AASHTO Preservation Management - Local Agency Outreach Working Group

Bridge Maintenance Scoping

5/15/2024

Outline

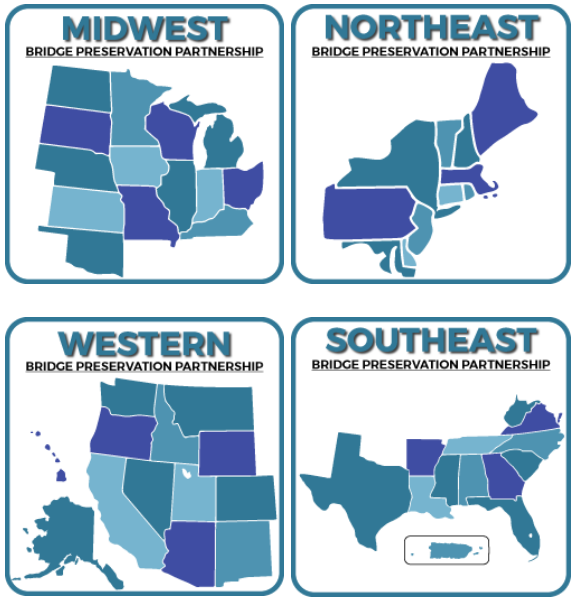
- AASHTO TSP2
- Bridge Maintenance Information Resources
- Bridge Maintenance Scoping
  - Proactive Maintenance
  - Deck Preservation
  - Barrier Preservation
  - Bridge Joints




AASHTO TSP2 Overview

- 4 Regional Partnerships

  Monthly Teleconference Meetings
  - Technical Presentations/Discussion
    - Innovative Products/Practices
    - Preservation Challenges
    - Current Topics
    - Best Practices
    - Contact ncpp@egr.msu.edu
- Regional In-Person Partnership Meetings
  - Annual
- National Bridge Preservation Partnership Meeting
  - September 9 – 13, 2024 – Salt Lake City

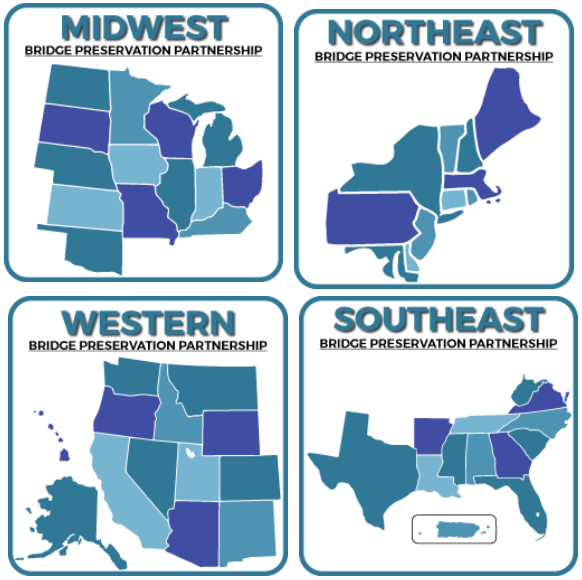


Current Working Groups

- Regional Working Groups
- Bridge Inspection Program Managers

National Working Groups

- Bridge Deck Preservation NWG
- Bridge Preservation BMS NWG
- Bridge Preservation Outreach & Communication
- Construction Quality of Bridge Preservation NWG
- Innovative Technology Demonstration (ITD) NWG
- Local Agency Outreach NWG



Local Agency Outreach

- Increase preservation of Local Infrastructure Assets.
- Provide education opportunities to Local Agencies.

Figure 15. Steps for establishing a bridge preservation program.

Establishing a Preservation Program

Bridge Preservation Resources

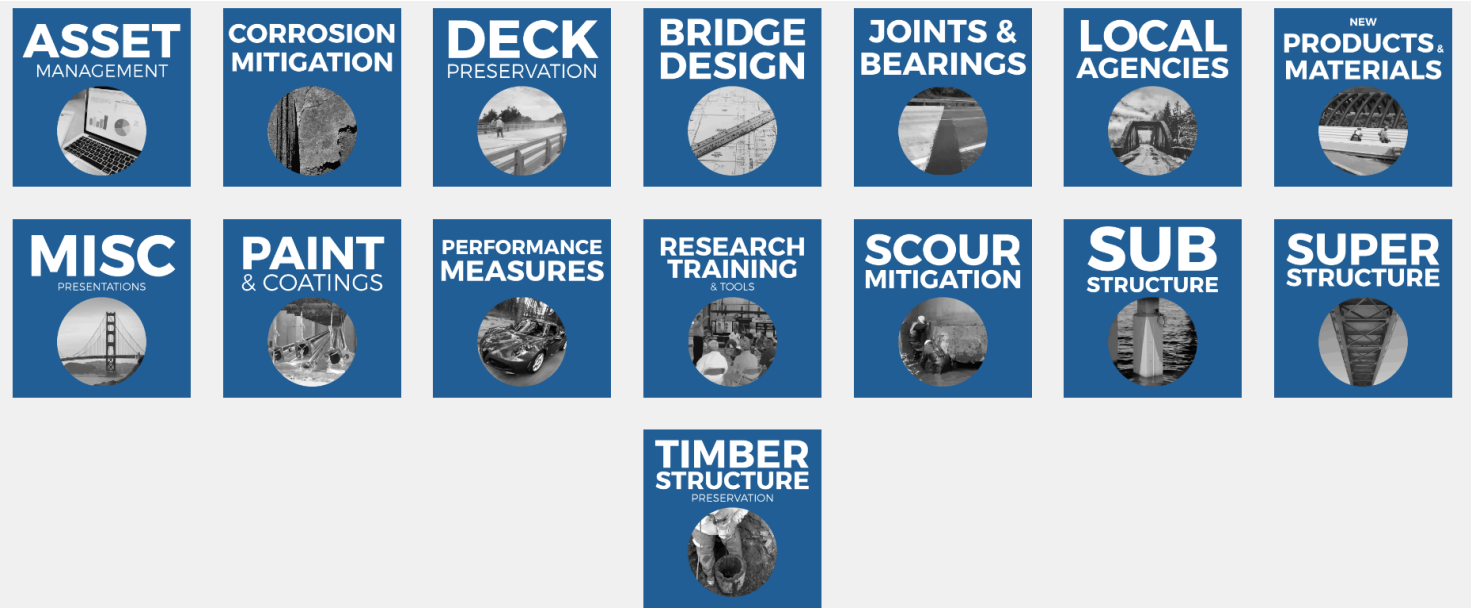
- TSP 2 Archives
- FHWA Bridge Preservation
- NHI Bridge Maintenance Class

TSP2.ORG

Note: TSP2 has been renamed – Preservation Management – (Website to be updated at a future time)

TSP2.ORG

Archived video presentations from annual meetings



TSP2.ORG

Sealing Panel Discussion	Sondag, Sarah; Peters, Walt	2019-10-17	
Installation of very early strength LMC overlays	Martens, Pat	2019-10-16	
MidWest Bridge Deck DeteriorationTPF 5(432)	Oliva, Bill	2019-10-16	
Chloride Testing & Hydro Demolition	Pilarski, Paul	2019-10-16	
Protocols for Concrete Bridge Deck Protections & Treatments	Bektas, Basak	2019-10-15	
Installation of very early strength LMC overlays	Martens, Pat	2019-10-15	
Sealing Panel Discussion Sarah Sondag (Minnesota DOT)	Peters, Walt	2019-10-15	
Bridge Deck Preservation Working Group	Welch, Ed	2019-09-11	
Bridge Deck Chloride Testing	Blower, Andrew	2019-09-10	
Installation of Very Early LMC Overlays	Martens, Pat	2019-09-10	
UHPC Overlay Solutions	Nault, Gregory	2019-09-10	
NDE & Materials Testing for Bridge Deck Condition & Service Life Assesment for Asset Planning	Boone, Shane	2019-05-15	
Panel Discussion: Deck Preservation Treatments	Henning, Brandon; McDowell, Herbert; Hardan, Chris	2019-05-15	
National Working Group: Bridge Deck Chloride Testing	Kinney, Travis	2019-05-15	

FHWA Bridge Preservation Expert Task Group (BPETG)

Goals & Strategic Objectives

1. Provide information on cost-effective bridge preservation strategies
2. Communicate the benefits of including bridge preservation as a component of asset and performance management
3. Advise and assist in developing educational materials on bridge preservation
4. Foster a collaborative environment that encourages research and innovation

BP-ETG under FHWA | TSP2 Bridge Preservation (pavementpreservation.org)/

Preservation Pocket Guides

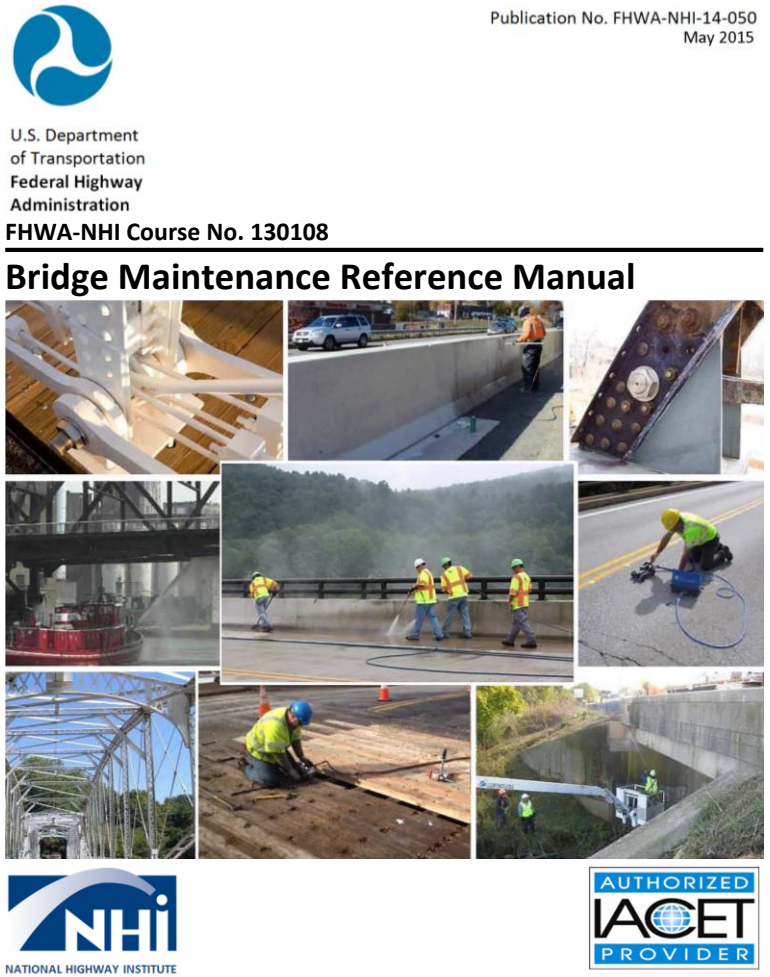
Pocket Guides are also Smart Phone Apps

Note: In App Store – Search "Applied Research Associates"

