

ORIGINATION FORM

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Specification: 346 Portland Cement Concrete

Subject: 346 sections 1, 2.1, 2.4, 2.5.1, 6.1, 6.2, 7.1.1 and 7.1.2

Origination date: October 10, 2008

Originator: Andre Pavlov

Office/Phone: 850-414-4293

Problem statement: Additional measures are necessary to reduce deck shrinkage cracking on bridges constructed using prestressed concrete slab units.

Proposed solution: For decks on prestressed concrete slab units, add concrete specifications for the addition of steel fibers in moderately and slightly aggressive superstructure environments, and add specifications for the addition of polymeric fibers in extremely aggressive superstructure environments.

Information source: Materials Office, Structures Lab Testing

Recommended Usage Note:

Estimated fiscal impact, if implemented: None

Implementation of these changes, if and when approved, will begin with the July 2009 letting.



Florida Department of Transportation

CHARLIE CRIST
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

STEPHANIE KOPELOUSOS
SECRETARY

M E M O R A N D U M

DATE: December 17, 2008
TO: Specification Review Distribution List
FROM: Rudy Powell, Jr., P.E., State Specifications Engineer
SUBJECT: Proposed Specification: 3460000FRC, Fiber Reinforced Concrete

In accordance with Specification Development Procedures, we are sending you a copy of a proposed specification change.

This change was proposed by Andre Pavlov to provide for fiber reinforced concrete for use in deck overlays on prestressed concrete slabs and will be used as a Special Provision in conjunction with the new Interim Design Standard developed by the Structures Office.

Please share this proposal with others within your responsibility. Review comments are due within four weeks and should be sent to Mail Station 75 or to my attention via e-mail at ST986RP or rudy.powell@dot.state.fl.us. Comments received after January 16, 2009 may not be considered. Your input is encouraged.

RP/dr
Attachment

FIBER REINFORCED CONCRETE.
(REV 11-18-08)

ARTICLE 346-1 (of the Supplemental Specifications) is expanded by the following:

Additionally, this specification includes material, labor, equipment, and services requirements necessary to complete the work for fiber reinforced concrete used in concrete decks on prestressed concrete slab units. Based on the superstructure environmental classification, use the following type of fiber reinforcement:

- 1) polymeric fiber reinforced concrete (PFRC) in extremely aggressive superstructure environments,*
- 2) steel fiber- reinforced concrete (SFRC) in moderately and slightly aggressive superstructure environments.*

SUBARTICLE 346-2.1 (of the Supplemental Specifications) is expanded by the following:

*Polymeric Fibers**.....ASTM C 1116, Type III*

*Steel Fibers***.....ASTM A 820*

*** Use a synergistic blend of high performance macro-monofilaments with sinusoidal deformations and collated-fibrillated polypropylene fibers. Package the blend of fibers in degradable bags with a volume of one bag per cubic yard.*

Conform to the requirements of ASTM C 1116 for a Type III fiber and produce an Average Residual Strength (ARS) of no less than 215 psi from a test set of 5 beams in accordance with ASTM C 1399 Test Method for Determining Average Residual Strength of Fiber Reinforced Concrete. Perform the ARS test at the time the mix design is developed and submit samples to the State Materials Office for testing.

****Use steel fibers made with low-carbon steel and with a minimum ultimate tensile strength of 120,000 psi. Meet the following requirements: length equal to 2 inches +/- 5 percent, average equivalent diameter equal to 0.035 inch with an aspect ratio of 60 +/- 15 percent. Ensure the material is a continuously deformed circular segment, clean and free of rust, oil and deleterious materials and corrugated full length for increased mechanical anchorage.*

SUBARTICLE 346-2.4 (of the Supplemental Specifications) is expanded by the following:

For polymeric fiber and steel fiber reinforced concrete, use size 89 coarse aggregate.

SUBARTICLE 346-2.5.1 (of the Supplemental Specifications) is expanded by the following:

In polymeric fiber and steel fiber reinforced concrete mixes, Type D water-reducing and retarding admixture, and shrinkage reducing admixture (SRA) is required. The shrinkage

reducing admixture must be approved by the Department prior to its use.

