

**MATERIALS DIVISION**  
  
**MEMORANDUM**

<b>GENERAL SUBJECT:</b> Precast Concrete		<b>NUMBER:</b> MD 286-06
<b>SPECIFIC SUBJECT:</b> Quality Control Plan Review Check list; Approved list Nos. 26 and 34; Precast Repair Manual		<b>DATE:</b> December 27, 2006
<b>DIRECTED TO:</b> District Construction Engineers	<b>SIGNATURE:</b> Andrew Mergenmeier, PE <i>Signature on original copy of memorandum</i>	

The Virginia Department of Transportation/Materials Division working with the Precast Concrete Association of Virginia has refined documentation for current practices regarding precast concrete. This includes the Department's process by which a miscellaneous precast concrete or a concrete pipe producer is approved to supply product for VDOT projects (Materials Division's Approved Lists Nos. 26 and 34), the producer's Quality Control Plan, the Department's Quality Control Plan review and a Precast Concrete Repair Manual. This memorandum incorporates this documentation into the Materials Division Manual of Instructions.

This documentation is necessary for the following reasons:

1. Providing additional clarification/information for the process of placing miscellaneous precast concrete and concrete pipe producers on the corresponding Approved Lists and the Department's internal review process.
2. Adding the Precast Concrete Repair Manual to the Manual of Instructions. The repair manual is a new tool that provides guidance when repairs to precast concrete items/concrete pipe are unnecessary, when repairs should be made and when units are beyond repair.
3. Aligning AASHTO references to the corresponding ASTM to match the current VDOT Road and Bridge Specifications.

For these reasons, the following changes are being made:

1) Amend Chapter II, page II-2 to correct the page number reference for Section 209 Chapter II - Appendix A and correctly reflect the page number references for Appendix A as follows:

SECTION 209 CHAPTER II - APPENDIX

A.....	1
<i>Link to Prequalified Materials covered by Standard Specifications.....</i>	<i>II-A</i>
Concrete Pipe Plant Monitor Report .....	2II-B
Corrugated Metal Pipe Plant Monitor Report .....	4II-C
Reinforcing Steel Fabrication Shop .....	4II-D
Reinforcing Steel Epoxy Coating Plant Review .....	4II-E
Precast Concrete Plant Monitor Report.....	4II-F
Pavement Marking Materials Inventory Ledger .....	3II-G
Polyethylene Pipe Plant Monitor Report.....	4II-H
<i>Precast Concrete Quality Control (QC) Plan Checklist.....</i>	<i>II-I</i>
<i>Precast Concrete Repair Manual.....</i>	<i>II-J</i>

2) Amend Section 204.22(c), paragraph 2 to the following:

The following classifications of miscellaneous precast products, such as: 1) Manholes, 2) Box Culvert Systems, 3) Drainage Structures, 4) Barriers (*including temporary traffic barriers*), 5) Retaining Walls, 6) Sound walls, 7) R/W monuments and 8) other Precast Concrete Products upon approval by VDOT, may be accepted on the manufacturer’s certification based on the requirements of the VDOT Precast Concrete Products Quality Assurance Program as outlined below. (Temporary precast traffic barrier service shall be visually accepted at the project site for cleanliness, structural integrity, and functionality).

3) Insert as paragraph 3 in Section 204.22(c), the following:

*In order to supply miscellaneous precast concrete products to a VDOT project, the precast concrete producer must be on the Materials Division Approved List No. 34. To qualify for placement on this list, the precast concrete producer must submit a Quality Control (QC) Plan defining his routine business quality control practices. The QC plan is submitted to the responsible Materials Section as coordinated by the Materials Division Central Office Physical Laboratory. After review for completeness and conformance of the producer’s QC plan to the Quality Control Plan Checklist as found in the Appendix II-I of this chapter, a plant visit will be made to evaluate the producer’s conformance to his QC Plan. If during the inspection deficiencies are noted, this will be documented in a report with a follow-up visit scheduled. If no deficiencies are found, the precast concrete producer is probationarily approved until one or more successful projects have been completed demonstrating conformance to the QC plan and that a quality product has been consistently supplied. If problems are encountered during the production and supply within this probationary period, then additional projects may be necessary for the producer to work out QC Plan conformance issues. The miscellaneous precast concrete producer will be added to the Approved List No. 34 with a “p” to denote that the facility is probationarily approved. Once the probationary period has been successfully completed, the “p” will be removed. The Department will continue to monitor the producer’s facility to ensure conformance to the QC plan and project specifications. Annually, the Department will review the updated QC plan submitted by the producer and update the Approved List with the latest review date. The approving/ revoking authority is the District Materials Engineer for plants located in their respective district or Concrete Programs Engineer in Central Office for plants located outside of the state, and not covered by a district. Appeals may be submitted to the State Materials Engineer for final disposition.*

4) Amend Section 204.22(c)1, paragraph one as follows:

**(1) Testing**

The producer will ~~submit for VDOT approval a Quality Control Plan and~~ perform the following minimum quality control procedures and the statement "We certify that these items have been tested and conform to the VDOT Precast Concrete Products Quality Assurance Program" shall be on each shipping document and signed by a responsible company representative. The shipping document should also contain the following information: The plant name, plant location, telephone number, document number, contractor's name, and project number. One additional copy of the shipping document shall be provided to the monitoring ~~District~~ Materials Section for distribution to the receiving District.