Intent of the Pocket Guides

- Installation guidelines
- Equipment and tools
- Limitations & restrictions
- Avoiding potential failure mechanisms
- Recommended training
- Required technical support
- Recommended QA/QC

Additional Resources (NHI)



Additional Resources (NHI cont)

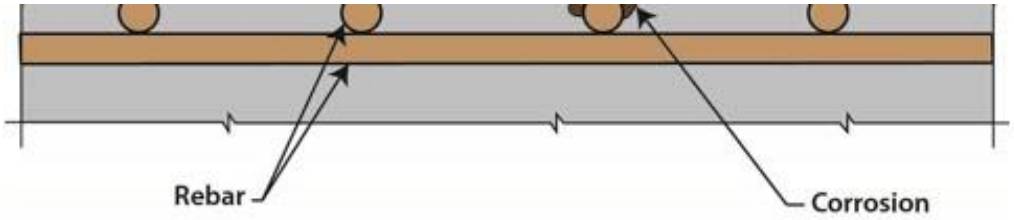


Figure 7.1 Typical Reinforced Concrete Deck and Slab Deterioration

Sealing the bridge deck cracks and overlaying the surface with dense materials will slow the rate of deterioration by limiting the water and salts that reach the reinforcing steel. If a significant amount of chlorides have already reached the reinforcing steel, cathodic protection may be used to stop corrosion from progressing. This section presents various aspects of concrete bridge decks and slabs and the related bridge maintenance activities.

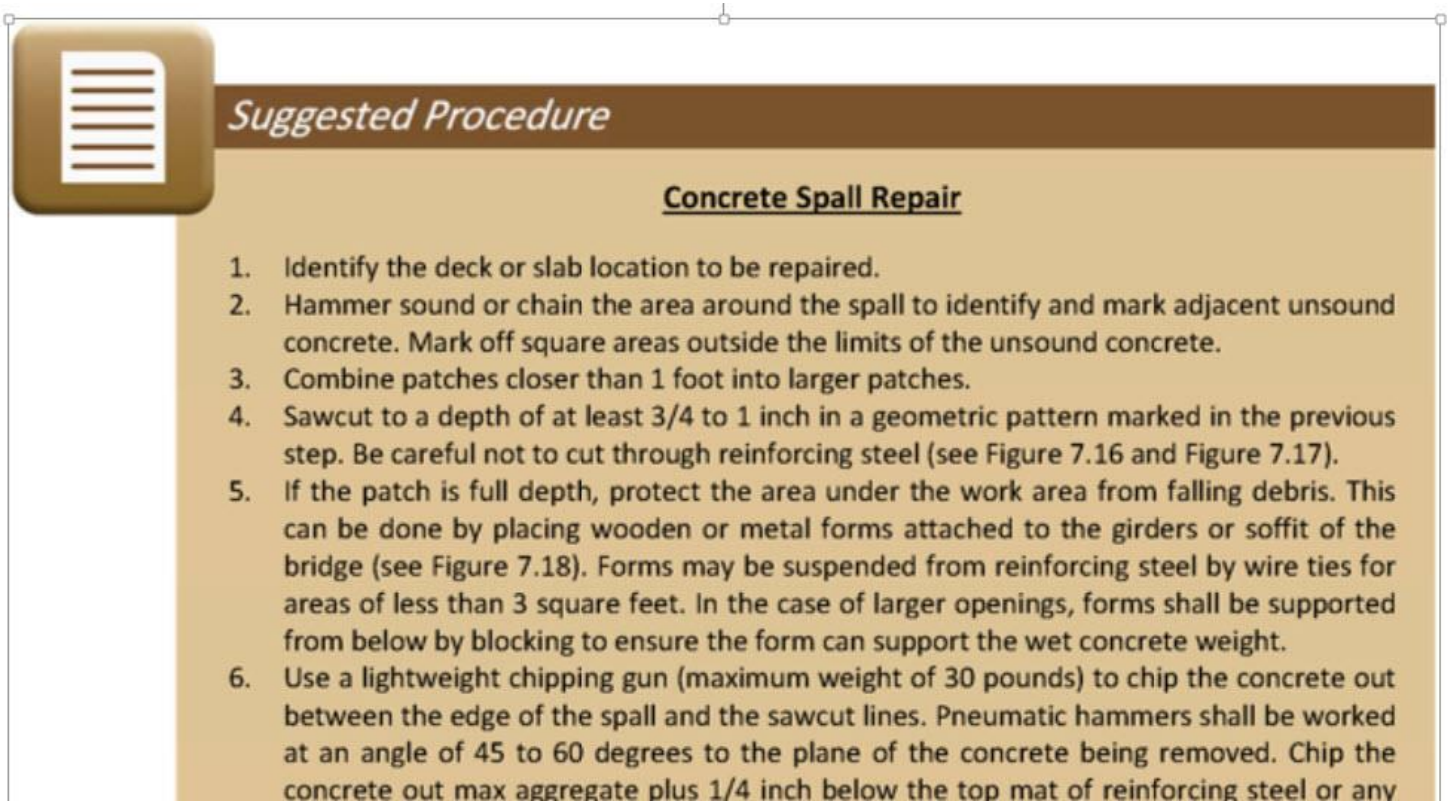
What To Look For

- Cracks
- Spalls
- Leaks on underside of deck
- Efflorescence in edges or underside of deck
- Accumulated debris on deck
- Evidence of ponding on deck

7.2.2 Deck Protection Methods

Proactive deck protection is the best way to preserve the life of any concrete bridge deck or

Additional Resources (NHI cont)



Suggested Procedure

Concrete Spall Repair

1. Identify the deck or slab location to be repaired.
2. Hammer sound or chain the area around the spall to identify and mark adjacent unsound concrete. Mark off square areas outside the limits of the unsound concrete.
3. Combine patches closer than 1 foot into larger patches.
4. Sawcut to a depth of at least 3/4 to 1 inch in a geometric pattern marked in the previous step. Be careful not to cut through reinforcing steel (see Figure 7.16 and Figure 7.17).
5. If the patch is full depth, protect the area under the work area from falling debris. This can be done by placing wooden or metal forms attached to the girders or soffit of the bridge (see Figure 7.18). Forms may be suspended from reinforcing steel by wire ties for areas of less than 3 square feet. In the case of larger openings, forms shall be supported from below by blocking to ensure the form can support the wet concrete weight.
6. Use a lightweight chipping gun (maximum weight of 30 pounds) to chip the concrete out between the edge of the spall and the sawcut lines. Pneumatic hammers shall be worked at an angle of 45 to 60 degrees to the plane of the concrete being removed. Chip the concrete out max aggregate plus 1/4 inch below the top mat of reinforcing steel or any

Bridge Maintenance Scoping

- What is Bridge Maintenance Scoping?
- Bridge Preservation Types
  - **Scheduled Maintenance**
  - **Preventive Maintenance**
  - Rehabilitation
  - Replacement
- Maintenance Scoping Bridge Elements
- Important Scheduled Maintenance Activities
- Incorporating a Bridge Maintenance Program in your LAP

Bridge Maintenance Scoping

The process that bridge inspectors would identify, prioritize, and provide guidance on preservation activities **BEFORE** potential distress areas occur on the bridge by integrating repair strategies and develop preliminary cost estimates.

Bridge Maintenance Scoping

Bridge Preservation Components

- **Schedule Maintenance (Keep current cond)**
- Preventive Maintenance (address fairs)
- Rehabilitation (poor to fair / good)
- Replacement (poor to good)

Bridge Maintenance Scoping

Scheduled Maintenance (Proactive)

- Bridge Cleaning
- Vegetation Control
- Joint Sealing and Gland Replacement
- Weep Holes
- Crack Sealing
- Silanes

Bridge Cleaning

- Potable Water
- Remove & collect materials such as dirt, nests, bird excreta
- High Volume Low Pressure
- Flush Drains
- Bridge Seats and Beam Ends

Bridge Cleaning - Tips

- Engage your local Fire Department
- What about Birds?
- Migratory Bird Protection – Cleaning Prohibited in Michigan April 15th – September 1st when nests present.

Bridge Cleaning

- Clean Joints

Bridge Cleaning

- Clean Joints

Bridge Cleaning

- Clean Toe of Barrier Wall

Bridge Cleaning

- Clean Toe of Barrier Wall

Bridge Cleaning

- Clean Bird Debris on Beams

Bridge Cleaning

- Clean Bird Debris on Beams

Bridge Cleaning

- Benefits
- Reduced Deterioration and Corrosion Rates
- Difficult to determine cost benefit
- Washington DOT Research Reports
  - WA-RD 811.1
  - WA-RD 811.2

Vegetation Control

Vegetation Control

Improve Line of Sight to Obstacles

Rigid and Mobile

Vegetation Control

- Inspector access
- Visibility
- Trapping of moisture on structural elements
  - Beams
  - Deck Fascias
  - Paint Systems

Vegetation Control

Remove Hazardous Trees, Tree Limbs, Brush and Poison Ivy

Vegetation Control

Reduce Standing Water on Roadways
Full Sun Exposure Speeds De-Icing Efforts

Vegetation Control

Reduces Fire Potential

Vegetation Control

Vegetation Management Reduces Maintenance Costs and Protects Highway Assets

Joint Maintenance

- Guidelines for Maintaining Small Movement Bridge Expansion Joints – NCHRP 12-100

