VOLUME I

Section 6.3

QUALITY ASSURANCE PROGRAM OF PRECAST CONCRETE BOX CULVERTS AND DRAINAGE STRUCTURES

6.3.1 PURPOSE

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

6.3.2 AUTHORITY

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

6.3.3 REFERENCES


Design Standards Topic No. 625-010-003, Florida Department of Transportation.


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

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

Approved Products List, Florida Department of Transportation.
Field sampling and Testing Manual, Florida Department of Transportation.

6.3.4 **SCOPE**

Primary offices affected by this procedure include the State Materials Office, District Materials Offices, District Construction Offices, and 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 District Materials and Research Offices verify that manufactured Structures conform to the requirements of the Contract Documents. The District Materials and Research Office accepts (approves) their quality control plans and inspects the Plants prior to commencement of any work.

6.3.6 **DISTRICT MATERIALS OFFICES RESPONSIBILITIES**

6.3.6.1 **Plant Qualification Review Process**

6.3.6.1.1 **Plant's Initial and Annual Qualification Review**

The Plant submits the proposed quality control plan in compliance with **Section 5.6 of the Materials Manual**. The District Materials and Research Office (DMRO) makes arrangements for the Plant's initial and routine annual qualification reviews, including Plants that are submitting their first quality control Plan as well as the 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 Engineer, District Concrete Production Manager, District and State Drainage Engineers, the Verification Inspectors, and representative(s) of the Federal Highway Administration.
The qualification review team reviews the Plant’s manufacturing process, quality control 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. The review team checks the Plant’s production process.

Upon the satisfactory plant qualification reviews, the DMRO accepts (approves) the proposed quality control plan and documents the Plant’s status as “A” on the Department’s Production Facility Listing.

6.3.6.1.2 Maintenance of Plant Quality Control Plan and Qualification:

The Plant submits, in writing, any changes to quality control plan to the District Materials Office and annually, submits the revised quality control 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 at any time. If the qualification review team or Verification Inspectors find any process which would result in products not meeting Specifications, they shall immediately bring it to the attention of the Plant. The Plants with acceptable quality control plans and satisfactory qualification reviews are considered to be qualified Plants.

6.3.6.2 Routine Inspection and Materials Testing of Qualified Plants

6.3.6.2.1 General

The District Materials Offices shall make sure that the Plants perform all quality control sampling and testing of the 346 Specification designated class of concrete in accordance with the 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 C 478 are waived for the concrete inlets, manholes, junction boxes, and endwalls.

The inspections, sampling, and testing are performed as specified in applicable 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.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Minimum Inspection, Sampling and Testing Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Aggregate</td>
<td>Certification with each shipment</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td>Certification with each shipment</td>
</tr>
<tr>
<td>Cementitious Materials</td>
<td>Certification with each shipment</td>
</tr>
<tr>
<td>Admixtures</td>
<td>Certification with each shipment. Admixtures may be used, when it is listed on the Approved Products List, meeting the requirements of Section 924-2 of the Florida Department of Transportation Specifications or approved by the District Materials Office.</td>
</tr>
<tr>
<td>Water Chemical Analysis</td>
<td>Check the Plant's testing record for compliance with Section 923 of the Florida Department of Transportation Specifications.</td>
</tr>
<tr>
<td>Reinforcing Steel</td>
<td>Sample from two LOTs per year per Plant</td>
</tr>
<tr>
<td>Patching materials</td>
<td>Meet the applicable requirements of Sections 407, 410, or 449 of the Florida Department of Transportation Specifications. Pre-mixed packaged compounds may be used, when it is listed on the Approved Products List or approved by the District Materials Office.</td>
</tr>
<tr>
<td>Plastic Property Tests</td>
<td>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.</td>
</tr>
<tr>
<td>Concrete compressive strength tests: core samples and Test cylinders</td>
<td>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</td>
</tr>
</tbody>
</table>
cylinders or test core samples, provided by Plant.

Absorption test
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.

6.3.6.2.2 Responsibilities of Verification Inspectors

6.3.6.2.2.1 General

The following are the general responsibilities of Verification Inspectors:

(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 quality control Inspectors maintain the required certification documents.

(C) Randomly selects two Lots of reinforcing steel and welded wire reinforcement and takes sample from each LOT.

(D) Samples other Structures material components, as needed.

(E) Checks the handling and storage for each material component of Structures.

(F) Visually checks the condition of steel reinforcement.

(G) Ensures that the Plant’s quality control manager and inspectors are performing inspections in compliance with the quality control plan.

(H) Performs random spot-checks of the finished Structures to ensure that they are fabricated in compliance with the requirements of the Contract Documents.