5) Amend Section 204.22(c)2 as follows:

**(2) Test facilities**

Producer facilities, equipment and testing personnel will be adequate to conduct the applicable tests outlined in AASHTO T280, and will be approved by the Department. Quality Control procedures shall be performed by or under the direction of a VDOT certified Hydraulic Cement Concrete Plant and Field Technician.

Entrained air will be checked with a pressure type meter according to ~~AASHTO T-152~~ASTM C231.

Compression cylinders or cores will be tested with facilities, equipment and personnel sufficient to conduct such tests according to ~~AASHTO T22~~ASTM C39. Compressive strength cylinders may be either 6 inch (150 mm) diameter by 12 inch length (300 mm), or 4 inch (100 mm) diameter by 8 inch (200 mm) length.

Producers will maintain current calibration certificates on all analytical equipment used in testing.

Producers may elect to use the services of an independent commercial testing laboratory acceptable to the Department in lieu of conducting their own tests.

6) Amend Section 204.22(c)5 as follows:

**(5) Monitoring**

The producer's production and testing facilities, processes, records, and product will be monitored weekly, ~~as a minimum,~~ *or as deemed necessary depending on project-related work* by the Department. ~~A Checklist of items to be inspected is provided in Appendix II-F. (Precast Concrete Plant Monitor Report)~~ The checklist must be completed in its entirety each quarter. The weekly monitoring effort should emphasize inspection of one or two of the items on the list. Shipment of samples to the District or Central Office laboratory for testing shall be in accordance with Sec. 203, using Form TL-10 or Form TL-13, as outlined in Sec. 800.

7) Amend Section 204.22(c)7 and 7a as follows:

**(7) Repairs**

~~Edge and corner spalls are to be repaired to their original neat lines. Mortar used in the repair work shall be from the approved list and the color for exposed units is to be selected/made to closely match the color of the concrete in the unit. Patching materials are to be applied in accordance with the manufacturer's recommendations. Cracks of less than 12 inches (300 mm) in length and less than 0.01 inch (0.25 mm) in width may be repaired with mortar, except soundwall will be repaired in accordance with current specifications. Generally speaking, units with large cracks are not to be used. Units having full depth cracks are not to be used. When the effectiveness of a connection is reduced but involves damage to less than 20% of the longitudinal dimension of that connection, repair may be performed as in paragraph above. When damage to the tongue or groove involves 20% or more of the longitudinal dimension, the repair must be doweled into the undamaged portion of the unit and performed using hydraulic cement concrete, cured in~~

accordance with the provisions of Section 404 of the specifications. Note: The rejection criteria for length and width of cracks is taken from AASHTO M199. The 20% criteria for keyways is a collective judgement.

Repairs will be in accordance with *The Precast Concrete Repair Manual* listed in the Appendix II-J.

**(7a) Repairs to Used Barriers**

~~Delineators and other required reflective materials are to be replaced with new material and the marks/blemishes caused by the removal are to be repaired or acceptably covered. Used barrier sections should not be expected to look like new. They should be cleaned/coated sufficient to afford good visibility and uniformity of appearance. The barrier sections must be structurally sound with no concrete missing along the top surface, and no through cracks.~~

8) Insert the following as paragraph three to Section 204.26(f):

*In order to supply concrete pipe products to a VDOT project, the concrete pipe producer must be on the Materials Division Approved List No. 26. To qualify for placement on this list, the concrete pipe producer must submit a Quality Control (QC) Plan defining his routine business quality control practices. The QC plan is submitted to the responsible Materials Section as coordinated by the Materials Division Central Office Physical Laboratory. After review for completeness and conformance of the producer's QC plan to the Quality Control Plan Checklist as found in the Appendix II-I of this chapter, a plant visit will be made to evaluate the producer's conformance to his QC Plan. If during the inspection deficiencies are noted, this will be documented in a report with a follow-up visit scheduled. If no deficiencies are found, the concrete pipe producer is probationarily approved until one or more successful projects have been completed demonstrating conformance to the QC plan and that a quality product has been consistently supplied. If problems are encountered during the production and supply within this probationary period, then additional projects may be necessary for the producer to work out QC Plan conformance issues. The concrete pipe producer will be added to the Approved List No. 26 with a "p" to denote that the facility is probationarily approved. Once the probationary period has been successfully completed, the "p" will be removed. The Department will continue to monitor the producer's facility to ensure conformance to the QC plan and project specifications. Annually, the Department will review the updated QC plan submitted by the producer and update the Approved List with the latest review date. The approving/revoking authority is the District Materials Engineer for plants located in their respective district or Concrete Programs Engineer in Central Office for plants located outside of the state, and not covered by a district. Appeals may be submitted to the State Materials Engineer for final disposition.*

9) Amend Section 204.26(f)2, paragraph two as follows:

If compression cylinders or cores are used in lieu of three edge bearing tests, facilities, equipment and personnel will be sufficient to conduct such tests according to ~~AASHTO T22~~ASTM C39. Compression cylinders may be either 6 inch (150 mm) diameter by 12 inch (300 mm) length, or 4 inch (100 mm) diameter by 8 inch (200 mm) length.