Joint Maintenance

- Step 1 – Joint Identification – Asphaltic Plug

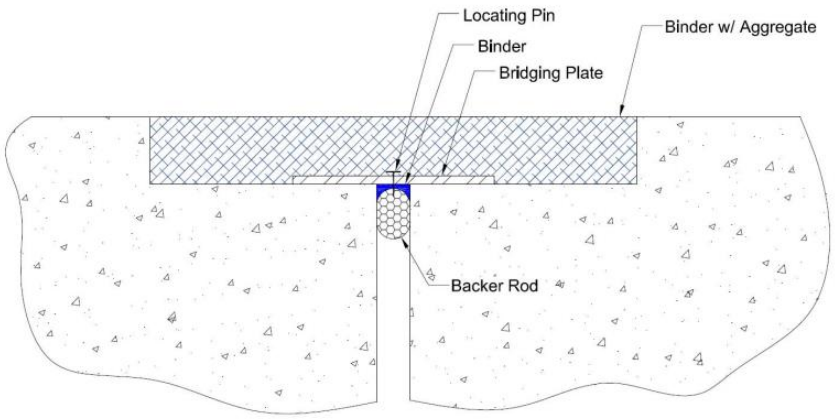
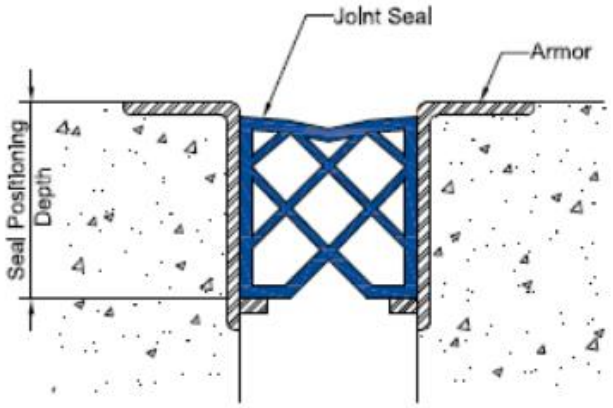
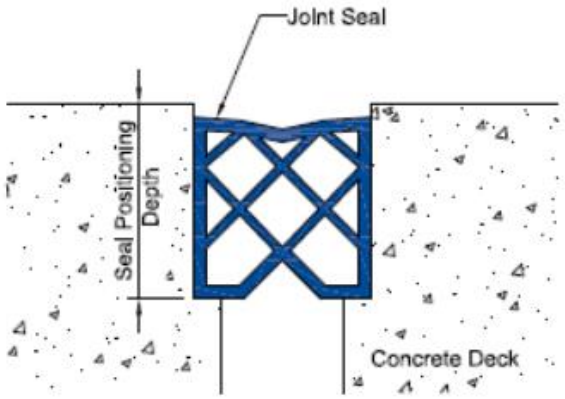


FIGURE 1.

Joint Maintenance

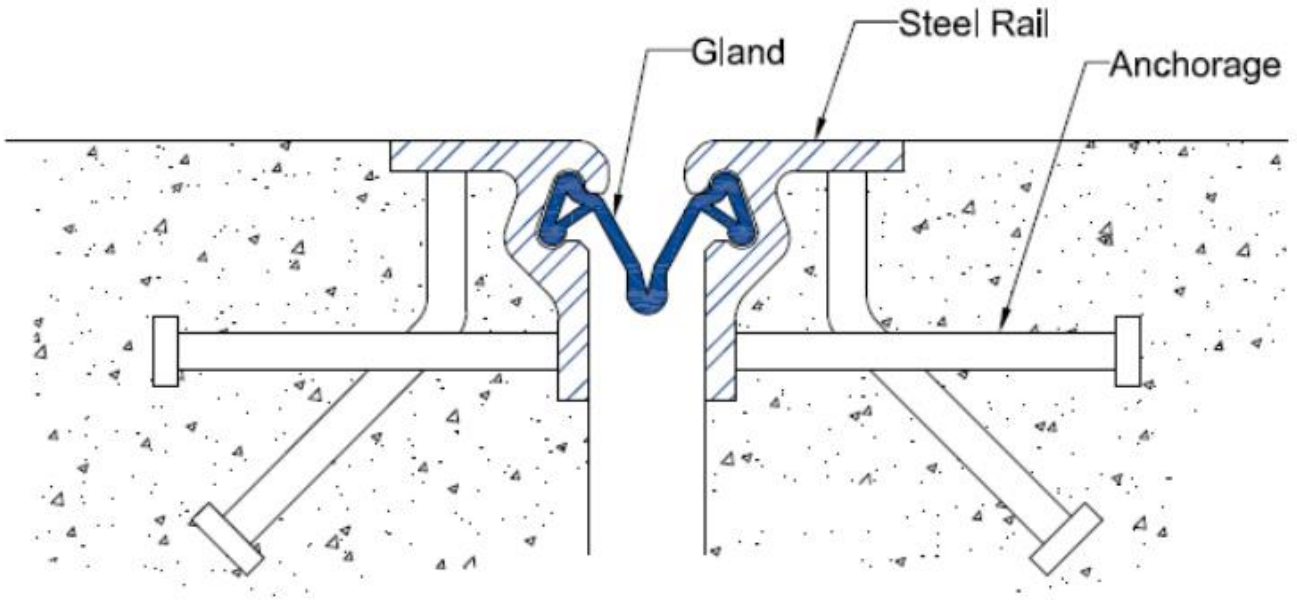
- Step 1 – Joint Identification – Open Cellular Compression Seal





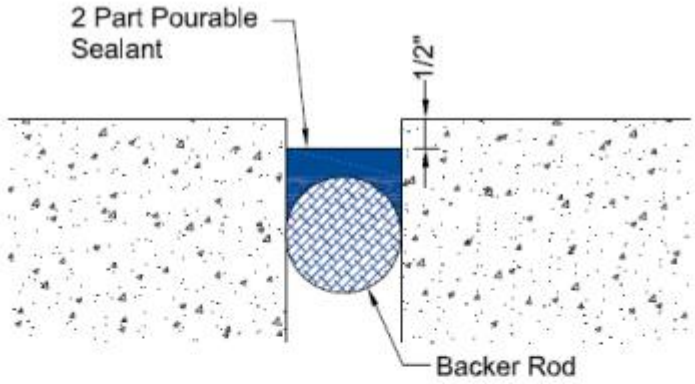
Joint Maintenance

- Step 1 – Joint Identification – Strip Seal



Joint Maintenance

- Step 1 – Joint Identification – Pourable



Joint Maintenance

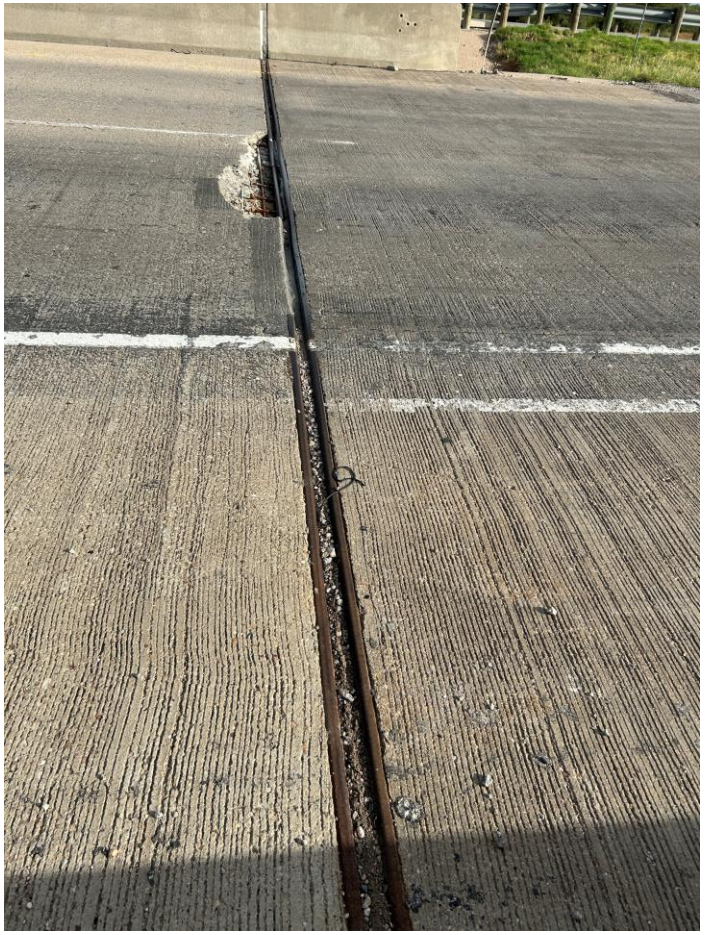
- Step 2 – Scoping
  - Best time to inspect a bridge – right after it rains

