ITEM 557.6201XX 16 - INTERNAL CURING CONCRETE FOR SUPERSTRUCTURE SLABS - BOTTOM FORMWORK REQUIRED OR PRECAST SLAB ALTERNATE - TYPE XX FRICTION

ITEM 557.6202XX 16 - INTERNAL CURING CONCRETE FOR SUPERSTRUCTURE SLABS - BOTTOM FORMWORK NOT REQUIRED OR PRECAST SLAB ALTERNATE- TYPE XX FRICTION

ITEM 557.6203XX 16 - INTERNAL CURING CONCRETE FOR STRUCTURAL APPROACH SLAB - TYPE XX FRICTION

DESCRIPTION.

Option 1:Furnish and place reinforcing steel and Internal Curing (IC) concrete to construct superstructure slabs as shown in the contract documents. Internal Curing concrete is a modified Class HP concrete with lightweight fine aggregate substituted for a portion of the standard fine aggregate to aid the curing process internally.

Option 2: Furnish and place precast concrete deck with ultra high performance concrete (UHPC) joints located as shown in the contract documents.

For both options:
XX = Friction Type
- 01 - Type 1 Friction
- 02 - Type 2 Friction
- 03 - Type 3 Friction
- 09 - Type 9 Friction

OPTION 1

MATERIALS.

Use materials meeting §557-2. Perform additional work as follows:

Manufacture IC concrete, with lightweight fine aggregate according to §501, and the following modifications:

1. Design an IC concrete mixture with lightweight fine aggregate, proportioned according to the American Concrete Institute Manual of Concrete Practice, ACI 211.2, Standard Practice for Selecting Proportions for Structural Lightweight Concrete. Produce a homogeneous mixture of cement, pozzolan (fly ash or GGBFS), microsilica, fine aggregate, lightweight fine aggregate, coarse aggregate, air entraining agent, water-reducing and set-retarding admixture, and water as designed.

2. Use Type I, I/II, II or Type SF cement. Use a minimum total cementitious content of 400 kg/m³. Use 15-20% pozzolan (fly ash or GGBFS) and 6-10% microsilica.*

   *If Type SF Blended cement is used, the separate addition of Microsilica is not required.

3. Substitute lightweight fine aggregate, meeting the requirements of AASHTO M 195, for 30% (by volume) of standard fine aggregate.

4. Construct lightweight fine aggregate stockpile(s) at the production facility so as to maintain uniform moisture throughout the pile. Continuously and uniformly sprinkle the stockpile(s) with water for a minimum of 24 hours using a sprinkler system approved by the Materials Engineer. If a steady rain of comparable intensity occurs, turn off the sprinkler system at the direction of the Materials Engineer, until the rain ceases. At the end of the wetting period, or after the rain ceases, allow stockpiles to drain for 12 to 15 hours immediately prior to use, unless otherwise directed by the Materials Engineer.

5. After the materials have been accepted for this work, determine the proportions for concrete and equivalent batch masses based on trials made with materials to be used in the work.

Make appropriate adjustments to the specific gravity (Bulk SSD) and fineness modulus of the combined fine aggregate when developing the mix design.

At least 1 week prior to concrete placement, provide the Materials Engineer with a copy of the trial mix design with the following data:

a. Fine and coarse aggregate (saturated, surface dry condition) content in kg/m³.*
b. Cementitious content in kg/m³.
c. Water content in kg/m³.
d. 28-day compressive strengths.
e. Batch masses.

* The moisture content of the lightweight fine aggregate must be determined immediately prior to batching, using Materials Procedure 703-19E. If the supplied mix design is based on "oven dry" weight of lightweight fine aggregate, a corresponding adjusted weight must be supplied to account for the actual absorbed moisture content, so that the mix design entered in to the automated batching system is based on SSD weight. After the adjusted mix design is entered into batching system, additional adjustments must be made to the fine aggregate and water quantities to account for the "surface" moisture of the fine aggregates.

The Materials Engineer, or his representative, will approve the batch weights prior to use. Use these values to manufacture all high performance concrete with lightweight fine aggregate for this project, and periodically correct the batch masses to account for changes in the fine aggregate fineness modulus and aggregate moisture contents.

6. Achieve an average 28-day compression strength of 25 MPa, or greater, with no individual cylinder compressive strength less than 21 MPa.

