Rising to the Occasion
Stormwater Edition

Eric Gonzalez, P.E. – Regional Engineer, South Florida
Cate Thompson, E.I. – Regional Engineer, North Florida

Who We Are

Eric Gonzalez, P.E.

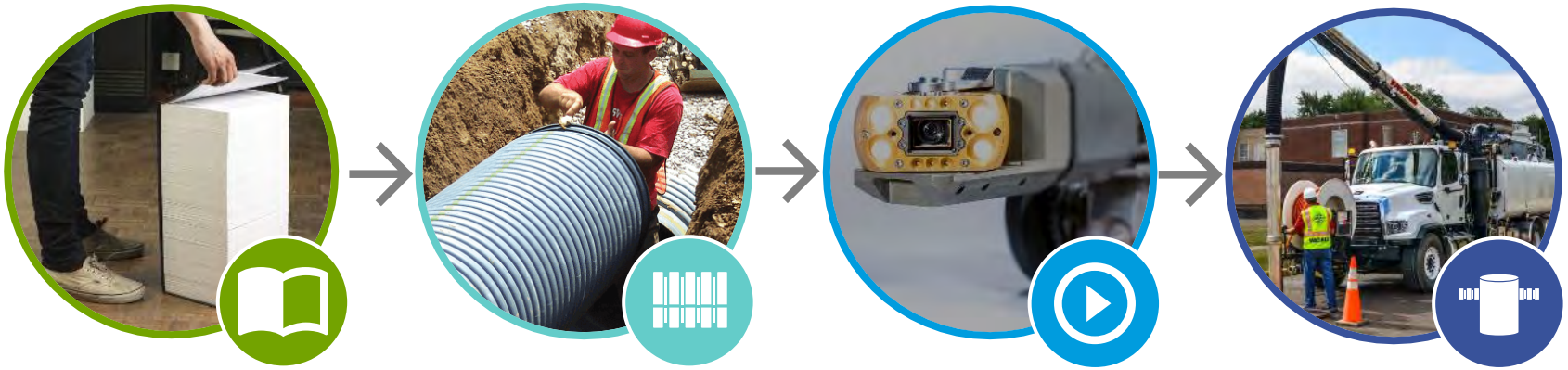
Regional Engineer, South Florida

Cate Thompson, E.I.

Regional Engineer, North Florida

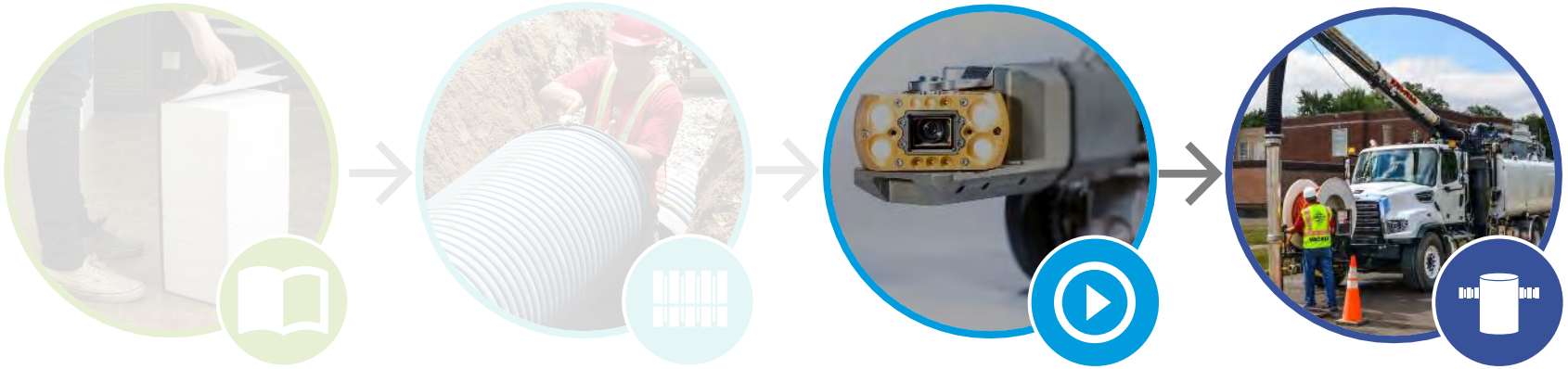

ADS

Specification to Service Life



Specifications Installation Inspection Service Life

Specification to Service Life



Specifications

Installation

Inspection

Service Life

HB 53: Public Works

Stormwater Management Analysis

By June 30, 2022, and every five years thereafter, the bill requires each county, municipality, or special district providing a stormwater management program or stormwater management system to develop a needs analysis for its jurisdiction over the subsequent 20 years. In projecting such needs, each local government must include:

- A detailed description of the stormwater management program or system and its facilities and projects.
- The number of current and projected residents served calculated in five-year increments.
- The current and projected service area for the stormwater management program or system.
- The current and projected cost of providing services calculated in five-year increments.
- The estimated remaining useful life of each facility or its major components.
- The most recent five-year history of annual contributions to, expenditures from, and balances of any capital account for maintenance or expansion of any facility or its major components.
- The local government's plan to fund the maintenance or expansion of any facility or its major components. The plan must include historical and estimated future revenues and expenditures with an evaluation of how the local government expects to close any projected funding gap.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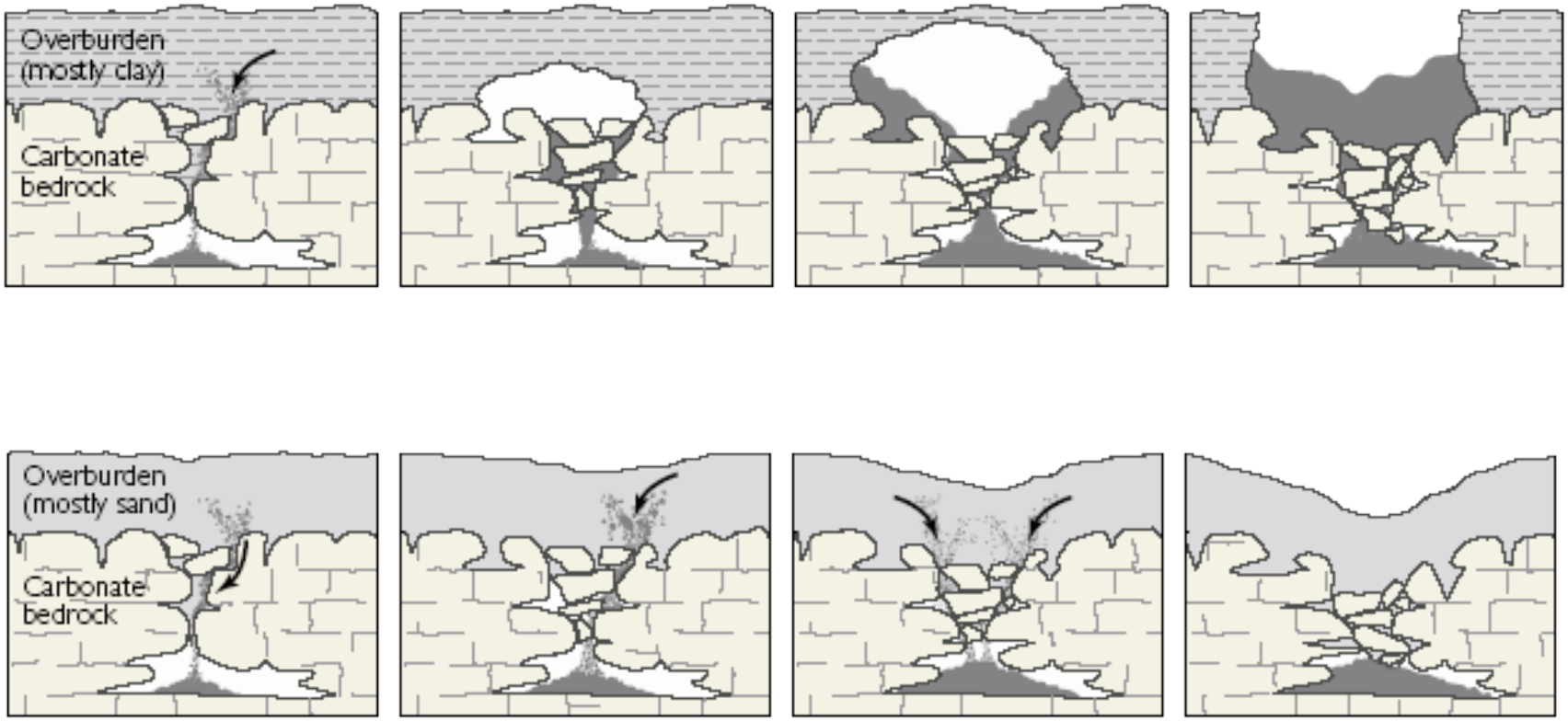
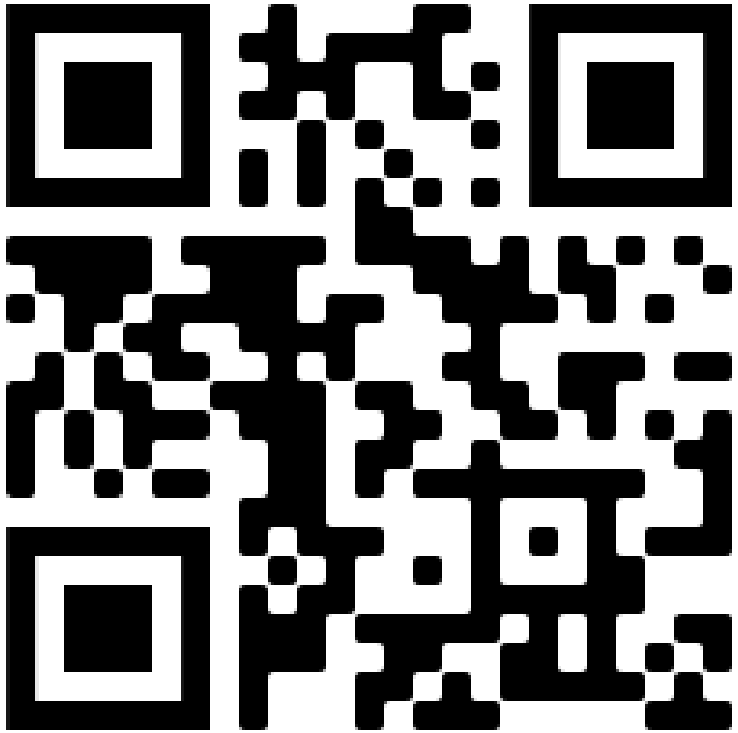
VACTOR