Joint Maintenance

- Step 3 – Identify the Problem

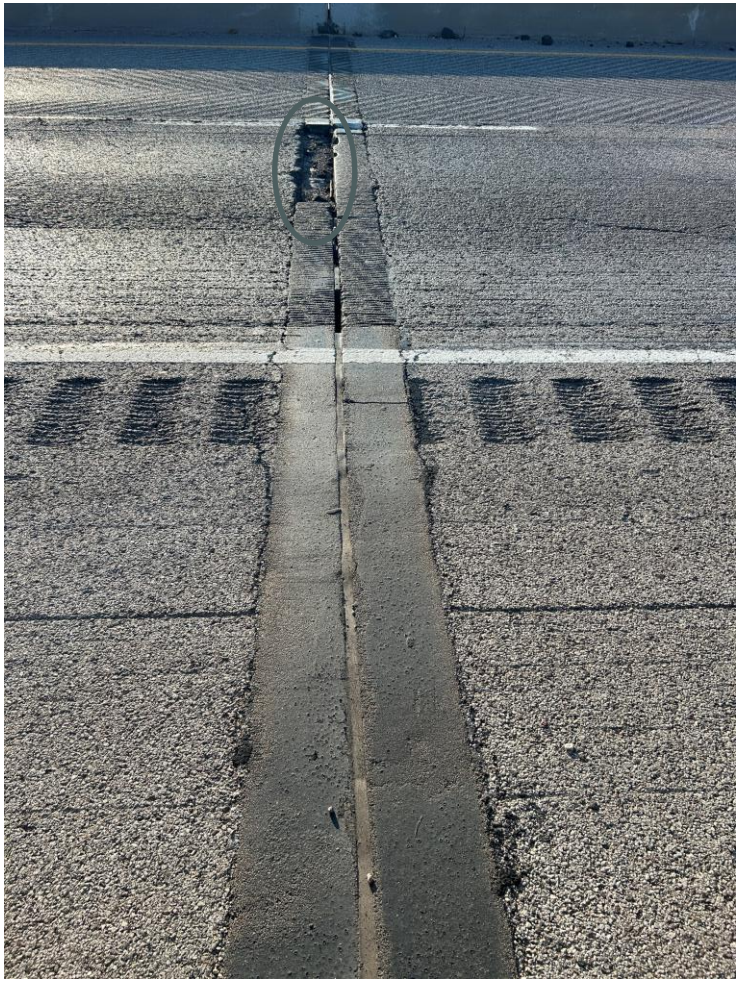
Joint Maintenance

- Step 3 – Identify the Problem



Joint Maintenance

- Step 3 – Identify the Problem



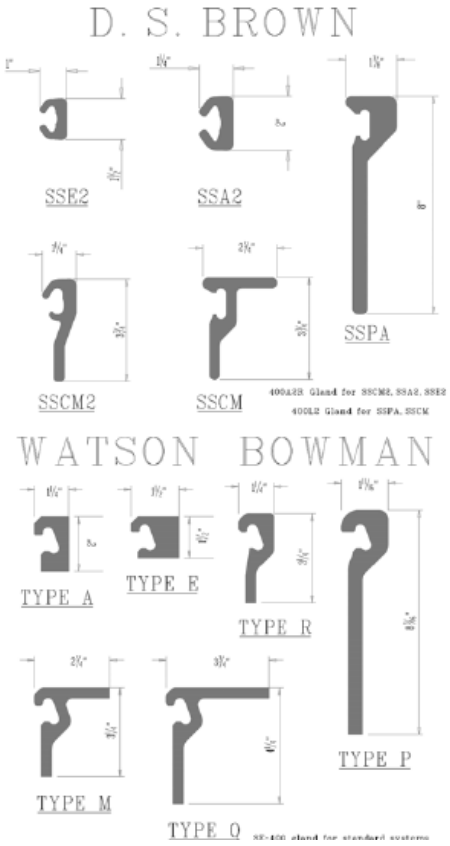
Gland Replacement

- An entire expansion joint may not require replacement if adjacent concrete is sound and rail is intact.

Expansion Joint Gland

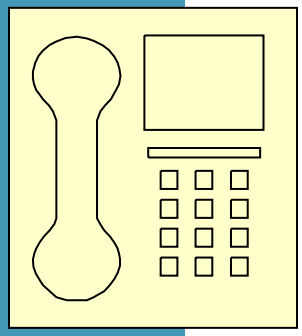
- Step 1 – Ensure Rail is Secure

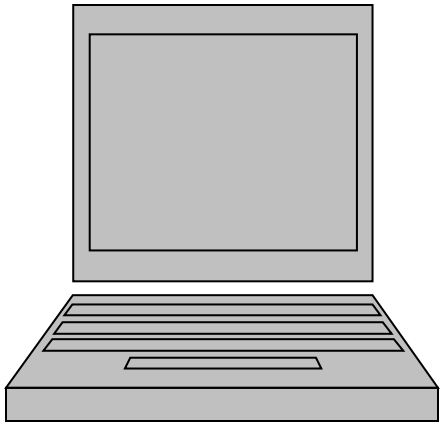
- Step 2 - Determine Joint Profile



Expansion Joint Gland

- Step 3 – Order Gland and Lubricant





- Step 4 - Determine Replacement Limits

Expansion Joint Gland

- Step 5 – Cut Down Center

- Step 6- Remove from Rail

Expansion Joint Gland

- Step 7- Clean the Channels

- Step 8 – Unroll and Lubricate the Gland

Expansion Joint Gland

Gland Alternative

(Also works on bare concrete and armor plate joints)

AASHTO TSP2 - Innovative Technology Demonstrations (ITD) Working Group

Field demonstration program documented by an **Independent Consultant** and managed by the ITD Working Group, with TSP-2 oversight. The purpose is to introduce new and innovative preservation materials and technologies to owners of the nation's highway systems. Demonstrations involve products, services, processes, and equipment for highway and bridge preservation.

- Maintainable Weep Hole Filters (Jet Filters)
- MALP Concrete (Phoscrete)
- Transparent Stay In Place Forms (TrueTech Bridge)
- Epoxy/Silane Multi Coat System (Advanced Chemical Technologies)

Maintainable Weep Hole Filters

Maintainable Weep Hole Filters

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Maintainable Weep Hole Filters

Maintainable Weep Hole Filters

Crack Sealing

- Whenever you go out to a bridge, plan on crack sealing.
- Seals cracks in bridge deck through direct application to crack
- Success is reliant on applicator filling cracks to refusal
- Reapply as often as cracks become visible
- Used for perimeters of deck patches and full depth joint replacements

Silane

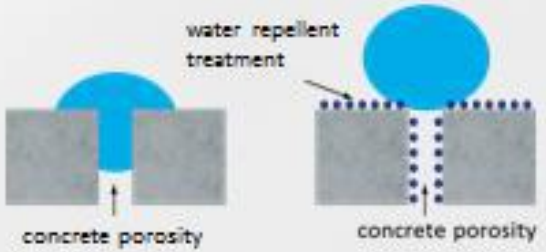
- Silanes are easy to apply
- Silanes are very cost effective
  - $7/SFT Substructure and Barrier
  - $3/SFT for Deck
- Silanes last for 5 – 8 years
- Silanes don’t change skid resistance
- Silanes dry fast 30 minutes to 2 hours

Silane

How Do Silanes Work?

From Hydrophilic to Hydrophobic

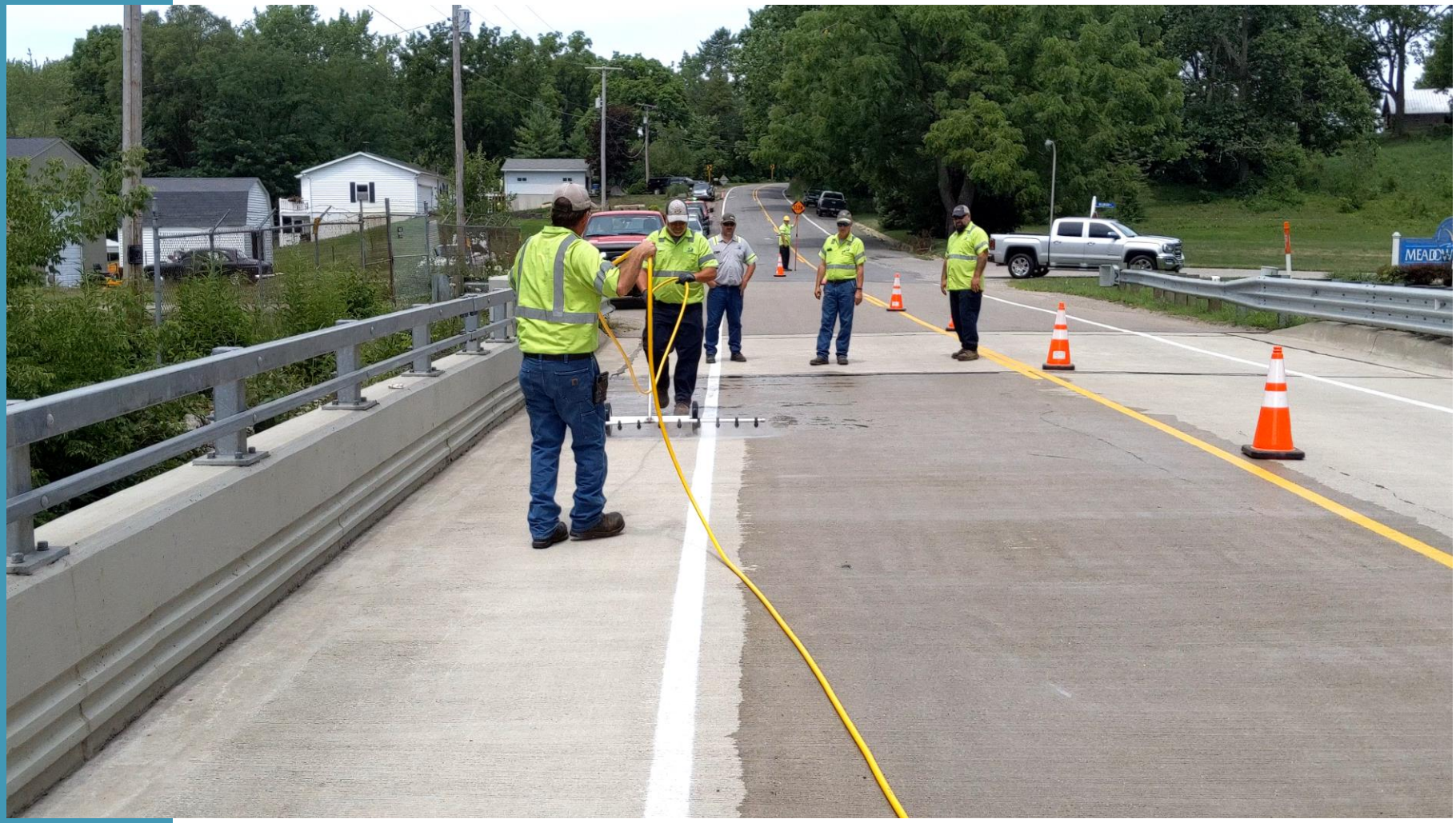
Water repellents penetrate the surface pores and cracks, so that they are internally lined but not filled.

