REPAIR AND FINSHING

American Concrete Pipe Association

Learning objectives

The importance of proper repair techniques and materials

Identify product deficiencies and understand specifications

Why Do We Need to Repair Precast Products?

While our Goal is NO REPAIRS it doesn't always work that way!

Repairs are necessary for two main reasons:

1. Manufacturing imperfections
2. Handling damage

Repairs for Pipe (ASTM C76) and Manholes (ASTM C478)

"Pipe *(& manholes)* may be repaired, if necessary, because of imperfections in manufacture 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"

Repairs for Box Culverts

ASTM C1433 & C1577 Section 13

"Box sections shall be repaired, if necessary, because of imperfections in manufacture or handling damage and will be acceptable if, in the opinion of the purchaser, the repaired box section conforms to the requirements of this specification."

Concrete is a Unique Construction Material

Almost every imperfection can be repaired if proper techniques and materials are used.

We must remember that:
Not everything should be repaired!

Basic Guidelines:

Will the product meet all the requirements after the repair?

Not only dimensional, but strength, durability and water-tightness as well.

Classification of Repairs

Structural

Performance

Cosmetic

Structural Repairs

Major defect repair

Compromises structural integrity or designated use of the piece

Needs to be inspected by qualified individual and documented

If it can’t be repaired, then reject it

Quality School

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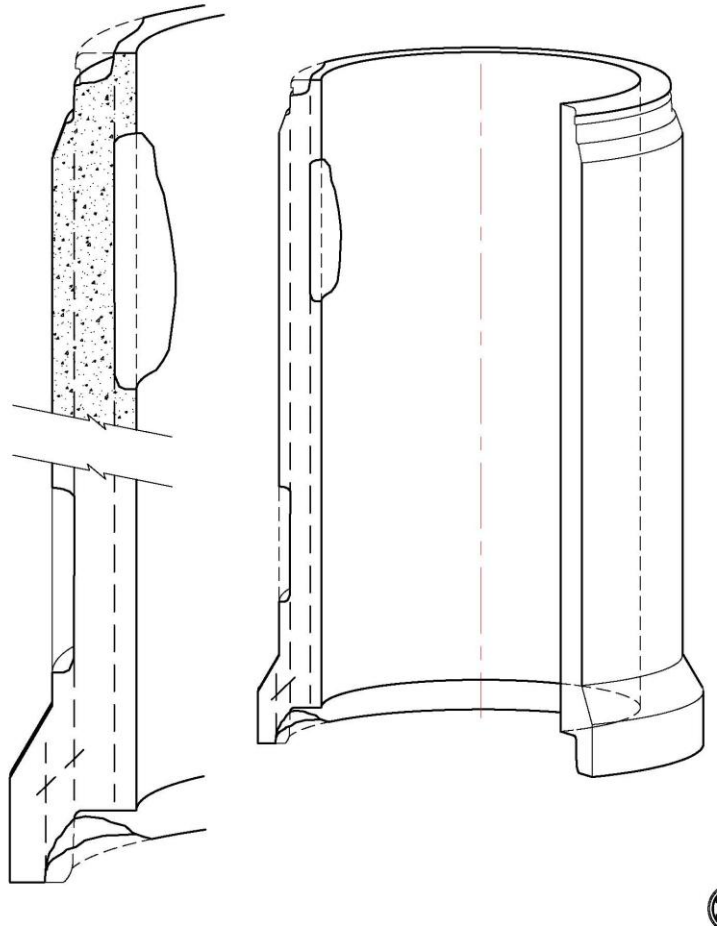
STRUCTURAL - REPAIRABLE



