

## Volume I

### Section 9.2

## STRUCTURAL CONCRETE PRODUCTION

### 9.2.1 PURPOSE

This document provides guidance to those Florida Department of Transportation (Department) personnel who are involved in activities related to structural concrete production. The purpose of these guidelines is to standardize the activities associated with the structural concrete (hereinafter referred to as concrete) production facilities (Plants) used for Department projects statewide.

### 9.2.2 AUTHORITY

Sections 334.044 (2), 334.044 (10) (a), 334.048(3) and 20.23(3)(a) Florida Statutes.

### 9.2.3 REFERENCES

Code of Federal Regulations (CFR); Federal-Aid Policy Guide (FAPG); Subchapter G – Engineering and Traffic Operations, Part 637 – Construction Inspection and Approval, Subpart B – Quality Assurance Procedures for Construction.

American Society for Testing and Materials (ASTM) Standard Test Methods and Specifications, Philadelphia, Pennsylvania.

American Association of State Highway and Transportation Officials (AASHTO), Part II Tests, Washington, D.C.

Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

Florida Department of Transportation Approved Products List (APL).

### 9.2.4 SCOPE

The principal users of this document include the District Materials and Research Offices (DMRO) and the State Materials Office (SMO).

### 9.2.5 GENERAL INFORMATION

This document outlines the Department's requirements for Plant inspections, sampling of raw materials, and other activities associated with concrete production. These guidelines have been provided to ensure that the

implementation of the Plant's Quality Control (QC) Plan will result in the production of concrete that meets the specified quality standards. All Plants that wish to provide concrete for the Department projects are required to be on the Department's Production Facility Listing. The Plants are required to submit a proposed QC Plan to the Department in accordance with the **FDOT Specifications Section 105**. Upon acceptance of a Plant's QC Plan; a satisfactory initial Plant qualification review; and being added to the Production Facility Listing; the Plant may begin the production of concrete for Department projects.

The Department will inspect the Plants at a minimum frequency of once every three (3) months, or as described in this document. The inspection checklist found in the Materials Acceptance and Certification system (MAC) will be used as a guide to perform and document the inspections.

## 9.2.6 STATE MATERIALS OFFICE (SMO) ROLES AND RESPONSIBILITIES

The following are the SMO's roles and responsibilities:

1. The SMO provides concrete related technical support during reviews of the Plant's proposed QC Plan, initial Plant qualification, reviews of Plant's inspection and testing records, or other concrete related information that may be needed by the DMRO's quality assurance personnel.
2. When requested by the DMRO, the SMO representative will accompany District personnel during the Plant inspection.
3. Performs the required Resolution testing, when the DMRO conducts Verification testing and requests the SMO's assistance. The Resolution Procedure Guide for IA Evaluation of Noncomparable Test Results, Appendix A, may be used to assist in performing the Resolution inspection and testing.
4. Provides the test results, performed on those materials collected during the inspection process.
5. Provides information to DMRO personnel regarding current **FDOT Specifications** and inspection procedures.
6. The Director, Office of Materials, and staff will coordinate with the concrete producers and DMRO personnel to resolve issues related to the production of approved concrete mix designs.
7. Maintains a current list of facilities with accepted QC Plans.

8. Provides technical support for the testing concrete design mixes and any other required testing.
9. Performs chloride testing.
10. Approves expedited aggregate source substitutions for approved base mix design under certain conditions.

### **9.2.7 DISTRICT MATERIALS AND RESEARCH OFFICE (DMRO) ROLES AND RESPONSIBILITIES**

The following are the DMRO's roles and responsibilities:

1. Reviews, accepts, or rejects a proposed QCP.
2. Performs the initial and routine Plant qualification reviews.
3. Performs concrete materials sampling and testing.
4. Assigns a unique Plant number, to the Plants with accepted QC Plan.
5. Maintains a copy of the Producer's QCP in accordance with the requirements of ***Materials Manual Section 5.6 Volume I***.
6. Performs the inspection and sampling functions at all Plants that are located within the District. The inspection of Plants located out of state is the responsibility of the DMRO with QC Plan acceptance authority.
7. Obtains split chloride testing samples once a year with the Plant personnel, in accordance with ***Materials Manual Section 9.2 Volume II***, for comparing the test results.
8. Ensures that the accepted QC Plan includes the minimum criteria required to produce concrete within the requirements of the ***Contract Documents*** on all Department projects. The detailed functions of the personnel performing the initial Plant qualification review process are described in this section.
9. Performs routine Plant qualification reviews of those Plants that continue to furnish concrete for Department projects. The detailed functions of the routine Plant qualification reviews are described in this Section.

