies shall be of a design to withstand lamp cycling, burnt out lamp and no lamp conditions in the socket without any adverse effect to any of the ballast components, including the lamp starter unit, for the entire duration of the guarantee period as specified in Subsection 601.10.

A lamp Volts versus lamp Watts trace shall be submitted for each size of lamp and ballast combination, as part of the shop drawing submittal.

(1) Integral Ballast Assemblies to be used on multiple lighting distribution systems shall consist of the core, copper wound coil, plug-in type or easily removable lamp starter unit, non-PCB type capacitor, and plug-in disconnect. All components of the integral ballast assembly shall be mounted on the ballast access door of the luminaires. The ballast shall be prewired to the lamp socket and terminal block, requiring only connection of the power leads to the terminal block fastened to the luminaire housing. The entire ballast module assembly shall be easily removable and replaceable by means of a quick disconnect plug. The capacitors shall be so located or positioned that they will not be in the direct stream of heat radiated from the ballast coils and the lamp. The ballast coils shall be protected with insulation of the highest grade, capable of withstanding all adverse effects of moisture, corrosive atmospheres, and high temperature.

The ballast shall be of magnetic regulator type for multi-tap or single Voltage operation as it is available by the ballast manufacturer for 50w-400w sizes or Constant Wattage Auto Regulating (CWA) for 50w-150w sizes for multi-tap operation and Constant Wattage Isolated Winding (CWI) for 200w-400w sizes for multi-tap operation. The ballast efficiency shall be minimum 68% for 50w-100w sizes and 77% for 150w-400w sizes. The power factor shall be over 90% over the entire life of the lamp. The ballast shall reliably start and operate at a minimum ambient temperature of -20 degree F and shall provide a lamp Wattage regulation of 8% for the nominal Voltage variation of plus or minus 10% throughout the lamp life. The ballast shall be of multi-tap type for operation at 120V, 240V and 277V line Voltage.

(2) Remote Ballast Assemblies to be used on series lighting distribution systems shall be of a design to operate on a 6.6A series system fed by a "Moving Coil" type constant current (c.c.) transformer and shall consist of the following two components:

(a) The remote ballast module shall be an encapsulated unit containing the core, coil and non-PCB type capacitor and shall be equipped with primary and secondary wire leads for field connections. All wire leads shall be a minimum of 12 inches long and set into the encapsulation in such a manner as to provide a positive waterproofing thereof.

(b) The starter unit shall be mounted within the luminaire housing and wired to the terminal block therein.

The ballast module may be of circular or rectangular cross section with a maximum 8 inch diameter or diagonal dimension, respectively, at the base.

The combination of the starter unit and the remote ballast module, rated at 6.6A, shall provide control of lamp Wattage within the prescribed limits of operation throughout the rated lamp life as defined by ANSI standards and/or the lamp manufacturer's specifications for the rated Voltage (nominal Volts) of the prescribed high pressure lamps.

The starter unit and the remote ballast module shall be designed to allow the placement of the remote ballast module at such distance away from the luminaire (starter unit and lamp) governed only by the maximum of 3% Voltage drop limitation based on the rated Voltage and operating current of the lamp and the secondary wire size used between the two components.

Electrical characteristics of the 6.6A series remote ballasts shall be as follows:

HPS Unit	Ballast Input (KW)	C.C. Transformer Loading Factor (KW)
50W	0.065	0.20
70W	0.085	0.28
100W	0.121	0.40
150W	0.174	0.57
200W	0.233	0.75

All electrical and operating characteristics of the remote ballast module and starter unit components of the series high pressure sodium ballast units shall be entirely compatible in order to properly operate the lamps. Both of these ballast components should be products of the same manufacturer to assure such compatibility. If the Contractor wishes to make a substitution for either or both components of the units specified herein, he shall submit the following for evaluation and approval.

(1) Outline drawing of each component, complete with dimensions.

(2) Electrical and operating characteristics of each component, complete with wiring diagrams.

(3) Two complete remote ballast assembly test units for each size.

The Contractor will not be permitted to issue purchase order(s) for the proposed ballast components until the evaluation and actual testing of the units by the Authority is completed and written approval is given for the substitution.

918.22 Sign Lighting Luminaires.

Sign lighting luminaires, as described in this section, shall be as per the QPL. The Contractor may submit an alternate luminaire for approval by submitting photometric calculations to the Engineer as a shop drawing process in accordance with Section 104.08.

The LED Luminaire shall meet the following specifications:

(A) General Requirements.

(1) LED Sign lighting luminaire shall be rugged cast aluminum housing for corrosion resistance and long life. The die cast aluminum housing shall be designed to prevent the buildup of water on the top of the housing. Exposed heat sink fins shall be oriented so that water can freely run off the luminaire to carry

dust and other accumulated debris away from the unit. Housing shall have two (2) cast in pipe entries, leveling steps and a two bolt mounting. The housing exterior shall be grey in color.

(2) Each Luminaire shall consist of a housing, LED array, and electronic driver (power supply).

(3) Each luminaire shall be rated for a minimum operational life of 50,000 hours at an average operating time of 11.5 hours per night at 40°C (104°F) while maintaining greater than 70% of its initial lumen output (L70).

(4) The rated operating temperature range shall be -40°C (-22°F) to +40°C (104°F).

(5) Photometry must be compliant with IESNA LM-79 and shall have been conducted at 25°C (75°F) ambient temperature.

(6) Luminaire shall be constructed such that LED modules may be replaced or repaired without replacement of whole luminaire.

(7) Housing and door frame shall be aluminum with a minimum 2.5 mil thick paint baked finish able to withstand a 3,000 hour salt spray test as specified in ASTM Designation: B117.

(8) The optical assembly of the luminaire shall be protected against dust and moisture intrusion per the requirements of IP-66 (minimum) to protect all optical components.

(9) The luminaire door shall open away from the sign face thus providing an easy and safe access to the electrical components.

(10) There shall be no penetrations other than the conduit hubs. No photo control receptacle required.

(11) Each refractor or lens shall be made from UV inhibited high impact optical grade acrylic or glass and be resistant to scratching and impact.

(12) Each luminaire shall be listed with Underwriters Laboratory, Inc.

(B) PHOTOMETRIC REQUIREMENTS.

(1) Optical assemblies shall have a minimum efficiency of 85%. All LEDs shall provide the same optical pattern such that failures of individual LEDs will not constitute a loss in the distribution pattern.

(2) Light Color/Quality: The luminaire shall have a correlated color temperature (CCT) shall be between 4,000K to 5,000K. The color rendition index (CRI) shall be 65 minimum.

(3) Each fixture shall have a Lamp Lumen Depreciation (LLD) factor over its rated L70 lifespan duration of no less than 0.90.

(C) THERMAL MANAGEMENT REQUIREMENTS.

(1) The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.

(2) Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.

(3) The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

(4) The heat sink material shall be aluminum.

(D) ELECTRICAL REQUIREMENTS.

(1) Drive current to the LEDs shall not exceed 350mA.

(2) Operation Voltage Regulation: The luminaire shall operate from a 60 HZ ±3 HZ AC line with a multi tap Voltage ranging from 108 VAC to 305 VAC. The fluctuations of line Voltage shall have no visible effect on the luminous output.

(3) Power Factor: The luminaire shall have a power factor of 0.90 or greater.

(4) Surge Suppression: The luminaire onboard circuitry shall include surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall protect the luminaire from damage and failure for common and differential mode transient peak currents up to 10 kA (minimum). SPD shall conform to UL 1449. The

SPD shall fail in such a way as the Luminaire will no longer operate. The SPD shall be field replaceable.

(5) The LED circuitry shall prevent visible flicker to the unaided eye over the Voltage range specified above.

(6) LED Drivers must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Section 15 regulations concerning the emission of electronic noise.

(7) Drivers shall be an IP66 rated UL class 2 power unit as per UL 1310 with a Class A sound rating and comply with FCC rules and regulations as per Title 47 CFR part 15.

(8) All LED fixtures shall come standard with a 10kV module for transient line surge protection. The electronics/power supply enclosure shall meet the requirements for NEMA/UL wet location.

918.23 Underbridge Lighting Luminaires.

Underbridge lighting luminaires shall be composed of a die-cast aluminum housing and door assembly equipped with a stainless steel hinge and latch combination, a precision optical assembly of reflector and prismatic-heat and shock resistant refractor, a heavy duty porcelain adjustable lamp socket, and a regulator type high pressure sodium ballast enclosed either within the luminaire housing or in a separate die-cast aluminum ballast housing attached to the luminaire housing with stainless steel bolts.

Ballast characteristics shall conform to integral ballast specifications set forth in Subsection 918.13. Each luminaire shall be equipped with a 6A internal fuse, conforming to applicable requirements of Subsection 918.04.

Each luminaire or ballast housing shall be provided with a drilled and tapped hole for 3/4" conduit on each side, complete with threaded flush plug.

The luminaire and ballast assemblies shall be finished with a light gray baked-on polyester paint inside and out. Cast aluminum grill guard or other protective equipment to deter vandalism, where required, shall be as specified.

The luminaires shall be furnished with factory set lamp socket position to produce the specified photometrics as shown on the Plans.

The photometric data to be submitted, as part of the shop drawing submittal, shall conform to applicable requirements set forth in Subsection 918.20.

918.24 Traffic Signal Lamps.

LED illumination of traffic signal indications shall be provided as shown on the Plans. LED signal heads shall be certified to meet all Institute of Transportation Engineers (ITE) requirements and shall not cause RF interference to emergency vehicle communications.

Traffic signal lamps shall be 120/125 Volts and clear. The 135-Watt lamp shall be rated for 6,000 hours of life, and the 60-Watt lamp shall be rated for 8,000 hours of life. The lamps shall meet or exceed the beam candlepower requirements of the Institute of Transportation Engineers signal lamp standard. The lamps shall also comply with the following:

Indication Size	Incandescent Wattage	Rated Initial Lumens	Center Length
8 inch	60	595	2 - 7/16 inches
12 inch	135	1,750	3 inches
Pedestrian	60	595	2 - 7/16 inches

918.25 Loop Detector Lead.

Loop detector lead shall conform to Subsection 918.07 and to the New Jersey DOT Electrical Materials Specification EB-LDL. Only one type of loop detector lead will be permitted on the Project.

918.26 Loop Wire.

The loop wire shall be thermoplastic single conductor wire with a ¼-inch PVC tube or ¼-inch, high-density, polyethylene tube extruded over the loop detector wire, shall be manufactured in conformance with ICEA Publication No. S-61-402/NEMA Publication No. WC5, and shall conform to the following:

(A) The conductor shall be No. 14 AWG soft-drawn copper wire with 19-wire (Class C) stranding or seven-wire (Class B) stranding conforming to ASTM B 3 and ASTM B 8.

(B) The insulation shall conform to UL Type THHN/THWN and shall be rated for 600 Volts.

(C) The extruded polyvinyl chloride tubing shall be UL listed FR-1 rated at 221 ºF, with a minimum wall thickness of 30 mils. It shall be chemical resistant and oil resistant with moisture absorption of less than one percent. The high density polyethylene tubing shall be UL listed with a minimum wall thickness of 30 mils.

918.27 Cabinets For Traffic Signals.

Cabinets shall be aluminum alloy conforming to Subsection 918.03.

The door of all meter and control equipment cabinets, other than traffic signal cabinets, shall be labeled with a permanent reflective metallic sign indicating the Voltage and the word **DANGER**. The sign shall be applied on a 0.040-inch minimum thickness aluminum alloy sheet. The lettering shall be approximately 1½ inches high and shall be red on a white background. The sign shall be installed with four stainless steel vandal proof screws.

A weatherproof print of the system field wiring shall be sealed in plastic and attached to the inside of the door of each meter cabinet, control equipment cabinet and controller cabinet.

918.28 Panel Boards And Circuit Breakers For Traffic Signals.

Panelboards for traffic signals shall be as shown on the Standard Drawings and unless otherwise noted be: single-phase, three-wire, 120/240-Volt, with 70-Ampere main-rated busses, conforming to Federal Specification W-P-115C, Type 1, Class 2. Circuit breakers shall be UL listed and shall comply with NEMA Standards. They shall conform to Federal Specification W-C-375B, Class 10A.

918.29 Pedestals, Poles, Transformer Bases, And Mast Bracket Arms For Traffic Signals.

Pedestals, poles, transformer bases, and mast bracket arms for traffic signal and highway lighting shall be fabricated with materials according to the appropriate ASTM Standard. The items shall also be manufactured in conformance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. All welds shall be made by welders certified as prescribed in Section IX of the ASME Boiler and Pressure Vessel Code. Copies of the certifications shall be presented upon request. The items shall be manufactured under a quality control program that conforms to the General Requirements for a Quality Program of the American Society for Quality Control.

Aluminum poles, lighting, bracket arms, and traffic signal mast arms shall have a rotary, sand-polish finish giving a nonreflecting outer surface. The external surfaces of the transformer bases and shoe bases shall have a satin-type finish. Steel poles and steel traffic signal arms shall be hot-dip galvanized according to ASTM A 123.

Where wire or cable passes through a hole or runs along a surface at any point, through or on the complete assembly, such holes and surfaces shall be deburred and void of any sharp edges or protuberances that may in any way damage the wire or cable. Rubber grommets shall be provided and installed in the entrance hole to the shaft and mast arms where mid-mounted traffic signals are installed.

All hardware, bolts, nuts, and washers used in the installation of the aluminum traffic signal standards shall be stainless steel. Hardware used for steel traffic signal standards shall conform to Specifications for Steel Bars, Carbon, Hot Wrought, Special Quality Mechanical Properties, Grade 90, and shall be galvanized according to ASTM A 153. Bolts shall conform to ASTM F 738M. Leveling nuts shall conform to ASTM F 836M.

Standards and mast bracket arms shall be tested by the manufacturer to ensure compliance with specified material and strength requirements. The testing shall also ensure that the items have been manufactured in conformance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. Five copies of the certification stipulating that the items meet the strength and material requirements shall be submitted.

All aluminum poles and mast bracket arms shall be factory wrapped to protect them during shipment.

Fabrication operations for aluminum alloy structures not specifically covered in these Specifications shall be according to Section 10, ANSI/AWS D1.2 for Class 1 structures.

918.30 Traffic Signal Cable.

Traffic signal cable shall conform to Subsection 918.07 and to the New Jersey DOT Electrical Materials

Specification EB-TS-CABLE. Only one type of traffic signal cable will be permitted on the Project.

918.31 CCTV Camera.

The camera shall meet the following general requirements:

(A) GENERAL.

The camera shall be a dome type. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system. All system and components shall have been thoroughly tested and proven in actual use.

The camera shall be an outdoor rated day/night PTZ standard definition color IP dome camera system with 28x optical zoom, a clear impact resistant polycarbonate bubble, and support High Power-over-Ethernet communications. The camera enclosure shall be rated for IP66 protection and equipped with a sunshield and heater. The camera shall be capable of rotating 360°, tilting 180° and support 256 preset positions with a repeatable accuracy of ±0.1°. The camera shall support privacy masking based on PT positions and shall automatically flip the video image based on tilt angle. The camera shall automatically adjust white balance to compensate for sodium vapor lamp lighting conditions. The camera shall be configurable and operable from a standard web browser and shall be password protected. The camera shall support H.264 video compression and conform to the ONVIF Profile S specification for product interoperability. The camera shall have integral surge protection and shall be capable of being powered by Power-over-Ethernet or an independent 24 VAC source.

An ITSS-mounted camera shall be provided with a pipe Mount Kit, a Remote Power Unit with a 120 VAC input and a 24 VAC output, and a Camera Mount Arm capable of swiveling 360 degrees for camera maintenance access.

A pole-mounted camera including the camera without a lowering device shall be provided with a Camera Pendant Arm Mount with an integral 24 VAC power supply and a Pole Mount Adapter if required.

A pole mounted camera with a lowering device shall be provided with a Camera Pipe Mount Kit and a Remote Power Unit with a 120 VAC input and a 24 VAC output.

(B) THE CAMERA SHALL COMPLY WITH THE FOLLOWING SPECIFICATIONS AND STANDARDS.

Video Standard:	NTSC
Effective Picture Elements:	768 (H) x 494 (V)
Lens:	28x Zoom (3.5-98.0 mm) F1.35 to F3.7
Focus:	Automatic with manual override
Iris:	Automatic with manual override
Digital Zoom:	12x
Optical Zoom Movement Speed:	2.5 sec. max. with focus tracking on
Optical Field of View:	2.1° to 55.8°
Day Mode Sensitivity (SensUp off):	0.33 lux
Day Mode Sensitivity (SensUp on):	0.02 lux
Night Mode Sensitivity (SensUp off):	0.066 lux
Night Mode Sensitivity (SensUp on):	0.0026 lux
Electronic Shutter Speed:	1/4 to 1/10,000 sec.
Wide Dynamic Range (WDR):	92 dB (50 dB with WDR off)
Signal-to-Noise Ratio:	>50 dB (weighting on)
Video Compression:	H.264 (ISO/IEC 14496-10), M-JPEG
Resolution:	CIF – 352(H) x 240(V), 4CIF – 704(V) x 480(V)
Ethernet:	10-BaseT/100 Base-TX, auto-sensing, IEEE 802.3
Data Protocols:	IPv4, IPv6, UDP, TCP, HTTP, HTTPS, RTP/RTCP, IGMP V2/V3, ICMP, ICMPV6, RTSP, FTP, Telnet, ARP, DHCP, SNTP, SNMP, DNS, DDNS, SMTP, UPnP, QoS

Ingress Protection:	IP66, NEMA 4X
Operating Temperature:	-40°C to 55°C
Storage Temperature:	-40°C to 60°C
Humidity:	0% to 100% relative, condensing
Input Voltage:	21-30 VAC, 50/60 Hz or High PoE
Power Consumption (typ.):	60 W (heaters on), 24 W (heaters off)
Product Safety:	CE, UL, and IEC Standards

918.32 CCTV Camera Mount.

The CCTV camera mount shall meet the following requirements:

(A) ITSS Mounted.

An ITSS mounted camera shall be mounted on an ITSS sign structure utilizing a parapet mount arm with a wall bracket. The wall bracket shall allow the parapet mount arm to swing a minimum of 180 degrees and shall include three (3) stainless steel set screws to lock the arm in any position. The ITSS mounted camera parapet mount arm shall include an end cap if required and a Pipe Mount Kit for attachment of the camera to the arm assembly.

(B) Pole Mounted.

A pole mounted camera shall be mounted on a 37-ft. pole as shown on Standard Drawings E-01 to E-04, utilizing the mounting hardware and appurtenances supplied with the specified camera. The pole mount arm shall be manufactured by the same manufacturer as the camera and shall include and integral 24 VAC power supply and a connectorized cable harness for power and communication connections to the camera. The pole mounted camera arm shall include a Pole Mount Adapter if required for attachment to the camera pole.

(C) Camera Lowering Device.

Pole mounted camera with a lowering device shall meet the following requirements:

(1) Structural components shall be heavy-duty cast aluminum alloy or stainless steel

(2) Housing seals shall be flexible polymer water-tight gaskets

(3) All dissimilar metals shall be protected from corrosion

(4) Pulleys shall have sealed, self-lubricated bearings, oil tight, bronze bearings or sintered bronze bushings.

(5) All external components shall be constructed utilizing industry-accepted corrosion resistant materials and coatings capable of withstanding exposure to unclean environments.

(6) Lowering cable at the minimum shall be 1/8-inch diameter stranded stainless steel cable, Breaking Strength minimum shall be 1740 lbs.

(7) Suspension Disconnect Unit:

(a) Load capacity shall be 200 lbs. with a 4:1 safety factor

(b) Suspension contact unit housing shall be weatherproof with gasket seal

(c) Locking mechanism between the fixed and moveable components

(d) The fixed unit shall have a heavy duty cast tracking guide

(8) Electrical Contacts:

(a) Minimum of 12 contacts

(b) Mated pin and socket contacts

(c) Self-aligning contact molded housing

(d) When in locked position, all contacts shall maintain an environmental seal.

(9) Divided Mast Arm

(a) Minimum 2 inch divided connection arm

(b) Provide rigid connection between the suspension disconnect unit and pole tenon assembly

(c) Separates lowering cable from electrical and communication wires

(d) Supports the suspension disconnect unit, camera junction box and camera assembly

(e) Suspension contact unit fitter shall rigidly connect the suspension disconnect unit and isolates the lowering cable from the electrical and communication cables

(1) Material: Heavy-duty cast aluminum alloy

(2) Pulleys: High strength and low resistance

(10) Camera Junction Box

(a) The camera junction box connects the camera to the lowering device, shall be a two-piece design with a 1.5-inch NPT pipe receptacle for easy camera mounting.

(b) Materials – corrosion resistant cast aluminum

(c) It shall contain a large capacity-splicing compartment for camera power, communication leads, and connectors

(11) Composite Cable

The camera lowering device shall be supplied with a direct continuous run of composite cable, wired and sealed from the suspension disconnect unit to the Pole Mounted ITS Enclosure. At a minimum, standard composite cabling shall consist of RG-6 coax cable, low capacitance data cable with individually shielded pairs with a common shield and drain, and 16 gauge low Voltage power cables. The overall cable jacket shall be constructed of polyurethane with a minimum .063 thickness.

(12) Camera Lowering Tool

The camera lowering tool shall be equipped with a portable device for raising and lowering the camera. The tool shall consist of the following two pieces.

(a) The first shall be a manual winch assembly with a lightweight corrosion resistant metal frame, automatically actuated disc brake to prevent freewheeling, pre-formed stainless steel cable, drum assembly, quick release cable connector, and capable of securely attaching to the specified pole.

(b) The second piece shall be a heavy duty double insulated ½" reversible variable speed drill capable of attaching to the winch assembly for powered operation. The drill shall have the following specifications:

(1) Nom. 5 Amp 115V universal motor

(2) Side handle for two handed operation

(3) Torque limiting overload clutch

918.33 Pole Mounted ITS Enclosure.

The Pole Mounted ITS Enclosure shall be provided to the dimensions as shown on the Plans, and sized to fit all components that will be mounted within. Additionally, the enclosure shall meet the following requirements:

(A) Type 5052-H32 Aluminum enclosure with NEMA 3R or 4X rating

(B) Continuously welded and ground smooth seams

(C) Rolled lip around three sides of door and all sides of enclosure opening

(D) Stainless steel panel screws and door clamp assemblies

(E) Easy removable doors by pulling stainless steel continuous hinge pins

(F) High-impact thermoplastic data pocket

(G) Padlockable

(H) Tapped pads for mounting optional panels

(I) Oil-resistant gasket

The Enclosure shall be provided with 2" round drop-in mount aluminum louvers on a side for ventilation. If not an integral part of the enclosure, the louver kit shall be installed as recommended by the manufacturer in such a way as to prevent water leakage into the enclosure.

Pole Mounted ITS Enclosure shall be as manufactured by Hoffman Enclosure Inc, part number A24H2010ALLP or approved equal. Enclosures of different size shall meet all specifications of this model except overall dimensions.

918.34 Video Encoder.

Video Encoders shall be designed to operate in harsh environments and provide for the compression and distribution of CCTV video and control signals over an Ethernet network utilizing non-proprietary industry standards. The encoder shall have the capabilities to control all functions of the CCTV cameras specified. Video transmission shall be via compatible with IEEE 802.3u for 100Base-TX and 100Base-FX. A separate processor shall be utilized for encoding the video stream to the format specified below. The encoder shall be equipped with an environmentally hardened and 100Base-FX SFP multimode transceiver module for fiber optic communications.

The video encoder shall be from an approved supplier as listed on the QPL, and shall be equipped with a 2-wire 18 AWG molded plug line cord and a 2-wire PVC jacketed DC cable for connection to the power supply, and shall meet the following specifications:

(A) ELECTRICAL SPECIFICATIONS.

Operating Temp:	-30ºC to +60ºC	
Construction:	Hardened Device	
Input Voltage:	10 to 30 VDC	
Power Consumption:	< 20W	
Power Connector:	Terminal Block	
Video Connector:	(1) BNC 75Ω	
Data Connector:	RJ45	
Fiber Connectors:	Small Form-Factor Pluggable (SFP) – LC module	
Nominal Wavelength:	1310nm	
SFP Module:	Cisco GLC-FE-100FX-RGD, or equal	
Cable Type:	62.5/125 multi mode	
Dimensions:	7.0" x 7.5" x 3.0" (maximum)	
Video Compression:	H.264, MPEG-2, MPEG-4, and MJPEG	
Video Resolution: (Horizontal x vertical PAL/NTSC)	4CIF (MPEG-4 only)	X10/X20: 704 x 576/480 (25/30 ips) X40: 704 x 576/480 (12.5/15 ips; all inputs used)
	2CIF	704 x 288/240 (25/30 ips)
	2/3 D1	464 x 576/480 (25/30 ips)
	1/2 D1	352 x 576/480 (25/30 ips)
	CIF	352 x 288/240 (25/30 ips)
	QCIF	176 x 144/120 (25/30 ips)
Video Frame Rate:	1 to 60 fps (NTSC)	
Video Bit Rate:	9.6 kbs to 6 Mbps	
Encoding Latency:	< 130 ms (typical)	
Software Compatibility:	Open streaming architecture, compatible with Genetec Omnicast software (Latest Version)	
Camera PTZ Interface:	PTZ interface shall accept various standard camera control protocols, such as Pelco D and Bosch	

918.35 HDPE Conduits and Innerducts.

HDPE conduits and innerducts shall be of High Density Polyethylene (HDPE) construction, and shall be installed continuous without splices. All conduits and innerducts provided shall conform to Schedule 40 pipe dimensional specifications. Conduits and innerducts shall be smooth-walled, both inside and outside, and shall be suitable for direct burial in earth, concrete encasement, and installation through conduits or pipe casings. HDPE conduits and innerducts shall be ETL listed as compliant with National Electrical Code Articles 300 and 353. Each innerduct installed in a group shall have permanent factory-applied exterior markings or color-coding to allow easy differentiation between the multiple conduits.

(A) Dimensional and Fabrication Specifications.

Conduit and inner duct dimension and construction shall meet the standards referenced below:

Standards:	ASTM D2447 Standard Specification for Polyethylene (PE) Pipe, Schedules 40, Based on Outside Diameter
	NEMA TC-7 Smooth-Wall Coilable Polyethylene Electrical Polyethylene Conduit.
	UL 651A Standard for Safety - Type EB and A Rigid PVC Conduit and HDPE Conduit
	UL 651B Standard for Safety - Continuous Length HDPE Conduit

(B) Resin Specifications.

The resin properties shall meet or exceed the values listed below for HDPE:

ASTM Test	Description	Values HDPE
D-1505	Density g/CM 3	0.941 - 0.955
D-1238	Melt Index, g/10 min Condition E	0.05 - 0.50
D- 638	Tensile strength at yield (psi)	3000 min.
D-1693	Environmental Stress Crack Resistance Condition B,F20	96 min.
D-790	Flexural Modulus, MPa (PSI)	80,000 min.
D-746	Brittleness Temperature	-75°C

918.36 Directional Drilled Pipe Sleeves.

Directional drilled pipe sleeves shall be of High Density Polyethylene (HDPE) construction, and shall be installed continuous without splices. All sleeves provided shall be of SDR type with constant outer diameter (O.D.) dimension and variable wall thickness. Sleeves shall be smooth-walled, both inside and outside, and shall be suitable for direct burial in earth and concrete encasement. Provide sleeves with sufficient wall thicknesses to ensure that the rated pulling tension or bending radius of the sleeve is not exceeded during installation.

(A) Dimensional and Fabrication Specifications.

Pipe sleeves dimension and construction shall meet the standards referenced below:

Standards:	ASTM D3035 Polyethylene (PE) Plastic Pipe (SDR) Based on Controlled Outside Diameter.
	ASTM F2160 Solid wall High Density Polyethylene (HDPE) Conduit based on Controlled Outside Diameter (O.D.)

(B) Pipe Sleeve Size.

Pipe sleeves shall be 16" diameter unless otherwise noted on the Plans or approved by the Engineer.

