

Section 6.3 VOLUME II

PRECAST CONCRETE DRAINAGE STRUCTURES AND BOX CULVERTS

6.3.1 PURPOSE

This procedure provides guidance for the development and implementation of the quality control for the manufacture, storage, and transportation of the precast concrete drainage structures and box culverts (Structures) for the Florida Department of Transportation projects. The Structures may include, but are not limited to, inlets, manholes, junction boxes, endwalls, three-sided precast concrete culverts, and precast concrete box culverts.

The Department will perform periodic quality assurance inspections, sampling, and testing to ensure of the quality and acceptability of the materials, methods, techniques, procedures and processes being utilized by the manufacturer in the fabrication of precast concrete products. The quality assurance inspection and testing will be performed in accordance with *Materials Manual Section 6.3, Volume I*.

6.3.2 AUTHORITY

334.044(2), 334.044(10)(a), and 334.048 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

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

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

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 Product List (APL), Florida Department of Transportation

Field Sampling and Testing Manual, Florida Department of Transportation

6.3.4 SCOPE

This procedure is used by the Precast Concrete Structures Plants (Plants). These requirements and activities pertain to the inspections, measurements, and necessary tests to substantiate materials and Structures in conformity with the **Contract Documents**. The Plant's quality control plan is designed to provide guidelines that are used by Plants to produce Structures in conformance to **Specifications** and project plans.

6.3.5 GENERAL INFORMATION

The Plants are responsible for the production, inspection, storage, and shipment of the Structures. The delivered Structures to the project site shall meet the requirements of the **Specifications**, plans, and other **Contract Documents**.

6.3.6 PLANT QUALIFICATION PROCESS

6.3.6.1 General

Submit the proposed quality control plan in accordance with **Specification Section 105** to the District Materials and Research Office (DMRO) for review and acceptance and make arrangement for qualification review of the Plant prior to commencement of any work for the Department projects. **Materials Manual Section 5.6** may be used as a guideline.

6.3.6.2 Review of Plant's Proposed Quality Control Plan

Submit the proposed quality control plan to the DMRO for the District in which the Plant is located. For out-of-state Plants, submit the quality control plan to the nearest DMRO. Upon the Plant's submittal of a quality control plan, the DMRO will review the proposed quality control plan in accordance with **Materials Manual Section 5.6** and make necessary arrangements for the initial Plant qualification review in accordance with **Materials Manual Section 6.3.6.3**.

In the quality control plan include the work experience, qualifications, and responsibilities of the Plant's production and quality control personnel. Identify the on-site production manager, Plant general manager, quality control inspectors/technicians, and Quality Control Manager. Identify the

key quality attributes in the quality control plan. Identify the responsibilities for monitoring key quality attributes and quality control data. Include the applicable information required in **Specification Sections 105, 407, 410, and 449**. Include a management statement of dedication to quality. Include any available proposed repair methods for minor deficiencies as part of the quality control plan.

The National Precast Concrete Association (NPCA) certified Plants may submit the document entitled “NPCA Quality Control Manual for Precast Plants (NPCA Manual)” as their quality control plan. In their submittal, the NPCA certified Plants include a statement that the Plants will comply with the requirements of the NPCA Manual. The **Specifications** and other **Contract Documents** will govern, when there is a discrepancy between the NPCA Manual and Department specifications. Submit any additional information, which is required by this Section of the Materials Manual, but are not included as part of the NPCA Manual, as an addendum to the NPCA Manual. When requested by the Department Inspectors, the NPCA certified Plants are required to provide the two most recent NPCA inspection reports, including the Plant’s responses to the deficiency reports, if applicable.

6.3.6.3 Plant Qualification Review

The Department will perform the initial Plant qualification review of the production facilities. An initial review includes an in-depth inspection by the Department of a Plant that submits its first quality control plan and Plants that have not produced Structures for the Department projects for more than a year. Upon the approval of the Plant’s quality control plan, the Department will also perform routine, at least quarterly, verification inspections, and Plant qualification reviews, at least annually, on all Plants that have continued to furnish Structures for the Department projects.