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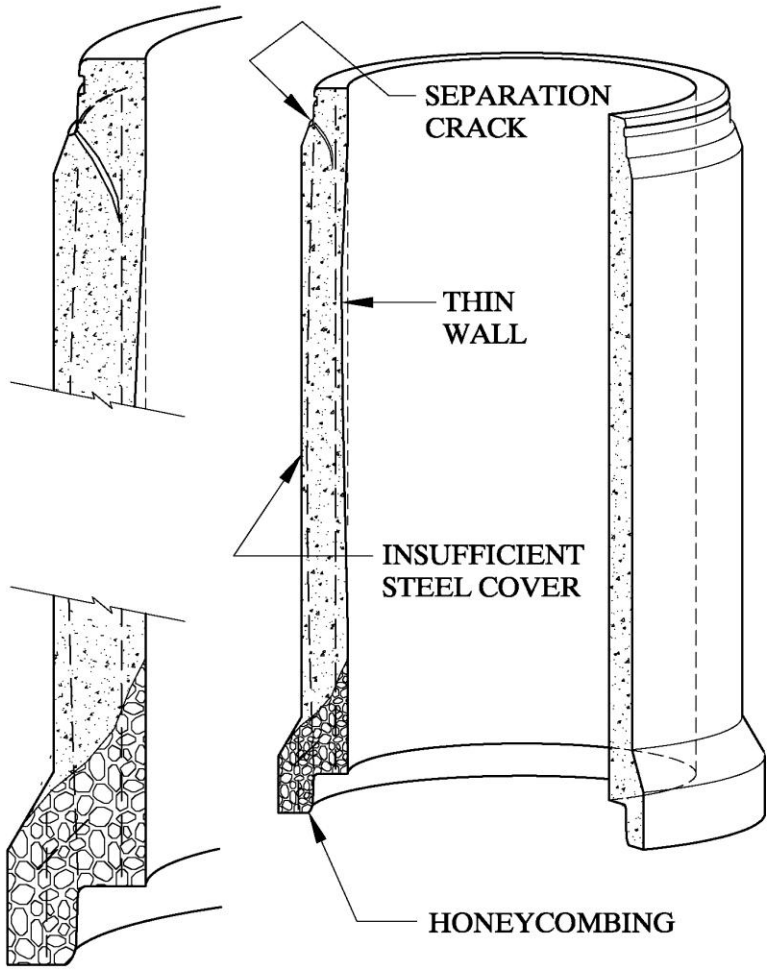
STRUCTURAL - NOT REPAIRABLE



