

## **Section 6.3**

### **Volume I**

# **QUALITY ASSURANCE PROGRAM OF PRECAST CONCRETE DRAINAGE STRUCTURES AND BOX CULVERTS**

### **6.3.1 PURPOSE**

This procedure provides guidance to Florida Department of Transportation (Department) personnel and their designees related to the implementation of the quality assurance (QA) programs for precast concrete box culverts and drainage structures (Structures).

### **6.3.2 AUTHORITY**

Sections 20.23(4)(a) and 334.048(3), Florida Statutes

### **6.3.3 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 Sections

Standard Plans for Road and Bridge Construction, Topic No. 625-010-003, Florida Department of Transportation (FDOT)

Florida Department of Transportation Standard Specifications for Road and Bridge Construction

Materials Manual Volume II, Section 6.3 Precast Concrete Drainage Structures and Box Culverts, Florida Department of Transportation

American Society for Testing and Materials (ASTM) International Standard Test Methods and Specifications

American Association of State Highway and Transportation Officials (AASHTO), Part I Specifications, and Part II Tests

Approved Products List (APL), Florida Department of Transportation

Materials Acceptance and Certification (MAC) System, Florida Department of Transportation

Materials Acceptance and Certification system (MAC) QC Program Maintenance User Manual

### 6.3.4 SCOPE

Primary offices affected by this procedure include the State Materials Office (SMO), District Materials and Research Offices (DMRO), District Construction Offices (DCO), and the State Drainage Office.

### 6.3.5 GENERAL INFORMATION

The Precast Concrete Box Culverts and Drainage Structures Plants (Plants) produce, inspect, store, and ship Structures meeting the requirements of the **Specifications** and other **Contract Documents**. The DMRO verifies that manufactured Structures conform to the requirements of the **Contract Documents**. The DMRO accepts (approves) their Quality Control (QC) Plans and inspects the Plants prior to commencement of production for Department projects.

### 6.3.6 DMRO RESPONSIBILITIES

#### 6.3.6.1 Plant Qualification Review

The Plant submits the proposed QC Plan in compliance with **Materials Manual Section 5.6**. The DMRO makes arrangements for the Plant qualification review, including Plants that are submitting their first QC Plan, as well as for Plants that have not produced for any Department projects for more than one year.

The DMRO forms the Plant qualification review team and performs the review. The qualification review team shall include the District and State precast concrete representatives. The qualification review team may also include other personnel, including District structural materials engineers, District concrete production managers, District and State drainage engineers, the verification inspectors, and representative(s) of the Federal Highway Administration (FHWA).

The qualification review team reviews the Plant's manufacturing process, QC testing, inspection, and documentation. The qualification review team may also review the Plant's records, forming, reinforcing steel placement, concrete placement operations, storage, and shipment of the products.

Upon the satisfactory Plant qualification reviews, the DMRO accepts (approves) the proposed QC Plan and documents the Plant's status in the Materials Acceptance and Certification system (MAC).

#### 6.3.6.2 Maintenance of Plant QC Plan and Qualification

The Plant submits, in writing, any changes to the QC Plan to the DMRO and annually submits the revised QC Plan or its addendum, if there are any changes.

Plants that are on the Department’s **Production Facility Listing** will be subject to a Plant qualification review or routine verification inspection at any time. At a minimum, quarterly verification inspections will be performed by DMRO personnel. If the qualification review team or verification inspectors find any process which would result in products not meeting the **Specifications**, they shall immediately bring it to the attention of the Plant. The Plants with acceptable QC Plans and satisfactory qualification reviews are considered to be qualified Plants.

**6.3.6.3 Routine Inspection and Materials Testing of Qualified Plants**

The DMRO shall make sure that the Plants perform all QC sampling and testing of the **346 Specification** designated class of concrete in accordance with **FDOT Specifications Section 346**.

When AASHTO or ASTM designated classes of concrete are used, perform the inspections, as well as sampling and testing, as specified below and in the applicable ASTM and AASHTO specifications and test methods. The absorption testing requirements of **ASTM C478** are waived for concrete inlets, manholes, junction boxes, and endwalls.

The inspections, sampling, and testing are performed as specified in applicable **FDOT Specifications Sections 407, 410, 449**, except as modified herein. The verification inspector performs the required inspection, sampling, and testing activities as summarized in Table 1.

If the Plant has not produced for Department projects for three consecutive quarters, the verification inspection frequency will be reduced to once every three quarters until the Plant produces for Department projects again. In addition, sampling and testing of materials is waived during periods that the Plant is not producing for Department projects. The minimum verification, sampling, and testing frequencies shall revert back immediately after the Plant reinitiates production for Department projects.