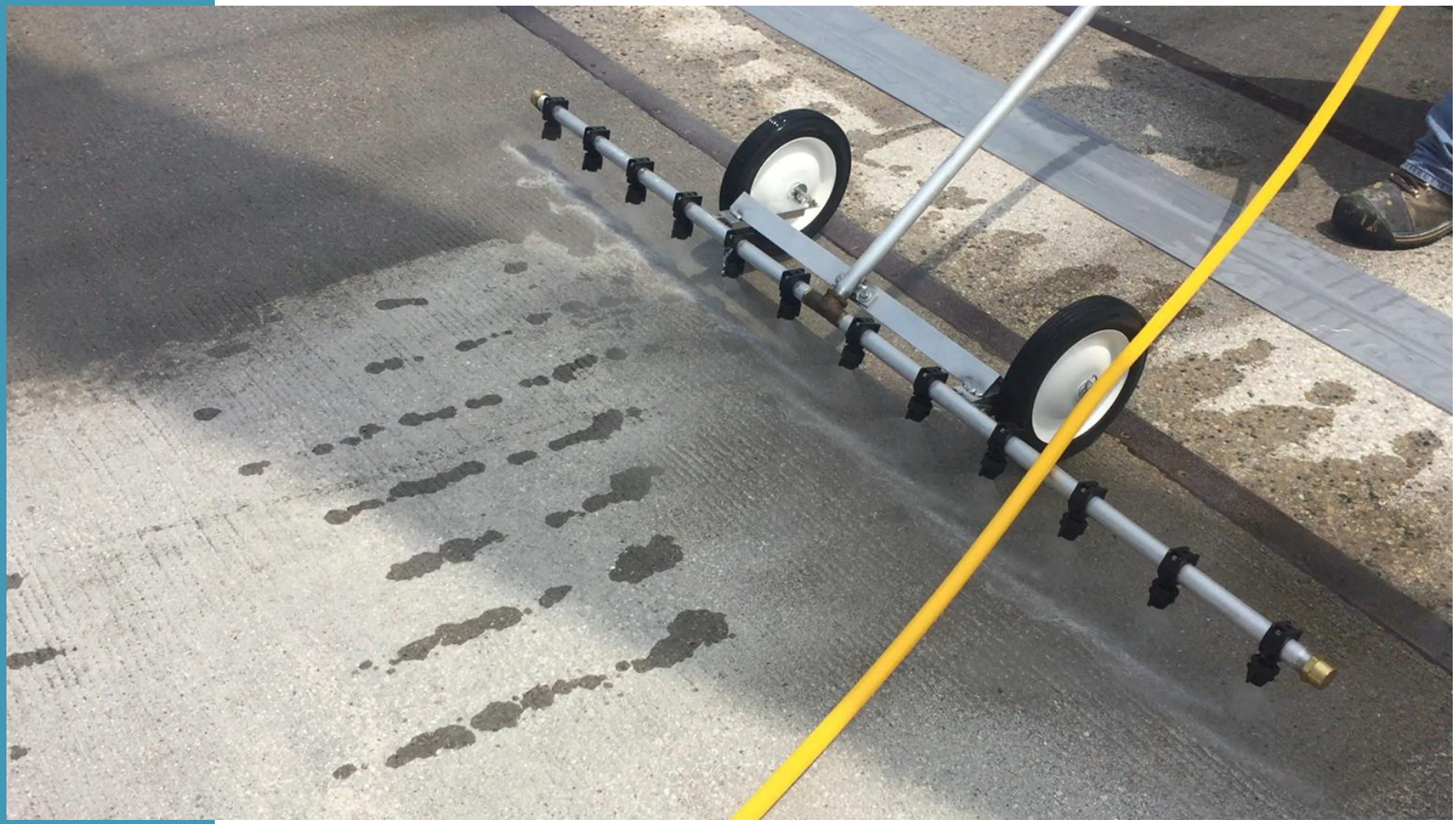


Reduction of concrete surface tension:
inter-molecular attraction of water molecules is much higher than the attraction of water into concrete

From hydrophilic (water-loving) to hydrophobic (water-hating) surface

Surface Preparations: Shot blasting





Bridge Maintenance Scoping

Bridge Preservation Components

- Schedule Maintenance (Keep current cond)
- **Preventive Maintenance (address fairs)**
- Rehabilitation (poor to fair / good)
- Replacement (poor to good)

BRIDGE DECK PRESERVATION MATRIX – DECKS WITH UNCOATED "BLACK" REBAR

DECK CONDITION STATE				REPAIR OPTIONS	POTENTIAL RESULT TO DECK BSIR		ANTICIPATED FIX LIFE
Top Surface		Bottom Surface			Top Surface BSIR #58a	Bottom Surface BSIR #58b	
BSIR #58a	Deficiencies % (a)	BSIR #58b	Deficiencies % (b)				
≥ 5	N/A	N/A	N/A	Hold (c) / Seal Cracks	No Change	No Change	N/A
				Silane			5 years
				Healer Sealer (d)			8 to 10 years
	≤ 10%	≥ 6	≤ 2%	Epoxy Overlay (f)	8, 9	No Change	15 to 20 years
	≤ 10%	≥ 4	≤ 25%	Deck Patch (e, j)	6, 7, 8	No Change	5 to 10 years
4 or 5	10% to 25%	≥ 5	≤ 10%	Deep Concrete Overlay (h, j)	8, 9	No Change	25 to 30 years
		4	10% to 25%	Shallow Concrete Overlay (h, i, j)	8, 9	No Change	20 to 25 years
				HMA Overlay with water-proofing membrane (f, i)	8, 9	No Change	8 to 10 years
		2 or 3	> 25%	HMA Cap (g, i)	8, 9	No Change	2 to 4 years
≤ 3	>25%	≥ 6	< 2%	Deep Concrete Overlay (h, j)	8, 9	No Change	20 to 25 years
		4 or 5	2% to 25%	Shallow Concrete Overlay (h, i, j)	8, 9	No Change	10 years
				HMA Overlay with water-proofing membrane (f, i)	8, 9	No Change	5 to 7 years
		2 or 3	>25%	HMA Cap (g, i)	8, 9	No Change	1 to 3 years
				Replacement with Epoxy Coated or Stainless Rebar Deck	9	9	60+ years

(a) Percent of deck surface area that is spalled, delaminated, or patched with temporary patch material. Top surface decision making based on concrete surface, not the condition of thin epoxy overlays or other wearing surfaces.
(b) Percent of deck underside area that is spalled, delaminated or map cracked.
(c) The "Hold" option implies that there is on-going maintenance to sustain current ratings.
(d) Seal cracks when cracks are easily visible and minimal map cracking. Apply healer sealer when crack density is too great to seal individually by hand. Sustains the current condition longer.
(e) Crack sealing must also be used to seal the perimeter of deck patches and joint replacements.
(f) Deck patching required prior to placement of epoxy overlay or waterproofing membrane.
(g) Hot Mix Asphalt cap without waterproofing membrane for ride quality improvement. Deck should be scheduled for replacement in the 5 year plan.
(h) If bridge crosses over traveled lanes and the deck contains slag aggregate, do deck replacement.
(i) When deck bottom surface is rated poor (or worse) and may have loose or delaminated concrete over traveled lanes, sidewalks or non-motorized paths, an in-depth inspection should be scheduled. Any loose or delaminated concrete should be scaled off and false decking should be placed over traveled lanes where there is potential for additional concrete to become loose.
(j) Some full depth repairs should be expected where top surface deficiencies align with bottom surface deficiencies.

Healer Sealer or Thin Epoxy Overlay

- Identify the Problem

Healer Sealer

- Flood Deck with Epoxy
  - Healer Sealer Fills Cracks – It does not seal surface
  - Sand is broadcast on deck –
    - Sand does not improve friction and wears off within a few years

Healer Sealer

- Seals cracks in bridge deck by penetration
- Aggregate wears off the surface and existing deck surface is still visible
- Less reliant on preparation than thin epoxy overlay
- Life expectancy of 8 to 10 years
- Deck preparation rates up to 1600-1700 square feet per hour (Rate based on one BW SCB16 Shotblaster)
- Production rates up to 1,000 – 3,500 square feet per hour
- Typical two hour cure time
- Cost - $30/SYD

Thin Epoxy Overlay

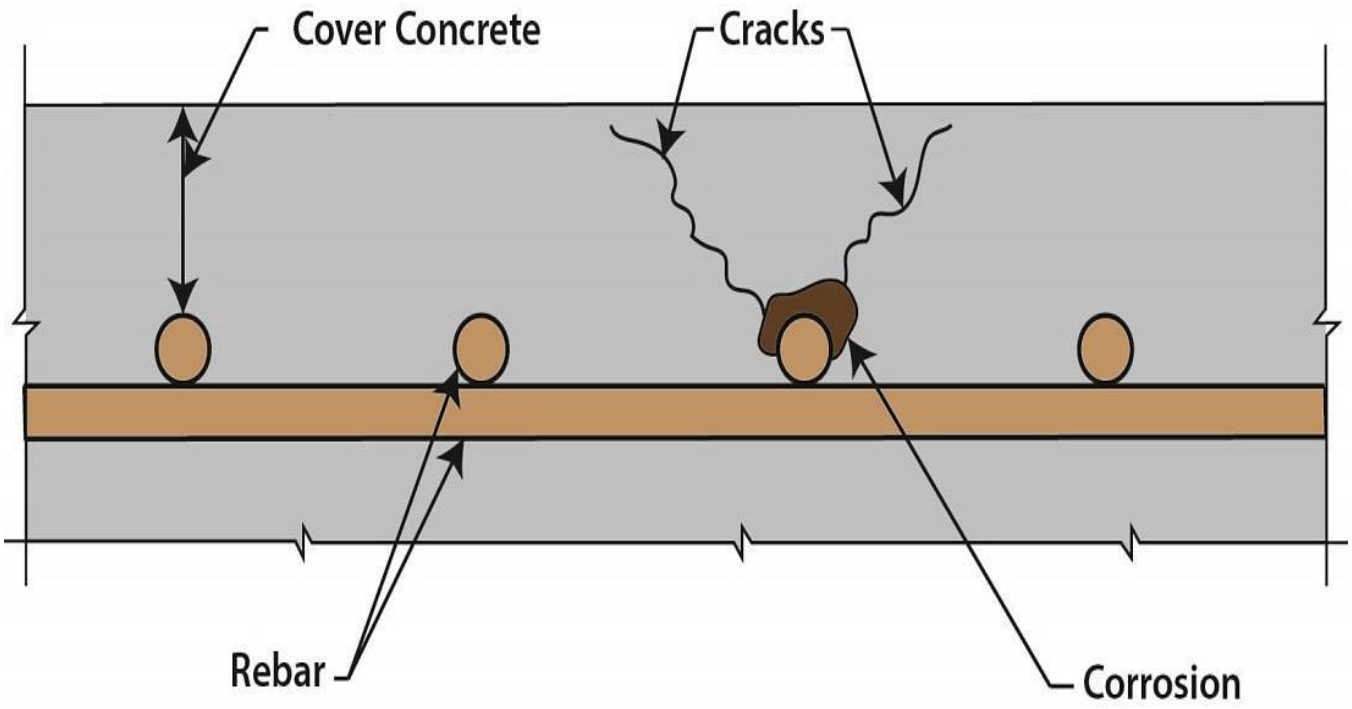
- Flood Deck with Epoxy
  - Thin Epoxy Overlay Bridges Cracks – And it seals the surface
  - Stone is broadcast on deck –
    - Stone improves surface friction and does not wear off