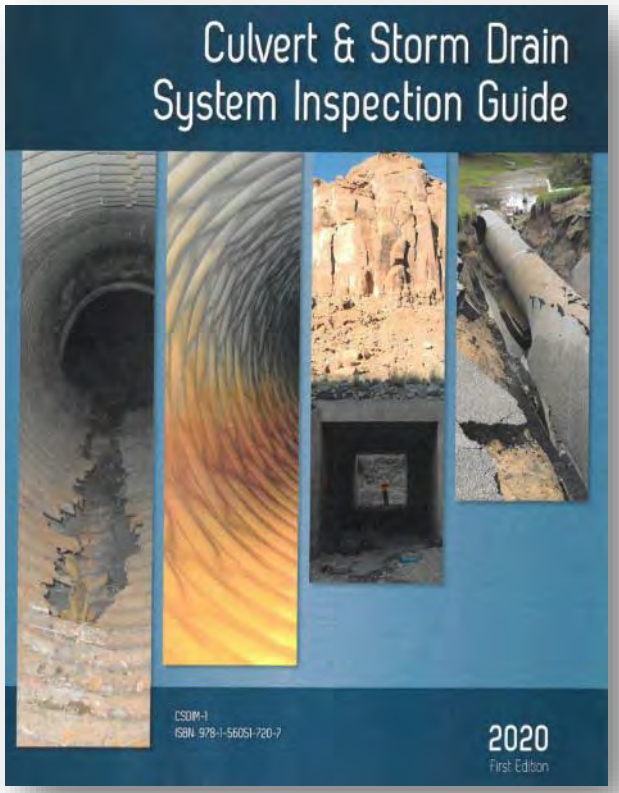

Overburden
(mostly clay)
Carbonate
bedrock
Overburden
(mostly sand)
Carbonate
bedrock



Engineering Tools

FDOT Specifications

AASHTO Inspection Guidelines



Engineering Tools

FDOT Specifications

- Specifications
  - Material
  - Installation
    - Inspection Requirements
- Pipe Repair Matrix
- Construction Project Administration Manual

AASHTO Inspection Guidelines

- Nonprofit, nonpartisan association representing highway and transportation departments…
- ..primary goal is to foster the development, operation, and maintenance of an integrated national transportation system.”
- Culvert & Storm System Inspection Guide

FDOT
Installation Specifications

FDOT

SECTION 430
PIPE CULVERTS

430-1 Description.

Furnish and install drainage pipe and end sections at the locations called for in the Plans. Furnish and construct joints and connections to existing pipes, catch basins, inlets, manholes, walls, etc., as may be required to complete the work.

Obtain pipe culverts and drainage products from a plant that is currently on the Department's Production Facility Listing. Producers seeking inclusion on the list shall meet the requirements of Section 105.

At the beginning of each project, submit a notarized certification statement to the Engineer in accordance with Section 6. The Quality Control Manager's stamp or label on each product indicates certification that the product was fabricated in conformance with the Producer QC Plan, the Contract, and this Section. Ensure that each shipment of drainage products to the project site is accompanied with a QC signed or stamped delivery ticket providing the description and the list of the products.

When the Producer Quality Control Program is suspended by the Department, accept responsibility of either obtaining products from a plant with an approved Quality Control Program, or await re-approval of the plant. The Engineer will not allow changes in Contract Time or completion dates as a result of the plant's loss of qualification. Accept responsibility for all delay costs or other costs associated with the loss of the plant's qualification.

Construct structural plate pipe culverts or underdrains in accordance with Sections 435 and 440.

For pipe culverts installed by jack & bore, install in accordance with Section 556.

430-2 Materials.

430-2.1 Pipe: Meet the following requirements:

Concrete Pipe	Section 449
Steel Pipe	556-2.1
Round Rubber Gaskets	Section 942
Resilient Connectors*	Section 942
Corrugated Steel Pipe and Pipe Arch	Section 943
Corrugated Aluminum Pipe and Pipe Arch	Section 945
Corrugated Polyethylene Pipe	Section 948
Steel Reinforced Polyethylene Ribbed Pipe	Section 948
Corrugated Polypropylene Pipe	Section 948
Corrugated Polyvinyl Chloride (PVC) Pipe	Section 948
Fiberglass Reinforced Polymer Pipe	Section 948
Liner Repair Systems	Section 948

*Use resilient connector products listed on the Department's Approved Product List (APL).

430-2.2 Joint Materials: Use joint materials specified in 430-7 through 430-9 according to type of pipe and conditions of usage.

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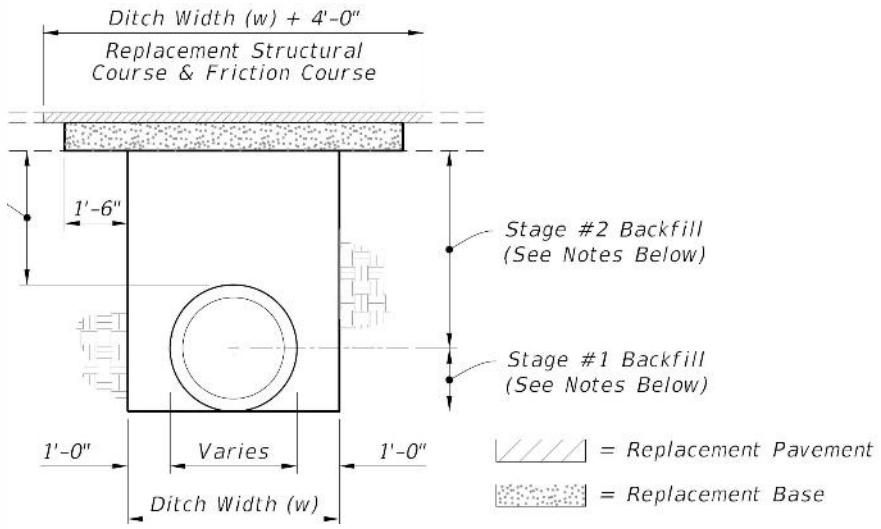


ADS

FDOT CPAM

Section 8.13

PIPE INSPECTION, EVALUATION AND REPAIR

8.13.1 Purpose

To establish a standard procedure to ensure consistent review of all post installation pipe inspections associated with construction projects.

8.13.2 Authority

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

8.13.3 Reference

Section 430 of the Standard Specifications for Road and Bridge Construction

8.13.4 Review

The Project Administrator (PA) will review all of the equipment, inspection, and reporting criteria for the post installation pipe inspection to ensure compliance with the Standard Specifications. Prior to final acceptance, the PA will evaluate the nature and severity of any observed defects and provide the Contractor with the Department's perspective on pipe repairs.

8.13.5 Preconstruction Conference

Project Administrator Responsibilities

The PA, or their delegate, shall provide a comprehensive review of the equipment, inspection, and reporting criteria found in Section 430 of the Standard Specifications to familiarize the Contractor with all the requirements for the post installation inspection. Discussion topics should include:

(1) Providing certification statements to the Department from the Contractor doing the work that the laser profiling and measurement technology is in compliance with the calibration criteria found on the Department's website.

(2) Discussion of all components of the pipe inspection report to be submitted to the Department.

8.13.6.2 - Report Evaluation

- Cracking in concrete pipe

- Deflection

- Stains in pipe

- Infiltration

- Joint gaps

So how do I know it has been installed correctly?

Pipe Inspection

430-4.8 Pipe Inspection: For pipes installed under the roadway conducted when backfill reaches 3' above pipe crown or completion of stabilized subgrade placement

Rigid

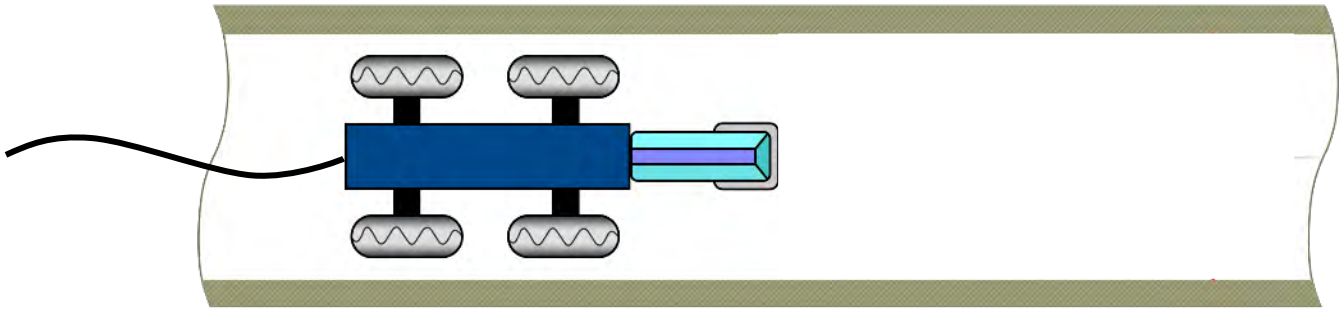
- Length & width measurements of all cracks
- Separation measurement for all rigid pipe joints

Video

- Equipment with laser profile technology, non-contact micrometer and associated software
- Pipe Observation Summary Report containing detailed observations of leaks, debris or other damage or defects