<b>Table 1 – Verification Inspection, Sampling, and Testing Activities</b>	
<b>Materials / Activities</b>	<b>Minimum Frequency</b>
Coarse Aggregate	Certification
Fine Aggregate	Certification
Cementitious Materials	Certification
Admixtures	Certification. Admixtures may be used when listed on the <b>APL</b> , or approved by the DMRO.
Water (Chemical Analysis)	Check the Plant’s testing record for compliance with <b>FDOT Specifications Section 923</b> .
Reinforcing Steel	Sample one LOT every six months, per Plant

Welded Wire Reinforcement (WWR)	Sample one LOT every six months, per Plant
Fiber Reinforced Polymer (FRP) Reinforcement	Check the Plant's records for compliance with <b>FDOT Specifications Section 932</b> .
Patching Materials	Meet the applicable requirements of <b>FDOT Specifications Sections 407, 410, 449</b> . Pre-mixed, packaged compounds may be used when listed on the <b>APL</b> or approved by the DMRO.
Plastic Property Tests	When the specification requires plastic property tests, at a minimum frequency of once per quarter, sample plastic concrete and perform slump, temperature, and air content tests.
Concrete Strength Tests: Core Samples, Test Cylinders	When the acceptability of Structure is based on core or cylinder tests, at a minimum frequency of once per quarter, sample and test compressive strength cylinders or test core samples, provided by the Plant.
Absorption Tests	Perform one verification absorption test per quarter per project for dry cast precast concrete box culverts. Absorption tests are waived for wet cast precast drainage structures.

#### 6.3.6.4 Responsibilities of the Verification Inspector

Following are the general responsibilities of the verification inspector:

- A. At a minimum frequency of once per quarter, reviews the records for materials received at the Plant and/or incorporated into the fabrication of Structures, including the certified physical property reports.
- B. Verifies that the QC inspectors maintain the required certification documents.
- C. Randomly selects samples from at least one LOT of reinforcing steel and Welded Wire Reinforcement (WWR) every six months.
- D. Verifies that the Plant is complying with the Buy America requirements outlined in **Materials Manual Volume II, Section 6.3**.
- E. Samples other Structures material components, as needed.
- F. Checks the handling and storage for each material component of Structures.
- G. Visually checks the condition of steel reinforcement.

- H. Ensures that the Plant's QC manager and inspectors are performing inspections in compliance with the QC Plan.
- I. Performs random spot-checks of the finished Structures to ensure that they are fabricated in compliance with the requirements of the **Contract Documents**.
- J. Performs in-depth reviews of some phases of work, as needed.
- K. Advises the QC manager of any observed deficiency.
- L. Performs spot checks of the repair methods.
- M. Advises the QC manager of the acceptability status of QC test results.
- N. Ensures that approved Producer shop drawings are present in the QC Plan for any routinely produced Drainage Structures that deviate from the **Standard Plans**.
- O. Documents the results of the inspections in MAC. Verification inspectors shall perform plant inspections in accordance with the QC Program (QCP) checklists in MAC. The results of the inspections shall be documented in MAC if the inspector has the access, otherwise verification inspectors shall document results of the QCP checklist inspections outside of the MAC system for each required inspection. Copies of the most current checklists can be accessed by anyone at <https://mac.fdot.gov> by clicking the Reports tab link and navigating to the Inspection/Evaluation Checklists under the Production Facility tab, choosing QCP under Checklist type, and selecting the appropriate Production Facility.

#### 6.3.6.5 Sampling and Testing of Structure Material Components

##### A. Reinforcing Steel

Each LOT of reinforcing steel is accepted based on the certified mill analysis from the steel manufacturing plant and Department's verification samples. Select samples randomly from at least one LOT every six months.

A sample shall consist of three seven-foot long bars. Send one of the bars from each LOT to the SMO for testing. Properly identify and tag the remaining two bars as check samples for future testing in the event of a failure.

If the sample meets the requirements of the Specifications, accept the LOT. All reinforcing steel materials subsequent to the previous passing verification tests are considered acceptable.

If the sample fails to meet the requirements of the Specifications, send the remaining two check samples for testing. Reject the LOT of reinforcing steel if the results of any two samples of the same LOT fail.

B. Welded Wire Reinforcement (WWR)

Each LOT of WWR is accepted based on the certified mill analysis from the steel manufacturing plant and Department's verification samples. Select samples randomly from at least one LOT every six months.