CONSTRUCTION DETAILS.
Apply the provisions of §557-3 and the following modifications:

1. Add the following to §557-3.01, Concrete Manufacturing and Transporting:

   a. The lightweight fine aggregate moisture content at the time of batching must be a minimum of saturated surface dry (SSD). Batch the lightweight fine aggregate first, then routinely batch the fine aggregate, coarse aggregate, admixtures, cement, pozzolan, microsilica, and remaining mixing water and mix completely.
   b. Have the lightweight aggregate manufacturer supply a service representative at the site for the first two days of concrete placement operations to assist in the control of IC concrete mixing and placement operations.

2. Make any repairs as per the provisions of §557-3.16, Damaged or Defective Concrete. The Engineer will reject any concrete represented by a 28-day cylinder set with an average compressive strength less than 25 MPa, or an individual cylinder with a compressive strength less than 21 MPa. Proposed repairs require Deputy Chief Engineer, Structures approval.

3. The loading limitations of §557-3.14 apply, except that concrete cylinder sets designated for early loading must attain an average compression strength of 25 MPa, or greater, with no individual cylinder less than 21 MPa.

METHOD OF MEASUREMENT. Apply all the provisions of §557-4.

BASIS OF PAYMENT. Apply all the provisions of §557-5.

OPTION 2 - PRECAST CONCRETE DECK SYSTEM
MATERIALS

MATERIALS

PRECAST DECK: Materials used in this work shall conform to the NYSDOT Prestressed Concrete Construction Manual (PCCM)-Current Edition and the following:

CONCRETE		
28 Day Compressive Strength	35.0 MPa	(Minimum)
Lifting Strength	20.0 MPa	(Minimum)
Stainless Steel Reinforcing Bars	709-13	
Mechanical Connectors for reinforcing bars splices		709-10
Leveling Bolts	ASTM F568M, Class 4.6	
Fasteners (Stainless Steel)		

UHPC: The material shall be Ultra High Performance Concrete, all components supplied by one manufacturer. Materials commonly used in UHPC are:
Fine aggregate
Cementitious material
Super plasticizer
Accelerator
Steel Fibers

Water shall meet the requirements of §712-01.

UHPC material shall meet the following, 28 days unless otherwise noted:

Minimum Compressive Strength (ASTM C39)	
Heat-Treated*	≥ 180 MPa
Not Heat-Treated	≥ 150 MPa
Not Heat-Treated 4 day	≥ 100 MPa
Prism Flexural Tensile toughness (ASTM C1018; 305 mm span)	$I_{30} \geq 48$
Long-Term Shrinkage (ASTM C157; initial reading after set)	≤ 766 microstrain
Chloride Ion Penetrability (ASTM C1202)	≤ 250 coulombs
Chloride Ion Penetrability (AASHTO T259; 12.7 mm depth)	< 0.07 kg/m^3
Scaling Resistance (ASTM C672)	y < 3
Abrasion Resistance (ASTM C944 2x weight; ground surface)	< 0.73 grams lost
Freeze-Thaw Resistance (ASTM C666A; 600 cycles)	RDM > 96%
Alkali-Silica Reaction (ASTM C1260; tested for 28 days)	Innocuous

* Heat-Treated - According to manufacturer's recommendation, temperature not to exceed 120ºC.

Results of all the tests above, conducted by an AASHTO accredited testing lab shall be submitted to the DCES for review and approval a minimum of 60 days prior to the use of UHPC in the field. Provide to the DCES a list of bridge projects in which the proposed UHPC material has been used as joint fill between precast concrete elements (within or outside the USA). The DCES reserves the right to reject a proposed UHPC material which lacks a proven track record in precast concrete joint filling in bridge applications.

Acceptance Testing: Note: acceptance testing will be waived if the same material from the same supplier has already been tested according to this standard. The Contractor shall complete the testing of the UHPC a minimum of three months before placement of the joint. The testing sequence will include

the submission of a plan for casting and testing procedures to the DCES for review and approval followed by casting and testing according to the approved plan.

Casting and testing must include the following:

A minimum of 12 cylinders 75 mm x 150 mm shall be cast.

The temperature during curing shall be 20º C or less. 2 cylinders shall be tested each testing day. Testing days are at 4 days, 7 days, 14 days, and 28 days. The compressive strength shall be measured by ASTM C39 and shall meet 100 MPa minimum at 4 days and 150 MPa minimum at 28 days. Only a concrete mix design that passes these tests may be used to form the joint.