6.3.6.4 Maintenance of Plant Qualification

Upon the Department’s satisfactory review of the proposed quality control plan, in compliance with **Materials Manual Section 5.6**, and satisfactory Plant qualification review, the DMRO will accept the proposed quality control plan and include the Plant on the Department’s **Production Facility Listing**. Immediately notify the DMRO in writing of any changes to the quality control plan. In case of change(s), revise the quality control plan annually in the form of addenda or complete revision of the entire document. Submit the revised quality control plan or its addenda to the DMRO annually.

Plants that are on the Department’s **Production Facility Listing** will be

subject to the Plant qualification review process at any time. The Plant qualification review team will perform at least one annual in-depth review of the Plant that is producing for the Department projects.

6.3.7 FUNCTIONS AND RESPONSIBILITIES OF PRECAST CONCRETE PLANTS

6.3.7.1 General

The Plants are responsible for the quality of the finished Structures. Provide facilities and qualified quality control personnel to perform specified tests and maintain an acceptable quality control program in compliance with the requirements specified herein and in **Specification Sections 407, 410, and 449**.

6.3.7.2 Quality Control Manager

The Quality Control Manager shall ensure that the quality of the products at each Plant meets the quality requirements of the **Contract Documents**. The Quality Control Manager may serve in more than one Plant. The responsibilities of the Quality Control Manager include, but are not limited to, the following:

- (A) Maintains the quality control approval stamp and applies it to acceptable Structures, or designates a technician, who is working under the direct supervision of the Quality Control Manager, to apply the Plant approval stamp. The Plant approval stamp mark shall be legible and applied to each Structure before its shipment to the project site.
- (B) Be present, or designates a quality control technician/inspector working under the direct supervision of the Quality Control Manager, to be present, all times, during the production of all Structures that will be shipped to Department projects.
- (C) Performs and/or supervises the quality control testing and inspection.
- (D) Ensures that the Plant has a sufficient number of quality control technician(s)/inspector(s) to maintain adequate inspection and testing during the production of Structures for Department projects. In lieu of a permanent staff, the Plant may retain the services of an engineering consulting firm or qualified laboratory meeting the requirements of **Specification Section 105** and quality control personnel qualification of this Section.
- (E) Ensures that testing equipment is properly maintained in accordance with the applicable test methods and **Specifications**.

Makes readily available, the current certification on testing equipment that is requiring calibration.

- (F) Visually inspects or ensures that a qualified quality control technician inspects each Structure before it is shipped to the project site.
- (G) Ensures that all materials used to manufacture Structures are from a Department approved source.
- (H) Maintains a daily production log of the manufactured Structures.
- (I) Ensures that all Structures are properly stored and marked indelibly with Plant name and number, Structure number that is traceable to the Department project, and date of Manufacture.
- (J) Maintains the quality control files of material certifications, test data, and inspection results.
- (K) Arranges monthly meetings with the verification inspector and representatives of the Plant's production personnel to discuss any deficiencies and quality control issues.

When the Plant's assigned Quality Control Manager discontinues his/her work without advanced notice, the Plant shall notify the DMRO within two-working days and employ reasonable efforts to seek a replacement. During such efforts to seek a replacement, the Plant engineer, technician, or other knowledgeable person designated in the Plant's quality control plan may perform the duties of the Quality Control Manager for a period established by the District Materials and Research Engineer (DMRE), based on efforts employed by the Plant to seek a qualified replacement and/or training another person leading up to the next available Department accredited training/certification programs.

6.3.7.3 Technicians/Inspectors

The quality control technicians may perform any or all of the inspections, sampling, or testing as directed by the Quality Control Manager, and may stamp the Plant approved Structures, when directed by the Quality Control Manager.

6.3.7.4 Quality Control of Certified Materials

6.3.7.4.1 General

Ensure that all materials used to manufacture of Structures are from Department approved sources and comply with requirements as specified herein.

