ITEM 557.6301XX04 - HPIC CONCRETE FOR SUPERSTRUCTURE SLABS
  - BOTTOM FORMWORK REQUIRED OR PRECAST SLAB ALTERNATE - TYPE XX FRICTION

ITEM 557.6302XX04 - HPIC CONCRETE FOR SUPERSTRUCTURE SLABS
  - BOTTOM FORMWORK NOT REQUIRED OR PRECAST SLAB ALTERNATE - TYPE XX FRICTION

ITEM 557.6303XX04 - HPIC CONCRETE FOR STRUCTURAL APPROACH SLAB
  - TYPE XX FRICTION

DESCRIPTION.
Option 1 – Cast-in-Place HPIC Deck: Furnish and place reinforcing steel and HPIC concrete to construct superstructure slabs as shown in the contract documents. Diamond grind, the top surface of the superstructure slabs and approach slabs.

Option 2 – Pre-Cast Concrete Deck System: Furnish and place precast concrete deck with ultra high performance concrete (UHPC) joints. Use joint details as shown in the contract documents; joint locations to be determined by the Contractor. Furnish and place reinforcing steel and HPIC concrete to construct approach slabs as shown on the contract documents. Diamond grind, the top surface of the precast concrete deck and HPIC approach slabs.

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

OPTION 1 – CAST-IN-PLACE HPIC DECK

MATERIALS.

Apply all the provisions of §557-2, except as noted below:

High Performance Internal Curing Concrete
Manufacture HP concrete according to §501, and the following modifications:
1. The slump range is 4-7 inches. High Range Water-Reducing Admixtures (§711-08, ASTM Type F), are permitted.
2. The maximum w/c ratio is reduced to 0.35.
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. Using a sprinkler system approved by the Materials Engineer. continuously and uniformly sprinkle the stockpile(s) with water for a minimum of 48 hours, or until the “Absorbed Moisture content” of the aggregate in the stockpile is at least 15% by weight (as determined by Test Method NY 703-19E). 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. 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
OPTION 1 – CAST-IN-PLACE HPIC DECK

“surface” moisture of the fine aggregates.

High Performance Internal Curing Concrete (cont.)

6. Use Calcium Nitrate Based Corrosion Inhibitor (CNBCI) in the mix at a rate of 4.0 gallons per cubic yard. Account for the water contained within the CN BCI when determining the amount of water used in the mix. The Materials Engineer, or his representative, will approve the batch weights prior to use. Use these values to manufacture all high performance concrete with corrosion inhibitor for this project, and periodically correct the batch weights to account for changes in the fine aggregate fineness modulus and aggregate moisture contents.

High Weight Methyl Methacrylate

The high molecular weight methacrylate (HMWM) resin shall be low viscosity and non-fuming. Acceptance is based on the manufacturer certifying that it conforms to the following, and the contractor forwarding the certification to the DCES:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity</td>
<td>Less than 25 cps when measured according to ASTM D2849</td>
</tr>
<tr>
<td>Density</td>
<td>Greater than 8.4 lb/gal. @ 77°F.</td>
</tr>
<tr>
<td>Flash Point</td>
<td>Greater than 200°F.</td>
</tr>
<tr>
<td>Vapor Pressure</td>
<td>Less than 1.0 mm Hg @ 77°F. (ASTM D323)</td>
</tr>
<tr>
<td>TG (DSC)</td>
<td>Greater than 136°F (ASTM D3418)</td>
</tr>
<tr>
<td>Gel Time</td>
<td>Greater than 40 minutes for a 100 gram mass</td>
</tr>
<tr>
<td>Percent Solids</td>
<td>Greater than 90 % by weight</td>
</tr>
<tr>
<td>Bond Strength</td>
<td>Greater than 1522.3 psi (ASTM C882)</td>
</tr>
</tbody>
</table>

Sand: for coating HMWM shall be commercial quality dry blast sand. 95% of the sand shall pass the #8 sieve, and 95% shall be retained on the #30 sieve. The container shall include the following information: The name of the manufacturer, the brand name of the product, the date of manufacture.

Water: shall meet the requirements of §712-01.

Curing Compound: shall meet the requirements of §711-05.

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 3 foot (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 a minimum of 7 days prior to the start of grinding operations.
OPTION 1 – CAST-IN-PLACE HPIC DECK

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

Form Work, Batching and Curing
The design and fabrication of forms shall follow approved installation drawings and shall be constructed from plywood or approved equal. The forms shall be removable and shall not absorb water.