Flexible

- Pipe ovality report with representative pipe diameter
- Pipe deformations with 5% deflection limit clearly delineated

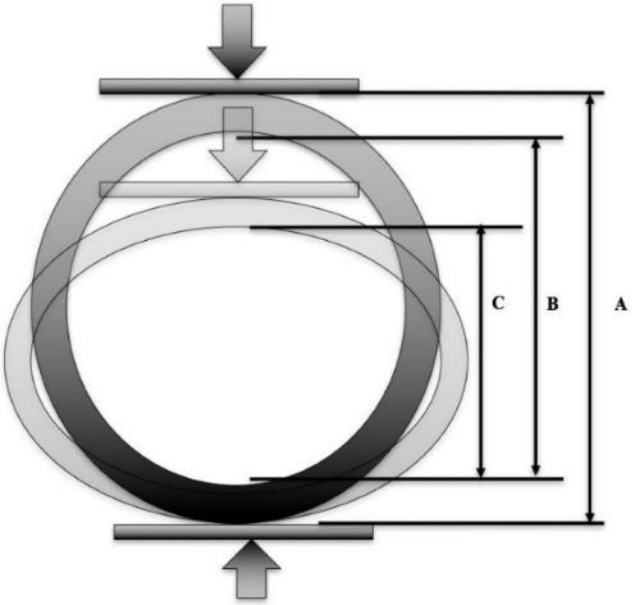


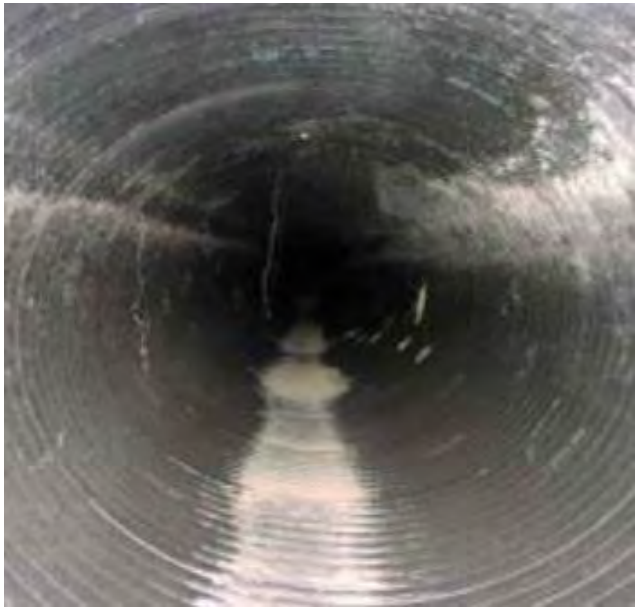
Cracking

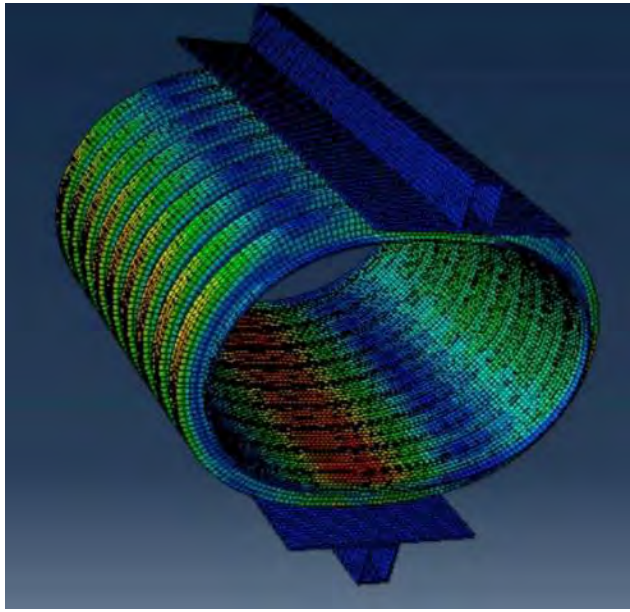
Cracks indicate that the steel has accepted part of the load

Deflection

Deflection indicates that the soil has accepted part of the load







Staining

Staining indicates a potential issue with the pipe

Infiltration

Infiltration indicates a poor seal at a joint or issue with the pipe

Joint Gap

"The Standard Specifications do not have joint gap tolerances for metal, PVC, Polypropylene, or HDPE pipes."

FDOT CPAM

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- Joint gaps

AASHTO
Culvert Inspection Guide

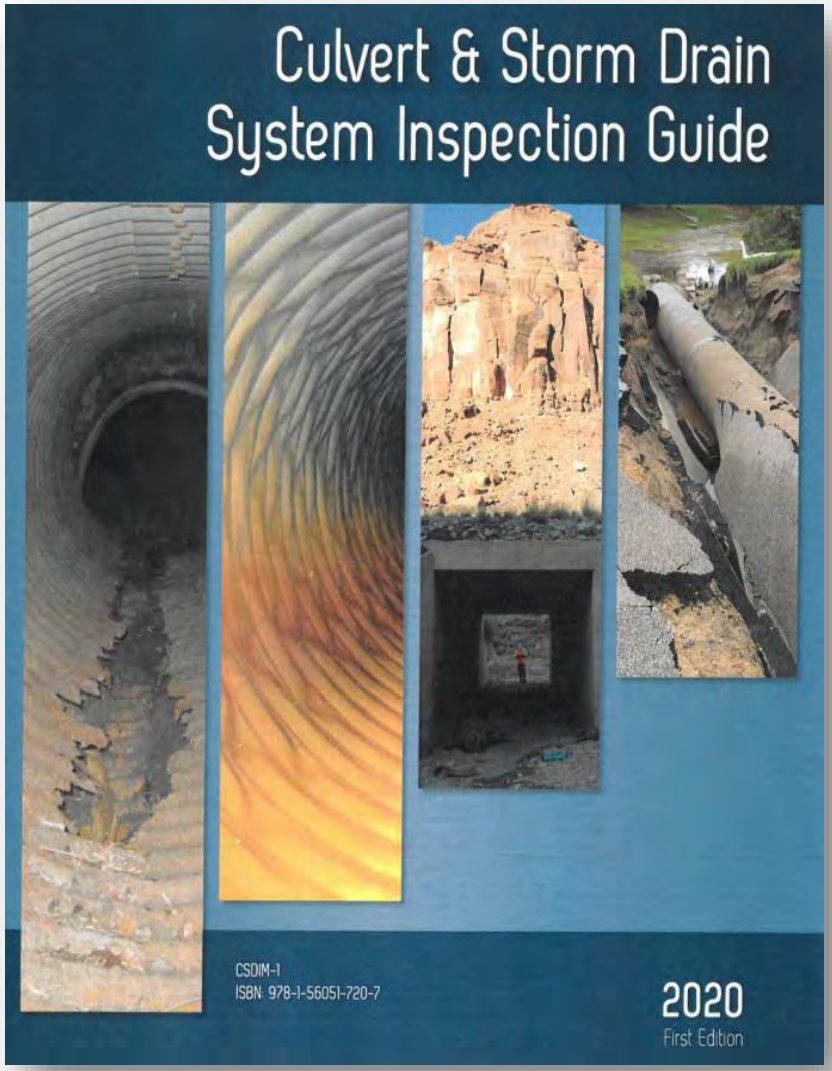


Table 4.2.1-1—Rating Scale and Associated Action

	1	2	3	4
	[illegible]	FAIR	POOR	[illegible]
CONDITION	Like new, with little or no deterioration, structurally sound and functionally adequate.	Some deterioration, but structurally sound and functionally adequate.	Significant deterioration, functional inadequacy, or both, requiring maintenance or repair.	Very poor conditions that indicate possible imminent failure or failure which could threaten public safety.
ACTION INDICATED	No action is recommended. Note in inspection report only.	No immediate action is recommended, but more frequent inspection may be warranted. Maintenance personnel should be informed.	Team Leader (Inspector) evaluates need for corrective action and makes recommendation in inspection report.	Corrective action is required and urgent. Engineering evaluation is required to specify appropriate repair.

Condition Ratings Table Titles	Table No.
Approach Roadway	4.3.2-1
Embankment	4.4.2-1
Channel Alignment and Protection	4.5.2-1
End Treatments and Appurtenant Structures	4.6.2-1
Concrete Footings and Invert Slab	4.7.2-1
Barrel Alignment	4.8.2-1
Plastic Barrel	4.9.2-1
Concrete Barrel	4.10.2-1
Corrugated Metal Barrel	4.11.2-1
Masonry Barrel	4.12.2-1
Timber Barrel	4.13.2-1
Joints	4.14.1-1
Seams of Corrugated Metal Plate	4.15.1-1
Manholes, Catch Basins, and Buried Junctions	4.17.1-1

Structural

	1 Good	2 Fair	3 Poor	4 Severe
Plastic	Vertical Deformation < 5%	Vertical deformation 5% - 7.5%	Vertical deformation 7.5% - 10%	Vertical deformation > 10%
Concrete	No cracks greater than 0.01" (hairline)	Longitudinal cracks 0.01" - 0.05" (thickness of a dime) longer than 3' Some circumferential cracks with no infiltration.	Longitudinal cracks 0.05" - 0.1" (thickness of a quarter) no exposed rebar 1'-3' Water Infiltration through circumferential cracks.	Longitudinal cracks greater than .1" Exposed rebar Water and/or soil infiltration.