6.3.7.4.2 Reinforcing Steel and Welded Wire Reinforcement

The quality control inspectors shall obtain steel Plant's certifications for all welded wire reinforcement and reinforcing steel that are used to manufacture Structures. These certifications shall indicate compliance with the appropriate ASTM or AASHTO standards for wire, wire reinforcement and for steel bars. Upon request, provide samples for the Department verification inspectors at each Plant, from at least two randomly selected LOTs per year. The Department will perform the testing of these samples. A LOT is a single vehicle load of the reinforcing steel or welded wire reinforcement of the same grade that is delivered to the Plant. Reinforcing steel shall meet the requirements of **Specification Section 415**.

6.3.7.4.3 Coarse and Fine Aggregates

The aggregates delivery tickets shall include the following information:

- (A) Name of the approved producer
- (B) Location of mine
- (C) Department pit number
- (D) Department material code
- (E) Delivery date
- (F) Aggregate producer's statement with each shipment indicating that the shipped products comply with Department **Specifications**.

Maintain each size of aggregates and mine sources in separate stockpiles. Each stockpile shall have Department Identification pit number. Prevent the contamination, segregation, or intermingling of stockpiled aggregates of different sizes with each other.

6.3.7.4.4 Cement

Accept the delivered cement on the basis of the cement producer's certification. The certification shall indicate compliance with **Specifications Section 921**. A certification for each shipment of cement is required. Verification samples may be obtained at the

discretion of the DMRE. Cooperate with the verification inspector in obtaining the cement sample.

6.3.7.4.5 Pozzolans and Slag

Accept the ground granulated blast furnace slag on the basis of the supplier's certification indicating compliance with **Specification Section 929** and other **Contract Documents**. A certificate for each shipment of pozzolans and slag is required. The verification inspector may take a sample at the Plant or source. Cooperate with the verification inspector in obtaining the required sample of the supplemental cementitious materials.

6.3.7.4.6 Batch Water

Water used for mixing concrete shall comply with **Specification Section 923**. The record of the well water testing will be maintained on file.

6.3.7.4.7 Chemical Admixtures

Admixtures shall meet the requirements of **Specification Section 924**. The Department allows the use of admixtures by one of the following qualification process:

- (A) The admixtures that are listed in the **Specification Section 924 (Article 924-2)** are required to be on the **APL**. The manufacturer shall use the products that are included as part of this list.
- (B) As part of the Plant's quality control plan, the DMRO reviews and approves the use of the admixtures that are used for workability, the ease of machine processing, and better consolidation of dry-cast concrete Structures and other machine- formed concrete products. The approval of the admixture as part of the Plant's quality control plan indicates that the admixture has been given contingent approval, as evidenced by previous tests and its apparent effectiveness under field conditions. This approval will continue as long as the admixture performs as claimed. For the use of reinforced concrete products, the concrete admixtures shall not contain calcium chloride or calcium chloride- based ingredients.

6.3.7.4.8 Resilient Connectors for Sealing Structures to Pipe Joints

The resilient connectors shall conform to the requirements of **Specification Section 942**. Maintain a copy of the certification of compliance in the Quality Control file.

6.3.7.4.9 Resilient Connector Lubricant

Ensure that the producers of the resilient connector lubricant provide a certification statement indicating compliance with requirements of the **Contract Documents**.

6.3.7.4.10 Patching Materials

All patching compounds shall comply with **Specification Section 449**. Pre-mixed packaged compounds may be used when listed on the **APL**. The cosmetic defects may be repaired in accordance with **Specification Section 450**, if approved by District Materials Office and is included in the Plant's quality control plan.

6.3.7.4.11 Fiber-Reinforced Concrete (FRC)

(A) Fiber Uses

- 1) Steel or carbon fiber-reinforced concrete may be used as structural reinforcement in the following drainage structures:
 - Type P Structures Bottoms (Index 200)
 - Manhole Risers and Conical Tops (Index 201-Type 8)
 - Drainage Inlet Bottoms with inside wall lengths less than 4' - 6" (Index 211, 218, 220)
 - Ditch Bottom Inlets Types A, C, and J (Index 230, 232, and 234)
 - U-Type Concrete Endwalls (Index 261);
 - Flared End Sections (Index 270)
- 2) Polymer fibers are not permitted as primary structural reinforcement.

