

3460203 Structural Portland Cement Concrete
COMMENTS FROM INTERNAL/INDUSTRY REVIEW

Mark Conley
FDOT
863-519-4233

Comments: (8-30-22, Industry)

Comment 1: Will samples be allowed to be entered into the Materials Acceptance and Certification (MAC) System with the 56 day compressive strength as an alternative to the 28 days?

Response: Agree, 56 Day mix designs will be identified as such and will be project specific.

Action: No changes in the proposed Specification 346. We are still identifying and developing the process in MAC.

Steven Nolan
FDOT
850-414-4272

Comments: (8-31-22, Industry)

Comment 1: Table 346-2, Footnote (5) is not clear on what concrete classes or environments this relaxation of HRP mix proportion % applies too. I suggest adding the following clarification to the beginning of the Note "For Slightly Aggressive and Moderately Aggressive Environments..."

Proposed revised footnote would be: "(5) For Slightly Aggressive and Moderately Aggressive Environments, highly reactive pozzolans may be used below the specified ranges to enhance strength and workability. A minimum concrete Surface Resistivity (SR) value is not required."

Response: Agree

Action: Foot note (5) of Table 346-2 was reworded.

josephp.conover@cemex.com
(for) James W Mack

Comments: (9-13-22 Industry)

On behalf of CEMEX for James W Mack, we provide the following comments for your consideration.

When the FDOT Section 350 specification was previously revised, FDOT Section 346 was purposely referenced so that there were no conflicts between sections. We see the proposed change as a step away from that philosophy. Unless the sampling frequency is being removed from that section 346 we don't feel any other guidelines need to be added to the Section 350 specification. In reviewing the 346 specifications, we do agree that some additional language to better represent paving could be added, but it should be done in the 346 section.

We also feel that the proposed language is too prescriptive and only provides one way to reduce lot size based on compressive strength on cores or cylinders. We would also like to have the Maturity of the concrete included as an alternative to evaluate strength. We also accept the thought process that tests from previous projects can be used. We would like to see alternate strength methods and other ways to show that lot size can be reduced and accepted too.

Response: Not Applicable. This comment is applicable to Section 350 where the language was modified.

For reduced testing frequency, the current Sub-article 346-9.2.1 refer to Section 350, but Sub-article 350-9.2.1 refers back to Section 346 for reduced testing frequency request in lieu of providing requirements.

Action: No changes in the proposed Specification 346.

Thomas Frank
Thomas.Frank@dot.state.fl.us
352.955.6683

Comments: (9-15-22 Industry)

1. In sub article 346-2.3, Class I (Seal) was not included. Recommend modifying the first paragraph as follows; expand the sub article and include Class I (Seal) in the exceptions:

SUBARTICLE 346-2.3 is deleted and the following substituted:

346-2.3 Supplementary Cementitious Materials: Supplementary cementitious materials (SCMs) are required in all classes of concrete specified in Table 346-3. **Nonreinforced concrete Class I (Seal) and Class I (Pavement) are exempted, and Class II** when used in slightly aggressive environments.

The quantity of **portland cement that is replaced with SCMs** must be on an **equal weight replacement** basis of the total cementitious materials in accordance with Table 346-2. When using Type IP, IS or IT blended cements, the total quantity of SCMs, including the blended cement added separately at the concrete plant shall meet the requirements of Table 346-2.

Response: Agree

Action: The language was modified as proposed.

2. In Table 346-9, Class V (Special), as highlighted below, should be removed for consistency.

Table 346-9 Sampling Frequency	
Class Concrete ⁽¹⁾	LOT Size
<u>I (Seal)</u>	<u>Each seal placement</u>
I (Pavement)	According to Section 350
II, II (Bridge Deck), III, IV, V (Special), V, VI, VII	50 cubic yards, or one day's production, whichever is less
IV (Drilled Shaft)	50 cubic yards, or one day's production, whichever is less ⁽²⁾
(1) For any class of concrete used for roadway concrete barrier, the lot size is defined as 100 cubic yards, or one day's production, whichever is less. (2) Start a new LOT when there is a gap of more than two hours between the end of one drilled shaft placement and the beginning of the next drilled shaft placement.	

Response: Agree

Action: The language was modified as proposed.

Ben Goldsberry, P.E.
 (850) 414-4278
Ben.Goldsberry@dot.state.fl.us

Comments: (9-15-22 Industry)
 Under Article 346-8, consider clarifying that density testing for lightweight concrete is for the hardened density, not plastic density.

Response: Agree

Action: The language was modified as follows. The modified version of 346-4.4 Lightweight Concrete was redistributed to the industry review by extension of deadline for receipt of the review comments.