(C) RESIN SPECIFICATIONS.

The resin properties shall meet or exceed the values listed below for HDPE:

ASTM Test	Description	Values HDPE
D-1505	Density g/CM 3	0.941 - 0.955
D-1238	Melt Index, g/10 min Condition E	0.05 - 0.50
D- 638	Tensile strength at yield (psi)	3000 min.
D-1693	Environmental Stress Crack Resistance Condition B,F 20	96 min.
D-790	Flexural Modulus, MPa (PSI)	80,000 min.
D-746	Brittleness Temperature	-75°C

918.37 Traffic Detection System – In-Pavement Wireless Detection.

(A) GENERAL REQUIREMENTS.

These specifications define requirements for components for an In-Pavement Wireless Traffic Detection System. The system shall be comprised of battery powered wireless traffic sensors installed under the pavement surface that communicate with a local Access Point device which in turn communicates with the Authority's existing Traffic Detection System server for traffic data collection, processing and dissemination.

Detection data shall be fully compatible with the Authority's existing traffic detection central software system and shall provide the following measurements:

(1) Vehicle volume (count) per lane over a specified time interval

(2) Lane occupancy (percent) over a specified time interval

(3) Vehicle speed (mph or kph)

  (a) Per-vehicle speed

  (b) Median speed over a specified time interval

  (c) Mean speed over a specified time interval

  (d) Distribution of speeds over a specified time interval, with a resolution of 1 mph/ 2 kph

(4) Vehicle classification

  (a) Per-vehicle length

  (b) Distribution of speeds over a specified time interval, with a resolution of 1 foot/ 0.5 meters

(5) The time interval for measurements shall be selectable, including at least the following intervals:

  (a) 30 seconds

  (b) 1 minute

  (c) 5 minutes

  (d) 15 minutes

  (e) 1 hour

  (f) 24 hours

The various traffic detection system components shall communicate using low-power radio technology to send time-stamped detection event data. All communications between the roadway sensors and nearby access points shall be without any lead-in cabling or other wires. The radios employed by the system shall operate in the globally available 2.4 GHz unlicensed frequency band and shall be based on the IEEE 802.15.4 PHY industry standard. As defined by the 802.15.4 PHY standard, the wireless detection system shall operate on 16 defined channels in the 2.4 GHz band.

Data for each event shall be sent as it occurs, or as many as 16 events shall be buffered at the sensor and transmitted at a fixed reporting interval or whenever the buffer is nearly full (synchronized reporting).

Sensor firmware shall be remotely upgradeable by transmission from the access point without requiring removal or local intervention. Access Point/Repeater firmware shall be remotely upgradeable by transmission from the central computer without requiring removal or local intervention. The detection system shall have the ability to individually turn off polling to spare or failed sensors in order to minimize polling time and maximize spare sensor battery life. The sensor spacing for each lane shall be able to be set to either 20 feet for normal operation or 40 feet for when a center sensor fails.

The communication subsystem of the wireless battery-powered magnetometer vehicle detection system shall further conform to the Sensys NanoPower (SNP) protocol, or an approved equal.

The wireless access point shall communicate the data received from the wireless sensors to the network switch in the Systems Control Cabinet through an outdoor rated network cable from the access point to the power injector and from the power injector to the network switch.

(B) TRAFFIC SENSOR WIRELESS ACCESS POINT (TS-WAP).

The Traffic Sensor Wireless Access Point shall serve as a communication hub for the in-pavement wireless sensors (918.37 D). A wireless access point shall be able to support at least 48 sensors. An access point shall be factory-configured to support powering from a Power-Over-Ethernet Power Injector with 110VAC input. Maximum power consumption of the wireless access point shall be 2 Watts.

The wireless access point shall operate at temperatures from –37° F (-38.3° C) to +176° F (+80° C). All components of the wireless access point shall be contained in a single housing. The housing shall conform to NEMA Type 4X and IEC IP67 standards and shall be no larger than 12″ H x 8″ W x 4″ D. The housing shall include an adjustable mounting bracket for optimum radio signal alignment with the sensors and attachment to a vertical or horizontal surface.

(1) The access point shall have a host processor, a minimum of 4 MB of flash memory, and a minimum 16 MB of DRAM. The access point shall have an Ethernet interface with the following characteristics:

   (a) 10/100 BaseT

   (b) IP address via DHCP or static

   (c) IP67 RJ45 bulkhead connector

   (d) Proprietary Power Over Ethernet (12V to 24V)

   (e) Standard Power Over Ethernet (36V to 60V)

(2) The access point shall be capable of TCP/IP support as follows:

   (a) Protocols supported: Telnet, FTP, HTTP, PPP, PPTP

   (b) Tunneling to VPN shall allow a connection to the access point without a static address

   (c) Encryption over Tunnel

The access point shall be capable of storing and forwarding to the server a minimum of ###### of sensor data after recovering from a temporary interruption of sensor-to-access point or access point-to server communications.

The access point shall be provided with a software utility for local or remote configuration, real-time operational monitoring, and diagnostics of the access point from a Windows OS computer.

(C) TRAFFIC SENSOR WIRELESS REPEATER (TS-WR).

The Traffic Sensor Wireless Repeater shall be capable of communicating with a Traffic Sensor Wireless Access Point and In-Pavement Wireless Sensors and shall serve as a data-transparent extension between these devices. The Wireless Repeater shall be IEEE 802.15.4 PHY protocol compliant and shall be capable relaying data packets at a rate of 80 packets per second over a distance of up to 1,000 feet between the access point and repeater.

The Traffic Sensor Wireless Repeater shall operate at temperatures from –40° F (-40° C) to +176° F (+80° C). All components of the Wireless Repeater shall be contained in a single housing. The housing shall conform to NEMA Type 4X and IEC IP67 standards.

The Wireless Repeater shall be battery powered with a minimum operational battery life of eight (8) years. Repeater batteries shall be owner replaceable. Maximum power consumption of the wireless repeater shall be 2 Watts.

(D) IN-PAVEMENT WIRELESS SENSOR.

The in-pavement wireless sensor shall detect vehicles by measuring changes in the earth's magnetic field near the sensor as caused by stopped or passing vehicles travelling at freeway speeds. The sensor shall sample the earth's magnetic field at a rate of 128 Hz. The sensor shall communicate time-stamped ON and OFF vehicle detection events. As an option, the sensor shall provide a mode where the complete X-Y-Z magnetic signatures of detected vehicles are transmitted as data. Each sensor shall automatically recalibrate in the event of a detector lock.

The wireless sensor shall have dimensions of 2.9-inch length, 2.9-inch width, and 1.9-inch height. It shall conform to the following RF specifications:

(1) IEEE 802.15.4 Standard Compliant

(2) Operate in any one of 16 MHz channels in the 2.4 – 2.48 GHz ISM band

All sensor components shall be contained within a single housing. The sensor housing shall conform to NEMA Type 6P and IEC IP68 standards. The sensor components shall be fully encapsulated within the housing to prevent moisture from degrading the components. The sensor housing shall be capable of being installed in a 4-inch diameter hole approximately 2 ¼ inches deep. It shall operate at temperatures from –37° F (-38.3° C) to +176° F (+80° C). The wireless sensors shall be battery-operated with an average lifetime of ten (10) years when the sensor is configured for and operating under normal traffic conditions

918.38 Traffic Sensor Wireless Access Point (TS-WAP).

The Traffic Sensor Wireless Access Point shall serve as a communication hub for the in-pavement wireless sensors (918.33). A wireless access point shall be able to support at least 48 sensors. An access point shall be factory-configured to support powering from a Power-Over-Ethernet Power Injector with 110VAC input. Maximum power consumption of the wireless access point shall be 2 Watts.

The wireless access point shall operate at temperatures from –37° F (-38.3° C) to +176° F (+80° C). All components of the wireless access point shall be contained in a single housing. The housing shall conform to NEMA Type 4X and IEC IP67 standards and shall be no larger than 12" H x 8" W x 4" D.

(A) The wireless access point shall consist of a Sensys Networks AP240-E Access Point or approved equal. The access point shall have a host processor consisting of 66 MHz Coldfire processor, 4 MB of flash memory, and 16 MB of DRAM. The Ethernet interface shall have the following characteristics:

(1) 10/100 BaseT

(2) IP address via DHCP or static

(3) IP67 RJ45 bulkhead connector

(4) Proprietary Power Over Ethernet (12V to 24V)

(5) Standard Power Over Ethernet (36V to 60V)

(B) The access point shall be capable of TCP/IP support as follows:

(1) Protocols supported: telnet, ftp, http, PPP, PPTP

(2) Tunneling to VPN shall allow a connection to the access point without a static address

(3) Encryption over Tunnel

918.39 Traffic Sensor Wireless Repeater (TS-WR).

The Traffic Sensor Wireless Repeater shall operate at temperatures from –40° F (-40° C) to +176° F (+80° C). All components of the Wireless Repeater shall be contained in a single housing. The housing shall conform to NEMA Type 4X and IEC IP67 standards.

The Wireless Repeater shall consist of a Sensys Networks model RP240-B-LL with a minimum battery backup of Eight (8) years.

Maximum power consumption of the wireless repeater shall be 2 Watts.

Wireless Repeater shall be IEEE 802.15.4 PHY protocol compliant.

918.40 In-pavement Wireless Sensor.

The in-pavement wireless sensor shall detect vehicles by measuring changes in the earth's magnetic field near the sensor as caused by a stopped or passing vehicle. The sensor shall sample the earth's magnetic field at a rate of 128 Hz. The sensor shall communicate time-stamped ON and OFF vehicle detection events. As an option, the sensor shall provide a mode where the complete X-Y-Z magnetic signatures of detected vehicles are transmitted as data. Each sensor shall automatically recalibrate in the event of a detector lock.

The wireless sensor shall have dimensions of 2.9-inch length, 2.9-inch width, and 1.9-inch height. It shall conform to the following RF specifications:

(A) IEEE 802.15.4 Standard Compliant

(B) Operate in any one of 16 MHz channels in the 2.4 – 2.48 GHz ISM band

All sensor components shall be contained within a single housing. The sensor housing shall conform to NEMA Type 6P and IEC IP68 standards. The sensor components shall be fully encapsulated within the housing to prevent moisture from degrading the components. The sensor housing shall be capable of being installed in a 4-inch diameter hole approximately 2 ¼ inches deep. It shall operate at temperatures from –37° F (-38.3° C) to +176° F (+80° C). The wireless sensors shall be battery-operated with an average lifetime of ten (10) years when the sensor is configured for and operating under normal traffic conditions.

The in-pavement wireless sensors shall be battery powered and have an expected battery lifetime of 10 years.

The in-pavement wireless sensor shall be a Sensys Networks VSN240-f Wireless Sensor or approved equal.

918.41 Power Injector.

The power injector shall have the following features:

(A) Lightning and surge protection on data and power lines

(B) Industrial grade cast aluminum housing

(C) Shielded RJ-45 jacks EMI noise suppression

(D) RoHS Compliant (Individual Injector)

(E) The power injector shall be in compliance with the following specifications:

(1) Electrical Specifications:

Operating Temperature:	-40° C to +70° C
Output Current:	1 A
Power Connector:	Standard 2.5mm Coaxial DC Power Jack (2.5mm x 5.5mm x 10mm Center Positive Plug Required)
Output Voltage	48VDC, +2% max line & load
Input Voltage:	90-264 VAC
Over Voltage Protection:	110-125%
Over Current Protection:	115-150%(auto-recovery)
Short Circuit Protection:	Continuous
Surge Protection:	EN61000-4-5, +2KV Line-Earth, +1KV Line-Line
Ethernet Connectors:	(2) RJ45 Jack
Data Lines:	Pair 1: Pins 1 and 2 Pair 2: Pins 3 and 6
CAT-5 Power Pinouts:	+ VDC: Pins 4 & 5- VDC: Pins 7 & 8

(2) Mechanical Specifications:

Weight:	.28 lbs. (.13 kg)
Dimensions:	6.5 x 3.0 x 1.5 (inches)
Enclosure:	Cast Aluminum or Polycarbonate

RoHS Compliant:	Yes

The power injector shall be a industrial grade Power-over-Ethernet (PoE) device that provides DC power for one PoE-equipped device. It shall be compatible with access points and other equipment supporting the IEEE standard PoE pinout (Pins 4 & 5 Power + / Pins 7 & 8 Power -).

The power injector shall contain an internal DC power supply with over-Voltage, over-current and short circuit protection along with a removable 3-wire AC power cord.This unit shall be capable of being used as either an "Injector" or as a "Tap". When used as an injector the device shall send DC power through the Ethernet cable to a remote PoE device. When used as a "Tap" the unit shall tap the injected DC power from the Ethernet cable for use by certain non-PoE devices.

The power injector shall have an integral lightning and surge protection which individually protects the 4 data lines as well as protection for the power lines. The limits are +/- 15 Volts on pins, 1, 2, 3, 6 and +/- 58 Volts on pins, 4, 5, 7 and 8.

The power injector shall have shielded RJ45 jacks. This along with the unit's metal housing shall help reduce the effects of EMI interference. A ground lug and terminal shall be provided directly on the injector housing providing superior grounding and shall be grounded.

918.42 Epoxy.

The epoxy shall be a black two (2) part, self-leveling, 100% solid polyurea based joint sealant with a 2:1 volume ratio. It shall be capable of being applied at temperatures ranging from 20° F to 180° F and have a five (5) minute typical tack-free curing time.

The epoxy shall have the following physical properties, depending on the volume ratio:

Specification	Standard	Volume Ratio	
		2: 1	1:1
Tensile Strength	ASTM D412	2950	1500
Elongation (%)	ASTM D412	350	800
100% Modulus	ASTM D412	1620	1400
Tear Strength (PLI)	ASTM D412	500	450
Hardness (Shore A)	ASTM D2240	95A	85A
Flexibility (1/8" Mandrel)	ASTM D1737	PASS	PASS
Flashpoint (ºF)	ASTM	>200	>200

918.43 Media Converter.

The media converter shall have the following characteristics:

(A) 10/100Base –TX to 100Base-FX Conversion

(B) Comply with NEMA TS1 & TS2 Environmental requirements

(C) Multi-Mode SC fiber optic terminations

(D) Hardened aluminum case

(E) Supports DIN-Rail, Panel or Rack Mounting

(F) The media converter shall be in compliance with the following specifications:

(1) Electrical Specifications:

Operating Temperature:	-40° C to +75° C
Input Voltage:	10 to 48VDC
Maximum Current:	3 A @ 12V
Power Connector:	Terminal Block or Power Jack
Ethernet Connectors:	(1) RJ45 Jack
Fiber Connectors:	Multimode SC

Nominal Wavelength:	1310nm
Cable Type:	62.5/125 multi mode
Optical Budget:	15 dB
Packet Buffer Memory:	768K bits
Latency:	Less than 128.9µs

(2) Mechanical Specifications:

Weight:	1.76 lbs.
Dimensions:	1.97x4.33x5.35 (inches)
Enclosure:	Aluminum

The Media Converter shall be as manufactured by EtherWAN, Media Converter part number EL900-A-B-I-B with a power supply part number 41-136044-1.

918.44 CCTV Remote Power Unit.

The CCTV Remote Power Unit shall consist of a complete assembly comprised of a weatherproof enclosure with a low Voltage power supply, PTZ terminal blocks, coaxial camera video terminal block, fuses, and other components as supplied by the manufacturer. The Remote Power Unit shall be provided with all required mounting hardware in order to provide attachment as shown on the Plans.

The CCTV Remote Power Unit shall be Bosch model VG4-A-PSU1 Outdoor Power Supply Box, with required mounting hardware.

918.45 Fiber Termination Panel.

(A) The Fiber Termination Panel (FTP) for installation within a pole mounted ITS Enclosure shall be a compact wall or DIN rail mountable unit for interconnectivity and termination of optical fibers with the following general requirements.

(1) General Requirements:

Maximum Dimensions:	6.30”H x 5.50”Wx1.57”D
Fiber Capacity:	Minimum of Six (6) Single SC connectors
Material:	18 Gauge Steel
Coating:	Electrostatic polyester powder coat paint

Each fiber termination panel shall be provided with a minimum of 6 simplex multi-mode SC connector ports. Multi-mode adapter connectors shall be color coded beige. A DIN rail mountable unit shall be provided with a suitable length of rail for attachment to the ITS Enclosure back panel.

(B) The 12-Port Fiber Termination Panel (FTP) for installation within a System Control Cabinet shall be a compact 19″ rack mountable unit for interconnectivity and termination of optical fibers with a swing out master panel for accessing terminations and splicing. The panel shall be provided with 19″ rack mounting hardware and meet the following general requirements:

(1) General Requirements for 12-Port FTP at SCC:

Dimensions:	1.87”H x 17.0”Wx9.75”D
Fiber Capacity:	Two (2) fiber optic adapter panels (12 ports total)
Material:	16 Gauge Steel
Coating:	Black electrostatic applied power coat

Each SCC fiber termination panel shall be provided with two (2) 6-port fiber adapter panel with simplex multi-mode SC connectors. Multi-mode adapter connectors shall be color coded beige. Each connector shall be provided with a plastic dust cap for protection when not in use.

(C) The 36-Port Fiber Termination Panel (FTP) for installation within a System Control Cabinet shall be a compact 19″ rack mountable unit for interconnectivity and termination of optical fibers with a slide out

master panel for accessing terminations and splicing. The panel shall be provided with 19" rack mounting hardware and meet the following general requirements:

(1) General Requirements for 36-Port FTP at SCC:

Dimensions:	1.75"H x 17.0"Wx 14.0"D
Fiber Capacity:	Three (3) fiber optic adapter panels (36 ports total)
Material:	16 Gauge Steel
Coating:	Black electrostatic applied power coat

Each SCC 36-port fiber termination panel shall be provided with three (3) 12-port fiber adapter panels with the following configuration:

(a) One (1) 12-port adapter with six (6) multi-mode ST duplex connectors

(b) One (1) 12-port adapter with six (6) multi-mode SC duplex connectors

(c) One (1) 12-port adapter with six (6) single mode SC duplex connectors

The adapter panels shall be manufactured to be physically compatible with and have the same finish as the provided FTP enclosure. Multi-mode adapter connectors shall be color coded beige. Single mode adapter connectors shall be color coded blue. Each connector shall be provided with a dust cap for protection when not in use.

918.46 Rodent Blocking.

The rodent blocking material shall consist of a wad of corrosion resistant metallic mesh, such as Stuff-It or Copper Blocker brand copper mesh or approved equal, and capped with a pest control foam sealant, such as IPF Foam from Todol Products or approved equal.

918.47 Polymer Concrete Junction Box.

Polymer concrete junction box Type PS shall be of configuration and dimensions as shown on the plans and shall be as manufactured by Quazite Part No. PG3660DC36 with Quazite Junction Box Cover Part No. PG3660HA00 or approved equal.

918.48 Network Switch.

The Network Switch installed in the Systems Control Cabinet shall be 19" rack mounted, environmentally hardened Layer 2 switch and shall be modular in design. The switch shall consist of a core unit with two dual-purpose backhaul ports, configurable for either 10/100/1000 Ethernet or SFP-based Gigabit fiber optics, and eight 10/100 TX down-link ports. The fiber optic backhaul ports shall be configurable for single mode or multi-mode fiber with LC connector SFP transceivers. The core unit shall be expandable by direct connection to an 8 port 10/100Base TX or 100Base FX fiber optic port expansion module and dual AC input, DC output power supplies. The core unit shall be equipped with a compact flash memory card for storage of the switch configuration settings. The switch operating system shall be ISO Layer 2 based with encryption functionality.

The network switch assembly shall include all mounting brackets, DIN rails, terminal blocks, cables, power cords, jumper clips, patch cords, and any other hardware necessary for an operational and complete system.

Software configuration engineering and implementation of the network switch shall be the responsibility of the Authority and shall not be included in the bid price for this item.

The Network Switch core unit shall be Cisco model IE-3000-8TC. It shall be equipped with two (2) AC input power supplies, Cisco model PWR-IE3000-AC=, and a 19-inch rack mounting kit, Cisco model STK-RACKMNT-2955=. The 8 port 10/100Base TX expansion module shall be Cisco model IEM-3000-8TM=. The 8 port 100Base FX expansion module shall be Cisco model IEM-3000-8FM=. Expansion modules shall only be required if and where indicated on the plans.

918.49 Coaxial Cable.

Coaxial Cable RG-6 cable shall consist of 18AWG solid bare copper conductors with foam polyethylene insulation be model 9290 Coax – 75 Ohm as manufactured by Belden or approved equal.

Specifications for the cable shall be as follows:

Number of Coax Conductors:	1
Conductor Stranding:	Solid

Conductor Material:	Bare Copper
Insulation Material:	Foam Polyethylene
Outer Jacket Material:	PVC – Polyvinyl Chloride
Outer Shield %Coverage:	95 %
Overall Nominal Diameter:	0.288 inches
Operating Temperature Range:	-40°C To +80°C
Installation Temperature Range:	-25°C To +75°C
Bulk Cable Weight:	54 lbs/1000 feet
Max. Recommended Pulling Tension:	108 lbs.
Min. Bend Radius (Install):	2.80 inches
NEC/UL Specification:	CM
EU RoHS Compliant (Y/N):	Yes
EU RoHS Compliance Date	01/01/2004
RG Type:	6/U
Suitability – Outdoor:	Yes
Suitability – Indoor:	Yes
Impedance:	75 Ohm
Oil Resistance:	Yes
Nominal Conductor DC Resistance @ 20 Deg. C:	7.5 Ohms/1000 ft
Max. Operating Voltage – UL:	300 V RMS
Flame Test	UL1685 UL Loading

918.50 PoE Surge Protector.

(A) PoE Surge Protector, Standard Power.

The Standard Power-over Ethernet (PoE) surge protector shall be a high performance lightening protector for 10/100 Base-T networks. The surge protector shall provide protection for two Category 5e Ethernet data pairs and the PoE DC power feed.

The surge protector shall employ high speed solid state protection and shall be UL listed for Primary (497) and Isolated Loop (497B) applications. The surge protector shall meet or exceed the TIA/EIA Standards 568 and 758 for CAT 5e performance and shall comply with pinouts and the operating Voltage of IEEE 802.3af.

The surge protector shall include modular RJ45 jacks for both the line side and equipment side connections. The unit shall be furnished with an external copper ground lug for bonding the protection device and cable shield to earth ground.

(1) Electrical Specifications:

Data Clamping Voltage:	16 Volts
PoE Clamping Voltage:	68 Volts
Clamping Response Time:	1-5 Nanoseconds
Capacitance:	< 20 pF

(2) Additional Specifications:

Copper Ground Lug:	10 AWG Max.
Operating Temperature:	-40 C (-40 F) to +80 C (+176 F)
Nominal Dimensions:	4.5 x 4.5 x 1.5 (inches)

(B) PoE Surge Protector, High Power.

The High Power-over Ethernet (PoE) surge protector shall be a high performance lightening protector for 10/100 Base-T networks. The surge protector shall provide protection for two Category 5e Ethernet data pairs and a high power PoE DC power feed.

The surge protector shall employ high speed solid state protection and shall be UL listed for Primary (497) and Isolated Loop (497B) applications. The surge protector shall meet or exceed the TIA/EIA Standards 568 and 758 for CAT 5e performance and shall comply with pinouts and the operating Voltage of IEEE 802.3at.

The surge protector shall include modular RJ45 jacks for both the line side and equipment side connections. The unit shall be furnished with an external copper ground lug for bonding the protection device and cable shield to earth ground.

(1) Electrical Specifications:

Data & PoE Clamping Voltage:	75 Volts
Clamping Response Time:	1-5 Nanoseconds
Capacitance:	< 20 pF

(2) Additional Specifications:

Copper Ground Lug:	10 AWG Max.
Operating Temperature:	-40 C (-40 F) to +80 C (+176 F)
Nominal Dimensions:	4.5 x 4.5 x 1.5 (inches)

918.51 CCTV Surge Protector.

The CCTV surge protector shall be a high performance lightening protector for Pan-Tilt-Zoom (PTZ) camera networks. The surge protector shall provide protection for two PTZ data pairs, one analog video feed and two 12VDC/24VAC power wires.

The surge protector shall employ high speed solid state protection and shall be UL listed for Primary (497) and Isolated Loop (497B) applications. The surge protector shall provide complete lightning and surge protection for outdoor/indoor mounted PTZ cameras.

The surge protector shall include 75-Ohm BNC connectors for both the line side and equipment side video connections and shall include barrier terminal blocks for both the line side and equipment side PTZ and power connections. The surge protector shall include LED indicators to indicate that the unit is functional and capable of providing surge protection. The unit shall be furnished with an external copper ground lug for bonding the protection device and cable shield to earth ground.

The PoE surge protector shall be ITW Linx model MSL-PTZ-BNC or approved equal.

(A) Electrical Specifications:

Data Clamping Voltage	7.5 Volts
Power Circuit Clamping Voltage	30VAC / 45VDC
Video Clamping Voltage	2.8 Volts
Clamping Response Time	1-5 Nanoseconds
Data Line Capacitance	<50pF

(B) Mechanical Specifications:

Copper Ground Lug	10 AWG Max.
Operating Temperature	-40 C (-40 F) to +80 C (+176 F)
Nominal Dimensions	4.5 x 4.5 x 1.5 (inches)

918.52 Variable Message Signs (VMS).

Enclosure:	Shallow depth with front or rear accessibility for maintenance

Panel Height (max):	8ft – 6 in (Rear Access), 8ft – 6 in (Front Access)
Panel Width(max):	26ft – 6 in (Rear Access), 24ft – 0 in (Front Access)
Panel Depth(max):	1ft – 5 in (Rear Access), 1ft – 5 in (Front Access)
Weight (max):	2500 lbs (Rear Access), 2500 lbs (Front Access)
Display Modules:	Exposed face modular LED boards (no mask) removable from the front or rear of the sign.
Pixels:	RGB pixels, 20mm pitch (distance between pixels). 30 Deg nominal viewing cone with a half power angle of 15 Deg.
Communications:	NTCIP (version 2 draft for color and graphics)
Power Source:	120/240VAC, Single Phase
Max. Power:	6400 Watts

VMS shall be manufactured with lifting eye bolts for moving and installation purposes.

918.53 Variable Speed Limit Signs (VSLS).

VSLS are oversized MUTCD Speed Limit panels with LED modules used for variable speed indication. Modules are of the same type and size as those used for the VMS.

Configuration:	Full matrix, full color LED, capable of displaying two-digit speed limits. Typical operation will be white numerals on black background.
Enclosure:	Sign enclosure is rear accessible for maintenance.
Height (max):	6ft – 0 in
Width (max):	5ft – 0 in
Depth (max):	1ft – 0 in
Weight (max):	250 lbs
Display Modules:	Exposed face modular LED boards (no mask) removable from the rear of the sign.
Pixels:	RGB pixels, 20mm pitch (distance between pixels). 30 Deg nominal viewing cone with a half power angle of 15 Deg.
Communications:	NTCIP (version 2 draft for color)
Power Source:	120/240VAC, Single Phase.
Max. Power:	300 Watts

918.54 Hybrid Changeable Message Sign (HCMS).

HCMS signs are the combination or rotating drum panels and embedded Variable Message Sign modules. Following are the general Characteristics of the Sign Module.

Enclosure:	Sign enclosure is non-walk-in with rear accessibility for maintenance.
Front Display Modules:	Rotating Drum Panels with Exposed face modular LED boards removable from the rear of the sign.
Pixels:	RGB pixels, 20mm pitch (distance between pixels). 30 Degree nominal viewing cone with a half power angle of 15 Deg.
Communications:	NTCIP (version 2 draft for color and graphics; not ratified)
Power Source:	120/240VAC, Single Phase
Front Panel Height (max):	9ft – 8 in (Ramp)
Front Panel Height (max):	9ft – 8 in (Mainline)
Panel Width (max):	20ft (Ramp)

Panel Width (max):	33ft (Mainline)
Panel Depth(max):	2ft – 6 in (Ramp)
Panel Depth(max):	2ft – 6 in (Mainline)
Weight (max):	4500 lbs (Ramp)
Weight (max):	9000 lbs (Ramp)
Max. Power:	10000 Watts

918.55 Portable Variable Message Sign (PVMS).

The PVMS shall meet the following specifications:

(A) Type.