10) Amend Section 204.30(a)2b, paragraph 3 (page II-53), first sentence as follows:

Certified Delivery Ticket When materials are shipped from inventory, the contractor shall prepare a delivery ticket (see sample form, Appendix II-E-2G) for each shipment and for each project.

11) Insert the Quality Control Plan Review Check List into the Appendix, beginning with Page II-I-1:

### Quality Control Plan Review Check List

Plant Name: \_\_\_\_\_

Location: \_\_\_\_\_

Date: \_\_\_\_\_

Reviewer: \_\_\_\_\_ Reviewer's Section: \_\_\_\_\_

Description: This Quality Control (QC) Plan Review Check List is to be used by the VDOT Monitor to assess the completeness of the Quality Control Plan submitted by the miscellaneous precast concrete or concrete pipe producer. If the QC Plan is deemed complete, the QC Plan can be approved and the producer can make product for VDOT projects according to the instructions.

Note: N/A = Not Applicable

Does the QC Plan have a:

Cover sheet specific to the Facility with the latest revision date: Yes No

Statement of Commitment to Quality Control: Yes No

Plant Personnel Organizational Chart:  
(Including Plant Manager, QC Technician/Manager/Director  
and Personnel Qualifications) Yes No

Plant Organization (line of reporting) Yes No

Types of Precast concrete items produced for VDOT projects Yes No

Records:

Types of Records kept Yes No

Retention time of records Yes No

Materials Section – Are the location and retention time of the following documentation included?

If purchasing concrete from a concrete producer not on site, is  
the concrete producer an approved source? Yes No N/A

Cement Supplier's name, location and mill certificates Yes No N/A

## Fine and Coarse Aggregates

Stamped Delivery Tickets or Certifications kept on file	Yes	No	N/A
Documentation of Gradations and Moisture checks	Yes	No	N/A
Frequency of Visual Inspections	Yes	No	N/A
Admixtures: Product Data sheets and types of admixtures used	Yes	No	N/A
Water quality	Yes	No	N/A
Welded Wire Fabric fabrication procedure	Yes	No	
Steel/Rebar/Epoxy-coated rebar mill certifications	Yes	No	
Grates, frames and covers			
Certifications under an approved program	Yes	No	N/A
Materials Storage	Yes	No	
Does the QC Plan state how each material used will be stored?			
Form Work	Yes	No	
Does the QC Plan provide details of how forms are cleaned, stored and prepared for the next pouring operation?			
Set-up Inspection	Yes	No	
Does the QC Plan provide information on how the equipment is prepared prior to form set-up; equipment available and functioning properly, etc.?			
Prepour Inspection			
Form set-up	Yes	No	
Product set-up	Yes	No	
Postpour Inspection	Yes	No	
Batching	Yes	No	
Curing:	Steam	Air	Other_____
Cold Weather curing procedures:	_____		
Hot Weather curing procedures:	_____		
Finished Product Inspection	Yes	No	
Does the QC Plan describe how the finished product is inspected?			

Product Storage and Shipping		Yes	No
Does the QC Plan describe how the product is stored and how the product is shipped including any precautions and inspection that is performed?			
Patching			
Level of Patching		Yes	No
Brand Name of Patching Material used		Yes	No
Procedure for patching in hot and cold weather		Yes	No
Problem Resolution Procedure		Yes	No
Does the QC Plan outline a procedure to follow when problems involving production, testing, product meeting specifications, etc. are encountered?			
Quality Control Testing Frequency and Test Method			
Does the QC Plan define the testing performed to ensure product meets specifications?			
Making cylinders/curing			ASTM C31
	AASHTO T126		ASTM C192
Temperature of Concrete			ASTM C1064
Slump Test			ASTM C143
Air Content			
Pressure Meter			ASTM C231
Volumetric Meter			ASTM C173
Absorption tests	AASHTO T280		ASTM C497
Strength tests			ASTM C39
	AASHTO T280		ASTM C497
Scale/Balance calibration frequency		Yes	No
Frequency of Hopper/Chute Inspection		Yes	No
Consequences of failing tests		Yes	No
What is done with the product when failing tests are encountered?			
Mix Designs		Yes	No
Identification and Handling of unacceptable units		Yes	No
Product stamping and Shipping Ticket with identifications		Yes	No



12) Amend the Materials Division Approved List No. 26 as follows:

**(26) CONCRETE PIPE PRODUCERS ON QA/QC PROGRAM – (Physical Lab)**

The following manufacturers of concrete culvert pipe have VDOT approved Quality Assurance programs as outlined in the instructions. For additions and deletions to this list contact the District Materials Engineer or the Materials Division Physical Laboratory.

<b>Manufacturer</b>	<b>Plant Location</b>	<b>Monitored by</b>	<b>Next Review Date</b>
Producer's Name	Producer's Location	Materials Section	Review Date

13) Amend the Materials Division Approved List No. 34 as follows:

**(34) \*\*CONCRETE PRECAST PRODUCERS ON QA/QC PROGRAM\*\* - (Physical Lab)**

The following manufacturers of concrete precast products have VDOT approved Quality Assurance programs as outlined in the instructions. For additions or deletions to this list contact the District Materials Engineer or the Materials Division Physical Laboratory.

