3460000, Portland Cement Concrete
Comments From Industry Review

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John Previte

Comments:

346-2.5, line3: Proposed change from 'Engineer' to 'Department'? 'Engineer' is correct. See definition p. 5 of Spec Book.

346-2.5.3.1, line 6: Proposing to remove definition of 'HRWR'-need to insert in 346-3.4, line 5.

346-2.5.3.2, line 5:
Do we mean 'The maximum allowable difference between the standard sizes of aggregates ~~distribution~~ is less than…'?

346-3.2 (4), last sentence: Do we mean: 'Agitate the mixer when the concrete is not being mixed'?

346-3.2 (5), last sentence: Do we mean: '*Verify* that *the water*/cement ~~to cementitious material~~ ratio and other delivery ticket data meet ~~s~~ the design mix requirements'?

346-3.3, line 9:
The Specialty Engineer shall select the concrete design mix proportions
that will generate the lowest maximum temperatures possible to ensure ~~the~~ that a 35°F differential
temperature between concrete core and exterior surface is not exceeded. *The mass concrete maximum allowable temperature is 180°F. If either the differential temperature or maximum temperature is exceeded,* ~~*event occurs*~~*, the Specialty Engineer shall be* ~~*available for immediate consultation*~~ *immediately consulted.*

346-3.4, line 5: Insert definition of HRWR followed by '(HRWR)'

346-4.2.3, Proposed change from 'Specialty' to 'Professional'? 'Specialty' is correct. See definition p. 7 of Spec Book.

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Henry Haggerty

346-1 Description.
Use concrete composed of a mixture of portland cement, aggregate, water, and, where specified, admixtures, pozzolan and ground granulated blast furnace slag. Deliver the portland cement concrete to the site of placement in a freshly mixed, unhardened state.
Obtain concrete from a plant that is currently on the list of Producers with accepted *Accepted* Quality Control Program*s*. Producers seeking inclusion on the list shall meet the requirements of 105-3. If the concrete production facility's Quality Control Plan is suspended, the Contractor is solely responsible to obtain the services of another concrete production facility with an approved *accepted* Quality Control Program *Plan* or await the re-approval *acceptance* of the affected concrete production facility's Quality Control Plan prior to the placement of any

further concrete on the project. There will be no changes in the contract time or completion dates. Bear all delay costs and other costs associated with the concrete production facility*'s Quality Control Plan* approval *acceptance* or re-approval*acceptance*.

Comment: 105-3.3 requires Prestressed and/or Precast Concrete Products and Drainage Products have an accepted Quality Control Program. 105-3.6 Producers Quality Control Plan is one requirement. If the facility's QC plan gets suspended, the contractor needs to find another producer on the Accepted Quality Control Programs list or wait until the producer's QC plan and therefore their program gets reinstated.

346-2.3 Pozzolans and Slag: Use as desired, on an equal weight replacement basis, fly ash, silica fume, ultrafine fly ash, metakaolin, other pozzolans, and slag materials as a cement replacement in all classes of concrete, with the following limitations:
(1) Mass Concrete:
a. Fly Ash - ensure *Ensure* that the quantity of cement replaced with fly ash is 18% to 50% by weight, except where the expected core temperature is to rise above 165° F. When the core temperature is expected to rise above 165° F, *. In that case, ensure that* the percentage of fly ash is required to be 35% to 50% by weight.
b. Slag - ensure *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 of total cementitious materials when used in combination with silica fume, ultrafine fly ash and/or metakaolin.

Comment: This is repetitive.

(4) For all other concrete uses not covered in (1), (2) and (3) above,
a. Fly Ash - ensure *Ensure* that the quantity of cement replaced with fly ash is 18% to 22% by weight.
b. Slag - ensure *Ensure* that the quantity of cement replaced with slag is 25% to 70% for Slightly and Moderately Aggressive environments,*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 of total cementitious materials when use*d* in combination with silica fume*, ultra fine fly ash* and/or metakaolin.

Comment: This is repetitive.

(6) Silica Fume, Metakaolin and Ultrafine Fly Ash**:** -
a. Cure in accordance with the manufacturer's recommendation and *as* approved by the Engineer.

Comment: This section discusses requirements for pozzolans and slag (raw materials). Why is there a curing requirement in this section?
346-2.5 Admixture Requirements: *Use* Admixtures *admixtures* will meet the requirements of this *in accordance with the requirements of this* subarticle. Chemical admixtures not covered in this subarticle may be approved by the Engineer*Department*. Submit statistical evidence supporting successful laboratory and field trial mixes which demonstrate improved

concrete quality or handling characteristics.

Comment: Why was this changed to Department? Engineer seems to make more sense.

346-2.5.3.1 General: *When a high range water reducing admixture is used, meet the requirements of a Type F or Type I. When a high range water reducing and retarding admixture is used, meet the requirements of a Type G or Type II. Do not use Type I, II, F or G admixtures* The Contractor may propose the use of a Type F or G admixture, meeting the requirements of Section 924, in all classes of concrete, except for concrete used in drilled shafts*shaft concrete*. The use of High Range Water Reducing (HRWR) admixtures in concrete mixes incorporating *When* silica fume or metakaolin is *incorporated into a concrete mix design, the use of a high range water reducing admixture Type I, II, F or G is* mandatory.

Comment: Water-reducing admixture above has the dash. Is there no dash when referring to high range water reducing or high range water reducing and retarding admixture?