The PVMS shall utilize a three (3) line LED display. Each display pixel shall be formed from a minimum of 4 amber LEDs with a maximum horizontal and vertical spacing of 2".

(B) Visibility.

The PVMS shall be capable of displaying a minimum of three lines of 18-inch high characters with eight characters per line. Messages shall be visible from a minimum distance of ½ mile under normal day and night conditions and clearly legible from a minimum distance of 1,000 feet and a minimum total viewing angle of 30° under all weather and lighting conditions.

(C) Protection.

The PVMS display panels shall be protected from water, dust, and debris without reducing message visibility under all lighting conditions and angles. The PVMS display shall be designed to minimize or, preferably, eliminate the potential for message "wash-out" caused by direct sunlight or artificial lighting.

(D) Intensity Control.

The PVMS shall incorporate an automatic intensity control feature in order to keep the LED intensity constant with a reduction in voltage and changes in ambient temperature. The PVMS shall also include a photo-control to automatically adjust the LED intensity to provide optimum message legibility in all ambient lighting conditions.

(E) Environment.

The complete PVMS assembly, including sign, controller, and power system shall be designed to operate continuously over a minimum ambient temperature range of -30° to +165° F and shall be unaffected by relative humidity from 0% to 95% non-condensing. The sign, controller, and power system enclosures shall meet the requirements for NEMA rating 3R.

(F) Structure.

The trailer mounted PVMS shall be structurally adequate to withstand sustained freeway travel speeds of 65 miles per hour with the sign panels in the travel position. When in operation with all stabilizing devices in place, the sign shall be capable of withstanding wind gusts up to 72 miles per hour without overturning or changing orientation and shall be capable of withstanding wind gusts up to 100 miles per hour without damage.

(G) Support.

The PVMS sign panel shall be supported on a telescoping upright member to permit raising the sign for operation and lowering the sign for transport. The lifting mechanism shall use an electro-hydraulic pump with a hydraulic cylinder. Raise and lower travel shall nominally be 5 feet and shall be at least 7 feet above ground when in the raised position. The sign supporting member shall include a device to enable 360° rotation of the sign and shall lock into the position to which it is manually rotated. In the transport position, the sign shall orient to the longitudinal axis of the trailer and securely lock in place.

(H) Control.

The PVMS shall be controlled in all functions by an on-board dedicated computer controller. The controller shall be a fully self-contained, compact, solid state, modularized, and removable unit with an integral or removable LCD display screen and a removable (non-integral) keyboard for local control, configuration,

and diagnostics. The controller shall have the dual capability of allowing messages to be programmed and activated locally from the on-board keyboard and display, and remotely through a digital cellular modem. The controller software shall be menu driven and shall show a miniaturized version of the message being displayed, or to be displayed, on the sign panel. Access to the controller software shall be password protected and it shall be possible to remotely change the password by an operator with system administrator privileges. The controller unit shall be housed in a lockable NEMA 3R enclosure, but shall continue to operate, without harmful effect, in the rain with the enclosure door left open.

918.56 Portable Variable Speed Limit Sign (PVSLS).

The PVSLS shall meet the following specifications:

(A) Display Panel.

The PVSLS shall utilize a white LED display module insert in an MUTCD compliant black and white speed limit sign panel. The LED display module shall be capable of producing 18-inch height, white on black or black on white, numeric characters utilizing either monochrome white LEDs or a combination of red, green, and blue (RGB) LEDs.

(B) Protection.

The PVSLS display panels shall be protected from water, dust, and debris without reducing message visibility under all lighting conditions and angles. The PVMS display shall be designed to minimize or, preferably, eliminate the potential for message "wash-out" caused by direct sunlight or artificial lighting.

(C) Visibility.

The PVSLS messages shall be visible from a minimum distance of ½ mile under normal day and night conditions and clearly legible from a minimum distance of 1,000 feet and a minimum total viewing angle of 30^{o} under all weather and lighting conditions.

(D) Intensity Control.

The PVSLS shall incorporate an automatic intensity control feature in order to keep the LED intensity constant with a reduction in voltage and changes in ambient temperature. The PVMS shall also include a photo-control to automatically adjust the LED intensity to provide optimum message legibility in all ambient lighting conditions.

(E) MUTCD Requirements.

Because the PVSLS will serve as temporary replacements for enforceable variable speed limit signs on the NJ Turnpike, they will be operating 24 hours a day/7 days per week, must be MUTCD compliant, and they must be equipped with electronic hardware and software to continuously monitor and report the sign's operational status, including the posted speed limit and the operational status of all display pixels.

(F) Environment.

The complete PVSLS assembly, including sign, controller, and power system shall be designed to operate continuously over a minimum ambient temperature range of -30^{o} to $+165^{o}$ F and shall be unaffected by relative humidity from 0% to 95% non-condensing. The sign, controller, and power system enclosures shall meet the requirements for NEMA rating 3R.

(G) Structure.

The trailer mounted PVSLS shall be structurally adequate to withstand sustained freeway travel speeds of 65 miles per hour with the sign panels in the travel position. When in operation with all stabilizing devices in place, the sign shall be capable of withstanding wind gusts up to 72 miles per hour without overturning or changing orientation and shall be capable of withstanding wind gusts up to 100 miles per hour without damage.

(H) Support.

The PVSLS sign panel shall be supported on a hinged upright support to permit raising the sign for operation and lowering the sign for transport. The sign display shall be at least 7 feet above ground when in the raised position. In the transport position, the sign shall orient to the longitudinal axis of the trailer and securely lock in place.

(I) CONTROL.

The PVSLS shall be controlled in all functions by an on-board dedicated computer controller. The controller shall be a fully self-contained, compact, solid state, modularized, and removable unit with an integral or removable LCD display screen and a removable (non-integral) keyboard for local control, configuration, and diagnostics. The controller shall have the dual capability of allowing speed limits to be programmed and activated locally from the on-board keyboard and display, and remotely through a digital cellular modem. The controller software shall be menu driven and shall show a miniaturized version of the speed limit being displayed on the sign panel. Access to the controller software shall be password protected and it shall be possible to remotely change the password by an operator with system administrator privileges. The controller unit shall be housed in a lockable NEMA 3R enclosure, but shall continue to operate, without harmful effect, in the rain with the enclosure door left open.

918.57 Radio Antenna.

The Radio Antenna shall be as described in the Contract Plans. The installation and alignment of the Radio Antenna shall be performed by the Contractor. It shall be the Contractor's responsibility to furnish and install the radio communications materials to be installed under this item. Installation of the antenna (including furnishing of mounting hardware as required), alignment of the antenna, and coordination with the Engineer for the Authority to test and commission the radio communications link shall be performed by the Contractor. Each ITSS structure shall have its own radio cabled back to the SCC. The Contractor shall provide and install appropriate outdoor rated network cable and surge protector between the radio and SCC.

The work shall include furnishing and installing the Radio Antenna Mount, POE Injector , surge protector, all cabling, connectors and patch cords for connection between the radio and surge protector, surge protector and power injector, and the power injector and network switch in the SCC complete with all necessary hardware and fittings as shown on the Plans. The mount shall consist of an aluminum pipe mounted in a stainless steel sleeve. The sleeve shall be mounted to the sign structure as shown on the plans and as directed by the Engineer.

The Contractor shall furnish and install the radio antenna mounts as shown on ITS Standard Drawings. Final location of the mount and the mounting height shall be coordinated with the Engineer.

918.58 End Node Radio.

The wireless End Node Radio shall be as described in the Contract Plans. Installation and alignment of the End Node Radio Antenna shall be performed by the Contractor. Coordinate with the Authority to test, configure and commission the radio communications link. Each ITSS structure shall have its own radio cabled back to the SCC. The Contractor shall furnish and install the outdoor rated network cable and surge protector between the radio and SCC and CAT-5 patch cords between the surge protector, power injector and network switch.

SECTION 919 - LANDSCAPING MATERIALS.

919.01 Tree Paint.

Tree paint shall be an antiseptic, waterproof, adhesive, and elastic material such as asphalt, gutta percha and certain oils with a fungicide, and which remains tacky for four hours and retains its elasticity after setting when tested under the heat of the hand. It shall be especially prepared for tree surgery and shall be approved by the Engineer. Tree paint shall not contain kerosene, coal tar creosote, or other material harmful to the living tissue of the trees.

919.02 Cement for Mortar.

Cement for mortar shall conform to ASTM C150, Type I or Type II.

919.03 Aggregates.

Aggregates consisting of fine aggregates for mortar, broken stone Size No. 3 or 4, and gravel Size No. 57 shall conform to the requirements of Section 902.

919.04 Subsurface Drain.

Subsurface drain shall be pipe conforming to the requirements of AASHTO M252 or ASTM D2729 for polyethylene corrugated tubing and polyvinyl chloride pipe respectively.

919.05 Rubble Stone.

Rubble stone shall consist of trap rock, granite, gneiss or other approved hard, durable, tough rock. They shall be sound, free from weathered or decomposed pieces, shattered ends, structural defects, and shall be approved by the Engineer.

For tree wells, the face stones shall be not less than 4 and not more than 12 inches in height. The width (normal to face) shall be not less than 8 inches and the length not less than 1.5 and not more than 3 times the height. Sixty-five to seventy-five percent of the stones shall be 4 to 8 inches in height and twenty-five to thirty-five percent shall be 8 to 12 inches in height.

For tree walls, the face stones shall be not less than 8 inches in height. The width shall be not less than 1.5 times and not more than 2 times the height and the length not more than 3 times nor less than 1.5 times the height.

919.06 Weed Barrier.

Weed barrier shall be a material capable of limiting weed growth in mulched or dry-laid paved areas. This material shall be a polyethylene or polyvinyl film or a specifically manufactured landscape fabric conforming to the requirements of ASTM D4397.

The poly film shall be black in color and a minimum of .006 inches (6 mil) thick and be available in rolls of six feet minimum width.

The landscape fabric shall be a sheet structure composed entirely of preferentially oriented isotactic polypropylene continuous filaments thermally bonded mostly at the crossover points and weighing 1.9 $\pm$ oz/yd^2. This material shall be available in rolls of five feet minimum width and shall be from an approved supplier as listed on the QPL.

919.07 Topsoil.

Topsoil shall be material obtained from stripping operations and/or from sources provided by the Contractor. Material obtained from muck excavation operations not exposed to salt water may be used as topsoil provided the following requirements are met. Material which has been exposed to salt water, but otherwise conforming to the following requirements, may be used if it is spread in place and exposed to normal rainfall for a period of one year, provided testing for conductivity (soluble salts) after that period results in normal readings.

Topsoil shall not contain stones, lumps, roots, or similar objects larger than 2 inches in any dimension and shall have not less than a 5.8 pH value. When the topsoil has less than a 5.8 pH value, it shall be increased by applying pulverized limestone at a rate necessary to attain a 6.5 pH value.

Material stripped from the following sources shall not be considered suitable for use as topsoil:

(A) Soils having less than a 4.1 or more than a 7.0 pH value.

(B) Chemically contaminated soils.

(C) Areas from which the original surface has been stripped and/or covered over such as borrow pits, open mines, demolition sites, dumps and sanitary landfills.

(D) Unacceptable wet excavation.

Topsoil furnished from sources outside the limits of the Project shall have a minimum organic content of not less than 2.75 percent by weight. When the organic content is less than 2.75 percent, it shall be increased by adding peat at a rate necessary to attain this minimum organic content. The organic content of soils will be determined by the Engineer using the Chromic Acid Titration method as described in the United States Department of Agriculture's Circular 757.

The organic content of all topsoil used for planting shall conform to the requirements specified above.

The gradation of the topsoil furnished from sources outside the limits of the Project will be determined by the Engineer using the Bouyoucos Hydrometer Analysis conforming to AASHTO T88. The gradation of the topsoil shall be within the following ranges:

If more than one-half the sand is smaller than 0.5 mm:

	Percent
Sand (2.000 mm to 0.050 mm)	40 - 80
Silt (0.050 mm to 0.005 mm)	0 - 30

	Percent
Clay (0.005 mm and smaller)	0 - 30

If more than one-half the sand is larger than 0.5 mm:

	Percent	Percent
Sand (2.000 mm to 0.050 mm)	40 - 80	40 - 75
Silt (0.050 mm to 0.005 mm)	0 - 30	0 - 30
Clay (0.005 mm and smaller)	15-30	0 - 30

Materials outside these ranges are not suitable for use as topsoil.

Organic content shall be determined in accordance with AASHTO T194.

Stripped topsoil shall be cleaned of lumps, roots, matted leaves, stones more than two inches in diameter, branches, and other unsuitable material. Growing weeds shall be removed from stored topsoil immediately prior to its use. Chemical weed killers shall not be used.

919.08 Lime.

Lime shall be pulverized limestone, composed of not less than 85 percent calcium and magnesium carbonates equivalent to not less than 40 percent calcium and magnesium oxides.

Each delivery of lime shall be accompanied by a delivery slip indicating its weight and certified analysis of its chemical composition and gradation, including calcium and magnesium oxide equivalents, which shall be furnished at the time of delivery.

The physical properties shall be as follows:

(A) Minimum of 40% passing through 100 mesh sieve.

(B) Minimum of 98% passing through 20 mesh sieve.

919.09 Fertilizer.

Fertilizer for establishing turf shall have a commercial designation of 10-20-10 or any 1-2-1 ratio fertilizer containing a minimum of 5 percent nitrogen (N), 10 percent available phosphoric acid (P) and 5 percent soluble potash (K).

Fertilizer Analysis (N-P-K)	Weight of Bag (lbs.)	Bags/Acre
5-10-5	50	18
5-10-5	80	11
5-10-5	100	9
10-20-10	50	9
10-20-10	80	5.5
10-20-10	100	4.5

If the fertilizer is to be applied with mechanical spreader in the dry form, a minimum of 75 percent shall pass a No. 8 sieve and a minimum of 75 percent shall be retained on a No. 16 sieve, and the maximum free moisture content shall be 2 percent.

Fertilizer for establishing sod shall be any 1-2-2 ratio fertilizer containing a minimum of 5 percent nitrogen, 10 percent available phosphoric acid and 10 percent soluble potash.

Fertilizer Analysis (N-P-K)	Weight of Bag (lbs.)	Bags/Acre
5-10-10	50	18
5-10-10	80	11
5-10-10	100	9
10-20-20	50	9

Fertilizer Analysis (N-P-K)	Weight of Bag (lbs.)	Bags/Acre
10-20-20	80	5.5
10-20-20	100	4.5

50% of the nitrogen shall be in the form of Urea-Formaldehyde conforming to the following:

UREA-FORMALDEHYDE	By Weight
Total Nitrogen	37 - 39%
Cold Water Insoluble Nitrogen	27 - 30%
Hot Water Insoluble Nitrogen	13%
Urea Nitrogen	1 - 3.5%
Activity Index	45 - 50%
Particle Size	100% passing through #6 mesh; less than 2% passing through #80 mesh.

Fertilizer shall be thoroughly and uniformly mixed before bagging. Bags shall be multi-walled paper bags or plastic lined paper bag of the 50 pound, 80 pound, or 100 pound size. Each delivery of fertilizer shall be accompanied by a delivery slip showing the weight and a certified chemical analysis of the composition of the fertilizer which shall be furnished to the Engineer at the time of the delivery.

919.10 Seed.

Seed shall conform to the mixture, purity, and germination tabulated below.

Each shipment of grass seed mixture and legume seed mixture shall be accompanied by a certified weight slip and an analysis of the composition, purity, and germination of the grass seed mixture, and the purity and germination of the legume seed mixture, sampled and tested after delivery to the Project. Such sampling and testing will be done (at no expense to the Contractor) in accordance with the Rules and Regulations for Testing Seeds adopted by the Association of Official Seed Analysts.

The grass seed used shall be the new crops seed and the mixtures to be used shall be as follows:

Purity Grass Seed Mixture	Minimum Purity Percent	Minimum Germination Percent	Percent of Total Weight of Mixture
Type A			
Kentucky Blue Grass (American, Merit)	98	85	25
Creeping Red Fescue	97	85	25
Tall Turf-type Fescue (Houndog, Mustang, K-31)	95	90	25
Fine Textured Perennial Rye Grass, (Fiesta, Premier)	95	90	25
Type B			
Tall Turf-Type Fescue (Houndog, Mustang, K-31)	95	90	75
Perennial Rye Grass (Linn)	95	90	25
Type C			
Kentucky Blue Grass (Banff, American)	98	85	30
Kentucky Blue Grass (Merit, Touchdown)	98	85	30
Fine Textured Perennial Rye Grass, (Premier)	95	90	40

Type L Legume Seed			
Crown Vetch* plus Nitrofying Bacteria	95	68	35
Bird Foot Trefoil plus Nitrofying Bacteria	95	90	25
Perennial Rye Grass	98	92	40

*Including not more than 35% hard seed.

919.11 Tree Protectors.

Tree protectors shall be one of the following:

Plastic, wrap-around-the-trunk type, dark brown, dark gray or dark green in color.

Wire mesh, 1/4 by 1/4 inch mesh, forming a 6 inch diameter cylinder around the trunk with the abutting edges fastened together with wire.

919.12 Sod.

Sod shall be good quality cultivated upland meadow grass free from noxious weeds and objectionable grasses and shall be Kentucky bluegrass blend, Kentucky bluegrass/rye blend, or other grasses as approved.

Sod shall be grown from high quality seed of known origin, field produced by a commercial sod farm.

Sod shall be machine cut at a uniform soil thickness of 5/8 plus or minus 1/4 inch at the time of cutting. Measurement for thickness shall exclude top growth and thatch. Individual strips of sod shall be of a uniform width. Broken strips and torn or uneven strips may be rejected. Standard size strips of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from the upper 10 percent of the strip.

Before removing the sod, the grass shall be cut to a length of 2 inches and its surface shall be raked of all debris. Sod shall be taken from approved sources, in the locality of the work, where the soil is of such character that it will not breakup or crumble during cutting, transportation, or laying. Storage of sod will not be permitted.

Pegs for fastening sod on slopes shall be wood lathe not less than 9 inches long, or similar pieces of wood.

919.13 Mulch.

Mulch shall be either straw or salt hay. Straw shall be stalks of oats, wheat, rye, or barley relatively free from seeds, noxious weeds, and other foreign material.

919.14 Fiber Mulch. Tree.

Fiber mulch shall be made from whole wood fiber or pulped wood cellulose fibers. The fibers must be compatible with current hydraulic seeding equipment and contain no growth or germination inhibiting factors.

919.15 Emulsified Asphalt.

Emulsified asphalt for binding straw or salt hay mulch shall be slow setting (SS) types conforming to ASTM D977 and shall be nontoxic and free of plant growth or germination inhibitors.

919.16 Emulsions and Gels.

Synthetic plastic emulsion shall be miscible with all normally available water when diluted to any proportions. After drying, the synthetic plastic binder shall no longer be soluble or dispersible in water but shall remain tacky until the grass seed has germinated. The plastic binder shall be physiologically harmless and shall not have any phytotoxic or crop damaging properties.

Vegetable based gels which can be classified as naturally occurring powder-based hydrophilic additives formulated to provide gels which, when applied under curing conditions will form membraned networks of water insoluble polymers. The vegetable gel shall be physiologically harmless and shall not have phytotoxic or crop damaging properties.

919.17 Plant Material.

All materials and living plants shall be subject to the approval of the Engineer at the source of supply and prior

to shipment to the site of the work. The Contractor shall notify the Engineer of the source of supply selected and only approved individual plants, trees, or shrubs will be accepted for use.

Plant materials shall be trees, shrubs, vines, and plants of all descriptions called for and shall conform to the current American Standard for Nursery Stock sponsored by the American Nursery and Landscape Association. They shall be healthy and vigorous with well developed branch and root systems, and shall be free from disfiguring knots and gall, sun scald injuries, bark abrasions, and other objectionable disfigurements. Plant materials that are weak or thin, or which have been cut back from larger grades to meet specified requirements, will not be accepted. All plant materials shall conform to State and Federal laws relating to inspection for diseases and infestation, and inspection certificates shall be filed with the Engineer. The current edition of Standardized Plant Names published by the American Joint Committee on Horticultural Nomenclature shall be the authority for all plant names. All plant materials specified on the Plans as "in variety" shall be labeled with the correct botanical names.

Deciduous trees shall be of the large growing species which lose their foliage in the fall. Deciduous trees over 10 feet tall shall have no branches below 5 feet, nor shall branches be cut off trees to conform to this requirement.

Evergreen trees shall be coniferous or broadleaf trees which retain foliage throughout the year.

Small and flowering trees shall be of the smaller-growing deciduous species.

Vines and ground cover shall be creeping, spreading, or climbing plants. All pot grown vines shall be pot bound and in a vigorous growing condition.

Perennials shall be herbaceous plants with hardy roots that live for a period of at least five growing seasons.

Shrubs shall be multi-stemmed or bushy deciduous and broadleaf evergreen plants.

Bare rooted plant materials shall be thoroughly protected from drying out during transportation and until permanently planted.

Quality and size of plants, spread of roots, and size of balls shall be in accordance with USA-Z60-1990, "American Standard of Nursery Stock" as published by the American Nursery and Landscape Association.

All plants specified balled and burlapped shall be dug with balls of sufficient depth to incorporate the majority of roots. No plant will be accepted when the ball has been cracked or broken preparatory to or during the process of planting.

919.18 Pesticide.

Pesticide shall generally be defined as a chemical compound capable of limiting or eliminating various undesirable vegetative, animal, or insect life forms and shall be broken down to the following materials:

Herbicide shall be a narrow or broad spectrum chemical compound capable of limiting or eliminating undesirable vegetative growth on a selective or general basis.

Insecticide shall be a chemical compound capable of preventing, controlling, or eliminating various insects which are infesting plants or structures.

Fungicide shall be a chemical compound capable of controlling fungi existing on various forms of plant material including various turf areas.

Rodenticide shall be a chemical compound capable of repelling or eliminating various types of rodents from areas where there is potential for damage from these animals.

919.19 Planting Packets.

Fertilizer packets shall be of a slow release type contained in polyethylene, perforated bags with micropore holes for controlled feeding. The bag should contain 4 ounces of soluble fertilizer of 16-8-16 minimum analysis per unit to last for eight years.

Minimum guaranteed analysis:

Total Nitrogen (N)

16% - 9% Ammoniacal Nitrogen

7% Nitrate Nitrogen

Available Phosphoric Acid (P_2O_5)

8% from Ammonium Phosphate

Soluble Potash

16% from (KCl)

919.20 Plastic Chainlock Tree Tie.

Plastic chainlock tree tie shall be a material specifically manufactured for this purpose. It shall be black in color and of sufficient size shape and strength to adequately support plant material for a period of one and one-half years.

919.21 Mycorrhizal Innoculant.

Endo and ectomycorrhizal fungus innoculants, soil moistening agents and biostimulants shall be from an approved supplier as listed on the QPL.

919.22 Antidesiccant.

Antidesiccant shall be emulsion or other materials which will provide a protective film over plant surfaces, permeable enough to permit transpiration.

919.23 Guy Posts.

Guy posts shall be of white cedar, of 2 inch minimum and 3 inch maximum diameter at the thinner end or, any new wooden posts, 2 inches square of solid reasonably knot free lumber, and as approved by the Engineer.

The length of posts shall be one-half the height of the plant to be supported plus a minimum of 24 inches for setting in the ground, to a maximum of 8' long.

919.24 Guy Stakes.

Guy stakes shall be of white cedar, minimum 2" diameter and 30 inches long, or of solid reasonable knot free 2" x 2" x 30" lumber, and as approved by the Engineer.

919.25 Guy Wire.

Guy wire shall be 14 gage galvanized steel wire or 16 gage galvanized malleable iron wire.

919.26 Log or Timber Deadmen.

Log or timber deadmen for anchoring wire rope guys shall be two (2) feet long and 6 to 8 inches in diameter.

919.27 Polypropylene Strap.

Polypropylene strap with brass grommets a minimum of 1″ wide with an approximate break of 1000 lbs nominal.

919.28 Twine.

Twine for securing wrapping material shall be 2-ply jute twine.

919.29 Wire Rope.

Wire rope for guying trees shall be 3/8 inch galvanized wire rope. Each guy shall be supplied with one galvanized iron turnbuckle.

919.30 Wrapping Material.

Wrapping material for trees shall be 6 inch wide strips of natural-colored 8 ounce burlap, craft crinkle paper, or other material approved by the Engineer.

919.31 Wood Chips.

Wood chips shall be produced by a wood chipping machine. They shall be hard chips and shall not contain leaves, twigs, branches, wood shavings, dirt, stones, clods of turf, tin cans, or other foreign material or debris.

Wood chips shall be 1/8 inch nominal thickness, with sixty (60) percent having an area of not less than one (1) inch square and having the dimensions of no longer than three (3) inches and not shorter than one (1) inch.

Wood chips, of acceptable quality, obtained from clearing and grubbing, selective thinning, and tree trimming may be used as mulch. Where wood chips are obtained from outside sources, the following shall be complied with:

(A) Samples of wood chips shall be submitted to the Engineer for approval before delivery to the Project.

(B) Inspection of each shipment of wood chips will also be made upon delivery to the Project.

(C) Each shipment of wood chips shall be accompanied by a delivery slip which shall be furnished to the Engineer at the time of delivery.

919.32 Peat Humus.

Peat humus shall consist of incompletely decomposed plant residues resulting from anaerobic activity in water-saturated areas. Peat humus shall not contain gravel, debris, or toxic compounds. The pH value of peat humus shall be not less than 4. The organic content of the peat humus shall be not less than 75 percent by weight, and the inorganic content shall consist of sand, silt, and clay. The minimum water absorbing ability of the peat humus shall be 200% by weight, on an oven dry basis. The Contractor shall furnish the Engineer, for approval, a certification and analysis of the peat humus certifying to its conformance to the requirements of these Specifications by an approved testing laboratory. The Engineer's approval shall be obtained prior to its use.

919.33 Peat Moss.

Peat Moss shall be a sphagnum peat moss with a minimum water absorbing capacity of 20 times its dry weight. A bale containing 7-1/2 cubic feet of compressed peat moss which expands to approximately 15 cubic feet of thoroughly loosened material shall be considered a standard bale.

919.34 Broken Stone.

Broken stone shall be sound, durable and shall be graded for 1-1/2 inch to 2 inch size. Stone need not be washed.

919.35 Soil Stabilization Matting.

Soil stabilization matting shall be one of the following:

(A) Jute Mesh shall be cloth of a uniform plain weave of undyed and unbleached single jute yarn, 48 inches in width plus or minus one inch and weighing an average of 1.2 pounds per linear yard of cloth with a tolerance of plus or minus 5 percent, with approximately 78 warp ends per width of cloth and 41 weft ends per linear yard of cloth. The yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one half its normal diameter.

(B) Excelsior Mat shall consist of a machine produced mat of curled wood excelsior of 80% six inch or longer fiber length, with consistent thickness, formed into a blanket 48 inches $\pm$ 1 inch in width and weighing 0.90 pounds per square yard $\pm$ 10%. The excelsior material shall be covered with a biodegradable extruded plastic netting to aid in handling and increase strength.

919.36 Staples.

Staples for anchoring soil stabilization matting shall be made of 12 inch lengths of No. 8 gauge plain iron wire bent to form a "U".

919.37 Timber.

Timber shall be Southern Pine, C.C.A. pressure treated to 0.40 lbs./cu.ft. per AWPA Standard C-2. Dimensions shall be 6" x 8" x 8' nominally. Timbers shall be new wood with a minimum of splits, checks, and other deformities, and shall be approved by the Engineer prior to installation.

919.38 Steel Edging.

Steel edging shall have the dimensions of 1/4 inch thick by 5 inches wide. The edging shall be prepainted green or black, and shall be installed with its own integral staking system.