SUBARTICLE 346-6.1 (of the Supplemental Specifications) is expanded by the following:

For polymeric fiber and steel fiber reinforced concrete mixes, detail the method of finishing and curing prior to the concrete surface drying in the quality control plans.

SUBARTICLE 346-6.2 (of the Supplemental Specifications) is expanded by the following:

For polymeric fiber and steel fiber reinforced concrete, ~~include~~ submit the following information with the mix design to the State Materials Office ~~prior to~~ for approval:

- 1. Manufacturer's printed product data to indicate proposed polymeric or steel fiber reinforced concrete materials including application rate per cubic yard of concrete.*
- 2. Manufacturer's printed batching and mixing instructions.*
- 3. Listing of projects completed within the last five (5) years under the same trade name and manufacturer.*
- 4. Manufacturer's Certification of Registration for the facility.*
- 5. Manufacturer's Certification of performance meeting or exceeding ASTM C 1116.*

SUBARTICLE 346-7.1 (of the Supplemental Specifications) is expanded by the following:

346-7.1.1 Polymeric Fiber Reinforced Concrete: *Follow the requirements of the manufacturer's recommendation for mixing sequence, number of revolutions at mixing speed, and mixing procedure. Batch polymeric fiber reinforced concrete in whole cubic yard quantities. Add fibers at the concrete plant, unless otherwise approved by the Engineer. Limit the size of the transit mixer to three-quarters (~~3/4~~) of its rated capacity, unless the Engineer approves a larger size.*

~~*For currently used manual polymeric fiber charging methods, equip workers with protective gloves and goggles. It is essential*~~ *Ensure that no tightly bound fiber clumps be broken up or prevented from entering* ~~*enter the mix. Prove a satisfactory method of introducing the polymeric fibers into the mixture during the trial mix. Ensure the fiber reinforced concrete is free of fiber balls when delivered.*~~

The Engineer ~~shall~~ will utilize pre-project trials to determine acceptable surface finishability and ability to introduce polymeric fibers without clumping. Place Polymeric fiber reinforced concrete only if the surface evaporation rate, as affected by ambient air temperature, concrete temperature, pavement temperature, relative humidity, and wind velocity, is 0.2 lbs/ft² per hour or less as determined by Section 308 of the ACI Manual of Concrete Practice. Determine and document the atmospheric conditions, subject to verification by the Engineer.

346-7.1.2 Steel Fiber Reinforced Concrete: ~~*use of*~~ *Use one of the following mixing sequences:*

- 1. Add the fibers to the truck mixer after all other ingredients, including the water, have been added and mixed. -With the mixer rotating at full speed, add fibers in a clump-free state so that the mixer blades can carry the fibers into the mixer. Then slow mixer to the*

When Fiber Reinforced Concrete is Called For

recommended mixing speed and mix for 40 to 50 revolutions. Using this method, steel fibers can be added at the batch plant or on the job site.

2. Add the fibers to the aggregate stream in the batch plant before the aggregate is added to the mixer. Steel fibers can be added manually on top of the aggregates on the charging conveyor belt, or via another conveyor emptying onto the charging belt. Spread the fibers out along the conveyor belt to prevent clumping.

Limit the transit mixer load size to $\frac{3}{4}$ three-quarters of its rated capacity, unless the Engineer approves a larger size.

Ensure ~~s~~Steel fiber-reinforced concrete delivered to projects conforms to the applicable provisions of ASTM C 1116. ~~For currently used manual steel fiber charging methods, equip workers with protective gloves and goggles. It is essential~~ Ensure that no tightly bound fiber clumps be broken up or prevented from entering enter the mix. Prove a satisfactory method of introducing the steel fibers into the mixture during the trial mix. ~~Ensure the Fiber reinforced concrete is free of fiber balls when delivered.~~

The Engineer ~~shall~~ will utilize pre-project trials to determine acceptable surface finishability and ability to introduce steel fibers without clumping. Detail the method of finishing and curing prior to the concrete surface drying in the QC Plans.

Place ~~S~~steel fiber-reinforced concrete only if the surface evaporation rate, as affected by ambient air temperature, concrete temperature, pavement temperature, relative humidity, and wind velocity, is 0.2 lbs/ft² per hour or less as determined by Section 308 of the ACI Manual of Concrete Practice. ~~Determine and document the atmospheric conditions, subject to verification by the Engineer.~~