

April 27, 2016

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATION  
DEPARTMENT OF ADMINISTRATION

DIVISION OF PURCHASES BID NO. 7550450

RHODE ISLAND DEPARTMENT OF TRANSPORTATION

RHODE ISLAND CONTRACT NO.2016-CB-030

FEDERAL-AID PROJECT NO. FAP Nos: BRO-0471(002)

**Improvements to I-195 Superstructure Replacment of Paw. Ave. Br.471**

Pawtucket Avenue Bridge No. 471

CITY/TOWN OF East Providence, Barrington

COUNTY OF PROVIDENCE, BRISTOL

NOTICE TO PROSPECTIVE BIDDERS

ADDENDUM NO. 3 Prospective bidders and all concerned are hereby notified of the following changes in the Plans, Specifications, Proposal and Distribution of Quantities for this contract. These changes shall be incorporated in the Plans, Specifications, Proposal and Distribution of Quantities, and shall become an integral part of the Contract Documents.

**A. Specifications - Job Specific**

1. Pages JS-77A thru JS-77H

Insert pages JS-77A thru JS-77H attached to this Addendum No. 3. Item Code 808.9910 has been added.

**B. Plans**

1. VOLUME 2 SHEET 5 - GENERAL BRIDGE NOTES SHEET 2 OF 3

Remove and replace Sheet 5 in its entirety with revised Sheet 5(R-1) attached to this Addendum No. 3. This sheet has been revised.



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RI Department of Transportation  
Chief Engineer

**CODE 808.9910**  
**ULTRA-HIGH PERFORMANCE CONCRETE (UHPC)**

**DESCRIPTION:** The work under this item consist of field casting of the deck closure pour joints between the prefabricated Superstructure Modular Units (SMUs), including batching and casting on site, testing, and curing.

Ultra-High Performance Concrete (UHPC) shall conform to the applicable provisions of Sections 601, 606, 808 and 814 of the RI Standard Specifications including all applicable compilations of approved specifications. and the following:

The material, mixing, and placing equipment shall be as supplied by the UHPC Manufacturer. All testing (unless otherwise stated herein) shall be performed by the Contractor and UHPC Manufacturer using ACI Certified Technicians. The Contractor, Manufacturer's Representative(s), their Technicians required for testing, and RIDOT shall be present during the Trial Batch Testing, Mock-up Testing, Pre-Pour Meeting, and the Production Pour.

**MATERIALS:**

UHPC material shall meet the following criteria:

Minimum Compressive Strength (AASHTO T22):

For typical deck closure pour between adjacent SMU units:

4 days  $\geq 14,000$  psi

For common deck closure pour between Phase 1 and Phase 2 SMU units:

12 hours  $\geq 12,000$  psi

Chloride Ion Permeability (AASHTO T277)  $\leq 250$  coulombs at 28 days\*

Freeze-Thaw Resistance (AASHTO T161 Procedure A; 300 cycles) RDM  $\geq 95\%*$

Slump Flow (ASTM C1437) 7 – 10 inch diameter after 25 drops

No visual segregation of steel fiber and aggregate

Shrinkage (AASHTO T160)  $\leq 800$  microstrains at 28 days\*

\*Manufacturers historical test data may be submitted in lieu of Contractor testing. Test data must be submitted 30 days prior to the trial batch.

**Submittals**

- Quality Control Plan
  - A minimum of 30 calendar days prior to the Trial Batch Testing, the Contractor shall submit a Quality Control Plan.

- Trial Batch Test Results
  - A minimum of 30 calendar days prior to the Mock-up Testing, the Contractor shall submit their results for all required tests from the trial batch.
  
- Construction Procedures

A minimum of 30 calendar days prior to the Mock-up Testing, and 90 calendar days prior to placing the UHPC closure pours the Contractor shall submit construction procedures to the Engineer for approval. The Construction procedures shall include, but may not be limited to:

  - The Mock-up Testing procedures – materials, equipment, and procedures, including forming and placement details, casting, testing and storing cylinders.
  - The Production Pour – materials, equipment, and procedures for the closure pours production and the casting of the test cylinders. The submittal shall include information on the forming details, timing and sequencing of the pours, the number of crews and equipment used to mix and place the UHPC. Curing of the closure pours and the cylinders shall be included here, as well. All submittals shall be in English units.
  
- Regional Experience of the Manufacturer
  - The manufacturer of the Ultra-High Performance Concrete product shall demonstrate the successful completion of a minimum of four similar projects in the New England region of the United States.

## QUALITY CONTROL (QC)

### Testing Equipment

The testing equipment listed below will be required at the site for the Trial Batch Testing, the Mock-up Testing, and for the Production Testing.