919.39 Bark Mulching.

Bark mulching shall be shredded hardwood materials consisting of 86% organic matter, and shall have a minimum water absorbing capacity of 15 times its dry weight, a pH value of 4.2, and a loose dry weight of 25

lbs./cubic foot.

919.40 Block Pavers.

Block pavers shall be of concrete, having a minimum allowable compressive strength of 8,000 psi on an individual basis, manufactured of Portland cement and aggregate conforming to the requirements of ASTM C936. Portland cement shall conform to ASTM C150, Type 1 or Type II. The aggregate shall conform to ASTM C33 (average water absorption shall not be greater than 5%). The Contractor shall supply the specified colors and shapes for the paved areas as shown on the Plans. Block samples shall be made available to the Engineer prior to installation for approval and color selection.

919.41 Sand.

Sand shall be material composed predominately of sand free from clay or organic material. Sand shall be clean, sharp, and of a quality approved by the Engineer.

919.42 Stone.

Stone shall consist of clean, tough, durable fragments free from all excess flat, elongated, soft, or disintegrated pieces. Stone shall conform to Standard Size (1) No. 57 or (2) No. 67 of Table 1 of AASHTO M43.

919.43 Gravel.

Gravel shall be clean, Delaware Valley River gravel graded to 3/4 inch to 1-1/2 inch diameter. The Contractor shall furnish samples of the gravel he intends to use on the Project. Color and size shall be approved by the Engineer.

919.44 Brick Pavers.

Brick pavers shall consist of clay modular paving brick matte brown in color with a flash finish, dry laid in clean sharp sand. Clay brick shall be solid conforming to the requirements of ASTM C902, grade SX, Type I, Application PA and shall be new, whole, of best quality, and of a standard brand and manufacturer. A brick sample shall be made available to the Engineer prior to installation for approval and color selection.

919.45 Composted Sewage Sludge.

Sewage sludge shall be a stabilized organic humus, comprised of fully digested sewage sludge which has been composted with deciduous and coniferous wood chips such as "Earthlife". The material shall meet or exceed the following specifications and no substitutions will be considered. Certification is required.

(A) Sludge.

The sludge must come from a treatment plan featuring primary and secondary sewage treatment and anaerobic digestion to assure that the product meets pathogen standards. The sewage treatment department must employ a full time industrial waste inspection division to help assure that a sludge low in heavy metals (based on the specifications of New Jersey Department of Environmental Protection) is produced.

(B) Dewatering.

The sludge must be dewatered using a polymer based system in order to produce a product of consistent pH with a range of 6.5 to 7.5.

(C) Composting.

The digested sludge must be compost for 21 days and cured for a minimum of 30 days to help assure additional pathogen destruction and to produce a product that meets all Federal and State biologic and agronomic standards. The composting process must meet all Federal, State, and local regulations.

(D) Screening.

The finished compost must be screened so as to remove all coarse material.

(E) Storage.

The composting facility must have a minimum inventory to 10,000 cubic yards on hand at all times to assure a readily available supply of materials.

(F) LOADING.

The composting facility must have the capacity to load a minimum of 4,000 cubic yards onto trucks for delivery in a single day is desired.

919.46 Block Edging.

Block Edging shall be a flexible PVC paver edge restraint system with vertical flex strips and back supports and shall be from an approved supplier as listed on the QPL.

919.47 Retaining Wall System.

Retaining Wall System shall be from an approved supplier as listed on the QPL. Color to be selected by the Engineer from current samples. The retaining wall system shall consist of the following components.

(A) RETAINING WALL (RW) UNITS.

RW units shall meeting the following architectural requirements:

(1) Finish of RW units shall be split face.

(2) Unit faces shall be of straight geometry and have a maximum height of 6 inches.

(3) RW units shall be capable of being erected with a variable bond configuration. Bond should vary between 1/4 to 1/3 bond.

(4) All RW units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the construction. Cracking or excessive chipping may be grounds for rejection. Units showing cracks larger than ½ when measured along their length shall not be used within the wall. Units showing chips visible at a distance of 30 feet from the wall shall not be used within the wall.

(B) RW UNIT REQUIREMENTS.

RW units shall meet the following structural requirements:

(1) The RW units shall be solid through the full depth of the unit.

(2) For constructability, the RW units shall provide a minimum weight of 125 psi of wall face area.

(3) Concrete used to manufacture RW units shall have a minimum 28 days compressive strength of 3000 psi in accordance with ASTM C90 and C140.

(4) The concrete shall have adequate freeze/thaw protection with a maximum moisture absorption rate, by weight, of 8%. Compressive strength test specimens shall conform to the saw-cut coupon provisions of Section 5.2.4 of ASTM C140 with the following exception:

(5) Coupon shall be taken from the least dimension of the unit of a size and shape representing the geometry of the unit as a whole.

(6) RW units molder dimensions shall not differ more than + or - 1/8 inch from that specified, except height which shall be + or - 1/16 inch.

(C) CONSTRUCTABILITY AND GEOMETRIC REQUIREMENTS.

RW units shall meet the following constructability and geometric requirements:

(1) Units shall be capable of attaining concave and convex curves and 90 to 140 degree outside corners.

(2) Units shall be positively engaged to the unit below with connection pins so as to provide a ¾ -inch horizontal setback per 6-inch-high course (a cant of 7 degree from vertical). The installed wall cant shall not differ more than + or - 2 degrees from that specified.

(D) RETAINING WALL UNITS CAPS.

Retaining Wall Units Caps shall be both Type A and B and conform to the requirements of the standard retaining wall units. Caps shall be installed with VERSA-LOK concrete adhesive and conform to the requirements of ASTM D1248.

(E) RW Connection Pins.

RW connection pins which interlock the units shall meet all Retaining Wall manufacturer's specifications.

(F) RW Connection Pins.

Concrete adhesive shall be a superior grade weatherproof, copolymer adhesive from an approved supplier as listed on the QPL.

(G) Gravel.

Gravel shall conform to the requirement of Subsection 919.44.

(H) Slotted Drainage Pipe.

Slotted drainage pipe shall be perforated corrugated HDPE pipe.

919.48 Spray Heads, Drains, Solenoid Valves, and Controllers.

Such products shall be from an approved supplier as listed on the QPL and in accordance with Subsection 711.02.

919.49 Plastic Valves and Box Covers.

Such products shall be from an approved supplier as listed on the QPL and in accordance with Subsection 711.02.

919.50 Cold Water Pipe Insulation and Insulation Adhesives.

Such products shall be from an approved supplier as listed on the QPL and in accordance with Subsection 711.03.

919.51 Hydromilling.

Hydromilling for paint stripe removal shall be performed using an approved system from an approved supplier as listed on the QPL and in accordance with Subsection 516.04.

Section 920 - Traffic Control Devices

920.01 Traffic Cones.

Traffic Cones shall be NCHRP 350 compliant and shall meet the requirements listed herein. Cones shall have either separate or molded bases. Cones need not be new but must be in good condition as approved. The Engineer may order the replacement of any cones that are dirty, cracked, unstable, exhibiting loose/frayed collars or not in conformance with the requirements herein. The cone material shall be impregnated with orange pigment, and the surface shall have a glossy, non-reflectorized finish. The color of the cone surface shall be in accordance with the Manual on Uniform Traffic Control Devices (fluorescent orange). The contractor shall submit certification from the vendor that the cones meet the evaluation criteria of NCHRP 350 and the physical properties listed below, in accordance with 105.04.

(A) Cones.

Each cone shall be provided with a 6-inch wide collar and 4-inch wide collar of silver (white) retroreflective sheeting meeting the requirements of ASTM D-4956, type III.

The retroreflective sheeting shall be applied to the cone so that the 6-inch collar is three to four inches from the top of the cone and the 4-inch collar is 2 inches below the 6-inch collar.

The cones shall be constructed in a manner so that the cones in any given delivery, shipment or mobilization will nest or stack with each other, with or without stabilizers, without difficulty.

Cone bases shall be black in color. Bases for 36" Cones shall be flat (no cleats).

Cones shall have the following physical properties:

		Design Criteria	
		28" Cone	36" Cone
(1)	Material	PVC/Plastic or Rubber	PVC
(2)	Overall Height	28"	36"
(3)	Cone Weight	7 lbs. (min.)	15.5 lbs. (min.)
(4)	Total in-place Weight	7 lbs. (min., Parkway only) 15 lbs. (min., Turnpike only)	15.5 lbs. (min.)
(5)	Cone Diameter, Top Interior (1" from top)	2-3/8" ± 1/8"	2-3/8" ± 1/8"
(6)	Cone Diameter, Bottom Interior	10-5/8" ± 1/2"	11-3/8" ± 1/2"
(7)	Base Size, Square	13-3/4" ± 1/2" With Cleats	17" ± 1/2" Without Cleats
(8)	Tensile Strength	1,000 psi (min.)	1,000 psi (min.)
(9)	Elongation	200% (min.)	200% (min.)
(10)	Hardness – Durometer ASTM D2240	80 ± 10	80 ± 10
(11)	Fold Resistance – A cone is placed in an upright position and folded at a point near the middle of its vertical height by holding the upper tip of the cone by hand for ten seconds to the base and touching the surface upon which the base is resting.	The cone shall return to its original vertical position within 15 seconds after release.	
(12)	Heat Resistance - Cones are placed upright for 1 hour at 180°F with a 3± 0.11 Lb mass suspended approximately 14" from the top of each cone. and secured using a 2.6 inch diameter flat metal disc. Cones are returned to ambient air temperature, and are stacked in various configurations with one another.	The cones shall not stick to one another and shall be easy to remove from the stack(s).	
(13)	Cold Resistance – A cone is placed upright for 3 hours at 0°F. Immediately after, a steel ball weighing 2 pounds (0.9 kg) is dropped a distance of 5 feet (1.5m) through a virtually frictionless guide tube onto the surface of the cone. The surface of the cone that was struck by the steel ball shall be in a horizontal position, with the cone supported and held in position at both ends. The cone shall be subjected to five concurrent impacts concentrated near the middle.	The cone shall show no evidence of fracturing, cracking or splitting	

(B) STABILIZERS.

On Authority roadways, separate stabilizers shall be provided for 28" cones to meet the Total in-place Weight requirement listed herein for cones without molded bases; on Parkway roadways, separate stabilizers are not required for 28" cones that meet the Total in-place Weight required. 36" cones do not require separate stabilizers if the cones meet the Total in-place Weight required. The separate stabilizers shall be black in color and shall be constructed so that they rest evenly on the base of the cone without overhanging. The stabilizer shall be a minimum of 5 pounds and shall have the same physical properties as cones in tensile strength, elongation and hardness. Only one stabilizer per cone shall be used.

920.02 Timber Barrier.

Timbers for timber barrier curbs shall be new 12" x 12" solid, Grade 2, southern yellow pine in accordance with Standard Grading Rules for Southern Pine Lumber published by Southern Pine Inspection Bureau and shall be pressure treated using water borne preservatives conforming to the requirements of AWPA Standard P5. Preservatives shall be either Cromated Copper Arsenate (CCA) or Ammoniacal Copper Arsenate (ACA). The wood shall be pressure treated in accordance with the requirements of AWPA Standard C1; the minimum net retention of CCA or ACA preservative shall be 0.40 pounds per cubic foot of timber, determined in accordance

with AWPA Standard C2.

Timber barrier curbs shall be rough cut and prepared in accordance with the Plans. Timber ends shall be cut by bench, table, or band saw to provide for overlapping joints. Cutting of the joints by chainsaw or axe shall not be permitted. All cuts are to be either perpendicular or parallel to the face of the timber. Dimensional tolerances for the overlapping joint ends shall be 1/4"± from the dimensions shown on the Plan. All holes shall be drilled truly perpendicular to the face of the timber with either a fixed or stationary drill at the location shown on the Plan. The diameter of the hole shall be 1-1/8". Drilling of holes with a hand held drill shall not be permitted; the holes shall be drilled after drying of the timber but prior to preservative treatment, all as detailed on the Plans. Timbers shall be either kiln dried or air dried after treatment to 19% maximum moisture content. Timbers shall be furnished unpainted.

920.03 Safety Vests.

Safety vests shall meet the ANSI 107-2010 (Class 3) approved American National Standard for High Visibility Safety Apparel.

920.04 Flashing Lights.

Flashing lights shall be from an approved supplier as listed on the QPL.

920.05 Batteries.

Batteries for flashing lights shall be from an approved supplier as listed on the QPL.

920.06 Signs and Overlay Panels.

Signs and overlay panels shall conform to Section 912 except as modified herein.

(A) Reflective Sheeting.

Reflective Sheeting for all sign panels and overlay panels shall be from an approved supplier as listed on the QPL.

(B) Sign Lettering, Symbols and Border.

Sign Lettering, Symbols and Border shall be black and from an approved supplier as listed on the QPL. Application may be either prior to or after sheeting application. Each sign panel shall also have the Authority identification, as shown on the Plans.

(C) Sign Identification.

All sign panels and overlay panels shall be die stamped on the back with one quarter inch size numbers (three) and letters (two or three) with drawing identification (TE ___) as shown in the sign schedule.

(D) Panel Clips.

Following completion of sign panels which provide for overlays, three aluminum clips shall be provided and fastened to the front of each, as shown on the Plans.

The upper panel clips shall be from 1/2" extruded aluminum channel, from an approved supplier as listed on the QPL. Each 1/2" channel shall have 1/8" thick legs and web. The upper panel clip shall be fabricated as shown on the above mentioned drawing and be 1/8" thick aluminum.

Each clip shall be carefully located by a template and riveted to the panels with 1/4" diameter stainless steel round or truss headed bolts with stainless steel collars or stainless steel rivets, from an approved supplier as listed on the QPL. Rivets if used, shall be 100 degree countersunk head and proper length to provide firm anchorage without excessive peened material on the driven head.

920.07 Folding Sign Stands.

Folding sign stands shall be from an approved supplier as listed on the QPL.

920.08 Concrete Barrier.

Precast concrete construction barrier for traffic control and protection shall be white or grey and shall conform to ASTM C825. Additional reinforcement, interlocking, and other details shall be as shown on the Plans.

Concrete construction barrier and interlocking devices shall be in accordance with Standard Drawings TP-24

and TP-25. The Contractor may submit alternate barrier systems with interlocking devices that meet NCHRP Report 350 – Test Level 3 requirements to the Engineer for review and approval.

Concrete construction barriers shall be provided with delineators mounted on the side of the barrier with epoxy glue or mounting screws 6 inches from the top at twenty (20) foot intervals for grey and forty (40) foot intervals for white. The side mounted delineators shall be yellow when the construction barrier is to the left of traffic and white when the construction barrier is to the right of traffic. Delineators shall also be mounted on the top of concrete construction barriers at 100-foot intervals on tangent sections, curves of radii greater than 1,910 feet, and at 50-foot intervals on curves of 1,910 feet or less. Delineators shall be provided in accordance with Subsection 923.18.

On tapered portions of precast concrete construction barrier, flashing lights shall be mounted instead of delineators. One flashing light is to be mounted at the beginning of the taper and additional flashing lights are to be mounted at forty (40) foot intervals. The flashing lights shall be in accordance with Subsection 920.04 and shall be operational twenty-four (24) hours a day.

920.09 Flags.

Flags shall be international orange of plasticized cloth, 18 inches square, with 1-1/2 inch diagonal stripes of silver reflective sheeting from an approved supplier as listed on the QPL., spaced 1-1/2 inches apart, or an approved equal, mounted with suitable diagonal stays on a sturdy 36 inch shaft.

920.10 Removable Wet Weather Pavement Marking Tape.

The removable wet weather preformed patterned pavement marking tape shall consist of white or yellow films with clear microcrystalline beads incorporated to provide immediate and continuing retroreflection during both wet and dry conditions at the specific luminance levels listed below. The underside of the tape shall be precoated with a pressure sensitive adhesive which bonds the tape to the roadway surface so as to be able to withstand traffic immediately after installation.

Daylight color of the white tape shall be no darker than color No. 37778 of FED-STD-595B. Daylight color of the yellow tape shall conform to the FHWA color tolerance chart for highway yellow.

When measured with an Advanced Retro Technology (ART) model MX-30 handheld retroreflectometer, the tape shall have initial, minimum retroflectance values conforming to:

(A) Dry Condition – ASTM E 1710

(B) Entrance Angle = 88.76°

Observation Angle	Specific Luminance	
(Degrees)	White (Millicandelas per square foot per footcandle)	Yellow (Millicandelas per square foot per footcandle)
1.05	500	300

Note: The angular aperture of both the photoreceptor and the light projector shall be six minutes of arc. The reference axis shall be taken perpendicular to the test sample.

(C) Continuous Wet Condition – ASTM E 2176

(D) Entrance Angle = 88.76°

Observation Angle	Specific Luminance	
(Degrees)	White (Millicandelas per square foot per footcandle)	Yellow (Millicandelas per square foot per footcandle)
1.05	250	200

Tape shall be capable of being removed manually, intact or in large pieces, at temperatures above 40°F without the use of solvents, burning, grinding, or blasting.

The Contractor shall provide the Engineer with the manufacturer's installation recommendations and Certification of Compliance in accordance with Subsection 105.04.

920.11 Arrow Board.

Provide Type C flashing arrow boards in accordance with the MUTCD (latest edition) and meeting the

following requirements:

(A) Non-reflective, black boards equipped with battery-operated amber lights.

(B) A minimum peak luminous intensity of 8800 candelas and equipped with photocells that will automatically reduce the luminous intensity to 1500 candelas when the ambient light level drops to 5 foot-candles.

(C) A light on the rear face of the board to indicate that the lights are operating.

(D) Solid state controls with polarity and surge protection.

(E) Panel operation controls mounted in a lockable enclosure.

(F) Flashing rate shall be 30 times per minute.

(G) Arrow Board displays shall be in accordance with the Traffic Protection Manual.

(H) The front and rear faces of the board shall be devoid of advertising to include owner, operator, phone numbers, internet addresses, etc.

Ensure flashing arrow boards are equipped with a diesel charged battery system. Do not use gasoline powered systems. Securely mount flashing arrow boards on a manufacturer-approved 2-wheeled towing trailer.

Flashing Arrow Board Trailer system shall be from an approved supplier as listed on the QPL. The Engineer will approve the arrow board displays and available options used or purchased.

Trailer chassis lighting shall be in accordance with Federal and New Jersey State Motor Vehicle regulations (New Jersey Title 39, Section 39:3-61 (d)). Include license plate bracket and weatherproof registration document holder. A locking mechanism shall be included to hold the panel in the operating position or travel position.

920.12 Flagman Uniform.

Flagmen shall wear a navy blue police-type uniform with billed cap. A vest, as specified in Subsection 920.03 shall be worn over the uniform.

920.13 Vehicle Lights.

Caution lights consisting of not less than two six inch diameter flashing amber lights mounted upon the vehicle and satisfactory, in the opinion of the Engineer, to warn traffic.

920.14 Removable Black Line Mask.

Material shall consist of a highly durable, skid resistant, non-reflective, pliant polymer tape designed for temporary obliteration of existing pavement markings. The black line mask shall be removable when no longer needed.

The removable black line mask shall be pre-coated with a pressure sensitive adhesive, and it shall be capable of being adhered to existing pavement markings, asphalt cement concrete or Portland cement concrete in accordance with the manufacturer's instructions without the use of heat, solvents or other additional adhesives, and shall be immediately ready for traffic after application. The material shall be weather resistant and, through normal traffic wear, shall show no lifting or shrinkage which will impair the intended use of the tape throughout its useful life, and shall show no tearing or other signs of poor adhesion.

The non-reflective, removable black line mask shall not contain metallic foil, and it shall consist of a mixture of high quality polymeric materials, pigments and inorganic fillers distributed throughout its base cross sectional area, with a matte black non-reflective top layer. The patterned surface shall have a minimum of 20 percent of the surface area raised and coated with non-skid particles, and the channels between the raised areas shall be substantially free of particles. The film shall be pre-coated with a pressure sensitive adhesive.

The removable black line mask, without adhesive, shall have a minimum caliper of 0.065 inch (1.65mm) at the thickest portion of the patterned cross section and a minimum caliper of 0.02 inch (0.5mm) at the thinnest portion of the cross section. The surface of the material shall provide an initial average skid resistance value of 60 BPN when tested in accordance with ASTM E 303.

The Contractor shall demonstrate that the removable black line mask can be removed after its intended use, intact or in large pieces, manually, at temperatures above 40° F (4°C) without the use of heat, solvents, grinding or sand or water blasting. The removable black line mask shall remove cleanly from the surface adhered to without damage to the existing pavement markings or roadway surface.

The removable black line mask shall be from an approved supplier as listed on the QPL.

920.15 Temporary Impact Attenuator.

Temporary Impact Attenuators shall be NCHRP 350, Test Level 3 compliant and from an approved supplier as listed on the QPL.

Modules produced by different manufactures shall not be intermixed when different manufactures supply inertial impact attenuators for a contract.

Sand placed in the modules should be washed concrete sand conforming to ASTM C-33 or equal.

For non-gating re-directive telescoping temporary impact attenuators installed on a temporary basis, refer to Subsection 920.20.

920.16 Traffic Pylons.

Traffic pylons shall be a 36 inches high, yellow, non-discoloring, co-extruded polyethylene post with two 3" x 7-1/2" high-intensity reflective wraps with pin lick surface mount base.

920.17 Modular Glare Screen System.

Modular Glare Screen System shall be from an approved supplier as listed on the QPL. The panels shall be 6 inches wide with a height of 24 inches. The panels shall be FHWA highway green in color.

Reflective tape three (3) inches wide and six (6) inches high shall be applied to the blades every ten (10) feet. The tape shall be high intensity grade reflective sheeting 3870 (white) when traffic is to the left and 3871 (yellow) when traffic is to the right, as manufactured by 3M Company or approved equal. Tape shall be applied vertically centered on the blade on the edge closest to passing traffic.

The Modular Glare Screen System shall include a debris shield mesh netting on the interior construction face only (not adjacent to traffic). This debris shield shall be secured 3 inches from the top, center and bottom every three (3) feet along the System as required to prevent sagging and fluttering. The debris shield shall be a high density polyethylene material 24 inches high with a maximum mesh opening of ½". The debris shield shall be from an approved supplier as listed on the QPL.

920.18 Truck Mounted Attenuator.

The truck mounted attenuator shall be NCHRP 350 Test Level 3 compliant, including optional tests 52 and 53.

The attenuator shall have high intensity orange reflective sheeting. The attenuator shall have a standard trailer lighting system, including brake lights, tail lights, turn signals and ICC bar lights.

920.19 Portable Variable Message Signs.

Provide a portable variable message sign capable of displaying messages that are visible under ideal day and night conditions from a minimum distance of 1/2 mile and that are legible from a minimum distance of 900 feet with a viewing angle of at least 25 degrees. Ensure that the portable variable message sign is able to operate in ambient temperatures of −30 to 160 °F and is capable of withstanding wind gusts up to 80 miles per hour when raised or lowered. Provide a portable variable message sign with the following:

(A) Sign Panel.

Provide a sign panel capable of displaying three (3) lines of a message, with each line capable of displaying up to eight (8) characters. Ensure that the characters have a minimum height of 18 inches, a minimum width of 12 inches, and are spaced at least 3 inches apart. Compose characters of a 5 wide by 7 high pixel matrix, with each pixel composed of between 4 and 6 LED lights. Ensure that the LED lights have a dominant wavelength between 585 and 595 nanometers and are set against a black background. Ensure that the LED lights provide a minimum daylight luminance of 1000 candelas-per-square-meter. Ensure that the sign is equipped with a photocell to automatically reduce the LED lights' luminance to between 30 to 100 candelas-per-square-meter when the ambient light level drops to 5 foot-candles. Ensure that LED lights maintain constant luminance intensity with changes in battery voltage.

Ensure that the sign panel is covered with an ultraviolet-resistant, clear polycarbonate.

(B) Controller.

Ensure that the controller is unaffected by radio transmissions. Ensure that the controller is capable of displaying 3 messages sequentially. Ensure that controller has an adjustable display rate with a minimum of 3 seconds per phase. Ensure that the controller is capable of storing 100 user programmed messages in

nonvolatile memory that will retain the programmed messages when power is interrupted. Provide a controller display screen that allows the operator to review messages before displaying on the message sign. Ensure that the controller display shows the operator all programming instructions. Ensure that the messages are able to be programmed at the sign with an integral or plug-in keyboard, and remotely with a cellular telephone.

Secure panel controls in a lockable weatherproof enclosure. Prevent unauthorized access to the controller by requiring a password to the keyboard. Prevent unauthorized remote access by requiring a password. If the correct password is not entered within 60 seconds of initial phone contact, the phone call will terminate.

(C) Power Source.

Equip portable variable message signs with either a diesel charged or a solar charged battery system. Ensure that the variable message sign is also capable of operating on 120-volt AC electrical service. Provide the power with a battery backup system capable of providing continuous operation when the primary power source fails. Ensure that the power source meets the following requirements:

(1) Diesel.

Ensure that the fuel tank is capable of operating the sign for a period of seventy (72) hours without refueling. Equip with an exhaust muffler and a United States Department of Forestry approved spark arrester. Ensure that the engine is shock mounted to reduce vibration and locked in a ventilated enclosure.

(2) Solar.

Provide solar panels capable of recharging the batteries at a rate of 4 hours of sun for twenty-four (24) hours of sign usage. Ensure that the battery capacity is capable of operating the sign for a period of 18 days without sunlight.

(D) Structural Support System.

Mount the variable message sign on a portable 2-wheeled trailer, equivalent to the trailer as stated in 920.11, Arrow Board. Ensure that the sign panel is capable of being raised or lowered during sustained wind speeds of fifty-five (55) miles per hour. Ensure that the sign panel is capable of being locked into position and is capable of being positioned at the proper height and orientation required for visibility according to the MUTCD (latest edition).

920.20 Non-Gating, Re-Directive Impact Attenuator.

The system shall be from an approved supplier as listed on the QPL.

Section 921 - Ramp Gates

Unless required otherwise by Supplementary Specifications, the ramp gates shall be horizontal and manually operated gates and shall be from an approved supplier as listed on the QPL.

921.01 Horizontal Ramp Gate.

(A) Column.

The column shall be fabricated from hot rolled steel galvanized in accordance with Subsection 911.02. The column shall be not less than the dimensions as shown on the Plans and have sufficient strength to carry a capstan assembly and arm of a maximum length of 45 feet.

(B) Capstan Assembly.

The capstan shall be fabricated from alloy steel not less than 6 inches in diameter and a wall thickness of not less than 0.5 inches. The capstan shall be affixed to the column and rotate freely around same. The top of the capstan shall be equipped with a weatherproof cap and shear pins.

Shear pins shall be of such material and size as recommended by the manufacturer for the particular arm length

The rotating capstan shall not be less than 6 inches outside diameter and shall be journaled in radial and thrust, self-lubricating bearings. It shall be heavy construction that will not distort when the arm socket is clamped in place or in the event of collision. The entire capstan mechanism shall be lubricated for life.

(C) Arm Socket.

The roadway arm shall be attached to the rotating capstan with a heavy steel arm socket, which shall be hot-dipped galvanized after fabrication. The arm socket shall be clamped to the rotating capstan with stainless steel fasteners. The arm socket shall be of a design that may be positioned at any point within a 360 degree full circle. The arm socket shall be provided with the means to be locked at 90 degree intervals and have a vertical adjustment of from 12 inches to 13 inches as shown on the Plans.

Attached to the extreme end of the arm adapter shall be the arm socket of a design that shall permit adjusting the arm 10 degrees above or below the horizontal.

(D) Arm Adapter.

The arm shall be attached to the capstan assembly with a steel arm adapter. The arm adapter may be adjusted vertically within a range of from 12 inches to 13 inches.

(E) Electrical Cubicle with Flasher and Circuit Protection.

The electrical cubicle shall be of NEMA construction and shall be mounted on the outside of the gate housing supported by the main frame. The cubicle shall be equipped with a spring return single batch door on the gate housing as shown on the Plans. A hasp type of locking arrangement with a .50 inch diameter hole shall be provided to lock the door. Locks will be furnished by others.