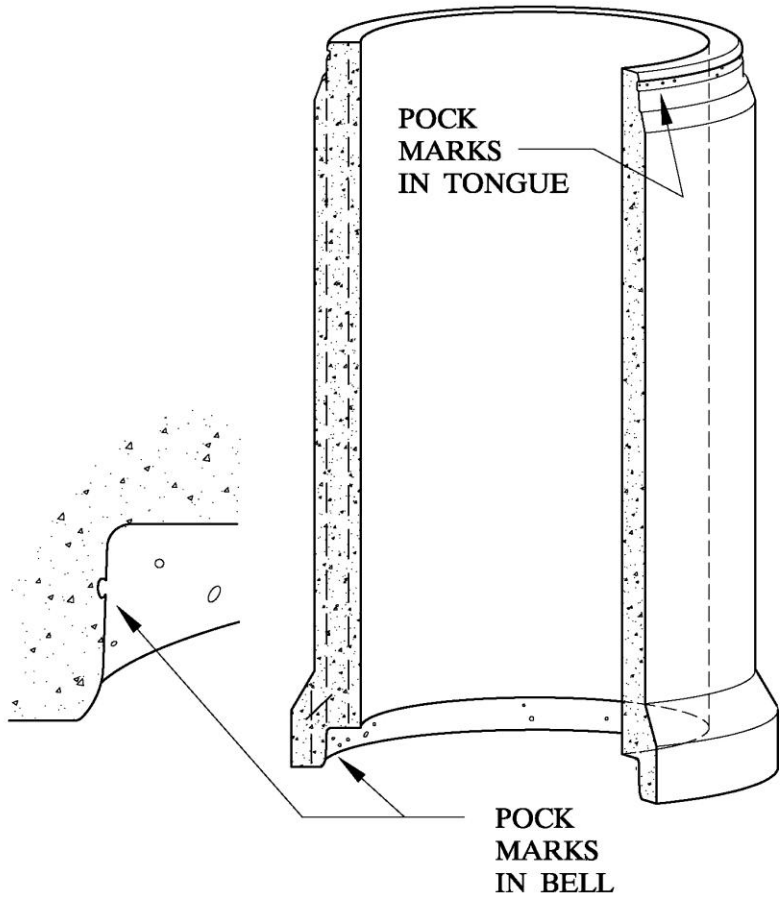
Performance / Functional Repairs

Fix only what needs fixing – don't create more problems

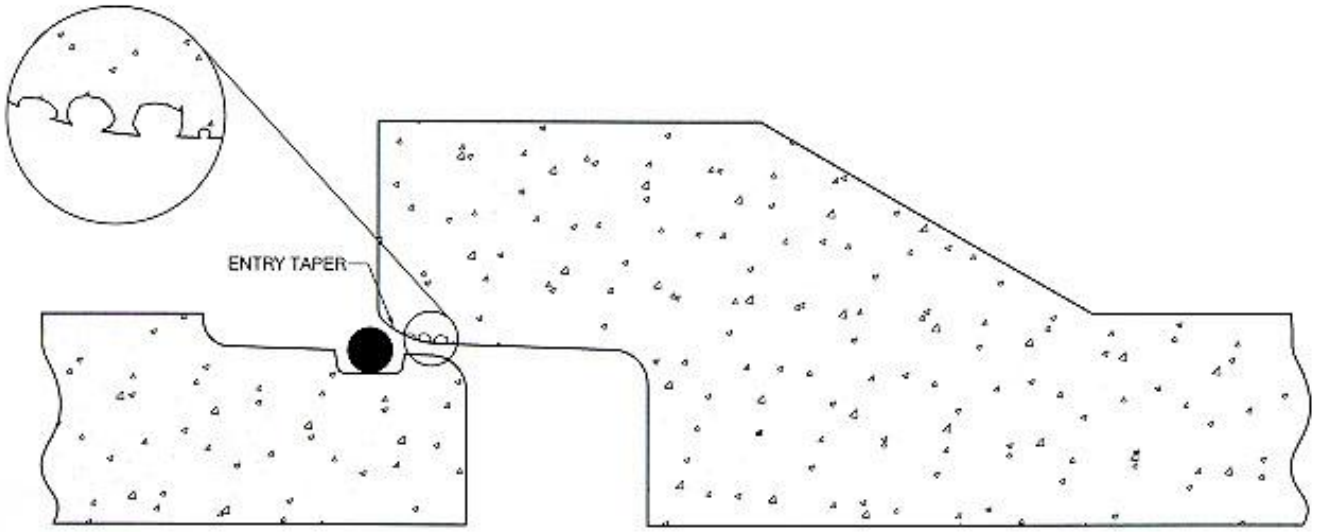
Use Approved Materials – strong, durable, good bond

Final Appearance and Function is important

PERFORMANCE



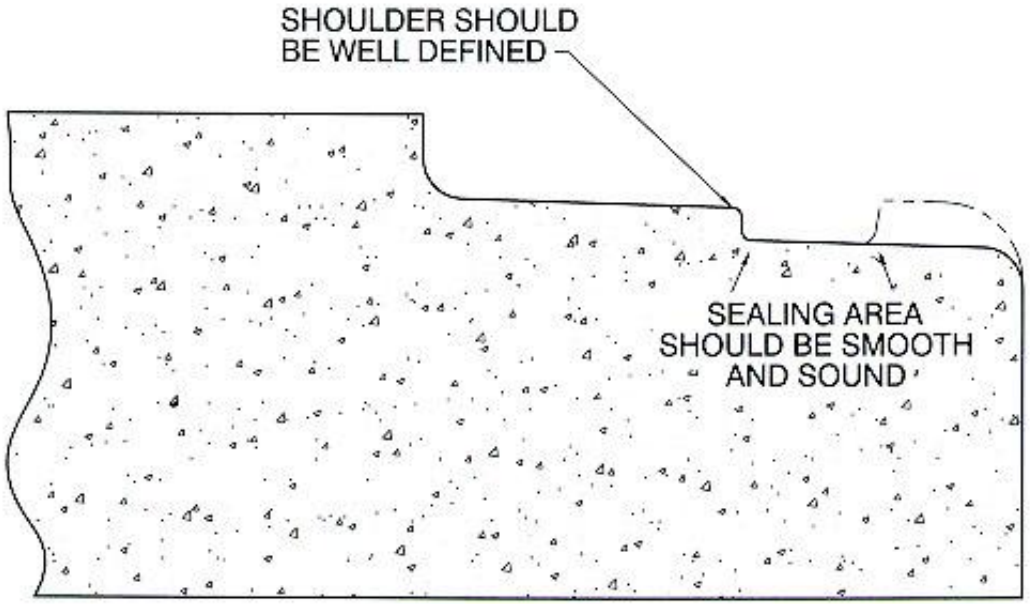
CRITICAL PARTS OF A GASKET JOINT



OPENED POSITION

1. SMOOTH ENTRY TAPER

CRITICAL PARTS OF A GASKET JOINT



Cosmetic Repairs

Appearance is important!