346-2.5.3.2 Flowing Concrete Admixtures for Precast/Prestressed Concrete: Use a Type I, or Type II, *F or G* admixture , meeting the requirements of Section 924, for producing Flowing *flowing c*Concrete. *If Type F or G admixture is used, verify the distribution of aggregates in accordance with ASTM C 1610 except allow for minimal vibration for consolidating the concrete. The maximum allowable difference between the aggregate distribution is less than or equal to 15 percent.* Produce flowing concrete mix with target slump of 9 inches. The use of flowing concrete admixtures is limited to the construction of precast/prestressed concrete products. Add the flowing concrete admixtures at the ready mixed concrete production batch plant*facility*.
~~Submit the proposed flowing concrete mix design and test data as specified herein and in *Materials Manual* Section 9.2 of the Materials Manual.~~

Comment: There is now no longer reference to Materials Manual 9.2 in this Specification. I realize this requirement is in 105-3.2 Compliance with the Materials Manual. It states "Producers of Portland Cement Concrete shall meet the requirements of Section 9.2, Volume II of the Department's Materials Manual, which may be viewed at the following..." This seems to require all concrete to meet 9.2 requirements including non-structural and drainage. Is this the case?

346-3.1 (f*e*) When precast box culverts or precast drainage products require a Class III concrete, the minimum cementitious materials will be 470 lb/yd3 and the target slump and air content range shall meet the requirements for a Class II concrete and note (a) above*the target slump will not apply*.

Comment: Minimum cementitious materials is discussed in Table 3. Why is this here? Target slump doesn't apply and the air content requirement for a Class II is n/a. It seems like this whole note could go away.

346-3.2 Drilled Shaft Concrete: When drilled shaft concrete is placed in any wet shaft, provide concrete in accordance with the following specified slump loss requirements.

Ensure that drilled shaft concrete has a *target* slump between *of* 7*8*.5 inches and 9.5 inches when placed and maintains a slump of 4 *5* inches or more throughout the drilled shaft concreting *concrete* elapsed time. *Maintain target slump by testing each load of concrete.* Ensure that the slump loss is gradual as evidenced by slump loss tests described below. The concrete elapsed time is the sum of the mixing and transit time, the placement time, and the time required for removal of any temporary casing that causes or could cause the concrete to flow into the space previously occupied by the temporary casing *and bolt/embedment installation*.

Comment: Concrete has a certain slump when placed. Its target slump doesn't change. It doesn't really have a target slump when placed.
Comment: Does this mean that the Department won't allow drilled shaft concrete in the tolerance range to be placed? I think the intent of this sentence could be stated more clearly.

346-3.2.1
(4) Mix the concrete intermittently for 30 seconds every five minutes at the mixing speed of the mixer. *Agitate mixer when not being mixed.*

Comment: Why was this changed? The mixer being stationary seems to more accurately represent the in place concrete in the shaft

(5) Determine slump, concrete temperature, ambient temperature and air content at 30 minute intervals until the slump is 4 *5* inches or less. Remix the mix for one minute at the mixing speed of the mixer before these tests are run. *Verify the water to cementitious material ratio and delivery ticket meets the design mix requirements.*
(6) Begin all elapsed times when water is initially introduced into the mix.
(7) Ensure that the concrete maintains a slump of at least 4 *5* inches for the anticipated elapsed time.

Comment: Shouldn't this be done prior to beginning the slump loss test? At step (3)?

Comment: I've seen confusion with the mixing time and the elapsed time even with this statement. Some people want to include the 30 seconds in the five minutes. Others mix for 30 seconds and then wait 5 minutes and then mix for 30 seconds again. This is also true for the 30 minutes and then one minute, but the overall effect isn't as great. I think this needs to be clarified.
Comment: 346-3.2 already states that the drilled shaft concrete will maintain at least a 5 inch slump during the elapsed time.
Also, Step (5) states that the slump loss test will be performed until the slump is less than 5 inches. The slump is being determined. I don't think the contractor should be told to ensure the concrete maintains a certain slump. It sounds like we are instructing him/her to modify the concrete. It seems like (7) could be removed completely.

346-3.3, 4th paragraph:

The readings will begin when the mass concrete placement is complete and continue until the maximum temperature differential (*and* not *the* maximum *allowable* temperature) is reached and a decreasing temperature differential is confirmed as defined in the temperature control plan

Comment: It's already been stated that the maximum temperature isn't to be exceeded. The readings are monitoring the differential. We're not really requiring that both of these requirements be met. What happens if the maximum allowable is never reached?

346-3.4, 6th paragraph, last sentence.
.Perform surface resistivity tests on the core samples or test cylinders at 28 days.

Comment: In 346-3.1 (d), resistivity tests are required when silica fume, ultrafine fly ash, or metakaolin is required as a pozzolan in Class IV, Class V, Class V (Special), or Class VI concrete.

Comment: For precast/prestressed, this needs to be done for all classes? For SCC mixes, the Materials Manual just requires resistivity tests when it's required for the specific class of concrete.

346-3.4, 8th paragraph

Upon the review and verification of the laboratory trial batch, field demonstration test data, inspection reports and contractor's certification statement, the Department will approve the proposed mix design

Comment: What about for precast producers who want to get a mix approved without regard to a specific project or contractor? Shouldn't the mix design procedure be a part of the Materials Manual and the Specification require that the contractor follow the Materials Manual?

Table 3 Notes
*The calculation of the water to cementitious materials ratio (w/cm) is based on the total cementitious material including cement,
silica fume, slag, fly ash, ultrafine fly ash, or metakaolin *and any supplemental cementitious materials that are used in the mix*.
**When the use of silica fume or metakaolin is required as a pozzolan, the maximum water cementitious material ratio will be
0.35. When the use of ultrafine fly ash is required as a pozzolan, the maximum water cementitious material ratio will be 0.30.

Comment: water to cementitious

346-4.2.1 General: Use the following maximum chloride content limits for the concrete application or exposure environment shown:

Comment: and? We're not giving the choice to use concrete application or exposure environment. I guess it could be..."concrete application or concrete application and exposure environment shown:"

346-4.2.1, 2nd paragraph after Table 4
Submit the chloride test results obtained from the testing lab within fourteen calendar days of concrete sampling.

Comment: Is this to the Engineer? How does this apply to precast producers?

