SP-230133
(New)

SPECIAL PROVISIONS
FOR
FIBER REINFORCED HIGH PERFORMANCE STRUCTURAL CONCRETE

Benton County
BRFN-150-2(024)--39-06

Effective Date
January 17, 2024

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

230133.01 DESCRIPTION.

A. High performance concrete (HPC) for structures shall include fiber reinforcement as called for in the contract documents. Use approved products and proportions of synthetic micro and macro fiber, and incorporate into the high performance concrete mix in accordance with these Special Provisions. The purpose of the fiber reinforcement is to mitigate risk and effects of cracking and improve the durability of the concrete.

B. Apply the Developmental Specifications for High Performance Concrete for Structures, and Sections 2403, 2406, 2412, and Division 41 of the Standard Specifications, with the following modifications.

230133.02 MATERIALS.

A. Fiber.

1. General.
Fiber reinforcement shall consist of micro and macro fibers. Micro and macro fibers may be supplied as separate products to be proportioned and blended with the mix at the time of concrete production, or may be supplied as a pre-combined, pre-packaged blended fiber product.

2. Microfiber.
For microfiber supplied as a separate product:
- **a.** Use approved microsynthetic-fibrillated concrete fibers in accordance with Materials I.M. 491.27 Appendix A.
- **b.** Dose microfiber at a minimum rate of 1 pound per cubic yard of concrete.

3. **Macro Fiber.**
   For macro fiber supplied as a separate product:
   a. Use approved macrosynthetic concrete fibers in accordance with Materials I.M. 491.27 Appendix B.
   b. Dose macro fiber at a minimum rate of 4 pounds per cubic yard of concrete.

4. **Pre-Combined Micro / Macro Fiber Blend.**
   For microfiber and macro fiber supplied as a pre-combined, pre-packaged product:
   a. Use approved macrosynthetic blend concrete fibers in accordance with Materials I.M. 491.27 Appendix B.
   b. The blend ratio by weight of microfiber to macro fiber in the pre-combined product shall be 20% microfiber to 80% macro fiber, +/- 5%, unless otherwise approved in writing by the Engineer.
   c. When pre-combined micro / macro fiber blends are used, the entire dosage of fiber shall be made using a single blended product. Do not mix blended fiber products with other blended or non-blended fiber products.
   d. Dose pre-combined micro / macro fiber blend at a minimum rate of 5 pounds per cubic yard of concrete.

B. Concrete.

1. **General.**
   Select a mix which satisfies all applicable requirements and achieves appropriate workability upon incorporation of fibers at the required dosage rate.

2. **High Performance Structural Concrete.**
   a. Meet the requirements of the Developmental Specifications for High Performance Concrete for Structures.
   b. Place concrete with slump as specified in Article 2403.02, B, 2, a of the Standard Specifications. When mid-range water reducer is used, target slump may be increased to 5 inches, allowing a maximum of 6 inches as a tolerance. Commence testing for concrete slump within 0 to 4 minutes after the concrete is discharged.

C. Documentation and Acceptance of Fiber Reinforced Concrete.

1. Fiber reinforced concrete (FRC) shall comply with ASTM C1116, Type III. Furnish documentary evidence by the fiber manufacturer demonstrating satisfactory performance history and compliance with ASTM C1116, Type III for fiber product(s) used.

2. When separately packaged micro and macro fiber products are used, furnish a statement by the fiber manufacturer verifying product compatibility and fitness for intended purpose at the specified dosage rates.

3. A trial batch and test placement will be required in accordance with Article SP-230133.03, A. Acceptance of the FRC mix shall be contingent on successful completion of the trial batch and test placement. At a minimum, the trial batch and test placement must demonstrate all the following:
   - Compliance with the contract documents and specified material properties.
   - Acceptable workability.
   - Batching and finishing processes representative of the proposed means and methods of construction for production work.
   - No detrimental effects associated with mix inconsistency, mix segregation, bleeding, or balling of fibers.

230133.03 CONSTRUCTION.

A. Trial Batch and Test Placement.

1. General.

a. Provide the Engineer notice, mix proportions, and scheduled date at least 7 calendar days prior to trial batch and test placement. Do not proceed with trial batch and test placement without authorization of the Engineer.

b. Conduct trial batch and test placement at least 7 calendar days prior to planned placement of production FRC.

c. Do not place production FRC until the trial batch and test placement have been accepted by the Engineer. Trial batches or test placements which fail to meet acceptance criteria must be repeated at no additional cost to the Contracting Authority, following appropriate material and/or procedure modifications by the Contractor.

d. After acceptance of the trial batch and test placement, any contractor-initiated changes to the mix design, fiber product or dosage, mix batching process, and/or methods of installation shall constitute basis for requiring a new trial batch and test placement at no additional cost to the Contracting Authority.

e. The Engineer may waive the trial batch and test placement on the basis of past successful placement of the same combination of mix design, fiber product and dosage, mix batching process and key personnel, and installation process and key personnel.

