SPECIAL PROVISIONS
FOR
HIGH-EARLY STRENGTH CONCRETE

Webster County
MB-926-1(506)1--77-94

Effective Date
July 19, 2022

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.

150865.01 DESCRIPTION.

This work consists of using high-early strength concrete (HESC) for the field repair of deteriorated pretensioned prestressed concrete beam (PPCB) ends. HESC is a self-consolidating cementitious material composed of granular constituents and a water-to-binder (*w/b*) ratio of 0.3. The HESC mixture described in this special provision shall be used at locations specified on the project plans. All work shall be in accordance with the Standard Specifications, except as modified herein.

150865.02 MATERIALS.

A. Mixture Ingredients.
Provide materials in accordance with Division 41 of the Standard Specifications and as follows.

1. **Coarse Aggregate:** Use only those allowed in Section 4115 of the Standard Specifications with a Class 2 Durability at minimum.

2. **Fine Aggregate:** Use only those allowed in Section 4110 of the Standard Specifications.

3. **Type III Portland Cement**: It shall be in accordance with Section 4101 of the Standard Specifications.

4. **Class C Fly Ash:** It shall be in accordance with Section 4108 of the Standard Specifications.

5. **Accelerating Admixture**: It shall be in accordance with Section 4103 of the Standard Specifications and Materials I.M. 403.

6. **High-Range Water Reducer (HRWR):** It shall be in accordance with Section 4103 of the Standard Specifications and Materials I.M. 403. The HRWR content shall be determined based on the trial batch to reach the desired slump flow.

7. **Water**: It shall be in accordance with Section 4102 of the Standard Specifications.

B. Submittals.

Submit the following to the Engineer for review and approval, at least 15 calendar days before trial mixing and field casting can take place:

- Material certifications and ingredient specifications from their manufacturers.
- A Quality Control plan that shall include, but is not limited to, the following: (1) Mixing protocol; (2) Casting procedure; (3) Sampling and testing procedure; (4) Curing procedure; and (5) Finishing procedure after field placement.

C. Mix Design.

1. The mix shall meet desired placement, finishing, and curing characteristics. A trial batch and test placement will be conducted to ensure these qualities are met prior to field work.

2. Mix the HESC mixture based on the material proportions below and meet the requirements of this special provision. Do not place concrete prior to approval by the Engineer.
   - **Coarse Aggregate:** 1591 pounds per cubic yard with a maximum aggregate size of 3/8 inch.
   - **Fine Aggregate**: 1543 pounds per cubic yard.
   - **Cement:** 640 pounds per cubic yard of Type III Portland cement.
   - **Fly Ash**: 160 pounds per cubic yard of Class C fly ash.
   - **Non-Chloride Accelerator:** 12.9 pounds per cubic yard, or as specified by the manufacturer with the approval of the Engineer.
   - **High-Range Water Reducer (HRWR):** As specified by the manufacturer with the approval of the Engineer to achieve adequate workability. 14.5 pounds per cubic yard can be used as a starting point.
   - **Water:** 279.5 pounds per cubic yard.

150865.03 CONSTRUCTION.

A. Storage.

Assure the proper storage of all constituent materials, including but not limited to cement, aggregates, and additives, as required by the specifications provided by their suppliers/manufacturers in order to protect the integrity of the materials against the loss of physical, chemical, and mechanical properties.

B. Placement Plan and Pre-Pour Meeting.

1. Submit a Placement Plan (with a detailed field work schedule) to the Engineer for review and approval at least 15 calendar days prior to the scheduled HESC placement pour. The following list is intended as a guide and may not address all 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 HESC.
   - 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, water, and admixtures.
   - Quality Control of mixing.
   - Batch procedure sequence.
   - Formwork – including materials and removal.
   - Placement procedure – including but not limited to the preparation of existing concrete surfaces (in terms of roughness and wetness) before HESC placement, in addition to spreading, finishing, and curing details.

- Threshold limits for ambient temperature, ambient relative humidity, batch consistency, batch temperature, batch times, and related corrective actions as appropriate.

2. Arrange for an onsite meeting with the Engineer and the Research Personnel at least 7 calendar days prior to the HESC placement. The objective of the meeting will be to outline the procedures for mixing, transporting, finishing, and curing of the HESC.

C. Trial Batch and Test Placement.

1. Produce a trial batch and perform a test placement. Provide the Engineer and the Research Personnel notice and mix proportions at least 7 calendar days prior to this event. The trial placement will be witnessed by the Engineer.

