

- Certificates will be provided via email
- All attendees will receive a copy and recording of the webinar, this may take up to a week to distribute
- We appreciate your patience

# CRACK REPAIR

RANDALL KRATZ – DISTRICT MANAGER MD/DC/VA  
SIKA CORPORATION – REFURBISHMENT, SEALING & BONDING  
WITH SIKA SINCE 1991  
GRADUATE DREXEL UNIVERSITY - COMMERCE & ENGINEERING  
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# AGENDA

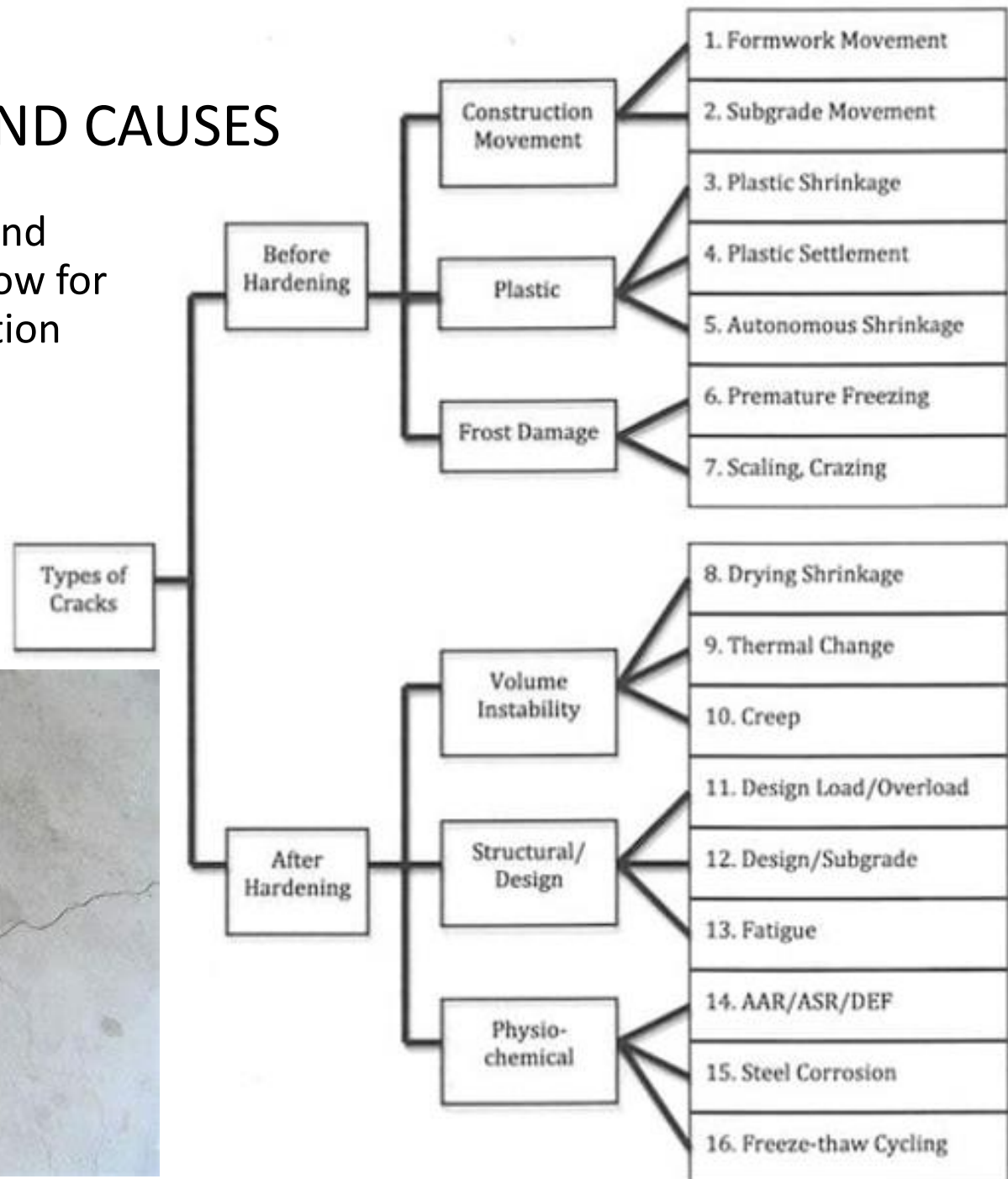
- Types, Causes, and Concerns of Cracks
- Selecting Crack Repair Method
  - Rout & Seal [ $< \$10/\text{LF}^*$ ]
  - Rout & Fill [ $< \$10/\text{LF}^*$ ]
  - Flood & Fill [ $< \$5/\text{SF}^*$ ]
  - Epoxy Injection [ $> \$50/\text{LF}^*$ ]
  - Urethane Injection [ $> \$50/\text{LF}^*$ ]
  - Sealers & Coatings [ $< \$10/\text{SF}^*$ ]

\*Cost provided for general comparison reference.  
Varies substantially based on factors such as  
quantity, access, labor rates...