#### **9.2.7.1 INITIAL PLANT QUALIFICATION REVIEW PROCESS**

The DMRO will review the proposed QC Plan submitted by the Plant in accordance with the ***Materials Manual Section 5.6 Volume I*** and make arrangements for the initial Plant qualification review.

The DMRO personnel will perform the initial qualification review of the Plant. Upon completion of the Plant qualification review, the inspector will submit recommendations to the DMRE or their representative regarding the QC Plan acceptance. If needed, the DMRE or their representative will investigate the Plant and its quality control procedures related to areas of non-compliance and/or unacceptable materials.

The DMRE or their representative will accept or reject the Producer's QC Plan based on a review of the Producer's QC Plan and the initial Plant qualification review recommendations. A concrete Plant number will be assigned, and the required information will be entered in MAC in accordance with **Materials Manual Section 5.6 Volume I**. The Plant and/or its QC procedures may be inspected at any time.

### 9.2.7.2 ROUTINE PLANT QUALIFICATION REVIEWS

The DMRO monitors the Plant's QC operations at least once every three months or at a reduced inspection frequency, if approved by DMRE, to ensure conformity with the Contract Documents and the QC Plan. The DMRO performs the inspection and sampling of the materials at the Plant to verify the effectiveness of the QC Plan since the last inspections. Department inspectors will not issue instructions to a Plant's representatives on how to run their operations.

#### (A) Plant's Routine Quality Control Review

The Verification inspector reviews the following items during routine Plant inspections:

1. Reviews the Plant's records for materials received at the Plant.
2. Verifies that the scales, meters, and calcium nitrite dispensing equipment are calibrated.
3. Checks the records showing that the suppliers of the admixture/water dispensers have annually certified the accuracy of their equipment.
4. Ensures that the records are adequate to verify that all materials meet the requirements of the Contract Documents and the accepted QC Plan.
5. Reviews the batching sequence, mixing devices, and method of delivery of concrete to ensure compliance with the requirements the Contract Documents and the accepted QC Plan.
6. Reviews the handling and storage processes for each of the materials to ensure compliance with the FDOT Specifications.

7. For miscellaneous materials, such as admixtures for concrete, will ensure that the Plant has used products listed on the Approved Products List (APL) and applicable material certifications to verify compliance with Contract Documents requirements are on file.
8. Documents inspection process and include this information as part of the project's records, where possible.
9. May sample any material and submit the sample to DMRO or SMO as needed for testing to ensure compliance with the Contract Documents.
10. Ensures that the Plant's Manager of Quality Control (MOQC) and other Plant QC personnel are performing the required Plant QC duties.
11. Ensures that the Plant is following the requirements of the QC Plan.

(B) Production or Quality Control Deficiencies

The Verification inspector evaluates that the Plant is in compliance with the requirements of the accepted QC Plan and Contract Documents. The Verification inspector documents and notifies the Plant's MOQC of any deficiencies noted during the inspections. An appropriate time frame should be established for the MOQC to correct any deficiencies noted during the inspection.

When evidence shows that the Plant has failed to sample for chlorides within the required frequency, an increased sampling frequency will be implemented. The Plant shall sample concrete for chlorides testing at a frequency of once per week during production until the approval to return to the normal sampling frequency is given by the DMRE or their representative. Failure to comply with the sampling frequency shall be cause for suspension of the QC Plan.

If necessary, the MOQC and Project Administrator (PA) should be notified in writing that the QC Plan will be suspended in accordance with the **Materials Manual Section 5.6 Volume I**. If a Plant does not correct noted deficiencies, the DMRE or their representative will suspend the QC Plan. The Plant's QC Plan acceptance status will be reinstated upon satisfactory resolution of deficiencies found by the Department.