(I) Performs in-depth review of some phases of work, as needed.

(J) Advises the quality control manager of any observed deficiency.
6.3.6.2.2.2 Sampling and Testing of Structure Material Components

6.3.6.2.2.2.1 Reinforcing Steel

Each LOT of the reinforcing steel is accepted based on the certified mill analysis of the steel manufacturing plant and Department’s Verification samples. Take steel samples from at least two LOTs per year. From each of the randomly selected LOT of reinforcing steel, take three seven-foot long samples.

Send one of the samples from each LOT to the State Materials Office for testing. Properly identify and tag the remaining samples for future testing in the event of failure of the first sample.

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

If the first sample fails to meet the specified requirements, send the second sample for testing. If both samples fail to meet the specified requirements, reject the LOT of steel.

If one sample fails and one sample passes, send the third sample to confirm material acceptability. Reject the LOT of the reinforcing steel if the results of any two samples of the same LOT fails.

6.3.6.2.2.2 Sampling and Testing of Welded Wire Reinforcement

The welded wire reinforcement is accepted based on certified mill analysis of the welded wire reinforcement manufacturer. The Verification Inspector may request the quality control personnel to take samples of welded wire reinforcement at any time when there is a concern related to the validity of the
certification test data. The Verification Inspector will request the quality control personnel to take samples from at least two LOTs per year. From each of the two randomly selected LOTs of welded wire reinforcement, three samples should be taken in accordance with ASTM A 1064.

Send one of the samples from each LOT to the State Materials Office for testing. Properly identify, tag and store the remaining samples for future testing in the event of failure of the first sample. If first sample passes, the LOT is accepted based on the welded wire reinforcement manufacturer’s certification and Verification test results. All welded wire reinforcement deliveries to the Plant, subsequent to the previous Verification test, are considered acceptable. If the first sample fails to meet the specified requirements, the second sample shall be tested. If both samples fail to meet specified requirements, the LOT of material will be rejected and replaced with material meeting the requirements. If one sample fails and one sample meets the specified requirements, the third sample may be tested to confirm material acceptability. The LOT of the welded wire reinforcement will be rejected if the results of the two samples of the same LOT fails.

Reject each LOT of material that does not conform to the requirements of the specification and other Contract Documents.

6.3.6.2.2.2.3 Certified Materials

Accept aggregates, cementitious materials, chemical admixtures, and patching materials based on certification. As described in Volume II of the Materials Manual, ensure that that the Plants use only the admixtures that are listed on the Department’s Approved Products list or approved by the District Materials Office as part of their quality control plans. The Approved Products List includes the admixtures that are listed in the Florida Department of Transportation Specifications, Subarticle 924-2. Similarly, the Plants may propose the Structures repair methods and repair materials as part of the
Plant’s quality control plan.

The Verification Inspector checks that the quality control Inspector maintains the required documentation.

At the DMRO’s discretion, the Verification Inspector may take samples of any certified materials.

6.3.6.2.2.3 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 Indexes, shop drawings, Specifications, and performs a random review of the Plant’s fabrication methods, procedures, workmanship, and quality control 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 cylinder from a randomly selected LOT, at a frequency of one sample per quarter, during concrete placement, if the acceptability of Structures are 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 core test.

(F) Inspects 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
6.3.6.2.2.4 Post-Manufacturing Inspection and Testing of Structures

(A) The Verification Inspector verifies the following during the inspection of stored Structures at the Plant:

(B) Verifies the quality control testing and inspection records of manufactured Structures.

(C) Takes core samples from a randomly selected LOT of manufactured Structures, if acceptability of the Structures is based on core test.

(D) Inspects any finished manufactured Structures, including the products that are stored in the Plant and have been stamped.

(E) Visually inspects the manufactured Structures and randomly selects at least one of the stamped LOT to determine if the Structures are free from the deficiencies. Checks the dimensions of the Structures to verify if they meet the specified dimensional tolerances.

(F) Performs visual inspection of all stored manufactured Structures and measures the dimensions of at least 5% of the randomly selected Structures in the LOT.

(G) Advises the quality control manager to reject any Structure that does not fully comply with the requirements of the Specifications or other Contract Documents.

(H) Advises the Plant to remove the acceptance stamps from the rejected Structures.

(I) Visually inspects the repaired Structures and their repair methods

(J) Compares Verification test results to the quality control acceptance test results

(K) After each inspection, the Verification Inspector provides a list of deficiencies and discusses them with the Plant’s quality control manager.

6.3.6.2.2.5 Acceptance Status of Quality Control Test Results

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

6.3.6.2.2.6 Close-out Meeting and Documentation

The following are the responsibilities of Verification Inspector upon completion of each inspection:

(A) Meets with the quality control manager at the completion of each inspection. During the meetings, the Verification Inspector discusses the product deficiencies found during the inspections.