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

The lightweight fine aggregate, at the time of batching must be at least 15% absorbed moisture content. Batch the lightweight fine aggregate first, and then routinely batch the fine aggregate, coarse aggregate, admixtures, cement, pozzolan, Microsilica, and remaining mixing water and mix completely.

Place the concrete when the ambient temperature is at least 60 F and no more than 85 F.
Curing shall be as per §502-3.11.

Quality Control
The contractor shall take four sets of compressive strength test samples for each day of placement. Each set consists of 2 cylinders 6 inches X 12 inches. All sets shall be cured in an environment similar to the material they represent. The contractor’s concrete cylinder curing procedure shall be included on the installation drawings. Cylinders shall be provided to the Engineer at least 12 hours prior to the proposed testing.

The following tests shall be performed:
Compressive strengths shall be according to ASTM C 39. The timing of the testing shall be as needed to open to traffic and as ordered by the Engineer, except that one set shall be tested at 28 days. The cylinders will be broken by the Department.

DIAMOND GRINDING:
The depth of the grinding shall be a minimum of 1/4” 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 3 foot 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.

After completion of the diamond grinding, HMWM shall be applied to the construction joints.

Application of HMWM
Abrasive blast clean the area to be treated, removing all contaminants from the surface. Clean adjacent surfaces of the area to be treated using compressed air which is free of oil and moisture.

Do not apply HMWM if rain is expected within 12 hours of completion. Apply HMWM to clean, dry surfaces when the surface temperature is at least 50° F, and if near 50° F, rising. The HMWM shall be
mixed and applied according to the manufacturer’s instructions and no more than 5 gallons at a time. Apply the HMWM as shown in the plans and to all cracks as directed by the Engineer.

When the HMWM surface will be used as a driving surface, sand must be applied to provide friction. After the HMWM has been applied, at least 20 minutes shall elapse before applying the sand. The sand shall be broadcast at a rate of approximately two pounds per square yard, completely covering the HMWM.

**Opening to traffic**
The HMWM must be tack-free before construction traffic is permitted to resume. The concrete must have a minimum compressive strength of 3000 psi, unless a different strength is shown in the Plans. If the concrete does not achieve the proper strength, contact the Deputy Chief Engineer of Structures.

**METHOD OF MEASUREMENT.**

Apply all the provisions of §557-4.

**BASIS OF PAYMENT.**

Apply all the provisions of §557-5.
The unit price bid per square yard shall include the cost of all labor, materials and equipment necessary to satisfactorily perform the work including the diamond grinding.

*(Specification continued on next page with Option 2)*
OPTION 2 - PRECAST CONCRETE DECK SYSTEM

MATERIALS.

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

CONCRETE

<table>
<thead>
<tr>
<th>Descriptive Parameters</th>
<th>Required Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 Day Compressive Strength</td>
<td>5000 psi (Minimum)</td>
</tr>
<tr>
<td>Lifting Strength</td>
<td>2900 psi (Minimum)</td>
</tr>
<tr>
<td>Mechanical Connectors for reinforcing bars splices</td>
<td>709-10</td>
</tr>
<tr>
<td>Leveling Bolts</td>
<td>ASTM F568, Class 4.6</td>
</tr>
<tr>
<td>Fasteners (Stainless Steel)</td>
<td></td>
</tr>
</tbody>
</table>

Application of the protecting sealer to the top surface of the precast panels is not required.

High Weight Methyl Methacrylate (used to prevent leaking joint)
The high molecular weight methacrylate (HMWM) resin shall be low viscosity and non-fuming. Acceptance is based on the manufacturer certifying that it conforms to the following, and the contractor forwarding the certification to the DCES:

- Viscosity: Less than 25 cps when measured according to ASTM D2849
- Density: Greater than 8.4 lb/gal. @ 77°F.
- Flash Point: Greater than 200°F.
- Vapor Pressure: Less than 1.0 mm Hg @ 77°F. (ASTM D 323)
- TG (DSC): Greater than 136°F (ASTM D3418)
- Gel Time: Greater than 40 minutes for a 100 gram mass
- Percent Solids: Greater than 90% by weight
- Bond Strength: Greater than 1522.3 psi (ASTM C882)

Sand The sand shall be commercial quality dry blast sand. 95% of the sand shall pass the #8 sieve, and 95% shall be retained on the #30 sieve.

The container shall include the following information: The name of the manufacturer, the brand name of the product, the date of manufacture.