Thin Epoxy Overlay

- Seals cracks in bridge deck by bridging
- Use on any deck 1 year old or greater with a fair or better top and deck bottom condition
- Increases skid resistance
- Heavily dependent on surface preparation
- Life expectancy 15-20 years
- Deck Preparation Rate – 600 to 850 sft / hr
- Placement rate – 1,000 – 3,500 sft / hr / layer
- Cost - $48/SYD

Deck Patch Scoping

Deck Deterioration



Deck Patch Scoping

Visually inspect deck surface & bottom for all areas of deterioration

Deck Patch Scoping

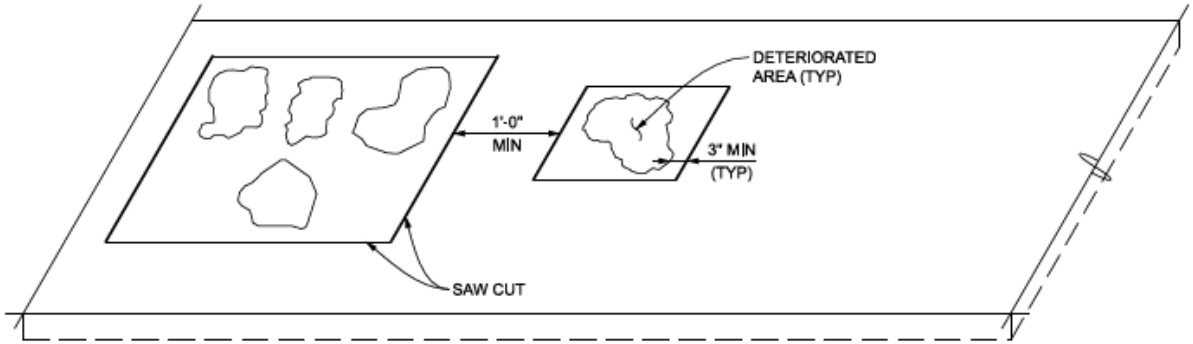
Sound area to be patched and/or around patch area to identify all unsound concrete

Deck Patch Scoping

- Deck Patch Budgeting
  - $70 /SFT for Deep or Shallow Deck Patches
  - $140 / SFT for Full Depth Deck Patches

Bridge Maintenance Manual

Shallow Deck Patching



STEP 1

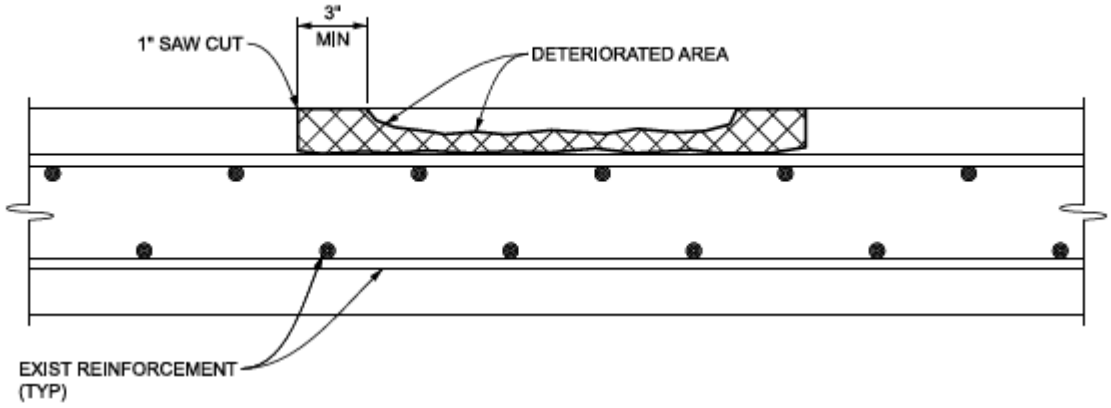
1. SOUND DECK, MARK DELAMINATED, SPALLED AND/OR DETERIORATED AREAS ON THE DECK SURFACE.

2. MARK LIMITS OF REMOVAL TO ENCOMPASS DETERIORATED AREA PLUS 3" MINIMUM ON ALL SIDES. PATCHES MUST BE AS SQUARED OFF WITH NO ACUTE ANGLES. IF TWO PATCHES THAT ARE LESS THAN 1 FT APART, THE TWO PATCHES MUST BE COMBINED INTO ONE PATCH.

3. SAW CUT THE DECK TO A DEPTH OF 1" ALONG THE LIMITS OF REMOVAL. EXTEND SAW CUT 1" BEYOND INTERSECTION LINES.

Bridge Maintenance Manual

Shallow Deck Patching



STEP 2

1. FOR REMOVING SUPERSTRUCTURE CONCRETE ON STEEL BEAM BRIDGES, MACHINE-MOUNTED HYDRAULIC OR PNEUMATIC EQUIPMENT MAY BE USED. USE MANUAL PNEUMATIC HAMMERS TO REMOVE THE BRIDGE DECK OVER CONCRETE BEAMS. LIMIT MANUAL PNEUMATIC HAMMER TO 60 POUND MAXIMUM.

2. SANDBLAST CONCRETE TO REMOVE LOOSE DEBRIS AND ESTABLISH PROFILE FOR CONCRETE ADHESION.

Patch Preparation

Saw Cutting

Patch Preparation

Chip Limits of Deterioration

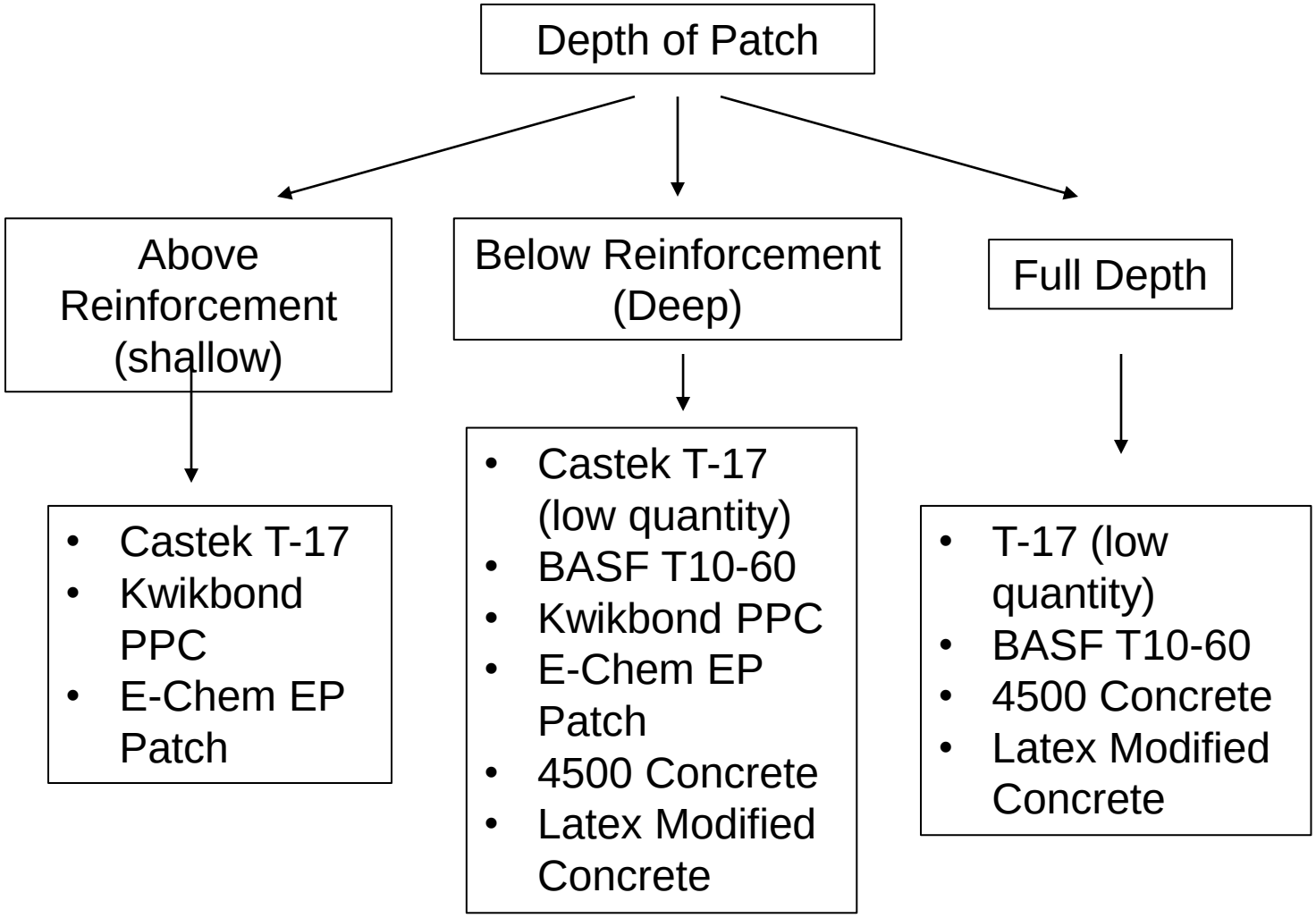
Patch Preparation

Ensure to chip all unsound concrete

Patch Preparation

Check Edges

Material Selection (Patch Depth)



Material Selection (Cure Time)

Rapid Cure Time

- MasterEmaco T 1060 by BASF – Rapid Mortar
  - 2-3 Hours
- Castek T-17
  - 2-3 Hours
- Kwikbond Polymers – PPC Easy Patch
  - 2-3 Hours
- Echem – EP Patch
  - 3-5 Hours

Longer Cure Time

- 4500 Concrete (Michigan)
  - 7 Day (wet)
- Latex Modified Concrete (Michigan)
  - 48 Hours wet & 48 hours dry
- Other Standard Mix Approved by your DOT

Rapid Set Concretes

BASF 1060

Rapid Set Concretes

BASF 1060

Rapid Set Concretes

BASF 1060

Rapid Set Concretes

Transpo – T-17

Substructure Repair

- Temporary Supports
  - Typically required when more than 25% of bearing is undermined – but always consult an engineer

