ICRI
CONCRETE REPAIR
Restore | Repurpose | Renew

2024 SPRING CONVENTION

APRIL 21-24, 2024
ICRI.ORG

Injection Grouting to Address Longitudinal Cracks on I-10 Bridge Approaches

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APRIL 21-24, 2024
ICRI.ORG

What is Chemical Grouting

Liquid resin that turns into an impermeable solid in a predictable timeframe used to:

- Stop leaks in above ground structures
- Stop infiltration into below grade structures
- Stabilize/Improve soils
- Control groundwater
- Seal annular spaces
- Stabilize and lift concrete slabs

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➢ Chemical Grouting

- Chemical Grouts are used to make long lasting repairs quickly and economically.

- There are several types of Chemical Grouts. Selection depends on several factors.

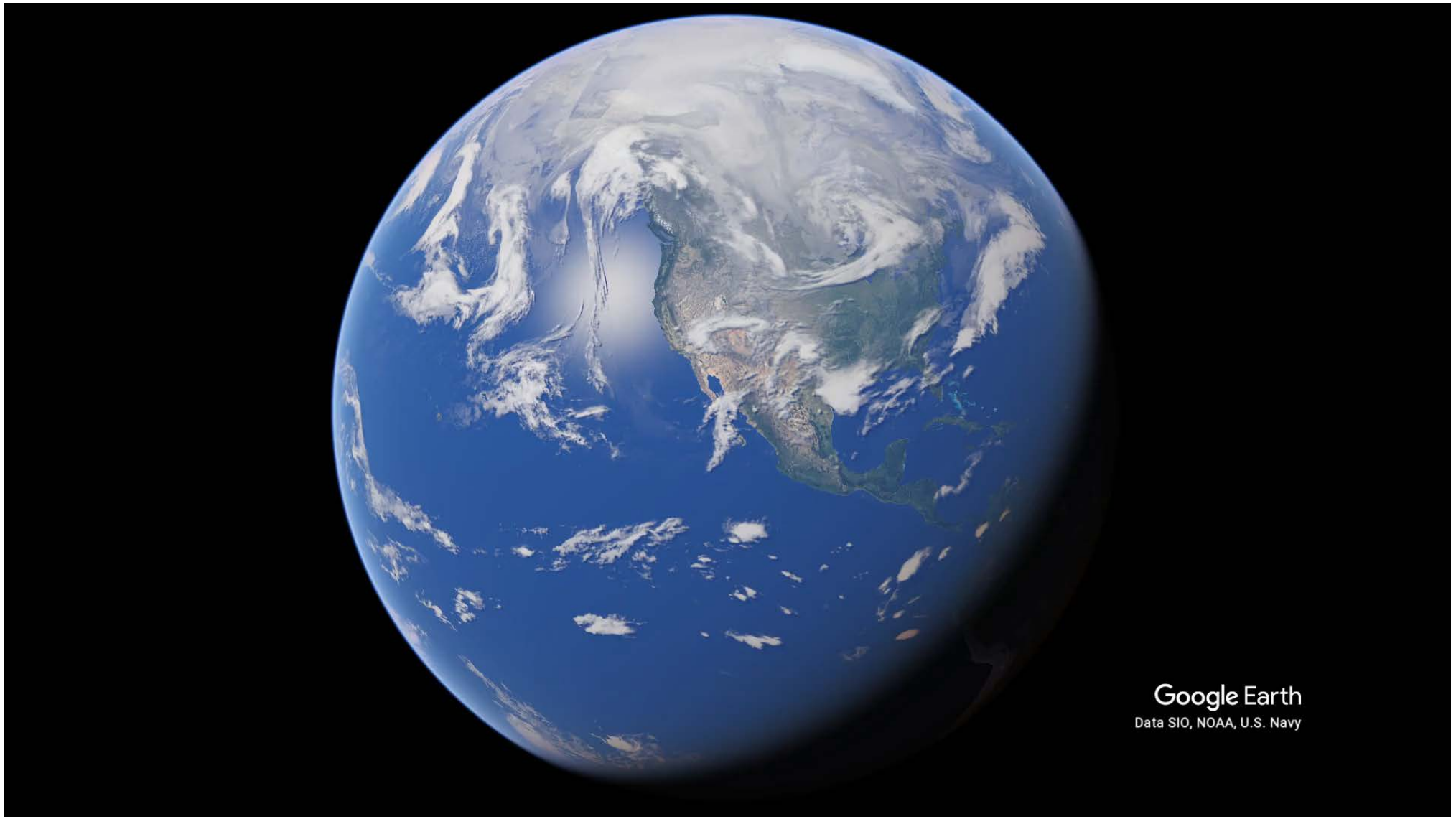
Polyurethane Grouts Families

- Water Reactive
  - Hydrophilic
  - Hydrophobic
- Two-Component

Water Reactive Polyurethane Grouts

Single Component	
Hydrophobic (pushes water)	**Hydrophilic** (seeks out water)
Rigid Foam • Fills Voids • Stabilizes Soils • Stops Gushing Leaks Requires a Catalyst • Percent catalyst affects reaction time & expansion • Fast Reaction/More Expansion than philic	Flexible Foam • Non-structural leak repairs (crack injection) • Sealing Joints with Oakum • Seal Pipe Penetration • Use where movement expected Flexible Gel (high water to resin ratio) • Curtain Grouting • Soil Stabilization • Gushing Leaks
Mechanical Seal	Chemical Bond to Concrete / Mechanical Seal