Product appearance can be your:
BEST SALESMAN OR
YOUR WORST SALESMAN

Cosmetic Repairs

Evaluate
Minor defect repair
One that does not impact the functional use or expected service life of the product, routine (e.g. chips, bug holes)
Should have standard repair techniques and approved materials

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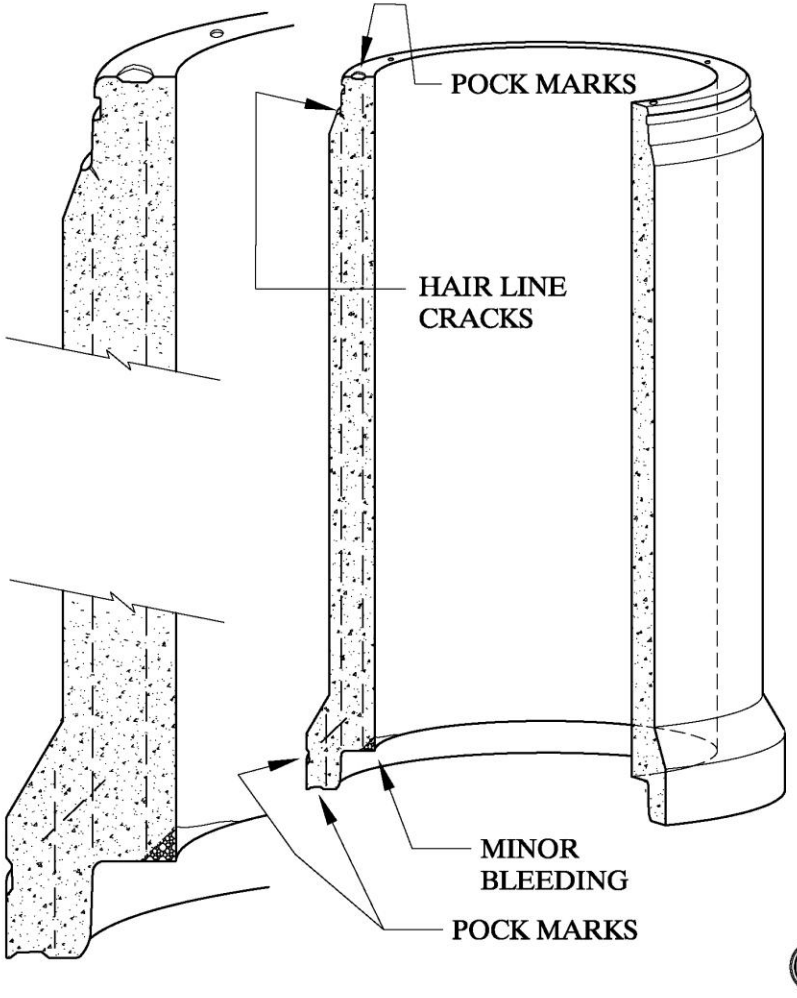
COSMETIC



Joint Repairs for Gasketed Joints

ASTM C443 - *Joints Using Rubber Gaskets,* Section 14

Repair must be smooth, free of spalls, cracks, and imperfections that would adversely affect the performance of the joint (7.1.2)

Circumferential length of a single area to be repaired shall not exceed one fourth of the inside diameter or equivalent diameter

Circumferential length of several areas combined shall not exceed one half of the inside diameter or equivalent diameter

Owner may require water-tightness testing to prove performance (13 psi, 10 minutes, straight)

Joint Repairs

¼ of 48 inches = 12 inches

Circumferential length of several areas combined shall not exceed one half of the inside diameter or equivalent diameter -
For 48” dia = 24”

Repair Materials

Repair Material Selection

Repairs should be made with like materials

Therefore: Repair concrete with concrete

Basic Repair Materials

Cement – Portland (can blend gray and white)

Sand – screened or Masons

Water

Patching Recipe Example

Large patches – use same concrete as the product was produced from or a stiff mixture of:

1 part cement: 3 parts sand (1:3 volume) + water

Smaller, more refined patches – very stiff paste

1 part cement: 2 to 2-1/2 parts sand + water

Water = clean water

Additives

Air entraining - as required for F/T

Water reducers – limit water content, shrinkage

Polymer admixtures – improve bond, cure

Cosmetic Repair Recipes

Cosmetic wipe – paintable
Fill porous bells and spigots – stiff consistency

1 part cement: 1 part sand + water
(preferred over just cement and water)