# TYPES OF CRACKS AND CAUSES

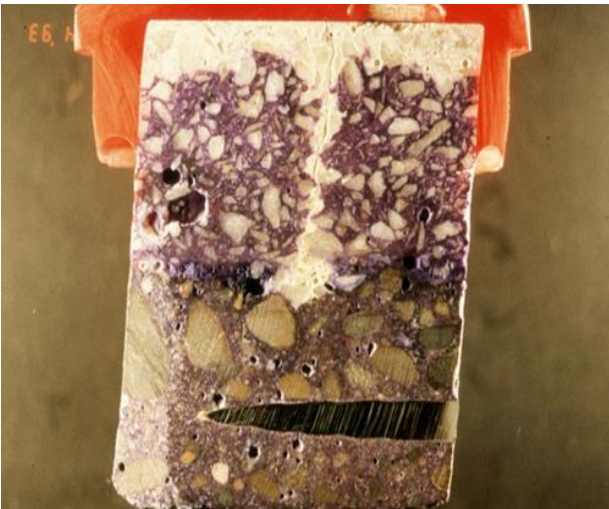
- Understanding the type and cause of the crack will allow for better selection of a solution





# CRACK CONCERNS

- Unsightly
- Leak water/chemicals in or out
- Worsen with freezing/thawing
- Allow entry of water, chlorides, & CO<sub>2</sub> causing corrosion of reinforcing steel resulting in further cracking and spalling
- Hasten sulfate attack
- Structural impact





**Table 4.1 Guide to reasonable\* crack widths, reinforced concrete under service loads**

Exposure condition	Crack width	
	in.	mm
Dry air or protective membrane	0.016	0.41
Humidity, moist air, soil	0.012	0.30
Deicing chemicals	0.007	0.18
Seawater and seawater spray, wetting and drying	0.006	0.15
Water-retaining structures <sup>†</sup>	0.004	0.10

\*It should be expected that a portion of the cracks in the structure will exceed these values. With time, a significant portion can exceed these values. These are general guidelines for design to be used in conjunction with sound engineering judgement [sic].

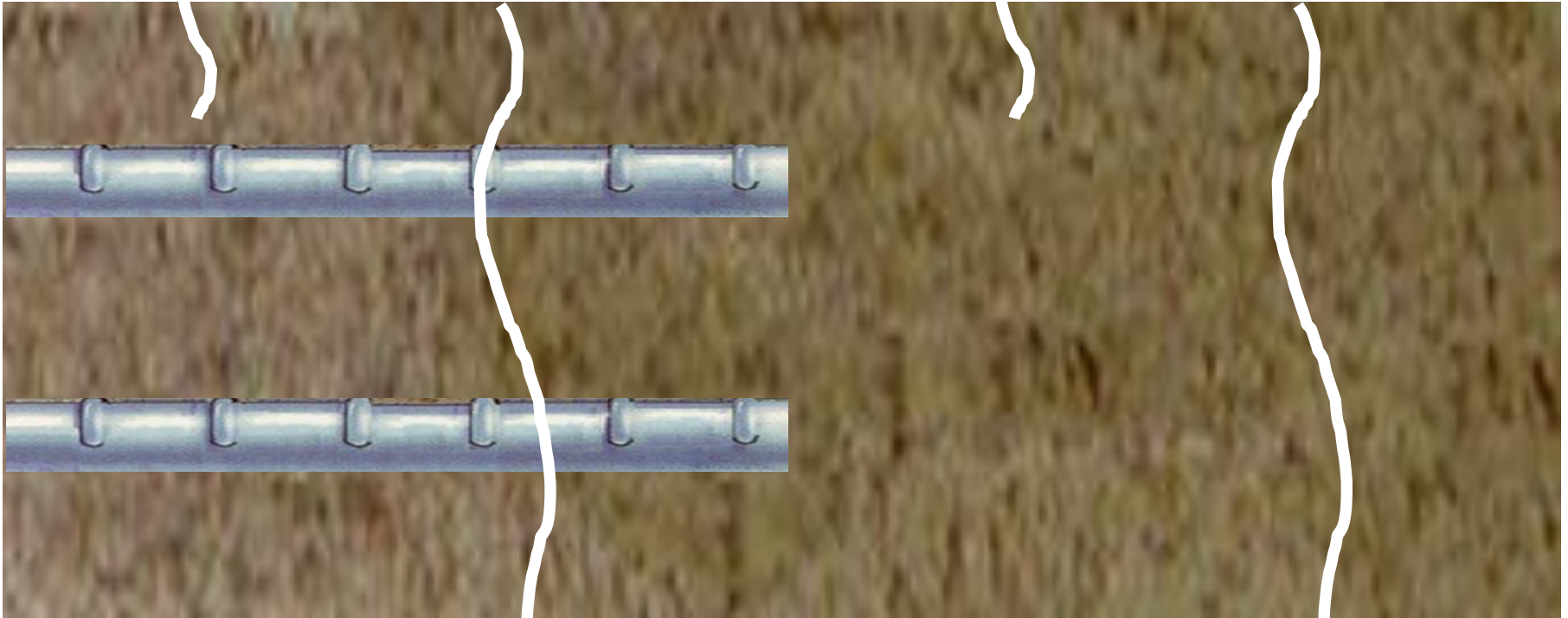
<sup>†</sup>Excluding [sic] nonpressure pipes.

Note: Table 4.1, Guide to Reasonable Crack Widths, Reinforced Concrete Under Service Loads, was reproduced from ACI 224R-01 (Reapproved 2008) *Control of Cracking of Concrete Structures* with permission from the American Concrete Institute.

- Sheet of 20# paper is 4 mils thick
- Once cracks reach ½" wide, generally treat as a spall repair
- Width of crack based on throat, not mouth

# DETERMINING A SOLID OR FLEXIBLE APPROACH

- Should crack be allowed to move like a joint?
- Is there an existing stress that would cause another crack?
- Is there a pattern to the cracking?

