**ITEM 557.11020101 INTEGRAL PRECAST CONCRETE BARRIER**
**ITEM 557.65010101 PRECAST BRIDGE SYSTEM WITH EMBEDDED STRUCTURAL STEEL**
**ITEM 557.65020101 PRECAST CONCRETE APPROACH SLABS**

**DESCRIPTION:** This specification covers the material and fabrication and installation requirements for Precast Bridge System with Embedded Structural Steel, Precast Concrete Approach Slabs, and Integral Precast Concrete Barrier. "Panels" refers to both the precast bridge system and to the approach slab.

The design and detail shown in the contract documents is only applicable when the panel layout as shown is used. If the Contractor proposes a different layout, all necessary revisions and supporting calculations, stamped by a Professional Engineer, shall be submitted to the DCES.

**MATERIAL REQUIREMENTS**:

| | |
|---|---|
| Lightweight Concrete for Precast Bridge System | See Lightweight Concrete Below |
| Concrete for Approach Slabs | PCCM |
| Concrete for Precast Barrier | See Lightweight Concrete Below |
| Concrete Reinforcing | §709 |
| Concrete Repair Material | §701-04, §701-06, §701-08, or §701-09. |
| Paint | as specified by the contract documents. |
| Structural Steel | §715-01 |
| Stud Shear | §709-05 |
| Fasteners | §715-14, and SCM Chapter 10 |
| Nuts, bolts and washers | §715-14, and SCM Chapter 10 |
| Closure pour concrete for panels | See Below |
| Closure pour concrete for barrier | §709 Class HP |

## LIGHTWEIGHT CONCRETE

Manufacture lightweight high-performance concrete according to §501, and the following modifications:

**A. Design.** Design a lightweight high-performance concrete mixture, proportioned according to the American Concrete Institute Manual of Concrete Practice, ACI 211.2, Standard Practice for Selecting Proportions for Structural Lightweight Concrete.

1. Produce a homogeneous mixture of cement, fly ash, microsilica, fine aggregate, lightweight coarse aggregate, air entraining agent, normal range set-retarding water-reducing admixture, and water as designed.

2. Use Type II cement (§701.01). Use a minimum cementitious content of 360 kg/m³. Use 15-20% pozzolan (§711-10, Flyash or §711-12, GGBFS), and 6-10% microsilica (§711-11).

3. Use lightweight coarse aggregate conforming to §703-10, with a gradation in the 25 mm to 4.75 mm size designation in Table 1, ASTM C330.

4. Determine the cement content for each trial batch by means of a yield test according to ASTM C138.

   **a.** At least 10 working days prior to concrete placement, provide the Materials Engineer with a copy of the trial mix design with the following data:
   - Fine and coarse aggregate (saturated, surface dry condition) content in kg/m³.
   - Cementitious content in kg/m³.

- Water content in kg/m³.
- Unit weight of freshly mixed concrete in accordance with ASTM C138.
- Dry unit weight in accordance with ASTM C567.
- 28-day compressive strengths.
- Batch quantities of all materials as they will appear on the batch record.

**b.** The Materials Engineer, or their representative, will approve the batch quantities prior to use. Use these values to manufacture all lightweight concrete for this project, and periodically correct the batch masses to account for changes in the fine aggregate fineness modulus and aggregate moisture contents in accordance with Materials Method 9.1, or current Department directives.

**B. Batching.** 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.

**C. Stockpile Handling.** Construct lightweight coarse 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, using a sprinkler system approved by the Materials Engineer. Soak for a minimum of 48 hours, or until the stockpile has achieved a minimum internal moisture content of 15% by weight. If a steady rain of comparable intensity occurs, turn off the sprinkler system. If the rain ceases prior to the end of the wetting period, restart the sprinkling system. At the end of the wetting period, or when a rainfall ceases beyond the end of the wetting period, allow stockpiles to drain for 12 to 15 hours immediately prior to use.

**D. Compressive Strength Determination.** Achieve an average 28-day compressive strength of 35 MPa.

**Density Determination.** Produce concrete with an average dry unit mass ranging from 1750 to 1850 kg/m³ when tested in accordance with ASTM C567.

## CLOSURE POUR CONCRETE FOR PANELS

MATERIALS AND EQUIPMENT.