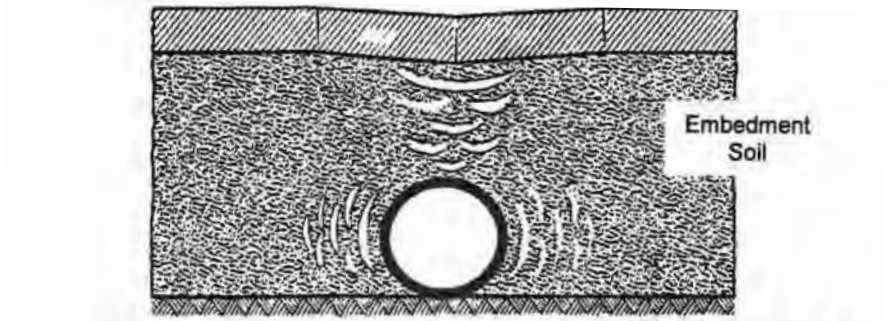


Figure 4.3.2-1—Pavement Failure Due to Inadequate Embedment Soil Compaction or Low-Quality Embedment Soil Adjacent to Flexible Pipe
(Photo courtesy of Colorado Department of Transportation)

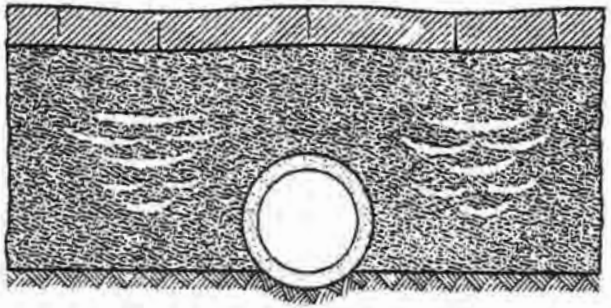
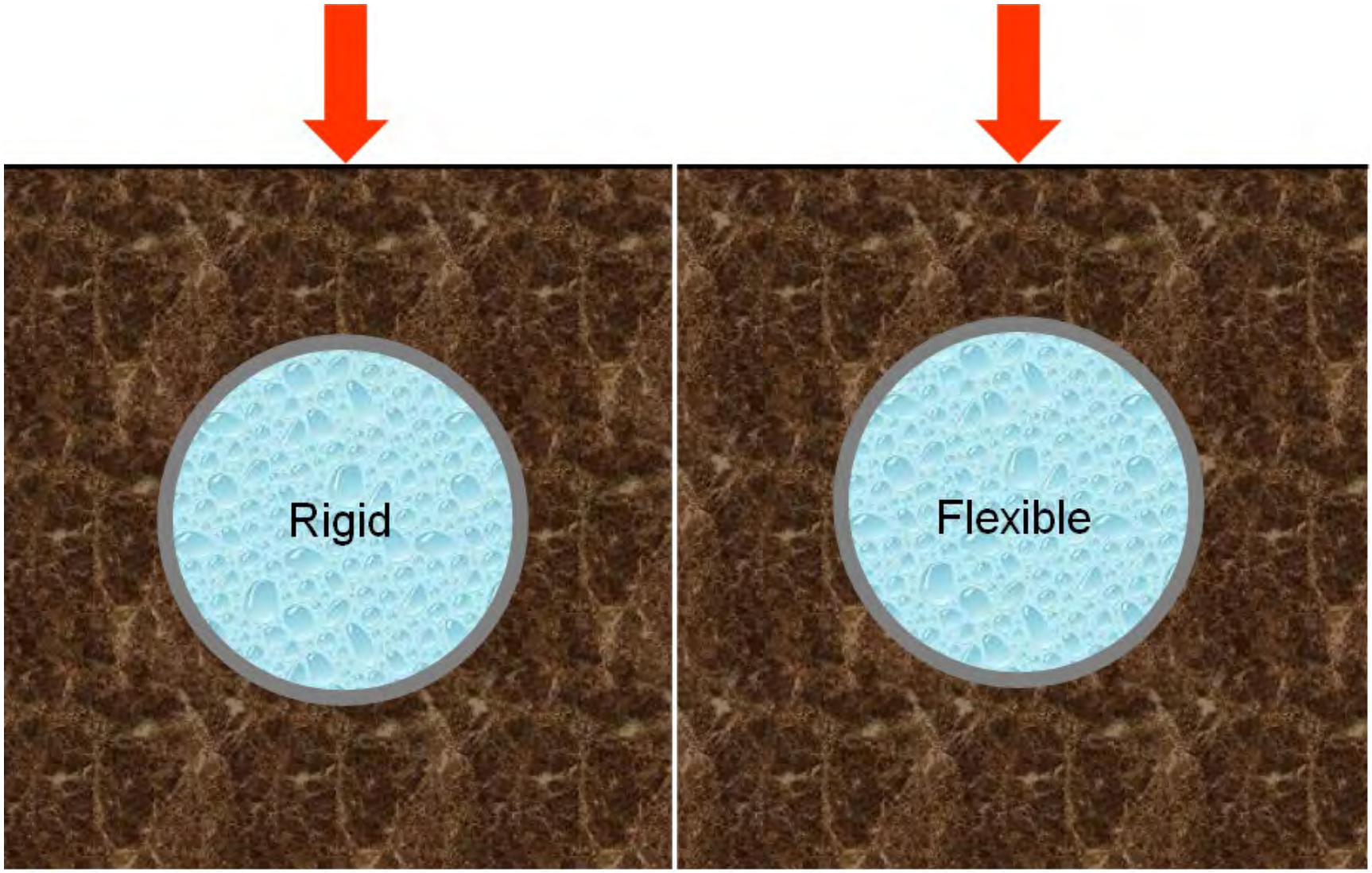
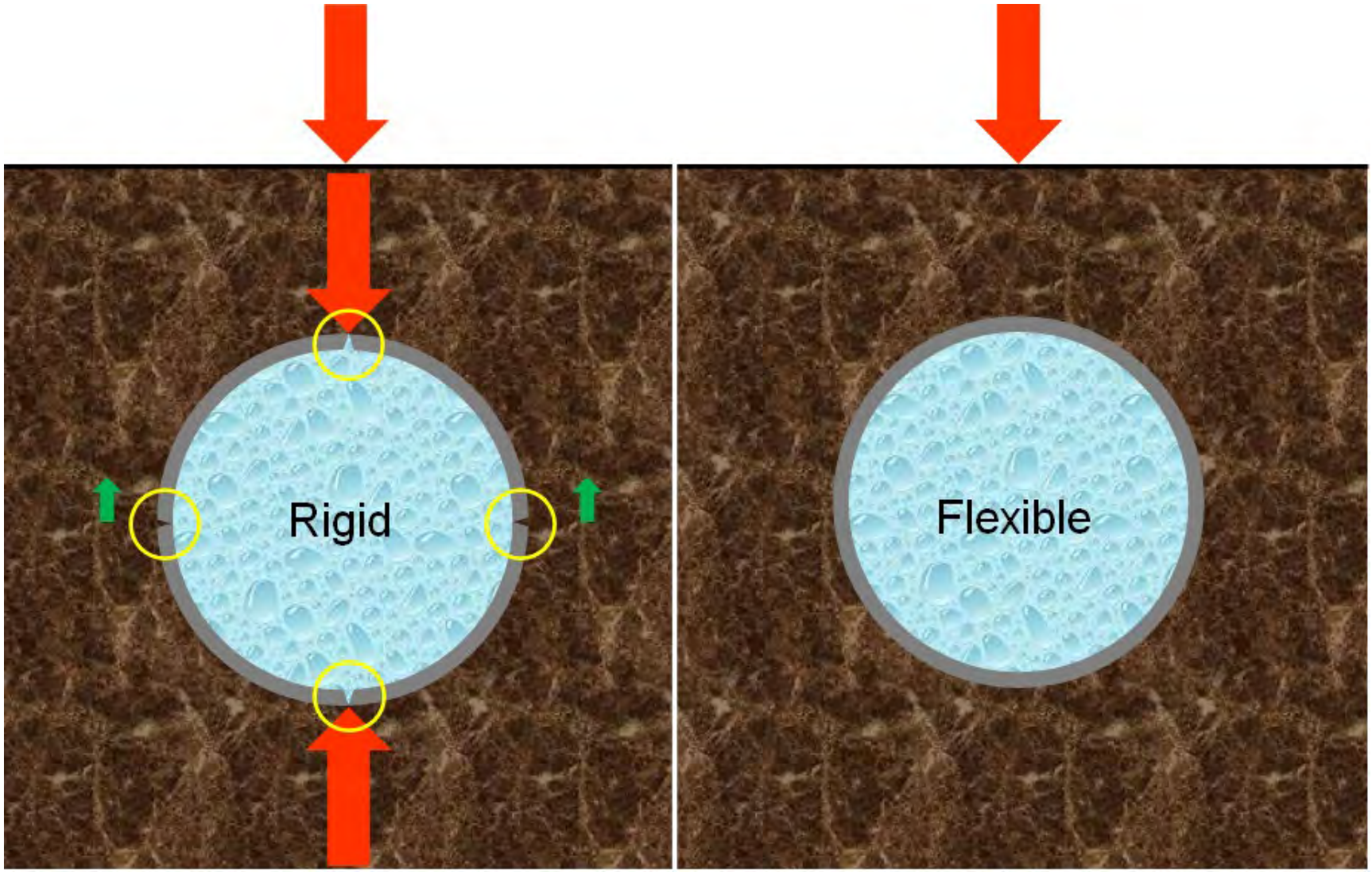


Figure 4.3.2-2—Pavement Failure Due to Inadequate Compaction or Low-Quality Fill Soil Adjacent to Rigid Pipe

