



Iowa Department of Transportation

SPECIAL PROVISIONS FOR ULTRA HIGH PERFORMANCE CONCRETE

Pottawattamie County
BRF-092-1(64)--38-78

Effective Date
December 16, 2014

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

120245a.01 DESCRIPTION.

- A. Furnish all materials, tools, and labor necessary for the performance of all work to form, prepare bonding surfaces, cast, finish, and cure Ultra High Performance Concrete (UHPC) where required per plan for Ultra High Performance Concrete Joints. Prior to casting UHPC for actual superstructure module joints, the Contractor shall construct a Demonstration UHPC Joint to demonstrate their ability to properly cast the UHPC in accordance with the design plans and these Special Provisions.

All UHPC shall be produced using DUCTAL concrete materials manufactured by Lafarge North America.

B. Submittals.

Provide submittals to the Office of Bridges and Structures in electronic format, in accordance with Article 1105.03, F of the Standard Specifications.

The submittals requiring written approval from the Engineer are as follows:

1. UHPC Placement Plan.

- a. Submit the UHPC Placement Plan for approval 28 days before placement of UHPC for longitudinal superstructure module connections.
- b. The UHPC Placement Plan shall include, but not necessarily be limited to, the following:
 - Proof of prequalification for placement of DUCTAL by Lafarge North America.
 - Proposed method(s) of joint surface preparation to achieve the required concrete surface profile texture, as required in the design plans.
 - Proposed forming method(s).
 - Proposed batching sequence. The batching sequence shall include the order and time of introduction of the materials and the mixing time.
 - Proposed sequence and schedule for UHPC placement operations.
 - Details of all equipment to be used to batch and place UHPC materials, including mixers, pumps, concrete buggies, etc.

- Curing procedures, including minimum cure time and minimum strength requirements prior to loading.
- Testing procedures.
- Quality control / quality assurance procedures for verification of mix uniformity.
- Proposed schedule for Watertight Integrity Testing of completed UHPC joint. Contractor shall propose schedule and duration of traffic control required for completion of this work, subject to review and approval by the District.

2. UHPC Mix Design.

Submit UHPC mix design to the Office of Bridges and Structures and the District Materials Engineer 28 days prior to first placement of UHPC.

120245a.02 MATERIALS.

A. DUCTAL JS 1000 Concrete.

1. Use the concrete mixture supplied by Lafarge North America with the following proportions of mix parameters based on the supplier's recommendations:

Premix	3700 lbs / cu. yd.
Water	219 lbs / cu. yd.
Super Plasticizer Liquid	51 lbs / cu. yd.
Steel Fiber	263 lbs / cu. yd.

2. **Qualification Testing.**

Complete qualification testing of the UHPC 2 months before placement of the joint. The minimum concrete compressive strength shall be 10 KSI at 96 hours and 15 KSI for opening the bridge to traffic. 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. Testing shall be performed by an approved testing lab.

3. **Material supplier for DUCTAL concrete.**

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B. Water.

Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

C. Admixtures.

Chryso Premia 150 (30% solid content).

D. Fiber Reinforcement.

Steel chord type Bekaert OL 13 / 0.2 inches or equivalent – high carbon fibers with a minimum tensile strength 300,000 psi.

120245a.03 CONSTRUCTION.

A. Quality Assurance.

1. The Contractor shall be prequalified by Lafarge North America to demonstrate the capability to mix and place DUCTAL concrete.
2. The surface of the UHPC field joints shall be filled flush or overfilled by up to 1/4 inch relative to the top of the prefabricated superstructure module deck. Other tolerances shall be in compliance with PCI MNL – 116 or as otherwise specified in the design plans.

B. Demonstration UHPC Joint.

Construction of a Demonstration UHPC Joint, herein referred to as a “joint mockup”, shall be required in accordance with the design plans, these Special Provisions, and as recommended by the UHPC Manufacturer. The prepared joint surfaces must be reviewed and approved by the Engineer prior to placement of UHPC within the joint mockup. Following placement and sufficient curing of the UHPC, the mockup shall be cut transversely at two locations determined by the Engineer, to allow for visual inspection by the Engineer of the joint interface and material bond. The completed joint mockup cut sections shall be available for review and approval by the Engineer 28 days prior to placement of UHPC for the superstructure modules. The joint mockup shall remain the property of the Contractor after acceptance and shall be removed from the project site prior to completion of construction activities.

C. Pre-Pour Meeting.

Prior to the initial placement of DUCTAL, arrange for an onsite meeting with the Lafarge North America representative and District Materials Engineer. The Contractor's staff 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. Arrange for a representative of Lafarge North America to be on site during the placement all UHPC, inclusive of the joint mockup and all longitudinal superstructure module connections. The Lafarge North America representative shall be knowledgeable in the supply, mixing, delivery, placement, and curing of the DUCTAL material.

D. Storage.

Assure the proper storage of DUCTAL premix including powder, fibers and additives, obtained from Lafarge North America, as required by the Lafarge North America specifications in order to protect materials against loss of physical and mechanical properties.