346-4.2.2 Certification: Certify for each mix design during mix design approval, as well as from the first day of production and every 30 calendar days or less thereafter to the Department that all reinforced concrete produced *for the Department* meets the requirements of this Section. Section. Include in the certification all pertinent chloride test data. The Department will require properly executed certifications showing the chloride content within the required limits for acceptance of all concrete produced in accordance with these Specifications. Include all the chloride certificates that apply with the monthly certification of compliance as required in *Section* 105-2 of these Specifications.

Comment: There is some confusion about chloride certification for precast producers. The stamp certifies that all DOT requirements have been met. Chloride results are obtained and then retained at the plant which Materials personnel inspect on a monthly basis.

Comment: Is there a specific form that we are requiring?

346-4.2.3
If chloride test results exceed the limits of Table 4, *suspend concrete delivery immediately for every mix design represented by the failing test results, until corrective measures are made.* reject *Reject* all *concrete placed* from the first *last* passing chloride test to the present, or perform *an* engineering analysis to demonstrate that the material meets the intended service life of the structure. In the event that an engineering analysis is proposed, supply this information within 30 business days *of the failing test results* from a Specialty *Professional* Engineer *registered in the State of Florida and* knowledgeable in the areas of corrosion and corrosion control. A written request for time to develop the engineering analysis may be provided to the Engineer; however, the Engineer has the sole option to accept or reject this request.

Comment: Did we do this to allow the EOR to do the analysis?

346-6.3 Delivery Certification: Ensure that an electronic *printed* delivery ticket is furnished with each batch of concrete before unloading at the placement site. The delivery ticket may be proprietary software or in the form of an electronic spreadsheet, but shall be printed. Ensure that the materials and quantities incorporated into the batch of concrete is *are* recorded on the delivery ticket. Include the following information on the Delivery Ticket:
(1) Arrival time at jobsite,
(2) Time that concrete mix has been completely discharged,

(3) Number of revolutions upon arrival at the jobsite,
(4) Total gallons of water added at the jobsite,
(5) Additional mixing revolutions when water is added,
(6) Total number of revolutions at mixing and agitating speed.
Items 3 through 6 do not apply to non-agitating concrete transporting vehicles.
Ensure the batcher responsible for production of the batch of concrete signs the delivery ticket, certifying the batch of concrete was produced in accordance with the Contract Documents.
Sign the delivery ticket certifying that the maximum specified water to cementitious materials ratio was not exceeded due to any jobsite adjustments to the batch of concrete, and that the batch of concrete was delivered and placed in accordance with the Contract Documents.

Comment: The requirements for the delivery ticket are already listed in 9.2. Is the arrival time at the jobsite required for precast producers?
This also doesn't apply to precast producers. The contractor doesn't sign off on the delivery ticket.

346-6.4, Last sentence
If the Contractor does not implement adjustments at the earliest possible time, the Engineer will reject the concrete and terminate further production until the Contractor makes corrections.

Comment: Why are we restricting this to a will? We usually state the Department's actions as a "may."

346-7.7 Adding Water To *to* Concrete at the Placement Site: Perform an initial slump before the addition of water at the jobsite. *If the slump is delivered within the target range, no water will be added to the load. If the slump is outside the target range but is within the tolerance range, that load may be accepted, but water added at the site will be reduced to maintain a slump within the target range on successive loads.* After adjusting the slump, perform a test to confirm that the slump of the concrete is within the target range as defined in Table 6. If the slump exceeds the target range but is within the tolerance range, that load may be accepted, but water added at the site will be reduced to maintain a slump within the target range on successive loads. If the slump is delivered within the target range, no water will be added to the load. Confirm with another test that the next load is within the target range after the addition of water at the placement site. Repeated incidents of concrete being placed outside the target range will result in revocation of that portion of the QCP. No concrete represented by plastic test results outside of the tolerance range will be accepted for placement.

Comment: At the site? or at the plant?
If water is added at the site (the concrete is on the dry side) and then the slump is out of target, but within tolerance(concrete is now on the wet side), then this sentence makes sense.
This is confusing. It makes more sense if this is at the beginning of the sentence or it could just be removed.

346-7.8 c

Obtain all other samples from the discharge of the mixer delivering concrete to the pump. Ensure the plastic properties of the concrete being delivered to the pump are within the comparative sampling correlation.

Comment: ...are within the plastic properties tolerances with the applied comparative sampling correlation

346-8, 4th and 5th paragraphs

Furnish sufficient concrete of each design mix as required by the Engineer for verification testing. When the Engineer's verification test results do not compare with the QC plastic properties test results, within the limits defined by the Independent Assurance (IA) checklist comparison criteria, disposition of the concrete will be at the option of the Contractor.

If a*ny of the* QC *plastic properties* test*s* fails, reject the remainder of that load, terminate the LOT and notify the Engineer. Make cylinders representing that LOT from the same sample of concrete.

Comment: Can the Specification indicate where this checklist can be found?

Comment: The location of where the failing concrete was placed needs to be recorded.

The Department may *will* perform Independent Verification testing at any time to evaluate the QC of the concrete*to verify compliance with specification requirements*. The comparison between the Independent Verification testing and the QC testing is identified in the IA Checklist Criteria. When a test does not compare, the Contractor will revise the QCP as deemed necessary by the Engineer. *When the Department's Independent Verification tests results do not meet the requirements of this Section, the Contractor will revise the QCP as deemed necessary by the Engineer.*

Comment: 346-9.2 and other references to IV tests states "may." Why was this one instance changed?

Comment: I think this needs to be more specific. This isn't referring to the IA Checklist comparisons? It's just the IV's results?

346-9 Acceptance Sampling and Testing.