(B) Environment Use Location Restrictions

- 1) Slightly or moderately aggressive environments- Plain steel fibers, galvanized steel, stainless steel, or carbon fibers are allowed on the projects that are located in the slightly and moderately aggressive environments.
- 2) Extremely aggressive environments- Use only galvanized steel, stainless steel, or carbon fibers on the projects that have been classified by the Department as extremely aggressive environments.

(C) Shop Drawings

Structure dimensions and FRC mix design shall match the details shown on the shop drawings approved by the State Drainage Office for each structure that utilizes the fibers as substitution of all, or part of, the reinforcement in the concrete. The drawings shall include the following information:

- Design Method (*fib* Model Code 2010 or an approved Evaluation Report);
- The type of fiber and its ultimate strength meeting the requirements of ASTM A 820 and C 1116;
- Flexural performance values of the FRC in accordance with the Design Method;
- Toughness value of the FRC in accordance with ASTM C 1609 reference test;
- Fiber reinforced concrete mix design, including fiber dosage, dimensions (length, effective diameter, slenderness);
- Slump and air content of FRC;
- Compressive strength of FRC;
- Absorption of FRC.

(D) Certifications

- Furnish a certificate of compliance and test reports indicating that the fibers meet the requirements of the specifications and approved shop drawings.
- The Department verification inspector may take samples of the fibers at the fabrication facility.

(E) Laboratory Trial Batch of the Proposed Mix Design

Submit the proposed mix design to the District Materials Office for review. Include proportions of the FRC mix ingredients, including fiber dosage. Make and cure test specimens in accordance with ASTM C 192, as modified herein.

- Perform air content (ASTM C 173 or ASTM C 231), slump (ASTM C 143), and unit weight (density) test (ASTM C 138).
- Make and cure samples of compressive strength test cylinders (ASTM C 31)
- During the laboratory trial batch process, determine the acceptable batching sequence and mixing time associated with this batching sequence to produce the required

properties.

- Cast five 6- inch x 6- inch x 20- inch reference test beams (ASTM C 1609) during the laboratory trial batch. Deliver the beams to the State Materials office for verification and approval of the mix design.
- Cast and test five beams for determining characteristic flexural properties in accordance with the selected Design Method and provide the test results to the State Materials Office.

(F) Flexural Performance of FRC Reference Test Beams

The State Materials Office will verify the flexural performance of FRC beams that were cast during the laboratory trial batch process. The following properties of the FRC mix will be determined for each test beam:

- First peak load and first peak strength
- Peak load and peak strength
- Residual strengths at net deflections
- Toughness
- Equivalent flexural strength ratio

The established flexural performance of the mix design is based on the average values of the five test beams.

(G) Field Demonstration of the FRC

- Subsequent to a satisfactory laboratory trial batch, perform field demonstration of the proposed mix design by casting a full scale mockup of drainage structure utilizing FRC.
- Mix, deliver, place, vibrate, finish and cure the proposed FRC mix in accordance with the batching method and sequence that are described in the quality control plan.
- Ensure that FRC remains workable during concrete placement.
- Perform slump, air content, and unit weight (density) of the batched concrete.
- Determine the fiber contents of the first $\frac{1}{4}$ discharge and last $\frac{3}{4}$ discharge of FRC batch being tested by taking representative concrete samples from each portion. Determine the uniformity of the fiber content of the batched concrete using the following test method:

- 1) Perform the unit weight (density) tests of each sample taken in

accordance with ASTM C 138.

- 2) Then pour and wash each sample over a number 8 sieve. All cement paste and aggregate shall be completely removed from the fibers during the washing. A magnet may be used to separate the steel fibers from the concrete and flotation method may be used to recuperate the synthetic fibers from concrete.
- 3) Oven dry the extracted fibers at temperature of $230 \pm 10^{\circ}$ F for a period of at least 16 hours or to obtain constant weight, whichever comes first.