(B) Documents the results of the inspections.

(C) Maintains the documentation of the inspection activities in a notebook or any other format that reflects key inspection, sampling and testing activities as well as key discussions with the Plant personnel.

(D) Maintains a record of the Verification testing and disposition of all material samples taken for testing.

(E) For each component, the Verification Inspector assures that quality control manager maintains documents indicating compliance with the quality control plan.

(F) Documents the deficiencies that have caused the suspension of the Plant’s quality control Plan and maintains documentation of the Plant's corrective actions.

6.3.6.2.3 Resolution Procedure

The District Materials Office initiates the resolution procedure. The resolution procedure may consist of Independent Assurance 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 quality control data, accept the quality control 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 District Materials Office determines the disposition of the 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 quality control 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 quality control Inspectors are using.

6.3.6.2.4 Independent Assurance Inspection and Testing

Independent Assurance sampling and testing are performed in accordance with Section 5.5 of the Materials Manual.

6.3.6.2.5 Independent Verification

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

6.3.7 STATE MATERIALS OFFICE RESPONSIBILITIES

The following are responsibilities of the State Materials Office:

(A) Provides precast concrete materials technical support for the Districts Materials and Construction personnel.

(B) The State Materials Office may accompany District personnel during the quarterly inspections, and Independent Verifications.

(C) The State Materials Office representative will serve as member of a plant
qualification review team.

(D) Provides information regarding specification changes and inspection procedures to the DMRO.

(E) The State Materials Office Precast Concrete Unit will coordinate with the Plant, District Materials Office personnel, and Construction Personnel to discuss the repeating deficiencies of the manufactured Structures.

(F) The State Materials Office reviews the proposed training and qualification programs and issues the accreditation letters to the providers.

6.3.8 STATE DRAINAGE OFFICE RESPONSIBILITIES

The State Drainage Engineer reviews 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 State Materials Office.

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

The Construction Personnel at the project site accept only Structures that are properly marked by the Plant's approved quality control 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 stamp mark 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 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 Plant's approved quality control plan. The sample certification statement may be viewed at the State Materials Office’s web site.
Ensure that each delivery ticket of the shipped products includes information related to project number, manufacturing date and serial number of each product.

6.3.11 TRAINING

6.3.11.1 General

Ensure that the Plant’s quality control personnel and Department inspectors who are involved in the inspection and testing of the Structures have the required qualifications as specified in Section 6.3 Volume II of the Materials Manual.

Ensure the Plant’s quality control plan include a copy of the certificates of their qualified quality control personnel.

The State Materials Office maintains the list of the accredited precast concrete courses.

6.3.11.2 Department Inspectors of the Precast Concrete Drainage Products and Precast Concrete Box Culverts

The 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

There are no forms associated with this procedure.
Appendix A

QUALITY ASSURANCE REVIEW REPORT
PRECAST CONCRETE DRAINAGE STRUCTURES PLANT

<table>
<thead>
<tr>
<th>Type of Inspection or Review:</th>
<th>Initial Qualification</th>
<th>Monthly</th>
<th>Quarterly</th>
<th>Annual Qualification</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>District No: _________________________________</td>
<td>FDOT Plant Designation No:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant name: ________________________________</td>
<td>Location:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FDOT Quality Assurance (QA) Inspectors:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection Date:</td>
<td></td>
<td></td>
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<tr>
<td>Plant Quality Control Manager:</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Plant Quality Control Inspectors:</td>
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</tr>
</tbody>
</table>

**General Notes:** The inspection checklist items are a general guide. The inspection is performed by FDOT QA inspectors accompanied with Quality Control (QC) Manager and plant QC inspectors. The compliance status of the inspected items are marked in the provided space with the letter “Y” for compliance and letters “N-1”, “N-2”, “N-3”, etc. for noncompliance. The details of each noncompliance is described in the remarks section of the report, unless noncompliance is self-explanatory. The non-applicable items will be marked with “NA”.