Crack Injection Project



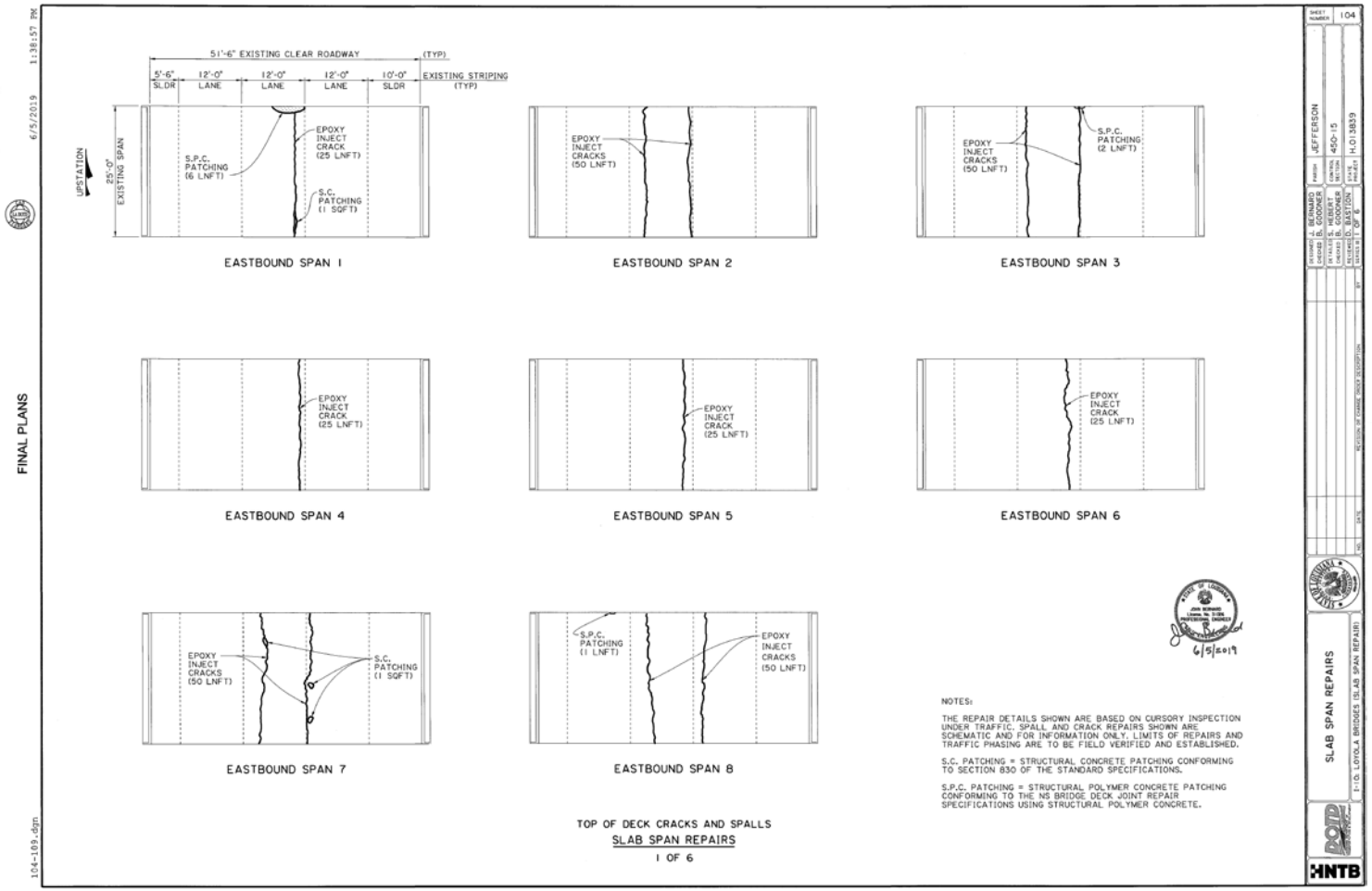
Loyola Bridge on Interstate I-10 New Orleans, LA

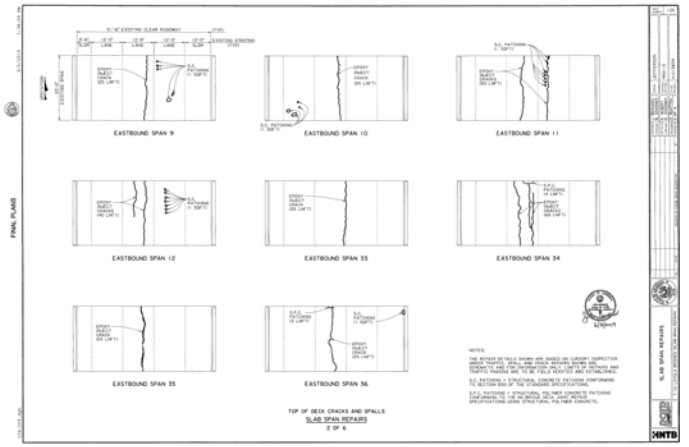
STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT

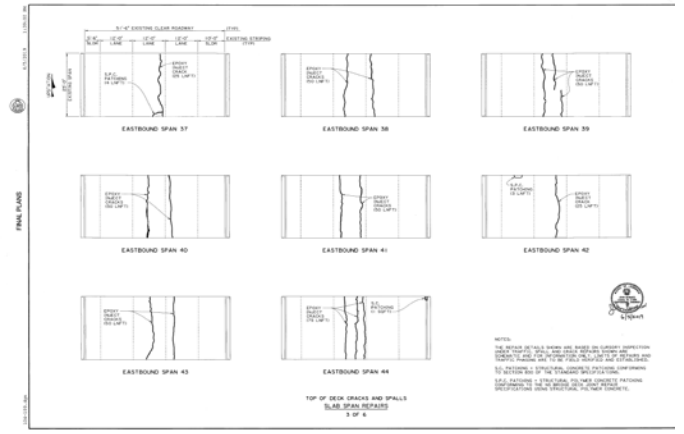
PLANS OF PROPOSED STATE HIGHWAY

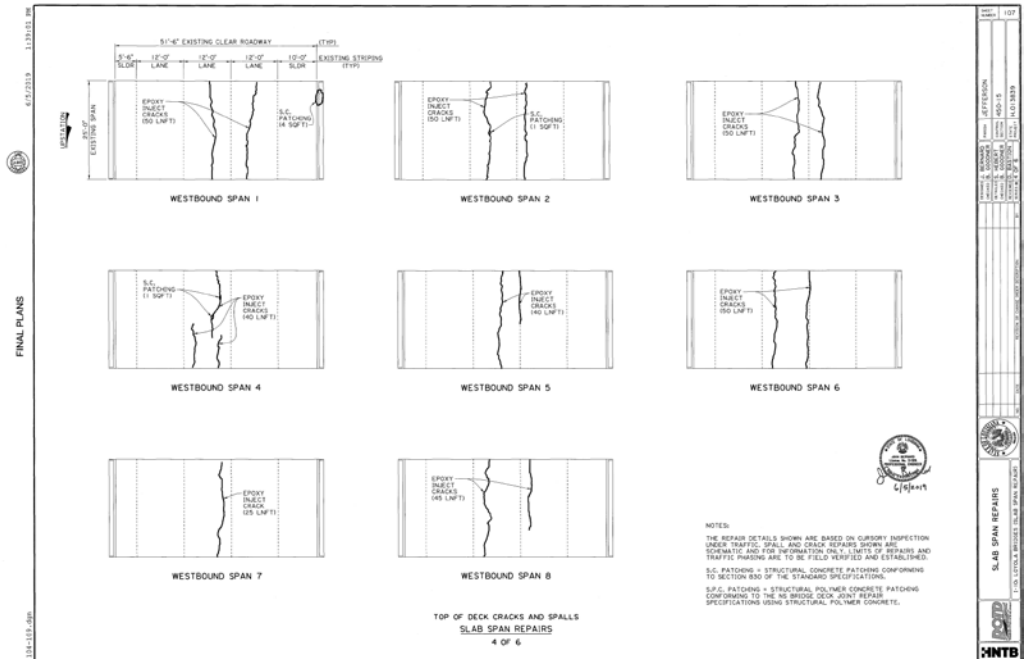
FEDERAL PROJECT H013839
STATE PROJECT H.013839

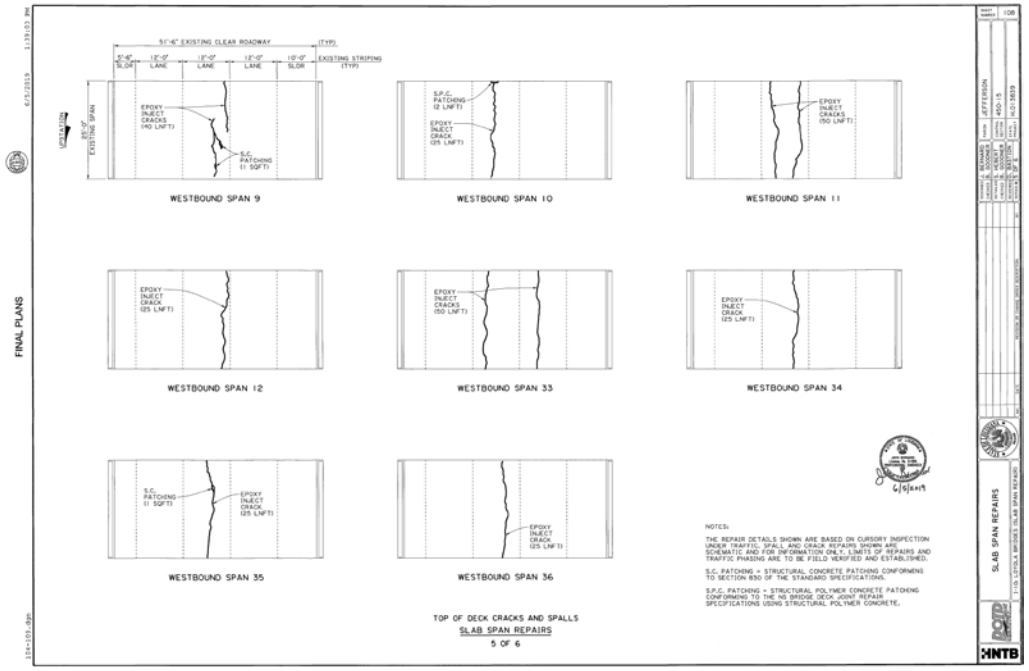
I-10: LOYOLA BRIDGES (SLAB SPAN REPAIR)