Must be finished flush and not overdone

Bonding Grout

Bonding Grouts – paintable

None

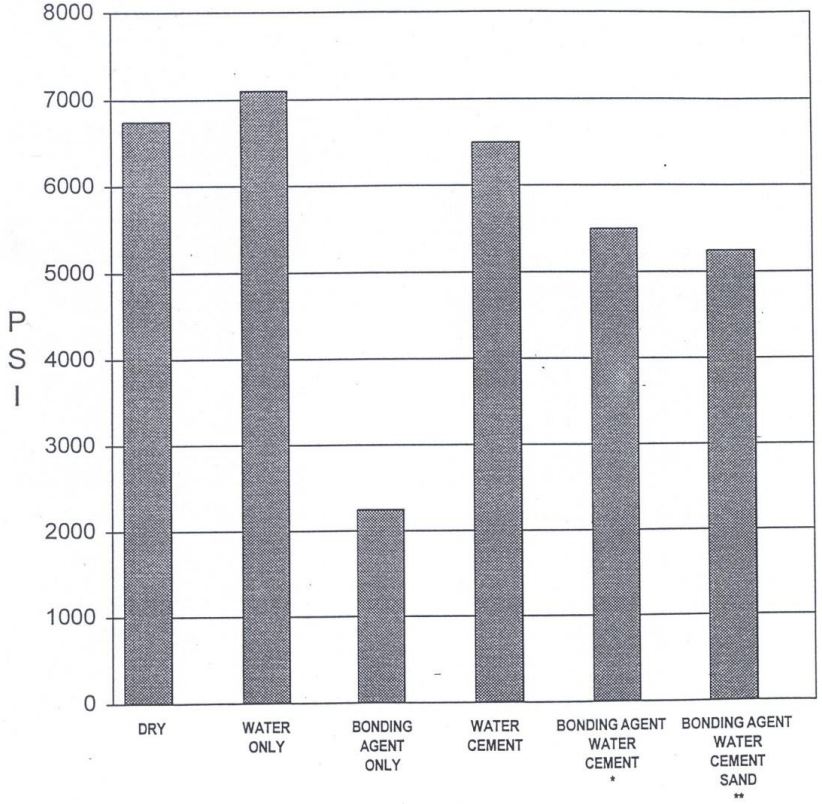
1 part cement + water

Applied immediately before patching

Avoid emulsifying bonding agents

- PVA (polyvinyl acetate)

PATCH BOND STRENGTH COMPARISON



* 1 PART CEMENT + MIX WATER
** 1 PART CEMENT + 1 PART SAND + MIX WATER
MIXED WATER = 1 PART WATER + 1 PART BONDING AGENT

Dry

Moist

Cement Water

Agent w/cement

Agent w/sand cement

Neat Agent

Slant Shear Tests of Bonding Agents

Pre-packaged Patch Materials

They have their place, especially in special applications

- very thin overlays
- need for quick setting
- need for high early strength
- special curing requirements
- non-shrink applications
- flowable materials, if specified.

Some are excellent, some are questionable.

Pre-packaged Materials

Read and follow ALL labeled directions exactly.

Reasons for failure:

Too much water or re-tempering
Improperly mixed
Improperly applied
Improperly cured
Wrong material formulation

Repair Methods

Structural Repair

1) Remove unsound concrete from area to be repaired
2) Check the position of reinforcing and/or add additional reinforcing as necessary
3) Form as necessary to reconstruct product to original shape
4) Dampen mating surface with water and let go surface dry (SSD) or apply bonding agent as required

Structural Repair

Make repair with original concrete or low slump repair mortar (1 part cement : 3 parts sand), depending on the size of repair and detail required
Air entrain repair mortar when necessary
Best to make repairs as soon after casting as practical

Tarp product or repaired area immediately after repair is completed to allow repair to pre-set.

Steam cure after pre-set is recommended.

