



**SPECIAL PROVISIONS
FOR
FIBER REINFORCED HIGH PERFORMANCE STRUCTURAL CONCRETE**

**Story County
NHSX-030-5(277)--3H-85**

**Effective Date
January 18, 2023**

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.

150940.01 DESCRIPTION.

- A.** High performance structural concrete for bridge decks and other components as called for in the contract documents shall include fiber reinforcement as specified herein.
- B.** Use a combination of micro and macro non-metallic synthetic fibers to provide crack control and improve the long-term performance of bridge decks and other components. Incorporate the fibers into the mix design in accordance with this Special Provision and the applicable requirements of the Developmental Specifications for High Performance Concrete for Structures.

150940.02 MATERIALS.

- A.** Supply a fiber blend of high-performance macro-monofilaments with sinusoidal deformations and collated-fibrillated polypropylene. The stated manufacturer purpose of the synthetic fibers is for controlling plastic shrinkage cracks in concrete (micro fibers) and to provide increased residual flexural strength in the concrete (macro fibers). Supply Type III fibers in accordance with ASTM C1116.

B. Polypropylene Micro Fibers.

Provide synthetic fibers that meet the following:

- Absorption – Nil;
- Specific Gravity - 0.91;
- Fiber Length – Multi-Design Gradation;
- Electrical Conductivity – Low;
- Tensile Strength – 70 ksi minimum; and
- Melt Point – 320°F minimum.

C. Polypropylene Macro Fibers.

Provide synthetic fibers that meet the following:

- Absorption – Nil;
- Specific Gravity - 0.91;
- Nominal Filament Diameter - 0.033 inches;
- Fiber Length – 1.8 inches minimum;
- Electrical Conductivity – Low;
- Tensile Strength – 85 ksi minimum; and
- Melt Point – 320°F minimum.

D. Acceptance.

1. Based on previous history, the following manufacturers and dosage rates are preapproved for use:
 - a. Sika Novomesh 950 at a dosage rate of 5 pounds per cubic yard;
 - b. Master Builder Solutions MasterFiber MAC Matrix at a dosage rate of 4 pounds per cubic yard with Master Builder Solutions MasterFiber M100 at a dosage rate of 0.5 pounds per cubic yard; or
 - c. Forta-Ferro at a dosage rate of 5 pounds per cubic yard.
2. Alternate blended polypropylene fiber products that conform to the listed requirements at a minimum dosage rate of 5 pounds per cubic yard may be submitted for approval by the Engineer. In all cases a trial placement will be required to demonstrate slump, air loss, and workability. The trial placement should be made in weather conditions similar to the weather conditions expected on the day of the deck placement.

E. Dosage, Documentation and Testing.

1. Supply a written statement from the manufacturer of the fibers verifying the compatibility of the combination of materials and the sequence in which they are combined, to the Engineer prior to using it in this project.
2. Assure fibrous concrete conforms to ASTM C1116, "Standard Specification for Fiber-Reinforced Concrete". Furnish fiber manufacturer's documentary evidence of satisfactory performance history and compliance with ASTM C1116 Type III. Submit proposed fiber dosage rate to the Engineer for approval.

F. Mix Design.

Meet the applicable requirements of the Developmental Specifications for High Performance Concrete for Structures.

150940.03 CONSTRUCTION.

A. Application Requirements.

1. Identify dedicated personnel involved in introduction of fibers during mixing to the Engineer. Do not toss a fiber reinforcement bag into the mixer. Add synthetic fiber reinforcement into concrete mixer using one of the following methods:
 - a. Open bag and distribute fibers on aggregate belt at ready-mix concrete plant.
 - b. Open bag and break apart any fiber clumps and introduce fibers into ready-mix concrete truck in a well-distributed manner.
2. Mix synthetic fiber reinforcement in concrete mixer in accordance with mixing time and speed of ASTM C94, "Standard Specification for Ready-Mixed Concrete" to ensure uniform distribution and random orientation of fibers throughout concrete.

3. Other methods to add fibers to the concrete mix may be submitted for approval by the Engineer following demonstration of the method by a successful trial placement. Ensure the manufacturer's technical representative is available by phone or in person to troubleshoot fiber inclusion into the mix during the trial placement and bridge deck placement.
4. The fiber reinforced concrete deck and other components shall be placed per Standard Specifications and Developmental Specifications for High Performance Concrete for Structures, as appropriate, and/or as modified in this Special Provision.
5. Have floats of various materials available for trial/use. Use floats that give the optimum finish to the fiber reinforced concrete at the time of placement.
6. Place two layers of prewetted burlap on floor immediately after finishing with a maximum time limit of 10 minutes after final finishing. Apply water to burlap covering for entire curing period by means of a continuous wet sprinkling system, or other approved method that is effective in keeping burlap continuously wet during moist curing period.
7. Do not use tined rakes.

B. Trial Batch and Test Placement.

1. In addition to a flexural strength test in accordance with Article 2403.03, N, 2 of the Standard Specifications, the Contractor is required to produce a test batch and test placement.
2. Allow District Materials Engineer ample opportunity to witness trial batching. Provide District Materials Engineer notice and mix proportions 7 calendar days prior to this event.
3. Mix trial batch (a minimum of 3 cubic yards in size) at least 7 calendar days prior to planned placement. Establish batching sequence of materials during trial batch.
4. Use concrete for testing purposes that is representative of the entire batch while having a slump within 1 inch of the maximum slump allowed, an intended in place air content of 6% \pm 1%, and a w/c ratio that will be typical deck placement. Perform the following tests for each trial batch:
 - Specific Gravity of Each Individual Aggregate Materials I.M. 307
 - Gradation of Each Individual Aggregate Materials I.M. 302
 - Unit Weight of Plastic Concrete Materials I.M. 340
 - Slump of Plastic Concrete Materials I.M. 317
 - Air Content of Plastic Concrete Materials I.M. 318
5. Mimic the anticipated delivery conditions by driving the mix truck over the road for the anticipated haul time.
6. The test batch shall be 8 inches in thickness and 100 square feet minimum in plan dimensions. Four layers of epoxy coated reinforcement in two mats shall be placed in a test batch with a similar bar size, spacing and minimum clearance as shown for the production deck in the contract plans. Place and consolidate using methods typical for the component being poured. Finish concrete by hand and evaluate mix workability and finishability for the intended application and method of placement. The test placement may be directly poured on grade. Contractor is required to demonstrate the proposed placement and finishing processes.

7. In the presence of the Engineer, demonstrate that the trial batch can be successfully finished before placing production concrete.

150940.04 METHOD OF MEASUREMENT.

- A. The quantity of Fiber Reinforced High Performance Structural Concrete will be the quantity shown in the contract documents.
- B. The quantity for Trial Batch and Test Placement includes one trial. Payment will be based on number of trials completed, with a maximum of three allowed if required.

150940.05 BASIS OF PAYMENT.

- A. The Contractor will be paid the contract unit price for bid item Fiber Reinforced High Performance Structural Concrete per cubic yard.
- B. The Contractor will be paid the contract unit price for each separate Trial Batch and Test Placement performed.