

SECTION 434 - HIGH PERFORMANCE CONCRETE (HPC)

434.01 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.

434.02 MATERIALS.

Materials shall conform to the following Sections and Subsections:

Aggregates	902
Concrete, Mortar and Grout	905
Portland Cement Concrete	905.05
Concrete Admixtures and Curing Materials	906
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	923.37

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* and the Standard Specifications of the New Jersey Turnpike Authority, Sixth Edition, dated 2004.

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.

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.

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.

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.

1. As per the provisions of Subsection 401.11, Subpart C, a plan of operation for placement of the HPC items shall be submitted for review and approval by the Engineer at least 20 days prior to the proposed start of placing bridge deck concrete. In addition to the requirements of Subsection 401.11, Subpart 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 by fog misting, wind shields or other methods.

The following is added to the requirements of Subsection 401.11, Subpart 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. Slip forming for placing concrete parapets will not be permitted.

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.

2. 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. The curing by wet burlap and white polyethylene sheets shall be for a minimum period of seven (7) calendar days for cast-in-place bridge and retaining wall parapets. The contractor shall contain water runoff from the wet burlap curing of parapets over active facilities.

- a. The finishing machine equipment shall be set up so that the HPC is placed only 5 to 8 feet ahead of the machine.
- b. 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 7 calendar days prior to the start of the HPC placement. No separate payment will be made for the HPC trial placement.

- c. 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.
- d. The Contractor shall have ACI grade certified personnel on-site, one of whom is 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.
- e. *Application of Concrete Penetrating Sealer is not required for HPC decks, parapets, sidewalks, bridge approach slabs, relief slabs or sleeper slabs.*

434.06 MEASUREMENT.

Measurement for the bridge deck, headblocks, sidewalks, bridge and parapets shall be made as described in Subsection 401.23.

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.

434.07 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

No separate payment will be made for the crack sealer, but all the cost thereof shall be included in the unit price bid for the bid item Concrete in Deck, HPC.

SECTION 401 - CONCRETE STRUCTURES

[NOTE FOR THE DESIGNER:

For LMC overlay finish on rehabilitation and widening contracts use either section 401.17 (F)(2) or 401.17 (F) (3) depending on staging and other considerations. For new construction with no staging use section 401.17(F)(3):]

[NOTE FOR THE DESIGNER:

Contracts containing a large quantity of Class A concrete shall use "Protective Coatings for Concrete Surfaces". For contracts which have a small amount of concrete, water repellant treatment should be used. Water repellant treatment should also be used for the protection of Class B, C, D concrete:]

~~*[Include the following with High Performance Concrete (HPC) Latex Modified Concrete (LMC) work.]*~~

[Include the following with High Performance Concrete (HPC) or Latex Modified Concrete (LMC) work.]

401.16 TEST SPECIMENS.

Delete the paragraph in its entirety and replace with the following:

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 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.

(B) STANDARDS AND FREQUENCY OF TESTING PRIOR TO FINAL ACCEPTANCE TESTING.

Delete the third paragraph in its entirety and replace with the following:

- (2) Coulomb Test (AASHTO T277) and Ponding Test (AASHTO T259/T260).
The Coulomb Test (AASHTO T277) and Ponding Test (AASHTO T259/T260) are used to evaluate the permeability of concrete. For each truckload (Sublot) of LMC and silica fume concrete the Engineer will cast two (2) 4" x 8" cylinder specimens for AASHTO T277 testing. For LMC, two (2) 6" x 6" x 3" specimens will be cast for AASHTO T259/T260 testing. 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. For LMC, the two (2) 4" x 8" cylinders will be tested for 28 day and 56 day permeability in accordance with AASHTO T277 and the two (2) 6" x 6" x 3" molds will be tested for permeability in accordance with AASHTO T259/T260. For silica fume concrete, the two (2) 4" x 8" cylinders will be tested for 28 day and 56 day permeability in accordance with AASHTO T277.

Delete the last paragraph in its entirety and replace with the following:

Refer to Subsection 401.18(I) Acceptance Testing, for requirements for LMC and silica fume concrete overlays prior to final acceptance. 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.

[Include the following with any bare deck or concrete overlay.]

401.23 MEASUREMENT

Add the following to the end of the subsection:

Sawcut Grooved Deck Surface shall be measured by the square yard of deck that is sawcut with grooves in accordance with Subsection 401.17(F)(3).

401.24 PAYMENT.

Payment will be made under:

<i>PAY ITEM</i>	<i>PAY UNIT</i>
<i>Sawcut Grooved Deck Surface</i>	<i>Square Yard</i>