Performance / Functional Repair

1) Remove unsound concrete from area to be repaired (if any)
2) Dampen mating surface with water let surface dry (SSD)
3) Make repair with very stiff repair mortar consisting of: 1 part cement (1-1/2 to 3) parts sand and water, depending on size or imperfection
4) Remove excess material (especially on joint sealing surfaces)
5) Cure properly to prevent premature drying and shrinkage

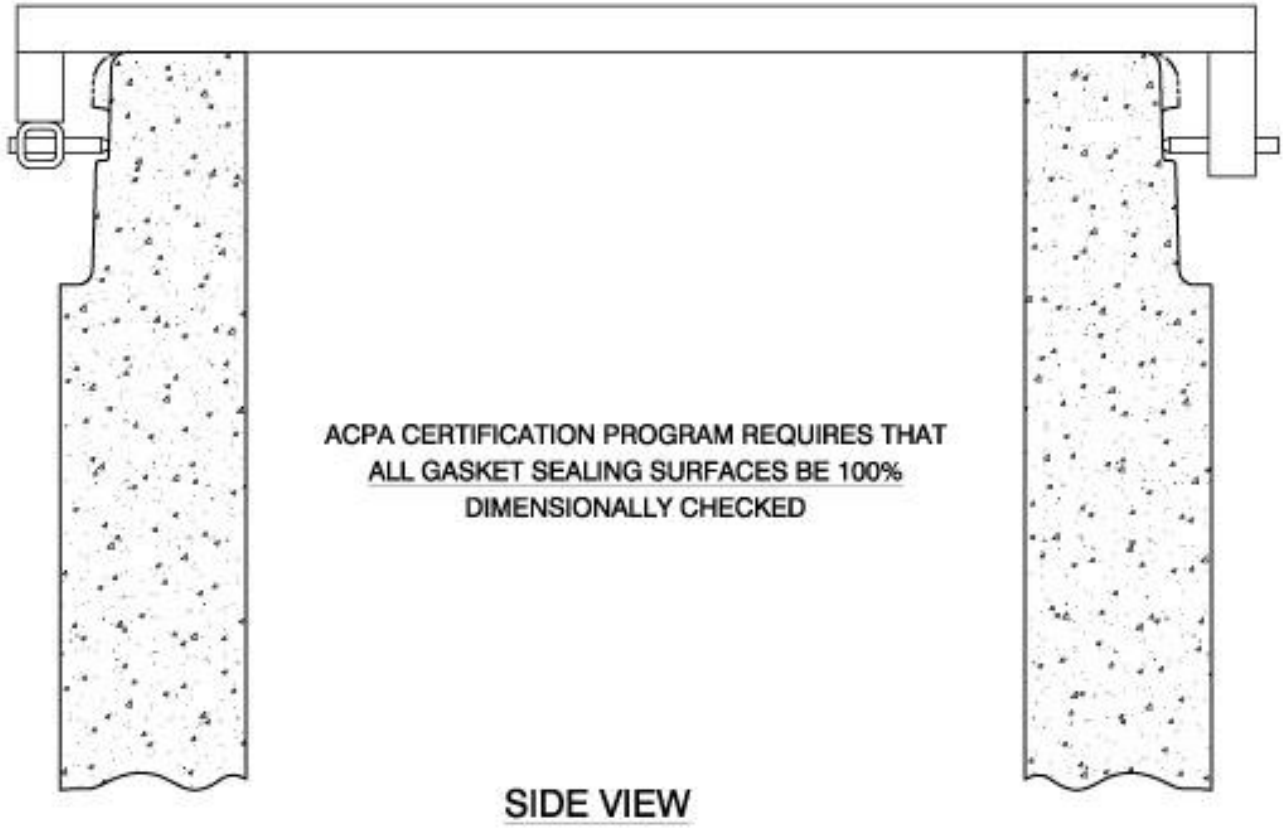
FINISH THE JOB - Check your work

Dimensional Tolerance – Product Specifications

Dimensional Tolerance – Joint Tightness and Function

Appearance

GO, NO-GO GAUGE



Defect Review

Defect Review – Pipe (C76) and Manhole (C478)

Rejection due to cracking:

Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint

Damaged or cracked ends where such damage would prevent making a satisfactory joint

Any continuous crack having a surface width of 0.01” or more for a length of 12” or more (unloaded)

Defect Review – Box Culverts

Rejection due to cracking, **ASTM C1433 & C1577**

Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint

Defect Review – Pipe (C76) and Manhole (C478)

Rejection due to material or production defects

Defects that indicate proportioning, mixing, and molding not in compliance or surface defects indicating honeycombed or open texture that would adversely affect the function of the product

The ends of the piece are not normal to the walls and center line of the pipe, and not within the limits of variations given in the standards

Defect Review – Box (ASTM C1433 & C1577)

Rejection due to material defects

Defects that indicate mixing and molding not in compliance with 9.1, or honeycombed or open texture that would adversely affect the function of the box sections

Defect Review – Box (C1433 & C1577) (cont.)