Pullout Test: Cast 6 additional cylinders 305 mm diameter and 190 mm deep. Each cylinder shall have one 800 mm long epoxy-coated reinforcing bar cast in the center of the circular face. The axis of the bar shall be perpendicular to the formed surface. 3 of the bars shall be #19 bars embedded 125 mm deep and 3 of the bars shall be #13 bars embedded 75 mm deep. These cylinders will be kept wet for four days then delivered to the Materials Bureau for testing according to Test Method No. NY 701-14 E. Contact the Materials Bureau prior to casting for specific instructions on preparing the test specimens. The test will be performed as soon as practical after the corresponding samples reach 100 MPa. The samples pass if the bars yield without the concrete failing and without the bars pulling out of the concrete.

DIAMOND GRINDING: Use equipment having gang-mounted diamond saw blades on a multi-blade arbor specifically designed for PCC pavement production grinding. Using equipment capable of producing a 900 mm (minimum) grinding pass width that is equipped with a vacuum system capable of removing slurry from the bridge deck surface, such as the Target 3800, Boart-Longyear (Kushion Kut) PC 5000 or PC600, or equal as approved by the Director, Materials Bureau. Contractor shall submit requests to use other equipment at 7 days prior to the start of grinding operations.

Profilograph: Use an automated California-type profilograph capable of producing and analyzing a profile trace in accordance with Materials Method 24, Portland Cement Concrete Pavements, Profilograph Operations. Use automation capable of reporting profile indices in mm/km using a 5mm blanking band and in mm/km using a 0 blanking band. Provide the means to transport the profilograph. The profilograph must be approved by the Engineer prior to use. Approval includes verifying true vertical scale on the trace, 25:1 horizontal scale on the trace and automation filter accuracy when compared to manual trace analysis conducted in accordance with Materials Method 24. Provide the Engineer 14 days advance notification of the profilograph use to obtain approval. Submit requests to use other equipment at least 14 days before grinding.

CONSTRUCTION

DRAWINGS

Shop drawings and installation drawings shall be prepared and submitted as per the requirements of the Prestressed Concrete Construction Manual, (PCCM), and the following:
The submitted drawings shall include details of lifting and handling of panels in the production facility and their storage, transportation, handling and storage at the construction site. Lifting holes will not be permitted. The proposed handling and lifting shall be such that the maximum tensile stress in concrete for handling and erection loads when analyzed according to the proposed handling and installation procedures, shall not exceed 0.40 $(f'ci)^{1/2}$,where $f'ci$ is the concrete compressive strength at the time being considered. Calculations showing actual concrete stresses based upon the proposed support locations and expected dynamic loading of the panels during handling, storage and transportation of the panels shall be prepared by a Professional Engineer and shall be submitted along with the drawings. These drawings and calculations shall be stamped and signed by a Professional Engineer.

The proposed method of mixing, placing, and curing the UHPC joints shall be shown on the drawings. The Contractor shall perform qualification testing as shown on the installation drawing to demonstrate that the proposed method will achieve the required strength at the required time.

QUALIFICATION TESTING

At least 30 days before placing the joint, cast and test the following:

Contractor shall use similar mixing equipment intended to mix the UHPC for the joint.
A minimum of 12 cylinders 75 mm x 150 mm shall be cast.

The temperature during curing shall be 20º C or less. 2 cylinders shall be tested at each required testing time. The time *t* shall correspond to the expected time to reach the required strength shown in the contract documents. Tests shall take place at 1/8 *t*, ¼ *t*, ½ *t*, and *t*. Compressive strength shall be determined by an ASTM C39

FABRICATION

Fabrication shall meet the requirements of the PCCM and the following:

Fabrication Tolerances

1. Width (transverse direction of the bridge): +3, -3 mm
2. Length (longitudinal direction of the bridge): +3, -3 mm
3. Depth (overall): +3, -0 mm
4. Bulkhead alignment (deviation from square or designated skew)
   - Vertical 4 mm
   - Horizontal 4 mm
5. Horizontal alignment (deviation from straight line parallel to centerline of unit):
   - 4 mm for 12 m length
   - 6 mm for 12 m to 18 m length
   - 8 mm for greater than 18 m length

Welding of steel shall comply with the requirements of the New York State Steel Construction Manual.

Placing Concrete, Curing and Finishing

OPTION 2 - PRECAST CONCRETE DECK SYSTEM
CONSTRUCTION

All requirements stipulated in PCCM shall apply except for the following:
After curing, all form release material and all other forming material adhering to the shear keyway and block out concrete shall be removed. Shear key faces shall be roughened and blast cleaned.

Shipping and Handling of Precast Panels. Shall be as per approved drawings.

Steel Embedments. Steel embedments for the panel leveling devices and hold down devices shall be installed in the shop based upon the locations shown on the shop drawings.