<b>Manufacturer</b>	<b>Plant Location</b>	<b>Monitored by</b>	<b>Next Review Date</b>
Producer's Name	Producer's Location	Materials Section	Review Date

14) Insert the following into the Appendix beginning with Page II-J-1:

## **Virginia Department of Transportation/Materials Precast Concrete Repair Manual**

### **INTRODUCTION**

Precast concrete, as a manufactured material, will not be 100% defect free; however, with proper quality control (QC) repairs can be minimized. Repaired precast concrete can be just as good as structurally sound concrete not needing repairs. The purpose of this manual is to provide guidance in the identification and repair of defects in precast concrete units. The manual will also help identify the precast piece and help one identify the piece as the one ordered.

### **ACCEPTABLE MATERIALS FOR REPAIR**

Materials used in repairs should be listed on the proper VDOT Materials Division Approved List numbers 28, 29 or 31. The lists can be found at <http://www.virginiadot.org/business/resources/bu-mat-ALwlab.pdf>.

Repair materials must be applied and cured in accordance with the manufacturer's recommendations.

### **DEFINITIONS**

**Structural Defect** – Broken corners, large spalls and defects that expose rebar.

**Cosmetic Defect** – Chips, bug holes, surface defects, fractures and small spalls that do not expose any reinforcement. Defects that do not affect the integrity of the structure, i.e. only affect the look of the structure.

**Bug Holes** – Entrapped air voids at the surface. The air voids should be small in size less than ¼ inches (6 mm) in diameter.

### **PRECAST CONCRETE UNITS**

**Basics** – Typically, the design strength of a precast structure is at least 4000 PSI (30 megapascals) at 28 days and  $6 \pm 2\%$  air content. Units should not be shipped until 85% design strength is achieved. Some units will have exposed rebar for tying into adjacent cast in place structures.

**Endwalls** – The basic look of an endwall is rectangular with a thicker base (Photo 1 & 2). There will also be at least one opening for a pipe connection. The opening could be circular, elliptical or arched. Larger endwalls will most likely have wings. The endwall should have neat, clean edges without spalls, cracks or exposed reinforcement. Pipe openings shall not exceed the outside cross sectional dimensions of the pipes by more than a total of 8 inches (200 mm) regardless of the placement of pipes, the angles of intersection, or the shapes of the pipes.



**Photo 1 - EW - 12**



**Photo 2 - Endwall**

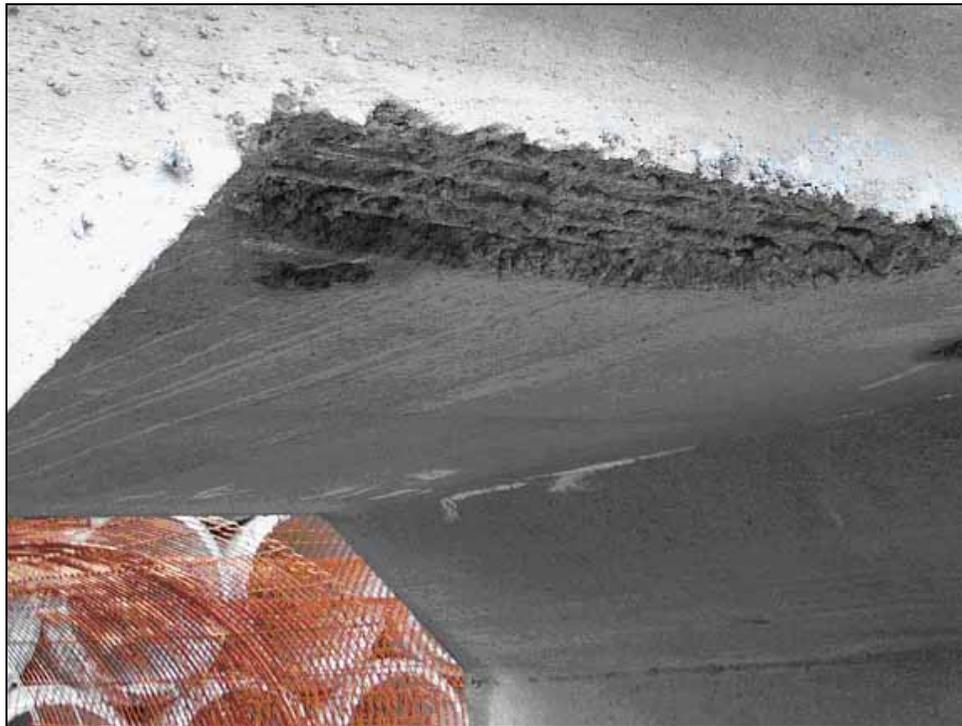
**Box Culverts** – There are numerous looks to box culverts. The typical cross section should have a rectangular look to it. The number of boxes in a typical section is the type of culvert. Two boxes make a double box culvert.

The box culvert should be free of visible defects and have neat, clean edges.



**Photo 3 - Box Culvert**

The top edge needs to be patched before item can be installed.