346-9.1 General: Perform plastic properties tests in accordance with 346-8 and cast a set of three QC cylinders (either 4 inch by 8 inch or 6 inch by 12 inch cylinders are acceptable), for all structural concrete incorporated into the project. Take these acceptance samples randomly as determined by a random number generator (acceptable to the Department). The Department will independently perform *verification* plastic properties tests and cast a set of verification cylinders. The verification cylinders will be the same size cylinder selected by the Contractor, from a separate sample from the same load of concrete as the Contractor's QC sample.

*The Department may perform inspections of the precast plants producing Class I and II concrete in lieu of plastic properties tests f*For *Class I and Class II concrete, excluding Class II (Bridge Deck)*Class I and Class II concrete (excluding Class I Pavement and Class II Bridge Deck), the Department may perform inspections of the plants producing Class I and II concrete

in lieu of plastic properties tests.

Comment: We don't need to state Class I and Class II concrete twice. End the sentence with tests and incorporate the excluding Class II (Bridge Deck) earlier in the sentence.

Comment: Did we mean to limit this to precast plants? If so, do precast producers use Class II Bridge Deck?

Test the QC laboratory cured samples for compressive strength at the age of 28 days, or any other specified age, in a laboratory meeting and maintaining at all times the qualification requirements listed in *Section* 105

Comment: 346-5 Table 5 lists the method that must be followed to perform compressive strength tests. Is there or does there need to be a requirement that QC and VT use the same acceptable method to achieve planeness? If QC caps, saw-cuts, or uses neoprene pads, should VT use the same method? Could using different methods cause problems in the comparison criteria?

The Department will average the QC compressive strength test data*, average the Verification compressive strength test data,* and compare this data to the average*s* of the Verification compressive strength test data and,*.* based *Based* on this comparison value at 28 days, *the Department will* determine *if* the Comparison Criteria as shown in Table 8 *has been met*. In the event that one set of compressive strength data for a set of cylinders falls outside the range of the other set of cylinders, use the lower Range of Average Compressive Strength to determine the comparison criteria.

Comment: I would place this as the second sentence of this paragraph to explain the comparison criteria. Since the Department is averaging the test data, replace "use" with "the Department will use...as shown in Table 8. Based on this comparison, the Department will determine if the Comparison Criteria has been met."

346-9.2 Sampling Frequency for Quality Control Tests:
As a minimum, sample and test concrete of each design mix for water to cementitious materials ratio, air content, temperature, slump and compressive strength *once per LOT* in accordance with these specifications *as defined by Table 9*. The Engineer will randomly verify one of every four consecutive LOTs of each design mix based on a random number generator, and may perform additional Independent Verification tests. All QC activities, calculations, and inspections will be randomly confirmed by the Department.

Comment: Does this apply to incidental precast concrete?

346-9.5 Resolution Procedure: The Department may initiate an IA review of sampling and testing methods. The resolution procedure may consist of, but need not be limited to, a review of sampling and testing of fresh concrete, calculation of water cementitious materials ratio, handling of cylinders, curing procedures and compressive strength testing. Core s*amples* of the hardened concrete may be required.

Comment: water to cementitious

The resolution investigation will determine the strength test results for each of the four or less LOTs. When the QC strength test results are deemed to be the most accurate, the QC strength test results will represent the four *or less* consecutive LOTs and the Department will pay for the resolution testing *and investigation*. When the verification strength test results are deemed to be the most accurate, the Contractor will pay for the resolution testing and the resolution investigation will determine the strength test results for each of the four LOTs.*the Department will assess a 5 percent reduction of payment for the quantity represented by the Resolution Investigation.*

Comment: Who pays for the resolution testing and investigation in this instance?

The results of the resolution procedure will be forwarded to the Contractor within five days *after completion of the investigation*. If the Department finds deficiencies based on the Contractor's QCP, the Engineer may suspend that part of the QCP. When the QC plan is suspended, submit corrective actions for approval of the Engineer. The Engineer may take up to five working days to review corrective actions to the QCP. The Engineer will not allow changes to Contract Time or completion dates. Incur all delay costs and other costs associated with QC plan suspension and re-approval.

Comment: to the Engineer
Comment: Previously wasn't capitalized (Contract Time).

346-9.6 Small Quantities of Concrete: When a project has a total plan quantity of less than 50 yd3, that concrete will be accepted based on the satisfactory compressive strength of the QC cylinders. Provide certification to the Engineer that the concrete was batched and placed in accordance with the Contract Documents. Submit a quality control plan for the concrete placement operation in accordance with Section 105.

Comment: Is this referring to a section in the project's QCP or a separate QCP?

346-10.2 Determination of Structural Adequacy: If core strength test results are less than 500 psi or 10%, whichever is greater, below the specified minimum strength, consider the concrete represented by the cores structurally adequate. If the core strength test results are more than 10% or 500 psi, whichever is greater, below the specified minimum strength, the Department will consider the concrete represented by the cores structurally questionable. Submit a structural analysis performed by the Specialty Engineer. If the results of the structural analysis indicates adequate strength to serve its intended purpose with adequate durability, and is approved by the Department, the Contractor may leave the concrete in place subject to the requirements of 346-11, otherwise, remove and replace the LOT of concrete in question at no additional expense to the Department.

Comment: indicate
Comment: Engineer

346-11.5 Core Strength Representing Equivalent 28 Day Strength: For cores tested no later than 42 days after the concrete was cast, the Engineer will accept the core strengths obtained as representing the equivalent 28-day strength of the LOT of concrete in question. The Engineer will calculate the strength value to be the average of the compressive strengths of the three individual cores. The Engineer will accept this strength at its actual measured value.