A sample shall consist of three sections, three-foot by three-foot each. Send one of the sections from each LOT to the SMO for testing. Properly identify and tag the remaining two sections as check samples for future testing in the event of a failure.

If the sample meets the requirements of the Specifications, accept the LOT. All WWR materials subsequent to the previous passing verification tests are considered acceptable.

If the sample fails to meet the requirements of the Specifications, send the remaining two check samples for testing. Reject the LOT of WWR if the results of any two samples of the same LOT fail.

C. Fiber Reinforced Polymer (FRP) Reinforcement

FRP reinforcing bars are obtained from producers on the Department's **Fiber Reinforced Polymer Production Facility Listing**. FRP reinforcing from each producer is accepted based on the requirements of **FDOT Specifications Section 932**.

D. Certified Materials

Accept aggregates, cementitious materials, chemical admixtures, and patching materials based on certification. Ensure that the Plants use only the admixtures that are listed on the **APL** or approved by the DMRO as part of their QC Plans. The **APL** includes the admixtures that are listed in **FDOT Specifications Section 924**. Similarly, the Plants may propose the Structures repair methods and repair materials as part of the Plant's QC Plan.

The verification inspector checks that the QC inspector maintains the required documentation.

At the DMRO's discretion, the verification inspector may take samples of any certified materials.

### 6.3.6.6 Inspection and Testing Prior to and During Structures Manufacturing Process

The verification inspector performs the following inspections, prior to and during concrete placement:

- A. Reviews the **Plans**, **Standard Plans**, shop drawings, **Specifications**, and performs a random review of the Plant's fabrication methods, procedures, workmanship, and QC inspection records.

- B. Checks the Plant's basis for acceptance of miscellaneous Structures materials.
- C. Performs a random review and visual inspections of all other major phases of work, such as formwork, and reinforcing steel placement.
- D. Inspects delivery, placement, and consolidation process of concrete.
- E. Takes concrete test cylinders from a randomly selected LOT, at a frequency of one sample per quarter, during concrete placement, if the acceptability of Structures is based on the cylinder test. In lieu of test cylinders, take core sample, from a randomly selected LOT of manufactured Structures during post-manufacturing inspection and testing of Structures, if acceptability of the Structures is based on the core test.
- F. Inspects the finishing and curing process of concrete.
- G. Inspects the storage of materials that will be used for the manufacturing of Structures.
- H. Documents the results of the inspections in MAC.

#### 6.3.6.7 Post-Manufacturing Inspection and Testing of Structures

The verification inspector performs the following during the inspection of stored Structures at the Plant:

- A. Verifies the QC testing and inspection records of manufactured Structures.
- B. Takes core samples from a randomly selected LOT of manufactured Structures, if acceptability of the Structures is based on core test.
- C. Inspects any finished manufactured Structures, including the products that are stored in the Plant and have been stamped.
- D. Visually inspects the manufactured Structures and randomly selects at least one of the stamped LOTs to determine if the Structures are free from deficiencies. Checks the dimensions of the Structures to verify they meet the specified dimensional tolerances.
- E. Performs visual inspection of all stored manufactured Structures and measures the dimensions of at least 5% of the randomly selected Structures in the LOT.
- F. Advises the QC manager to reject any Structure that does not fully comply with the requirements of the **Specifications** or other **Contract Documents**.
- G. Advises the Plant to remove the acceptance stamps from rejected Structures.
- H. Visually inspects the repaired Structures and repair methods.
- I. Compares verification test results to the QC acceptance test results.

J. After each inspection, the verification inspector provides a list of deficiencies and discusses them with the Plant's QC manager.

K. Documents the results of the inspections in MAC.

#### **6.3.6.8 Acceptance Status of QC Test Results**

The verification inspector performs quarterly inspection and testing. Use the QC test results for acceptance of Structures, when the QC results compare favorably with the verification test results. Consider the QC and verification tests as favorable when the results of both tests are either both passing or both failing. Consider the test results not favorable, when one of the test results passes and the other one fails. If the comparison is not favorable, the Department and the Plant proceed to the resolution inspection and testing.

#### **6.3.6.9 Close-out Meeting and Documentation**

The following are the responsibilities of the verification inspector upon completion of each inspection:

A. Meets with the QC manager at the completion of each inspection. During the meetings, the verification inspector discusses deficiencies found during the inspections.

B. Maintains the documentation of the inspection activities, as well as key discussions with the Plant personnel.

C. Maintains a record of the verification testing and disposition of all material samples taken for testing.

D. For each component, the verification inspector assures that the QC manager maintains documents indicating compliance with the QC Plan.