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)

<table>
<thead>
<tr>
<th>Description</th>
<th>Minimum Compressive Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat-Treated*</td>
<td>≥ 25 ksi</td>
</tr>
<tr>
<td>Not Heat-Treated</td>
<td>≥ 21 ksi</td>
</tr>
<tr>
<td>Not Heat-Treated 4 day</td>
<td>≥ 12 ksi</td>
</tr>
</tbody>
</table>
OPTION 2 - PRECAST CONCRETE DECK SYSTEM

Prism Flexural Tensile toughness (ASTM C1018**, 10 in. span) \[ I_{30} \geq 48 \]
Long-Term Shrinkage (ASTM C157; initial reading after set) \[ \leq 800 \text{ microstrain} \]
Chloride Ion Penetrability (ASTM C1202) \[ \leq 250 \text{ coulombs} \]
Chloride Ion Penetrability (AASHTO T259; 1/5 in. depth) \[ < 0.07 \text{ oz/ft}^3 \]
Scaling Resistance (ASTM C672) \[ Y < 3 \]
Abrasion Resistance (ASTM C944 2x weight; ground surface) \[ < 0.025 \text{ oz lost} \]
Freeze-Thaw Resistance (ASTM C666A; 600 cycles) \[ \text{RDM} > 96\% \]
Alkali-Silica Reaction (ASTM C1260; tested for 28 days) \[ \text{Innocuous} \]

* Heat-Treated - According to manufacturer’s recommendation, temperature not to exceed 120°C.

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 3 in. X 6 in. shall be cast.

All cylinders shall be cured using the same method of curing proposed to be used in the field. The temperature during curing shall be within 18°F of the low end of the proposed temperature range for curing in the field. 2 cylinders shall be tested each testing day. Testing times are at 4 days, 7 days, 14 days, and 28 days. The compressive strength shall be measured by ASTM C39 and shall meet 12 ksi minimum at 4 days and 21 ksi minimum at 28 days. Only a UHPC mix design that passes these tests may be used to form the joint.

Pullout Test: Cast 6 additional cylinders 12 inch diameter and 7 1/2 inches deep. Each cylinder shall have one 32 in. 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 #6 bars embedded 5 inches deep and 3 of the bars shall be #4 bars embedded 3 inches 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 12 ksi.

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 3 foot (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.
CONSTRUCTION DETAILS.

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 0.15 \( f'ci^{1/2} \), where \( f'ci \) is the concrete compressive strength in ksi 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.

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

Fabrication Tolerances
1. Width (transverse direction of the bridge): +1/8”, -1/8”
2. Length (longitudinal direction of the bridge): +1/8”, -1/8”
3. Depth (overall): +1/8”, -0
4. Bulkhead alignment (deviation from square or designated skew)
   - Vertical: +1/8”
   - Horizontal: +1/8”
5. Horizontal alignment (deviation from straight line parallel to centerline of unit):
   - 3/16” for up to 40’ length
   - 1/4” for 40’ to 60’ length
   - 5/16” for greater than 60’ length

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

Placing Concrete, Curing and Finishing
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 such that the aggregate becomes exposed.

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 10 ksi.

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.

**Form Work, Batching and Curing**
The design and fabrication of forms shall follow approved installation drawings and shall follow the recommendations of the manufacturer. 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 to the precast panels to within a tolerance of + 1/16", - 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 7 inches and 10 inches. 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 3 inches x 6 inches. 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 1/4" 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 3 foot 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.

Watertight Integrity Test
After the joint has reached the required strength, a watertight integrity test may be performed in accordance with §567-3.01.H. If leakage does not occur the Contractor need not seal the joint.

Sealing the Joint
Abrasive blast clean the area to be treated, removing all contaminants from the surface. Clean adjacent surfaces of the leaking joints using compressed air which is free of oil and moisture. Do not apply sealer if rain is expected within 12 hours of completion. Apply sealer to clean, dry surfaces when the surface temperature is at least 50°F, and if near 50°F, rising. The sealer shall be mixed and applied according to the manufacturer’s instructions and no more than 5 gallons at a time. Pour the sealer over the joints.

When the methacrylate surface will be used as a driving surface, sand must be applied to provide friction. After the resin has been applied, at least 20 minutes shall elapse before applying the sand. The sand shall be broadcast at a rate of approximately two pounds per square yard, completely covering the sealer. The sealer must be tack-free before construction traffic is permitted to resume.

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

BASIS OF PAYMENT.
Apply all the provisions of §557-5. The unit price bid per square yard shall include the cost of all labor, materials and equipment necessary to satisfactorily perform the work including the diamond grinding.