346-11.6 Core Strength Adjustments: For cores tested later than 42 days after the concrete was cast, the Department will establish the equivalency between 28 day strength and strength at ages after 42 days based on test data developed by a Department approved testing laboratory to relate strength at the actual test age to 28 day strength for the particular class of concrete and design mix represented by the cores. Obtain such data at no additional expense to the Department. When such data is not available and cannot be produced, as determined by the Department, the Department will determine the equivalent 28 day strength by adjusting the tested core strengths according to the following relationship:

Comment: Engineer accepts the core strengths. It seems that the responsibilities in this section should also be for the Engineer.
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Ghulam Mujtaba
(352) 955-6685
ghulam.mujtaba@dot.state.fl.us

Review Comments:

1. 346-2.5.2 This shows that bridge deck belongs to the category of precast concrete.

2. 346-2.5.3 The title shows viscosity modifying admixture and there is nothing in the body of the section about this admixture.

3. 346-2.5.3.2 ASTM C 1610 does not use the terminology of “aggregate distribution”. The proper term is “static segregation”.

4. 346-3.1. Paragraph 2 The terminology “may be allowed” should be changed to “is allowed if approved by the engineer”.

5. 346-3.1, Paragraph 2 Change “the design strength and acceptance data” to “specified strength of the substituted higher class and the acceptance compressive strength test results”.

6. 346-3.1, (b) Add also Types I and II admixture.

7. 346-3.1, (e) The Table 2 does not require air content for Class II. Both, the air content and slump are not applicable.

8. 346-3.2.1, Paragraph 1, Last Sentence Change “using personnel” to “by personnel”.

9. 346-3.1.2, (5) Change “material” to “materials”, “delivery ticket” to “information on the delivery ticket”, and “meets” to “meet”.

10. 346-3.3, Paragraph 2 Please verify if the temperature of 180° is safe. It may cause cracks. When fresh concrete is exposed to temperatures exceeding 150° that may cause a delayed ettringite formation.

11. 346-3.3, Paragraph 2 The “either event” should be explained that they are related to the maximum and differential temperatures.

12. 346-8, Paragraph 2 It has not been mentioned that who is removing the identification card. It should state that the Engineer will remove the identification card of noncompliant trucks.

13. 346-9, Paragraph 2 Bridge decks are usually cast-in-place, not precast. This paragraph is related to the precast concrete plant.

14. 346-9.6, Second to the Last Sentence Change the sentence to read “obtain the acceptance sample from the middle portion of the batch”.

15. 346-9.6, Last Sentence The provision is in conflict with the requirements of ASTM C 172, which requires the samples from the middle portion.

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Christopher Wood
(904) 360-5673
Christopher.Wood@dot.state.fl.us

Comments:

1. In 346-3.2 it removes the slump range of 7 inches to 9.5 inches and replaces it with 8.5 inches as the target slump. Is there ± range or should all concrete outside the 8.5 inch target be rejected?
2. In 346-3.3 Mass Concrete is the Specialty Engineer be required to be on site during concrete placement?
3. In 346-5 Table 5 in the notes don’t the QC and VT need to use the same size cylinders weather it 4x8 or 6x12. You don’t want one using 4x8 and the other using 6x12. It states in 346-9 that the VT should use the same size cylinders that are selected by the contractor. Should that be stated in both places?

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Karen Byram
(850) 414-4353
karen.byram@dot.state.fl.us

Comment:

The Product Evaluation Office has identified that the QPL reference is missing from this specification. The Department is requiring that all Division II specifications identify the QPL when QPL categories are referenced, therefore we are requesting the it be included.

Response:

This will be processed in the January 2010 Workbook along with other similar changes to other sections.

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Dan Haldi

Comments:
I cut out what I could to make sense, and highlighted all changes (my comments) in turquoise.

346-1 Description.

Use concrete composed of a mixture of portland cement, aggregate, water, and, where specified, admixtures, pozzolan and ground granulated blast furnace slag. Deliver the portland cement concrete to the site of placement in a freshly mixed, unhardened state.

Obtain concrete from a plant that is currently on the list of Producers with ~~***accepted***~~ *Accepted* Quality Control Program*s*. Producers seeking inclusion on the list shall meet the requirements of 105-3. If the concrete production facility's Quality Control Plan is suspended, the Contractor is solely responsible to obtain the services of another concrete production facility with an ~~***approved***~~ ~~a~~ *Accepted* Quality Control Program ~~***Plan***~~ or await the re-approval *acceptance* of
the affected concrete production facility's Quality Control Plan prior to the placement of any further concrete on the project. There will be no changes in the contract time or completion dates. Bear all delay costs and other costs associated with the concrete production facility*'s Quality Control* ~~***Plan***~~ ***Program*** approval *acceptance* or ***Quality Control Plan*** re-approval *acceptance*.

Correct spelling – change lower case p in Portland to capital "P"; it is a surname and deserves the respect.

346-2.3 Pozzolans and Slag:

(1) Mass Concrete:

c. For Slightly and Moderately Aggressive environments - , ensure *Ensure*
that there is at least 20% fly ash by weight and 40% Portland *portland* cement by weight for mixes containing Portland *portland* cement, fly ash and slag.

(3) Precast concrete – *Ensure that the precast concrete* will have *has* a maximum

of 25% fly ash or a maximum of 70% slag. *In* ***eE****xtremely aggressive environments, ensure that the precast concrete has a minimum of 18% fly ash or a minimum of 50% slag.*

b. Slag - ensure *Ensure* that the quantity of cement replaced with slag is 25% to 70% for Slightly and Moderately ~~A~~***a***ggressive environments,*environments* and 50% to 70% by weight when used in Extremely ~~A~~***a***ggressive environments. Ensure that slag is 50% to 55% of total cementitious content by weight of total cementitious materials when use*d* in combination with silica fume*, ultra fine fly ash* and/or metakaolin.

c. As an option for Slightly and Moderately ~~A~~***a***ggressive environments ensure that there is at least 20% fly ash by weight and 40% Portland *portland* cement by weight for mixes containing Portland *portland* cement, fly ash and slag.