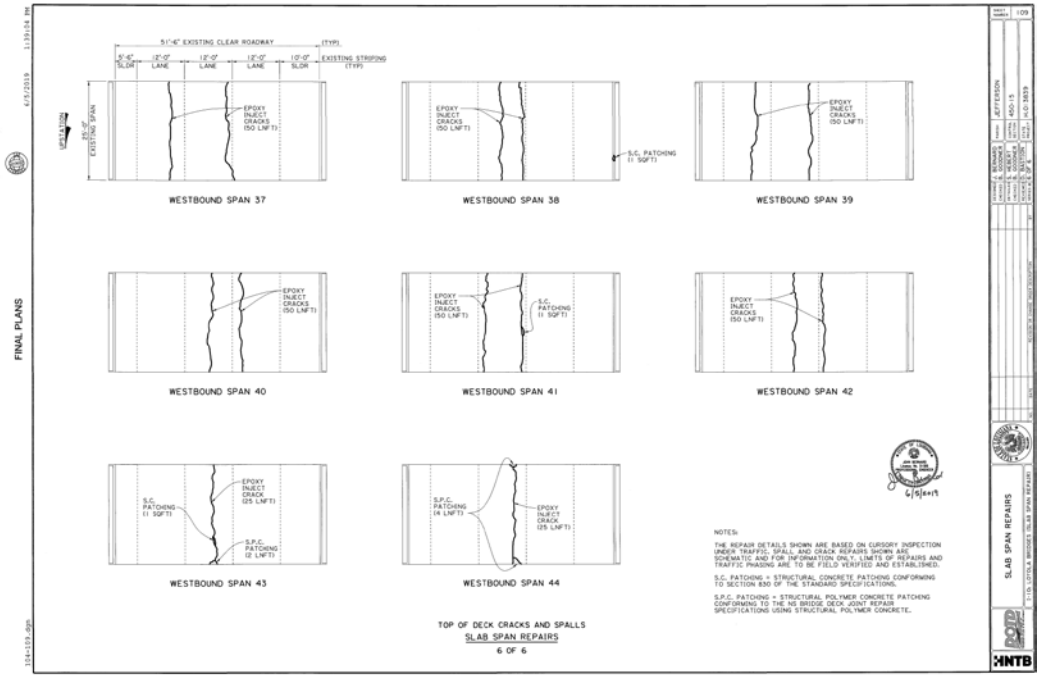












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Scope:
Epoxy injection 1944 linear feet
Structural Polymer Concrete Patch Spalls & Joint Nosing

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1
2
3
4
5
SPEED-MARK

Are these structural cracks?

➢ Structural vs. Non-Structural Defects

Structural Repairs

- Epoxy
- Rigid
- Restrains crack from moving

Non-Structural Repairs

- Polyurethane
- Flexible
- Allows for movement

Was determined that the cracks were not structural and the objective was to seal the cracks to prevent any further deterioration of the slabs.

PRESERVE

Product Demo – Low Viscosity Hydrophilic Polyurethane

Product Demo – Low Viscosity Hydrophilic Polyurethane

Crack Injection Project?

Pressure Injection Steps - Polyurethane

1. Clean surface of crack to expose defect
2. Create an access path to defect (drill holes)
3. Flush drill holes with water (clean dust to facilitate bonding)
4. Install ports & inject with water under pressure (wet out & verify)
5. Inject resin under pressure (watch for travel)
6. Cure and dress out (make pretty)

Pressure Injection Steps - Polyurethane

1. Clean surface of crack to expose defect

Pressure Injection Steps - Polyurethane

2. Create an access path to defect (drill holes)

Pressure Injection Steps - Polyurethane

3. Flush drill holes with water (clean dust to facilitate bonding)

Pressure Injection Steps - Polyurethane

4. Install ports & inject with water under pressure

Pressure Injection Steps - Polyurethane

5. Inject resin under pressure (watch for travel)

- Start at the lowest point
- Progress from port to port advancing resin to fill crack
- Only use enough pressure to get material into the crack
- You may need additional holes

Pressure Injection Steps - Polyurethane

6. Cure and dress out

- Allow 24 hours
- Helps ensure all migratory leaks have been eliminated
- Remove ports – Do not grind flush
- Grind cured polyurethane off
- Plug holes with a high-quality Hydraulic Cement or Epoxy Gel


BULKHAUL
MAWP 4 BAR

Funding provided/approved through the

National Highway Performance Program

Priorities -

Goal 1: Preserve/Sustain the System
Goal 2: Operate the System
Goal 3: Improve Safety of System
Goal 4: Expand the System
Goal 5: Improve Quality of Life

Federal Funding under the Category “Preservation”

Challenges

- Active Interstate
  - Lane Closures
  - Limited Work Hours
  - Night Time Work
- Length and Thickness of Slabs
- Variation in Widths of Cracks
- Need to Surface Seal Top and Bottom
- Strict Compliance to the Specification
- Surprise!