Rejection due to material or production defects

Abnormalities in the ends of the box sections to the walls and center line of the box section, within the limits of variations given in Section 11, except where beveled ends are specified, and

Damaged ends, where such damage would prevent making a satisfactory joint.

Standard Practice for

Evaluation of Precast Concrete Drainage Products

AASHTO Designation: R 73-16[1] (2020)

Technical Subcommittee: 4a, Concrete Drainage Structures

Provides criteria for product acceptance for state highway projects and provides guidance on repairable or rejectable products

AASHTO R73 - Acceptable Defects – No Repair Needed

Single end crack not exceeding depth of joint
Crack in wall less than 12-in. that does not pass through wall
Minor defects & bugholes that do not affect strength, durability or function

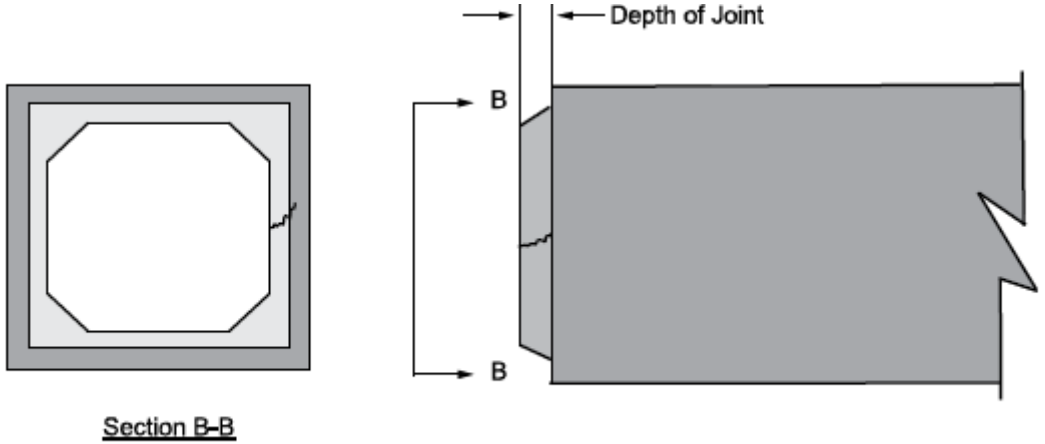


Figure 5—Acceptable Cracks; Single End Crack Does Not Exceed Depth of Joint

Acceptable bugholes

AASHTO R73 - Acceptable Defects – No Repair Needed

Single fracture to joint not exceeding 3-in of circumference or 2-in into joint
Chips to ends that do not affect function of joint
Exposed spacers or longitudinal wires at end of product

Figure 10—Acceptable Exposed Longitudinal Reinforcement (*Photo Courtesy of ACPA*)

AASHTO R73 - Defects That Can Be Repaired

Repairs must not affect function, design life, nor change dimensional requirements
Pipe - Cracks over 0.01-in. and over 12-in can be repaired if not through wall
Other Products Through Wall Cracks can be repaired if approved (not pipe)
Repairs to slab-off of uncured drycast can be performed within 1 hour of casting
Honeycomb/Slab offs/Spalls can be repaired if single location <4% area and total <10% surface area

Figure 12—Repairable Honeycombing (*Photo Courtesy of ACPA*)

AASHTO R73 - Defects That Can Be Repaired

Lift hole repairs are allowed
End chips can be repaired (%)
Joint damage for gasketed pipe must consider joint performance (%)

Before

After

Figure 25—Acceptable Pipe Spigot Repair (*Photos Courtesy of ACPA*)

AASHTO R73 - Defects That Are Rejectable (Can not be repaired)

Defects that affect function or design life
Cracks that penetrate through the wall of pipe or not repaired per Section 5.2
Crack that prevents a satisfactory joint
Pipe – Crack 0.01-in or wider and greater than 12-in length that has not been repaired per Section 5.2.
Lack of concrete cover to reinforcing
Rifling 1/4-in. or greater
Honeycomb >size of coarse aggregate & exposes steel; single area <4% - 10% max
Single slab off >4% area or >10% total
Unrepaired joint damage exceeding limits or that affects joint function

Repairable or Non-Repairable ?