(1) The Contractor shall furnish and install the following components in the electrical cubicle:

- (a) Mainline circuit breaker.
- (b) Solid state flasher for gate arm lights.
- (c) Step down transformer.
- (d) Necessary terminal blocks.
- (e) A convenience receptacle with ground fault protection.

(2) The Contractor shall furnish detailed descriptions listing sizes, ratings and all pertinent data for each electrical component.

(3) Spare Electrical Components. The Contractor shall furnish the following spare components:

- (a) Five circuit breakers.
- (b) Five solid state flashers.
- (c) Thirty (30) arm lights with lamps.
- (d) Sixty (60) lamps for arm lights.

(F) Gate Arms.

Gate Arms shall be either tubular type or rectangular type where indicated. Both types shall be of sufficient strength to withstand a wind pressure of 80 miles per hour. They shall be interchangeable with the arm socket on all gate mechanisms.

(1) Arm, Tubular Type.

Tubular arms over 25 feet shall be heavy wall double tubular construction. Arms shall consist of two aluminum tubes (6061-t6 heat treated aluminum) adequately braced. The length of the arm from the arm socket assembly to the tip of the arm shall be in accordance with the Plans and field verification measurements made by the Contractor. Tubular sections of 4.5 inches in diameter shall have a minimum wall thickness of 0.237 inches and tubular sections of 4 inches shall have a minimum wall thickness of 0.226 inches. Each arm shall be equipped with two stainless steel guy cables securely fastened.

(a) Arm, Rectangular Type.

Rectangular arms shall not exceed 24 feet in length when measured from center line of arm socket assembly to the tip of the arm. Each arm shall be equipped with two stainless steel guy cables securely fastened. Each arm shall be fabricated from 2 inches by 5 inches, rectangular, aluminum, 6061-T6 tubing with a wall thickness of not less than 0.185 inches. Exact length of arm shall be in accordance with the Plans and field verification measurements made by the Contractor.

(b) Arm, Fabrication and Finish.

Gate arms shall be properly cleaned at the factory and provided with reflectorized sheeting. The sheeting shall be installed on the oncoming traffic side only. The reflectorized sheeting shall be ASTM Type IX, such as 3M Diamond Grade (VIP), pressure sensitive Scotchlite #3990 white and #3992 red. The red and white stripes shall be 16 inches wide and shall be vertical.

Stainless steel pickup aircraft cable having a breaking strain of not less than 8,000 pound tensile shall be furnished and installed. Each cable shall be adjustable by galvanized steel turnbuckles.

The arm shall be equipped with 7 inch one-way traffic lights with visors similar to B & B Electromatic Corp., Type TS-700, Model C, with a 32 candle power automotive lamp. Lamp shall be of the twin contact type mounted on adjustable bracket for correct focusing. Bracket shall be fastened with shock mounts to absorb roadway and bridge vibrations and prolong lamp life. Traffic lights shall be mounted so that each light may be rotated to shine parallel to the roadway and in the direction of oncoming traffic. Final field connection to gate operating mechanism shall be #14 AWG Flexible S.0. cable. Traffic signal lenses shall be held in place with four tamper resistant screws. Lenses shall be traffic signal red. Housing shall be aluminum alloy, heat treated. Wiring of all traffic signals on each arm shall be such that the lamps shall flash alternately.

The arm shall be shipped fully assembled and wired with all traffic signals in place and properly packed to prevent damage.

The arm shall be identified as to length and location of installation. The horizontal swing gate arm shall be subject to the following additional requirements. The horizontal aluminum gate arm extension from the gate socket shall be fabricated with two parallel lengths of extruded aluminum tubing alloy 2014-T6.

The gate arm extension shall be rigidly clamped in the gate socket. A shear pin shall be provided in a readily accessible location to facilitate replacement. The shear pin shall be capable of resisting a load of 40 psi applied to the entire assembly, with a factor of safety of 150%. In addition, the shear pin must yield at any impact or sustained load on the entire gate assembly without sustaining damage to any portion of the gate mechanism with exception of the aluminum portion of the gate arm. Design of the gate socket and shear pin shall be subject to the approval of the Engineer based in part upon a written documentation of actual testing of the ability of the gate socket and shear pin to function as specified. Further field tests may be ordered by the Engineer to verify the proper functioning of the shear pin mechanism.

(G) FASTENERS.

Fasteners shall be stainless steel.

(H) SPARE ARMS.

Gate arms complete with all specified components, except striping, shall be furnished to the Authority for storage and future use. The arms shall be properly packaged for storage and the package clearly marked with the actual length.

SECTION 922 - TOLL BOOTHS, ISLANDS, AND CANOPIES

922.01 General Requirements.

Toll booths shall be fabricated from stainless steel ASTM A167, Type 302; carbon steel ASTM A36, hot-dip galvanized after fabrication per ASTM A123 at 2 oz. per square foot. Mechanical fastenings and hardware shall be of stainless steel unless otherwise noted and adhesives shall be as recommended by manufacturer of material to be attached unless otherwise noted.

All hardware shall be fitted and components preassembled in the shop prior to shipping. Items may be disassembled for shipping.

922.02 Booth Shell.

The booth shell shall be fabricated stainless steel, in accordance with the Plans and the following:

(A) TUBULAR FRAME.

Tubular Frame - 2" x 2" x 11 Ga. Stainless steel. Finish shall be No. 4 on all exposed surfaces. Weld all

joints, grind smooth, buff and polish to match adjacent finish. Include 6 anchoring locations internal to the booth.

(B) Panels.

Stainless Steel, from an approved supplier as listed on the QPL. Rivet front and back sheets together for weathertightness. Two layers of 3/4" exterior plywood are to be inserted into the panel, and insert sealing tape between connecting surfaces of interior and exterior panels; fasten to tubular frame and caulk with Thiokol base caulking compound.

(E) Glass Gasket Flange.

Glass Gasket Flange - stainless steel; spot welded to frames.

(F) Roof.

Roof - stainless steel with a No. 4 finish, laminated to plywood using waterproof Resorsinol glue from an approved supplier as listed on the QPL.

(G) Roof Frame.

Roof Frame - Galvanized carbon steel.

(H) Roof Fascia.

Roof Fascia - stainless steel; satin finish; apply 3/16 inch thick closed cell neoprene gaskets between bent roof sheet and fascia sheet.

(I) Ceiling.

Ceiling - Perforated stainless steel No. 4 finish. Insert neoprene gaskets between ceiling panel and framework; cut, bend and provide fastening strips and clips for lights; reinforce all cut edges.

(J) Trim.

Trim - 18 gauge stainless steel; No. 4 finish to match other stainless steel; to be used to close gaps at counters and booths and where required.

(K) Exposed Surfaces.

Exposed Surfaces - All exposed interior and exterior surfaces shall be protected wherever practicable with an approved covering or coating during fabrication, transportation, and storage. The covering or coating shall be promptly removed when directed by the Engineer, and all surfaces cleaned and polished.

922.03 Interior Equipment.

(A) Control Panel.

Control Panel - Control panels shall be 16 gauge stainless steel; No. 4 Finish; cut, reinforce, tap, and otherwise prepare for electrical boxes, speakers, bulletin board and other items, as shown; weld and grind smooth all joints; front to be hinged with full piano hinge.

(B) Bulletin Board.

Bulletin Board - One bulletin board per booth; size as shown, equal to those manufactured by Coin and Paddock. Cork center with stainless steel trim.

(C) Counter.

Counter - galvanized carbon steel framework, with stainless steel fronts, panels, drawers, and other items indicated; cut, bend and reinforce as required. For the various units which others are to install, provide access panels to all areas where mechanical connections occur.

(1) Counter Fronts.

Counter Fronts (aprons) - stainless steel No. 4 finish.

(2) Drawer.

Drawer - Full suspension drawer shall be removable body with recessed pull handles; capable of supporting a combined load of 250 pounds in the open position, mounted with lock washers; cash

drawer locks shall be with all locks keyed differently and master keyed; two sets of keys for each counter with two master keys and ten key blanks. All keys and blanks shall be turned over to the Authority.

(3) Miscellaneous.

Miscellaneous - Holes for the toll terminal cable connector will be made by the Contractor in accordance with the details supplied by the Engineer. The identifier cover plate as detailed on the Plans shall also be fabricated by the Contractor.

(D) NAMEPLATE HOLDERS.

Nameplate Holders - Nameplate holders shall be stainless steel. Fasten to booth with phillips head screws.

922.04 Internal Electrical Work.

(A) ELECTRICAL SERVICE CHARACTERISTICS .

Electrical Service Characteristics - The electric service characteristics utilized for distribution to toll plaza systems and in conjunction with equipment in toll booths is 120/208 volts, 3 phase, 4 wire, 60 hertz, A.C.

(B) CONDUITS.

Conduits - Flexible metallic conduit shall be the liquid tight type consisting of a spirally wound extra flexible galvanized steel core and smooth, extruded thermoplastic cover. Connectors shall be of a type approved for liquid tight connections. A continuous and integral copper ground wire shall be incorporated in all flexible conduit runs. Ends of conduits shall be coated with a joint compound as found on the QPL prior to conduit connections.

(C) WIRES.

Wires - Wires shall be stranded, tinned copper, single conductor type, rated for 600V., No. 12 AWG minimum size unless otherwise indicated. Requirements for copper material and stranding shall conform to the provisions of the current ICEA Publication No. S-61-402 Part 2 and Table 2-2 for Class B Stranding. Insulation shall be UL Type THHN-THWN conforming to Part 3 and Table 3-1 of such publication.

Wire terminals, connectors, lugs, solder and flux are to be of an acceptable type.

(D) BOOTH LIGHTS.

Booth Lights - Booth light fixtures shall contain four (4) cool white 20 Watt fluorescent lamps each and shall be of the recessed type equal to American Lighting Corporation, special design. The housing shall be 19 gauge steel. The frame shall be stainless steel with Alba glass panels. Wiring sockets, high power factor 120 Volt Type Class P trigger start ballasts to operate the lamps shall be provided. The finish shall be baked white synthetic enamel. Clips shall be provided for mounting in the booth metal ceiling.

(E) WIRING DEVICES.

Wiring Devices - Duplex receptacles shall be 20 amps., 125 volt rated, 3 wire ground fault current interrupter type as listed on the QPL. Switches shall be 20 amp., 277 volt rated. Single pole or 3 way switch as listed on the QPL.

922.05 Toll Islands.

(A) STAIRWELL GRATING.

Shall be as listed on the QPL and in accordance with Subsection 520.02.

(B) STAIRWELL LIGHTING FIXTURES.

Shall be as listed on the QPL and in accordance with Subsection 520.02.

(C) FIRE EXTINGUISHERS AND MOUNTING BRACKETS.

Shall be as listed on the QPL and in accordance with Subsection 520.02.

922.06 Canopy.

(A) Fesco Board Insulation.

Shall be as listed on the QPL and in accordance with Subsection 521.05.

(B) 4 Ply Built Up Roof.

Shall be as listed on the QPL and in accordance with Subsection 521.05.

(C) Bituminous Flashing.

Shall be as listed on the QPL and in accordance with Subsection 521.05.

(D) Gravel Stop and Fascia.

Shall be as listed on the QPL and in accordance with Subsection 521.05.

SECTION 923 - MISCELLANEOUS

923.01 Architectural Panels.

Architectural panels shall be metal and as required by the plans, applicable Supplementary Specifications and from an approved supplier as listed on the QPL.

Exterior face - design shall be an approved profile. Side joints shall have concealed male and female lips so as to provide a continuous protected interlocking factory sealed joint, allowing for expansion without opening to the weather. Male lip shall have an off-set design so as to center it and securely lock it into the female lip. Exposed fasteners, button-punching, and pop rivets will not be permitted. End joints shall be either counter-sunk or butted with lap strips.

Exterior pattern, color and finish shall be approved by the Engineer if not shown on the plans or given in the Supplementary Specifications.

Exterior metal shall be fabricated from aluminum. The gauge shall be as required to meet the load and deflection criteria, in conjunction with the minimum metal thicknesses that might be required for the specific finishing process.

Exterior color shall be a color as selected from manufacturer's standard color chart available for the particular finish.

Perimeter Trim - interior corners, exterior corners and base trim shall be extruded aluminum design so as to completely eliminate sheet metal trim and exposed fasteners. Color and finish of the extruded aluminum trim shall be the same as the face sheet finish.

Structural Tests - panel designs shall have been verified by structural tests for both positive and negative wind loads by the "Chamber Method" as outlined in ASTM E72. Standard loading shall be 20 pounds per square foot wind load and a deflection limit of 1/180 of the span.

923.02 Bearing Pads.

(A) Elastomeric Bearing Pads for Bridge Railing Posts.

Elastomeric Bearing Pads for Bridge Railing Posts shall conform to the material requirements of Subsection 923.15.

(B) Preformed Fabric Reinforced Pads.

Elastomeric Preformed Fabric Reinforced Pads shall conform to the latest edition of the LRFD Bridge Construction Specifications, with current interims, Section 18.10.2.

923.03 Calcium Chloride.

Calcium chloride shall conform to ASTM D98 or AASHTO M144 except that the alkali and impurity requirements need not apply.

923.04 Canopy Drain.

Canopy drain shall be from an approved supplier as listed on the QPL. Drain leader shall be galvanized steel

pipe conforming to the requirements of ASTM A53.

923.05 Caulking Compound.

Caulking compound shall be an aluminum-impregnated caulking compound conforming to the requirements of Federal Specification TT-C-598, consistency Grade I.

923.06 Dampproofing and Waterproofing.

(A) Dampproofing.

Asphalt primer for dampproofing shall conform to ASTM D41. Asphalt for mopping coats shall conform to ASTM D449, Type I for use below ground, and to ASTM D449, Type II and III for use above ground.

(B) Waterproofing.

Waterproofing shall consist of a coating of fabric and bituminous materials and insulation board protection as follows:

(1) Fabric shall be cotton fabric conforming to ASTM D173 or glass fabric conforming to ASTM D1668, Type I. The fabric shall be stored in a dry, protected place. Fabric rolls shall not be stored on end.

(2) Primer shall conform to ASTM D41. Mopping coats shall conform to ASTM D449, Type I.

(3) Insulation board for protection course shall be Mineral fiber insulation of a minimum of ½" in thickness and conforming to the requirements of ASTM C726.

(C) Preformed Sheet Membrane Waterproofing.

Preformed Sheet Membrane Waterproofing shall consist of a primer, preformed sheet membrane, mastic and protection course as follows:

(1) Primer shall be as recommended by the sheet membrane manufacturer.

(2) Preformed sheet membrane shall consist of a tough, pliable waterproof sheet of self-adhering rubberized asphalt integrally bonded to an outer layer of polyethylene film and shall be from an approved supplier as listed on the QPL.

(3) Mastic shall be as recommended by the manufacturer of the sheet membrane.

(4) Protection course shall be insulation board as specified in (B)(3) above, a polystyrene bead board or cellular plastic board for vertical surfaces, or an approved equal.

(D) Membrane Waterproofing for Bridge Decks.

Membrane Waterproofing for Bridge Decks shall consist of a primer, preformed membrane sheet and mastic as follows:

(1) Primer as recommended by the manufacturer of the sheet membrane.

(2) Sheet Membrane shall be preformed and from an approved supplier as listed on the QPL.

(3) Mastic as recommended by the manufacturer of the sheet membrane.

(4) Curb flashing as recommended by the manufacturer of the sheet membrane.

(E) Epoxy Resin Waterproofing.

Epoxy Resin Waterproofing_shall consist of a liquid coating of a two component epoxy resin sealing compound and sand to be applied to horizontal concrete surfaces as follows:

(1) Epoxy Resin shall be a high build, flexible, two component, two color system from an approved supplier as listed on the QPL.

(2) Sand shall be clean, dry silica sand approved by the Engineer.

(F) Water Repellent Treatment.

Water Repellant Treatment shall be a water miscible, colorless, penetrating treatment of a solution of an organosilane in ethyl alcohol, or an aromatic hydrocarbon carrier, and shall be from an approved supplier as listed on the QPL. The treatment shall conform to the following:

(1) Water absorption values for treated concrete surfaces shall not exceed 1% moisture after 48-hour submersion in water, when compared to similar untreated concrete surfaces with approximately 4.8% moisture after 48-hour submersion in water, according to ASTM Designation C642 testing procedure.

(2) The treated specimen from (1) above shall not exceed 1.3% moisture by weight when submerged in boiling water for 24 hours following the 48-hour soak in accordance with ASTM C642 test procedure.

(3) The treatment must allow treated substrates to retain vapor permeability and application must be compatible with damp substrate surfaces. Verification of this property will be demonstrated by treating the sample specimen which is in a water saturated condition at the time of application, drying the treated sample to a constant weight, and then performing the ASTM C642 testing procedure when the treated sample gaining no more than 1% of its weight when submerged for 24 hours.

(4) No staining, discoloration, darkening or texture change of the surface shall occur as a result of the treatment used.

(5) Treated specimens shall show no scaling when subjected to 50 freezing-and-thawing cycles in accordance with ASTM C672 test procedure.

(6) The treatment must be able to resist salt penetration as measured by AASHTO T259 and T260. After 90 days of salt ponding, the treated samples shall absorb less than 1.5 lbs. chloride per cubic yard at the 1/16-inch to 1/2-inch depth and no more than 0.75 lbs. at the 1/2-inch to 1-inch level compared to an untreated sample with 6 lbs./C.Y. and 3.5 lbs/C.Y. respectively.

(G) CONCRETE PENETRATING SEALER.

Penetrating Sealer shall be a VOC compliant silane-based concrete penetrating sealer containing a minimum of 40 percent active ingredients and shall be from an approved supplier as listed on the QPL.

Penetrating Sealer treatment shall conform to all Subsection 923.06(F) requirements of Water Repellent Treatment except 923.06(F) paragraph (1) is revised as follows:

(1) Water absorption values for treated concrete surfaces shall not exceed 1 percent moisture after 48-hour immersion in water and 2 percent after 50 days immersion in water in accordance with ASTM C642 testing modified as follows:

(a) The untreated surfaces of the oven-dried sample shall be coated with a waterproof substance (i.e. epoxy) prior to determining the oven-dried weight.

No staining, discoloration, darkening or texture change of the surface shall occur as a result of the penetrating sealer treatment used. The treatment shall not form a film or otherwise buildup on the treated concrete surface.

All water repellent treatment and penetrating sealer materials shall conform to all the appropriate NJDEP requirements in accordance with Subsection 105.13.

(H) WATERPROOFING SYSTEMS FOR SUBSTRUCTURES.

(1) Substructure Waterproofing.

Substructure Waterproofing shall conform to the requirements of (E) Epoxy Resin Waterproofing.

(2) Substructure Membrane Waterproofing.

Substructure Membrane Waterproofing shall consist of a primer and the membrane. The membrane system must originate from one manufacturer to insure compatibility. The membrane system shall be from an approved supplier as listed on the QPL. The membrane shall conform to the following:

Property	Test Method	Criteria
Solids Content		100%
Coverage Rate 80 mils (2mm)		20.5 sq. ft./gal
Cure Time		30 minutes at 68 degrees F
Water Vapor Transmission	ASTM E96	4.3 g/m2/day
Water Absorption	ASTM D570	<0.5%
Tensile Strength	ASTM D638	400 psi (min)
Elongation (min)	ASTM D638	100%

Property	Test Method	Criteria
Adhesion to Concrete	ACI 503A	100 psi (min)
Crack Bridging	ASTM C836	Pass at -15 degrees F 62.5 mils at 10 cycles
Resistance To:		
Ethylene Glycol	ASTM D543	Pass
Calcium Chloride	ASTM D543	Pass
Diesel Fuel	ASTM D543	Pass
Gasoline	ASTM D543	Pass

The following samples and information along with the current published technical product data and material safety data sheets for the system selected shall be submitted to the Engineer at least one month before application of the waterproof membrane system is anticipated by the Contractor:

(a) The design mix for the membrane system, including samples for testing and approval prior to ordering any materials for the waterproofing membrane.

(b) Primer Coat – 1 quart

(c) Liquid Components of the membrane – 1 quart each

(d) Hardener Powder

(e) Aggregate – 25 lbs.

(f) Written procedures for the surface preparation, application, quality control and placement of the waterproof membrane.

(g) Manufacturer's Literature including descriptive data and specific recommendations for surface preparation, mixing, and application of all materials, and a copy of the manufacturer's quality assurance program listing all in-house testing criteria.

(h) Manufacturer's "Materials Safety Data Sheets" for each respective product to be used.

(I) METHACRYLATE CRACK SEALER.

Methacrylate sealer shall be from an approved supplier as listed on the QPL.

923.07 Elastomeric Sheet.

Elastomeric sheet shall be a minimum thickness of 1/8 inch with material and physical properties conforming to the requirements of ASTM D2000 for Grade 4, Type B, Class A. Hardness shall be 50 durometer A and tensile strength 2,000 psi.

923.08 Epoxy Bonding Compound.

Epoxy bonding compound shall be from an approved supplier as listed on the QPL. Only materials formulated by manufacturers or their licensees with a minimum consecutive three (3) year history of successful performance on similar installations will be acceptable. The Contractor shall submit evidence of the successful application and performance of the material, which the Engineer will require, and a written certification from the manufacturer that the materials comply with these Specifications.

No epoxy bonding compound shall be used six months after the date of manufacture.

923.09 Epoxy Mortar.

Epoxy mortar may be a pre-proportioned, epoxy-based plate grouting system from an approved supplier as listed on the QPL.; or it may consist of a two-component epoxy resin and aggregate, proportioned and mixed as follows:

(A) EPOXY RESIN.

Epoxy Resin shall be a two component, rapid setting, bituminized epoxy, designed as a binding agent for mixing with aggregates to produce a mortar. The mortar is to be used to repair Portland cement concrete. Such resin shall be from an approved supplier as listed on the QPL.

(B) AGGREGATE.

Aggregate shall be clean sand consisting of hard angular particles completely free of dust. In hardness it shall be at least equal to #2 Q-ROK and from an approved supplier as listed on the QPL. Gradation of the aggregate shall be as follows:

Sieve Size	Per Cent Passing (by Weight)
No. 4	100
No. 8	90-100
No. 16	80-100
No. 30	20-60
No. 50	0-10
No. l00	0-2

Mortar proportions shall be four parts aggregate to one part epoxy resin by weight (approximately three to one parts by volume).

Mixing shall be in accordance with the manufacturer's written directions.

923.10 Modified Epoxy Mortar.

Modified epoxy mortar shall consist of the following two-component epoxy system, sand and gravel:

Epoxy resin shall be a two-component modified epoxy system. Component "A" shall be a blend of modified Bisphenol-Epichlorohydrin epoxy resins and monoepoxide compound. Component "B" shall be a modified polyamine curing agent.

Fine aggregate shall be bagged, clean, dry, hard sand, and shall conform to the following requirements:

Fine aggregate shall be a fine aggregate washed and processed material composed of quartz or other hard durable particles conforming Subsection 902.04 except gradation and hardness shall be as required in Subsection 923.09(B). The fine aggregate shall be predominantly angular in shape.

Coarse aggregate shall be bagged, extra clean, dry 3/8" gravel.

Mortar proportions for all but the top 1/4" of the area to be filled shall be 4-1/2 parts sand and 6 parts gravel to 1 part epoxy resin by weight.

Mortar proportions for the top 1/4" overlay of the filled area shall be at the rate of 6 parts sand to 1 part epoxy resin by weight. The epoxy resin shall contain pigmentation to produce a black color when so directed.

Primer coat for the mortar shall consist of the mixed epoxy resin system (components "A" and "B"), without aggregates.

923.11 Not in Use.

This heading is not currently in use.

923.12 Gaskets.

Gaskets for use with steel flange bridge drainage pipe shall be 1/8-inch neoprene conforming to the Type A material requirements of AASHTO M198.

923.13 Granite Curb.

Granite curb shall be a tough, dense, sound and durable stone of uniform color, reasonably fine grained and free from seams, pyrite inclusions, or other structural defects. Stones shall be from one quarry and of the same color and texture. Stones shall have nominal lengths of 3 to 4 feet when set on a radius of 150 feet or greater including straight sections.

Stone shall be cut to the dimensions shown on the Plans. The top face of stones shall be free from wind, shall be sawed to an approximately true plane, and shall have no projections or depressions greater than 1/8 of an inch. The front arris line shall be pitched straight and true. The plane of the back shall be vertical.

The front face of stones above the top of pavement shall be sawed to an approximate true plane, with no

projections or depressions of more than 1/8 inch. For the remaining distance, there shall be no projection greater than 3/4 inch and no depression greater than 1/4 inch.

Intersection of top and front face shall be rounded as shown on the Plans. The ends of all stones shall be square with the planes of the top and face so that when the stones are placed end to end as closely as possible no space shall show in the joint for a depth of 5/8 of an inch for the full width of the top and for 9 inches down on the face after which the end may break back not over 2 inches from the plane of the joints. The stones shall be thoroughly cleaned of any iron rust particles by sandblasting or other approved methods. Any conspicuous saw marks shall be removed with a peen hammer. Holes shall be carefully drilled onto the back face of the curb to provide for stone anchors. Spacing, size, and depth of the holes shall conform to the details shown on the Plans.

923.14 Metal Roof Deck.

Metal roof deck shall be manufactured from zinc-coated steel sheets of structural quality meeting the requirements of ASTM A653, Grade 40. Metal roof deck of lengths spanning 3 or more spans shall be fabricated of 22 gauge materials; lengths spanning 2 spans shall be fabricated of 20 gauge materials, single span lengths shall be fabricated of 18 gauge materials.

923.15 Neoprene Washers.

Neoprene washers shall be of 100 percent virgin chloroprene (neoprene), conforming to the basic requirements of ASTM D2000, and having physical properties as follows:

Hardness, Durometer, Shore A	60±5
Tensile Strength, Minimum	2,000 PSI
Ultimate Elongation	350%

The material shall also be resistant to ozone and outdoor aging and shall have a maximum compression set of 25 percent when tested in accordance with ASTM D395, Method B for 22 hours at 212°F.

923.16 Nylon Washers.

Nylon washers shall conform to the requirements of ASTM D789, Type 1.

923.17 Waterstops.

Waterstops shall be either synthetic rubber or polyvinyl chloride conforming to Division II, Section 8, AASHTO Standard Specifications for Highway Bridges.

923.18 Delineators.

Flexible delineator units shall be made of a fiberglass reinforced, thermosetting, high-density polymer resin or an extruded polycarbonate resin, which are resistant to ultraviolet and infrared radiation, and which meet the following minimum physical requirements:

(A) Delineator Dimensions.

Delineator units shall be 4 inch wide by 8 inch high, with a minimum thickness of 1/8 inch.

(B) Delineator Color.

Delineator colors shall be as shown on the plans.

(C) Retroreflective Sheeting.

Use 3M "Diamond Grade" reflective sheeting. Affix yellow, white or red reflective sheeting to the traffic-facing side of the delineator according to the manufacturer's recommendations.

Manufacturing sources for delineator products shall use recycled materials as recommended by the EPA, unless waived by the Engineer. Submit a certification of compliance, as specified in Subsection 105.04 for the delineators.

923.19 Safety Treads.

Non-slip safety tread nosings shall be from an approved supplier as listed on the QPL, with anchors, bolts and nuts.

923.20 Skid Resistant Coating.

Skid resistant coating for steel plates subject to vehicular traffic and/or foot traffic shall be of a type which will provide a proven skid resistant surface acceptable to the Engineer.

Coatings shall be a two-component, high solids, epoxy system containing abrasive granules or silica aggregates, applied in two coats, from an approved supplier as listed on the QPL.

An alternate type of coating consisting of a two-coat coal tar epoxy system and aggregate from an approved supplier as listed on the QPL may be acceptable when approved by the Engineer.

923.21 Filter Fabric.

Filter fabric shall be of the non-woven or woven type consisting of a pervious sheet of polymeric fibers oriented into a stable network such that the fibers retain their relative positions with respect to each other. The fabric shall be mildew and rot resistant, insect and rodent resistant, and shall be free of any treatment or coating which might significantly alter its physical properties. The fabric shall be protected during shipment and storage from ultra violet rays, temperature greater than 140 °F., and contaminants such as mud and dust.