Substructure Repair

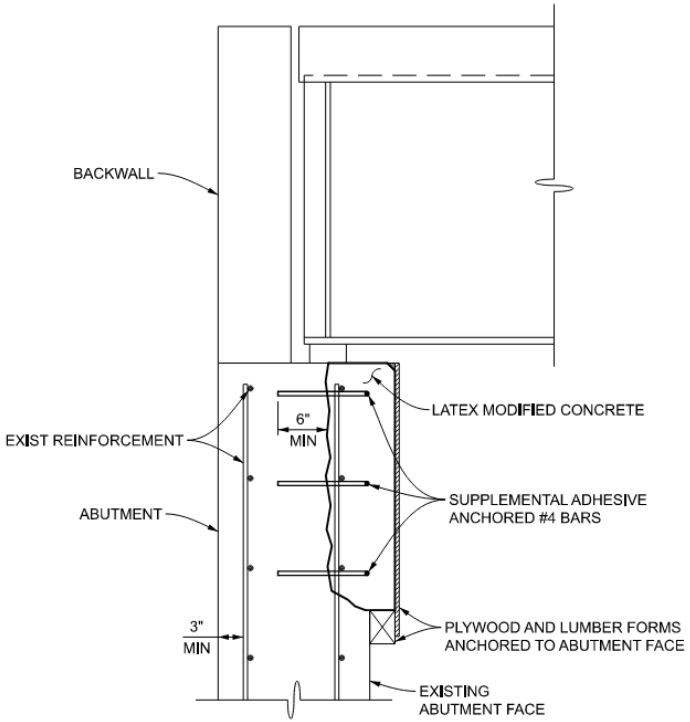
- Columns and Caps
  - Temp support beams when bottom of cap moment reinforcement completely exposed or overhangs have shear / moment cracks

Substructure Repair

- Costs
  - $360 / CFT for the Chipping, Forming and Concrete Placement
  - Temp Supports - $4,000 - $10,000 Depending on height, load and complexity

Substructure Repair

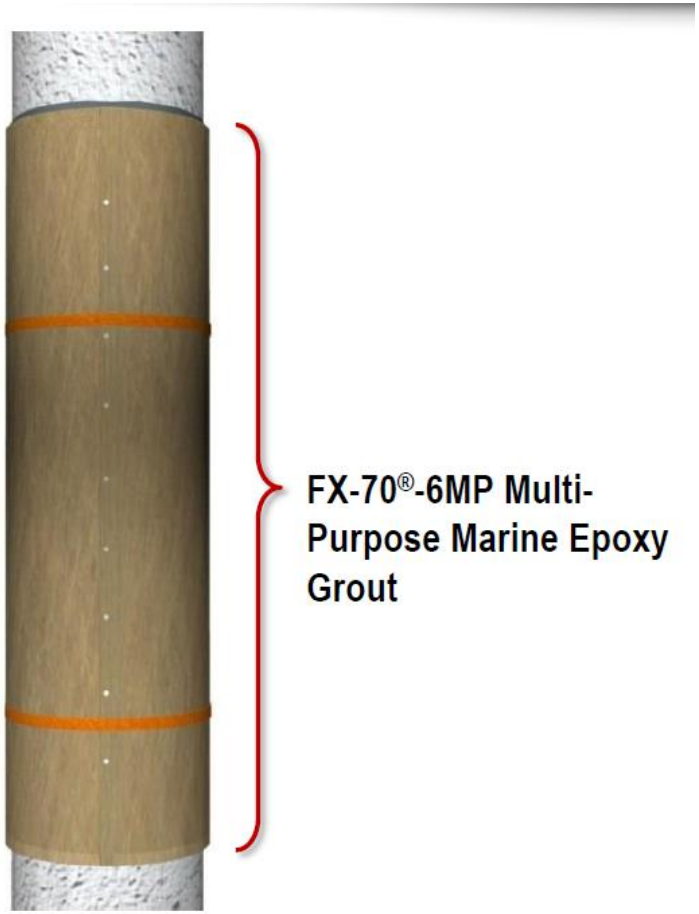
- Abutments (Pier Caps Similar)
  - Consider Overcasting if clear cover is insufficient



Substructure Repair

- Columns
  - Do not work on adjacent columns without temporary supports
  - Do not repair more than 2 sides of a square column at same time.

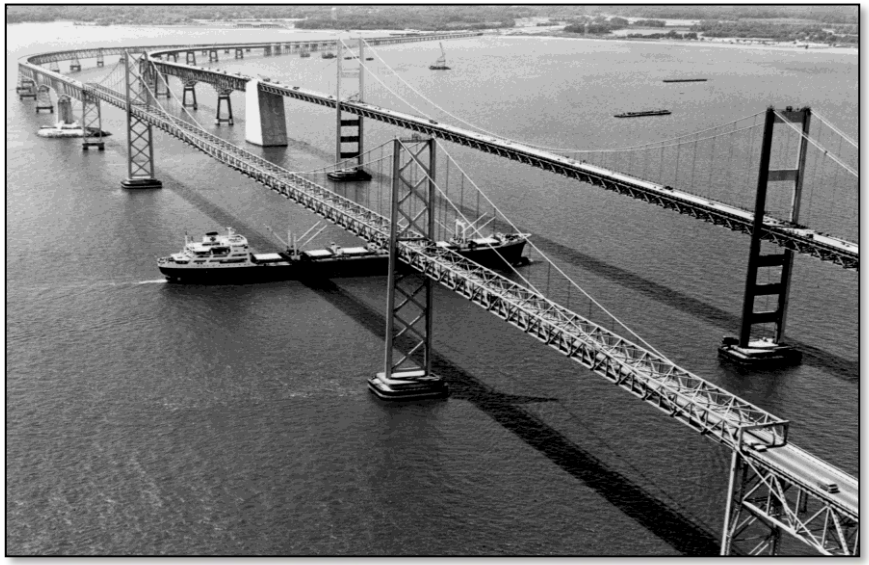
Substructure Repair



- Simpson Strong-Tie product
- Used when section loss is 25% or less
- Fiberglass Jacket
- Filled with three component, epoxy grout
- ½” annular void between jacket and column (obtained with spacers)
- Used on Concrete, Steel or Timber Piles