Recommended Installation Procedure:

1. The Contractor shall place Prime Plug 2 (hydraulic cement) to seal the top and bottom of the crack. On the top of the deck, care shall be taken to ensure the hydraulic cement material is placed no deeper into the crack than 0.25" from the top of the deck surface.
2. Once hydraulic cement material is hardened, Contractor shall, under positive pressure, inject cracks with Prime flex 900LV (joint seal material).
3. Once joint seal material has set (approximately 24 hours), Contractor shall remove hydraulic cement material and visually inspect top and bottom of cracks to ensure proper distribution of joint seal material. Where necessary, trim joint seal material at the top of the deck to provide 0.25" recess from the top of the deck to the top of the joint seal material as required by the plans.
4. In areas where joint seal material distribution is inadequate, Contractor shall reapply material to the Engineer's and Manufacturer's satisfaction.

from engineer's email

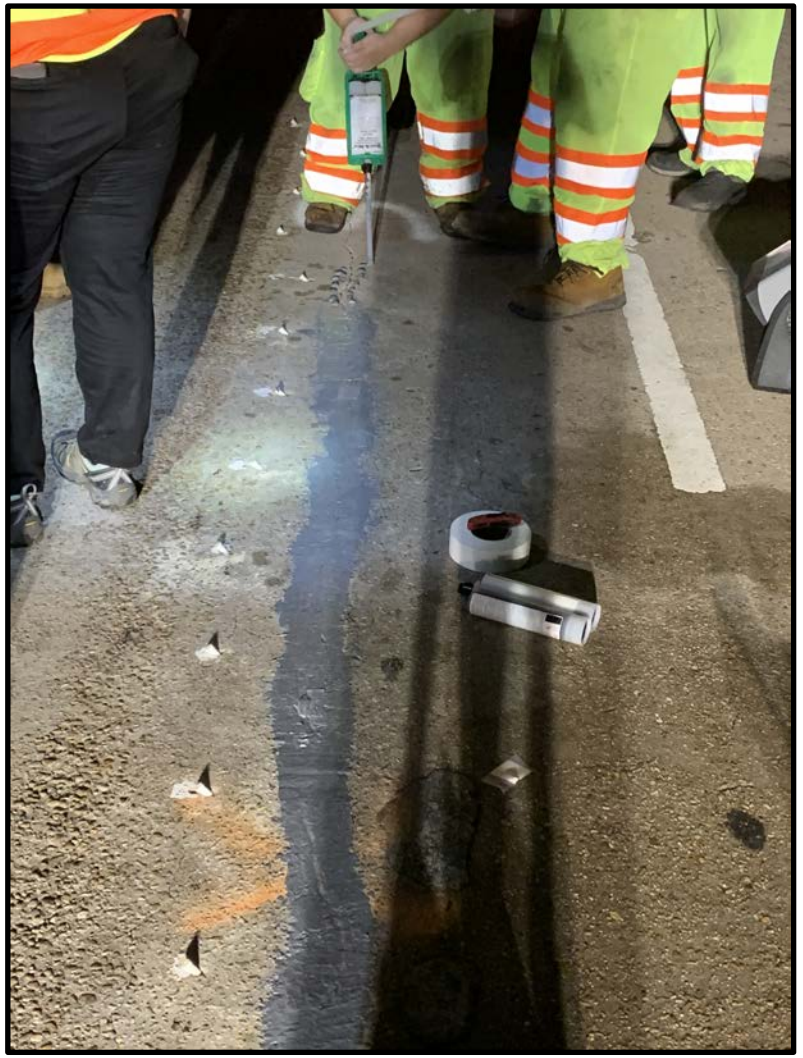
Addressing Surface Seal Issue – TOP & BOTTOM