Cementitious Materials ..... 501-2.02A
Aggregates ..... 501-2.02B
Concrete Batching Facility Requirements ..... 501-2.03
Concrete Mixer and Delivery Unit Requirements ..... 501-2.04
Handling, Measuring, and Batching Materials ..... 501-3.02
Concrete Mixing, Transporting, and Discharge ..... 501-3.03
Membrane Curing Compound ..... 711-05
Admixtures ..... 711-08
Water ..... 712-01

Use non-reactive aggregate, as identified in the *Approved List of Sources of Fine & Coarse Aggregate,* when using high alkali cementitious products.

**Transit Mixed and Truck Mixed Closure Pour Concrete.** Use trucks calibrated and approved by the Regional Materials Engineer. Apply a total of 100 – 200 mixing revolutions before discharge. Apply the following in addition to the standard specification sections listed above.

***A. Accelerating Admixtures.*** Accelerating admixtures may be batched into transit mixed concrete at the plant in accordance with §501-2.03F, Admixture Dispensing Systems, or added at the site during or after any water addition. For truck mixed concrete, accelerating admixtures are always added at the site and after the water is added.

When adding accelerating admixtures at the site, equip trucks with an air pressurized tank that:

- Contains the correct volume of admixture (for the volume of concrete in the truck) dispensed through the plant's Admixture Dispensing System.
- Discharges the admixture into the mixer drum in less than 1 minute.
- Has a clear plastic tank output hose that leads into the mixer drum.
- Has a properly working relief valve.

Add the entire accelerating admixture into the mixer drum in 1 uninterrupted operation in 1 minute or less.

***B. Aggregate Moisture Content.*** Twice daily, or more frequently if weather conditions change significantly as determined by the Engineer, determine the aggregate moisture content in accordance with Materials Method 9.1, *Plant Inspection of PCC.* Compute the corresponding water added to the concrete in the truck from aggregate moisture. Subtract that quantity, as well as the water portion of the admixture in the tank and water added at the plant from the design water for the truck. Submit these calculations to the NYSDOT plant inspector for approval. Upon approval, write the maximum volume of water to be added to the truck at the site on the delivery ticket. Upon arrival at the site, provide the delivery ticket to the Engineer. Do not add more water than the maximum volume indicated on the delivery ticket.

***C. In-Line Water Flow Meter.*** Equip trucks with an in-line water flow meter that:

- Resets easily to "0".
- Is mounted to allow easy reading.
- Withstands water temperatures up to 93°C.
- Is equipped with air strainers capable of removing entrapped air within the system.
- Has a batching delivery tolerance of 1% by weight or volume.
- Has a manufacturer's certified flow rate capacity of 265 l/min.
- Has a minimum actual flow rate of 190 l/min.

The Regional Materials Engineer will measure the actual flow rate and inspect the flow meter prior to use. Reset the flow meter to 0 before adding any water at the site.

For truck mixed concrete, execute 20 dry revolutions at 12 to 18 rpm before adding water. Add water in 1 uninterrupted operation. No water is to be removed from the truck for any purpose while water is being added to the drum. After the required water designated on the delivery ticket has been added, add the entire accelerating admixture, if any, as described above in Accelerating Admixtures.

**Closure Pour Concrete Trial Batch.** Design the mix to satisfy Table 1, Closure Pour Concrete Mix Requirements. Submit the mix design to the Engineer. Include admixture brands and dosages as well as mixing, transporting, placing, curing, and anticipated strength gain details.

Produce and place a 3.1 $m^3$ (minimum) trial batch at an off-project location approved by the Engineer. Produce the trial batch using the same materials and processes as those to be used to produce the project concrete. Provide the Engineer a 7 day minimum advance notification of trial batch production. Coordinate trial batch production to ensure the presence of the Engineer, the Regional Materials Engineer, and Materials Bureau personnel.

Provide an American Concrete Institute (ACI) Certified Concrete Field Testing Technician, Grade I, or higher, to:

- Measure slump, air content, and unit weight.
- Cast cylinders for compressive strength and freeze-thaw resistance.