(C) Reduced Inspection Frequency

The Plant may request a reduced inspection frequency if it meets the requirements of **Materials Manual Subsection 9.2.5 Volume II**.

Suspension of a QC Plan for a Plant on a reduced inspection frequency will result in the Plant returning to a minimum inspection frequency of once every three months for a minimum of six months.

### 9.2.7.3 CONCRETE MIX DESIGN

The DMRE or their representative will monitor or otherwise review the proportioning, mixing and testing of structural concrete mix designs at their discretion and as resources permit. When the mix design properties and components have been verified, the DMRO will submit the mix design request through MAC to the SMO. The SMO will review the mix design request for approval. Those mix designs with final properties or components that cannot be verified will be returned to the producer as unacceptable for use on Department projects.

The DMRE or their representative will review the proposed cement, aggregates, and supplementary cementitious materials substitution in accordance with ***Materials Manual Section 9.2 Volume II***. The DMRO will submit the mix design request through MAC to the SMO. The SMO will review the mix design request for approval.

Mix designs requiring additional transit time exceeding those limits found in ***FDOT Specifications Section 346*** requires Department Approval.

The DMRO will acknowledge the availability of concrete mix design components per project and Plant in MAC on the Contractor QC Plan.

### 9.2.7.4 CONCRETE MIXER DESIGN

The DMRE or their representatives will review and approve the use of concrete mixers that have been altered from the original design with respect to blade design and arrangement, or drum volume, with mixer manufacturer concurrence.

Upon request from the Plant, the DMRE or their representative will issue a mixer identification card for truck mixers meeting the requirements of ***Materials Manual Section 9.2 Volume II*** and ***FDOT Specifications Section 346***.

### 9.2.7.5 CHLORIDE TESTING -- MONITORING

The Department will monitor the chloride content through comparison samples at a minimum frequency of one sample for each Plant every 12 months. DMRO personnel will obtain split samples in accordance with the ***Materials Manual Section 9.2 Volume II*** for testing by an approved DMRO laboratory or the SMO laboratory.

### 9.2.7.6 RESOLUTION

The Project Administrator (PA) initiates the resolution procedure of the concrete compressive strength test results in accordance with **FDOT Specifications Section 346**, when the results of concrete Quality Control (QC) and Verification Test (VT) do not compare. The PA with input from the District Materials and Research Office (DMRO) will determine whether the QC or VT results are more accurate.

When the VT test cylinders are not available, or the accuracy of the test results cannot be determined by comparison of the test results of the resolution test cylinders or core samples, the DMRO may initiate an Independent Assurance (IA) review of concrete sampling and testing methods. The IA resolution procedure may consist of, but not be limited to the review of the following activities:

1. Sampling and testing procedure of fresh concrete.
2. Calculation of water to cementitious materials ratio.
3. Handling, curing, and compressive strength testing procedure of the cylinders.

The DMRO will conduct the required IA evaluation of the resolution investigation when advised of the requirement by the PA. The Resolution Procedure Guide for IA Evaluation of Noncomparable Test Results, Appendix A may be used to assist in performing the Resolution Investigation. When the DMRO is providing verification support to the PA and requests assistance of the other DMROs, through an agreement between Districts, the other DMROs or the SMO will perform the IA resolution investigation responsibilities.

### 9.2.7.7 SLUMP LOSS TEST

The DMRO will witness all Slump Loss Tests. The Slump Loss Test shall be conducted using the procedures in **Materials Manual Section 9.2 Volume II**. The results of the Slump loss tests are required to be entered in MAC. The Slump Loss Test data may be used for lower temperature placements without any admixture adjustments.

### 9.2.7.8 CONCRETE WITH LUMPS AND BALLS

When lumps and balls are found in the delivered concrete of a project, the PA will advise the DMRO. The DMRO will use the following guidelines to evaluate and address the issue of concrete with lumps and balls:

1. The DMRO will make a note for future Plant inspections, when lumps and balls are present in one truck of delivered concrete to the project

site.