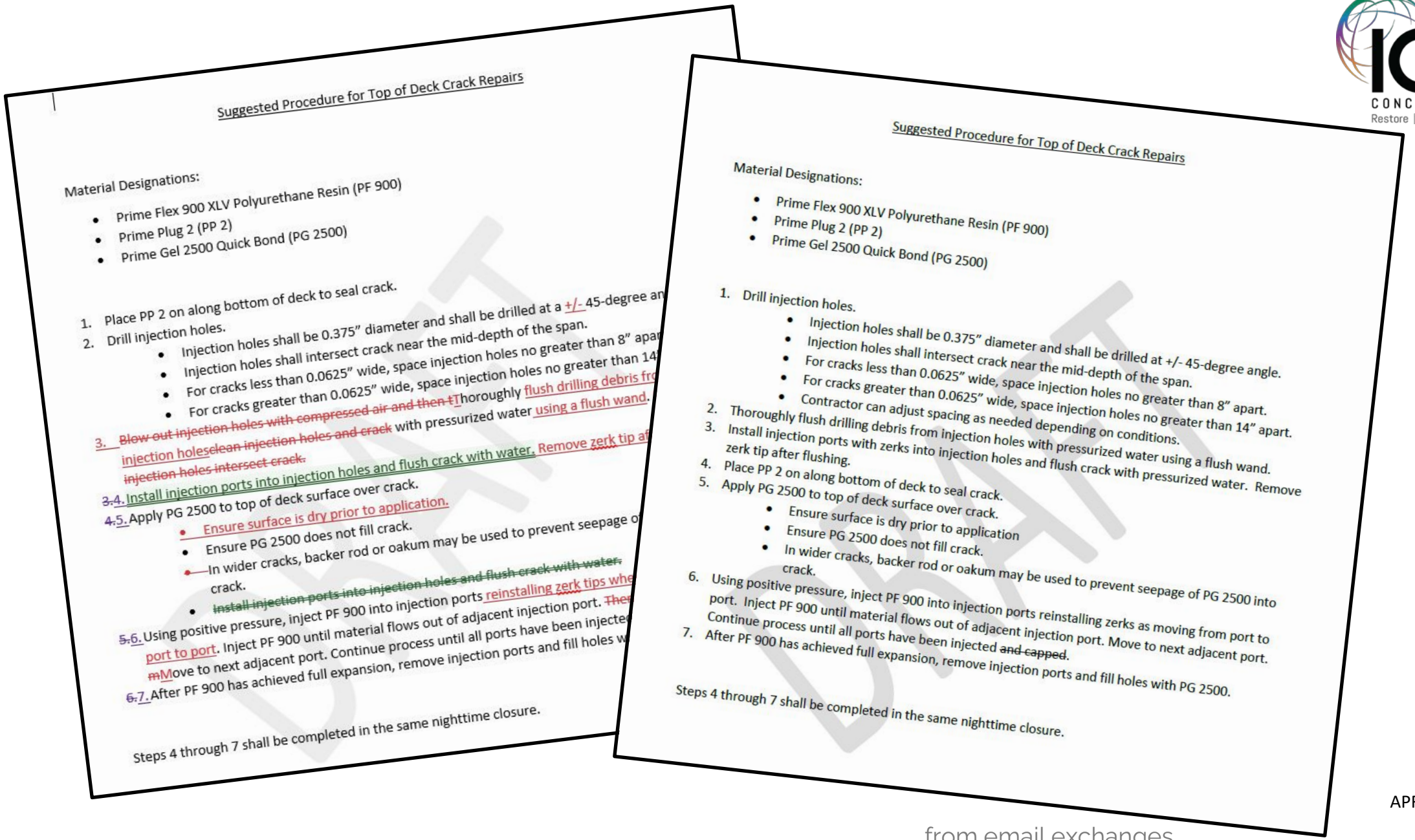
DEMO Conclusions

Hydraulic Cement
- Quick set 3-5 minutes
- Not permanent
- Can tolerate high water/moisture

Epoxy Gel Adhesive
- Very Thin
- Took Longest to Cure
- More Durable than Hydraulic Cement

Epoxy Gel Adhesive – fast curing
- Thicker Consistency
- Was tack free <10 minutes
- More Durable than Hydraulic Cement





Suggested Procedure for Top of Deck Crack Repairs

Material Designations:

- Prime Flex 900 XLV Polyurethane Resin (PF 900)
- Prime Plug 2 (PP 2)
- Prime Gel 2500 Quick Bond (PG 2500)

1. Place PP 2 on along bottom of deck to seal crack.
2. Drill injection holes.
   - Injection holes shall be 0.375" diameter and shall be drilled at a +/- 45-degree an
   - Injection holes shall intersect crack near the mid-depth of the span.
   - For cracks less than 0.0625" wide, space injection holes no greater than 8" apar
   - For cracks greater than 0.0625" wide, space injection holes no greater than 14
3. ~~Blow out injection holes with compressed air and then t~~Thoroughly flush drilling debris fr injection holes~~clean injection holes and crack~~ with pressurized water using a flush wand. ~~injection holes intersect crack.~~
3.4. Install injection ports into injection holes and flush crack with water. Remove zerk tip af
4.5. Apply PG 2500 to top of deck surface over crack.
   - Ensure surface is dry prior to application.
   - Ensure PG 2500 does not fill crack.
   - In wider cracks, backer rod or oakum may be used to prevent seepage o crack.
   - ~~Install injection ports into injection holes and flush crack with water.~~
5.6. Using positive pressure, inject PF 900 into injection ports reinstalling zerk tips whe port to port. Inject PF 900 until material flows out of adjacent injection port. ~~Ther~~ ~~m~~Move to next adjacent port. Continue process until all ports have been injecte
6.7. After PF 900 has achieved full expansion, remove injection ports and fill holes w

Steps 4 through 7 shall be completed in the same nighttime closure.