Begin compressive strength testing of the trial batch concrete 1 hour after discharge. Unless otherwise noted in the contract documents, use an agency accredited by the AASHTO Accreditation Program (AAP) in the field of construction materials testing of portland cement concrete to perform compressive strength testing. Cast and test in the presence of the Engineer, or the Engineer's representative. Provide acceptable proof of ACI Certification and AASHTO Accreditation to the Engineer before placing any concrete.

Cast a minimum of 12 cylinders in accordance with Materials Method 9.2, Field Inspection of Portland Cement Concrete. Determine the concrete compressive strength in accordance with ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. The mix will be considered acceptable for use if 3 cylinder pairs (6 total) meet the following strength criteria:

- Average compressive strength of all cylinder pairs exceeds 17.3 MPa in 3 hours.
- Average compressive strength of each cylinder exceeds 14 MPa in 3 hours.

Cast a minimum of six (6) 100 mm x 200 mm cylinders for freeze-thaw testing. The Regional Materials Engineer will transport the cylinders for freeze-thaw testing conducted by the Materials Bureau.

Changes other than minor fluctuations in admixture dosage rates require a new mix design and trial batch. The Engineer may halt placing and order additional trial batches whenever the specified properties are not achieved.

**TABLE 1 CLOSURE POUR CONCRETE MIX REQUIREMENTS**

| Property | Minimum | Desired | Maximum |
|---|---|---|---|
| Compressive Strength | 17.3 MPa | - | - |
| Freeze-Thaw Loss | - | - | 10 % |
| Slump* | 25 mm | - | 200 mm |

NOTES:
* Minimum slump provided the mix consolidates and finishes properly. Maximum slump provided the mix is nonsegregating and holds grade.

### Equipment.

Forms ..... §502-2.04B1
Vibrators ..... §502-2.04C
Saw Cutting Equipment ..... §502-2.04E
Curing Compound Applicators ..... §502-2.04F

## CONSTRUCTION DETAILS

## FABRICATION REQUIREMENTS

### Steel:

FABRICATION REQUIREMENTS: All structural steel fabrication and shear connector installation work shall be done in accordance with the requirements of the New York State Steel Construction Manual (SCM). If the steel is to be painted, it shall be painted prior to shipping from the fabrication shop.

## Concrete

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 concrete units in the production facility and their storage, transportation, handling and storage at the construction site. Lifting holes will not be permitted in panels. The proposed handling and lifting shall be such that the maximum tensile stress in concrete due to handling and erection loads shall not exceed 0.40 $(f'ci)^{1/2}$, 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.

Integral precast concrete barrier shall be cast integrally with the precast concrete bridge system prior to shipping. Curing compound is acceptable for barrier. Proposed procedures for the casting, handling, and shipping shall be included in the drawings for the precast concrete panels. All precast concrete barrier shall conform to the tolerances contained in §704-03, §704-05 and to the misalignment tolerance in §569-2.02.

Approach slab installation drawings shall show a procedure to bed and level slabs in accordance with the system designer's instructions such that the vertical differential across any joint is ¼ in. or less. Slabs shall be placed on grade and have grout pumped underneath to ensure that they are completely supported.

The following supplements to the PCCM shall apply:
**Section 5.5.1** - The following shall also apply: All structural steel to be embedded in concrete shall exhibit a cleanliness grade as defined by SSPC-Vis 1, cleanliness grades BSt3, or CSt3, as applicable.
**Section 5.8**, Second sentence - Change to: If no strength is indicated, the required minimum strength shall be 21 MPa at lifting, and 35 MPa at 28 days or at the time of shipping, if earlier.
**Section 5.9.1**, add the following: In addition, all steel stringers shall be cast such that the webs will be truly vertical upon installation at their permanent locations.
If the structural steel portions of the unit have been painted prior to concrete casting, all material which might act as a bond breaker between the concrete and steel shall be removed. In addition, all paint shall be protected from the effects of the curing procedure by a method(s) acceptable to the Inspector. All paint damage shall be repaired in a manner approved by the DCES at no additional cost to the State.
**Section 5.10.2** - Delete this subsection, replace with: The tops of all units shall be finished in an identical manner. The finished surface shall be that approved on the Shop Drawings.
**Section 6.1** - Add: Lifting of Units. Units shall be lifted as soon as the final curing phase is completed, and the minimum lifting strength is reached. Lifting shall be done in the manner approved on the Shop Drawings.