2. Mix the trial batch at least 15 calendar days prior to the planned field placement. The trial batch shall be of sufficient quantity to complete the test placement. Produce the trial batch under the same ambient conditions (e.g. time of day, weather, etc.) as anticipated during the field work. Include documentation of ambient conditions at the time of trial batch and anticipated ambient conditions at the time of trial placement in the submittal to the Engineer.

3. For mockup test placement, prepare a full-scale trial batch mix and place in a full-scale mockup as shown in the project plans. Use at least the minimum mix capacity of the mixing equipment for the trial batch, including quantities for sampling and testing. Use the same equipment and the same forming, casting, and curing procedures that will be used during the field work for the trial placement.

4. Test the trial batch for workability according to ASTM C1611 and chloride transport properties according to ASTM C1202. Perform the compressive strength test on a set of 4 by 8 inch cylinders after 12 hours, 1 day, 14 days, and 28 days, in accordance with ASTM C39. Each set shall contain at least three samples and all test sets shall be cured similar to that of the trial batch.

5. Submit the results of density (unit weight), slump flow, rapid chloride ion penetrability, 12 hour compressive strength, 1 day compressive strength, 14 day compressive strength, and 28 day compressive strength to the Engineer for review and approval a minimum of 10 calendar days prior to the use of the HESC in the field. To be considered a successful test placement, there shall be no segregation of the HESC and no visible voids when the forms are removed.

D. Formwork, Casting, and Curing.

1. Forms shall be watertight and coated to prevent the absorption of water and leakage of the mix after placement. The formwork shall be resistant to the hydraulic pressure of the HESC mix.

2. For casting, do not place HESC at ambient air temperatures below 40°F, nor above 90°F.

3. Forms shall remain in place for 7 calendar days for curing. In addition, cover exposed surfaces with plastic within 10 minutes after final finishing. The moist curing period will be 7 days. This period can be reduced to 4 days if it can be proved that, due to early-age reactions, the target 28 day properties will be achieved.

4. In addition to Article 1105.11, D of the Standard Specifications, limit any loads or vibrations on the spans where the HESC has been placed until the mix has completed its initial set.

E. Acceptance Testing.

1. The Engineer and the Research Personnel will be on site during the placement of HESC. Coordination with the Engineer and the Research Personnel shall be made a minimum of 48 hours prior to the anticipated HESC placement.

2. Provide an appropriate location to place acceptance specimens for initial curing prior to transport to the laboratory. Curing boxes should be equipped with supplemental heat or cooling as necessary to cure the specimens in accordance with ASTM C31.

3. Testing shall be performed by the Contractor and approved by the Engineer. The required testing is summarized in the following table. The table contains the test methods, minimum acceptance criteria, and expected frequencies. Tests may be performed at a more frequent intervals than described below, at the discretion of the Engineer.

Description	Test Method	Acceptance Criteria	Frequency
Slump Flow	ASTM C1611	22 inches (Minimum) 28 inches (Maximum); Visual stability index of 0 or 1	One per batch
Compressive Strength*	ASTM C39 (4×8 inch cylinders)	≥ 3000 psi (at 12 hours) ≥ 3500 psi (at 1 day) ≥ 5000 psi (at 14 days) ≥ 6000 psi (at 28 days) (150 psi/sec loading rate)	12 hour, 1 day, 14 day**, and 28 day
Rapid Chloride Ion Penetrability*	ASTM C1202 (4×8 inch cylinders)	≤ 1000 coulombs	28-day (two per job)

* Each set shall contain at least three samples and all test sets shall be cured similar to that of the field work.

** 14 day compressive test shall be used for acceptance.

150865.04 METHOD OF MEASUREMENT.

A. Measurement of Beam End Repair High Early Strength Concrete (HESC) will be plan-measured quantity per cubic foot.

B. The quantity for HESC Trial Batch per each includes one trial batch. The Engineer may authorize up to two additional combined trial batches, to be measured and paid per each.

C. The quantity for HESC Test Placement per each includes one test placement. The Engineer may authorize up to two additional combined test placements, to be measured and paid per each.

150865.05 BASIS OF PAYMENT.

A. Payment will be for the contract unit price of Beam End Repair High Early Strength Concrete (HESC) per cubic foot. Payment is full compensation for furnishing all submittal, materials, labor, testing, results, formwork and incidental work for completion of the beam end repair as indicated in this special provision and the contract documents.

B. Payment will be for the contract unit price for HESC Trial Batch per each trial batch. Payment is full compensation for furnishing all submittal, materials, labor, testing, results, and incidental work for completion of the trial mix as indicated in this special provision and the contract documents.

C. Payment will be for the contract unit price for HESC Test Placement per each test placement. Payment is full compensation for furnishing all submittal, materials, forms, labor, and incidental work for completion of the trial placement as indicated in this special provision and the contract documents.