346-2.4 Coarse Aggregate Gradation: Produce all concrete using Size No. 57, 67 or 78 coarse aggregate. With the Engineer's approval, Size No. 8 or Size No. 89 may be used either alone or blended with Size No. 57, 67 or 78 coarse aggregate. The Engineer will consider requests for approval of other gradations individually. Submit sufficient statistical data to establish production quality and uniformity of the subject aggregates, and establish the quality and uniformity of the resultant concrete. Furnish aggregate gradations sized larger than nominal maximum size of 1.5 inch as two components. ~~Ensure the maximum coarse aggregate size does not violate the reinforcement spacing provisions given for reinforced concrete in the AASHTO LRFD Bridge Design Specifications.~~

Do NOT remove last statement. All academia (ie ACI, PCA, AASHTO, etc.) recommends using largest size aggregate available to prevent shrinkage and structural cracking. The specs could state use largest provided it doesn't fill ¾ space between rebar; 1/3 depth of slabs; or 1/5 width of walls. If anything remove statistical data verbiage.

346-2.5.1 Water Reducer/Water Reducer Retardant Admixtures: *When a* Use w*w*ater-reducing admixture *is used, meet the requirements of* ***a*** , Type A*. When a* ***, or*** water reducing and retarding admixture *is used, meet the requirements of* ***a***, Type D. Use in accordance with the manufacturer's recommended dosage rate.

346-2.5.3 High Range Water Reducing *Admixtures* and Viscosity Modifying Admixtures:

346-2.5.3.1 General: *When a high range water reducing admixture is used, meet the requirements of* ***a*** *Type F or Type I. When a high range water reducing and retarding admixture is used, meet the requirements of* ***a*** *Type G or Type II. Do not use Type I, II, F or G admixtures* ~~The Contractor may propose the use of a Type F or G admixture, meeting the requirements of Section 924, in all classes of concrete, except for concrete used~~ in drilled ~~shafts~~*shaft concrete*. ~~The use of High Range Water Reducing (HRWR) admixtures in concrete mixes incorporating~~ *When* silica fume or metakaolin is *incorporated into a concrete mix design,*

the use of a high range water reducing admixture Type I, II, F or G is mandatory.

346-2.5.5 Accelerating Admixture for Precast Concrete: *The use of non-chloride admixtures Type C and Type E is allowed in the manufacturing of precast concrete products that are used in slightly aggressive environments. Use only non-chloride accelerating admixtures or non-chloride accelerating and water reducing admixtures.*

TABLE 2
Class of
Concrete
Specified Minimum Strength
(28-day) (psi)
Target Slump (inches)
(c) (e)
Air Content
Range (%)
STRUCTURAL CONCRETE
I (a) 3,000 5 (b) n/a
I (Pavement) 3,000 2 1.*0* to 6.*0*
I (Special) (a) 3,000 6 maximum *(b)* n/a
II (a) 3,400 6 *5* maximum *(b)* n/a
II (Bridge
Deck) 4,500 3 (b) 1.*0* to 6.*0*
III (f*e*) 5,000 3 (b) 1.*0* to 6.*0*
III (Seal) 3,000 8 1.*0* to 6.*0*
IV 5,500 3 (b) 1.*0* to 6.*0* ***DOES the (d) apply? When required to use SF or MK I think coulomb testing should be required, know we getting value from its' cost & use. If not required, then no special testing.***
IV (Drilled
Shaft) 4,000 8.5 0.*0* to 6.*0*
V (Special) 6,000 3 (b) (d) 1.*0* to 5.*0*
V 6,500 3 (b) (d) 1.*0* to 5.*0*
VI 8,500 3 (b) (d) 1.*0* to 5.*0*

(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 exceeds a resistivity of 29 KOhm-cm at 28 days, when tested in accordance with FM 5-578. 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 yd^3. 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 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.

346-3.2 Drilled Shaft Concrete:
346-3.2.1 Slump Loss Test Requirements:

(9) Obtain the Engineer's approval of slump loss test results in terms of elapsed time ***and average maximum concrete and ambient temperatures*** before concrete placements.

346-3.3 Mass Concrete:

Use a Specialty Engineer competent in the design and temperature control of concrete in mass elements. The Specialty Engineer shall follow the procedure outlined in Section 207 of the ACI Manual of Concrete Practice to formulate, implement, administer and monitor a temperature control plan, making adjustments as necessary to ensure compliance with the Contract Documents. The Specialty Engineer shall select the concrete design mix proportions that will generate the lowest maximum temperatures possible to ensure the 35°F differential temperature is not exceeded. *The mass concrete maximum allowable temperature is 180°F. If either* ***temperature*** *event occurs, the Specialty Engineer shall be available for immediate consultation.*

The Specialty Engineer, or a qualified technician employed by the Specialty Engineer, must personally inspect and approve the installation of monitoring devices and verify that the process for recording temperature readings is effective for the first placement of each size and type mass component. Submit to the Engineer for approval the qualification of all technicians employed to inspect or monitor mass concrete placements. For placements other than the first, designate an employee(s) approved by the Specialty Engineer, as qualified to inspect monitoring device installation, to record temperature readings, to be in contact at all times with the Specialty Engineer if adjustments must be made as a result of the temperature differential *or the maximum allowable temperature* being exceeded, and to immediately implement adjustments to temperature control measures as directed by the Specialty Engineer. Read the monitoring devices and record the readings at intervals no greater than 6 hours. The readings will begin when the mass concrete placement is complete and continue until the maximum temperature differential (*and* not *the* maximum ~~***allowable***~~ ***[implies 180 F deg is permitted whenever the next might be higher]*** temperature) is reached and a decreasing temperature differential is confirmed ***by two or more lowering temperatures*** as defined in the temperature control plan. *Do not remove*
3460000
All Jobs
the temperature control mechanisms ***[should this include formwork – whether it is steel or insulated, since most is lined, acts as insulation or needs to have insulation removed inorder to extract it from beneath – removing formwork often looses enough heat to cause over differential because can't regain the loss]*** *until the core temperature is within 35°F of the ambient temperature.* Furnish a copy of all temperature readings to the Engineer as they are determined, *recorded, the determined temperature differentials* and a final report within three days of completion of monitoring of each element.