Suggested Procedure for Top of Deck Crack Repairs

Material Designations:

- Prime Flex 900 XLV Polyurethane Resin (PF 900)
- Prime Plug 2 (PP 2)
- Prime Gel 2500 Quick Bond (PG 2500)

1. Drill injection holes.
   - Injection holes shall be 0.375" diameter and shall be drilled at +/- 45-degree angle.
   - Injection holes shall intersect crack near the mid-depth of the span.
   - For cracks less than 0.0625" wide, space injection holes no greater than 8" apart.
   - For cracks greater than 0.0625" wide, space injection holes no greater than 14" apart.
   - Contractor can adjust spacing as needed depending on conditions.
2. Thoroughly flush drilling debris from injection holes with pressurized water using a flush wand.
3. Install injection ports with zerks into injection holes and flush crack with pressurized water. Remove zerk tip after flushing.
4. Place PP 2 on along bottom of deck to seal crack.
5. Apply PG 2500 to top of deck surface over crack.
   - Ensure surface is dry prior to application
   - Ensure PG 2500 does not fill crack.
   - In wider cracks, backer rod or oakum may be used to prevent seepage of PG 2500 into crack.
6. Using positive pressure, inject PF 900 into injection ports reinstalling zerks as moving from port to port. Inject PF 900 until material flows out of adjacent injection port. Move to next adjacent port. Continue process until all ports have been injected ~~and capped~~.
7. After PF 900 has achieved full expansion, remove injection ports and fill holes with PG 2500.

Steps 4 through 7 shall be completed in the same nighttime closure.

from email exchanges

Project Resumes

March 8, 2020

Change Orders in place &
Costs Negotiated and Finalized

"Contractor is scheduled to mobilize back on to the project on the night of March 8, 2020"

Project Delayed

COVID

Work came to a stop before it even got started.

COVID, Tropical Storm Cristobal, Contractor from out of state.

Back on

July 1, 2020

Initial injection starting around 11pm on the West bound side. Everyone in attendance.

DOT Approval – Top Deck Crack Repair
New Specification Created

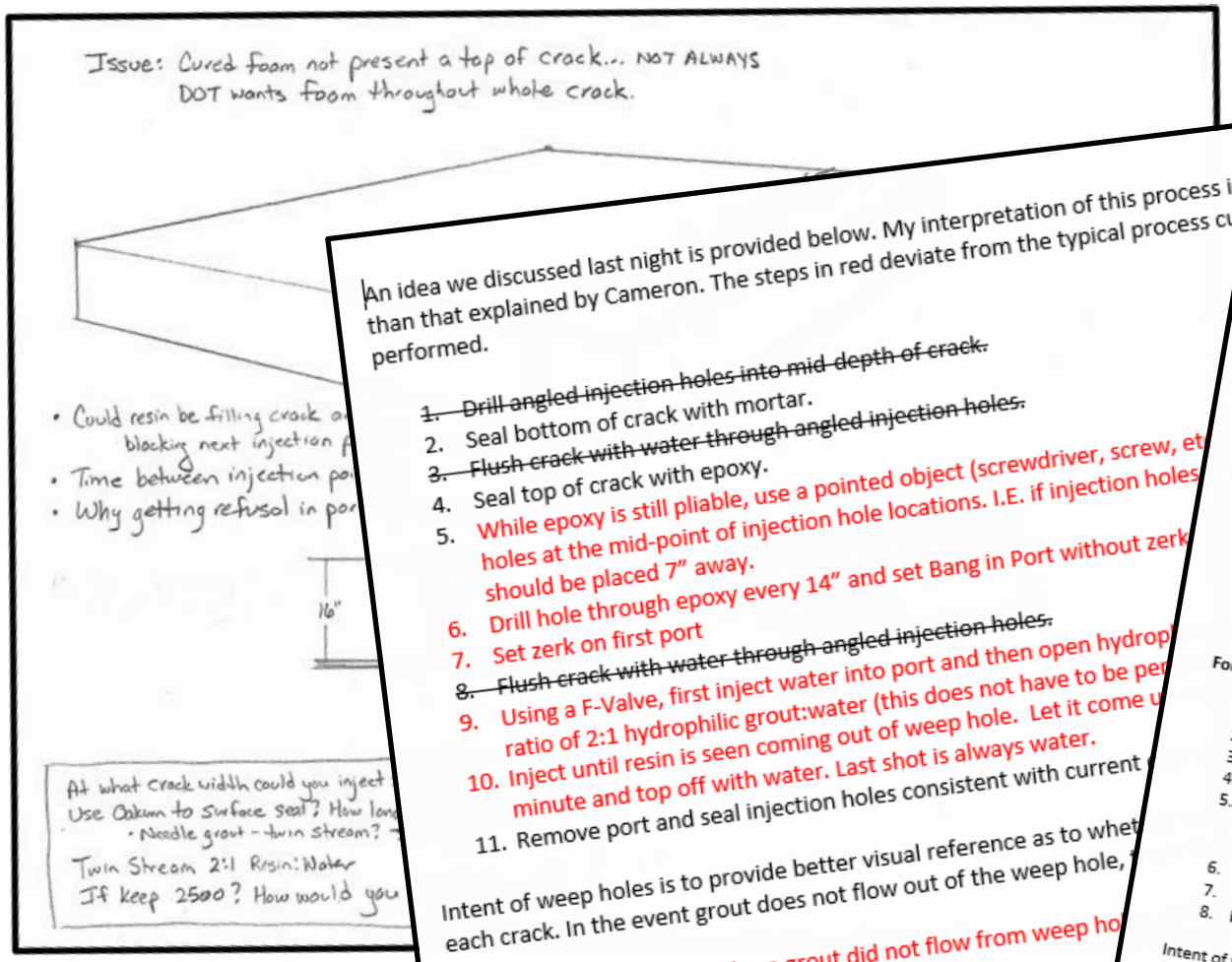
- Preparation for Injection
  - Drill Holes at 45° angle to intersect crack
  - Pressure Wash Cracks
  - Flush Crack with Flush Wand
- Inject Water under pressure
  - Install Ports (Bang In Ports)
  - Inject Water
  - Remove Zerks
- Seal Deck Bottom with Fast Set Hydraulic Cement