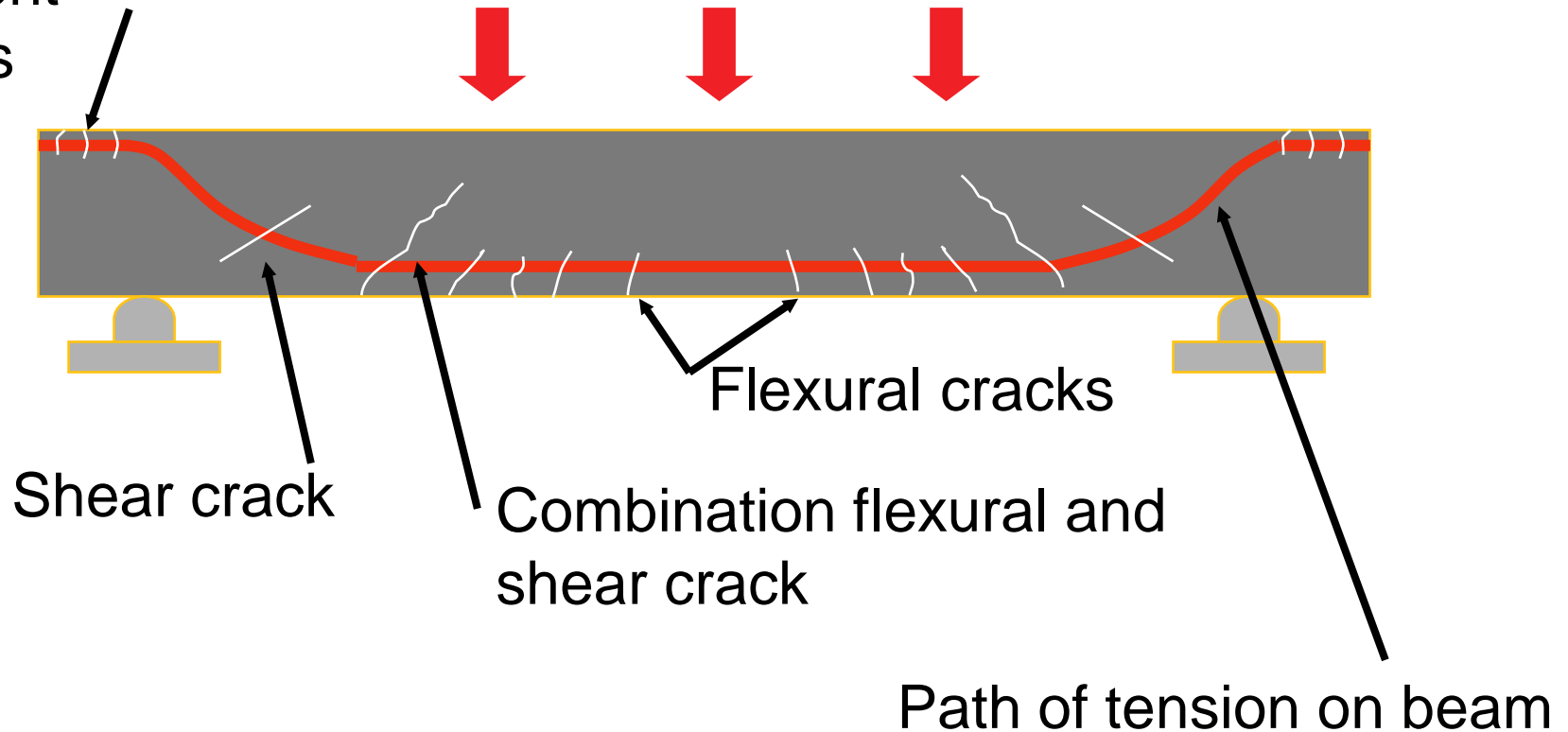


- Consult licensed structural engineer

# CONCRETE BEAM – STRUCTURAL CONCERN?

Negative moment cracks

Load



- Consult licensed structural engineer

