

# Materials & Tests Unit



## Standard Operating Procedures Inspection of Precast Concrete Units

### **Objectives:**

The purpose of this SOP is to establish guidelines for the inspection, the acceptance and reporting of Precast Concrete Units including Barriers and Circular Manholes. The guidelines are designed to insure all technicians/inspectors follow the same procedures and comply with all NCDOT, AASHTO and ASTM specifications. The technicians/inspectors will insure quality control techniques, quality control records, and testing equipment are being followed. The technician shall personally inspect each piece of pipe and place a “NCDOT Approved” stamp on each piece of pipe once it meets approval.

Precast Concrete Units should meet Section 1077 of the NCDOT Standard Specifications, ASTM C913 and AASHTO M199 and applicable NCDOT Standard Drawings or NCDOT Approved Stamped Drawings.

### **Materials Inspection and Acceptance:**

It is mandatory for technicians/inspectors to follow these guidelines in order to establish, manage and monitor quality control, quality assurance and quality documentation. Following the proper inspection process will ensure effectiveness and efficiency in the quality systems of the NCDOT.

- Periodically review Reinforced Concrete Pipe guidelines.
- Periodically review ASTM C 76, AASHTO M 170 and NCDOT Standard Specifications Sub article 1032-6 to insure proper procedures are followed during the inspection
- Ensure all equipment required for testing the material and any safety equipment needed is in possession and serviceable before arrival.
- Is the facility, an approved NCDOT producer? Is the NCDOT annual facility inspection up to date?
- Does the facility have a current third party inspection?
- Verify the facility technicians have all the required NCDOT certifications required for the production of concrete pipe.
- Review the assigned NCDOT approved mix designs for the facility.

### **Safety Equipment List:**

Safety Shoes with ANSI Z 41 rating  
Hard Hat with ANSI Z89.1 rating  
First Aid Kit  
Fire Extinguisher  
Safety Glasses  
Gloves  
Safety Vest  
Ear Plugs  
Sun Block (optional)  
Dust Masks (optional)

### **Safety Concerns:**

- Access to product for inspection – Must be able to inspect precast piece from all sides. Do not inspect if stockpiled in a dangerous manner.
- Heavy Equipment/Backing Incidents – Vehicular hazards from producer and customers
- Possible dusty conditions.

### **Equipment Required for Precast Sampling:**

- Precast Inspection Worksheet and/or Cylinder Break log
- Tape Measure
- Level/straight edge
- Micrometer
- Calculator
- Black Paint ( Blue Paint for traffic bearing or special design products)
- Stencil (octagon, rectangle)
- NCDOT Standard Drawing book or NCDOT Stamped Approved Drawings

### **M&T Inspector's Duties for Precast Concrete Inspection:**

1. Periodically review the guidelines for a Precast Concrete Unit inspection.
2. Periodically review NCDOT Standard Specifications Section 1077, 854 or 1090 to insure proper procedures are followed during the inspection.
3. Ensure all equipment required for testing the material and any safety equipment needed is in possession and serviceable before arrival.
4. Is the facility/manufacture, an approved NCDOT producer? Is the NCDOT annual facility inspection up to date.
5. Does the facility have current third party inspection.( NPCA or ACPA)
6. NCDOT representative will verify facilities quality control technician has all the required NCDOT certifications required for the production of Precast Units.
7. Review the assigned NCDOT approved mix designs for the facility.
8. When arriving at the facility, inspectors should check into main office (if required).
9. Make contact with QC technician to determine items to be inspected.
10. Is the product to be inspected a Standard or Non-Standard Precast Drainage Structure? The following approval guidelines were mailed to all Precast Producer's on September 23, 2013.

## **NCDOT Approval Guidelines for Precast Drainage Structures**

The following guidelines should be followed by Precast Suppliers when producing precast drainage structures for installation within NCDOT right of way.

