



Iowa Department of Transportation

SPECIAL PROVISIONS FOR ULTRA HIGH PERFORMANCE CONCRETE

Pottawattamie County
BRF-006-1(114)--38-78

Effective Date
February 15, 2011

THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

090112a.01 DESCRIPTION.

- A. The Contractor shall furnish all materials, tools, and labor necessary for the performance of all work to form, cast, finish, and cure Ultra High Performance Concrete (UHPC) where required per plan. Before casting UHPC for actual construction, the contractor will cast mockups to demonstrate the ability to properly cast the UHPC for transverse, longitudinal, vertical and barrier closure pours.

All UHPC shall be produced using "DUCTAL" concrete materials manufactured by Lafarge North America. See plan sheets for UHPC placement locations.

B. Submittals.

The contractor shall submit his batching sequence, forming, placing, curing, and testing procedures to the District Materials Engineer for review 14 days prior to casting. The mixing sequence shall include the order and time of introduction of the materials, mixing time and QA/QC procedure for the verification of the mix uniformity.

090112a.02 MATERIALS.

A. DUCTAL CS JS 1000 Concrete.

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

Premix	3698 3700 lbs / cu. yd.
Water	248 219 lbs / cu. yd.
Super Plasticizer Liquid	51 lbs / cu. yd.
Steel Fiber	263 lbs / cu. yd.

Qualification Testing: The contractor shall complete the qualification testing of the UHPC two months before placement of the joint. The minimum concrete compressive strength shall be 10

KSI at 48 96 hours and 24 15 KSI at 28 days for opening the bridge to traffic. ~~The minimum flexural strength at 28 days shall be 5 KSI.~~ The compressive strength shall be measured by ASTM C39. ~~Concrete flexural strength shall be according to ASTM C 78.~~ Only a concrete mix design that passes these tests may be used to form the joint. ~~The contractor shall submit a Time versus Strength curve for the first four days of the UHPC.~~ Testing to be performed by an approved testing lab.

Material supplier for DUCTAL concrete:

Lafarge North America
#1200, 10655 Southport RD SW
Calgary, Alberta T2W 4Y1
Phone (403) 225-5456
Fax (403) 278-7420

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 ~~360,000 psi (2,500 MPa)~~ 300,000 psi (2,100 MPa).

090112a.03 CONSTRUCTION.

A. Quality Assurance.

1. The contractor shall be pre-qualified by Lafarge North America that they have the capability to mix and place DUCTAL concrete. Proof of pre-qualification shall be submitted in writing from the contractor to the District Materials Engineer 14 days before any UHPC is cast.
2. The surface of the UHPC field joints shall be filled flush with the precast deck to within a tolerance of plus or minus 1/8 inch. Other tolerances shall be in compliance with PCI MNL – 116 or otherwise specified on plans.

B. Pre-Pour Meeting.

Prior to the initial placement of the DUCTAL, the contractor shall arrange for an onsite meeting with the Lafarge 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. The contractor shall arrange for a representative of Lafarge to be on site during the placement of the UHPC. The Lafarge representative shall be knowledgeable in the supply, mixing, delivery, placement, and curing of the DUCTAL material. Mockup requirements will be performed per the recommendations of the Lafarge representative.

C. Storage.

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

D. Forming, Batching, Placement, And Curing.

The contractor shall work together with Lafarge 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. If significant fiber pullout is observed during grinding operations, grinding shall be suspended and not resumed until approved by the Engineer.

The bridge can be opened to traffic when strength of 15 KSI has been achieved.

Construction loads applied to the bridge during UHPC placement and curing are the responsibility of the Contractor. Contractor shall 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 and as submitted and accepted by the District Materials Engineer.

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

Mockups of each UHPC pour shall be performed prior to actual UHPC construction and conducted per the requirements of this special provision and the recommendation of the Lafarge representative. Mockups of horizontal closure pours shall be four feet in length with all other dimensions to match those required by the plans. Mockups of vertical closure pours shall be two feet in length with all other dimensions to match those required by the plans. The mockup process shall be observed by the Lafarge representative.

Two portable batching units will be supplied by Lafarge to the contractor for mixing of the UHPC. The contractor shall follow the batching sequence as specified by Lafarge and approved by the District Materials Engineer.

Each UHPC placement shall be cast using one continuous pour. No cold joints are permitted.

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

E. 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 contractor grinding UHPC, three specimens shall be tested to validate the achievement of 10 KSI compressive strength at 48 hours by an approved testing lab. Three specimens shall be tested to validate the achievement of 15 KSI compressive strength prior to opening the bridge to traffic. Three final specimens shall be tested at 28 days to verify final strength. Three specimens with ends ground to 1 degree planeness shall be tested at Lafarge North America and by an approved testing lab at 28 days. 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.

Testing by Lafarge shall be sent to their facilities as directed by Lafarge representatives.

~~2. Concrete flexural strength according to ASTM C 78. Use six specimens 1.6 inches by 1.6 inches by 6.3 inches. Three specimens shall be tested by an approved testing lab after 48 hours. Three specimens shall be tested by an approved testing lab at 28 days.~~

3.2. 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 ~~8.5~~ 10 inches. The test shall be performed on every concrete batch.

~~4. Determination of the air content according to ASTM C 231 on the first concrete batch. The air content shall be limited to a maximum of 5%. Air content shall be verified before any concrete is placed.~~

Note: All specimens shall be exposed to the same process as the mockup and each UHPC placement and shipped to Lafarge North America and an approved testing lab accordingly for testing. A flow table may be obtained from Lafarge North America to conduct testing.

F. Contacts.

Material Supplier and Cylinder Testing:

Vic Perry
Lafarge-North America
#1200, 10655 Southport Road, SW
Calgary, Alberta T2W 4Y1
403-292-9423
vic.perry@lafarge-na.com

090112a.04 METHOD OF MEASUREMENT.

The concrete quantities shown on the plan, measured by the cubic yard, are for contractor's information only.

090112a.05 BASIS OF PAYMENT.

This item and all incidental items required to provide this item per contract documents including labor, materials, equipment and testing is subsidiary to other items and will not be paid for separately.