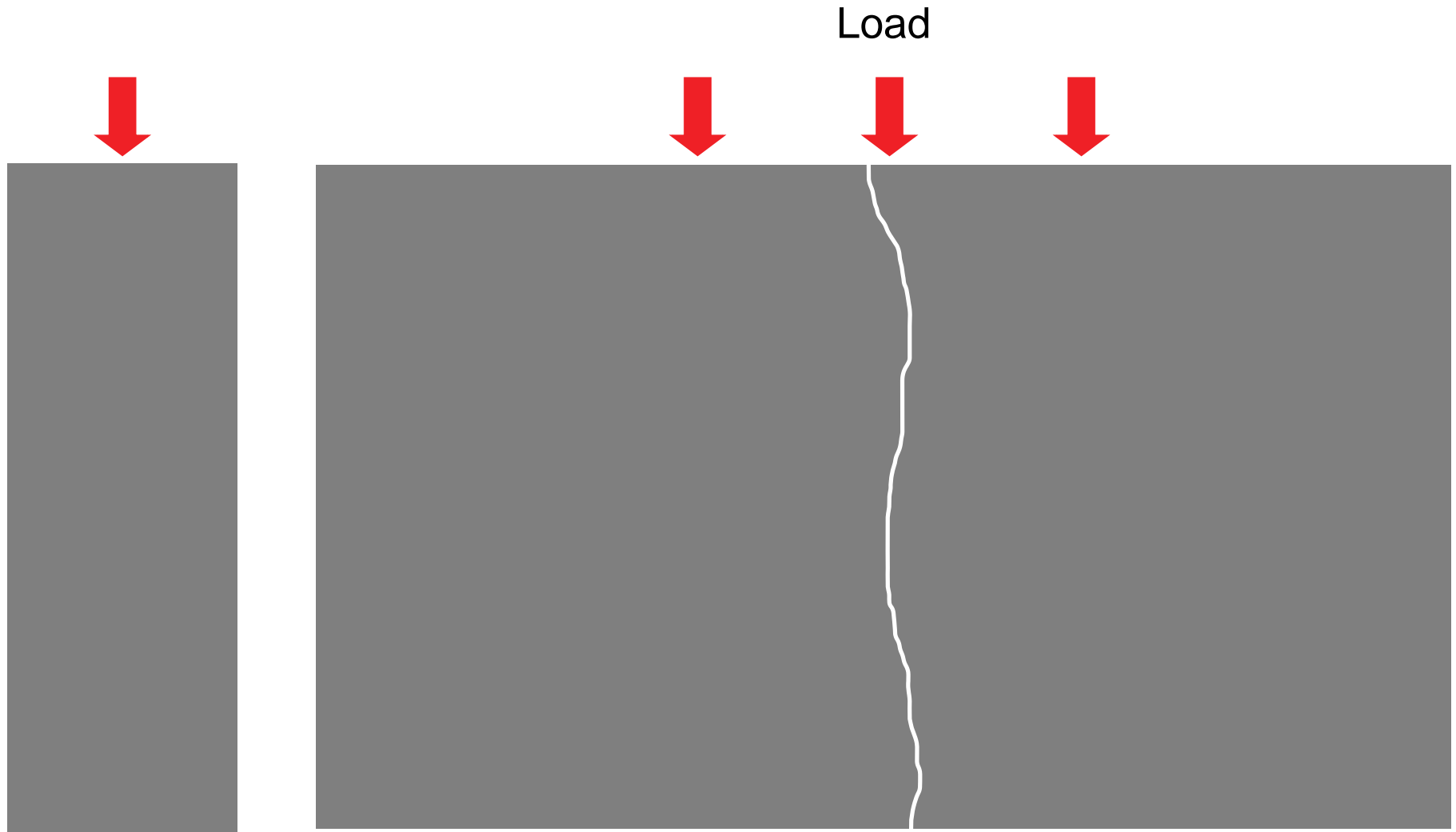


# CONCRETE BEAM – BEYOND CRACK REPAIR



- Consult licensed structural engineer

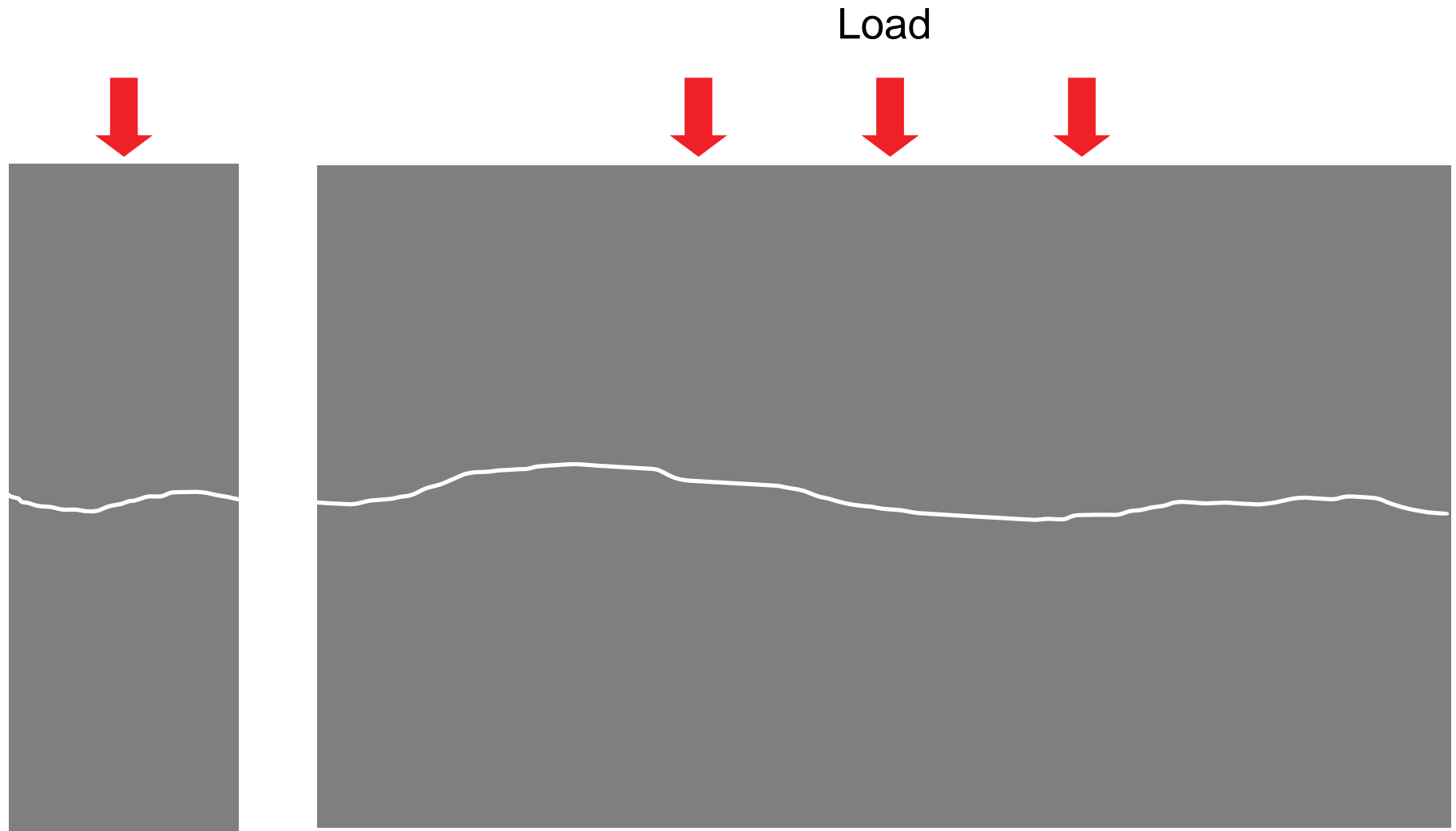
# CONCRETE WALL – STRUCTURAL CONCERN?