E. Documents deficiencies that have caused the suspension of the Plant's QC Plan and maintains documentation of the Plant's corrective actions.

F. Documents the results of the inspections in MAC.

#### **6.3.6.10 Resolution Procedure**

The DMRO initiates the resolution procedure. The resolution procedure may consist of Independent Assurance (IA) inspection, sampling, and testing of the products. Upon the review of the records, test procedures, and additional inspection, sampling and testing, the resolution inspector reports the cause of the non-comparable results.

If the resolution testing compares favorably with the Plant's QC data, accept the QC data. If the resolution testing compares favorably with the verification data, use the verification data for acceptance. The test results of a LOT are considered to be non-comparable when one result passes and the other result fails.



Based on the resolution results, the DMRO determines the disposition of any failed LOT and the LOTs subsequent to the previous verification test. The investigations may consist of verification/resolution sampling and testing of the two available LOTs of the Structures that have been manufactured immediately prior to the failed LOT. If any of the LOTs fails, the verification inspector tests two more available LOTs and continues testing backward until the results of the two verification LOTs compare favorably with the results of the QC testing. The verification inspector advises the Plant to reject all failed verification/resolution LOTs. The resolution and verification Inspectors will use the same type of tests that QC inspectors are using.

#### **6.3.6.11 Independent Assurance (IA) Inspection and Testing**

IA sampling and testing are performed in accordance with *Materials Manual Section 5.5*.

#### **6.3.6.12 Independent Verification (IV)**

The Department may perform IV at any time by sampling and testing any Structure or its material ingredients. This is a checking function outside of the verification program.

#### **6.3.6.13 Process Reviews**

The SMO will perform annual process reviews in each District and generate a report. The intent of the process reviews is to ensure consistency in procedures and policy enforcement across the state. The review includes the verification of *Materials Manual Volume I, MAC QC Program Maintenance User Manual*, and any other relevant document requirements. DMRO will respond to any action items outlined in the report within the specified time frame.

### **6.3.7 SMO RESPONSIBILITIES**

Following are responsibilities of the SMO:

- A. Provides precast concrete materials technical support for the DMRO and Construction personnel.
- B. Serves as member of the Plant qualification review team.
- C. Performs process reviews with DMRO precast concrete personnel and generates a report.
- D. Provides information regarding specification changes and inspection procedures to the DMRO.
- E. Coordinates with the Plant, DMRO, and Construction personnel to discuss any repeated deficiencies of the manufactured Structures.
- F. Reviews the proposed training and qualification programs and issues the accreditation letters to the qualified providers.

- G. Maintains the list of accredited precast concrete courses.
- H. May accompany District personnel during quarterly Plant inspections, and Independent Verifications.

### **6.3.8 STATE DRAINAGE OFFICE RESPONSIBILITIES**

The State Drainage Engineer reviews the plans for modified or special designs requested by the Plant. The State Drainage Office reviews and approves the Plant's proposed modifications and distributes them to the Plant, District Construction Office, DMRO, and the SMO.

### **6.3.9 STATE STRUCTURES DESIGN OFFICE RESPONSIBILITIES**

The State Structures Design Office approves any changes to the standard structural drawings.

### **6.3.10 DISTRICT CONSTRUCTION OFFICE RESPONSIBILITIES**

Project personnel accept only Structures that are properly marked by the Plant's approved QC stamp. Project personnel do not accept any Structure that has been severely damaged during delivery or unloading.

The personnel at the project site shall make sure that a legible QC stamp is affixed to each Structure that is received at the job site.

Ensure that at the beginning of each project, the Plant provides a notarized statement to the project administrator (PA) from a responsible company designated representative certifying that the Plant will manufacture the products in accordance with the requirements set forth in the **Contract Documents** and the Plant's approved QC Plan. The sample certification statement may be viewed at the SMO web site.

Ensure that each delivery ticket of the shipped products includes the Financial Project Number, manufactured date and serial number of each product.

### **6.3.11 TRAINING**

#### **6.3.11.1 General**

Ensure that the Plant's QC personnel and Department inspectors who are involved in the inspection and testing of the Structures have the required qualifications as specified in **FDOT Specifications Section 105**.

Ensure the Plant's QC Plan include a copy of the certificates of their qualified QC personnel.

### **6.3.11.2 Department Inspectors of Precast Concrete Drainage Structures and Box Culverts**

Department inspectors who are involved in the testing and inspection of the precast concrete drainage Structures and box culverts shall be Level II Quality Control Inspectors.

### **6.3.12 FORMS**

None needed.