Note: For immediate approximate field determination of the fiber content of FRC, towel drying may be used in lieu of oven drying.

- 4) Measure the mass of the fibers, W , in grams.
- 5) Calculate the fiber content (F) of each sample in lb /yd³ as follows:

$$F = 0.059525 \times W/V$$

V = Volume of unit weight container in ft³

- 6) Report the results the fiber content of each sample and their average value.

(H) Post Fabrication inspection of the FRC Mockup Structures

- After removal of forms, perform inspection of the mockup structures in accordance with the applicable Sections of ASTM C823 – Standard Practice for Examination and Sampling of Hardened Concrete in Constructions.
- Ensure that FRC is free from defects such as honeycombs, cracks, fiber or aggregate segregations, sedimentation, and cold joints
- Obtain five drilled core samples from randomly selected locations of each mockup structure.
- Examine the cores for any sign of defects.
- Perform compressive strength (ASTM C 42) and absorption (ASTM C 478) tests on the cores samples to determine if they meet the requirements of the specifications.

(I) Submittal of the Verified Mix Design

- Submit the proposed mix design along with the results of the laboratory and field demonstration of the verified FRC trial batches to the District Materials Office for review. Upon

concurrency, the District Materials Office will forward the proposed mix design and verification data to the State Materials Office for FRC mix design approval.

(J) Production of FRC

- During the production of FRC use the same batching sequence and mixing time determined during the satisfactory laboratory and field demonstration process.
- The fabrication facility shall perform routine applicable quality control testing for the class of concrete, as specified in 346 Specifications or ASTM C 478.
- The quality control inspector shall make a minimum of five FRC flexural beams for quarterly verification testing of the flexural properties of FRC. The ASTM C 1609 Toughness, based on the average of 5 test beams, shall not be less than 10% below the mix design value.
- Determine the fiber contents of the FRC samples, taken at the first $\frac{1}{4}$ discharge and last $\frac{3}{4}$ discharge of the batch, at a frequency of once per Lot.
- The average fiber content of the samples taken at the first and last portions of the batch shall remain within $\pm 10\%$ of the mix design value.
- Cast and test five beams (ASTM C 1609) per lot subsequent to any Lot with fiber content more than 10% below the approved mix design value.
- The ASTM C 1609 Toughness, based on the average of 5 test beams, shall not be less than 10% below the mix design value.

(K) FRC Quality Control Plan Requirements

Include the following information in the fabrication facility's quality control plan:

- FRC mixing, delivery, placement, finishing and curing process;
- Approved mix designs and guidelines for the production and quality control personnel. The guidelines shall include information about production, quality control, and inspection of the FRC material ingredients and products.

6.3.7.5 Quality Control of Concrete Production and Placement Equipment

Ensure that the batching and mixing equipment be capable of properly proportioning and mixing the various ingredients into a uniform mixture. Use adequate means for casting, consolidation, and curing of concrete.

6.3.7.6 Calibration of Equipment

Check or calibrate all quality control testing equipment such as the batching scales, compressive strength testing machines, portable weighing scales, air meters, density buckets, and temperature recording devices for compliance with the applicable ASTM specifications. For 346 Specification Class of concrete calibrate the equipment in accordance with Section 9.2 Materials Manual.

6.3.7.7 Quality Control of Structures Manufacturing Process

The following are quality control inspections and testing, related to operations prior to, during, and after concrete placement.

6.3.7.7.1 Concrete Mix Design

Unless otherwise shown on the Plans or required by the specifications, the concrete mix produced for the manufacture of project Structures shall comply with the requirements specified in **Specification Section 449** and the following documents:

- (A) ASTM C 478 for manholes, inlets, and endwalls
- (B) Specification Sections 346 and 407 for three-sided precast culverts
- (C) Specifications Section 410 for box culverts

The mix design information shall include the source of aggregates, cementitious materials, and admixtures, along with the proportions of all concrete ingredients. Include the Department approved mix designs as part of the quality control plan.