**Photo 4 - Close-up of Box Culvert**

This box culvert (Photo 4) can be patched to cover the exposed rebar. More severe damage may be cause for rejection or may be repaired in accordance with a procedure approved by the Engineer. Repair procedures may be submitted on a case-by-case basis.

**Top Units** – The top unit will be circular (Photo 5) or rectangular with various openings or grates. The joint will be of fabricator's design meeting approval of the Engineer. Joints are to be sealed with mortar, rubber gasket, or butyl rubber. The unit shall be free of visible defects and have neat, clean edges.



**Photo 5 - Top Unit**

## Drop Inlets

**DI-2** – Will have a similar look to what is pictured (Photo 6) but can have slight modifications depending on its use.



**Photo 6 - DI-2**

**DI – 3, 4** - The item will come in several pieces. The main section should be a rectangular box. The box will have an IC-2 frame and cover. One side of the box will be open with the bottom having a smaller opening (Photo 7). The main piece will also contain dowel holes used to connect to the curbing. The second piece is the face block (Photo 8). The face block will have at least two loops cast in the face. Face blocks should be sealed with grout or polysulfide from the appropriate approved list. The pieces shall be free of visible defects and have neat, clean edges.



**Photo 7 - DI-4**



**Photo 8 - Face Block**

**DI – 5** – This item will be slanted (Photo 9) to fit a ditch. Unit should not be placed in traffic. The unit shall be free of visible defects and have neat, clean edges.



**Photo 9 - DI-5**

**DI – 7** – Grate design can vary depending on if unit will be subject to traffic loading or not.



**Photo 10 - DI-7**

**DI- 10, 14 (Photo 11) – Unit is to be used with median barriers.**



**Photo 11 - DI-10**

**DI – 12 – Unit should not be placed in traffic loading conditions. Grate bars should be installed parallel to ditch flow (Photo 12).**



**Photo 12 - DI-12**

**Taper units** – Circular units that are attached under a manhole frame. The unit will taper from a larger section to a smaller section (Photo 13). The unit shall be free of visible defects and have neat, clean edges.



**Photo 13 - Taper Unit**

The taper should be flush with its mated surface. This item should be repaired before installation.

**Riser** – Circular units that are attached under a manhole frame (Photo 14). The unit shall be free of visible defects and have neat, clean edges.



**Photo 14 - Riser**

**Base Units (Photo 15)** – Openings for pipe will be a minimum of 4 inches (100 mm) to a maximum of 8 inches (200 mm) larger than the outside diameter of proposed pipe. Joints are to be sealed with mortar, o-ring gasket, or butyl rubber.



**Photo 15 – Base Unit**

**Manhole Tee Bases (Photo 16)** – Riser section is to have a minimum wall thickness of 5 inches (125 mm). Base section should be same class and strength as the adjoining pipe culvert. Tongue and groove joints are to be of identical design as adjoining pipe culvert.



**Photo 16 - Manhole Tee Base**

**Flared End Section** – The unit will have either a tongue end (Photo 17) or a groove end (photo 18). The unit shall be free of visible defects and have neat, clean edges.



**Photo 17 - Tongue Flared End Section**



**Photo 18 - Grooved Flared End Section**

**Used Barriers:** Delineators and other required reflective materials are to be replaced with new material and the marks/blemishes caused by the removal are to be repaired or acceptably covered.

Used barrier sections should not be expected to look like new. They should be cleaned or coated sufficiently to afford good visibility and uniformity of appearance. The barrier sections must be structurally sound with no concrete missing along the top surface and no through cracks.

**Cosmetic Repair:** Minor chips, small spalls or bug holes

- Areas that require repair are to be clean, sound and free of contaminants
- Provide an aggregate fractured surface
- When using a water-based repair material, saturate the repair surface to SSD condition
- Follow the manufacturer's instruction for patching for an approved repair material
- Allow repaired unit to cure to at least 85% of design strength before moving.

**Structural Repair:** Large chips, spalls or exposed reinforcement

- Areas that require repair are to be clean, sound and free of contaminants
- Provide an aggregate fractured surface
- Remove concrete a minimum of 1 inch (25 mm) beyond all exposed reinforcement
- Saturate the repair surface to provide an SSD (Saturated, Surface-Dry) condition, if using a water-based repair material
- Follow the manufacturer's instruction for patching for an approved repair material
- Allow repaired unit to cure at least 85% of design strength before moving.