- A mini-slump cone meeting the requirements of ASTM C1437, for on-site testing.
- Concrete thermometer meeting the requirements of AASHTO T309.
- 3 inch diameter by 6 inch tall cylinder molds for making samples for compressive testing in accordance with AASHTO T22.
- Only for Trial Batch Testing, all equipment and molds necessary to fabricate samples for AASHTO T160, T161, and T277 tests (if historical test data is not available).

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.
- Provide accuracy to within +/- 1° F when the meter is calibrated as per the manufacturer's instructions.
- Take readings every half hour for the first 15 hours.
- Print data and/or download it into a spreadsheet.

A minimum of three thermocouples per each UHPC joint shall be installed, one at each end, and one at midway with additional thermocouples as recommended by the manufacturer.

RIDOT will retain ownership of said equipment upon project completion.

### Sampling and Testing

Trial Batch Testing, Mock-up Testing, and Acceptance of Production Pour Testing shall be in accordance with the following sampling and testing procedures.

The Quality Control sampling and testing shall be performed by the Contractor/Manufacturer using ACI Certified Technicians for Field Testing Technician Grade 1. All materials, testing equipment, mixers, etc. shall be supplied by the Contractor/Manufacturer. In addition, compression testing of hardened UHPC shall be performed by the Contractor/Manufacturer, at an AASHTO accredited laboratory in accordance with these Special Provisions and the Manufacturer's recommendations. Chloride ion permeability, freeze-thaw, and shrinkage shall also be performed if historical data is not available. The Contractor shall provide a copy of the test results to the Engineer.

UHPC 4 days  $\geq$  14,000 psi:

- The test days shall be at 2 days, 4 days, 14 days, and 28 days. Four (4) - 3 inch diameter by 6 inch cylinders shall be used for each test day for a total of 16 cylinders (a total of 48 cylinders for all tests).
- The trial batch test cylinders shall be standard cured in accordance with RIDOT Standard Specifications.
- The mock-up test cylinders and the acceptance of production pour test cylinders used for the 2 and 4 day tests shall be field cured in the same environment as the closure pour material they represent. The cylinders for the remaining 14 day, and 28 day tests shall be standard cured in accordance with RIDOT Standard Specifications.
- For the trial batch and mock-up tests, four (4) additional concrete cylinders for each test shall be fabricated and maintained at 50°F in a controlled testing laboratory (a total of 8 cylinders for all tests). One (1) cylinder will be tested each test day. Compressive testing shall be performed at 2, 4, 14, and 28 days. Acceptance cylinders shall be tested by the Engineer. Quality Control cylinders shall be tested by the Contractor/Manufacturer, at an AASHTO accredited laboratory. Cylinder test preparations shall be in accordance with these Special Provisions.

UHPC 12 hours  $\geq$  12,000 psi:

- The test shall occur at 10 hours, 12 hours, 14 hours, 24 hours, and at 28 days. Four (4) - 3 inch diameter by 6 inch cylinders shall be used for each test for a total of 20 cylinders (a total of 60 cylinders for all tests). The cylinders shall be standard cured in accordance with RIDOT Standard Specifications.

- The trial batch test cylinders shall be standard cured in accordance with RIDOT Standard Specifications.
- The mock-up test cylinders and the acceptance of production pour test cylinders shall utilize the maturity testing method by taking periodic temperature readings of the in-place UHPC up to 10 hours or as recommended by the Manufacturer and then test at 10, 12, 14, and 24 hours, and at 28 days. The 10, 12, and 14 hours tests shall be field cured in the same environment as the closure pour material they represent. The cylinders for the remaining 24 hour, and 28 day tests shall be standard cured in accordance with RIDOT Standard Specifications.
- For the trial batch and mock-up tests, five (5) additional concrete cylinders shall be fabricated and maintained at 50°F in a controlled testing laboratory (a total of 10 cylinders for all tests). One (1) cylinder will be tested each test hour/day. Compressive testing shall be performed at 10, 12, 14, and 24 hours, and at 28 days. Acceptance cylinders shall be tested by the Engineer. Quality Control cylinders shall be tested by the Contractor/Manufacturer, at an AASHTO accredited laboratory. Cylinder test preparations shall be in accordance with these Special Provisions.

#### Methodology For Maturity Testing:

The procedure for utilizing the maturity method to determine in-place UHPC strengths includes three steps: obtain Manufacturers' strength-maturity relationship, monitoring the maturity of the placement by taking periodic temperature readings as recommended by the Manufacturer, 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 minimum 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 Engineer 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 AASHTO accredited testing.

#### Trial Batch Testing

60 calendar days prior to the Mock-up test, Trial Batch Testing shall be performed. The Trial Batch shall take place at a RIDOT approved location and be performed in the presence of RIDOT personnel. Trial batch samples will be tested to meet all UHPC criteria as per Materials above. The quantity of materials batched shall be that quantity sufficient to perform all tests required. All required review submittals prior to performing the Trial Batch Testing shall be as per Submittals above.