346-4 Composition of Concrete.
346-4.1 Master Proportion Table: Proportion the materials used to produce the various classes of concrete in accordance with Table 3:
3460000
All Jobs

TABLE 3
Class of Concrete
Minimum Total Cementitious Materials Content lb/yd3
*Maximum Water Cementitious Materials Ratio lb/lb
I 470 0.53
I (Pavement) 470 0.50
I (Special) 470 0.53
II 470 0.53
II (Bridge Deck) 611 0.44
III 611 0.44
III (Seal) 611 0.53
IV 658 0.41 ***[does ** belong here? If SF or MK is required, low cementitious may need low W/C to assure value and passing coulomb test see Table 2, add (d)]***
IV (Drilled Shaft) 658 0.41
V (Special) 752 0.37**
V 752 0.37**
VI 752 0.37**

*The calculation of the water to cementitious materials ratio (w/cm) is based on the total cementitious material including cement, silica fume, slag, fly ash, ultrafine fly ash, or metakaolin *and any supplemental cementitious materials that are used in the mix*.
**When the use of silica fume or metakaolin is required as a pozzolan, the maximum water cementitious material ratio will be 0.35. When the use of ultrafine fly ash is required as a pozzolan, the maximum water cementitious material ratio will be 0.30.

346-4.2 Chloride Content Limits for Concrete Construction:
346-4.2.1 General: Use the following maximum chloride content limits for the concrete application or exposure environment shown:

TABLE 4
Application/Exposure Environment
Maximum Allowable Chloride Content, lb/yd3
Non Reinforced Concrete No Test Needed
Reinforced Concrete Slightly aggressive environment 0.70
Moderately or ***eE***xtremely aggressive environment 0.40
Prestressed Concrete 0.40

346-5 Sampling and Testing Methods.
Perform concrete sampling and testing in accordance with the following methods:

TABLE 5
Description Method
Slump of Hydraulic Cement Concrete ASTM C 143
Air Content of Freshly Mixed Concrete by the Pressure Method* ASTM C 231
Air Content of Freshly Mixed Concrete by the Volumetric Method* ASTM C 173
Making and Curing Test Specimens in the Field ASTM C 31
Compressive Strength of Cylindrical Concrete Specimens** ASTM C 39
Obtaining and Testing Drilled Core and Sawed Beams of Concrete ASTM C 42
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All Jobs
Early Sampling of Fresh Concrete During the Initial Placement FM 5-501 ***[ADD "and determination of Water to Cementitious materials ratio" to guide technicians to this method for the appropriate math and calculations.]***
Low Levels of Chloride in Concrete and Raw Materials FM 5-516
Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete ASTM C 138
Temperature of Freshly Mixed Portland Cement Concrete ASTM C 1064
Sampling Freshly Mixed Concrete ASTM C 172
Static Segregation of Self Consolidating Concrete using Column
Techniques ASTM C 1610
Slump Flow of Self Consolidating Concrete ASTM C 1611
Passing Ability of Self Consolidating Concrete by J-Ring ASTM C 1621 ***[Did Self Consolidating Concrete become removed earlier? Or change to imply Flowing concrete.]***
Concrete Resistivity as an Electrical Indicator of its Permeability FM 5-578
*Use the same type of meter for QC tests as the Department uses for Verification testing. When using pressure type meters, use an aggregate correction factor determined by the concrete producer for each mix design to be tested. Record and certify test results for correction factors for each type of aggregate at the concrete production facility.
The Department will use the same size cylinder molds as the Contractor uses for his QC tests.. Use 4 x 8 or 6 x 12 inch cylinders for determination of the compressive strength. *[ADD "use throughout entire job – for consistency of test results.]***

346-6.3 Delivery Certification:

Sign the delivery ticket certifying that the ***design mix*** maximum specified water to cementitious materials ratio was not exceeded due to any jobsite adjustments to the batch of concrete, and that the batch of concrete was delivered and placed in accordance with the Contract Documents.

346-6.4 Tolerances: Meet the following tolerances from target values for plastic concrete properties specified in 346-3.1:
TABLE 6
Property Target Range Tolerance
Slump (Non-Drilled Shaft Concrete without

HRWR) ± 0.75 inch ± 1.5 inch
Slump (Non-Drilled Shaft Concrete with HRWR) ± 1.0 inch ± 1.5 inch
Slump (Drilled Shaft Concrete) ± 1.0 inch ± 1.5 inch
3460000
All Jobs
Air Content As shown in the range in Table 2
Reject concrete with slump or air content exceeding the above tolerances. Do not allow concrete to remain in a transporting vehicle to reduce slump. Water may be added only upon arrival of the concrete to the jobsite and not thereafter.
If the slump varies from the target range as described in Table 6, immediately adjust the concrete mixture to correct the slump of succeeding batches. The Engineer ***will allow a reasonable time*** ***[what do we mean – won't reject if failing?]*** for adjustment. Test each load to ensure only concrete meeting the specification is placed. The Engineer ***will take into consideration*** ***[what do we mean – won't reject if failing?]*** trucks already in route from the concrete production facility after the facility has been notified. If the Contractor does not implement adjustments at the earliest possible time, the Engineer will reject the concrete and terminate further production until the Contractor makes corrections. ***[If corrections are made, but concrete still fails, rejection still happens?]***

TABLE 7
Non-Agitator Trucks Agitator Trucks
45 minutes 60 minutes
3460000
All Jobs
75 minutes* 90 minutes*
*When a water reducing and retarding admixture (Type D, ~~***Type F***~~, Type G or Type II) is used. ***[Type F is not retarding. Will need to make exception everywhere else. If a Type F is used with a Type D then combination, but then so will the D above work; an F is just a double B]***