DOT Approval – Top Deck Crack Repair
New Specification Created

- Surface Seal Top Deck Cracks
  - Dry Surface
  - Apply 3” x 1/8” band of Fast Set Epoxy

DOT Approval – Top Deck Crack Repair
New Specification Created

- Inject Cracks
  - First with Low Viscosity Hydrophilic Polyurethane
  - Watch for travel
  - Top off with water
- Remove Port & Seal Injection Hole



An idea we discussed last night is provided below. My interpretation of this process is
than that explained by Cameron. The steps in red deviate from the typical process cu
performed.

~~1. Drill angled injection holes into mid-depth of crack.~~
2. Seal bottom of crack with mortar.
~~3. Flush crack with water through angled injection holes.~~
4. Seal top of crack with epoxy.
5. While epoxy is still pliable, use a pointed object (screwdriver, screw, et
holes at the mid-point of injection hole locations. I.E. if injection holes
should be placed 7" away.
6. Drill hole through epoxy every 14" and set Bang in Port without zerk
7. Set zerk on first port
~~8. Flush crack with water through angled injection holes.~~
9. Using a F-Valve, first inject water into port and then open hydrop
ratio of 2:1 hydrophilic grout:water (this does not have to be per
10. Inject until resin is seen coming out of weep hole. Let it come u
minute and top off with water. Last shot is always water.
11. Remove port and seal injection holes consistent with current

Intent of weep holes is to provide better visual reference as to whet
each crack. In the event grout does not flow out of the weep hole,

12. Only at locations where grout did not flow from weep ho
vertically into crack.
13. Flush crack with water at new vertical injection holes.
14. Inject crack with grout at new vertical injection holes.
15. Follow up with water

SP #H.013839

Revised Suggested Procedure for Top of Deck Crack Repairs **I-10: Loyola Bridges (Slab Span Repair)**

For cracks with greater than 0.5" opening at top of deck

1. Seal bottom of crack with mortar.
2. Seal top of crack with epoxy.
3. While epoxy is still pliable, use a pointed object (screwdriver, screw, etc.) to place 0.125" weep holes at the mid-point of injection hole locations. I.E. if injection holes are 14" apart, these holes should be placed 7" away.
4. Drill hole vertically through epoxy every 14" and set Bang in Port without zerk
5. Set zerk on first port
6. Using a F-Valve, first inject water into port and then open hydrophilic grout side, injecting at a ratio of 2:1 hydrophilic grout:water (this does not have to be perfect)
7. Inject until resin is seen coming out of weep hole. Wait 30 sec to a minute and top off with water. Last shot is always water.
8. Remove port and seal injection holes consistent with current operation.

Intent of weep holes is to provide better visual reference as to whether the grout is fully penetrating each crack. In the event grout does not flow out of the weep hole, the following steps are to be taken:

9. Only at locations where grout did not flow from weep holes, drill 2"-3" depth injection holes vertically into crack.
10. Flush crack with water at new vertical injection holes.
11. Inject crack with grout at new vertical injection holes.
12. Follow up with water
13. Remove port and seal injection holes consistent with current operation.

For cracks with less than 0.5" opening at top of deck

1. Drill angled injection holes into mid-depth of crack.
2. Seal bottom of crack with mortar.
3. Flush crack with water through angled injection holes.
4. Seal top of crack with epoxy.
5. While epoxy is still pliable, use a pointed object (screwdriver, screw, etc.) to place 0.125" weep holes at the mid-point of injection hole locations. I.E. if injection holes are 14" apart, these holes should be placed 7" away.
6. Flush crack with water through angled injection holes.
7. Inject cracks with hydrophilic grout.
8. Remove port and seal injection holes consistent with current operation.

Intent of weep holes is to provide better visual reference as to whether the grout is fully penetrating each crack. In the event grout does not flow out of the weep hole, the following steps are to be taken:

9. Only at locations where grout did not flow from weep holes, drill 2"-3" depth injection holes vertically into crack.
10. Flush crack with water at new vertical injection holes.
11. Inject crack with grout at new vertical injection holes.

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DOT Approval – Top Deck Crack Repair
New Specification Created

- Surface Seal Top Deck Cracks
  - Dry Surface
  - Apply 3” x 1/8” band of Fast Set Epoxy
  - **Add Weep Holes at Midpoint of Injection Holes to Observe Travel**

- **If No Travel Observed…**
  - **Drill Directly into Crack**
  - **Flush with Water**
  - **Inject Resin**
  - **Inject Water**

Summary

- Even though it can be challenging and possibly increase the cost of the project, sometimes the specification needs to be challenged for the best result.
- Structural repairs require an epoxy while non-structural repairs (leak sealing) require a polyurethane.
- Always follow “best practices” for injection grouting but understand that project conditions may pose challenges and require some modifications and leeway.
- Product Manufacturers are excellent resources with extensive experience with their products. Take advantage.

“No one can whistle a symphony. It takes a whole orchestra to play it”

~H. E. Luccock

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Questions?

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