UHPC batch temperatures shall be recommended by the Manufacturer and shall be representative of the proposed batch temperatures required for the production pours. The temperature shall be recorded.

The Trial Batch shall be representative of the production pour and shall consist of the same materials, equipment, methods of mixing, cylinder preparation, and curing methods.

The basis for approving the UHPC project mix based on the Trial Batch Testing shall be that the test results meet the criteria listed above under Materials. Trial Batch Testing shall continue at the Contractor's expense until all test results meet the requirements herein or as otherwise approved by the Engineer. The basis for acceptance of the Trial Batch test results will be that the concrete compressive strength at 4 days is equal to or greater than 14,000 psi. The 2 day, 14 day, and 28 day test results shall be recorded for information only. All test results, including those for information only, shall be submitted no later than 30 calendar days prior to the Mock-up test. The Mock-up testing shall not begin until the UHPC project mix is approved by the Engineer. Delays in achieving an approved mix shall not be considered cause for changes to the contract schedule or justification for claims by the Contractor.

#### Mock-Up Testing

A minimum of 60 calendar days prior to the proposed use of UHPC for the production closure pours the Contractor shall perform a Mock-up test. The Mock-up shall take place at a RIDOT approved location and be performed in the presence of the Engineer or his representatives. Batching, mixing, placement and curing shall be in accordance with the Manufacturer's recommendations. The Manufacturer's representative shall be present during the Mock-up to assist the Contractor and approve the mixing and placement procedures. The quantity of materials shall be sufficient to perform the Mock-up related tests required herein. The required review submittals prior to performing the Mock-up shall be as per Submittals above.

The Mock-up shall be a simulation of the production closure pour and shall consist of the same UHPC materials, equipment, mixing, batching, forming, surface preparations, placement, making of test cylinders, quality control by the Manufacturer's representative, and curing as for the production closure pours joining the SMUs. It shall consist of linking two concrete panels together with a closure pour of exactly the same width as shown on the Plans. Uncoated reinforcement may be used for the Mock-up. Each of the panels will be a minimum of 3 feet wide, 20 feet long, and of the same thickness as what is shown on the Plans.

As with the proposed production closure pours, the Mock-up joints shall be over-poured with the UHPC material by 1/4 inch to 3/8 inch above the tops of the joining precast concrete edges to account for settlement. Curing of the joint shall be as specified in these Special Provisions. After curing is completed, the Contractor shall diamond grind the closure pour to demonstrate to the Engineer the outcome and effective use of the equipment proposed to be used for the production closure pours.

A minimum of one slump flow test for each batch of UHPC during the Mock-up shall be performed and recorded by the Contractor for Quality Control. The slump flow test shall be

within the 7 to 10 inch acceptable range. The slump test shall be performed and accepted prior to placing the mix in the Mock-up joint.

UHPC batch temperatures shall be as recommended by the Manufacturer. The temperature shall be recorded. The UHPC shall be fully placed within 30 minutes after mixing and its temperature, as determined by AASHTO T309, shall not be in excess of 80°F prior to being placed into the closure pour.

The basis for accepting the Mock-up shall include the Engineer's approval of the Mock-up testing based on its successful outcome in meeting the criteria set forth in these Special Provisions. The results of the test shall also prove, that the forms, placement, workability procedures, and curing methods can reliably be used in construction of UHPC closure pours.

#### Approval to Proceed to Production Pour

No work for the UHPC closure pour shall commence until the results of the Trial Batch and the Mock-up and all required submittals have been approved in writing by the Engineer.

The Contractor shall measure and record the mixing time, mixture temperature, and the slump flow of each batch of UHPC as part of a daily report. The mixture temperature, as determined by AASHTO T309, shall not be in excess of 80°F prior to being placed into the closure pour. Concrete mixing operations during cold weather shall conform to Subsection 601.03.5; Cold Weather Concrete and per the manufacturer's recommendations. If there is a conflict, the more stringent requirement shall apply. Insulation blankets, and/or sufficient heating devices if required, of a type approved by the Engineer shall be installed under an enclosure or covering, capable of maintaining at all times and under all weather conditions during the protection period, a uniform concrete temperature of not less than 50°F throughout the entire surface of the UHPC. The slump flow shall be conducted in accordance with ASTM C1437. The flow for each batch shall be between 7 inches and 10 inches prior to being placed in the closure pour. If the slump is not within this range, the Manufacturer's Representative shall be consulted and a new batch shall be mixed, if required. Water shall not be added to increase the slump. If required to adjust the slump, additives shall only be added as directed by the Manufacturer's Representative. The Contractor shall provide a copy of the daily report to the Engineer within 24 hours after completion of that day's work.