Side View

- Consult licensed structural engineer

# CONCRETE WALL – STRUCTURAL CONCERN?

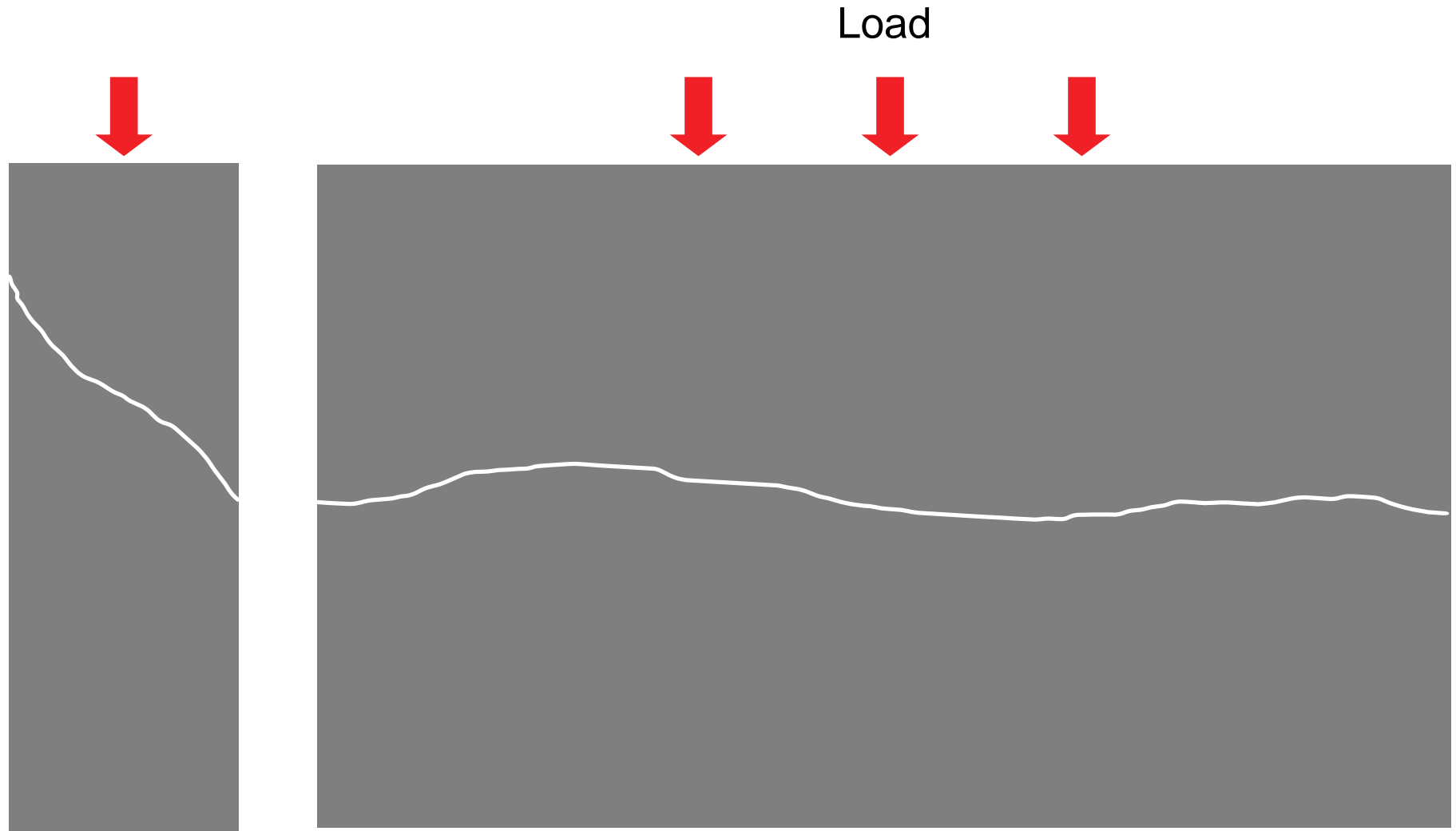


Side View

- Consult licensed structural engineer



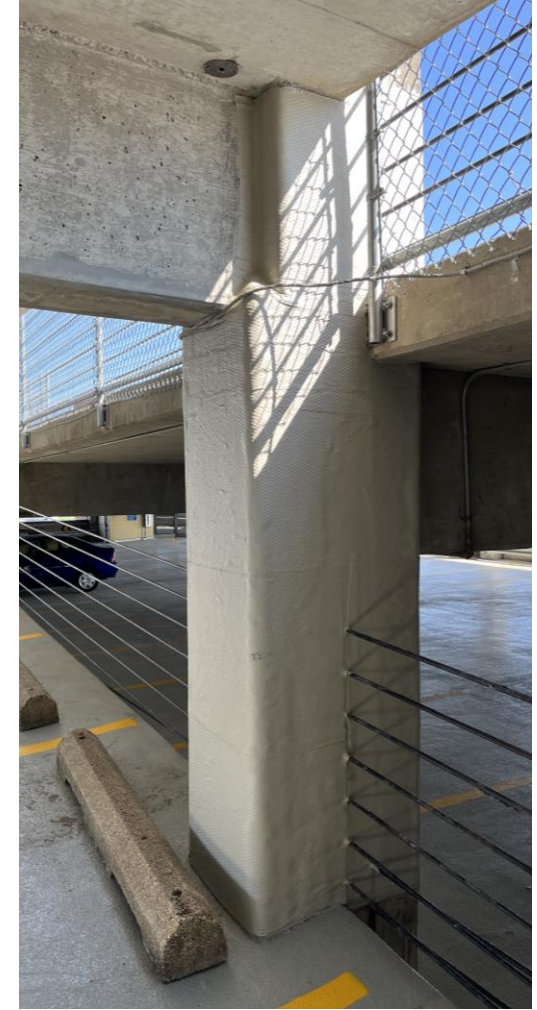
# CONCRETE WALL – STRUCTURAL CONCERN?



Side View

- Consult licensed structural engineer

# BEYOND CRACK REPAIR



- Consult licensed structural engineer

# SELECTING CRACK REPAIR METHOD

- Improve the appearance
- Protect concrete/steel
- Stop leakage
- Structurally restore

## **Rout & Seal**

- Flexible sealing

## **Rout & Fill**

- Solid filling

## **Flood & Fill**

- Solid filling

## **Epoxy Injection**

- Structural repair

## **Urethane Injection**

- Active leak sealing

## **Sealers & Coatings**

- Aesthetic protection