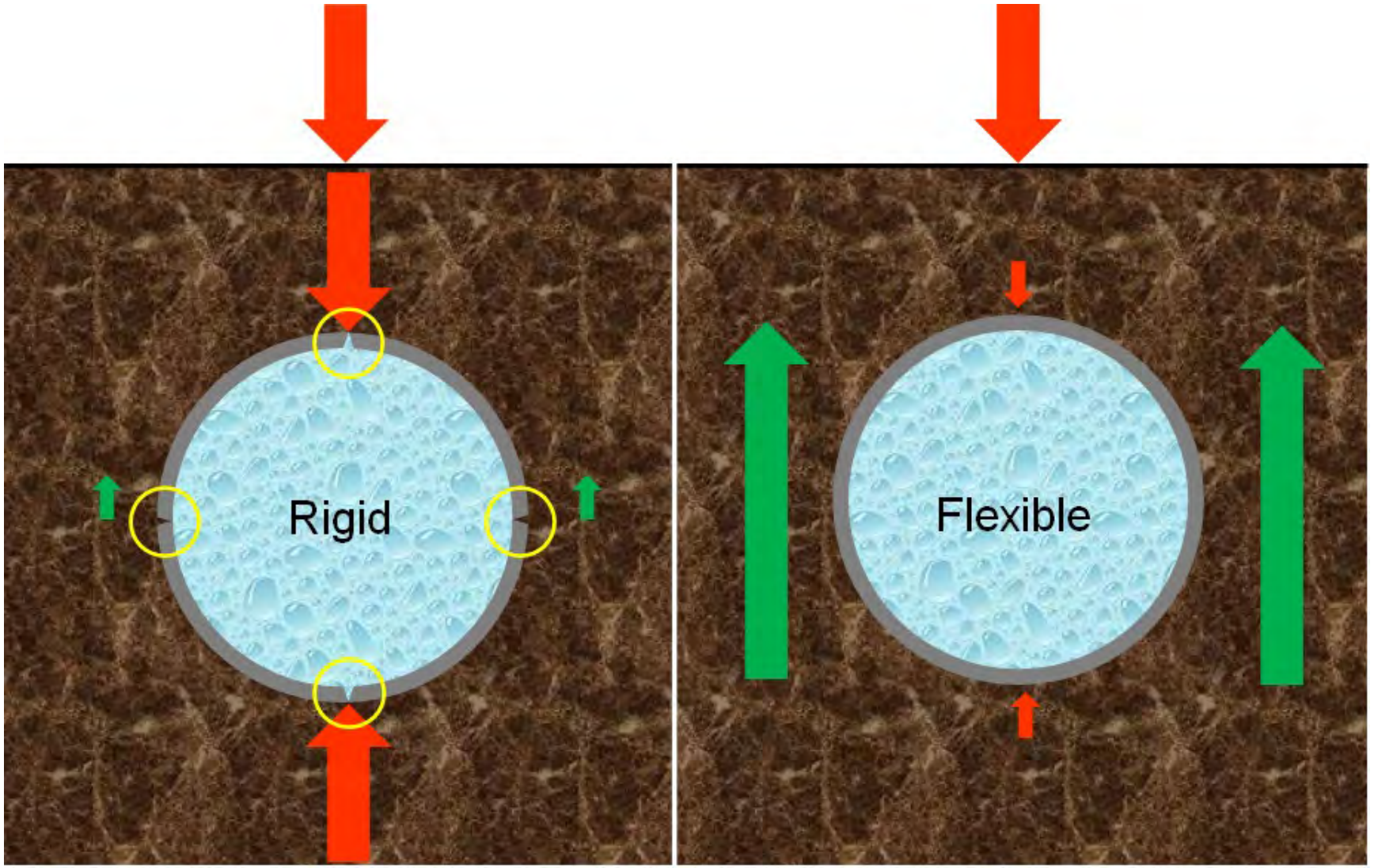
Pipe Reaction to Loading

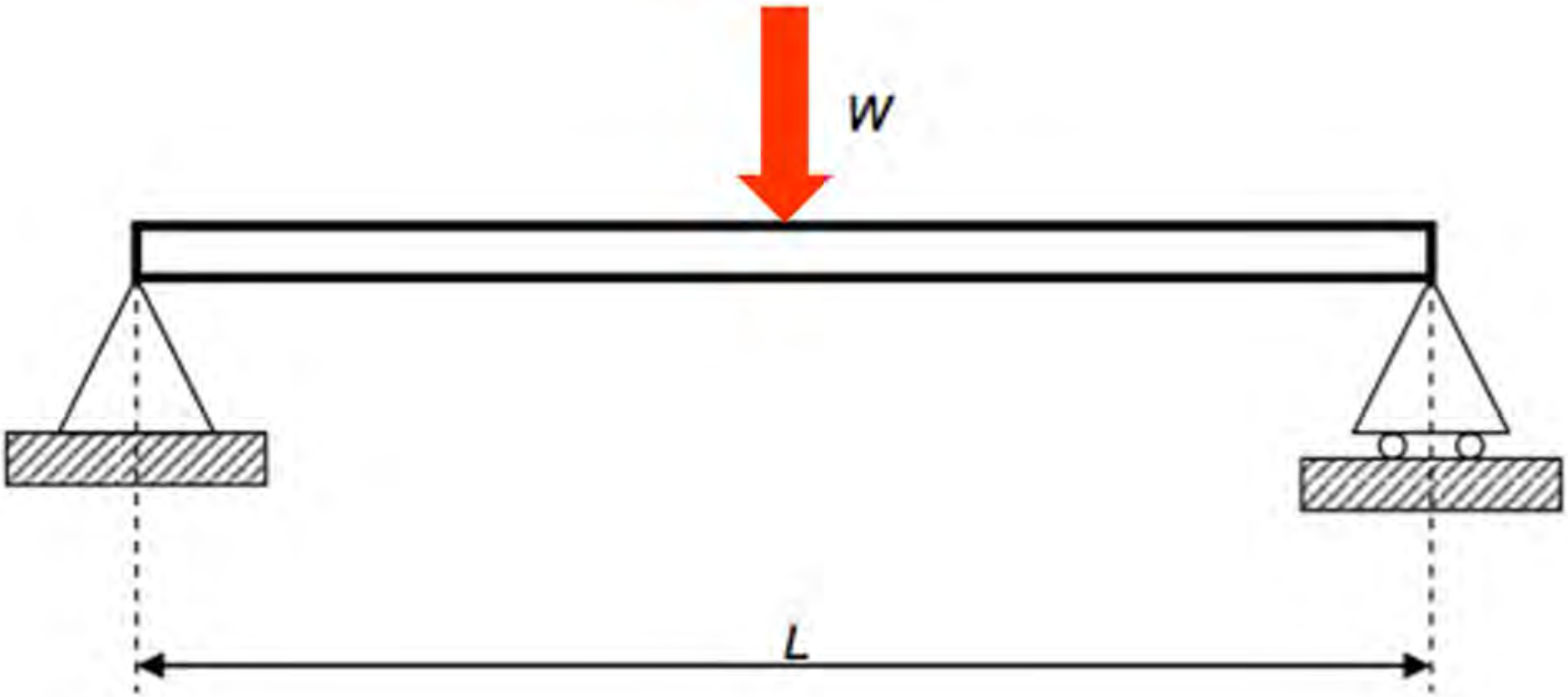


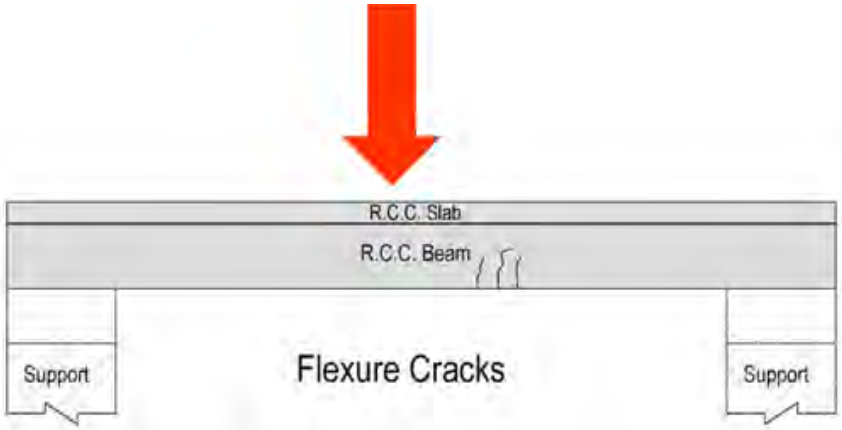
Pipe Reaction to Loading



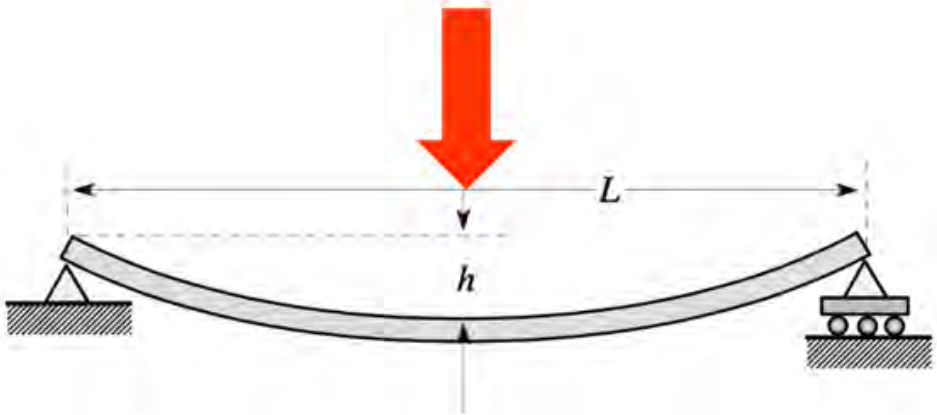
Pipe Reaction to Loading




W
L



Reinforced Concrete Beam