**APPLICABLE QC PERSONNEL QUALIFICATION CERTIFICATIONS**

<table>
<thead>
<tr>
<th>Type of Qualification</th>
<th>Compliance Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q. C. Inspector Level I</td>
<td></td>
</tr>
<tr>
<td>Q. C. Inspector Level II</td>
<td></td>
</tr>
<tr>
<td>Q. C. Manager</td>
<td></td>
</tr>
<tr>
<td>ACI Concrete Field Testing Technician – Grade I</td>
<td></td>
</tr>
<tr>
<td>ACI Concrete Laboratory Testing Technician – Level I</td>
<td></td>
</tr>
<tr>
<td>ACI Concrete Strength Testing Technician</td>
<td></td>
</tr>
<tr>
<td>Concrete Batch Plant Operator</td>
<td></td>
</tr>
</tbody>
</table>

**PRE-POUR INSPECTION**

<table>
<thead>
<tr>
<th>Materials Certification</th>
<th>Compliance Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine Aggregate</td>
<td></td>
</tr>
</tbody>
</table>

Volume I: Quality Assurance Program of Precast Concrete Box Culvert and Drainage Structures 6-3-14
Coarse Aggregate

Cement

Fly Ash

Slag

Remarks: __________________________________________________________________________________________________________

Storage and Stockpiling of Concrete Materials

Different grades of aggregates are stockpiled separately

Stockpiles are clearly labeled

Aggregate stockpile labels match certifications

Silos are clearly labeled

Different cementitious materials are stored separately

Cementitious materials stored labels match certifications

Reinforcement steel is stored above the surface of the ground

Heat identification tags are attached to reinforcement steel

Remarks: __________________________________________________________________________________________________________

Admixtures

Compliance Status

Admixtures meet the requirements of FDOT Specification Section 924

Remarks: __________________________________________________________________________________________________________

Reinforcing Steel

Compliance Status

Reinforcing steel meets the requirements of FDOT Specification Section 415

Manufactured in United States

Mill certifications are available
### Welded Wire Reinforcement

- **Compliance Status**: 
  - Welded Wire Fabric meets the requirements of ASTM A 1064
  - Manufactured in Untied States
  - Mill certifications are available
  - Remarks

### Carbon Steel Wire

- **Compliance Status**: 
  - Carbon Steel Wire meets the requirements of ASTM A 1064
  - Manufactured in Untied States
  - Mill certifications are available
  - Remarks

### Plastic Chairs and Bolsters

- **Compliance Status**: 
  - Plastic Chairs and Bolsters meets the requirements of FDOT Specification Section 415.5.13.3
  - Remarks

### Water: FDOT Specification 923

- **Compliance Status**: 
  - Water is sampled per specification
  - Results
  - Remarks
### DURING POUR INSPECTION

**Concrete Mix Design**

- Compliance Status: 
  - Approved concrete mix designs are available
  - Delivery ticket data meet the requirements of Materials Manual Section 9.2 Volume II, Appendix A

**Concrete Pour Inspection**

- Compliance Status:
  - The water-to-cementitious materials ratio is per approved concrete mix design
  - Consolidation is performed per QCP
  - Finishing is performed per QCP
  - Curing is performed per QCP

### POST POUR INSPECTION

- Compliance Status:
  - Repairs are completed in accordance with the QCP or specifications
  - Repair materials meet the requirements of the QCP or on Approved Products List
  
**Product Dimension Measurements**

- The dimensions of at least 20% of randomly selected units in each lot have been measured by QC personnel
- The dimensions of the structures meet the requirements of the project plans
- Remarks:

### TESTING AND CURING EQUIPMENT

- Compliance Status:
  - Certified laboratory are performing the concrete compressive strength tests
  - Concrete cylinder curing facility calibration are current
  - Compressive strength testing machine calibration are current

### QC RECORDS: Materials Manuals 6.3.7.8.9, Volume II

- Compliance Status:
  - Verify that the plant has maintained the following QC records:
  - Notarized certification statement delivered at the beginning of each project
  - Daily log of production activities
Copy of signed or stamped shipping tickets

Inspection of concrete forms

Lot identification sheet or tracking log

QC records available for:
  - Pre-pour inspection
  - During pour inspection
  - Post pour inspection
  - All required material certifications

Records are maintained for a minimum of three years

Standard specifications, indexes, Materials Manual Volume II

Remarks:

________________________________________________________

CONDITION OF STAMPED UNITS WHILE IN STORAGE

Storage methods of the units

Culling of failed materials or final products that do not meet the specification requirements

Remarks:

________________________________________________________
Precast Concrete Structures Plant Review
Close-Out Meeting

Date ___________________ Review conducted by ____________________________

Plant ___________________________ Plant Number ________________

Meeting Attendees:

Plant Personnel _______________________________________________________

FDOT Personnel _______________________________________________________

Type of Review (circle one):
Independent Verification Monthly Quarterly Annual

Noncompliance (N) / Remarks (R)
________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________
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Follow-up from previous noncompliance: □ N/A
Sampled:  □ WWR  □ Rebar  □ Cylinders  □ Absorption Core  □ Other ______

______________________________  ______________________________
FDOT Representative               Plant Representative