ITEM 557.6401XX03 -  PRECAST CONCRETE DECK - TYPE XX FRICTION
ITEM 557.6403XX03 -  PRECAST CONCRETE APPROACH SLAB - TYPE XX FRICTION
ITEM 557.11010003   -  INTEGRAL PRECAST CONCRETE BARRIER

DESCRIPTION.

Furnish and place precast concrete deck, precast concrete approach slab and integral precast concrete barrier with ultra high performance concrete (UHPC) joints. The maturity method shall be used to estimate the in-place UHPC strength. The time required before removal of the forms and loading of the structure will be determined based on the estimated in-place UHPC strength. “Panels” refers to both the concrete deck and to the approach slab.

XX = Friction Type
   01 - Type 1 Friction
   02 - Type 2 Friction
   03 - Type 3 Friction
   09 - Type 9 Friction

MATERIALS

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

STEEL EMBEDMENTS. Steel embeddings for the panel leveling devices and hold down devices shall be installed in the shop based upon the locations shown on the shop drawings.
Leveling Bolts                    ASTM F568M, Class 4.6

CONCRETE
28 Day Compressive Strength   5000 psi  (Minimum)
Lifting Strength              3000 psi  (Minimum)
Epoxy Coated Bar Reinforcement 709-04
Mechanical Connectors         709-10
Water                         §712-01
Aggregates (Friction Type)    501-202.B

PRECAST CONCRETE APPROACH SLAB
The supplier must demonstrate a system to place the approach slab using a grout bed such that the approach slab is fully supported at the proper line and grade.

INTEGRAL PRECAST CONCRETE BARRIER: The requirements of the PCCM and the following shall apply.

Tolerances:
1)  Bar Reinforcement Cover  -0, + ½ inch
2)  Width of Unit at the top  -0, + ¼ inch
3)  Width of Unit at the bottom  -0, + ½ inch
4)  Surface deviation from theoretical centerline  ½ inch in 20 feet
5)  Vertical Alignment (deviation from a line parallel to theoretical grade)  ½ inch in 20 feet
6)  Horizontal and Vertical Alignment (between adjacent units)  3/16 inch
JOINT MATERIAL 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

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

**Minimum Compressive Strength (ASTM C39)**
- High Heat-Treated*: \( \geq 25 \text{ ksi} \)
- Medium Heat-Treated 12 hours**: \( \geq 12 \text{ ksi} \)
- Not Heat-Treated 14 days***: \( \geq 21 \text{ ksi} \)

**Prism Flexural Tensile toughness (ASTM C1018; 12 in. span)**: \( I_{30} \geq 48 \)

**Long-Term Shrinkage (ASTM C157; initial reading after set)**: \( \leq 766 \text{ microstrain} \)

**Chloride Ion Penetrability (ASTM C1202)**: \( \leq 250 \text{ coulombs} \)

**Chloride Ion Penetrability (AASHTO T259; ½ 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)**: Innocuous

* High Heat-Treated - According to manufacturer’s recommendation, temperature not to exceed 250ºF.
** Medium Heat Treated temperatures not to exceed 120ºF
*** Not Heat Treated temperature not to exceed 70ºF

Results of all the tests above, conducted by an AASHTO accredited testing lab shall be submitted to the DCES along with the installation drawings. 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.

**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.

**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 one month 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 3in. x 6 in. shall be cast.

The temperature during curing shall be as per heat treatment temperature limits established in this specification. 2 cylinders shall be tested each testing interval. Testing intervals are at 10 hours, 12 hours, 14 hours, and 24 hours. The compressive strength shall be measured by ASTM C39. Only a concrete mix design that passes these tests may be used to form the joint.
Pullout Test: Cast 6 additional cylinders 12 in. diameter and 7.5 in. 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 in. deep and 3 of the bars shall be #4 bars embedded 3 in. 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 compressive strength samples reach 12 ksi. Acceptance criteria for pullout testing shall be when there is complete tensile failure of the reinforcing bar, prior to pullout from the concrete or failure of the concrete.

EQUIPMENT FOR MATURITY TESTING:

Use a Maturity Meter and thermocouples that can:

($) Provide a maturity value based on the Equivalent Age or Temperature Time Method as detailed in ASTM C 1074-11.
($) Continuously log and store maturity data.
($) Accurate to within +/- 1°F when the meter is calibrated as per the manufacturer's instructions.
($) Take readings every half hour for the first 48 hours and every hour after that at a minimum.
($) Print data and/or download it into a spreadsheet.

METHODOLOGY FOR MATURITY TESTING:

The procedure for utilizing the maturity method to determine in-place UHPC strengths includes three steps: development of the strength-maturity relationship, monitoring the maturity of the placement, and regular validation of the strength maturity relationship. Any changes in the mix design, its components, or proportions will require that a new strength-maturity relationship be developed. The strength-maturity relationship shall be developed one month prior to construction. Continue data collection for the strength-maturity relationship after acceptance of the maturity value until the strength reaches 21 ksi.

A procedure to develop the strength-maturity relationship shall be submitted to the DCES for review and approval along with the shop drawings. The submitted procedure shall include all necessary information for the development of the strength maturity relationship. All necessary testing included in the procedure shall be conducted by an AAHSTO accredited testing lab.

