



**SPECIAL PROVISIONS
FOR
FIBER REINFORCED STRUCTURAL CONCRETE**

**Cass County
BRF-092-2(44)--38-15**

**Effective Date
September 20, 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.

150884.01 DESCRIPTION.

- A. Structural concrete for bridge decks and other components as called for in the contract documents shall include fiber reinforcement as specified herein.
- B. Incorporate a combination of micro and macro non-metallic synthetic fibers in the structural concrete mix, in accordance with these Special Provisions, to provide crack control and improve the long-term performance of bridge decks and other components. Apply Section 2412 of the Standard Specifications with the following modifications.

150884.02 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.
3. In all cases a trial batch and test placement will be required to demonstrate slump, air loss, and workability of the mix. The test placement should be made in weather conditions similar to the weather conditions expected on the day of production fiber reinforced concrete placement.

E. Dosage, Documentation and Testing.

1. Prior to trial batch of fiber reinforced concrete, supply to the Engineer a written statement from the manufacturer of the fibers verifying the specified fiber material properties are met, compatibility of the fibers with the other constituent materials in the concrete mix, and the sequence in which the materials are to be combined.
2. Assure fiber reinforced concrete conforms to ASTM C 1116, "Standard Specification for Fiber Reinforced Concrete". Furnish fiber manufacturer's documentary evidence of satisfactory performance history and compliance with ASTM C 1116 Type III. Submit proposed fiber dosage rate to the engineer for approval.

F. Mix Design.

Meet the requirements of Article 2412.02 of the Standard Specifications, with inclusion of fibers in accordance with these Special Provisions.

150884.03 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 C 94, "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 batch. Ensure the manufacturer's technical representative is available by phone or in person to troubleshoot fiber inclusion into the mix during trial and production batching.
4. The fiber reinforced concrete deck and other components shall be placed and finished per Standard Specifications, except as modified in these Special Provisions. Note that optimal tools and methods for achieving the specified finish for fiber reinforced concrete may differ from those conventionally used for non-fiber reinforced concrete.
5. When fiber reinforced concrete is used for the base course of two course bridge decks, the surface smoothing, finishing and texture requirements of Article 2301.03, H, of the Standard Specifications shall be modified as follows and shall replace the final finish and texture requirements of Article 2412.03, D, 4, of the Standard Specifications:
 - a. The base course of two course deck systems shall receive final texturing by means of hydrodemolition after completion of the wet cure period, as required by contract. Texturing requirements of Articles 2301.03, H, 2, and 2301.03, H, 3, are not required for the Fiber Reinforced Structural Concrete base course.
 - b. With approval from the Engineer and at the Contractor's option, a heavy broom finish, tining, or drag finish using artificial turf, coarse carpet, or burlap for roughening, as specified in Articles 2301.03, H, 2, and 2301.03, H, 3, are acceptable methods for providing interim texture to the base course to facilitate efficiency of the hydrodemolition process. Coordinate with the hydrodemolition contractor to select an appropriate interim texturing method, subject to approval by the Engineer, prior to concrete placement for the base course.

B. Deck Curing.

1. Wet curing of the deck is required for the first 14 days of curing. The base course deck shall attain a minimum age of 21 days prior to placement of the second course overlay. No milling or hydrodemolition operations shall be performed during the wet cure period.
2. Use burlap that is prewetted by fully saturating, stockpiling to drain, and covering with plastic to maintain wetness prior to placement. Place two layers of prewetted burlap on floor as soon as feasible, but no more than 10 minutes after final finishing of the Fiber Reinforced Structural Concrete base course. Apply water to burlap covering for the entire wet 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.
3. Leave forms in place for 14 days minimum of curing.
4. Do not place curing compound on floor.

C. Trial Batch and Test Placement.

1. Demonstrate the proposed batching, placement, and finishing processes with a trial batch and test placement.
2. Allow District Materials Engineer ample opportunity to witness trial batching and test placement. 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 of production fiber reinforced concrete. 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 of the production deck placement. Perform the following tests for each trial batch:
 - 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 placement shall be made with the material from the trial batch and 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 the test placement with a similar bar size, spacing and minimum clearance as shown for the production deck in the contract plans. Place, consolidate, and finish the test placement using methods representative, to the Engineer's satisfaction, of the methods planned for the production work. Evaluate mix workability and finishability for the intended application and method of placement. The test placement may be directly poured on grade.
7. In the presence of the Engineer, demonstrate that the test placement can be finished in accordance with contract requirements using the planned means and methods, before placing production concrete.

150884.04 METHOD OF MEASUREMENT.

- A. The quantity of Fiber Reinforced Structural Concrete (Bridge) will be the quantity shown in the contract documents.
- B. The quantity for Trial Batch and Test Placement will be measured each for the combined completion of one Trial Batch and one Test Placement. Plan quantity includes one combined trial batch and test placement. The Engineer may authorize up to two additional combined trial batch and test placements, to be measured and paid per each combined trial batch and test placement.

150884.05 BASIS OF PAYMENT.

- A. The Contractor will be paid the contract unit price for bid item Fiber Reinforced Structural Concrete (Bridge) per cubic yard. In addition to the provisions of Article 2412.05 of the Standard Specifications, payment shall include incorporation of fibers and providing interim texture to plastic bridge deck base course concrete.
- B. The Contractor will be paid the contract unit price for each combined Trial Batch and Test Placement performed, as required by contract or authorized by the Engineer.