# ROUT & SEAL

- Waterproofing and protective
- Excellent positive side sealing
- Flexible to tolerate movement
- Fine to wide crack widths
- Long life expectancy
- Can be coated
- Easy to do
- Low cost

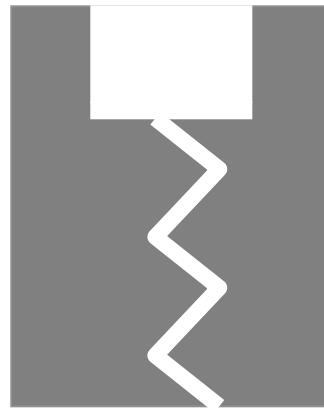


# ROUT & SEAL – PREPARATION

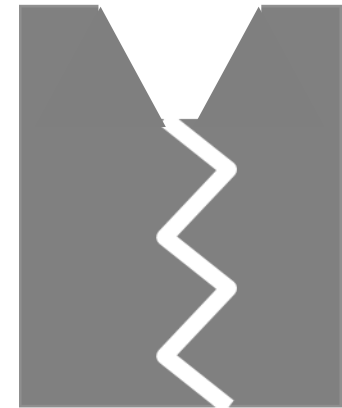
Crack



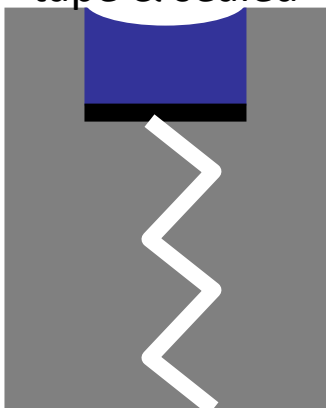
Routed



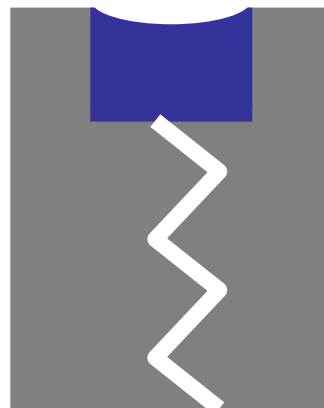
V-notched



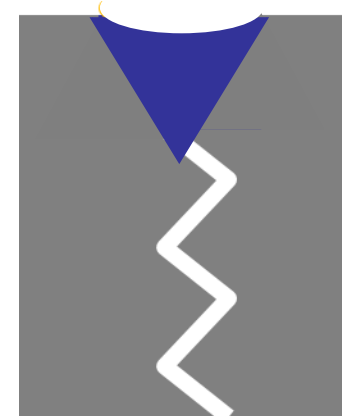
Bond-breaker  
tape & sealed



Sealed



Sealed



# ROUT & SEAL – PREPARATION

- Use crack chaser or saw
- Rout  $\frac{1}{4}$ " by  $\frac{1}{4}$ " to  $\frac{1}{2}$ " by  $\frac{1}{2}$ "
- Dustless equipment available
- Remove dust by blowing, vacuuming, or sweeping