2. Trial Batch.

a. Identify dedicated batching personnel for FRC.

b. Establish and demonstrate the sequence of constituent material introduction during the trial batch. Ensure the fiber manufacturer's technical representative is available for advice and guidance regarding fiber inclusion into the mix, as needed.

c. Batch the trial batch concrete for slump within 1 inch of the maximum slump permitted, air content of 6% +/- 1%, and w/c ratio typical of the production fiber reinforced concrete to be placed. Include any other admixtures proposed for use in the production concrete, including but not limited to water reducers, viscosity modifiers and set retarders as applicable, at their respective intended production dosage rates.

d. Sample and test the trial batch placement for the following:

- Materials I.M. 340 – Unit Weight of Plastic Concrete.
- Materials I.M. 318 – Air Content of Plastic Concrete.
- Materials I.M. 317 – Slump of Plastic Concrete
- Visual Stability of Plastic Concrete – Following slump test performed in accordance with Materials I.M. 317, leave slumped concrete undisturbed on the test board for 3 minutes and observe for mortar ring or bleed water at the base of the concrete. Report presence, description, and size of any mortar ring and/or bleed water halo.

e. Trial batch shall be 6 cubic yards volume, minimum.

3. Test Placement.

a. Utilize the trial batch concrete to conduct a test placement.

b. Test placement shall be made within side/edge forms on sufficiently rigid subbase to allow representative demonstration of the placement and finishing methods proposed for production work. Use a durable, impermeable separation barrier between the subbase and test placement.

c. Place, consolidate and finish the concrete within the test placement using methods that are representative of the methods to be used with the production concrete. For production methods deemed impractical to duplicate during the test pour (e.g. pump placement, large-scale machine finishing), substitute methods may be used subject to the Engineer's approval, provided the substitute methods allow full evaluation of any/all mix properties that may affect the actual production methods. Evaluate workability, finishability, and general suitability of the mix for production use.

d. Following completion of the test placement, deposit any remaining trial batch concrete to an open container or other accessible location to allow further inspection for potential mix inconsistency, mix segregation, bleeding, balling of fibers, or other detrimental properties.

Do not obscure or dispose of the trial batch or test placement concrete until a minimum time of 2 hours has elapsed after completion of the test placement, or until authorized by the Engineer, whichever comes first.

e. For bridge decks, the test placement shall simulate the general placement conditions for production concrete as follows:

1) Conduct the test placement in open air, during weather generally consistent with the anticipated conditions during production placement.

2) Following trial batching, suspend the test placement for a period of time approximately equal to the anticipated delivery time for production concrete. During this suspension, maintain the concrete in a state of agitation generally representative of the anticipated delivery conditions for production concrete.

3) The area of the test placement shall be a minimum of 200 square feet. The least horizontal dimension of the test placement shall be a minimum of 12 feet. Nominal thickness of the test placement shall match as close as practical the nominal thickness of the production concrete, except nominal thickness of the test placement need not exceed 9 inches.

4) Test placements shall include reinforcing steel, oriented in two mats of two layers each (longitudinal and transverse) within the test placement. Reinforcing steel shall have similar size, spacing, top clearance to top mat and bottom clearance to bottom mat, as shown in the contract documents for the production work.

B. Production Concrete.

1. Batching.

a. Production batching methods, equipment, sequence and personnel shall match those used for the approved trial batch.

b. Introduce fibers into the mix in accordance with the fiber manufacturer's recommendations, unless otherwise approved by the Engineer.

c. Mix FRC in accordance with the applicable Standard Specifications, unless otherwise approved by the Engineer.

d. Ensure uniform distribution and random orientation of fibers throughout the concrete.

2. Placing, Consolidating, Finishing and Curing.
Apply Article 2403, 2406, 2412, and the Developmental Specifications for High Performance Concrete for Structures.

230133.04 METHOD OF MEASUREMENT.

A. Fiber Reinforced High Performance Structural Concrete.
The quantity of Fiber Reinforced High Performance Structural Concrete will be the quantity shown in the contract documents.

B. Trial Batch and Test Placement.
Trial Batch and Test Placement is a combined item. The measured quantity of Trial Batch and Test Placement includes the combination of one trial batch and one test placement. Measurement will not be made for trial batch without a test placement.

230133.05 BASIS OF PAYMENT.

A. Fiber Reinforced High Performance Structural Concrete.
Payment with be at the contract unit price for Fiber Reinforced High Performance Structural Concrete, per cubic yard.

B. Trial Batch and Test Placement.
Payment will be at the contract unit price each for the combined bid item Trial Batch and Test Placement. The paid quantity of Trial Batch and Test Placement shall be limited to one

successful trial batch and test placement. Unsuccessful and/or unrepresentative trial batch(es) and test placement(s) will not be paid.