Defect Review

You are now the QC Inspector

Do the following products:
Meet specifications?
Can they be repaired?
Or should they be rejected?

Disclaimer: not representative of QCast Quality


QC
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42" TRCP C.


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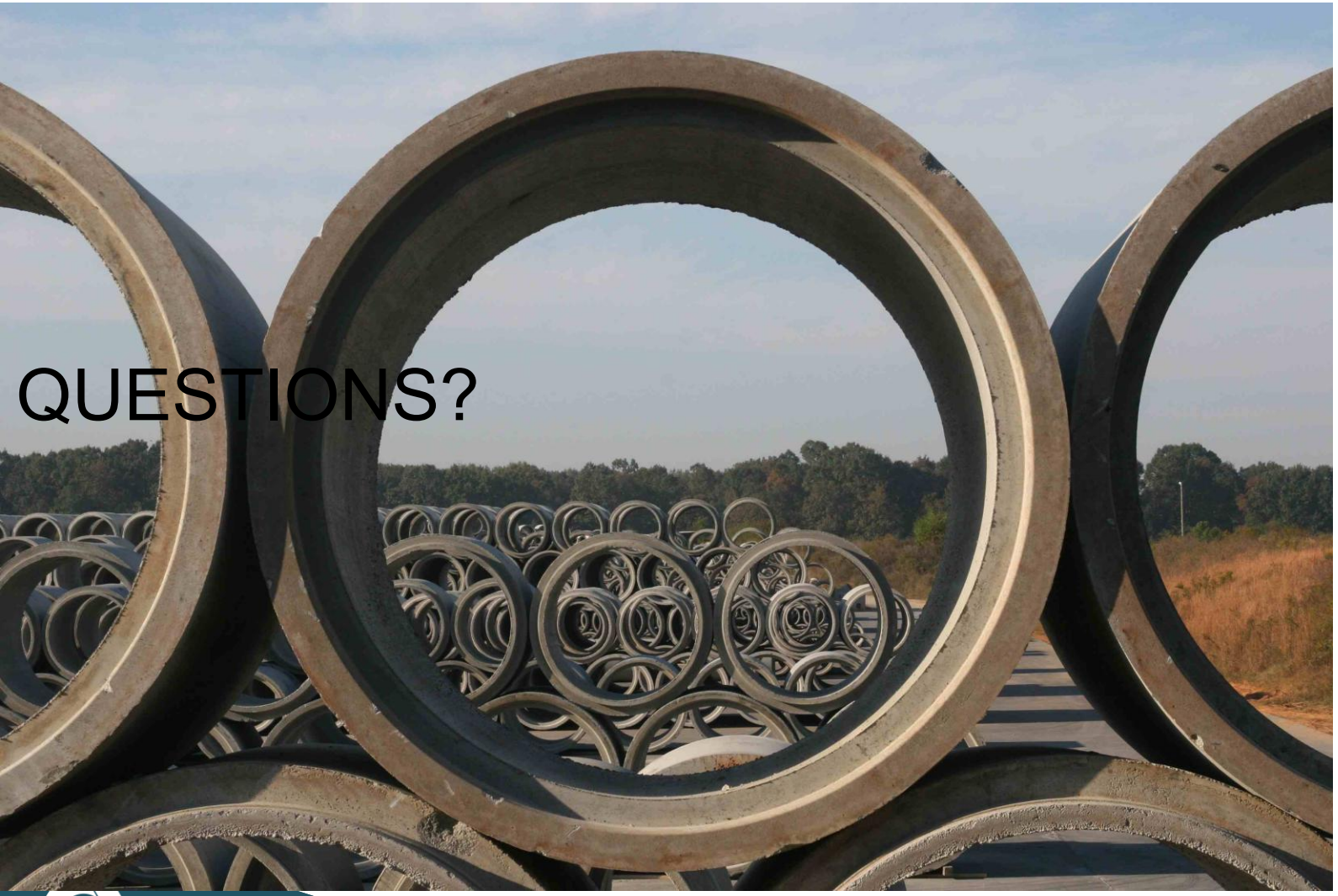

QUESTIONS?