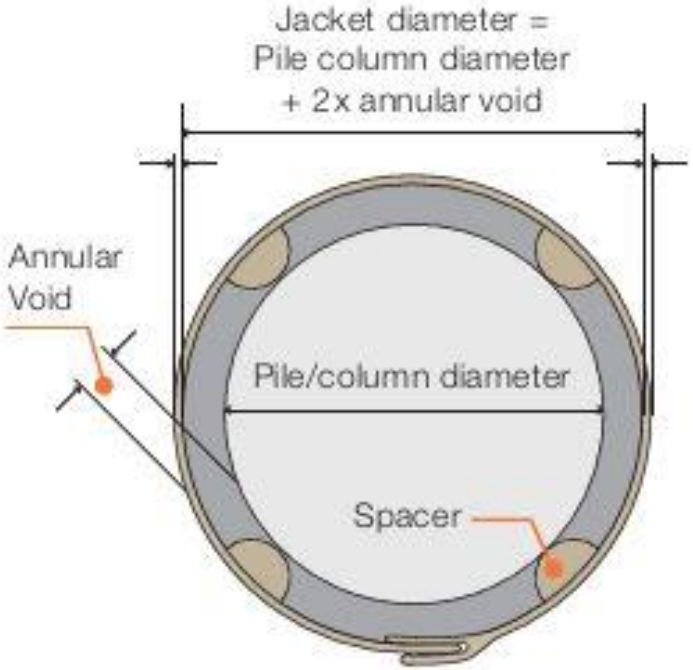
FX-70 Jacket Shapes

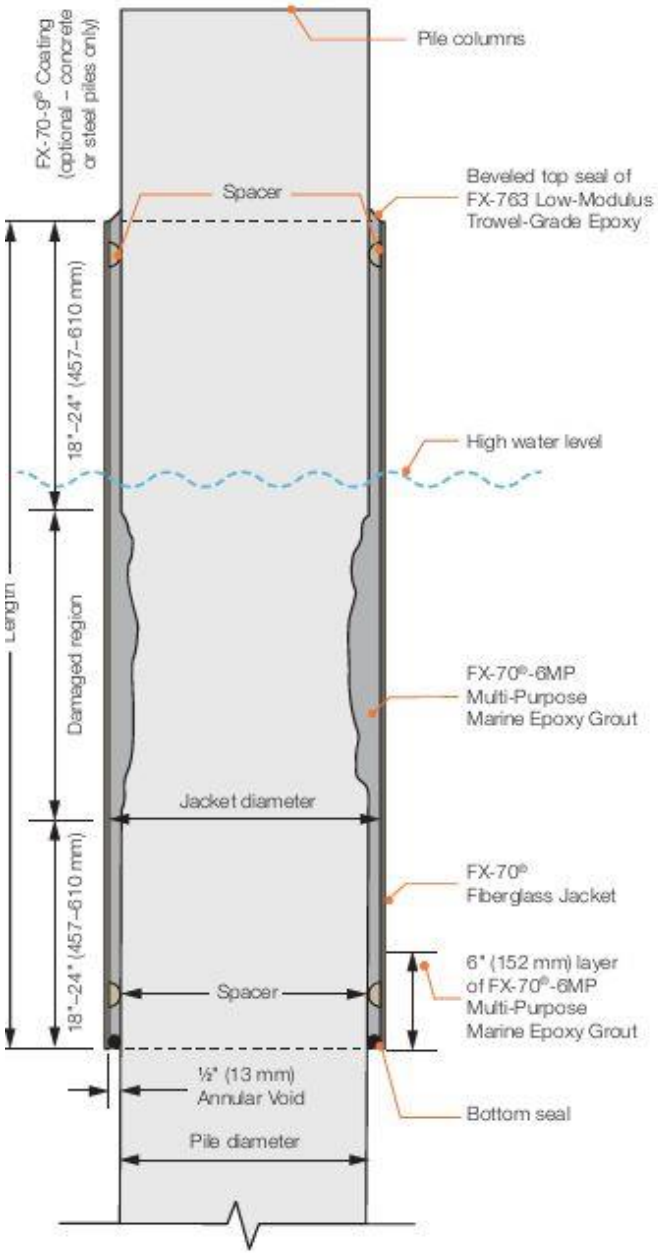
FX-70 Track Record



Case Study

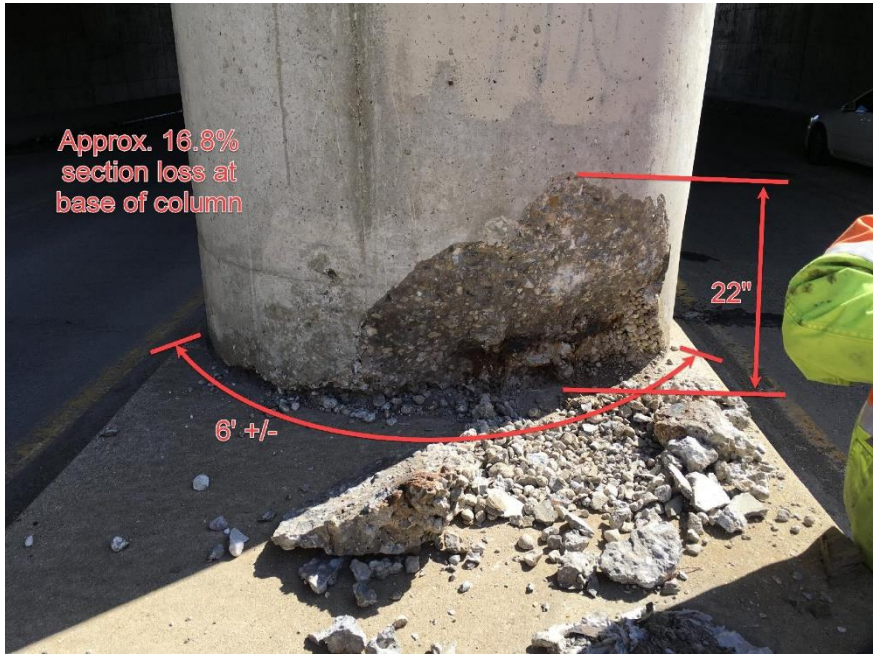
- Chesapeake Bay Bridge (US-50)
- 300 jackets installed
- 55’ diameter with ½” annular void
- 20+ years in service


Jacket diameter =
Pile column diameter
+ 2x annular void
Annular
Void
Pile/column diameter
Spacer


FX-70-9® Coating
(optional – concrete
or steel piles only)
Pile columns
Spacer
Beveled top seal of
FX-763 Low-Modulus
Trowel-Grade Epoxy
18"–24" (457–610 mm)
High water level
Length
Damaged region
FX-70®-6MP
Multi-Purpose
Marine Epoxy Grout
Jacket diameter
FX-70®
Fiberglass Jacket
18"–24" (457–610 mm)
6" (152 mm) layer
of FX-70®-6MP
Multi-Purpose
Marine Epoxy Grout
Spacer
½" (13 mm)
Annular Void
Bottom seal
Pile diameter

I-475 over CSX RR and Pierson Rd

R03-25132



I-475 over CSX RR and Pierson Rd

R03-25132

I-475 over CSX RR and Pierson Rd

R03-25132

I-475 over CSX RR and Pierson Rd

R03-25132

I-475 over CSX RR and Pierson Rd

R03-25132

- RFA – Complete

Bridge Approach

Settlement – Impacting Vehicles Accelerate Tailspan Deterioration

Bridge Approach - Replace

- $27/SFT
- Takes the longest of all options.

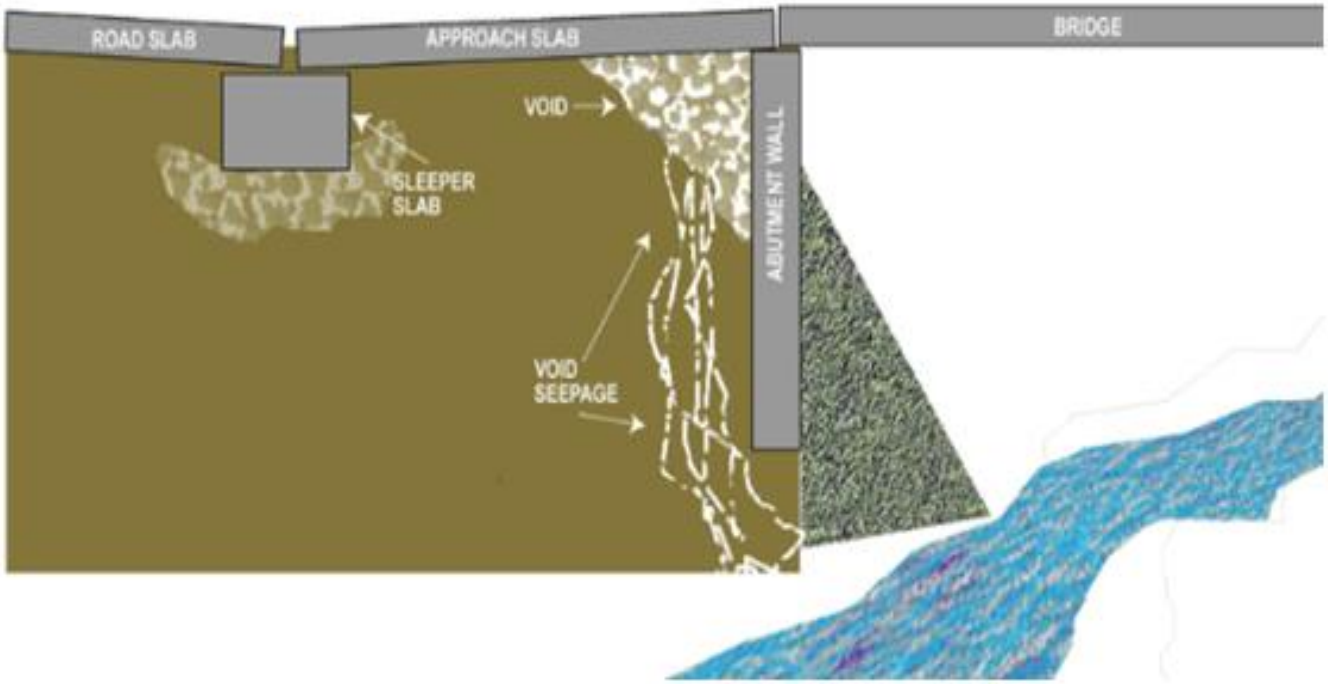
Approach Repair - Bit Wedge

- Cheapest
- Lowest Life Expectancy

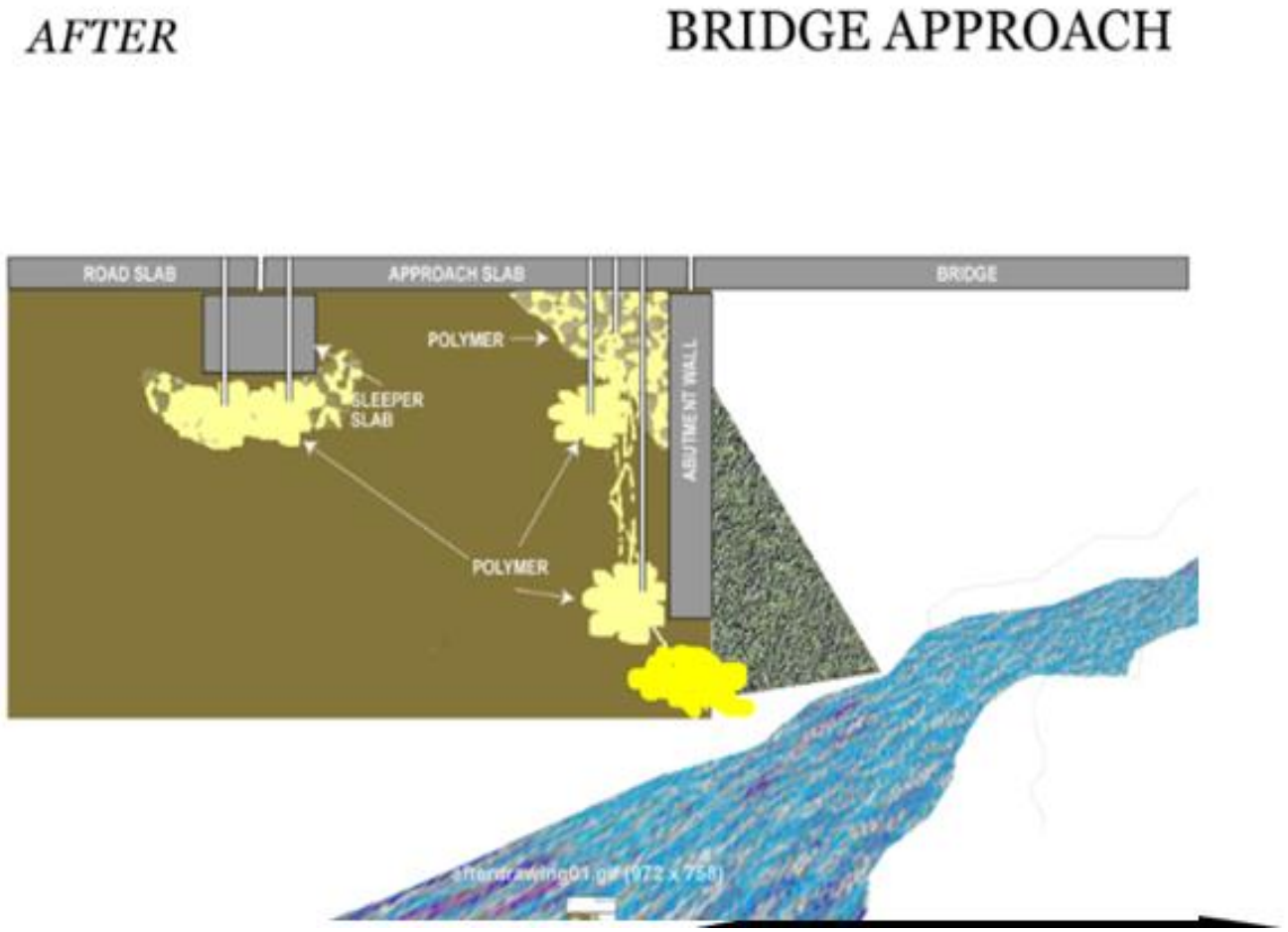
Approach Repair - Injecting

BEFORE

BRIDGE APPROACH



Approach Repair - Injecting



Approach Repair - Injecting

- I-94 over the St Joe River
- Inject expansive, high strength, polymer.
- 3 Lanes EB – 2” Settlement - $14,750
- 3 Lanes WB – 3” Settlement - $16,300
- Life expectancy – 10 years
- 2 Nights

Questions?

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