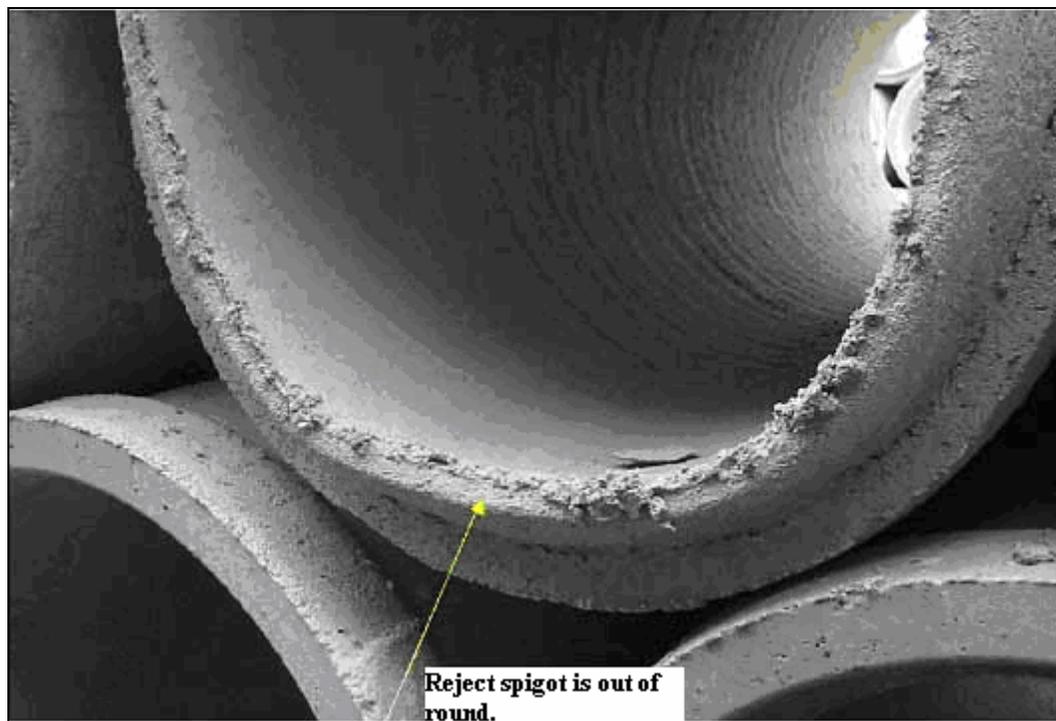
## **PIPE**

**Acceptable non-repaired pipe:** Should have neat edges, corners and be free of visible defects.

**Determination of Repairs to Precast Units:** Edge and Corner spalls are to be repaired to their original, neat lines. The mortar to be used for repair should closely match the color of the concrete unit if the unit is exposed. The manufacturer's directions should be followed when patching the concrete unit. Special precautions should be taken in hot or cold weather.

Cracks of less than 12 inches (300 mm) in length and less than 0.01 inches (.25 mm) in width may be repaired with mortar. Units having full depth cracks or larger than those noted above, shall be rejected or may be repaired in accordance with a procedure approved by the Engineer. Repair procedures may be submitted on a case-by-case basis.

When the effectiveness of a connection is reduced, but involves damage to less than 20% of the longitudinal dimension of that connection, repair may be performed as in the paragraph above. The connection refers to the spigot, bell, tongue or groove of pipe.



**Photo 19 - Spigot out of Round**



**Photo 20 - Repairable Pipe**

The above pipe can be repaired following the proper procedure.

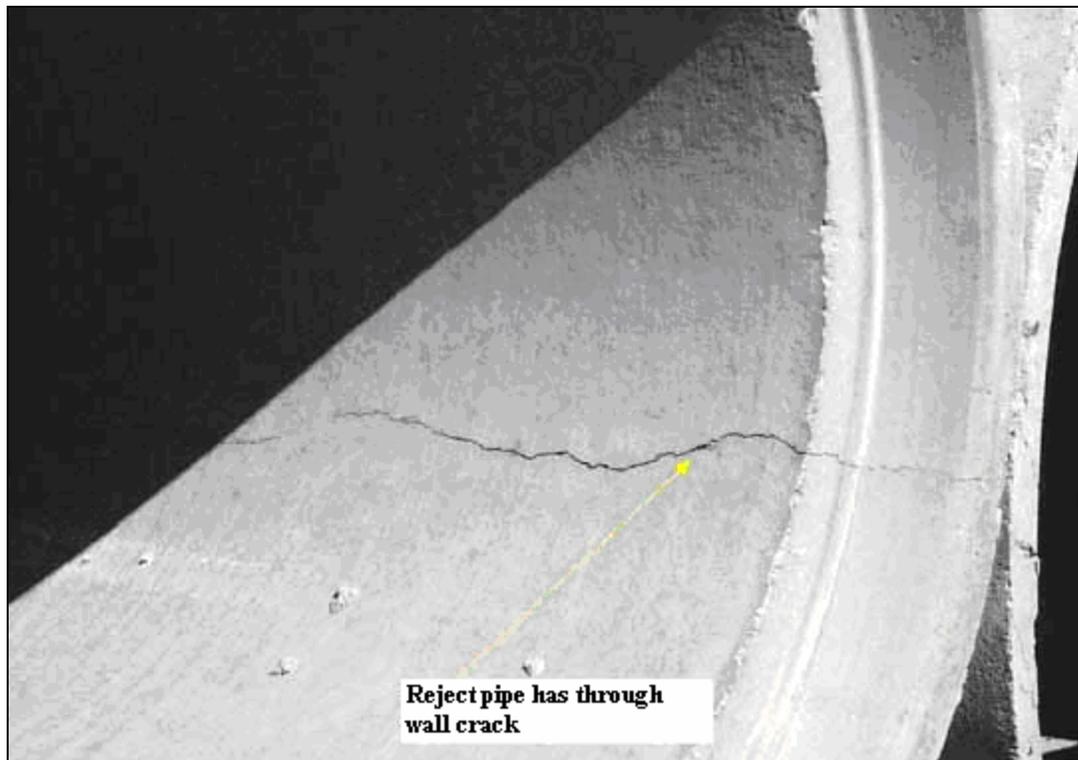


**Photo 21 - Non-Repairable Pipe**

Pipe that has as much damage as the pipe above shall be rejected and not repaired.

