Florida Department of Transportation

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SECRETARY

December 16, 2016

Khoa Nguyen
Director, Office of Technical Services
Federal Highway Administration
3500 Financial Plaza, Suite 400
Tallahassee, Florida 32312

Re: State Specifications Office
Section: **346**
Proposed Specification: **3460202 Portland Cement Concrete.**

Dear Mr. Nguyen:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Donnie Bagwell of the State Materials Office (SMO) to update the language..

Please review and transmit your comments, if any, within two weeks. Comments should be sent via email to dan.hurtado@dot.state.fl.us.

If you have any questions relating to this specification change, please call me at 414-4130.

Sincerely,

Signature on file

Dan Hurtado, P.E.
State Specifications Engineer

DH/dt
Attachment
cc: Florida Transportation Builders' Assoc.
State Construction Engineer

PORTLAND CEMENT CONCRETE.
(REV ~~10-27-16~~~~11-1-16~~12-15-16)

SUBARTICLE 346-2.2, Table 1, is deleted and the following substituted:

TABLE 1			
BRIDGE SUPERSTRUCTURES			
Component	Slightly Aggressive Environment	Moderately Aggressive Environment	Extremely Aggressive Environment
Precast Superstructure and Prestressed Elements	Type I or Type III	Type I, Type IL, Type II, Type III, Type IP, or Type IS	Type II (MH), Type IL, or Ternary Blend
Cast In Place	Type I	Type I, Type IL, Type II, Type IP, or Type IS	Type II (MH), Type IL, or Ternary Blend
BRIDGE SUBSTRUCTURE, DRAINAGE STRUCTURES AND OTHER STRUCTURES			
All Elements	Type I or Type III	Type I, Type IL, Type II, Type IP, or Type IS	Type II (MH), Type IL, or Ternary Blend
Note: Cements used in a more aggressive environment may also be used in a less aggressive environment.			

SUBARTICLE 346-2.3 is deleted and the following substituted:

346-2.3 Pozzolans and Slag: Fly ash or slag materials are required in all classes of concrete~~,~~ except for the following ~~:~~when used in slightly aggressive environments: Class II 3400, ~~and~~ Class I 3000, and concrete requiring a coloring agent used in slightly aggressive environments. When a concrete requiring a coloring agent is used in a moderately or extremely aggressive environment, slag~~,~~ must be used. Use fly ash or slag materials as a cement replacement, on an equal weight replacement basis with the following limitations:

1. Mass Concrete:

a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 18% to 50% by weight, except where the core temperature is expected to rise above 165°F. In that case, ensure that the percentage of fly ash is 35% to 50% by weight.

b. Slag - Ensure that the quantity of cement replaced with slag is 50% to 70% by weight. Ensure that slag is 50% to 55% of total cementitious content by weight when used in combination with silica fume, ultrafine fly ash and/or metakaolin.

2. Drilled Shaft:

a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 33% to 37% by weight.

b. Slag - Ensure that the quantity of cement replaced with slag is 58% to 62% by weight.

3. Precast Concrete – Ensure that the precast concrete has a maximum of 25% fly ash or a maximum of 70% slag. In extremely aggressive environments, ensure that the precast concrete has a minimum of 18% fly ash or a minimum of 50% slag.

4. For all other concrete uses not covered in (1), (2) and (3) above,

a. Fly Ash - Ensure that the quantity of cement replaced with fly ash is 18% to 30% by weight.

b. Slag - Ensure that the quantity of cement replaced with slag is 25% to 70% for slightly and moderately aggressive environments and 50% to 70% by weight when used in extremely aggressive environments. Ensure that slag is 50% to 55% of total cementitious content by weight when used in combination with silica fume, ultra fine fly ash and/or metakaolin.

5. Highly Reactive Pozzolans: Highly reactive pozzolans are considered to be silica fume, metakaolin and ultrafine fly ash. When silica fume, metakaolin or ultrafine fly ash is required, it must be used in combination with fly ash or slag and cured in accordance with the manufacturer's recommendations and approved by the Engineer.

a. Silica Fume - Ensure that the quantity of cement replaced with silica fume is 3% to 9% by weight of the total cementitious material.

b. Metakaolin - Ensure that the quantity of cement replaced with metakaolin is 8% to 12% by weight of the total cementitious material.

c. Ultrafine Fly Ash - Ensure that the quantity of cement replaced with ultrafine fly ash is 8% to 12% by weight of the total cementitious material.

SUBARTICLE 346-2.5 is expanded by the following:

346-2.5.6 Type S Admixtures: When a workability retention, shrinkage reducing or a rheology modifying admixture is used, meet the requirements of a Type S admixture.