# ROUT & SEAL - MATERIALS



**Sikaflex 1a** and **Sikaflex 2c NS EZ Mix** most common – durable, coat-able, damp

**Sika Hyflex 150 LM** – immediately coat-able, better UV resistance

**Sikasil WS 295** and **Sikasil 728** – completely UV resistant, not coat-able





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# ROUT & SEAL - MATERIALS

**Sikaflex 1a and Sikaflex 2c NS EZ Mix**

**Sika Hyflex 150 LM**

**Sikasil WS 295 and Sikasil 728**

- Lasting, flexible, and waterproofing
- Strike flush to make less noticeable
- Choose color for best substrate match
- Can broadcast sands and fines into surface to improve substrate match



# SELECTING CRACK REPAIR METHOD

- ❑ Improve the appearance
- ❑ Protect concrete/steel
- ❑ Stop leakage
- ❑ Structurally restore

## **Rout & Seal**

- Flexible sealing

## **Rout & Fill**

- Solid filling

## **Flood & Fill**

- Solid filling

## **Epoxy Injection**

- Structural repair

## **Urethane Injection**

- Active leak sealing

## **Sealers & Coatings**

- Aesthetic protection





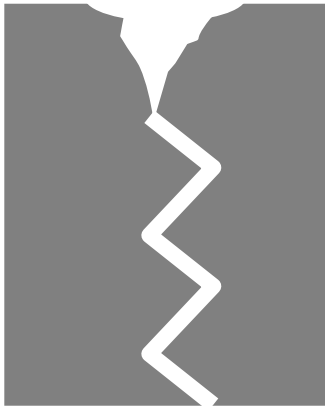
# ROUT & FILL

- Structural repair if full depth penetration is achieved
- Waterproofing and protective
- Welds/eliminates the crack
- Fine to ¼" wide cracks
- Permanent life expectancy
- Can be coated
- Easy to do
- Low cost

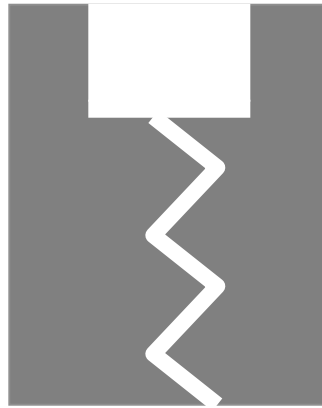


# ROUT & FILL - PREPARATION

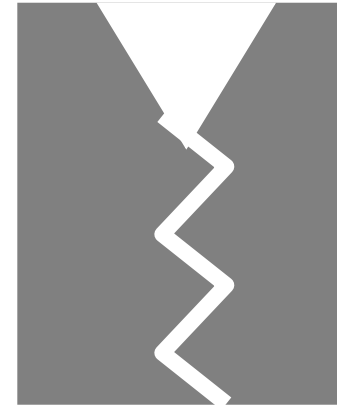
Crack



Routed



V-notched



Route or V-notch the crack, remove dust, then fill.

Filled



Filled



# ROUT & FILL - MATERIALS

**Sikadur 35 Hi-Mod LV** (375 cps)

**Sikadur 55 SLV** (105 cps)

**Sikadur CrackFix** (cartridge packaging of Sikadur 35 Hi-Mod LV)



- Routing/v-notching helps contain resin, improves edges, creates consistent width, and funnels resin into crack for better penetration



# ROUT & FILL - MATERIALS

**Sikadur 35 Hi-Mod LV**

**Sikadur 55 SLV**

**Sikadur CrackFix**

- Routing/v-notching helps contain resin, improves edges, creates consistent width, and funnels resin into crack for better penetration
- Adhesive strength of the epoxy is higher than adhesion strength of cement
- Compressive strength is much higher than 5,000 psi





# ROUT & FILL - MATERIALS

**Sikadur 35 Hi-Mod LV**

**Sikadur 55 SLV**

**Sikadur CrackFix**

- Permanent, durable, and protective
- Can broadcast sands and fines into surface to improve substrate match and remove gloss
- After filling crack, can fill rout with Sikadur 31 Hi-Mod Gel for better control and gray color
- After filling crack, can fill rout with repair mortar to improve substrate match



# SELECTING CRACK REPAIR METHOD

- Improve the appearance
- Protect concrete/steel
- Stop leakage
- Structurally restore

## Rout & Seal

- Flexible sealing

## Rout & Fill

- Solid filling

## Flood & Fill

- Solid filling

## Epoxy Injection

- Structural repair

## Urethane Injection

- Active leak sealing

## Sealers & Coatings

- Aesthetic protection





# FLOOD & FILL

- Structural repair if full depth penetration is achieved
- Blocks water and chlorides
- Fine (2 mils) to ¼" wide cracks
- Permanent life expectancy
- Can be coated
- Easy to do
- Cost effective for large volume of cracks over a given area
- Fast application
- Quick return to service



# FLOOD & FILL - PREPARATION

- Prepare entire area to open cracks and surface pores
- Shotblast, or pressure wash and allow to dry