6.3.7.7.2 Structure Materials Storage

Properly handle and store aggregates to minimize the segregation of particle size and prevent contamination.

Store all reinforcing steel according to **Specification Section 415**.

6.3.7.7.3 Concrete Forms

Provide Concrete forms made of wood, metal, or other materials meeting the requirements of this section and section 400.

Forms used in the manufacture of structures shall be sufficiently rigid and accurate to maintain the structures designed dimensions and avoid irregularities in the structure surface. Forms not meeting governing document requirements shall be repaired or removed from service.

Ensure that the condition of all forms be of a quality to produce acceptable Structures within the dimensional tolerances. The quality control inspector shall check cleanliness of the forms prior to each use. Check the form dimensions prior to its first use and at least annually for dimensional conformance.

6.3.7.7.3.1 Aluminum Concrete Forms

The Plant shall take the following actions when using aluminum forms for the first time:

- (1) In the quality control plan include information regarding the application of the protective barrier to minimize the natural reactivity between aluminum and fresh concrete. Also, include the name of the form release agent that will be used.
- (2) Prior its first use, perform the field demonstration of the proposed aluminum form by casting a full scale mockup of the precast concrete product. Demonstrate that the use of aluminum form will not cause any adverse effect in the quality of the concrete products.
- (3) Ensure that after stripping of the form, the product does not show any sign of bug hole, stain, spall, surface void, and streak in concrete.
- (4) Ensure that the forms do not show any sign of concrete buildup and sticking on their surfaces and panel edges.

6.3.7.7.4 Reinforcing Steel Placement

Ensure that the reinforcing steel placement meets the requirements of **Specification Section 415**. Prior to the concrete placement, check the fabrication, positioning, and minimum concrete cover requirements of steel reinforcement on all types of manufactured Structures. Ensure that that the steel reinforcement meets the specification requirements. Check the minimum steel area requirements for Structures in

accordance with the applicable design standards such as AASHTO, ASTM, or approved shop drawings.

6.3.7.7.5 Concrete Mixture and Placement Operation

Mix, deliver, and place concrete in accordance with the applicable standards to produce a homogeneous concrete.

6.3.7.7.6 Concrete Curing

Cure the Structures in accordance with the applicable curing methods that is included as part of the quality control plan.

6.3.7.8 Quality Control Testing and Inspection of Structures

6.3.7.8.1 General

Perform the quality control inspection and tests at the frequencies and LOT (Group) sizes that are specified in the applicable **Specification Sections** and other applicable **Contract Documents**.

The quality control plan shall include the Quality Control test methods, inspections, and minimum frequency and LOT sizes of tests that are used as the basis of acceptance of each type of Structures. The quality control inspectors shall obtain randomly selected samples from each LOT in accordance with the applicable **Specification Sections**. Take one sample per LOT. The LOT size shall not exceed one day's production or 50 Sections of the Structures, whichever results in smaller quantity

Each LOT of the Structures components is accepted when:

- (A) The test results and inspections meet the requirements as specified herein and in the applicable specifications
- (B) The Plant has completed all patching and repair work
- (C) The Quality Control Manager or his/her designated technician has stamped the Structures
- (D) The list of the Structures is included with each shipment of the products to the project site

6.3.7.8.2 Compressive Strength of Test Cylinders

When the Plant is using a **Specification Section 346** class of concrete, sample and test concrete in accordance with **Specification**

Section 346.

When the Plant is using **ASTM C 478** concrete, sample and test compressive strength test cylinders in accordance with **Section 6.3.7.8.1.**

6.3.7.8.3 Absorption Test

ASTM C 478 Section 8.2.2 is modified to waive the absorption test requirements of the precast reinforced concrete inlets, manholes, junction boxes, and endwalls.