#### Acceptance of Production Pour Testing

UHPC 4 days  $\geq$  14,000 psi:

- The basis for acceptance of the production test results will be that the concrete compressive strength at 4 days is equal to or greater than 14,000 psi. The 2 day, 14 day, and 28 day test results shall be recorded for information only.

UHPC 12 hours  $\geq$  12,000 psi:

- The basis for acceptance of the production test results will be that the concrete compressive strength at 10 to 24 hours is equal to or greater than 14,000 psi. The 28 day test results shall be recorded for information only.

Curing boxes shall be supplied by the Contractor to store standard cured cylinders in a humidity and temperature control environment as recommended by the Manufacturer prior to testing.

#### Manufacturer's Representative

The Manufacturer shall provide Quality Control on site for the UHPC using the Manufacturer's on site Representative(s). The Representative(s) on site shall use English units and measuring devices in English units, for consistency. The Manufacturer's Representative shall be present during the casting of the cylinders to ensure they are cast correctly and will be present to evaluate the closure pour in terms of consistency, composition, flow and placement, environmental conditions, and concrete temperature.

#### **CONSTRUCTION METHODS:**

##### Pre-Placement Meeting

Prior to the placement of the UHPC, the Contractor shall arrange for an on-site meeting. The UHPC Manufacturer's representative, the Contractor's staff, the RIDOT Engineer, and the Bridge Design Engineer and his representatives shall attend the site meeting. The objective of the meeting is to clearly outline the procedures for batching, mixing, moving, pouring, finishing, and curing of the UHPC material. No work shall proceed until the manufacturer and the Engineer approves the procedures.

##### Form Work, Batching, Mixing, and Curing

The Contractor shall arrange for a technical representative of the Manufacturer to be on site during the placement of the UHPC closure pours and shall provide sign-off on the quality of the UHPC being placed. The technical representative shall be knowledgeable in the supply, mixing, movement, placement, and curing of the UHPC material.

The design and fabrication of forms shall follow approved submittal drawings and the recommendations of the Manufacturer. The forms shall be coated to prevent absorption of water as per the Manufacturer's recommendations. Due to the highly flowable nature of UHPC, leakproof formwork is essential and thus, the Contractor shall ensure that the formwork is water tight and that the UHPC components will not leak out.

Prior to placement, the Contractor shall ensure that the precast surface is roughed to provide an exposed aggregate surface. Precast surface shall be kept wet for at least one hour prior to placing the UHPC and allowed to dry to a saturated surface dry condition just prior to placing the UHPC.

The Contractor shall follow the mixing and batching procedures as recommended by the Manufacturer. The UHPC closure pours shall be filled and over-poured by 1/4 inch to 3/8 inch above the top flanges of abutting precast SMUs to allow for settlement in accordance with the Manufacturer's recommendations. The UHPC shall be fully placed within 30 minutes after mixing.

UHPC shall be placed from the lower to the higher elevation of each closure pour without the use of vibration. Rodding may be used in situations where two successive pours meet.

The UHPC placed in the form shall be cured according to the Manufacturer's recommendations to attain the required strength specified herein. This shall include, but may not be limited to, sealing the area of the closure pour with a sheet of plastic to protect it from the weather and debris, and regulate the hydration process. UHPC shall be cured at the range of temperatures as specified by the Manufacturer in order to achieve required strengths at the specified timeframes. A minimum curing period prior to any subsequent work on the bridge superstructure shall be four (4) days and until the Engineer receives the satisfactory results of the 4-day compressive strength test, in writing, as per these Special Provisions. The Engineer will then notify the Contractor in writing that he/she may resume work on the deck if the test result is equal to or greater than 14,000 psi or as otherwise approved by the Engineer.

If anticipated weather conditions do not forecast the minimum curing temperatures for the pours, provisions shall be made by the Contractor for heating and insulating, and approved by the Engineer, to make any adjustments necessary to ensure compliant curing conditions. The UHPC shall not be subjected to freezing temperatures until it has cured for at least 4 days and has attained 14,000 psi compressive strength. Heat sources that use forced air shall not be applied to the exposed surface of the UHPC.

Formwork may be stripped after a compressive strength of 14,000 psi is reached.

The Spray Applied membrane waterproofing for bridge decks shall not be applied for a minimum of 7 calendar days after UHPC placement, unless otherwise recommended by the Spray Applied membrane waterproofing Manufacturer.

#### Storage

The Contractor shall provide for the proper storage of premix, fibers and additives as required by the Manufacturer's specifications in order to protect materials against loss of physical and mechanical properties.

**METHOD OF MEASUREMENT:** This item will not be measured for payment.

**BASIS OF PAYMENT:** No separate payment will be made for this item. Costs for this item shall be included in the lump sum bid prices of the appropriate items as listed in the Proposal.