2. If a second truck of concrete exhibits lumps and balls, the DMRE or their representative will inspect the Plant to ensure compliance with the Producer's QC Plan.
3. Should subsequent trucks exhibit lumps and balls, the DMRE or their representative will notify the producer that the Department will not accept concrete until the Plant demonstrates its ability to batch a full-size load of concrete free of lumps and balls. In addition, the Plant will revise that portion of the QC Plan that addresses the batching of concrete to reflect QC improvements.

### 9.2.8 TRAINING

Department personnel performing as verification inspectors are required to pass the ***Concrete Batch Plant Operator's*** written examination.

### 9.2.9 FORMS

Resolution Procedure Guide, for Noncomparable Test Results, IA Evaluation.  
Appendix A



## Appendix A

### Resolution Procedure Guide for IA Evaluation of Noncomparable Test Results

The following checklist provides guide for Independent Assurance (IA) Evaluation of the Resolution procedure, including the review of the Quality Control (QC), Verification Test (VT), QC Hold Cylinder (QR), and Verification hold Cylinder (VR) test data.

The District Materials Office IA Inspectors use the checklist as guidelines for evaluation of the data and preparation the report regarding the most accurate test data. The IA marks either Yes, No, or N/A columns for each item and enters remarks (R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, etc.) in the Remarks column, if needed. The explanation of each remark will be provided in the Remarks part of the Appendix.

SAMPLE INFORMATION					
1	Financial Number:				
2	Quality Control (QC) Sample Number:	Verification Test (VT) Sample Number:			
3	QC Sample Number in MAC:				
4	VT Sample Number in MAC:				
5	Design Mix Number:	Required Strength:			
<b>Remarks</b>					
VERIFICATION		Compliance			
		Yes	No	N/A	Remarks
1	QC and VT data meets Comparison Criteria ( <b>Specification Section 346</b> )				
2	VT Data is available for Comparison with QC ( <b>Specification Section 346</b> )				
3	Engineer initiates Resolution Procedure ( <b>Specification Section 346</b> )				
<b>Remarks</b>					
RESOLUTION PROCEDURE		Compliance			
		Yes	No	N/A	Remarks
1	QC and VT labs have delivered resolution cylinders (QR and VR) to resolution lab within 72 hours of being notified of resolution requirement ( <b>Specification Section 346</b> and ASTM C31).				
2	Hold cylinders are tested within fourteen days of the 28-day compressive strengths ( <b>Specification Section 346</b> , ASTM C39 and ASTM C511).				
3	Reviewed QR and VR hold cylinder test data. The QR data compares with the QC and VR data compares with VT test data.				

RESOLUTION PROCEDURE		Compliance			
		Yes	No	N/A	Remarks
4	Reviewed QC and VT field data for trends and inconsistencies.				
5	Reviewed QC and VT lab data for trends and inconsistencies.				
6	Implement a Field review:				
	Has IA been conducted with technician? If yes review IA data (ASTM C31, C143, C173 or C231) Follow up review may be required				
	Has IA been conducted with technician? If NO, implement IA procedures.				
	Reviewed Initial Curing facility ( <b>Specification Section 346</b> ) (ASTM C31).				
	Reviewed transportation procedure and equipment (ASTM C31).				
7	Summarized Field review.				
8	Implement a Lab review:				
	Has IA been conducted with QC Lab? If yes reviews IA data (ASTM C39, C511, C617 or C1231). Follow up review may be required.				
	Has IA been conducted with VT Lab? If yes reviews IA data (ASTM C39, C511, C617 or C1231). Follow up review may be required.				
	Has IA been conducted with QC Lab? if no implement IA procedures.				
	Cylinder end preparation was the same and in accordance with C39.				
	Loading rate when testing cylinders was in accordance with C39.				
	Has IA been conducted with VT Lab, if no implement IA procedures?				
	Reviewed Final Curing facility (ASTM C31 and ASTM C511).				
9	Summarized Lab review				
10	Core structure (at area of known non-comparing concrete).				
<b>Remarks</b>					
<b>CONCLUSION</b>					
	Based on the IA Evaluation Review of noncomparable test results, the following are the reviewer's recommendations to Project Administrator:				
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