6.3.7.8.4 Appearance and Inspection of Final Finished Structures

The Quality Control Manager or his/her designee performs final quality control inspection of the finished Structures, before the application of the quality control approval stamp, to ensure that the Structures are free from deficiencies and meet the specified dimensional tolerances. Forms used to manufacture Structures shall be sufficiently rigid and accurate to maintain the Structures designed dimensions and avoid irregularities in their surfaces. Structures may be repaired if necessitated by occasional imperfections in the manufacture or damage during handling, and will be considered acceptable if the repairs are sound and properly finished to conform to the dimensional tolerances of the specifications. Submit the proposed repair method for Department review and approval. Use the repair material from the **APL**. Dimensional tolerances shall comply with the applicable requirements of ASTM or AASHTO standards, except as modified in **Specification Section 449.**

The quality control inspectors shall perform visual inspection of all finished Structures, measure the dimensions of at least 20% of the randomly selected units in each LOT, and maintain a record of the inspections, including the deficiencies. Minor deficiencies may be repaired in accordance with the repair methods included as part of the quality control plan. The repair of major damage to a Structure requires engineering evaluation meeting the requirements of **Specification Section 450 (Article 450-14)**. The Plant shall determine the cause of the repetitive nonconformance and develop a corrective action plan. Submit the revised quality control plan to address the type of deficiencies and corrective action that will be taken to prevent or minimize the deficiencies.

6.3.7.8.5 Repair of Precast Concrete Structures

The Plant's Quality Control Manager shall examine and determine the magnitude of the deficiency. The quality control manager may authorize the immediate repair of minor deficiencies in accordance with the repair method that is included as part of the quality control plan. Perform the repair under the observation of the Quality Control Manager or under the observation of personnel working under his/her direct supervision. The Plant's quality control personnel shall document the type of deficiency and its repair method.

6.3.7.8.6 Handling and Storage

Handle and store all Structures properly to prevent damage. The quality control inspectors shall inspect the Structure handling operations and appropriate practices that will prevent damage. The quality control inspectors shall inspect Structures during storage to ensure that they are stored correctly and are not being damaged by point loading or stacking too high. Do not store the rejected Structures in the same area with the acceptable Structures. Rejected Pipe shall be culled and marked as rejected.

6.3.7.8.7 Stamping

The quality control inspector shall inspect the identification and stamp marks on the wall of the Structures to ensure that they are valid stamp marks. The Plant shall affix the Plant's quality control stamp to each section of Structure, indicating that the manufactured Structure meets the requirements of the **Contract Documents** and Plant's quality control plan.

In the QCP include a statement that the Plant's quality control stamp will be applied only on the Structures that are manufactured for **Department** projects or any other projects that require Department verification inspection.

A copy of the certification statement from the general manger of the Plant shall be included in the quality control plan regarding the stamp configuration.

6.3.7.8.8 Shipment

Address the Plant's shipping policy as part of the quality control plan.

Ensure that at the beginning of each project, the Plant provides a notarized statement to the Project Administrator from a responsible company 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 Quality Control Manager's stamp on each product indicates certification that the product was fabricated in conformance with the quality control plan and the **Contract Documents**. Ensure that each shipment of precast concrete products to the project site is accompanied with a signed or stamped delivery ticket providing the description and the list of the products.

The list of the product with each delivery ticket shall be on the Plant's letterhead and shall include as a minimum:

- (A) Project Number
- (B) Date shipped
- (C) Serial Number of the Structure section

The Quality Control Manager or quality control personnel working under the direct supervision of the Quality Control Manager shall stamp each Structure prior to its shipment to the project site. The quality control stamp indicates that the Plant certifies that the Structure was manufactured in conformance with the Plant's quality control Plan. Each shipment of the Structures to the project site shall include the list of the Structures.