Loading of Panels. Equipment shall not be permitted on the precast units between the initial set of the UHPC and the time the UHPC has reached a minimum strength of 70 MPa.

Mixing and Placing UHPC Joints and Haunches. Specifications in the PCCM and the following:

Thoroughly wet the concrete contact area 24 hours prior the placing of UHPC, keep wet and remove all surface water just prior to UHPC placement.

INSTALLATION REQUIREMENTS

Installation shall meet the requirements of the PCCM and the following:

1. Prior to installing panels, the supporting steel surfaces in contact with the panels or field placed concrete shall be cleaned, including removal of free water, to the satisfaction of the engineer.

2. Installation tolerances shall be as per the approved installation drawings. It is the responsibility of the contractor to develop appropriate controls during the fabrication and installation of the panels so that proper cross slopes and grades are achieved after the diamond grinding operation. Installation drawing shall show the details of the proposed controls.

WEARING SURFACE PREPARATION

The wearing surface shall be diamond ground.

Pre-Pour Meeting: Prior to the initial placement of the UHPC, the contractor shall arrange for an on site meeting with the UHPC representative. The contractor's staff and the NYSDOT Engineer and Inspectors shall attend the site meeting. The objective of the meeting will be to clearly outline the procedures for mixing, transporting, finishing and curing of the UHPC material.

The contractor shall arrange for a representative of the UHPC supplier to be on site during the placement of the joints until the Contractor’s own staff has become well-trained in the use of the material. The representative shall be knowledgeable in the supply, mixing, delivery, placement, and curing of the UHPC material.

Storage: The contractor shall assure the proper storage of premix, fibers and additives as required by the supplier's specifications in order to protect materials against loss of physical and mechanical properties.

OPTION 2 - PRECAST CONCRETE DECK SYSTEM CONSTRUCTION

Form Work, Batching and Curing

The design and fabrication of forms shall follow approved installation drawings and shall follow the recommendations of the manufacturer. All the forms for UHPC shall be constructed from plywood. The forms shall be coated to prevent absorption of water.

The contractor shall follow the batching sequence as specified by the supplier and approved by the DCES. The surface of the UHPC field joints shall be filled flush with the precast panels to within a tolerance of + 2 mm, - 0.

The UHPC in the form shall be cured according to Manufacturer's recommendations to attain the required strength shown on the contract documents.

Quality Control

The contractor shall measure the slump flow on each batch of UHPC. The slump flow will be conducted using a mini-slump cone. The flow for each batch shall be between 180 mm and 250 mm. The slump flow for each batch shall be recorded in the QA/QC log. A copy of the log shall be given to the Engineer.

The contractor shall take four sets of compressive strength test samples for each day of placement. Each set consists of 3 cylinders 75 mm x 150 mm. All sets shall be cured in an environment similar to the material they represent.

The following tests shall be performed:
UHPC compressive strengths shall be according to ASTM C 39. The timing of the testing shall be as required by the approved installation drawings.

DIAMOND GRINDING:

The depth of the grinding shall be a minimum of 5 mm in order to obtain proper cross slopes and grades. Begin and end diamond grinding lines normal to the bridge deck centerline. Grind the bridge deck longitudinally such that at least 95% of the bridge deck surface is ground and the bridge deck is in the same plane across a joint or crack when measured with a 1.0 m (minimum) straightedge. Provide surface drainage by maintaining the proper cross-slope on the finished surface and by blending adjacent passes. Regrind the bridge deck if an acceptable surface is not being obtained.

Continuously remove slurry from the bridge deck using the vacuum system on the grinding equipment. If required, provide equipment capable of transporting the slurry from the job site without spilling.
Profilograph: Provide traffic control (if necessary) and survey stationing for referencing measurements. The Engineer will divide the bridge deck into 160m long reporting segments, but may group segments shorter than 160m with previous or subsequent segments. The reporting segment width is the lane width or the distance between adjacent longitudinal joints as chosen by the Engineer. Develop an initial profile trace prior to the start of grinding, and determine the profile index (PI) for each reporting segment subsequent to grinding. Obtain the trace along the longitudinal center of the reporting segment in accordance with Materials Method 24. Develop a referencing system that allows the Engineer to readily associate a trace and PI to the actual corresponding reporting segment. Provide the traces and PIs (determined by both the 5mm and 0 blanking bands) to the Engineer.

OPTION 2 - PRECAST CONCRETE DECK SYSTEM CONSTRUCTION

METHOD OF MEASUREMENT. Apply all the provisions of §557-4.

BASIS OF PAYMENT. Apply all the provisions of §557-5.