CONSTRUCTION

DRAWINGS FOR PRECAST CONCRETE PANELS AND BARRIER

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 due to handling and erection loads shall not exceed 0.15(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.

Integral precast concrete barrier shall be cast integrally with the precast concrete deck prior to shipping. Proposed procedures for the casting, handling, and shipping shall be included in the drawings for the precast concrete panels.

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

**FABRICATION OF PRECAST CONCRETE PANELS**

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

**Fabrication Tolerances**

1. Width (transverse direction of the bridge): +1/8, -1/8 in.
2. Length (longitudinal direction of the bridge): +1/8, -1/8 in.
3. Depth (overall): +1/8, -0 in.
4. Bulkhead alignment (deviation from square or designated skew)
   - Vertical: ¼ in.
   - Horizontal: ¼ in.
5. Horizontal alignment (deviation from straight line parallel to centerline of unit):
   - ¼ in. for 40 ft length
   - 3/8 in. for 40 ft to 60 ft length
   - 1/2 in. for greater than 60 ft 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.

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

**Loading of Panels.** Equipment weighing more than 2500 pounds 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 and continuously wet the concrete contact area for 24 hours prior the placing of UHPC, keep wet and remove all surface water just prior to UHPC placement.

**INSTALLATION REQUIREMENTS FOR DECK SLABS**

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.

**INSTALLATION REQUIREMENTS FOR APPROACH SLABS**

Bed and level slabs in accordance with the system designer’s instructions such that the vertical differential across any joint is $\frac{1}{4}$ in. or less. Slabs shall be placed on grade and have grout pumped underneath to ensure that they are completely supported.

**INSTALLATION REQUIREMENTS FOR UHPC**

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.

**GROUTING OF HAUNCHES**

Grouting shall meet the requirements of the PCCM, except that the requirement related to post-tensioning shall not apply. Details of grouting ports, vents, method of pumping the grout, equipment with necessary back up shall be shown on the installation drawing. Required QC for the grouting also shall be listed on the drawings.

**PRE-INSTALLATION MEETING:** Convene a preplacement meeting 7 to 14 calendar days before the planned start of slab installation. The contractor shall arrange for an on site meeting with representatives from the UHPC and the precast system suppliers. 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 placing and leveling the precast concrete panels and for mixing, transporting, finishing and curing of the UHPC material.

**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 or approved equal. The forms shall be coated to prevent absorption of water using a form release agent from the Department’s Approved List of Materials.

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 as shown on the approved drawings.
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 in. and 10 in. 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.

**Estimation of In-Place Strength:**

1. Two thermocouples per each UHPC joints, one at each end, shall be installed. The locations of these installations shall be shown on the installation drawings. These locations shall be revised if directed by the DCES. The thermocouple wiring may be connected to reinforcing steel, but probe endings may not be in direct contact with the steel. Consider structural or exposure conditions when placing thermocouples.

2. Listed actions are allowed when the maturity value of all the thermocouples reaches the corresponding strength values listed below.

<table>
<thead>
<tr>
<th>Action</th>
<th>Strength Requirement</th>
</tr>
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<tbody>
<tr>
<td>Removal of top forms</td>
<td>10 ksi</td>
</tr>
<tr>
<td>Open Bridge deck to Traffic</td>
<td>12 ksi</td>
</tr>
</tbody>
</table>

3. Record and save the maturity data from the meter until the strength reaches 21 ksi. Disconnect the meter and clip all wires flush with the concrete surface.

A continuous read thermocouple or thermistor with a data logger can be used to estimate in place strength. The methodology outlined in ASTM C 1074-11 will be used. The maturity function used to estimate strength will be calculated with the same formula that is used by the maturity meter that established the initial strength maturity relationship. Copies of the calculations will be provided to the engineer.

**Validation of the Strength-Maturity Relationship:**

For each day of placement, perform validation tests by casting 7 cylinders. Equip one of the cylinders with a thermocouple. Test the cylinders as close as possible to the maturity value corresponding to 21 ksi. Record the maturity value immediately prior to testing. All testing shall be conducted by an AASHTO accredited testing lab. Report the results to the DCES.

If the average value of compressive strength of each pair of cylinders is within 10% of the estimated value, the strength-maturity relationship will be validated. If the average cylinder value is more than 10% below the estimated value, the strength maturity relationship will need to be re-established. If the first four cylinders produce acceptable results, the remainder need not be tested.

The Department may perform additional testing for research purposes. Casting and testing in addition to that required in this spec will be performed by NYSDOT personnel.

In case of loss of required data, or non verification of the strength-maturity relationship, use the cylinders cast above, one pair at a time, to verify the strength.
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**METHOD OF MEASUREMENT.** For precast concrete bridge decks and precast concrete approach slabs apply all the provisions of §557-4. For precast concrete bridge barrier apply all the provisions of §569-4.

**BASIS OF PAYMENT.** For precast concrete bridge decks and precast concrete approach slabs apply all the provisions of §557-5. For precast concrete bridge barrier apply all the provisions of §569-5.