Steel Beam

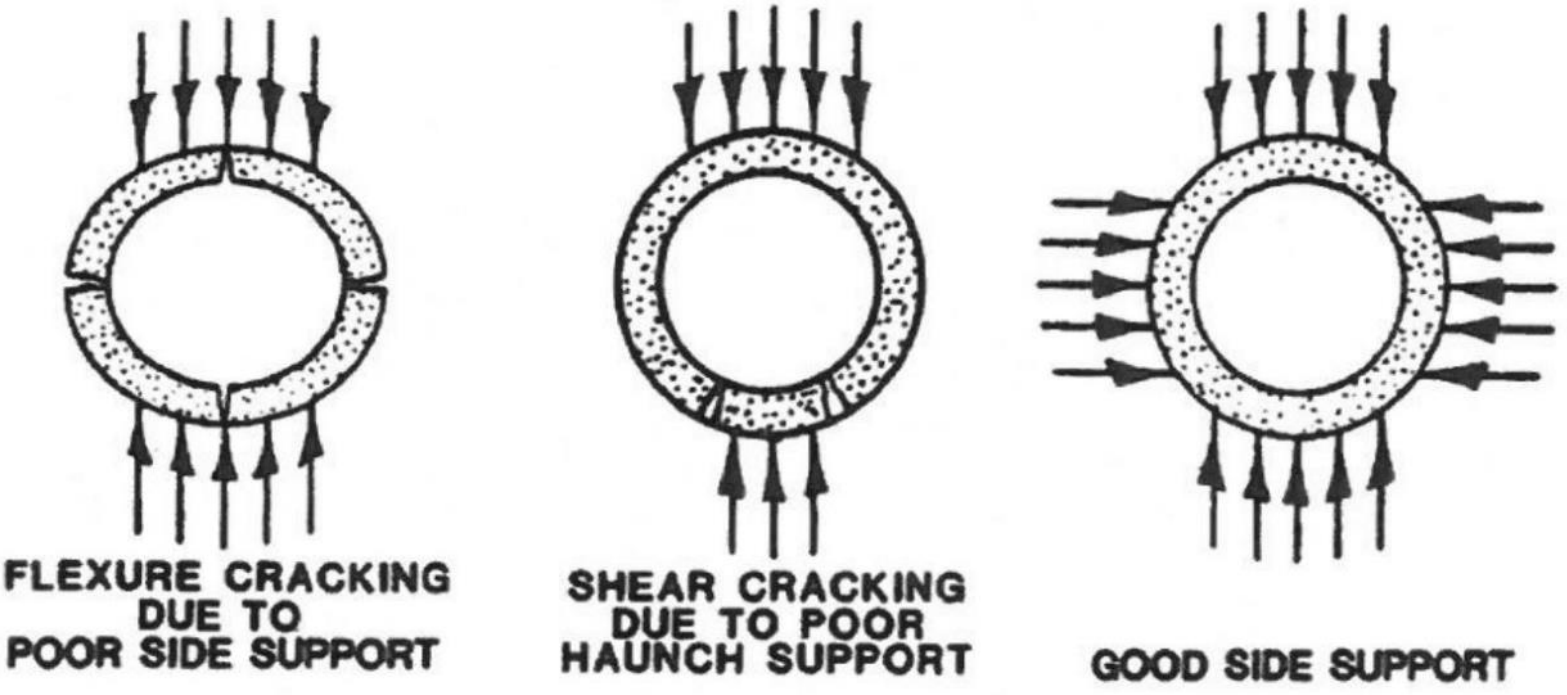
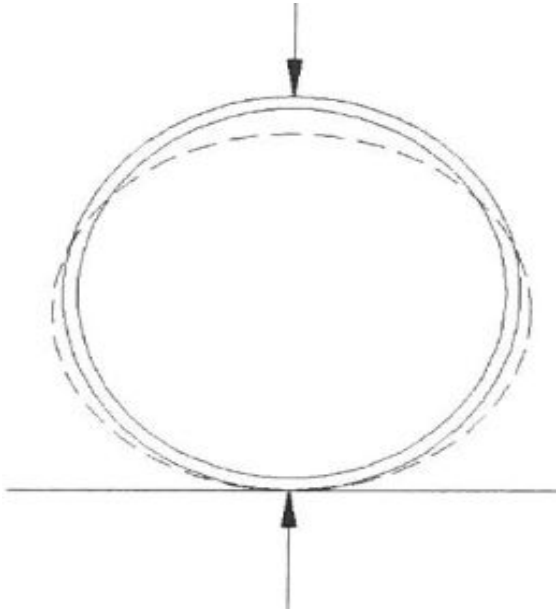
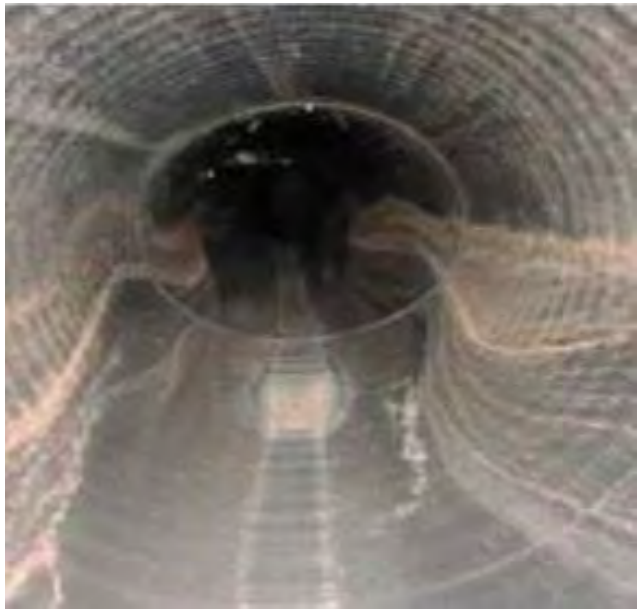


Figure 4.10.2-1—Results of Poor and Good Side Support in Rigid Pipe

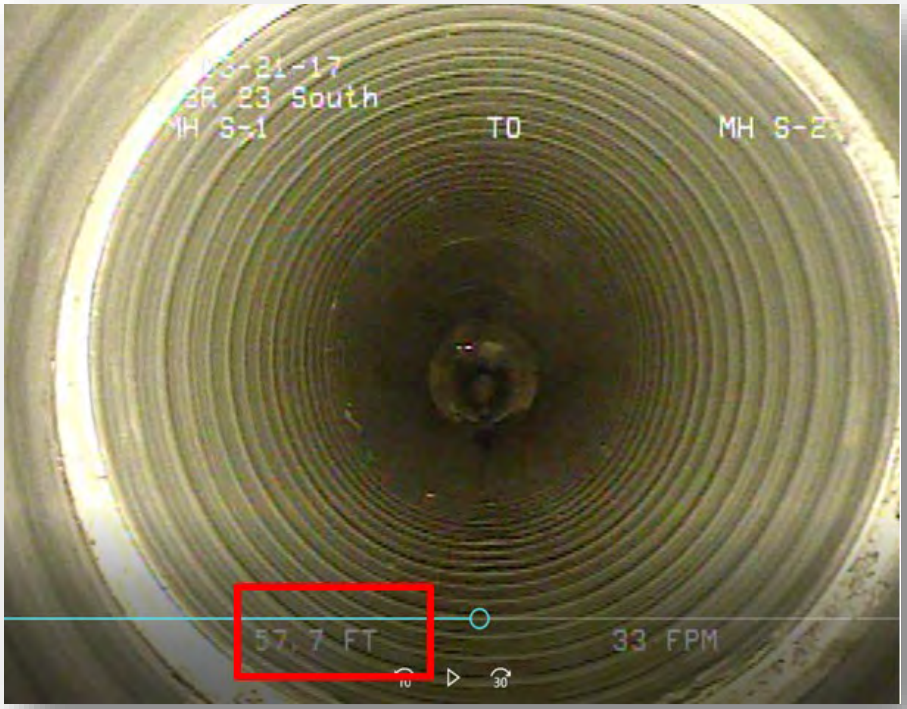
- pH, chlorides, sulfates, etc.