- All precast drainage structures that are built in accordance with Roadway Standard Drawings 840.45, 840.46 and 840.52 will continue to be inspected and approved as they are currently.
- All precast drainage structures, built in accordance with Roadway Standard Drawings 840.45 and 840.46, should have 6” of concrete over pipe openings in the corners of the structure and 4” of concrete over pipe openings in the sides of the structures.
- All precast drainage structures, built in accordance with Roadway Standard Drawings 840.52, should have 4” of concrete over pipe openings.
- For precast drainage structures built in accordance with 840.45, 840.46 and 840.52, that have less than 6” of concrete over pipe openings in the corners of the structure and 4” of concrete over pipe openings in the sides of the structures, the design drawings will have to be submitted to Standards Engineer, Joel Howerton, PE for approval. Design drawings should include: dimensions for the proposed precast structure, top view and side view of the precast structure, the layout and size of reinforcing steel, a plan view of the drainage structure with the location of where the precast structure will be on the project.
- For precast drainage structures that exceed the dimensions shown in Roadway Standard Drawings 840.45, 840.46 and 840.52, the design drawings will have to be submitted to Standards Engineer, Joel Howerton, PE for approval. Design drawings should include: dimensions for the proposed precast structure, top view and side view of the precast structure, the layout and size of reinforcing steel, a plan view of the drainage structure with the location of where the precast structure will be on the project.
- All precast drainage structures that need to be submitted to the Standards Engineer for approval will have to be approved prior to production. All precast drainage structures that require approval from the Standards Engineer will require 100% inspection by NCDOT personnel prior to production as well.
- For precast drainage structures that are built according to an NCDOT detail, no submittal or special approval is required. However, 100% inspection will be required during production.

<u>Classification</u>	<u>D-Load 0.01" crack</u>	<u>D-Load ultimate load</u>
Class I	800	1200
Class II	1000	1500
Class III	1350	2000
Class IV	2000	3000
Class V	3000	3750

e. Example: If a class III pipe is selected.

D-Load required to produce an 0.01" crack 1350

D-Load required to produce the ultimate load 2000

f. Example: Calculations for a 30" Class III 8' length pipe used to determine minimum readings required for acceptance in the test rack are as follows:

- 0.01" load = 1350 (D-Load) x 8' (length of pipe) x 2.5' (Diameter of pipe in decimal form) = 27000 lbs.

- Ultimate load = 2000 (D-load) x 8' (length of pipe) x 2.5' (Diameter of pipe in decimal form) = 40000 lbs.

g. The definition of a 0.01" crack is: "When the point of the measuring gage will, without forcing, penetrate 1/16" at close intervals throughout the specified distance of 1 FT."

h. The definition of Ultimate Load is: "Maximum load pipe will support."

i. Should the test pipe fail to meet the strength requirements, the manufacturer shall be allowed a retest two additional pipe for each pipe that failed, and the pipe shall be acceptable only when all of the retest specimens meet the strength requirements.

## 17. Concrete Cylinder Compression Tests

a. Pipe diameters 60" or larger may be strength tested by means of compression testing of concrete cylinders, in lieu of three-edge bearing testing, at the manufacturer's discretion.

b. If concrete cylinders are to be used for acceptance. A minimum of four cylinders are to be made for each class, diameter and lot from that day's production. A NCDOT Certified Field Concrete Technician representing the manufacturer must perform tests and make cylinders for acceptance.

c. NCDOT will witness cylinder breaks at the manufacture's facility. Compression machine must be calibrated annually or when a question of accuracy applies. Acceptance is the average of two cylinders. Specified concrete strength for acceptance is listed in AASHTO M 170-4 for the size, class and wall.

- d. Should the average of two cylinders fail to meet the strength requirements, the manufacturer shall be allowed to perform a three-edge bearing test on pipe.

18. Visual/Walk Thru Inspection and “NCDOT Approved” stamp.

a. Repairs

- Repair materials and methods must be approved by the Engineer before their use.
- AASHTO M 170-13  
“Pipe may be repaired, if necessary, because of imperfections in manufacturing or damage during handling and will be acceptable if, in the opinion of the owner, the repaired pipe conforms to the requirements of this specification.”

b. Technician will refer to AASHTO M 170-15. Causes of Rejection.

- Any fracture or crack that visibly passes through the wall of pipe.
- Any fracture or crack that is 0.01” wide or greater at the surface and 12” or longer regardless of position in the wall of the pipe.
- Offsets in form seam that would prevent adequate concrete cover over reinforcing steel.
- Delamination in the body of the pipe when viewed from the ends.
- Evidence of inadequate concrete cover for reinforcing steel.
- Any severe surface condition that affects the majority of the pipe section surface and could reduce the durability and service life of the pipe.
- Damaged or cracked ends where such damage would prevent making a satisfactory joint.