346-4.4 Lightweight Concrete: Submit the fresh and hardened concrete density for mix design approval. The hardened density is the equilibrium density in ASTM C567. Ensure that the hardened density of the mix design is within $\pm 2 \text{ lb/ft}^3$ of the hardened density specified in the Contract Documents.

During production, the freshly mixed concrete density must be within $\pm 3 \text{ lb/ft}^3$ of the approved mix design fresh density.

Anthony Rogers
Anthony.rogers@cemex.com
(813) 787-6331

Comments: (10-5-22 post-Industry)

Below is our comment (CEMEX) regarding the new proposed changes to 346-4.4

With the LW we did on I-4, we used +/-3 for equilibrium density, and +/- 4 for plastic density. We are not in support of the proposed +/- 2 equilibrium and +/- 3 plastic.

ACI 301

Applying coefficient of variation data from ASTM C567, +/- 3 is more realistic for equilibrium.

I too would want a better understanding of the penalty if applicable.

7.2.2.1 Density—Proportion lightweight concrete to meet equilibrium density specified in Contract Documents. Unless otherwise specified, calculate the approximate equilibrium density of mixture from measured or calculated oven-dry density in accordance with ASTM C567/C567M.

Correlate equilibrium density with fresh density of concrete. Fresh density will be used as the basis for acceptance during construction.

7.3—Execution

7.3.1 Field quality control

7.3.1.1 Density—Acceptance of lightweight concrete in field will be based on fresh density measured in accordance with **ASTM C138/C138M**. Required fresh density is based on specified equilibrium density and correlation with fresh density, as established in 7.1.3.1. Unless otherwise specified, do not use concrete for which fresh density varies by more 4 lb/ft³ from the required fresh density.

Note: This comment was received after the modified version of **346-4.4 Lightweight Concrete** was redistributed for industry review by extension of the deadline for receipt of the review comments.

Response: The proposed density tolerances were discussed with FDOT State Structures Design Engineers, and they agreed with the proposed lightweight concrete density tolerances. The following are rational for the proposed changes:

The lightweight concrete mix design approval will be based on meeting the specified Equilibrium Density (hardened density), since this is the basis for the design calculation capacities, and the value included in the Structures Plans (Contract Documents).

The Equilibrium Density can take many months to establish so the calculation of Approximate Equilibrium Density method may be used to accelerate the design mix approval process. The “target” fresh density (unit weight) is established based on the approved mix design.

It is not practical (or desirable) for the designer to provide both hardened and fresh density requirements in the Contract Documents (Structures Plans) since the difference between them is highly dependent on the mix design and aggregate sources and trying to “guess” the difference prior to construction would likely result in problems for the concrete supplier meeting both acceptance requirements during construction.

Therefore, the fresh density (unit weight) would be best established during mix design approval for the construction project, based on the actual approved mix design that meets the Equilibrium Density (hardened density) with some practical tolerance for acceptance allowed in the specifications.

Structures Design Engineers want to keep the total variation within $\pm 5 \text{ lb/ft}^3$ of the Contract Documents equilibrium density. Variations above 5 lb/ft^3 may cause structural design issues and may require an Engineering Analysis. To accomplish this, mix design ($\pm 2 \text{ lb/ft}^3$) and production

(± 3 lb/ft³) tolerances were established.

Example: Design value equilibrium density (Contract Documents) 120 lb/ft³

Mix design equilibrium density tolerance 120 \pm 2 lb/ft³ \Rightarrow Range [118 – 122]

Production plastic density tolerance: The tolerance is based on the approved mix design value, not on the Contract document value.

- Range 1 \Rightarrow 118 \pm 3 lb/ft³ [115 – 121]

- Range 2 \Rightarrow 122 \pm 3 lb/ft³ [119 – 125]

With the proposed tolerances, it is possible to deviate from the value specified in the Contract Documents up to ± 5 lb/ft³ [115 – 125]. When the lightweight plastic density is outside of the acceptable 346-4.4 tolerances the Engineer may require an Engineering Analysis.

It is important to mention that ACI 2132 (2014) suggests only specifying a maximum fresh and equilibrium density while NRMCA (2016) suggests using a tolerance on the densities of ± 4 lb/ft³. *The combination of tolerances proposed in 346-4.4 (± 2 lb/ft³ and ± 3 lb/ft³) provide a wider range than those recommended by NRMCA.*

The following are responses regarding the pay penalties:

The article 346-12 applies: *“The pay reduction for cast-in-place concrete will be twice the certified invoice price per cubic yard of the quantity of concrete in the rejected load”.*

Action: Corresponding language has been proposed for inclusion in **346-9.7 Structural Adequacy**, as follows:

346-9.7.1 Lightweight concrete: The Engineer may require an Engineering Analysis Scope in accordance with 6-4 to establish structural and durability adequacy when the lightweight concrete plastic density (unit weight) is outside of the specified tolerances.