Filter fabric having a minimum weight of 4 ounces per square yard shall be used for underdrains.

Filter fabric to be used with Stone, Grade A or Stone, Grade E shall meet the following requirements:

Property	Required Value	Test Method
Weight	10 oz. per sq. yd. (min.)	ASTM D3776
Permeability	0.02-0.30 cm. per sec.	-----
Grab Strength (Tensile)	250 lb. (min.)	ASTM D4632
Thickness (Woven)	30 mils (min.)	ASTM D1777
Thickness (Non-Woven)	90 mils (min.)	ASTM D1777

Filter fabric to be used with Stone, Grades B, C and D shall meet the following requirements:

Property	Required Value	Test Method
Weight	6 oz. per sq. yd. (min.)	ASTM D3776
Permeability	0.02-0.30 cm. per sec.	-----
Grab Strength (Tensile)	150 lb. (min.)	ASTM D4632
Thickness (Woven)	25 mils (min.)	ASTM D1777
Thickness (Non-Woven)	60 mils (min.)	ASTM D1777

Filter fabric selection where various grades of stone are used in combination shall be as approved by the Engineer.

923.22 Epoxy Resin System.

(A) Epoxy Resin for Injection.

Epoxy resin system for injection material to fill structural voids and cracks shall be a two component, 100% solids, moisture insensitive high modulus high strength epoxy resin adhesive and shall from an approved supplier as listed on the QPL.

The pressure injected epoxy shall be capable of penetrating the cracks and voids to their full depth and bond to surfaces of cracked concrete and/or structural steel.

(B) Epoxy/Resin for Anchor Bolts in Nominal Holes.

Epoxy resin system for injection material to install anchor bolts in non-tension applications in drilled holes of a nominal diameter as recommended by the epoxy or resin manufacturer shall be from an approved supplier as listed on the QPL.

(C) Epoxy/Resin/Grout for Anchor Bolts in Oversize Holes.

Epoxy resin system for injection material to install bearing anchor bolts in non-tension applications in drilled or preformed holes of up to 3" in diameter shall be from an approved supplier as listed on the QPL.

923.23 Epoxy Crack Sealant.

Epoxy crack sealant material shall be an epoxy resin gel from an approved supplier as listed on the QPL.

923.24 Crack Spanning Membrane.

Crack spanning membrane shall be a high density asphalt mastic laminated between two layers of nonwoven polypropylene meeting the following properties:

Color	Black
Width	20 Inches
Density	80.0 Lbs/Ft^3
Weight	0.8 Lbs/Ft^2
Caliper	0.120 inch
Gold Flex, (2" x 5" Specimen 180 deg Bend on 2 inch Mandrel – 0 ºF)	No Cracking or Separation
Heat Stability, (2" x 5" Specimen Hung Vertically in a Mechanical Convection Over 2 Hrs. – 190 ºF)	No Dripping or Delamination
Flammability (Self-extinguishing no burn rate when tested in accordance with Federal D.O.T. Specification 302).	
Percent Elongation (Instron)	100 percent
Tensile Strength (Instron)	900 lb. per in. width min.

Ensure that material is from an approved supplier as listed on the QPL and is applied in accordance with manufacturer's instructions.

Crack and joint sealant shall be a hot poured modified asphalt using an elastomer/plastomer blend or an asphalt vulcanized rubber crack sealant conforming to Subsection 904.03.

Sealers shall conform to the requirements of ASTM D6690 and D5167 when tested in accordance with ASTM D5329.

923.25 Temporary Orange Plastic Fence.

Temporary orange plastic fence shall be made of high-density polyethylene formed into a laminar netting by an extrusion process. The fence shall be 4 feet high and of a highly visible orange color. The fence shall be from an approved supplier as listed on the QPL.

923.26 Burlap.

Burlap made from jute or kenaf shall conform to AASHTO M 182 Class 4, with a minimum width of 10 inches and not less than 25 yards in one continuous piece.

923.27 Fly Ash.

Fly ash for portland cement concrete shall conform to ASTM C 618, Class C or Class F except that the loss on ignition shall not be more than three percent. When Class C fly ash is used, the magnesium oxide shall not exceed 2.5 percent. Fly ash used to control alkali-silica reactivity shall be Class F and shall contain not more than 1.5 percent available alkali according to ASTM C 618, Table 1A. Before each source of fly ash is approved, certified results of tests conducted by a testing agency shall be submitted to and verified by the Department. Accompanying the certification shall be a statement from the supplier listing the source and type of coal, the methods used to burn, collect, and store the fly ash, and the quality control measures employed.

Conformance to the requirements for loss on ignition and fineness shall be determined by the supplier for each truck load of fly ash delivered to the mixing site. The test values determined shall be included on the delivery ticket. The Engineer may require that the fly ash not be used until the Department has performed tests for loss on ignition and fineness.

Fly ash for other uses shall conform to ASTM C 593 except that the loss on ignition shall be not more than ten percent, and the combined content of silica and aluminum oxide shall be a minimum of 50 percent.

923.28 Sealant.

Sealant shall be a high-performance, moisture-cured, one-compound polyurethane base elastomeric sealant from an approved supplier as listed on the QPL.

923.29 Lead Shims.

Lead Shims shall be lead strips 1-1/4 inches wide of the required thickness projecting 1/8 inch from the base plates and shall be used instead of aluminum shims to adjust posts vertically.

The Contractor shall submit shop drawings detailing the steel, dimensions, profiles, welds, tolerances, surface coatings, horizontal radii and all other details prior to ordering the fabrication of new handrails and posts.

923.30 Silt Fence.

Provide geotextile material with protective wrapping and, before placement, store the rolls in a manner that protects them from moisture and minimizes exposure to ultraviolet radiation. Provide silt fence that is inert to commonly encountered chemicals, and that is stabilized against ultraviolet light degradation. Label each roll to provide product identification.

The geotextile material for both silt fence and heavy duty silt fence shall meet the requirements of AASHTO M 288. The color of silt fence and heavy duty silt fence shall be black.

923.31 Bonding Agent.

Bonding Agent shall be from an approved supplier as listed on the QPL. These bonding agents are suitable for spall repairs that are formed prior to placing concrete.

923.32 Anti-Corrosion Coating.

Anti-corrosion coating shall be from an approved supplier as listed on the QPL.

923.34 High Performance Permanent Cold Patch.

High performance permanent cold patch shall be a plant mixed high performance pavement patching material capable of storage in an uncovered outdoor stockpile for a minimum of 12 months. It shall be composed of laboratory approved mineral aggregates and modified bituminous QPR2000 Liquid Blend capable of coating wet aggregates(up to 4% moisture) without stripping and have stripping resistance of retained coating of not less than 95%. The permanent asphalt repair shall be uniform, remain flexible and cohesive to -15ºF and be capable of retaining adhesive qualities in wet applications. The patching materials shall be able to repair asphalt, concrete, surface treated roads and shall not require removal and replacement if ever the pavement is overlaid. The materials shall be from an approved supplier as listed on the QPL.

Aggregate used shall consist of 100% crushed limestone or a laboratory approved equivalent under ASTM C 136. All aggregate is to be from approved sources, and representative samples of both fine and coarse aggregate shall be from the plant site and laboratory tested. Sampling and testing methods shall be as approved by the Engineer.

Recommended gradation analysis shall be as follows:

Screen Size	Percentage Passing
3/8"	100
No. 4	20-55
No. 8	5-30
No. 16	0-10

Screen Size	Percentage Passing
No. 50	0-6
No. 200	0-2

All aggregate percentages are based on the total weight of aggregate:

ASTM C 88	Soundness Loss	12.0 % Max.
ASTM C 131	Los Angeles Abrasion	40.0 % Max.
ASTM C 117	No. 200 sieve(by wash)	2.0 % Max.
ASTM C 127, C 128	Absorption	1.0-2.0 % Max.
ASTM C 127, C 128	Specific Gravity	2.55-2.75 % Max.
ASTM C 123	Soft Aggregates	3.0 % Max.

(A) Aggregate Acceptance.

Compatibility approval must be obtained from the QPR quality control facility in Brantford, Ontario prior to material mixing at any mixing plant.

(B) Plant Preparation and Operation.

The mixture shall be produced through a conventional hot asphalt plant only under the direct supervision of a qualified QPR sales representative and the finished product shall not exceed 180ºF. The bituminous liquid blend shall not be heated above 200ºF. The final mixture must be tested in accordance with QPR on-site quality control requirements.

(C) Environmental Toxicity Testing.

The modified bituminous cold patch QPR2000 must have an independent test conducted by a certified laboratory as to toxicology results in a Static Acute Bio Assay Procedure for Hazardous Materials which determines effect of runoff into waterways, lakes, ponds and groundwater.

(D) Stockpile Inspection.

Prior to production, the stockpile site is to be inspected for any contaminant such as dirt, sand or debris that may affect the quality of the QPR2000 High Performance Cold Patch. The stockpile area should be a hard surface, preferably paved with concrete or a bituminous surface.

(E) Specification Sampling.

A one quart sample of the QPR2000 Liquid Blend will be retained at the asphalt depot prior to shipping. On delivery of the tank truck, an additional one quart sample will be taken by the QPR representative and is to be retained by the Authority for a period of one year, or until the stockpile is depleted.

(F) Quality Control.

On each load, a Quality Control Report will be prepared by the QPR quality control technician. All phases of production of the plant operation and the material testing on each 150 tons of production will be prepared and entered in each category. Site tests will be completed which will include Spot Test, Strip Resistance, Coating Observation and Roll Test.

(G) Stockpiling.

One (1) year shelf life. QPR2000 may be stockpiled up to 12 months in an uncovered stockpile.

923.35 Polyethylene Wear Strips.

Unless Plans or Supplementary Specifications require a different thickness than shown herein, the polyethylene sheets for wear strips shall be 1 1/4" thick ultra high molecular weight (UHMW) polyethylene, averaging 3.1-6 million weight, in full compliance with ASTM D4020-01. Material shall be a mechanical blend of virgin UHMW resin and a maximum of 25% by weight reprocessed UHMW polyethylene chips. Color shall be black with a minimum of 2.5% carbon black for UV protection. Material shall be from an approved supplier as listed on the QPL.

923.36 Estimation Table of Lot Percent Defective.

Estimation of Lot Percent Defective										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 1										
Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	48.98	47.96	46.94	45.92	44.90	43.88	42.86	41.84	40.82
0.1	39.80	38.78	37.76	36.73	35.71	34.69	33.67	32.65	31.63	30.61
0.2	29.59	28.57	27.55	26.53	25.51	24.49	23.47	22.45	21.43	20.41
0.3	19.39	18.37	17.35	16.33	15.31	14.29	13.27	12.24	11.22	10.20
0.4	9.18	8.16	7.14	6.12	5.10	4.08	3.06	2.04	1.02	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q", the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Note 2: This empirically derived table is suitable only for use with this Specification.

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 2										
Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	49.66	49.33	48.99	48.66	48.32	47.99	47.65	47.32	46.98
0.1	46.64	46.31	45.97	45.64	45.30	44.97	44.63	44.30	43.96	43.62
0.2	43.29	42.95	42.62	42.28	41.95	41.61	41.28	40.94	40.60	40.27
0.3	39.93	39.60	39.26	38.93	38.59	38.26	37.92	37.58	37.25	36.91
0.4	36.58	36.24	35.91	35.57	35.23	34.90	34.56	34.23	33.89	33.56
0.5	33.22	32.89	32.55	32.21	31.88	31.54	31.21	30.87	30.54	30.20
0.6	29.87	29.53	29.19	28.86	28.52	28.19	27.85	27.52	27.18	26.85
0.7	26.51	26.17	25.84	25.50	25.17	24.83	24.50	24.16	23.83	23.49
0.8	23.15	22.82	22.48	22.15	21.81	21.48	21.14	20.81	20.47	20.13
0.9	19.80	19.46	19.13	18.79	18.46	18.12	17.79	17.45	17.11	16.78
1.0	16.44	16.11	15.77	15.44	15.10	14.77	14.43	14.09	13.76	13.42
1.1	13.09	12.75	12.42	12.08	11.75	11.41	11.07	10.74	10.40	10.07
1.2	9.73	9.40	9.06	8.72	8.39	8.05	7.72	7.38	7.05	6.71
1.3	6.38	6.04	5.70	5.37	5.03	4.70	4.36	4.03	3.69	3.36
1.4	3.02	2.68	2.35	2.01	1.68	1.34	1.01	0.67	0.34	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q", the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Note 2: This empirically derived table is suitable only for use with this Specification.

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 3										
Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.72	49.45	49.17	48.90	48.62	48.35	48.07	47.79	47.52
0.1	47.24	46.96	46.69	46.41	46.13	45.85	45.58	45.30	45.02	44.74
0.2	44.46	44.18	43.90	43.62	43.34	43.05	42.77	42.49	42.20	41.92
0.3	41.63	41.35	41.06	40.77	40.49	40.20	39.91	39.62	39.33	39.03
0.4	38.74	38.45	38.15	37.85	37.56	37.26	36.96	36.66	36.35	36.05
0.5	35.75	35.44	35.13	34.82	34.51	34.20	33.88	33.57	33.25	32.93
0.6	32.61	32.28	31.96	31.63	31.30	30.97	30.63	30.30	29.96	29.61
0.7	29.27	28.92	28.57	28.22	27.86	27.50	27.13	26.76	26.39	26.02
0.8	25.64	25.25	24.86	24.47	24.07	23.67	23.26	22.84	22.42	21.99
0.9	21.55	21.11	20.66	20.19	19.73	19.25	18.75	18.25	17.74	17.21
1.0	16.67	16.11	15.53	14.93	14.31	13.66	12.98	12.27	11.51	10.71
1.1	9.84	8.89	7.82	6.60	5.08	2.87	0.00	0.00	0.00	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q", the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 4										
Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.67	49.33	49.00	48.67	48.33	48.00	47.67	47.33	47.00
0.1	46.67	46.33	46.00	45.67	45.33	45.00	44.67	44.33	44.00	43.67
0.2	43.33	43.00	42.67	42.33	42.00	41.67	41.33	41.00	40.67	40.33
0.3	40.00	39.67	39.33	39.00	38.67	38.33	38.00	37.67	37.33	37.00
0.4	36.67	36.33	36.00	35.67	35.33	35.00	34.67	34.33	34.00	33.67
0.5	33.33	33.00	32.67	32.33	32.00	31.67	31.33	31.00	30.67	30.33
0.6	30.00	29.67	29.33	29.00	28.67	28.33	28.00	27.67	27.33	27.00
0.7	26.67	26.33	26.00	25.67	25.33	25.00	24.67	24.33	24.00	23.67
0.8	23.33	23.00	22.67	22.33	22.00	21.67	21.33	21.00	20.67	20.33
0.9	20.00	19.67	19.33	19.00	18.67	18.33	18.00	17.67	17.33	17.00
1.0	16.67	16.33	16.00	15.67	15.33	15.00	14.67	14.33	14.00	13.67
1.1	13.33	13.00	12.67	12.33	12.00	11.67	11.33	11.00	10.67	10.33
1.2	10.00	9.67	9.33	9.00	8.67	8.33	8.00	7.67	7.33	7.00
1.3	6.67	6.33	6.00	5.67	5.33	5.00	4.67	4.33	4.00	3.67
1.4	3.33	3.00	2.67	2.33	2.00	1.67	1.33	1.00	0.67	0.33
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q", the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 5										
Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	49.64	49.29	48.93	48.58	48.22	47.86	47.51	47.15	46.80
0.1	46.44	46.09	45.73	45.38	45.02	44.67	44.31	43.96	43.60	43.25
0.2	42.90	42.54	42.19	41.84	41.48	41.13	40.78	40.43	40.08	39.72
0.3	39.37	39.02	38.67	38.32	37.97	37.62	37.28	36.93	36.58	36.23
0.4	35.88	35.54	35.19	34.85	34.50	34.16	33.81	33.47	33.12	32.78
0.5	32.44	32.10	31.76	31.42	31.08	30.74	30.40	30.06	29.73	29.39
0.6	29.05	28.72	28.39	28.05	27.72	27.39	27.06	26.73	26.40	26.07
0.7	25.74	25.41	25.09	24.76	24.44	24.11	23.79	23.47	23.15	22.83
0.8	22.51	22.19	21.87	21.56	21.24	20.93	20.62	20.31	20.00	19.69
0.9	19.38	19.07	18.77	18.46	18.16	17.86	17.55	17.25	16.96	16.66
1.0	16.36	16.07	15.78	15.48	15.19	14.91	14.62	14.33	14.05	13.76
1.1	13.48	13.20	12.93	12.65	12.37	12.10	11.83	11.56	11.29	11.02
1.2	10.76	10.50	10.23	9.97	9.72	9.46	9.21	8.96	8.71	8.46
1.3	8.21	7.97	7.73	7.49	7.25	7.02	6.79	6.56	6.33	6.10
1.4	5.88	5.66	5.44	5.23	5.02	4.81	4.60	4.39	4.19	3.99
1.5	3.80	3.61	3.42	3.23	3.05	2.87	2.69	2.52	2.35	2.19
1.6	2.03	1.87	1.72	1.57	1.42	1.28	1.15	1.02	0.89	0.77
1.7	0.66	0.55	0.45	0.36	0.27	0.19	0.12	0.06	0.02	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q", the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 6										
Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	49.63	49.27	48.90	48.53	48.16	47.80	47.43	47.06	46.70
0.1	46.33	45.96	45.60	45.23	44.86	44.50	44.13	43.77	43.40	43.04
0.2	42.68	42.31	41.95	41.59	41.22	40.86	40.50	40.14	39.78	39.42
0.3	39.06	38.70	38.34	37.98	37.62	37.27	36.91	36.55	36.20	35.84
0.4	35.49	35.14	34.79	34.43	34.08	33.73	33.38	33.04	32.69	32.34
0.5	32.00	31.65	31.31	30.96	30.62	30.28	29.94	29.60	29.26	28.93
0.6	28.59	28.25	27.92	27.59	27.26	26.92	26.60	26.27	25.94	25.61
0.7	25.29	24.96	24.64	24.32	24.00	23.68	23.37	23.05	22.74	22.42
0.8	22.11	21.80	21.49	21.18	20.88	20.57	20.27	19.97	19.67	19.37
0.9	19.07	18.78	18.49	18.19	17.90	17.61	17.33	17.04	16.76	16.48
1.0	16.20	15.92	15.64	15.37	15.09	14.82	14.55	14.29	14.02	13.76
1.1	13.50	13.24	12.98	12.72	12.47	12.22	11.97	11.72	11.47	11.23
1.2	10.99	10.75	10.51	10.28	10.04	9.81	9.58	9.36	9.13	8.91
1.3	8.69	8.48	8.26	8.05	7.84	7.63	7.42	7.22	7.02	6.82

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 6										
Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
1.4	6.63	6.43	6.24	6.05	5.87	5.68	5.50	5.33	5.15	4.98
1.5	4.81	4.64	4.47	4.31	4.15	4.00	3.84	3.69	3.54	3.40
1.6	3.25	3.11	2.97	2.84	2.71	2.58	2.45	2.33	2.21	2.09
1.7	1.98	1.87	1.76	1.66	1.55	1.45	1.36	1.27	1.18	1.09
1.8	1.01	0.93	0.85	0.78	0.71	0.64	0.57	0.51	0.46	0.40
1.9	0.35	0.30	0.26	0.22	0.18	0.15	0.12	0.09	0.07	0.05
2.0	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q", the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 7										
Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	49.63	49.25	48.88	48.50	48.13	47.75	47.38	47.01	46.63
0.1	46.26	45.89	45.51	45.14	44.77	44.40	44.03	43.65	43.28	42.91
0.2	42.54	42.17	41.80	41.44	41.07	40.70	40.33	39.97	39.60	39.23
0.3	38.87	38.50	38.14	37.78	37.42	37.05	36.69	36.33	35.98	35.62
0.4	35.26	34.90	34.55	34.19	33.84	33.49	33.13	32.78	32.43	32.08
0.5	31.74	31.39	31.04	30.70	30.36	30.01	29.67	29.33	28.99	28.66
0.6	28.32	27.98	27.65	27.32	26.99	26.66	26.33	26.00	25.68	25.35
0.7	25.03	24.71	24.39	24.07	23.75	23.44	23.12	22.81	22.50	22.19
0.8	21.88	21.58	21.27	20.97	20.67	20.37	20.07	19.78	19.48	19.19
0.9	18.90	18.61	18.33	18.04	17.76	17.48	17.20	16.92	16.65	16.37
1.0	16.10	15.83	15.56	15.30	15.03	14.77	14.51	14.26	14.00	13.75
1.1	13.49	13.25	13.00	12.75	12.51	12.27	12.03	11.79	11.56	11.33
1.2	11.10	10.87	10.65	10.42	10.20	9.98	9.77	9.55	9.34	9.13
1.3	8.93	8.72	8.52	8.32	8.12	7.92	7.73	7.54	7.35	7.17
1.4	6.98	6.80	6.62	6.45	6.27	6.10	5.93	5.77	5.60	5.44
1.5	5.28	5.13	4.97	4.82	4.67	4.52	4.38	4.24	4.10	3.96
1.6	3.83	3.69	3.57	3.44	3.31	3.19	3.07	2.95	2.84	2.73
1.7	2.62	2.51	2.41	2.30	2.20	2.11	2.01	1.92	1.83	1.74
1.8	1.65	1.57	1.49	1.41	1.34	1.26	1.19	1.12	1.06	0.99
1.9	0.93	0.87	0.81	0.76	0.70	0.65	0.60	0.56	0.51	0.47
2.0	0.43	0.39	0.36	0.32	0.29	0.26	0.23	0.21	0.18	0.16
2.1	0.14	0.12	0.10	0.08	0.07	0.06	0.05	0.04	0.03	0.02
2.2	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q", the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero,

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 7										
Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09

the table value must be subtracted from 100.

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 8										
Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.62	49.24	48.86	48.49	48.11	47.73	47.35	46.97	46.59
0.1	46.22	45.84	45.46	45.08	44.71	44.33	43.96	43.58	43.21	42.83
0.2	42.46	42.08	41.71	41.34	40.97	40.59	40.22	39.85	39.48	39.11
0.3	38.75	38.38	38.01	37.65	37.28	36.92	36.55	36.19	35.83	35.47
0.4	35.11	34.75	34.39	34.04	33.68	33.33	32.97	32.62	32.27	31.92
0.5	31.57	31.22	30.87	30.53	30.18	29.84	29.50	29.16	28.82	28.48
0.6	28.15	27.81	27.48	27.15	26.82	26.49	26.16	25.83	25.51	25.19
0.7	24.86	24.54	24.23	23.91	23.59	23.28	22.97	22.66	22.35	22.04
0.8	21.74	21.44	21.14	20.84	20.54	20.24	19.95	19.66	19.37	19.08
0.9	18.79	18.51	18.23	17.95	17.67	17.39	17.12	16.85	16.57	16.31
1.0	16.04	15.78	15.51	15.25	15.00	14.74	14.49	14.24	13.99	13.74
1.1	13.49	13.25	13.01	12.77	12.54	12.30	12.07	11.84	11.61	11.39
1.2	11.17	10.94	10.73	10.51	10.30	10.09	9.88	9.67	9.47	9.26
1.3	9.06	8.87	8.67	8.48	8.29	8.10	7.91	7.73	7.55	7.37
1.4	7.19	7.02	6.85	6.68	6.51	6.35	6.19	6.03	5.87	5.71
1.5	5.56	5.41	5.26	5.12	4.97	4.83	4.69	4.56	4.42	4.29
1.6	4.16	4.03	3.91	3.79	3.67	3.55	3.43	3.32	3.21	3.10
1.7	2.99	2.89	2.79	2.69	2.59	2.49	2.40	2.31	2.22	2.13
1.8	2.04	1.96	1.88	1.80	1.72	1.65	1.58	1.51	1.44	1.37
1.9	1.31	1.24	1.18	1.12	1.07	1.01	0.96	0.91	0.86	0.81
2.0	0.76	0.72	0.67	0.63	0.59	0.55	0.52	0.48	0.45	0.42
2.1	0.39	0.36	0.33	0.30	0.28	0.26	0.23	0.21	0.19	0.17
2.2	0.16	0.14	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.05
2.3	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q" the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 9										
Q	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	50.00	49.62	49.24	48.85	48.47	48.09	47.71	47.33	46.95	46.57
0.1	46.18	45.80	45.42	45.04	44.66	44.29	43.91	43.53	43.15	42.77
0.2	42.40	42.02	41.64	41.27	40.89	40.52	40.15	39.77	39.40	39.03

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 9										
Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.3	38.66	38.29	37.92	37.55	37.19	36.82	36.46	36.09	35.73	35.37
0.4	35.00	34.64	34.29	33.93	33.57	33.21	32.86	32.51	32.15	31.80
0.5	31.45	31.10	30.76	30.41	30.07	29.72	29.38	29.04	28.70	28.36
0.6	28.03	27.69	27.36	27.03	26.70	26.37	26.04	25.72	25.39	25.07
0.7	24.75	24.43	24.11	23.80	23.49	23.17	22.86	22.56	22.25	21.94
0.8	21.64	21.34	21.04	20.75	20.45	20.16	19.87	19.58	19.29	19.00
0.9	18.72	18.44	18.16	17.88	17.61	17.33	17.06	16.79	16.53	16.26
1.0	16.00	15.74	15.48	15.23	14.97	14.72	14.47	14.22	13.98	13.73
1.1	13.49	13.26	13.02	12.79	12.55	12.32	12.10	11.87	11.65	11.43
1.2	11.21	10.99	10.78	10.57	10.36	10.15	9.95	9.75	9.55	9.35
1.3	9.16	8.96	8.77	8.59	8.40	8.22	8.04	7.86	7.68	7.51
1.4	7.33	7.17	7.00	6.83	6.67	6.51	6.35	6.20	6.04	5.89
1.5	5.74	5.60	5.45	5.31	5.17	5.03	4.90	4.77	4.64	4.51
1.6	4.38	4.26	4.14	4.02	3.90	3.78	3.67	3.56	3.45	3.34
1.7	3.24	3.14	3.03	2.94	2.84	2.75	2.65	2.56	2.47	2.39
1.8	2.30	2.22	2.14	2.06	1.98	1.91	1.84	1.76	1.70	1.63
1.9	1.56	1.50	1.44	1.37	1.32	1.26	1.20	1.15	1.10	1.05
2.0	1.00	0.95	0.90	0.86	0.82	0.77	0.73	0.70	0.66	0.62
2.1	0.59	0.55	0.52	0.49	0.46	0.43	0.41	0.38	0.36	0.33
2.2	0.31	0.29	0.27	0.25	0.23	0.21	0.20	0.18	0.17	0.15
2.3	0.14	0.13	0.11	0.10	0.09	0.08	0.08	0.07	0.06	0.05
2.4	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01
2.5	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q", the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 10										
Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.0	50.00	49.62	49.23	48.85	48.46	48.08	47.70	47.31	46.93	46.54
0.1	46.16	45.78	45.40	45.01	44.63	44.25	43.87	43.49	43.11	42.73
0.2	42.35	41.97	41.60	41.22	40.84	40.47	40.09	39.72	39.34	38.97
0.3	38.60	38.23	37.86	37.49	37.12	36.75	36.38	36.02	35.65	35.29
0.4	34.93	34.57	34.21	33.85	33.49	33.13	32.78	32.42	32.07	31.72
0.5	31.37	31.02	30.67	30.32	29.98	29.64	29.29	28.95	28.61	28.28
0.6	27.94	27.60	27.27	26.94	26.61	26.28	25.96	25.63	25.31	24.99
0.7	24.67	24.35	24.03	23.72	23.41	23.10	22.79	22.48	22.18	21.87
0.8	21.57	21.27	20.98	20.68	20.39	20.10	19.81	19.52	19.23	18.95

Estimation of Lot Percent Defective (Continued.)										
Variability-Known Procedure					Standard Deviation Method					
Sample Size 10										
Q	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.08**	**0.09**
0.9	18.67	18.39	18.11	17.84	17.56	17.29	17.03	16.76	16.49	16.23
1.0	15.97	15.72	15.46	15.21	14.96	14.71	14.46	14.22	13.97	13.73
1.1	13.50	13.26	13.03	12.80	12.57	12.34	12.12	11.90	11.68	11.46
1.2	11.24	11.03	10.82	10.61	10.41	10.21	10.00	9.81	9.61	9.42
1.3	9.22	9.03	8.85	8.66	8.48	8.30	8.12	7.95	7.77	7.60
1.4	7.44	7.27	7.10	6.94	6.78	6.63	6.47	6.32	6.17	6.02
1.5	5.87	5.73	5.59	5.45	5.31	5.18	5.05	4.92	4.79	4.66
1.6	4.54	4.41	4.30	4.18	4.06	3.95	3.84	3.73	3.62	3.52
1.7	3.41	3.31	3.21	3.11	3.02	2.93	2.83	2.74	2.66	2.57
1.8	2.49	2.40	2.32	2.25	2.17	2.09	2.02	1.95	1.88	1.81
1.9	1.75	1.68	1.62	1.56	1.50	1.44	1.38	1.33	1.27	1.22
2.0	1.17	1.12	1.07	1.03	0.98	0.94	0.90	0.86	0.82	0.78
2.1	0.74	0.71	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46
2.2	0.44	0.41	0.39	0.37	0.34	0.32	0.30	0.29	0.27	0.25
2.3	0.23	0.22	0.20	0.19	0.18	0.16	0.15	0.14	0.13	0.12
2.4	0.11	0.10	0.09	0.08	0.08	0.07	0.06	0.06	0.05	0.05
2.5	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01
2.6	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00

Note 1: Numbers in the body of the table are estimates of lot percent defective corresponding to specific values of "Q", the Quality Index. For values of "Q" greater than or equal to zero, the estimate of percent defective is read directly from the table. For values of "Q" less than zero, the table value must be subtracted from 100.