- c. Technician shall personally inspect and accept each pipe. Technician must be able to visually look through pipe and inspect both ends of pipe.

- d. Pipe will be accepted and individually stamped, by the NCDOT technician after all criteria meets specifications.

19. Reinforcement Check

- a. Technician will randomly inspect reinforcement area and placement for concrete pipe at each visit. Refer to AASHTO M170-4 for specified areas for each class and wall thickness of concrete pipe.

- b. Refer to AASHTO M 170-8 for reinforcement requirements for reinforced concrete pipe. Below is a list of some items from M 170-8 that will assist you in your inspection.

- If splices are not welded, the reinforcement shall be lapped not less than 20 diameters for deformed bars, and deformed cold-worked wire, and 40 diameters for plain bars and cold-drawn wire. In addition, where lapped cages of welded-wire fabric are used without welding, the lap shall contain a longitudinal wire.

- When splices are welded and are not lapped to the minimum requirements above pull tests of representative specimens shall develop at least 50 percent of the minimum specified strength of the steel, and there shall be a minimum lap of 2” for butt-welded splices in bars or wire, permitted only with helically wound cages, pull tests of representative specimens shall develop at least 75 percent of the minimum specified strength of the steel.

c. Basic Wire Calculations for Area:

Area =

$$\frac{(\text{Diameter of Wire in Inches})^2 \times (\# \text{ of complete circumferential rolls}) \times (0.7854)}{\text{Length of Pipe in LF}}$$

20. Annual Samples

a. Cores for Absorption

- Absorption for concrete pipe shall not exceed 9 percent of the dry mass. Each sample shall have a minimum mass of 2.2 lbs. shall be free visible cracks (4” cores are normally used for this test). If absorption fails, the absorption sample shall be made on another sample from the same pipe.
- Concrete cores shall be taken for each diameter, class and wall annually, with additional samples taken for each diameter, class and wall after every 10,000 LF is produced and accepted.
- Cores shall be taken from pipe produced during the current year or the previous year if current year is not available.
- Samples will be sent to Materials and Tests Unit Physical Lab.

b. Reinforcement Sample

- Reinforcement wire and steel samples will be taken annually for each size, with additional samples taken for every 10,000 LF produced and accepted.
- Wire samples will be 30” with a minimum of three circumferential reinforcement wires.
- If wire reinforcement is welded at the lap, a representative sample shall be taken with the weld as part of sample. Sample shall be 30” with a minimum of three circumferential reinforcement wires.
- Reinforcing steel samples shall be two 30” bars for each diameter.
- All samples will be sent to Materials and Tests Physical Lab along with mill certs.

c. Cement Samples

- Cement samples shall be taken annually or if a questionable material is an issue.

d. Pozzolan

- Pozzolan samples shall be taken annually or if a questionable material is an issue.

e. Coarse Aggregate

- Coarse Aggregate samples shall be taken quarterly or if a questionable material is an issue.
- Material must come from the NCDOT's Approved List.

f. Fine Aggregate

- Fine Aggregate samples shall be taken quarterly or if a questionable material is an issue.
- Material must come from the NCDOT's Approved List.

**Standards:**

NCDOT Standard Specifications Section 1077

AASHTO M 199

ASTM C 913

**Sample Prep and Submittal:**

All inspections must be entered into Hicams under Field Inspection Report (FIR) within two working days. Enter your test data in the results tab. Make material selection based on the information below: **Do not use 'Precast Concrete Units'**.

Material Types:

Precast Concrete Barrier-Both  
Precast Concrete Culverts-Both

Precast Concrete Drainage Structures-Both  
Precast Concrete Manholes-Both  
Precast Concrete Walls & Panels-Both

Material:

-Precast Barrier-Each (includes all sizes & types)  
-Precast End Sections-Each (includes all types of end sections, wing walls & head walls)  
-Precast Culverts (includes box culverts & 1 or 2 piece-three sided culverts)  
-Precast Drainage Structure-Each (includes all types)  
-Precast Manholes-Each (includes all types & risers)  
-Precast Wall Panels-Each (includes MSE, noise & retaining wall panels, coping and posts)