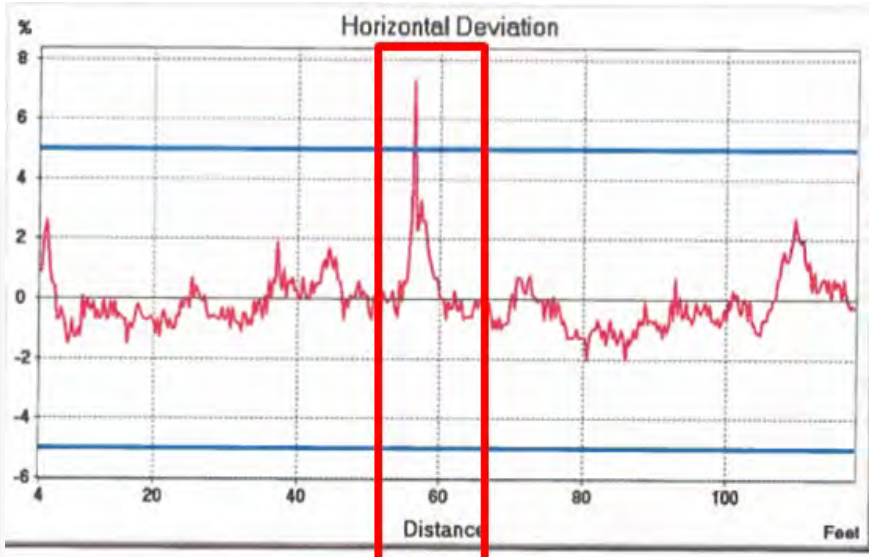


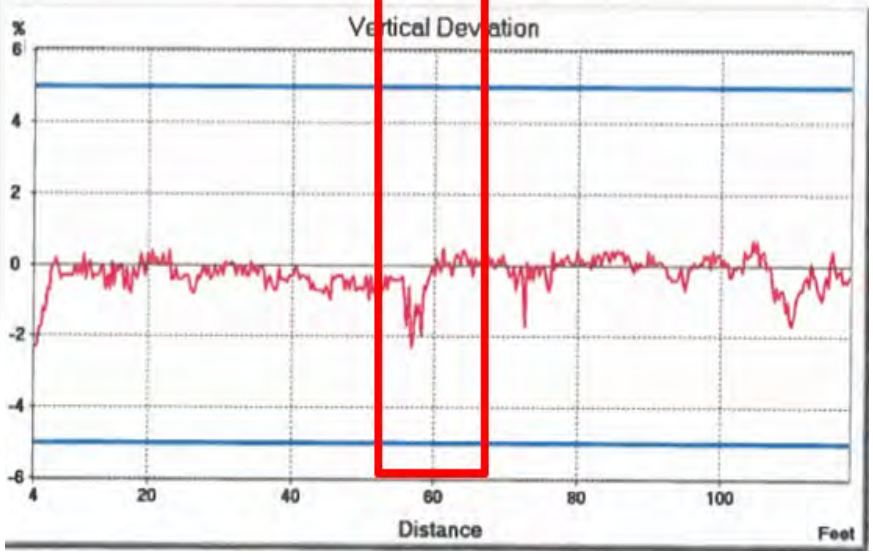


Deflection indicates pipe is carrying load

Ovality Report







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FDOT

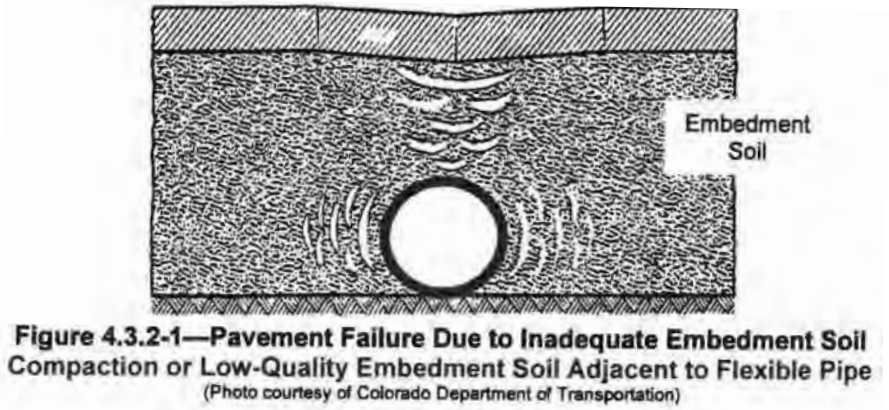


Figure 4.3.2-1—Pavement Failure Due to Inadequate Embedment Soil Compaction or Low-Quality Embedment Soil Adjacent to Flexible Pipe
(Photo courtesy of Colorado Department of Transportation)

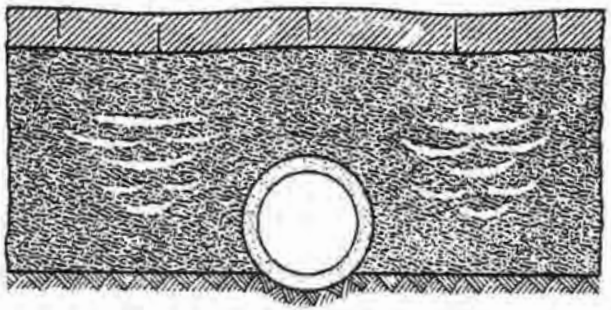


Figure 4.3.2-2—Pavement Failure Due to Inadequate Compaction or Low-Quality Fill Soil Adjacent to Rigid Pipe

Pavement, cont'd.

Severe: High-severity transverse or longitudinal cracks greater than ½ in. wide with raveling of pavement over the culvert or storm drain. High-severity sags or ruts with voids beneath pavement.

Courtesy of Minnesota Department of Transportation

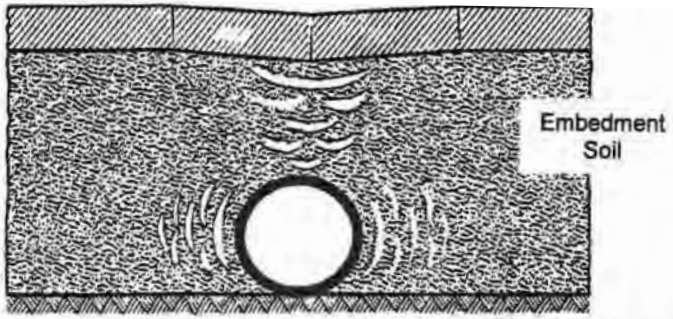
High-severity sags in roadway over culvert barrel.

Courtesy of Minnesota Department of Transportation

High-severity transverse cracks and high-severity sag over culvert barrel.

Courtesy of Ohio Department of Transportation

High-severity transverse cracking over culvert.



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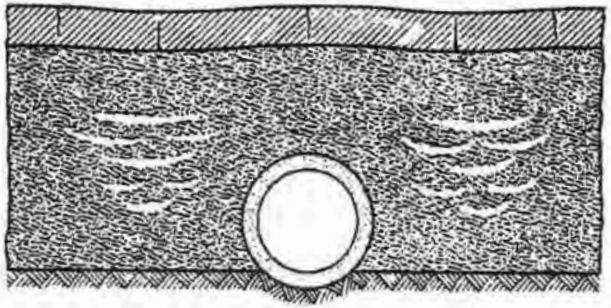

Figure 4.3.2-2—Pavement Failure Due to Inadequate Compaction or Low-Quality Fill Soil Adjacent to Rigid Pipe

Joints

	1 Good	2 Fair	3 Poor	4 Severe
Plastic & Concrete	Joints tightly installed and functioning as intended (soil/water tight)	Joint separation but performing as intended (soil/water tight)	Joint separation in more than one joint, exposed or missing gasket. Exposed or missing gasket. Water and/or silt infiltration.	Joint separation with exposed backfill material. Multiple exposed or missing gaskets. Distress to roadway, shoulder, and/or embankment.
Concrete Specific	No joint cracking.	Longitudinal cracks 0.01" - 0.05"	Longitudinal cracks 0.05" - 0.1"	Longitudinal cracks greater than 0.1".

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Figure 4.3.2-4—Bridging in Flexible Pavements
(Photos courtesy of Minnesota DOT)

Pipe Observation Summary Report

Date: 6/5/2019 12:16:00 PM
Street: N/A
Length Surveyed: 400.4
Pacp Quick Overall Rating: 3122
Height (Diameter): 42
Street: N/A

Pipe Segment Reference:
Upstream MH: CD3North
Downstream MH: CD3North
Direction of Survey: Upstream
Material: Reinforced Concrete Pipe

Severity
Light
Moderate
Average
Heavy
Severe

ID Number: CD3North

(0.0) AMH - Manhole Remark: CD3North
(0.0) MWL - Water Level
(2.0) MGO - General Observation Remark: 0.121
(8.1) MGO - General Observation Remark: 0.603
(16.2) MGO - General Observation Remark: 0.817
(24.3) MGO - General Observation Remark: 1.077
(24.3) MGO - General Observation Remark: 1.067
(24.3) MGO - General Observation Remark: 0.529
(24.3) MGO - General Observation Remark: 0.236
(32.2) MGO - General Observation Remark: 0.668
(39.9) MGO - General Observation Remark: 0.417
(47.9) MGO - General Observation Remark: 0.352
(55.9) MGO - General Observation Remark: 0.791
(63.7) MGO - General Observation Remark: 0.495
(63.7) IW - Infil Weeper - Position: 3
(71.8) MGO - General Observation Remark: 0.392
(71.8) ID - Infil Dripper - Position: 12
(80.1) MGO - General Observation Remark: 0.802
(87.8) MGO - General Observation Remark: 0.276
(95.2) MGO - General Observation Remark: 0.405

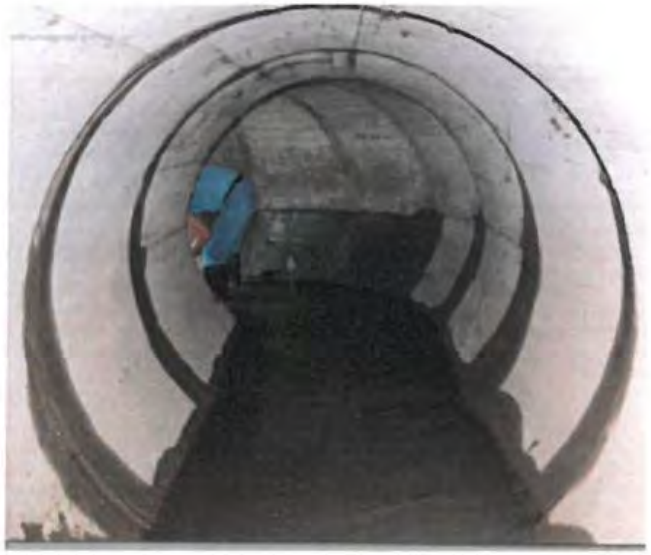


Figure 4.14.1-4—Water Infiltration Through Joints
(Photo courtesy of Plastic Pipe Institute)

