SECTION 434 – HIGH PERFORMANCE CONCRETE (HPC)

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*~~
Concrete Admixtures, Curing Materials and Film Evaporators *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 ..... 923.06(I)

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434.04 PRODUCTION OF THE HPC.

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.*~~ *through a combination of monomolecular evaporation retarders and 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*~~ *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.

d. The Contractor shall have personnel on-site certified through the ACI Inspector Certification Program with the certification level of "Concrete Construction Special Inspector" who 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.

434.05 HPC ACCEPTANCE REQUIREMENTS.

1. 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.

2. 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"
Chloride Permeability ** 56 days (coulombs) 90 day ponding	 AASHTO T 277, ASTM C 1202 AASHTO T 259/T 260	 1,100 maximum 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	4,500 PSI minimum

	ASTM C 39	
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 Subsection 905.05, Subparts 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.

** For chloride permeability testing, additional cylinders shall be provided in accordance with Subsection 905.22 for 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, 28 days and 8, 16, 32 and 64 weeks.

3. For quality acceptance limits, testing, sampling and pay adjustments see Subsections 905.21, 905.22 and 905.23.

NOTE FOR THE DESIGNER: The use of admixtures on bridge decks built under staged construction with live load shall be evaluated on a project by project basis. Designers shall consult with the Authority and consider the following minimum requirements:

4. Retarder admixtures shall not be permitted when bridge decks are poured under staged construction with live load.

5. 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.

Change the title of Section 906 to the following:

SECTION 906 – CONCRETE ADMIXTURES, CURING MATERIALS, AND FILM EVAPORATORS

[Include the following for contracts that specify High Performance Concrete:]

906.07 CURING MATERIALS.

Add the following at the end of the subsection:

(F) EVAPORATION RETARDERS.

Evaporation retarders shall be BRICKFORM Evaporation Retarder, as manufactured by Rafco Products – BRICKFORM, Rancho Cucamonga, CA (800) 483-9628 or (909) 484-3399 or CONFILM Evaporation Retarder, as manufactured by BASF Construction Chemicals, LLC, 23700 Chagrin Boulevard, Cleveland, Ohio (800) 628-9990 or an approved equal.