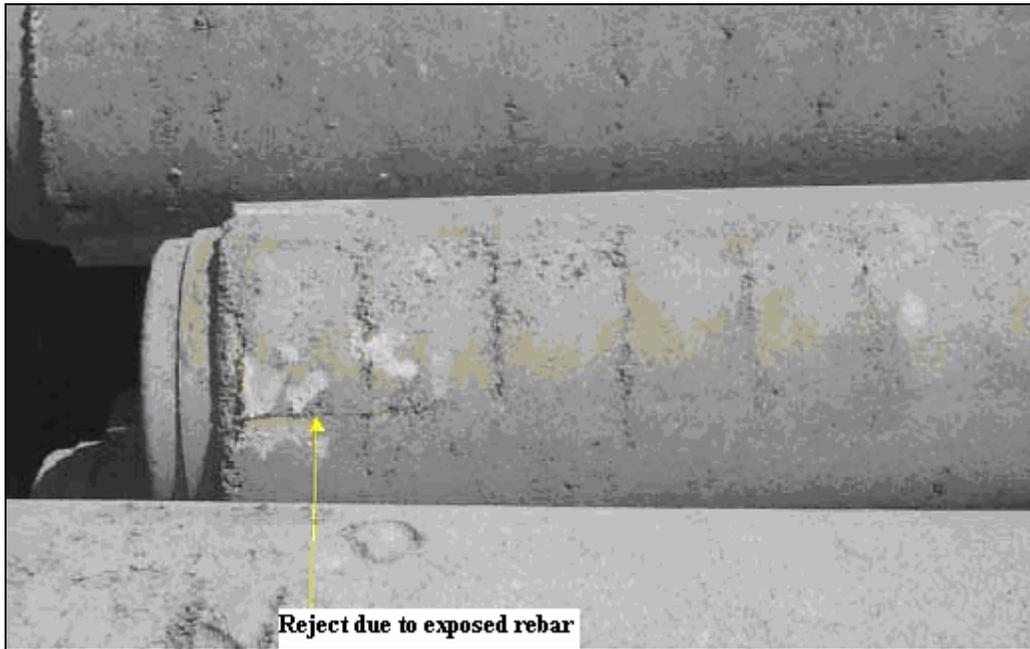
Repair to spalls in the inner barrel will be allowed in the acceptable limits at the male and female ends of joint. Spalls on the inner barrel may be considered cosmetic if reinforcement is not revealed within 1.5 times the joint depth from the end of pipe. Minor spalls at the lift hole may be repaired when the lift hole is plugged. Spalls with a size greater than 2 inches (50 mm) or have exposed rebar shall require structural repairs.

If a pipe section exhibits a through wall crack, it shall be rejected (Photo 22); except that a single end crack that does not exceed the depth of joint will be permitted. On a case-by-case basis, repair procedures for rejected pipe may be submitted for approval by the Engineer. Non-through wall cracks for pipe not tested but part of an approved lot will be accepted according to ASTM C76.

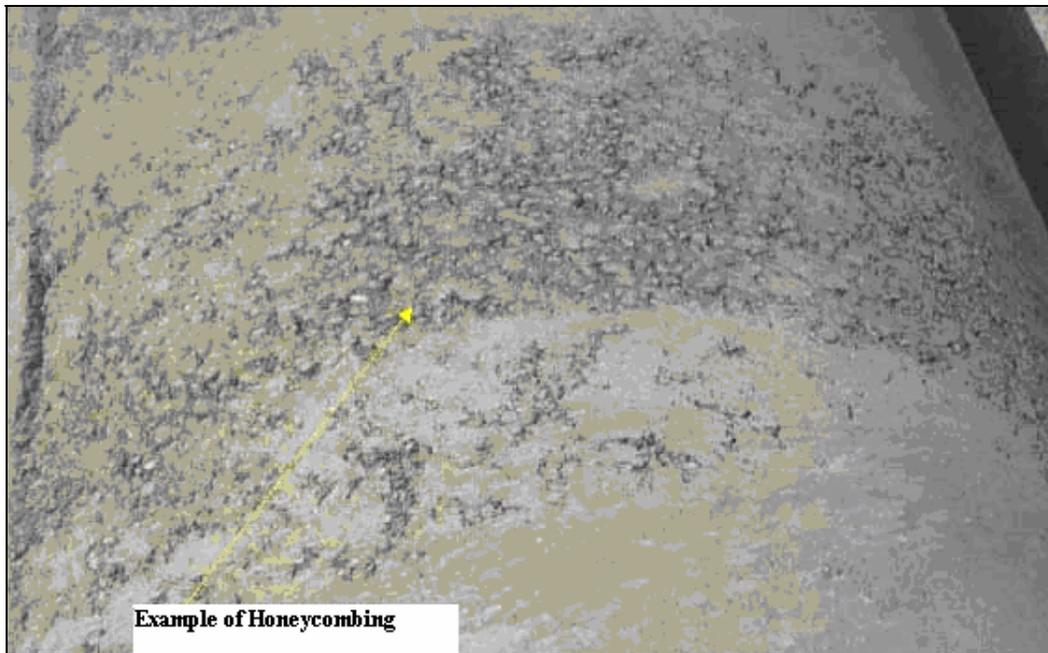


**Photo 22 - Throughwall Crack**

Pipe sections that exhibit signs of manufacturing defects such as honeycombing (Photo 24) or mixture insufficiencies exposing the reinforcement cage (Photo 23) shall be rejected. This statement does not include exposed end tips (Photo 25). Exposure of end tips shall not be justification for rejection.