346-7.7 Adding Water To *to* Concrete at the Placement Site: Perform an initial slump before the addition of water at the jobsite. *If the slump is delivered within the target range, no water will be added to the load. If the slump is outside the target range but is within the tolerance range, that load may be accepted, but water added at [* ***ADD" the plant or"****]the site site will be reduced to maintain a slump within the target range on successive loads.* After adjusting the slump, perform a test to confirm that the slump of the concrete is within the target range as defined in Table 6. If the slump exceeds the target range but is within the tolerance range, that load may be accepted, but water added at the site will be reduced to maintain a slump within the target range on successive loads. If the slump is delivered within the target range, no water will be added to the load. Confirm with another test that the next load is within the target range after the addition of water at the placement site. Repeated incidents of concrete being placed outside the target range will result in revocation of that portion of the QCP. No concrete represented by plastic test results outside of the tolerance range will be accepted for placement.

346-7.8 Sample Location: *Describe concrete placement and sampling methods in the QCP.* Obtain samples from the point of final placement.
Where concrete buckets are used to discharge concrete directly to the point of final placement or into the hopper of a tremie pipe, samples will be obtained from the discharge of the bucket. When the concrete is discharged directly from the mixer into the bucket, with*in* a minimal lapse of [*25% of the allowable transit* time] ***[is this the remainder of the 90 minute transit time for that particular load, or is it a quarter fraction of the 90 minute transit period ?]*** before discharge of the bucket, samples may be obtained from the discharge of the mixer.

346-8 Plastic Concrete Sampling and Testing.

Ensure that each truck has a valid ***inspection card*** ***(in other spec sections this is termed the "truck ID card" [identification card]*** issued by the Department, the revolution counter on the mixer is working properly, and calibration of the water dispenser has been performed within the last twelve months and verify batch weights within required limits of the mix design. *Reject any concrete batches that are delivered in trucks that do not have* ***Department identification cards****. When the* ***identification card*** *is removed for noncompliance, forward the* ***identification card*** *to the District Materials Engineer in the District where the plant is located.*
Perform plastic concrete tests on the initial delivery of each concrete design mix each day. Ensure QC technicians meeting the requirements of Section 105 are present and performing tests throughout the placement operation. Ensure one technician is present and performing tests throughout the placement operation at each placement site. If a placement site has multiple concrete trucks, identify the number of technicians in the Quality Control Plan. If a placement site has multiple trucks placing concrete, then have at least two technicians present at that site. Ensure ~~all~~ *that the* equipment ~~utilized~~ *used for delivery, placement and finishing* meets ~~this~~ *the requirements of this* Specification. Do not proceed with the placement operation *until QC tests confirm that the delivered concrete complies with the plastic properties specified. When a truck designated for QC testing arrives at the site of discharge, subsequent trucks* ***and current concrete*** *may not discharge until QC testing results are known.* ~~until the delivered concrete complies with plastic properties specified~~. After placement begins, perform ***random*** QC tests to ensure compliance with Specification requirements. Reject non-complying loads which cannot be adjusted at the jobsite. Ensure that corrections are made on subsequent loads.

The Department ~~may~~ *will* perform Independent Verification testing at any time to evaluate the QC of the concrete*to verify compliance with specification requirements*. ~~The comparison between the Independent Verification testing and the QC testing is identified in the IA Checklist Criteria. When a test does not compare, the Contractor will revise the QCP as deemed necessary by the Engineer.~~ *When the Department's Independent Verification tests results do not meet the requirements of this Section, the Contractor will revise the QCP as deemed necessary by the Engineer.*

When the Department performs Independent Verification, the Contractor may test the concrete at the same time. The Department will compare results based on the Independent Assurance Checklist tolerances. ~~The Department reserves the right to notify the IA to review the testing procedures and equipment.~~

346-9 Acceptance Sampling and Testing.

346-9.1 General: Perform plastic properties tests in accordance with 346-8 and cast a set of three QC cylinders ***(either 4 inch by 8 inch or 6 inch by 12 inch cylinders are acceptable)[remove, stated in Table 5]***, for all structural concrete incorporated into the project. Take these acceptance samples randomly as determined by a random number generator (acceptable to the Department). The Department will independently perform *verification* plastic properties tests and cast a set of verification cylinders. The verification cylinders will be the same size cylinder selected by the Contractor, from a separate sample from the same load of concrete as the Contractor's QC sample.

346-9.5 Resolution Procedure: The Department may initiate an IA review of sampling and testing methods. The resolution procedure may consist of, but need not be limited to, a review of sampling and testing of fresh concrete, calculation of water cementitious materials ratio, handling of cylinders, curing procedures and compressive strength testing. Core s*amples* of the hardened concrete may be required.

The Engineer will determine through the resolution procedure whether the QC strength test results or the verification strength test results can be relied upon. When the Engineer cannot determine that either the QC or verification strength test results are in error, the concrete represented by the four consecutive LOTs will be evaluated based on the QC data. The Engineer will inform the QC and the Verification lab *within four working days of the acceptance compressive strength test* to transport their "hold" cylinders to the resolution lab ~~within five working days~~. *The QC and Verification laboratories will transport their own hold cylinder to the resolution testing laboratory* ***within 72 hours after the Engineer notifies the Contractor that a resolution is required***. In addition, the Engineer will ensure that the QC and verification "***hold"***

cylinders are tested within seven days of the 28 dayacceptance strength tests. [sum of days exceed 7 permitted. Make four @ two (ideal) or three; make 72 hours @ two days, so Resolution Lab can have time to condition poorly (dry/cold) transported cylinders and do some concrete internal investigation and report]

The resolution investigation will determine the strength test results for each of the four or less LOTs.

****