923.37 Hydrated Lime.

Hydrated lime shall conform to ASTM C 207, Type N.

923.38 Granite Paving Block.

Granite paving block shall be new or used granite block of good quality. Blocks shall be free of all bituminous and cement grout coatings and other foreign matter.

923.39 Bags.

Bags for concrete bag slope protection shall conform to AASHTO M 182, Class 1. The bags shall measure approximately 18 by 29½ inches when closed and tied, and shall be capable of holding 1 cubic foot of concrete without ripping, tearing, bursting or loss of concrete during handling and placing on the slope.Section 990-Methods Of Tests.

923.40 Z-Turn Attenuator.

The attenuators for Z-Turns shall be the latest model Crash Cushion/Attenuating Terminal (CAT).

923.41 Geotextile.

Provide geotextile rolls with protective wrapping and, before placement, store rolls in a manner that protects against moisture and minimizes exposure to ultraviolet radiation. For applications that are above ground or exposed to ultraviolet radiation, provide geotextiles that are inert to commonly encountered chemicals and are stabilized against ultraviolet light degradation. Label each roll to provide product identification.

Use geotextiles conforming to the requirements in AASHTO M 288, Class 1 or 2. For Inlet Filters, use Class 2 for

woven monofilament geotextiles or Class 1 for all other types of geotextiles. For Inlet Filter, Type 2, in addition to the AASHTO M 288 requirements ensure that the geotextile's burst strength is at least 650 pounds per square inch when tested according to ASTM D 3786.

For geotextiles that are being permanently incorporated into the Contract, submit a certification of compliance as specified in 105.04.

923.43 Oil-Water Separator.

The Contractor shall provide an oil-water separator for removal of free product generated in dewatering excavations in each area of petroleum contaminated groundwater. Use a self-contained factory assembled oil-water separator meeting the following requirements:

(A) Capable of removing free petroleum product as required by Contractor-obtained discharge permits.

(B) Designed for intermittent, varied, or continuous flows of water, oil, or combinations of non-emulsified oil-water mixtures.

(C) Designed to minimize solids buildup in the separator's oil-water collection chamber.

(D) Capable of being moved about within the Contract limits as needed.

923.44 Ride Quality Test.

Contractor shall perform a ride quality test using an approved lightweight road profiler as listed on the QPL and in accordance with the specifications set forth in Subsection 401.12.

923.45 Shaft Inspection Device.

Drilled shaft inspection shall be performed using an approved Shaft Inspection Device (SID) as listed on the QPL and in accordance with the specifications set forth in Subsection 429.04.

923.46 Raised Pavement Markers and Adhesive.

Shall be from an approved supplier as listed on the QPL and in accordance with the specifications set forth in Section 530.

923.47 High Early Strength Patch Mix.

High early strength patch mix for use in emergency and routine roadway and bridge repairs shall be from an approved supplier as listed on the QPL and in accordance with the specifications set forth in Subsection 530.03.

SECTION 924 – VIBRATION AND DISPLACEMENT MONITORING

924.01 Seismographs.

All seismographs shall be from an approved supplier as listed on the QPL and in accordance with the specifications as set forth in Subsection 214.02.

924.02 Vibrating Wire Pressure Transducer.

All vibrating wire pressure transducers shall be from an approved supplier as listed on the QPL and in accordance with the specifications as set forth in Subsection 215.08.

924.03 Protective Conduit for Vibrating Wire Piezometers.

Conduit for protection of buried electrical cables shall be from an approved supplier as listed on the QPL and in accordance with the specifications as set forth in Subsection 215.08.

924.04 Terminal Boxes and Covers.

Terminal boxes and covers for protection of geotechnical instrumentation shall be from an approved supplier as listed on the QPL and in accordance with the specifications as set forth in Subsection 215.08.

SECTION 925 - MECHANICALLY STABILIZED EARTH (MSE) WALLS

Materials within this section shall conform to the current editions of AASHTO LRFD Bridge Design and Construction Specifications with Interims except as noted herein, and in accordance with provisions of the wall

system selected for construction in this contract, as approved by the Engineer.

The following are defined for the allocation of responsibilities as described herein:

"Engineer" shall be as defined in paragraph 101.02(B).

"Wall Manufacturer" shall be defined as the approved MSE wall supplier/vendor and shall also include a Professional Engineer licensed in NJ, responsible for the preparation of the Working Drawings and calculations associated with the MSE Wall.

925.01 Steel Reinforcing Elements.

(A) Steel Reinforcing Elements.

(1) Steel wire mesh and embedded loops shop fabricated from cold drawn steel wire meeting the minimum requirements of ASTM A82, and welded into the finished mesh fabric in accordance with ASTM A185. This type of Steel Reinforcing Element is also referred to as a "Bar Mat".

(2) Steel strips hot rolled from bars to the required shape and dimensions with physical and mechanical properties meeting ASTM A572/572M Grade 65 or as shown on the approved Working Drawings. Shop-fabricated hot rolled steel tie straps shall meet the minimum requirements of ASTM A1011/A1011 M, Grade 50, or as shown on the approved Working Drawings

(B) Corrosion Protection.

Steel reinforcing strips, tie strips, reinforcing mesh, connectors and all ferrous materials in direct earth contact used in permanent walls shall have corrosion protection as specified in the most current version of the AASHTO LRFD Bridge Design Specifications, the AASHTO LRFD Bridge Construction Specifications and as shown on the Working Drawings. Galvanization shall be applied in accordance with AASHTO M 111 (ASTM A123) for strip type, bar mat, or grid type reinforcements and ASTM A153 for accessory parts such as bolts and tie strips. Galvanization shall be applied after fabrication in accordance with ASTM A123. All steel reinforcement and connection hardware shall be galvanized unless specified as Stainless Steel by the approved Working Drawings.

All metallic elements in direct contact with one another shall be of the same alloy. Steel-to-steel contact between the soil reinforcement connections and the concrete facing steel reinforcement shall be prevented so that contact between dissimilar metals, e.g., bare facing reinforcement steel and galvanized soil reinforcement steel, does not occur

If galvanization is scratched or otherwise damage it shall be field repaired as per the requirements of ASTM A780 prior to installation to the satisfaction of the Engineer and in accordance with the manufacturer's recommendations, at no additional cost to the Authority.

(C) Quality Control.

The Contractor shall submit the Wall Manufacturer's written certification that the material was manufactured, sampled, tested, and inspected in accordance with, and meets the requirements specified above.

Additional Quality Control testing shall be specified in the Working Drawings as deemed necessary by the Wall Manufacturer, including the test designation, acceptable result, and frequency of testing.

(D) Quality Assurance.

Quality Assurance testing of steel reinforcing elements will be performed if deemed necessary by the Engineer in accordance with 925.01(A).

925.02 Geosynthetic Reinforcing Elements.

(A) Geosynthetic Reinforcing Elements.

The following information for each product shall be submitted by the Wall Manufacturer for verification purposes:

(1) Geosynthetic type and structure.

(2) Spacing and dimensions of geogrid elements.

(3) Polymer(s) used for fibers, ribs, etc.

(4) Polymer(s) used for coating, if present.

(5) Roll size (length, width, area).

(6) Typical lot size.

(7) Polymer source used for product.

(8) The primary resin used in manufacturing shall be identified as follows:

(a) High Density Polyethylene (HDPE) resin type, class, grade and category in accordance with ASTM D1248 shall be identified. For example Type III, Class A, Grade E5, Category 5.

(b) Polypropylene (PP) resins, group, class and grade in accordance with ASTM D4101 shall be identified. For example Group 1, Class 1, Grade 4.

(c) Polyester (PET) resins minimum production intrinsic viscosity (ASTM D4603) and maximum carboxyl end groups (ASTM D7409) shall be identified.

(B) PROTECTION.

The UV resistance as measured by ASTM D4355 shall be the minimum value included in the Working Drawings.

(C) QUALITY CONTROL.

Geosynthetic properties certifications with Minimum Average Roll Value (MARV), as defined in ASTM D4439, shall be provided from a laboratory accredited by the Geosynthetic Accreditation Institute-Laboratory Accreditation Program (GAI-LAP). For the testing geosynthetics, a "lot" shall be defined as a single day's production. The table below shall be completed and included in the Working Drawings by the Wall Manufacturer.

Test		Procedure	Testing Rate (Per SF Reinforcement)	Acceptable Result and Unit
Ultimate Tensile Strength	or	ASTM D6637	To be included in the Working Drawings by the Wall Manufacturer.	
Wide Width Tensile		ASTM D4595		
Creep (Extrapolate to Design Life)[1,2]		ASTM D5262/D6992		
Resistance to UV Degradation		ASTM D4355		
Hydrolysis Resistance (For PET Only)		ASTM D7409		
Intrinsic Viscosity		ASTM D4603		
Stress Cracking Resistance (For HDPE Only)		ASTM D1693		

1	ASTM D5262 Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics should have a minimum of 10,000 hours.
2	ASTM D6992 Standard Test Method for Accelerated Tensile Creep and Creep Rupure of Geosynthetic Materials Based on Time Temperature Superpostion Using the Stepped Isothermal Method should have sufficient data to provide a prediction of behavior to a minimum of 10^6 hours

(D) QUALITY ASSURANCE.

Quality Assurance testing of geosynthetic reinforcing elements will only be performed if deemed necessary by the Engineer.

925.03 Select Backfill for MSE Walls with Steel Reinforcing Elements.

(A) All pre-construction and production samples shall be tested by an AASHTO Materials Reference Laboratory (AMRL) accredited geotechnical laboratory. The laboratory utilized shall be certified for the given test being performed where offered by AMRL accreditation.

(B) Select Backfill used in the MSE CSV (Common Structure Volume) shall be reasonably free from deleterious materials, shale or poor durability particles and shall conform to the following gradation limits as determined by AASHTO T 27:

Sieve Size	Percent Passing
4 inches	100
¾ inch	30-100
No. 4	5-85
No. 40	0-60
No. 200	0-15

The upper three feet of Select Backfill shall contain no stones greater than three inches in their greatest dimension, and shall not be composed primarily of gravel with less than 40 percent passing the ¾″ sieve. No. 57 Coarse Aggregate in accordance with ASTM C33 shall be utilized in the CSV below the 100 year flood elevation.

(C) Recycled Concrete Aggregate (RCA) and Reclaimed Asphalt Pavement (RAP) shall not be permitted to be included in Select Backfill material.

(D) Select Backfill shall meet the following criteria:

Property	Standard	Test Procedure
Standard Proctor, lbs/ft^3	Maximum Dry Density within ±15% of the Unit Weight Approved on the Working Drawings.	AASHTO T 99
Organic Content, %	< 1.00% of Total Sample Weight	AASHTO T 267
Plasticity Index, PI %	≤ 6	AASHTO T 90
Resistivity, Ω – cm	> 3,000 (at 100% saturation)	AASHTO T 288[1]
pH, dim.	Acceptable Range of 5 – 10	AASHTO T 289
Chloride, ppm	< 100 ppm	AASHTO T 291 or ASTM D 4327
Sulfates, ppm	< 200 ppm	AASHTO T 290 or ASTM D 4327
Soundness (Magnesium Sulfate), % Loss	< 30% after 4 Cycles	AASHTO T 104[2]
Soundness (Sodium Sulfate), % Loss	< 15% after 5 Cycles	AASHTO T 104[2]
Internal Angle of Friction, ϕ, Degrees	≥ Value Specified (In Wall Manufacturer's Working Drawings[3])	AASHTO T 236[4]

1 ASTM G187 may be substituted for AASHTO T 288 in instances where insufficient material passing the No. 10 sieve is present. This test shall be completed on materials passing the number 4 sieve with an appropriately sized resistivity box utilized. Alternatively the sample may be crushed to obtain sufficient material passing the No. 10 sieve and retained on the number 100 sieve such that AASHTO T 288 can be performed.

2 Soundness by AASHTO T 104 may be performed with either Magnesium Sulfate or Sodium Sulfate, both are not required.

3 Internal angle of friction specified in the wall manufacturer's Working Drawings shall be between 30 and 38 degrees.

4 Conduct the test with the sample compacted to 95% of the maximum dry density and moister than of the optimum moisture content, obtained from the Standard Proctor (AASHTO T 99 Methods C or D with oversized correction factor as outlined in note 7 of AASHTO T99) on only the material passing the No. 10 sieve. Conduct the test at 0.5 tsf, 1.0 tsf, and 2.0 tsf confining pressures. Report the minimum friction angle obtained.

(E) Pre-Construction Testing Requirements:

The Contractor shall provide laboratory test results from an ARML accredited laboratory in the following quantities from each source proposed documenting that Subsections 925.03 (B) through (D) of the "Select Backfill Material for MSE Walls with Steel Reinforcing Elements" section are satisfied for a representative sample of the proposed material, along with a certificate of compliance that the material satisfies this specification from each source to be used. The initial sample's results shall be provided to the Engineer a minimum of 14 days prior to the start of construction on MSE Walls.

Parameter	Test	Quantity of Tests Required
Gradation	AASTHO T 27	3
Standard Proctor	AASHTO T 99	
Organic Content	AASHTO T 267	
Plasticity Index	AASHTO T 90	
Resistivity	AASHTO T 288	If Resistivity > 10,000 Ω-cm at 100% Saturation, **1 Test** If 5,000 ≤ Resistivity < 10,000 Ω-cm at 100% Saturation, **3 Tests** If Resistivity < 5,000 Ω-cm at 100% Saturation, **5 Tests**
pH	AASHTO T 289	If Resistivity > 10,000 Ω-cm at 100% Saturation, **3 Tests** If 5,000 ≤ Resistivity < 10,000 Ω-cm at 100% Saturation, **6 Tests** If Resistivity < 5,000 Ω-cm at 100% Saturation, **10 Tests**
Chloride Content	AASHTO T 291 or ASTM D 4327	
Sulfate Content	AASHTO T 290 or ASTM D 4327	
Soundness	AASHTO T 104	1
Internal Angle of Friction[1]	AASHTO T 236	1

1 Where greater than 75% of the particles of the Select Backfill are retained on the ¾" sieve, the direct shear and tri-axial compression test requirements may be waived if a 34 degree internal angle of friction was used in the Wall Manufacturer's design as documented on the Working Drawings.

(F) Production Testing Requirements:

The Contractor shall provide Quality Control (QC) laboratory test results at the following specified frequencies. The samples shall be taken from the source and the results shall be received prior to the material being delivered on site:

Parameter	Test	Frequency
Gradation	AASTHO T 27	Every **2,000 CY** with a Minimum of 2 Tests per Structure
Standard Proctor	AASHTO T 99	
Organic Content	AASHTO T 267	
Plasticity Index	AASHTO T 90	
Resistivity	AASHTO T 288	If Previous Test ≤ 5,000 Ω-cm at 100% Saturation, Every **2,000 CY** with a Minimum of 2 Tests per Structure or If Previous Test > 5,000 Ω–cm at 100% Saturation, Every **4,000 CY** with a Minimum of 2 Tests per Structure
pH[1, 2]	AASHTO T 289	If Previous Test ≤ 5,000 Ω-cm at 100% Saturation, Every **1,000** CY with a Minimum of 2 Tests per Structure or If Previous Test > 5,000 Ω–cm at 100% Saturation, Every **2,000 CY** with a Minimum of 2 Tests per Structure and Chloride and Sulfate Content Tests may be Waived by the Engineer
Chloride Content[2]	AASHTO T 291 or ASTM D 4327	
Sulfate Content[2]	AASHTO T 290 or ASTM D 4327	
Soundness	AASHTO T 104	Every **4,000 CY** with a Minimum of 2 Tests per Structure

Parameter	Test	Frequency
Internal Angle of Friction[3]	AASHTO T 236	Every **4,000 CY** with a Minimum of 2 Tests per Structure

1 A pH result outside the specified limits is cause for rejection of the material placed since the last pH test.

2 Backfill sources shall be rejected if resistivity measured for any one sample is less than 700 Ω-cm, chloride content > 500 ppm or sulfate content > 1000 ppm.

3 Where greater than 75% of the particles of the Select Backfill are retained on the ¾" sieve, the direct shear and tri-axial compression test requirements may be waived if a 34 degree internal angle of friction was used in the Wall Manufacturer's design as documented on the Working Drawings.

(G) Failing results shall be addressed as follows:

(1) Repeat failing QC tests at the Contractor's expense on a resample.

(2) Resampled tests shall be averaged with the failing sample test to determine the final tested soil properties.

(3) If the average of the failing sample and the resampled test also fails, the material shall be removed at the Contractor's expense up to the location where materials with passing test results were placed.

(H) Quality Assurance Testing:

The Engineer will utilize a laboratory certified by AMRL. The selected laboratory utilized shall be certified for the given test to be performed where offered by ARML accreditation, and other than the Contractor's laboratory performing QC testing, to perform Quality Assurance (QA) testing on Select Backfill sampled from the source or on site at the following frequencies:

The Engineer will perform a full series of QA testing on every 4,000 CY including all tests in subsections 925.03 (4) through (6) of the "Select Backfill Material for MSE Walls with Steel Reinforcing Elements" section, or additionally as deemed necessary by the Engineer based on a change in the appearance or behavior of the Select Backfill. The Engineer may waive some QA testing as follows:

(1) Plasticity Index, if less than 30 percent passes the No. 40 sieve

(2) Chloride Content, if QA resistivity test yields ≥ 5,000 Ω-cm

(3) Sulfate Content, if QA resistivity test yields ≥ 5,000 Ω-cm

(4) Soundness, if being quarried from a consistent source that is well documented to be capable of producing material with sufficient soundness.

(5) Internal Friction Angle, if a friction angle of 34 degrees or less is specified in the Working Drawings and greater than 75% of the particles of the Select Backfill are retained on the 3/4" inch sieve.

925.04 Select Backfill for MSE Walls with Geosynthetic Reinforcing Elements.

(A) All pre-construction and production samples shall be tested by an AMRL accredited geotechnical laboratory. The laboratory utilized shall be certified for the given test to be performed where offered by ARML accreditation.

(B) Select Backfill shall be reasonably free from deleterious materials, shale or poor durability particles and shall conform to the following gradation limits as determined by AASHTO T 27:

Sieve Size	Percent Passing
¾ inch	100
No. 4	5-85
No. 40	0-60
No. 200	0-10

No. 8 Coarse Aggregate in accordance with ASTM C33 shall be utilized in the Common Structure Volume below the 100 year flood plain.

(C) Recycled Concrete Aggregate (RCA) and Reclaimed Asphalt Pavement (RAP) shall not be permitted to be included in Select Backfill material.

(D) Select Backfill shall satisfy the following criteria:

Property	Standard	Test Procedure
Standard Proctor, lbs/ft^3	Maximum Dry Density within ±15% of the Unit Weight Approved on the Working Drawings.	AASHTO T 99
Organic Content, %	< 1.00% of Portion Passing No. 10 Sieve	AASHTO T 267
Plasticity Index, PI %	≤ 6	AASHTO T 90
pH	5 - 8 Permanent, 3 – 10 Temporary	AASHTO T 289
Soundness (Magnesium Sulfate), % Loss	< 30% after 4 Cycles	AASHTO T 104[1]
Soundness (Sodium Sulfate), % Loss	< 15% after 5 Cycles	AASHTO T 104[1]
Internal Angle of Friction, ϕ, Degrees	≥ Value Specified (In Wall Manufacturer's Working Drawings[2])	AASHTO T 236[3]

1 Soundness by AASHTO T 104 may be performed with either Magnesium Sulfate or Sodium Sulfate, both are not required.

2 Internal angle of friction specified in the wall manufacturer's working drawings shall be between 30 and 38 degrees.

3 Conduct the test with the sample compacted to 95% of the maximum dry density and moister than of the optimum moisture content, obtained from the Standard Proctor (AASHTO T 99 Methods C or D with oversized correction factor as outlined in note 7 of AASHTO T99) on only the material passing the No. 10 sieve. Conduct the test at 0.5 tsf, 1.0, tsf, and 2.0tsf confining pressures. Report the minimum friction angle obtained.

(E) Pre-Construction Sample Testing Requirements:

The Contractor shall provide laboratory test results from an ARML accredited laboratory in the following quantities from each source proposed documenting that Subsections 925.04 (B) through (D) of the "Select Backfill for MSE Walls Reinforced with HDPE Geo-Grids" section are satisfied for a representative sample of the proposed material, along with a certificate of compliance that the material satisfies this specification. The initial sample's results shall be provided to the Engineer a minimum of 14 days prior to the start of construction on MSE Walls.

Parameter	Test	Number of Tests Required
Gradation	AASTHO T 27	3 Tests
Standard Proctor	AASHTO T 99	
Organic Content	AASHTO T 267	
Plasticity Index	AASHTO T 90	
pH	AASHTO T 289	**3 Tests**
Soundness	AASHTO T 104	1 Test
Internal Angle of Friction	AASHTO T 236	1 Test

(F) Production or Samples Testing Requirements:

The Contractor shall provide Quality Control (QC) laboratory test results at the following specified frequencies. The samples shall be taken from the source and the results shall be received prior to the material being delivered on site:

Parameter	Test	Frequency
Gradation	AASTHO T 27	Every **2,000 CY** with a Minimum of 2 Tests per Structure
Standard Proctor	AASHTO T 99	
Organic Content	AASHTO T 267	
Plasticity Index	AASHTO T 90	
pH[1]	AASHTO T 289	
Soundness	AASHTO T 104	Every **4,000 CY** with a Minimum of 2 Tests per Structure

Parameter	Test	Frequency
Internal Angle of Friction	AASHTO T 236	Every **4,000 CY** with a Minimum of 2 Tests per Structure

1 A pH result outside the specified limits is cause for rejection of the material placed since the last pH test.

(G) Failing results shall be addressed as follows:

(1) Repeat failing QC tests at the Contractor's expense on a resample.

(2) Resampled tests shall be averaged with the failing sample test to determine the final tested soil properties.

(3) If the average of the failing sample and the resampled test also fails the material shall be removed at the Contractor's expense up to the location where materials with passing test results was placed, with the exception of Note One in the table above.

(H) Quality Assurance Testing Recommendations:

The Engineer will utilize a third party independent AMRL certified laboratory, other than the Contractor's laboratory performing QC testing, to perform Quality Assurance (QA) testing on Select Backfill sampled from the source or on site at the following frequencies:

The Engineer shall perform a full series of QA testing on every 4,000 CY including all tests in Subsections 925.04 (4) through (6) of the "Select Backfill Material for MSE Walls with Geosynthetic Reinforcing Elements" section, or additionally as deemed necessary by the Engineer based on a change in the appearance or behavior of the Select Backfill. The Engineer may waive some QA testing as follows:

(1) Plasticity Index, if less than 30 percent passes the No. 40 sieve

(2) Soundness, if being quarried from a consistent source that is well documented to be capable of producing material with sufficient soundness.

(3) Internal Friction Angle, if a friction angle of 34 degrees or less is specified in the Working Drawings

925.05 High Density Polyethylene (HDPE) Geomembrane Liner System.

HDPE geo-membrane liner systems shall have a nominal thickness of 30 mils. The geomembrane shall be manufactured of new, first quality resin and shall be compounded and manufactured specifically for the intended purpose. The resin manufacturer shall certify each batch for the following properties:

Property	Test Method	Requirements
Specific Gravity	ASTM D792	> 0.940
Melt Index	ASTM D1238	< 0.4g/10 min.
Carbon Black Content	ASTM D1603	2% - 3%

The HDPE supplier shall submit this certification for the Engineer's verification of the material.

The surface of the HDPE geo-membrane liner system shall not have striations, roughness, pinholes or bubbles and shall be free of holes, blisters and any foreign matter, such as soil or oil accumulation.

925.06 Class 2 Geotextile Fabric.

Class 2 Geotextile Fabric shall be in accordance with AASHTO M 288 designed for filtration performance following the guidelines in FHWA NHI-07-092 (Holtz et al., 2008).

SECTION 990 - METHODS OF TESTS

990.01 Description.

This Section consists of the following Methods of Tests which have been adopted and will be used by the Authority.

990.02 A-4 Determination of Percentage of Carbonates in Crushed Gravel by Petrographic Analysis.

(A) Scope.

This method of test is used for the visual determination of rock types and deleterious material in coarse aggregates.

(B) Apparatus.

The apparatus will be as follows:

(1) Binocular microscope.

(2) Dilute hydrochloric acid.

(3) Scale accurate to plus or minus 0.1 gram.

(4) Geology or mason hammer, or other cracking implement, and a steel striking plate.

(5) Penknife, screwdriver, or similar scratching device.

(C) Petrographer.

The examiner will have a degree in geology or will be a trained technician with a general background in geology and a specific background in petrology.

(D) Sample Preparation.

A sample of approximately 35 pounds will be split and screened to produce a representative sample of 300 grams of plus No. 4 material for aggregate sizes No. 3 through No. 5, 1,000 grams of plus No. 4 material for aggregate sizes No. 56 through No. 68, and 500 grams of plus No. 8 material for aggregate sizes No. 7 through No. 9. The samples will then be washed to remove any coating that would make particle examination difficult.

(E) Procedure.

The prepared sample will be divided into rock types as defined in ASTM C 294. This will be done by visual examination with the aid of the binocular microscope, dilute HCl, and cracking and scratching implements. The resulting groups will be weighed to the nearest gram and calculated as a percent of the whole.

Deleterious material samples will be examined for weathered and leached, porous, friable, fractured, altered, or otherwise unsound particles. Pieces affected by such conditions to the degree that their performance may be impaired will be sorted out, weighed, and calculated as a percent of the whole.

Since this is a subjective determination, the following guidelines will be used in determining if particles are weathered and unsound:

(1) Can be broken into several pieces by a light hammer tap.

(2) Show more than superficial oxidation or alteration of feldspars.

(3) Are visibly porous.

(4) Show numerous microfractures or cleavage planes.

(5) Are of abnormal coloration.

Particles that are as outlined above should be considered worthy of close examination.

(F) Report.

Report will contain the percentage by weight of individual rock types, as defined in ASTM C 294, and percentage by weight of deleterious material that will be reported as weathered and unsound.