**Photo 23 - Exposed Rebar**



**Photo 24 - Honeycombing**



**Photo 25 - Exposed Tips**

Note: The rejection criteria for length and width of cracks are taken from AASHTO M199. The 20% criteria for keyways is a collective judgment.

**Cosmetic Repair:** Minor chips, small spalls or bug holes

- Areas that require repair are to be clean, sound and free of contaminants
- Provide an aggregate fractured surface
- Saturate the repair surface to provide an SSD condition, if using a water based repair material
- Follow the manufacturer's instructions for an approved repair material
- Allow repaired pipe to cure to at least 85% of design strength before moving

**Structural Repair:** Large chips, spalls or exposed reinforcement

- Areas that require repair are to be clean, sound and free of contaminants
- Provide an aggregate fractured surface



**Photo 26 - Pipe with Formwork**

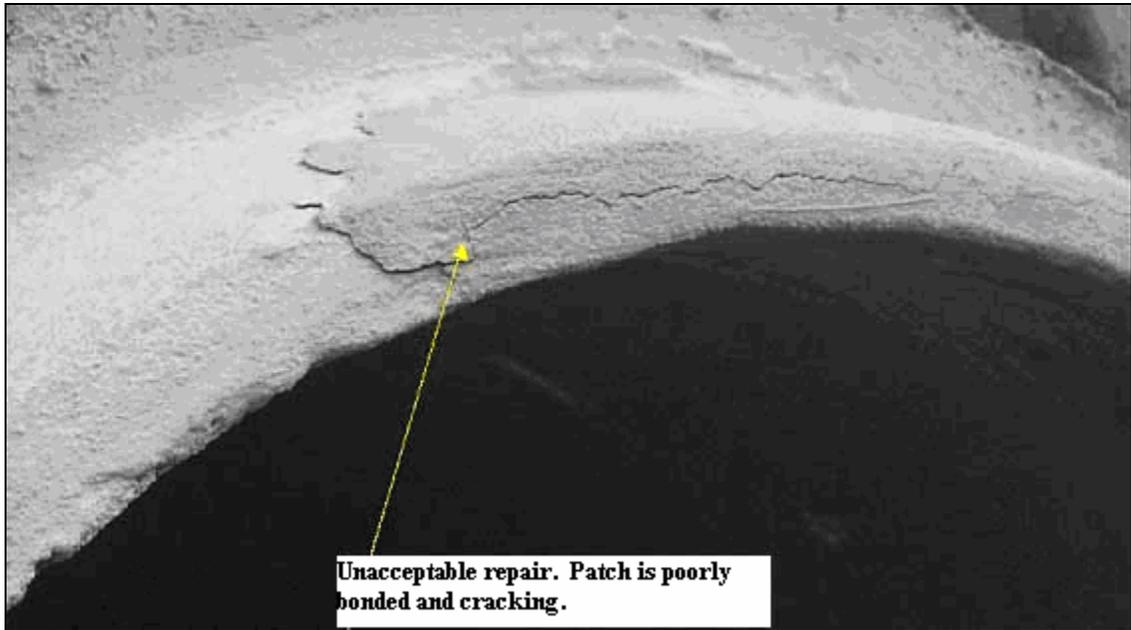
- Remove concrete a minimum of 1 inch (25 mm) beyond all exposed reinforcement
- When using a water-based repair material, saturate the surface to provide a SSD condition
- Follow the manufacturer's instructions for an approved repair material



**Photo 27 - Pipe with Patch**

Allow repaired pipe to cure to at least 85% of design strength before moving.

When damage to the tongue or groove involves 20% or more of the longitudinal dimensions, the repair must be doveled into the undamaged portion of the unit using EP-4 epoxy and repaired with hydraulic cement concrete (cured in accordance with the provisions of section 404 of the specifications) or with an approved patching material.



**Photo 28 - Bad Patch on Pipe**

Special Thanks to Pennsylvania Department of Transportation for use of their manual, Illinois Department of Transportation for use of their manual and the Precast Concrete Association of Virginia.

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cy:

Chief Engineer  
Residency Administrators  
District Materials Engineers  
Scheduling and Contract Division Administrator  
American Concrete Paving Association NE Chapter, Southern Region  
Virginia Asphalt Association  
Virginia Dept. of Minority Business Enterprise  
Virginia Ready-Mixed Concrete Association  
Precast Concrete Association of Virginia  
Virginia Transportation Construction Alliance  
Federal Highway Administration  
Old Dominion Highway Contractors Association