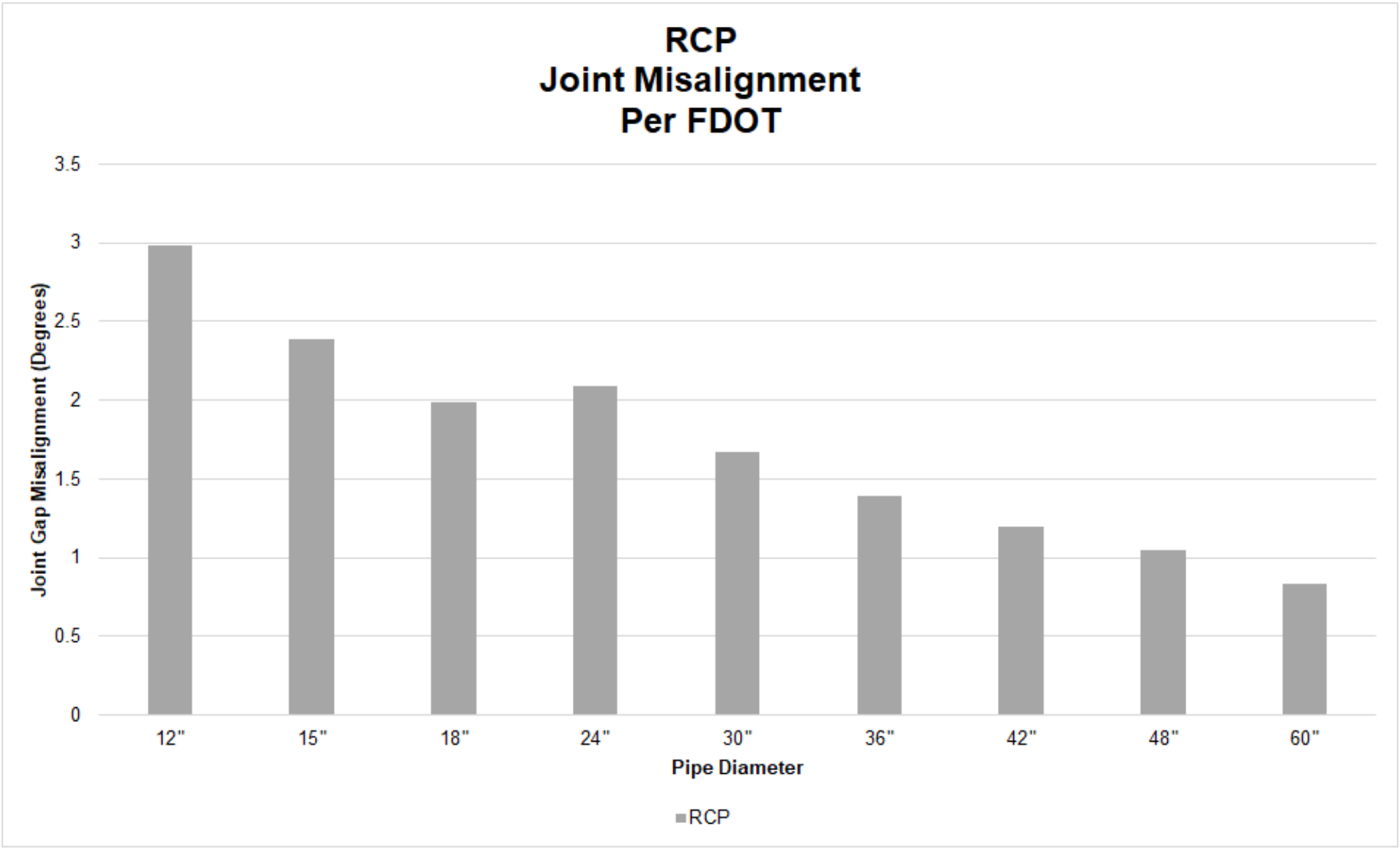
Figure 4.14.1-5—Severe Infiltration Through Joints in Concrete Pipe (Top). Surface Distress in Approach Roadway Caused by Loss of Backfill Due to Joint Infiltration.
(Photos courtesy of Utah Department of Transportation (top) and Minnesota Department of transportation (bottom))

Joints

	1 Good	2 Fair	3 Poor	4 Severe
Plastic & Concrete	Joints tightly installed and functioning as intended (soil/water tight)	Joint separation but performing as intended (soil/water tight)	Joint separation in more than one joint, exposed or missing gasket. Exposed or missing gasket. Water and/or silt infiltration.	Joint separation with exposed backfill material. Multiple exposed or missing gaskets. Distress to roadway, shoulder, and/or embankment.
Concrete Specific	No joint cracking.	Longitudinal cracks 0.01" - 0.05"	Longitudinal cracks 0.05" - 0.1"	Longitudinal cracks greater than 0.1".

FDOT

Figure 4.3.2-4—Bridging in Flexible Pavements
(Photos courtesy of Minnesota DOT)


RCP
Joint Misalignment
Per FDOT
Joint Gap Misalignment (Degrees)
3.5
3
2.5
2
1.5
1
0.5
0
12"
15"
18"
24"
30"
36"
42"
48"
60"
Pipe Diameter
RCP

Pipe Repair Matrix

This matrix is a guidance document ONLY and does not replace Engineering Judgement. It is a living document and will continue to evolve as the department refines its pipeline inspection and repair processes and as repair technologies advance

Metal Pipe

Damaged Coating
Dented Pipe
Compromised Joints

HDPE/PP Pipe

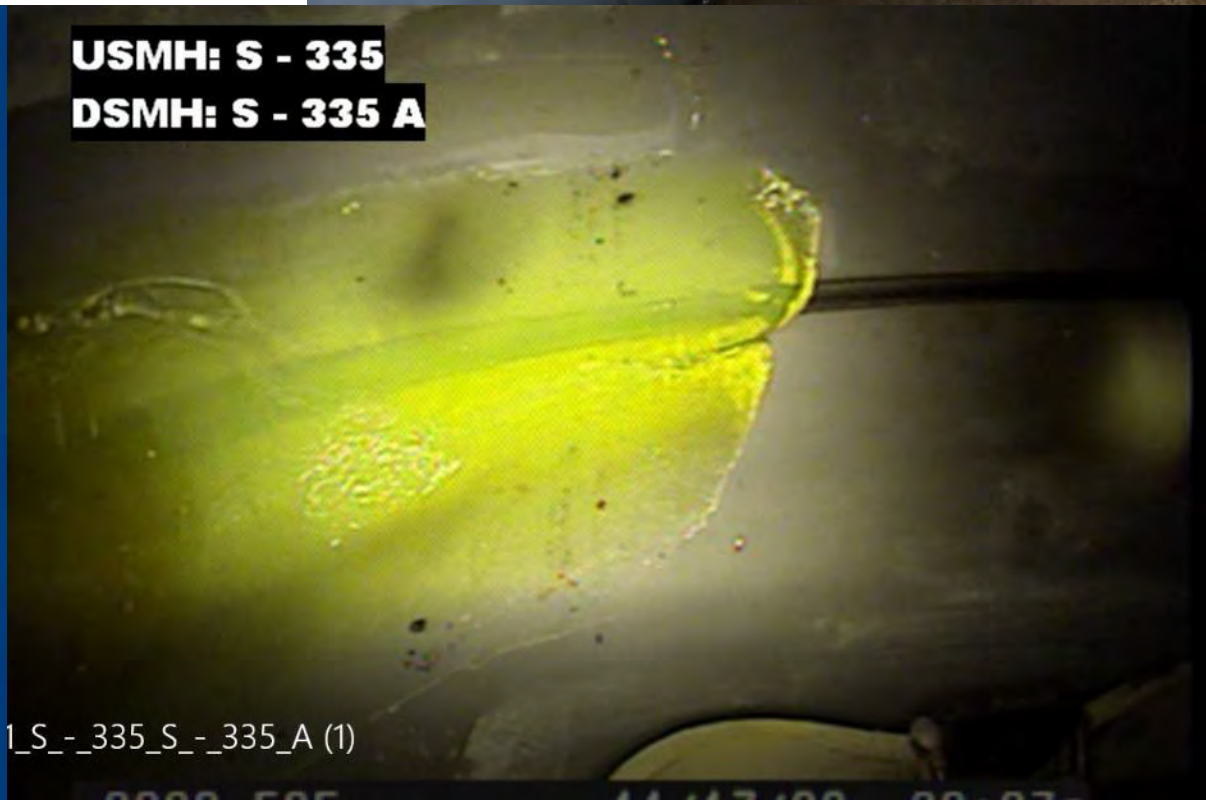
Cracks
Punctures
Compromised Joints

PVC Pipe

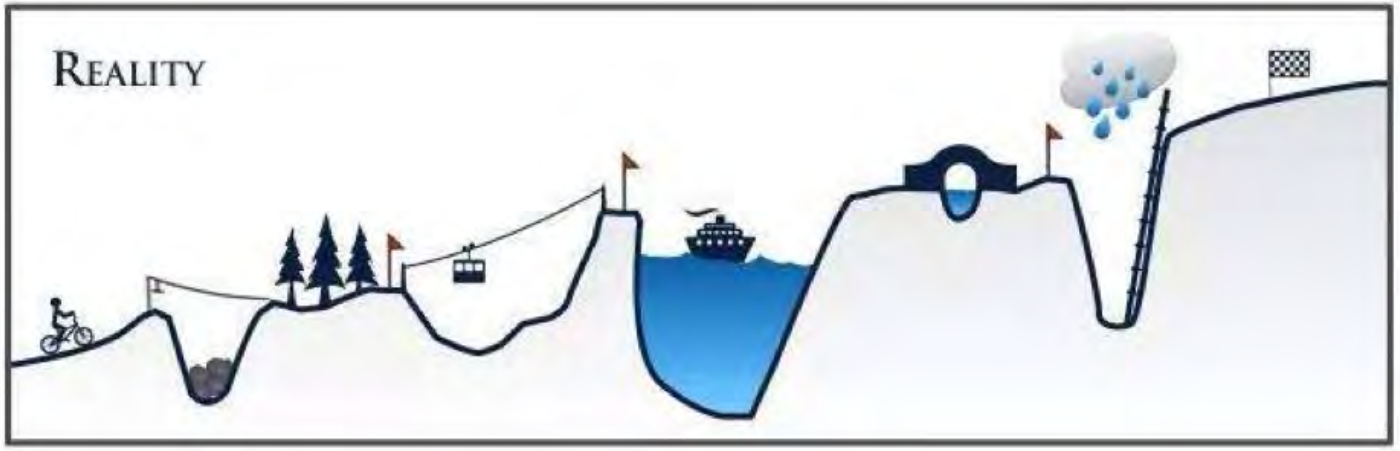
Breaks in Pipe
Punctures in Pipe
Compromised Joints

Concrete Pipe

Cracks
Spalling
Compromised Joints


USMH: S - 335
DSMH: S - 335 A
1_S_-_335_S_-_335_A (1)


YOUR PLAN


REALITY

"Since the technology was created over 10 years ago, there have been ZERO reported failures in pipelines that have passed post installation inspection requirements"

"Repairing just ONE location of pipe is over 3x more expensive than inspecting the pipeline during installation"

Don Hess, B&D Enterprises

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