990.03 B-2 Method Of Sampling Bituminous Mixtures.

(A) Scope.

This method will be used at the plant to sample bituminous mixtures for Marshall stability tests and acceptance extraction tests.

(B) APPARATUS.

The apparatus will be as follows:

(1) Table of random numbers.

(2) Scoop to make furrow and to dig material from the furrow in the pile of bituminous mixture.

(C) PROCEDURE.

The samples for extraction and stability testing will be taken from trucks, at the plant, by the Authority's plant inspector.

The rates of sampling will be applied to the plant's production for all Authority Projects rather than for individual Projects.

The plant's production will be divided into successive parts or lots of the size specified for the mixture being sampled. Five samples to be tested for stability and five samples to be used for extraction testing will be taken from each lot.

The Authority's plant inspector will assign consecutive lot numbers for each type of mix at the plant. The producer will include the assigned lot identification number on each weigh ticket.

A table of random numbers will be used by the Authority to make random selection as to which megagram of mix and thus from which truckload each sample will be taken.

The following method will be used to obtain samples from the designated truckloads of material:

(1) From one of the conical piles of mixture within the truck, a furrow 75 to 150 millimeters in depth will be dug extending from the top to the bottom of the pile. The furrow will be prepared within either the front or the rear half of the truck. A coin will be flipped to determine which half of the truck is to be used:

HEADS - front half, **TAILS** - rear half.

The furrow will follow the slope of the pile and be formed as near to its center as possible. Sampling in areas between piles will be avoided because of possible segregation.

Scoops of approximately equal volumes of material will be dug from the furrow, representing the top third, center third, and bottom third of the pile.

The sample will be a minimum of 13 kilograms in weight.

The sample removed from the truck will be reduced as follows:

(2) Marshall Specimen.

From the container of material, the Authority's representative will take a sample to be molded into one specimen for the Marshall stability test, taking care to ensure that the temperature of the mixture does not fall below that specified for molding.

During the production of the first lot of each mix supplied and for each succeeding fourth lot (1, 5, 9, etc.), the Authority's representative will mold three Marshall specimens in addition to those molded for stability tests. The specimens will be submitted to the Authority Laboratory for verification of the mix properties.

(3) Extraction Sample.

Following the removal of material for the Marshall specimen the remaining material will be remixed. The Authority's representative will then take a 1000-plus gram sample from the remixed material for the acceptance test. From the remaining material, a comparison sample of approximately 2.3 kilograms will be wrapped, sealed and labeled.

In the event of a situation whereby the test results will not be valid because of human or mechanical failure, the comparison sample will be tested and used in place of the initial acceptance sample.

The comparison sample is to be stored at the plant so it will be available for selection by Authority personnel if required.

Prior to and after each remixing and quartering, all tools shall be cleaned to prevent build-up of asphalt and fines. The cleaning during the remixing and quartering operations will be accomplished without solvents.

All samples forwarded for comparison testing must be identified as to their lot number and position in the lot's sampling sequence. For this purpose, an identification code, consisting of a number followed by a letter, will be used with each sample. The number portion of the code will be the number of the lot from which the sample was taken. The letter portion will indicate where the sample fits into the lot's sampling sequence. The letter "A" will be used to indicate the first sample of the lot, the letter "B" for the second sample, the letter "C" for the third, and so forth. When several samples (extractions and/or stability) come from the same truckload of mix, each of these samples will have the same identification code (number and letter).

990.04 B-3 Laboratory Analysis Of Bituminous Concrete.

(A) Quantitative Extraction of Bitumen.

(1) Scope.

This method of test is used for the quantitative determination of bitumen in paving mixtures and pavement samples. The bitumen content is calculated by difference from the weight of the extracted aggregate, moisture content and weight of ash in extract. As an alternate, AASHTO T 164, Method A, may be used except that the moisture content of the mixture at discharge from the plant shall not exceed 1.0 percent. Moisture determinations are based on the weight loss on heating for one hour in an oven at 138 ± 3 deg C of an approximately 1500-gram sample of mixture. A minimum of one sample per lot but not less than two samples per day will be tested for moisture. Samples for moisture determinations will be obtained in accordance with Subsection 990.02. The use of a steam bath for the ash determination is not required. A balance conforming to AASHTO M 231, Class C may be used to determine the weight of the ash.

(2) Apparatus.

The apparatus will consist of the following:

(a) Oven, capable of maintaining temperature at 138 ± 3 °C.

(b) Pan, 305-millimeter diameter.

(c) Balance, capable of weighing 2000 grams to an accuracy of 0.2 gram.

(d) Hot plate, electric, 3.6 kilowatts, low, medium, and high setting.

(e) Small mouth graduate, 1000-milliliter capacity.

(f) Test tube, 100-milliliter capacity.

(g) Desiccator.

(h) Analytical balance.

(i) Centrifugal extraction apparatus, consisting of a bowl (minimum capacity 1300 grams) and an apparatus in which the bowl may be revolved up to a speed of 60 revolutions per second. The apparatus will be provided with a container for catching the solvent thrown from the bowl and a drain for removing the solvent. The apparatus will be provided with explosion-proof features installed in a hood to provide ventilation.

(j) Filter rings, to fit the rim of the bowl.

(k) Reagent, inhibited solvent 1,1,1,-trichloroethane.

(l) Centrifuge, capable of rotating 100 milliliters test tubes at 25 revolutions per second.

(m) Torque wrench calibrated in newton meters with a minimum capacity of 12.4 newton meters.

(3) Procedure.

Random weight samples of 1000-plus grams are to be used for extraction. If the sample has cooled to ambient temperature, it will be heated at 138 °C for a minimum of 30 minutes. Samples taken at the batch plant which are still hot may be processed immediately.

The sample will be weighed to the nearest 0.1 gram and transferred into the bowl.

The sample will be covered in the bowl with solvent and sufficient time allowed for the solvent to disintegrate the sample (not over one hour). The bowl containing the sample and the solvent will be

placed in the extraction apparatus. The filter ring will be dried, weighed, and fitted around the edge of the bowl. The cover will be clamped on the bowl tightly with a torque wrench to 12.4 newton meters. A beaker will be placed under the drain to collect the extract.

The centrifuge will be revolved until the solvent ceases to flow from the drain. The machine will be allowed to stop, 200 to 250 milliliters of solvent will be added, and this procedure repeated twice more. The extract and the washings will be collected in a suitable graduate. Sufficient solvent additions will be used, as required, to produce an extract that is clear and not darker than a light straw color.

The filter ring will be removed from the bowl and dried. As much as possible of the mineral matter adhering to the ring will be removed and added to the aggregate. The ring and contents of the bowl will be dried to constant weight in an oven at 138 °C.

The volume of the total extract in the graduate will be recorded. The extract will be agitated thoroughly and 75 milliliters immediately measured out and poured into a previously weighed test tube. The test tube will be placed in a centrifuge and revolved at 25 revolutions per second for 60 minutes. The extract will be decanted and approximately 25 milliliters of clean solvent added to the test tube. The residue will be dislodged and stirred with a spatula. The test tube will be filled with solvent, cleaning the spatula, and placed back in the centrifuge for 30 minutes. The rinsing process will be repeated a second time and the test tube placed back in the centrifuge for 30 minutes. The test tube will be decanted and placed in an oven until dry, then cooled in a desiccator and weighed. A minimum of one determination of fines in the extract will be done on each lot of material.

Centrifuge fines in the extract will be calculated as follows:

$$\text{Weight of fines in extract} = \frac{AB}{75}$$

Where: A = Total amount of extract.

B = Amount of material in tube.

Convert to ash as follows:

$$Y = 1.0338\,X + 1.0488$$

Where: Y = Weight of ash in extract.

X = Weight of centrifuge fines in extract.

Calculate percentage of bitumen in the sample as follows:

$$\text{Percent Asphalt Cement} = \frac{(W1 + W2) - (W3 + W4 + W5)}{W1} \times 100$$

Where: W1 = Weight of sample.

W2 = Weight of ring.

W3 = Weight of aggregate.

W4 = Weight of ring after centrifuging.

W5 = Weight of fines in extract.

A minimum of one sample per lot but not less than two samples per day will be tested for moisture. The amount of moisture in the mixture can be compensated for by using the equation listed in AASHTO T 164, Method A, or by mathematically calculating the sample dry weight by dividing the wet weight by one plus the moisture content. The most recent moisture content for each mix will be used. Samples for moisture determination will be obtained.

The percentage of bitumen will be determined to the nearest 0.01 of a percent. This will be rounded to the nearest 0.05 percent. The rounding procedure will be in accordance with ASTM E 29.

(B) Mechanical Analysis of Extracted Aggregate.

(1) Scope.

This method is used to determine the particle size distribution of fine and coarse aggregates extracted from bituminous mixtures, using sieves with square openings. As an alternate, AASHTO T 30 may be

used.

(2) Apparatus.

The apparatus will be as follows:

(a) Balance or scale sensitive to within 0.2 gram.

(b) Sieves with square openings, mounted on substantial frames constructed in a manner that will prevent loss of material during sieving. Suitable sieve sizes will be selected to furnish the information required by the specifications covering the material to be tested. The woven wire cloth sieves will conform to the specifications for sieves for testing purposes in AASHTO M 92.

(3) Sample.

The sample will consist of the entire amount of mineral aggregate from which the bituminous material has been extracted.

(4) Procedure.

The test sample will be dried to a constant weight and weighed. The weight of mineral matter contained in the extracted bitumen will be determined and this weight added to the weight of the sample under test.

After being dried and weighed, the test sample will be placed over proper sieves decreasing in size down to the 2.00 or 2.36-millimeter sieve with a catch pan under them. The sieving operation will be conducted by means of lateral and vertical motion of the sieve, accompanied by jarring action so as to keep the sample moving continuously over the surface of the sieve. In no case will fragments in the sample be turned or manipulated through the sieve by hand. Sieving will be continued until not more than one percent by weight of the residue passes any sieve during one minute.

The fine aggregate in the catch pan will be weighed and recorded. The aggregate will then be placed in a large pan and covered with water which contains a wetting agent (Joy, Calgon, or other suitable product) and agitated vigorously and the wash water immediately poured over a nest of two sieves consisting of a 2.00-millimeter or 1.18-millimeter sieve superimposed over a 75-micrometer sieve.

The agitation will be sufficiently vigorous to result in a complete separation from the coarse particles of all particles finer than the 75-micrometer sieve, and bring them into suspension in order that they may be removed by decantation of the wash water. Care will be taken to avoid decantation of the coarse particles. The operation will be repeated until the wash water is clear.

All materials retained on the nested sieves will be returned to the container. The washed aggregate will be dried to constant weight at a temperature 110 ± 5 deg C and weighed to the nearest 0.1 percent.

If the amount of material passing the 75-micrometer sieve fails to meet the minimum requirement for the sample under test, the coarse aggregate of the sample must also be washed over a 75-micrometer sieve. The minute amount of fines washed from the coarse aggregate will then be added to the passing 75-micrometer material washed from the fine aggregate portion of the sample.

The dried material will then be placed over a set of proper sieves including the 75-micrometer sieve. It will be agitated mechanically for ten minutes.

The weight of material passing each sieve and retained on the next and the amount passing the 75-micrometer sieve will be recorded. The weight of dry material passing the 75-micrometer sieve by dry sieving will be added to the weight of mineral matter in the extract in the ring, and the weight removed by washing in order to obtain the total passing the 75-micrometer sieve.

(5) Report.

The results of the sieve analysis will be reported as follows:

(a) The total percentage passing each sieve will be determined to the nearest 0.1 percent when reported on the work sheet and daily inspection report. When recorded on the lot data report, results for the 2.36-millimeter sieve will be rounded to the nearest 0.5 percent. The 75-micrometer sieve will be reported to the nearest 0.1 percent and all other sieves will be reported to the nearest whole percent.

(b) The rounding procedure will be in accordance with ASTM E 29.

990.05 B-4 Measuring Thickness of Bituminous Concrete from Cores.

(A) Scope.

This method consists of placing the drilled bituminous concrete core in a measuring device and recording the individual lift thickness of the specified courses.

(B) Apparatus.

The apparatus will consist of a callipering device that will measure the axial lengths of individual lifts before separation. A drawing of this device is on file at the Authority Laboratory.

The apparatus is so designed that the specimen will be held with its axis in a horizontal position by two metal roller bearings sufficiently rigid and stable to maintain alignment without distortion or deflection.

The apparatus will provide for the accommodation of specimens of different nominal lengths over a range of at least 13 to 305 millimeters.

A suitable gauge will be provided to calibrate and check the zero reference point of the apparatus.

(C) Procedure.

The specimens will be placed in the measuring apparatus with the smooth end of the core, that is, the end that represents the upper surface of a pavement core, firmly against the hardened-steel reference pin.

Four equidistant measurements, approximately 90 degrees apart, will be taken around the periphery of the specimens using the sliding index attached to the scale to indicate to each reading the division of the various lifts. Each of these four measurements for each lift will be read directly to 0.0254 millimeter. The four measurements will be averaged and recorded to the nearest 0.254 millimeter.

If, during the course of the measuring operation, it is discovered that one or more of the measuring points is not representative of the plane of the core because of a small projection or depression, the specimen will be rotated slightly about its axis and the measurement taken at the nearest discernible point.

(D) Report.

The first (top) lift average thickness will be reported to the nearest 0.254 millimeter as the difference between the zero reference point and the demarcation point of the first lift.

The second lift average thickness will be reported to the nearest 0.254 millimeter as the difference between the zero reference point and the demarcation point of the second lift minus the measurement of the first lift.

Additional lift thicknesses will be reported as the difference between the zero reference point and the demarcation point of the subsequent lifts minus the total measurement of all previous lifts.

990.06 B-5 Determining Conformance Of HMA Mixture For Fully Automated Plants Using Hot Bin Samples And Batch Weight Printouts.

(A) Scope.

This method is used to determine the gradation and asphalt content of a HMA mixture by use of bin samples and printout ticket.

(B) Apparatus.

Apparatus for coarse and fine aggregate will conform to AASHTO T 27 and apparatus for mineral filler will conform to AASHTO T 37.

(C) Procedure.

Under the supervision of the Engineer, random samples of not less than 25 pounds shall be taken by the producer from each hot bin for each 600 tons batched. The bin samples shall be taken during the loading of the truck from which the Marshall samples are selected. When mineral filler is used, a minimum of one filler sample shall be taken per lot.

The minimum sample weight for testing shall be 25 pounds for bins No. 5 and No. 4, 10 pounds for bin No. 3, and 2 pounds for bin No. 2. Minimum test sample weight for bin No. 1 shall be 500 grams, and for mineral filler 100 grams.

Test samples from bins No. 2, 3, 4, and 5, after being weighed, will be placed over proper sieves decreasing

in size down to the No. 8 with a catch pan underneath. The sieving operation will be conducted by means of a mechanical sieve shaker. The material passing the No. 8 sieve will be washed and graded using the procedure hereinafter described for bin No. 1.

The bin No. 1 material will be weighed and recorded, then washed through a No. 200 mesh sieve. The sample will be carefully agitated during this washing operation resulting in the minus No. 200 material being removed by the washing medium.

The washed material will be thoroughly dried and weighed, then placed over the proper sieves, decreasing in size down to the No. 200 sieve with a catch pan underneath. It will be agitated mechanically for five minutes.

The amount of material passing each sieve and retained on the next and the amount passing the No. 200 sieve will be recorded. The weight of dry material passing the No. 200 sieve and the weight removed by washing will be added together to obtain the total passing the No. 200 sieve.

The mineral filler sample is to be washed over a No. 200 sieve using inhibited solvent trichloroethylene or according to AASHTO T 37.

(D) Report.

The percent of material from each bin will be determined by dividing the recorded delivery ticket weights for each bin by the total aggregate weight of the load.

The mix gradation will be determined by computing the percentage of material passing each sieve for each bin, and multiplying the percentage by each bin percentage determined above and then summing the products.

The asphalt content will be determined by dividing the recorded delivery ticket asphalt binder weight for the load by the total load weight. Percentages will be reported to the nearest 0.01 percent on the work sheet and the daily inspection report and rounded to the nearest 0.05 percent when reported on the lot data report.

Bin percentages and bin gradations will be determined to the nearest 0.1 percent when reported on the work sheet and daily inspection report. When recorded on the lot data report, results for the No. 8 sieve will be rounded to the nearest 0.5 percent. Results for the No. 200 sieve will be reported to the nearest 0.1 percent and all other sieves will be reported to the nearest whole percent.

The rounding procedure will be according to ASTM E 29.

990.07 B-6 Determination of Percent of Air Voids in Open-Graded Mix.

(A) Scope.

The method is used to determine the percent of air voids in open-graded HMA mix design specimens.

(B) Apparatus.

Apparatus will be according to AASHTO T 167 for molding, weighing, and curing specimens and according to AASHTO T 209 for determining maximum specific gravity. Apparatus will include a device to measure the specimens to 0.001 of an inch.

(C) Procedure.

Mold six specimens using the materials and formula for the particular mix being evaluated.

The specimens will be molded at 255 °F using a pressure of 2,000 pounds per square inch.

After removal from the mold, specimens will be oven cured for 24 hours at 140 °F and, thereafter, brought to test temperature of 77 °F by storing in the air bath at this temperature for not less than five hours before testing.

Weigh each specimen in air. Report in grams to the nearest 0.1 gram.

Measure the height and diameter of each specimen at four approximately equidistant locations and average respectively. Report to the nearest 0.001 inch.

Calculate the volume of each specimen based on the average height and diameter and convert to cubic centimeters.

Calculate the bulk specific gravity of the specimens using the formula:

$$\text{Bulk Specific Gravity} = \frac{\text{Density gm/cm}^3}{0.99707 \text{ gm/cm}^3}$$

Where: Density = mass divided by volume, and 0.99707 g/cm^3 is the density of water at 77 °F (25 °C).

Determine the maximum specific gravity of the specimens according to AASHTO T 209.

Calculate the percent of air voids using the formula:

$$\text{Percent Air Voids} = \frac{\text{Maximum Specific Gravity - Bulk Specific Gravity}}{\text{Maximum Specific Gravity}}$$

(D) Report.

Report the average air voids of the specimens to the nearest 0.1 percent.

990.08 B-8 Bulk Specific Gravity Of Compacted Bituminous Mixtures.

(A) Scope.

This method of test is used to determine the bulk specific gravity of specimens of compacted bituminous mixtures as defined in AASHTO M 132. The bulk specific gravity of the compacted bituminous mixtures may be used in calculating the unit weight of the mixture.

(B) Test Specimens.

Test specimens may be taken either from laboratory-molded bituminous mixtures or from field samples of bituminous mixtures.

The recommended thickness of specimens should be at least one and one-half times the maximum size of the aggregate.

Field samples will be taken with a core drill, diamond or carborundum saw, or by other suitable means. Care will be taken to avoid distortion, bending, or cracking of specimens during and after removal. Specimens will be stored in a safe, cool place.

Specimens may be separated from other pavement layers by sawing or other suitable means.

Specimens will be free of foreign materials such as tack coat, foundation material, soil, paper, or foil.

(C) Apparatus.

Apparatus will be as follows:

(1) Balance will conform to AASHTO M 231 for the class of balance required for the weight of the principal sample being tested. The balance will be equipped with suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of scale pan of balance. The holder should be immersed to a depth sufficient to cover it and the test sample during weighing. Wire suspending the holder should be the smallest practical size to minimize any possible effects of a variable immersed length.

(2) Water bath for immersing the specimen in water while suspended under the balance will be equipped with an overflow outlet for maintaining a constant water level.

(D) Procedure.

Dry the specimen by allowing it to remain undisturbed at room temperature, 25 ± 5.5 deg C, for at least 12 hours. A fan may be used to aid drying if needed. After the specimen is dry or cooled to room temperature, record the dry mass under "A". Immerse each specimen in water at 25 ± 5.5 deg C until all visible bubbling has ceased and record the immersed mass under "C". Remove the specimen from the water, surface dry by blotting with a damp towel, and determine the surface-dry mass under "B". If desired, the sequence of testing operations may be changed to expedite the test results. For example, first the weight of the immersed mass under "C" can be determined, then the surface-dry mass under "B" and finally the dry mass under "A".

(E) CALCULATION.

Calculate the bulk specific gravity of the specimen as follows:

$$\text{Bulk Specific Gravity} = \frac{A}{B - C}$$

Where: A = Mass in grams of sample in air.

B = Mass in grams of surface-dry specimen in air.

C = Mass in grams of sample in water.

(F) REPORT.

The bulk specific gravity will be reported to the nearest 0.001.

990.09 B-9 Procedure For Selection Of Cores To Be Tested For Maximum Specific Gravity To Be Used In Determination Of Air Voids Acceptance.

(A) SCOPE.

This method is used to randomly select the core samples on which the maximum specific gravity will be determined according to AASHTO T 209 for use in the calculation of air voids for acceptance of a lot, and the procedure to be followed in the event of a possible failing lot.

(B) PROCEDURE.

One core sample will be randomly selected from a five-core sample lot using the computer-generated random number selection program. Maximum specific gravity will be determined for the core selected. Bulk specific gravities will be performed on each core.

If the percent air voids for each core in the lot is within the acceptance range of the specification, plus 0.5 percent on the lower end and –0.5 percent on the upper end, the maximum specific gravity of the tested core sample will be applied to the remaining core samples of the same lot.

If the air voids percentage falls out of the acceptance range as noted above for the randomly selected and tested core sample, the maximum specific gravity will be determined for each of the core samples of that lot.

(C) CALCULATION.

Calculate the air voids for each core as follows:

$$\text{Air Voids} = \frac{A-B}{A} \times 100$$

Where: A = Maximum Specific Gravity

B = Bulk Specific Gravity

(D) REPORT.

The air voids will be reported to the nearest 0.1 percent.

990.10 P-1 Glass Beads.

(A) SCOPE.

These methods of tests are used to determine the suitability of glass beads for reflectorizing traffic paint.

(B) SAMPLING.

Bags selected at random are split by a sample splitter to about 3 pounds (1 quart). The number of bags selected will be the nearest cube root of the number of bags in the lot or shipment. Each sample will again be split to such a size that a combined sample of approximately 3 pounds (1 quart) will be obtained for the tests. For determining the percent spheres, grading, and daylight 45 degrees - 0 degree reflectance, the combined sample is split to such amounts as required for the particular tests.

(C) SPHERICAL PARTICLES.

The percentage of spherical particles will be determined according to ASTM D 1155, Procedure B.

(D) INDEX OF REFRACTION.

(1) General. When immersed in liquids, all transparent or translucent objects yield images under a microscope that are bounded by dark shadow outlines or halos. As the index of refraction of the solid nears that of the liquid, the dark shadow outlines decrease in prominence and disappear when both object and liquid have the same refractive index.

(2) Liquid Immersion Method at 25 °C. The crushed particles of glass beads are placed on a clean glass slide and covered with a small fragment of cover glass. (Small pieces of cover glass are advantageous because less sample and liquid are required and the crystals are more easily found.) A drop of liquid of known refractive index is introduced and the specimen examined under the microscope.

When the solid possesses a higher index than that of the liquid, the contours are usually dark and well defined with a halo or band of light within the back bands. As the microscope tube is raised, this band of light will appear to move inward, i.e., toward the center of the solid. If, on the other hand, the solid possesses a lower index of refraction, the black contours are relatively weak, with the bright halo outside the black bands. Upon raising the microscope objectives, the band of light or bright halo appears to move outward or away from the center.

If a solid of unknown index is immersed in a series of liquids of known refractive index, one after another, until the black contours bounding the image just disappear when the solid is immersed in one of the liquids, the index of that particular liquid is the index sought of the solid.

(E) GRADING.

Approximately 100 grams of glass beads are separated by mechanical sieving into a series of standard sieves and the following determinations are made:

(1) Percent passing Nos. 16, 20, 30, 50, and 100 mesh sieves.

(2) Percent retained on Nos. 16, 20, 30, 50, and 100 mesh sieves.

(F) CHEMICAL STABILITY.

Samples of beads will show no tendency toward decomposition or surface etching when subjected to each of the following tests:

(1) Resistance to Hot Water Attack. Twenty-five grams of beads are run with 250 ml of distilled water and subjected to 90 hours continuous running in a Soxhlet Extraction Apparatus.

(2) Resistance to Attack Comparable to that of Normal Soil Acidity (pH 5 to pH 6). Twenty-five grams of beads are soaked for 90 hours in 500 ml of buffered solution (pH 5 to pH 6) at room temperature. The solution is then decanted and the beads rinsed with 100 ml of distilled water.

(3) Resistance of Lime Water Attack (Encountered on Portland Cement Concrete Highways). Twenty-five grams of beads are boiled for two hours in 1,000 ml of saturated lime water solution. Solution is then decanted and beads are rinsed with 100 ml of distilled water.

(4) Resistance to Attack by Salt Solution (Encountered in Winter with Treated Sands, etc). Twenty-five grams of beads are boiled for three hours in 500 ml of a 1.0 normal solution of calcium chloride. Solution is then decanted and beads are rinsed with 100 ml of distilled water.

(G) COATING.

The embedment coating on the beads will be tested in the following manner:

(1) Set drying oven to 60 °C. Turn on the ultraviolet light (7,000 nanowatts per centimeter squared).

(2) Weigh 10 grams of beads to be evaluated and place into an aluminum weighing dish.

(3) Place a 2-inch diameter filter paper into a Buchner funnel and attach to a suction flask.

(4) Put the beads into the Buchner funnel and saturate the sample with dansyl chloride solution (98 percent) using a medicine dropper. Let the solution and sample stand for 30 seconds.

(5) Place the saturated beads into an aluminum dish and dry in the oven at 60 °C for 15 to 20 minutes. The beads will be yellow and agglomerated. Do not let the solution char.

(6) Remove the sample from the oven and place the glass beads in the Buchner funnel with new filter paper. Rinse the beads with 100 ml of acetone. Use the suction during this step. All yellow must be removed from the beads.

(7) Remove the beads from the funnel and place into a new aluminum tray. Allow the beads to dry in the oven for five to ten minutes until free flowing.

(8) Remove the beads from the oven and place on glass filter paper. If the beads are agglomerated, break them up with a spatula.

(9) Inspect the treated sample under the ultraviolet light in a darkened room.

Embedment coated beads will emit a yellow-green fluorescence. Color comparison samples are available from the Authority or manufacturer. If no fluorescence is observed, the test should be rerun using a new 10-gram sample of beads and a fresh solution of dansyl chloride. If there is no fluorescence observed on the second sample of beads, the material is not properly coated and the lot is rejected. If the second sample does fluoresce, the lot is accepted.

990.11 A-7 Rapidly Determining The Breakdown In Sizes of Soil Aggregate.

(A) Scope.

This method of test is used to determine rapidly the approximate amount of soil aggregate that may be expected to break down to finer sizes under field compaction and exposure to weathering.

(B) Apparatus.

(1) The apparatus for determining moisture density relationship and aggregate breakdown will conform to AASHTO T 99, Method C.

(2) The apparatus for performing the mechanical analysis will conform to AASHTO T 27.

(C) Preparation of Sample.

(1) A sample of approximately 150 pounds will be air dried and thoroughly mixed.

(2) A mechanical analysis will be run on two samples of approximately 12 pounds each, obtained from the above sample by quartering. These two gradations will be averaged and the average reported as the original gradation of the material.

(3) A sample will be prepared to have the same gradation as the original determined in Subpart C.2 above.

(4) The maximum density at optimum moisture content will be determined from a representative portion of the prepared sample by using AASHTO T 99, Method C including the replacement option, for material retained on the ¾-inch sieve.

(D) Procedure.

(1) Another sample will be compacted from the remaining material at the optimum moisture content determined in Subpart C.4 above.

(2) A mechanical analysis will be performed on the prepared sample after compaction.

(E) Report.

The report will include the following:

(1) Average of two gradations determined in Subpart C.2 above.

(2) Gradation of the prepared sample after compaction in Subpart D.2 above.

(3) Specified gradation for the material.

(4) Maximum density at optimum moisture of the prepared sample determined in Subpart C.4 above.

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