SPECIAL PROVISIONS
FOR
ULTRA HIGH PERFORMANCE CONCRETE OVERLAY

Kossuth County
BRFN-018-3(100)--39-55

Effective Date
July 18, 2017

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

150291.01 DESCRIPTION.

This specification consists of supplying, mixing, transporting, placing, finishing, curing, and diamond grinding of Ultra High Performance Concrete (UHPC) for use as an overlay and riding surface in accordance with the Contract Documents and as directed by the Engineer. UHPC is a cementitious composite material composed of an optimized gradation of granular constituents, a water-to-cementitious materials ratio less than 0.25 and a high percentage of discontinuous internal steel fiber reinforcement.

150291.02 MATERIALS.

A. Provide materials as follows. All materials in items (a) & (b) below must be premixed and proportioned in bags or supersacks, and come from the same batch or lot.

1. Fine Aggregate - Crushed Quartz with 100 % passing the No. 30 sieve and a maximum of 3% passing the No. 200 sieve.

2. Cementitious Material - Section 4101 of the Standard Specifications - Portland Cement and/or Blended Hydraulic Cements.

3. Steel Fibers - ASTM A 820, Type 1, cold drawn high-carbon steel with a minimum tensile strength of 300 ksi, length of 12 to 13mm, and diameter of 0.220 to 0.225mm. Minimum steel fiber content will be 3.25% of the mix's dry volume.

4. Water - Water for Mixing Portland Cement per Standard Specifications and as specified by the manufacturer for use in the UHPC mix.

5. Admixtures - Only as specified by the manufacturer.

B. The UHPC mixture shall meet the material properties listed in Table 1: UHPC Material Properties after 28 days, unless otherwise noted in the contract documents or as directed by the Engineer. Material properties listed below will be verified by the manufacturer and submitted for approval in the Placement Plan.

Table 1: UHPC Material Properties after 28 days		
Description	**Test Method**	**Acceptance Criteria**
Compressive Strength *Ends of cylinders must be ground flush prior to testing. Saw cutting, capping, and use of neoprene pads are not permitted.*	AASHTO T22 (3"x6" cylinders and *2"x2" Cubes) (150 psi/sec loading rate)	≥14 ksi at 28 days
Long-Term Shrinkage	AASHTO T160 (64 weeks)	≤ 800 micro-strain
Chloride Ion Penetrability	AASHTO T 259 (1/2" depth)	< 0.1183 lbs/yd^3
Scaling Resistance	ASTM C672	Y < 3
Freeze-Thaw Resistance	AASHTO T 161 / ASTM C666A (300 cycles)	Relative Dynamic Modulus of Elasticity > 95%
Alkali-Silica Reaction	ASTM C1260	Innocuous

*Note: The contractor shall also cast 2 inch by 2 inch cubes for 28 day acceptance testing by the Office of Construction and Materials, Ames, Iowa.

150291.03 CONSTRUCTION.

A. Storage.
Assure proper storage of all materials including but not limited to cement, aggregate, steel fibers and additives, as required by the supplier's recommendation in order to protect the integrity of the materials against the loss of physical and mechanical properties.

B. Placement Plan.

1. Submit a Placement Plan with a detailed construction work schedule to the Engineer for review and approval at least 30 days prior to the scheduled UHPC placement pour. The following list is intended as a guide and may not address all of the means and methods the contractor may elect to use. The Contractor is expected to assemble a comprehensive list of all necessary items for executing the placement of UHPC.
- Responsible personnel and hierarchy.
- Equipment – including but not limited to mixers, holding tanks, generators, wheelbarrows, scales, meters, thermometers, floats, screeds, burlap, plastic, heaters, blankets, etc.
- Quality Control of batch proportions - including dry ingredients, steel fibers, water and admixtures.
- Quality Control of mixing time and batch times.
- Batch procedure sequence.
- Form work – including materials and removal.
- Placement procedure – including but not limited to surface preparation of existing concrete surfaces and pre-wetting of the existing concrete interface to a saturated-surface-dry (SSD) condition before the placement of UHPC), spreading, finishing, and

curing protection. Include provisions for acceptable ambient conditions and batch temperatures and corrective measures as appropriate.
- Threshold limits for ambient temperature, ambient relative humidity, batch consistency, batch temperature, batch times and related corrective actions.

2. A preconstruction meeting will be held between the UHPC manufacturer's representative, the Contractor's staff, and representatives from Iowa DOT District Office, Office of Bridges and Structures, and Office of Construction and Materials to review the Contractor's Placement Plan prior to placement of UHPC materials. No UHPC pour will be permitted until the aforementioned Placement Plan has been submitted by the contractor and approved by the Engineer.

3. Pumping of UHPC is not allowed.

4. 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 for review as part of the proposed Placement Plan.

C. Forming, Mixing, Transporting, Placing and Curing.

1. Design and fabricate formwork if required to adhere to Standard Specifications and the recommendations of the UHPC manufacturer. Construct forms from nonabsorbent material that are properly sealed and capable of resisting the hydrostatic pressures from UHPC in the unhardened state. A curing compound will be applied to the UHPC overlay surface immediately after placement of the UHPC. Do not remove formwork until the UHPC overlay undergoes a minimum 3 day curing process and a compressive strength 11.00 ksi. minimum is achieved.