6.3.7.8.9 Documentation

The Quality Control Manager shall maintain documentation files in each Plant. Maintain these documents for a period of not less than three years after the last delivery of the Structures to the project site. The quality control documentation shall as a minimum include the following items:

- (A) A copy of the approved quality control plan
- (B) Approved shop drawings (if applicable)
- (C) Applicable ASTM and AASHTO standards
- (D) Applicable Department Specifications and Design Standards
- (E) Quality control personnel training and qualification records
- (F) Materials certification records for cement, aggregates, cementitious materials, chemical admixtures, reinforcing steel, and welded wire reinforcement

- (G) Concrete Mix designs
- (H) Equipment calibration, including concrete batching equipment, water meter, admixture dispensing equipment, concrete compression testing machine, and laboratory scales. Batch plants furnishing concrete in accordance with **Specification Section 346** are required to be on the Department's **Production Facility Listing**. For ASTM or AASHTO classes of concrete, perform the calibration of the testing machine and batch equipment in accordance with the applicable ASTM/AASHTO standards or equipment manufacturers' recommendation.
- (I) LOT number identification of each product
- (J) Number and type of Structures
- (K) Applicable test data
- (L) Disposition of all manufactured Structures
- (M) Record of the delivery tickets of each shipment of the products to the job site
- (N) Record of all structural deficiencies found as a result of quality control inspection and testing or verification inspection and testing and the corrective action taken. A copy of the deficiency reports shall also be maintained in the Plant's permanent file.

6.3.8 TRAINING

6.3.8.1 General

The Plant's quality control personnel who are involved in the inspection and testing of the precast concrete drainage structures and precast concrete box culverts shall have the required qualifications as specified herein.

The applicants shall attend a Department accredited precast concrete training course and receive a passing grade on the final examination for the course. Ensure that the Plant's quality control plan includes training certification copies for their qualified quality control personnel.

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

6.3.8.2 Quality Control Personnel of the Precast Concrete Drainage

Products and Precast Concrete Box Culverts

Ensure that all personnel performing the quality control inspection and testing of the precast concrete products at manufacturing facilities have the required qualifications as described herein.

6.3.8.2.1 Level I Quality Control Inspectors

Level I quality control inspectors perform routine concrete inspection and testing of the precast concrete drainage products and box culverts, including, concrete materials, pre-pour form and reinforcing steel placement inspections, concrete batching, mixing, placement, and post-placement inspections. The quality control inspectors shall be familiar with the precast concrete related plans and specifications and have completed a minimum of 12-hour, Department approved, training course, including the examination.

Prerequisites: Personnel performing the plastic property tests are required to have the ACI Concrete Field Testing Technician, Grade I, certification. Personnel performing the laboratory concrete tests are required to have ACI Level I Concrete Laboratory Technician- Grade I certification. Personnel performing concrete Strength Tests are required to have either ACI Level I Concrete Laboratory Technician - Grade I certification or ACI Concrete Strength Testing Technician certification.

6.3.8.2.2 Level II Quality Control Inspectors

Level II inspectors are involved in the design and verification of the concrete mixes and evaluate the needed repair method and its implementation. Advanced knowledge of the shop drawings, specifications, test methods, and Standard Indices are the requirements for Level II qualifications. Ensure that Level II Inspectors have Level I Quality Control Inspector certification and have successfully completed a minimum of additional 5-hour, Department approved course, including the examination.

6.3.8.2.3 Concrete Batch Plant Operator

The Batch Plant Operator shall have a Construction Training Qualification Program Batch Plant Operator qualification or complete a minimum of 6-hour, Department approved course, including the examination. The batch plant operator shall have a general knowledge of concrete and its materials ingredients, including the following:

- (A) Concrete specification requirements related to batch plants
- (B) Batch plant qualification process
- (C) Concrete mix design adjustments based on moisture content of the aggregates
- (D) Preparation of the delivery ticket
- (E) Batch plant mixer and other equipment inspections
- (F) Scale and meters calibration requirements
- (G) Maintaining of batch plant records

6.3.8.2.4 Quality Control Managers of Precast Concrete Drainage Products Plant and Box Culverts

The Quality Control Managers shall have Precast Concrete Drainage Products and Box Culvert Plant - Level II Quality Control Inspector certification and a minimum of two years of experience, directly related to cement concrete production.

6.3.8.3 Re-qualification of the Quality Control Personnel and Department Inspectors:

The Level I and II qualifications will expire at the end of five years, during which, the inspectors have the choice of attending the course and retaking the examination or only they take the examination to be re-qualified for an additional five years.

6.3.9 FORMS

There are no forms associated with this procedure.