E. Forming, Batching, Placement, And Curing.

Work together with Lafarge North America to ensure appropriate initial strength gains to meet the desired project schedule. An initial strength of 10 KSI can be achieved by adding accelerators and by maintaining the ambient temperature above 60°F for 48 hours after placement.

Grinding of the UHPC surface can be performed when strength of 10 KSI has been achieved, unless otherwise recommended by Lafarge North America. If significant fiber pullout is observed during grinding operations, grinding shall be suspended and shall not resume until written approval is obtained from the Engineer.

The bridge can be opened to traffic when strength of 15 KSI has been achieved, unless otherwise recommended by Lafarge North America.

Construction loads applied to the bridge during UHPC placement and curing are the responsibility of the Contractor. Submit the weight and placement of concrete buggies, grinding equipment or other significant construction loads to the Engineer for review prior to the pre-pour meeting described above.

Forming, batching, placing, and curing shall be in accordance with the procedures recommended by Lafarge North America and as submitted and accepted by the Office of Bridges and Structures and District Materials Engineer.

The design and fabrication of forms shall follow approved installation drawings and shall follow the recommendations of Lafarge North America. All the forms for UHPC shall be constructed from plywood.

Follow the batching sequence as specified by the UHPC Manufacturer and as approved by the Office of Bridges and Structures and District Materials Engineer.

Each UHPC joint shall be cast using one continuous placement. No cold joints shall be permitted between any individual length of UHPC joint.

The concrete in the form shall be cured according to manufacturer's recommendations at minimum temperature of 60°F to attain the design strength.

F. Material Testing.

The following tests shall be performed following casting of the mockup and for each day of UHPC placement:

1. Concrete compressive strength test according to ASTM C 39. Use twelve specimens 3 inch diameter by 6 inches. Prior to grinding UHPC, three specimens shall be tested to validate achievement of 10 KSI compressive strength. Three specimens shall be tested to validate achievement of 15 KSI compressive strength prior to opening the bridge to traffic. Three specimens shall be tested at 28 days to verify final strength. The remaining three specimens shall be treated as reserves.

All specimens shall be tested at Lafarge North America or by an approved testing lab. Each specimen shall have ends ground to 1 degree planeness.

If Lafarge North America is selected to perform the testing, the samples shall be sent to their facilities as directed by Lafarge North America representatives.

2. Determination of flow according to ASTM C 109 performed on a flow table constructed according to ASTM C 230. The measured diameter of the concrete after 20 table drops shall be within the following limits: minimum 7 inches; maximum 10 inches. The test shall be performed on every concrete batch.

Note: All specimens shall be cast of material representative of the UHPC placed for the joint mockup or longitudinal superstructure module connection, as applicable. The Contractor shall be responsible for shipping of test specimens to Lafarge North America or an approved testing laboratory. The Contractor shall be responsible for providing an approved flow table for on-site flow testing. Results of all tests shall be sent to the Engineer for review and approval.

G. Watertight Integrity Testing.

Following attainment of 28-day strength, perform watertight integrity testing of one longitudinal UHPC joint per bridge span. Location of the longitudinal joints to be tested shall be determined by the Engineer. Watertight integrity testing may be completed under temporary traffic control after completion of the critical closure construction activities. Schedule and duration of the traffic control shall be coordinated with the District.

The procedure for Watertight Integrity Testing shall be as follows:

- Test the designated UHPC joints by blocking out and covering the joint with ponded or flowing water to a depth of at least 1 inch, for at least 30 minutes. The Contractor may conduct a single test of the entire joint or may conduct separate tests of overlapping lengths of the joint.
- At the conclusion of the test, the Inspector will examine the underside of the joint for leakage. The Contractor shall be responsible for providing the Inspector with safe access to the

underside of the deck. The joint shall be considered watertight if no dripping water or water droplets are visible at the underdeck areas along the full length of joint.

- If leaking joints are identified, the Contractor may be required to perform additional watertight integrity testing, at locations to be determined by the Engineer, at no additional cost to the Contract Authority.
- The Contracting Authority may require leaking UHPC joints to be repaired by means approved by the Engineer. Repair of leaking UHPC joints will be addressed on a case-by-case basis and will be negotiated as additional work.

H. Material Supplier and Cylinder Testing Contact.

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120245a.04 METHOD OF MEASUREMENT.

A. Ultra High Performance Concrete Joint.

Measurement will be by length of UHPC joints placed for longitudinal superstructure module connections. The length of in-place UHPC shall be measured to the nearest linear foot.

B. Demonstration UHPC Joint.

Measurement for the Demonstration UHPC Joint will be lump sum plan quantity.

120245a.05 BASIS OF PAYMENT.

A. Ultra High Performance Concrete Joint.

Payment shall be based on field measurement of linear feet placed at the contract price for Ultra High Performance Concrete Joint and shall be full compensation for all labor, equipment, forms, material and testing to complete the work for Ultra High Performance Concrete Joints, as described in the plans and these Special Provisions.

B. Demonstration UHPC Joint.

Payment shall be based on lump sum plan quantity at the contract price for Demonstration UHPC Joint and shall be full compensation for all labor, equipment, forms, material and testing to complete the work for Demonstration UHPC Joint, as described in the plans and these Special Provisions.