2. Forming, batching, placing, and curing will be in accordance with the UHPC manufacturer's recommendations and as submitted and accepted by the Engineer.

3. Representatives of the UHPC manufacturer knowledgeable in supplying, mixing, transporting, placing, finishing and curing of the UHPC material must be present during mixing, transporting and placing of the UHPC. The contractor will arrange for two manufacturer's representatives to be on site for the duration of the UHPC construction; one representative will remain with the mixing operations and the second representative will remain with the placement operations. Do not start mixing or placing UHPC until the manufacturer's representatives are on-site. Place UHPC in accordance with the approved Placement Plan using one continuous pour per each stage of construction. The use of bulkheads will not be permitted. Keep UHPC from freezing until it has achieved a minimum compressive strength of 11.0 ksi minimum.

4. Provide a minimum of three portable batching units for mixing of the UHPC. Mixing equipment which is not supplied by the UHPC manufacturer, must be reviewed by the UHPC manufacturer for adequacy. During batching keep the temperature of the UHPC below 90°F; ice may be added to the mix as recommended by the UHPC manufacturer's representative.

5. The Contractor will arrange for an on-site meeting with the UHPC manufacturer's representative one day before the start of the actual UHPC placement. The Contractor's staff and representatives from Iowa DOT District Office, Office of Bridges and Structures, and Office of Construction and Materials, will attend the meeting. The objective of the meeting will be to clearly outline the procedures for mixing, transporting, finishing and curing of the UHPC.

D. Acceptance Testing.

1. The Office of Construction and Materials will be on site during the placement of UHPC. To schedule a representative, contact the Office of Construction and Materials a minimum of 48 hours prior to the anticipated UHPC placement. Final acceptance will be based upon 28 day strength. Field coring of UHPC for dispute resolution will not be allowed.

2. The Contractor is responsible for providing an adequate location to place acceptance specimens for initial curing prior to transport to the lab. Curing boxes will be equipped with supplemental heat or cooling as necessary to cure specimens in accordance with ASTM C31. Testing shall be performed by the Contractor and approved by the Engineer. Testing is summarized in Table 2: UHPC Acceptance Testing. Performance frequencies of each test listed in Table 2, are a minimum value. Tests may be performed at more frequent intervals then described in Table 2, at the discretion of the Engineer.

Table 2: UHPC Acceptance Testing

Description	Test Method	Acceptance Criteria	Frequency
Compressive Strength	AASHTO T 22	≥ 14 ksi (at 28 days) (3"x6" cylinders) (150 psi/sec loading rate)	12 tests in 1st day at intervals specified by engineer, 2-day, 3-day, 4-day, 8-day, 14-day, & 28-day
Rapid Chloride Ion Penetrability	AASHTO T 277 / ASTM C 1202	≤ 350 coulombs (4"x8" cylinders)	2 per job (During field placement)
Slump Flow and Visual Stability	ASTM C1437 / ASTM C 1611	7 inches (Min.) 10 inches (Max.) No bleed water Consistent fiber distribution	1 per batch

E. Surface Profile and Finish.

1. The finished surface of the UHPC overlay will match the proposed roadway profile to within a tolerance specified in Article 2413.03, E of the Standard Specifications. After curing, the entire UHPC overlay will be grooved in accordance with Article 2413.03, E of the Standard Specifications. The extent of the required diamond grinding will be described in the contract documents or as directed by the Engineer. Grinding and Grooving of the UHPC surface can be performed after the UHPC overlay undergoes a minimum 3 day curing process and a minimum compressive strength of 11.0 ksi. is achieved.

2. Traffic or other loading will not be permitted directly on the UHPC overlay until the UHPC undergoes the aforementioned curing process and achieves a minimum compressive strength of 11.0 ksi, unless otherwise approved by the Engineer.

150291.04 METHOD OF MEASUREMENT.

The quantity of Ultra High Performance Concrete will be measured as the number of square yards of UHPC placed and accepted. The volume will be computed using the dimensions shown on the plans. The quantity of grinding will not be measured.

150291.05 BASIS OF PAYMENT.

A. The quantity of UHPC overlay will be paid at the Contract unit price per square yards. Price and payment will constitute full compensation for surface preparation, supplying, mixing, transporting,

placing, finishing, curing, grinding, grooving, and for furnishing all equipment, tools, labor, and incidentals required to complete the work.

B. Additional quantity of material used in the determination of material properties and for acceptance testing as described herein will be furnished at no additional cost to the Contracting Authority. No additional payment will be made for surface preparation or for grinding procedures.

C. If the UHPC does not meet the minimal material properties as described herein, the UHPC will be removed and replaced or remediated to the satisfaction of the Engineer at the Contractor's expense. No additional payment will be made for remedial solutions to insufficient bonding between the UHPC and underlying bridge elements.