SUBARTICLE 346-3, Table 2, is deleted and the following substituted:

TABLE 2		
Class of Concrete	Specified Minimum Strength (28-day) (psi)	Target Slump Value (inches) (c) (g)
STRUCTURAL CONCRETE		
I (a)	3,000	3 (b)
I (Pavement)	3,000	2
II (a)	3,400	3 (b)
II (Bridge Deck)	4,500	3 (b)
III (e)	5,000	3 (b)
III (Seal)	3,000	8
IV (d)(f)	5,500	3 (b)
IV (Drilled Shaft)	4,000	8.5
V (Special) (d)(f)	6,000	3 (b)

V (d)(f)	6,500	3 (b)
VI (d)(f)	8,500	3 (b)

(a) For precast three-sided culverts, box culverts, endwalls, inlets, manholes and junction boxes, the target slump value and air content will not apply. The maximum allowable slump is 6 inches, except as noted in (b). The Contractor is permitted to use concrete meeting the requirements of ASTM C478 4,000 psi in lieu of Class I or Class II concrete for precast endwalls, inlets, manholes and junction boxes.
(b) The Engineer may allow a higher target slump when a Type F, G, I or II admixture is used, except when flowing concrete is used. The maximum target slump shall be ~~7~~9 inches.
(c) For a reduction in the target slump for slip-form operations, submit a revision to the mix design to the Engineer.
(d) When the use of silica fume, ultrafine fly ash, or metakaolin is required as a pozzolan in Class IV, Class V, Class V (Special) or Class VI concrete, ensure that the concrete meets or exceeds a resistivity of 29 KOhm-cm at 28 days, when tested in accordance with AASHTO T358. Submit three 4 x 8 inch cylindrical test specimens to the Engineer for resistivity testing before mix design approval. Take the resistivity test specimens from the concrete of the laboratory trial batch or from the field trial batch of at least 3 cubic yards. Verify the mix proportioning of the design mix and take representative samples of trial batch concrete for the required plastic and hardened property tests. Cure the field trial batch specimens similar to the standard laboratory curing methods. Submit the resistivity test specimens at least 7 calendar days prior to the scheduled 28 day test. The average resistivity of the three cylinders, eight readings per cylinder, is an indicator of the permeability of the concrete mix.
(e) When precast three-sided culverts, box culverts, endwalls, inlets, manholes or junction boxes require a Class III concrete, the minimum cementitious materials is 470 pounds per cubic yard. Do not apply the air content range and the maximum target slump shall be 6 inches, except as allowed in (b).
(f) When the concrete does not require a minimum resistivity of 29 KOhm-cm at 28 days, highly reactive pozzolans may be used outside the lower specified ranges to enhance strength and workability. Testing in accordance with AASHTO T358 is not required.
(g) The Engineer may allow a higher target slump when a Ternary Blend is used. The maximum target slump will be 7 inches.

SUBARTICLE 346-11.6 is expanded by the following:

346-11.6.4 Flyash-Slag-Cement Concrete (W/CM>0.41):

Equivalent 28 day compressive strength = $f'_c(28)$, where:

$$f'c(28) = 0.80f'c(t)e^{\{3.14/t\}^{0.72}}$$ (Type I/II Cement)

$f'_c(t)$ = Average Core Strength at time t (psi)
t = time compressive strength was measured (days)

346-11.6.5 Flyash-Slag-Cement Concrete (W/CM<0.41):

Equivalent 28 day compressive strength = $f'_c(28)$, where:

$$f'c(28) = 0.88f'c(t)e^{\{1.86/t\}^{0.90}}$$ (Type I/II Cement)

$f'_c(t)$ = Average Core Strength at time t (psi)
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346-11.6.6 Flyash-Silica Fume-Cement Concrete (W/CM<0.41):

Equivalent 28 day compressive strength = $f'_c(28)$, where:

$$f'c(28) = 0.84f'c(t)e^{\{0.92/t\}^{0.50}}$$ (Type III Cement)

$f'_c(t)$ = Average Core Strength at time t (psi)
t = time compressive strength was measured (days)

346-11.6.7 Flyash-Silica Fume-Cement Concrete (W/CM<0.41):

Equivalent 28 day compressive strength = $f'_c(28)$, where:

$$f'c(28) = 0.86 f'c(t) e^{[0.53/t]^{0.47}}$$ (Type III Cement)

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PORTLAND CEMENT CONCRETE.
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c. Ultrafine Fly Ash - Ensure that the quantity of cement replaced with ultrafine fly ash is 8% to 12% by weight of the total cementitious material.

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346-11.6.5 Flyash-Slag-Cement Concrete (W/CM<0.41):

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$f'_c(t)$ = Average Core Strength at time t (psi)
t = time compressive strength was measured (days)

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346-11.6.7 Flyash-Silica Fume-Cement Concrete (W/CM<0.41):

Equivalent 28 day compressive strength = $f'_c(28)$, where:

$f'c(28) = 0.86 f'c(t) e^{[0.53/t]^{0.47}}$ (Type III Cement)
$f'_c(t)$ = Average Core Strength at time t (psi)
t = time compressive strength was measured (days)