**Section 6.4.2** Add the following: Honeycombing of concrete to such an extent that chipping away the honeycombed concrete exposes:

a. Any reinforcement comprising the top reinforcing mat.

b. Reinforcement comprising the bottom reinforcing mat which is 24 diameters or longer, or two or more reinforcing bars regardless of length.

c. Any unit exhibiting a crack in any part of the concrete that is greater than 13 mm in depth and 0.05 mm in width.

**Section 7** The following tolerances shall apply:

Precasting Tolerances - The units shall comply with the applicable tolerances listed below:

| | |
|---|---|
| Width | 6 mm |
| Overall Depth of Structural Slab | +10 mm, -3 mm |
| Slope (Top of Unit) | +½%, -0% |
| Reinforcing Cover - Both Mats | ±6 mm |
| Reinforcing Placement - Horizontal | ±50 mm |
| Inserts | ±10 mm |
| Deviation from square, or designated skew | ±6 mm(vertical) |
| Deviation from theoretical diagonal length | ±20 mm |

Any movement of the forms during casting beyond the tolerances listed above is cause for rejection of the unit. The Inspector will document all form movements to the D.C.E.S. A determination will be made by the D.C.E.S. regarding the unit's acceptability.

Post Lifting - All units shall be inspected for compliance with the tolerances listed below within 24 hours after lifting. All units failing to meet any one tolerance limit will be rejected with the concurrence of the D.C.E.S.:

| | |
|---|---|
| Horizontal Alignment (Deviation from straight line parallel to centerline of unit): | 10 mm |
| Deviation between adjacent steel stringer flanges | ±6 mm(within units) |
| Camber deviation from design camber (upright position): | ±6 mm |

Overall length of Unit: ±20 mm, Adjacent units shall not vary by more than 20 mm.

**Installation**

Installation shall be in accordance with the approved Installation Drawings.

**Closure Pour Concrete For Panels**

Meet with the Engineer one week in advance to coordinate all aspects of removal, preparation, and material placement including mixing, transport, and discharge, jointing, material requirements and testing, and personnel requirements.

**Project Strength Determination.** Provide an ACI Certified Concrete Field Testing Technician, Grade I, or higher, to cast all cylinders. Unless otherwise noted in the contract documents, use an agency accredited by the AASHTO Accreditation Program (AAP) in the field of construction materials testing of portland cement concrete to perform compressive strength testing. Cast and test in the presence of the Engineer, or the Engineer's representative. The Engineer, or the Engineer's representative, will complete the Concrete Cylinder Report as cylinders are cast and tested.

Cast a minimum of 2 cylinder pair from each truck in a scheduled placement operation in accordance with Materials Method 9.2, Field Inspection of Portland Cement Concrete. A minimum of 6 cylinder pairs (12 total) is required for placement operations involving 3 or more trucks, with a minimum of 2 pair cast from the last truck of the operation. Develop an Engineer-approved marking system that allows a cylinder to be readily associated with the corresponding placement location and placement time.

Determine the concrete compressive strength in accordance with ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. Open the placement to traffic when the average compressive strength of the 2 cylinder pairs from each truck of the operation exceeds 17.3 MPa. Use other cylinders cast to properly anticipate the time frame required for that pair to reach 17.3 MPa.

If 17.3 MPa is not achieved, continue testing cylinders until 17.3 MPa is reached. If there are no more cylinders, then the concrete is defective and must be replaced at no additional cost to the state.

## METHOD OF MEASUREMENT

The work for panels will be measured for payment as the number of square meters of panels satisfactorily installed, measured to the nearest 0.1 square meters. No deduction will be made for the width of closure pours.

The work for barrier will be measured as the number of meters of concrete barrier installed. Measurement will be taken along the centerline of the top of the barrier. No deduction will be made for joints.

## BASIS OF PAYMENT

The unit price bid shall include the cost of all engineering, labor, materials and equipment necessary to complete the work.

| Item No. | Item | Pay Unit |
|---|---|---|
| 557.65010101 | Precast Bridge System With Embedded Structural Steel | Square Meter |
| 557.65020101 | Precast Concrete Approach Slabs | Square Meter |
| 557.11020101 | Integral Precast Concrete Barrier | Meter |