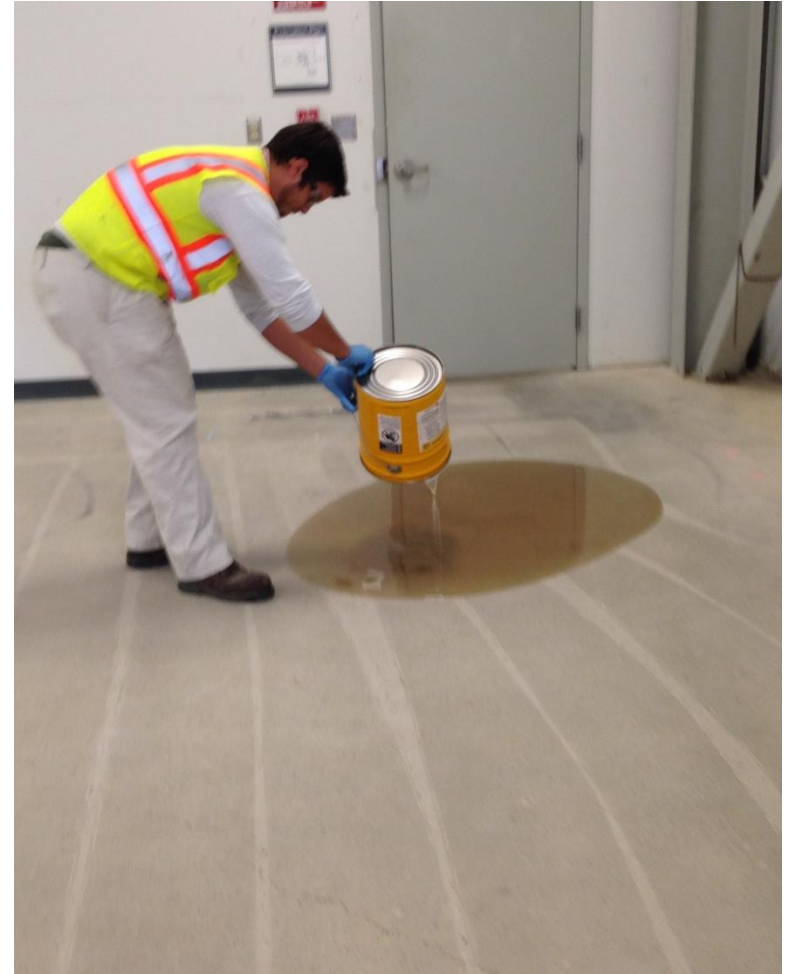
# FLOOD & FILL - MATERIALS

**Sikadur 55 SLV** – high modulus epoxy

**Sikadur 57** – low modulus epoxy

**SikaPronto 19 4K** – methacrylate

- Pour out resin onto the surface



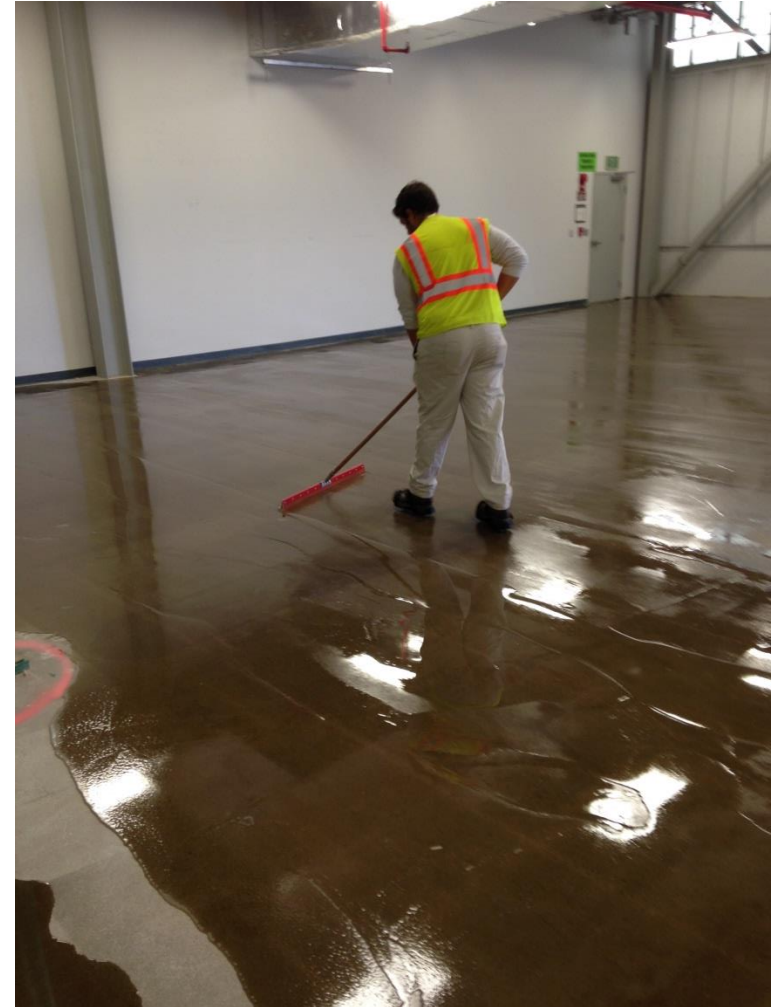
# FLOOD & FILL - MATERIALS

**Sikadur 55 SLV** – high modulus epoxy

**Sikadur 57** – low modulus epoxy

**SikaPronto 19 4K** – methacrylate

- Pour out resin onto the surface
- Spread by squeegee over the area



# FLOOD & FILL - MATERIALS

Sikadur 55 SLV

Sikadur 57

SikaPronto 19 4K



- Pour out resin onto the surface
- Spread by squeegee over the area
- Allow to pond about 20 minutes
- Keep pushing resin over cracks





# FLOOD & FILL - MATERIALS

**Sikadur 55 SLV**

**Sikadur 57**

**SikaPronto 19 4K**

- Pour out resin onto the surface
- Spread by squeegee over the area
- Allow to pond about 20 minutes
- Keep pushing resin over cracks
- Move pond along
- Broadcast sand for slip resistance and improved appearance



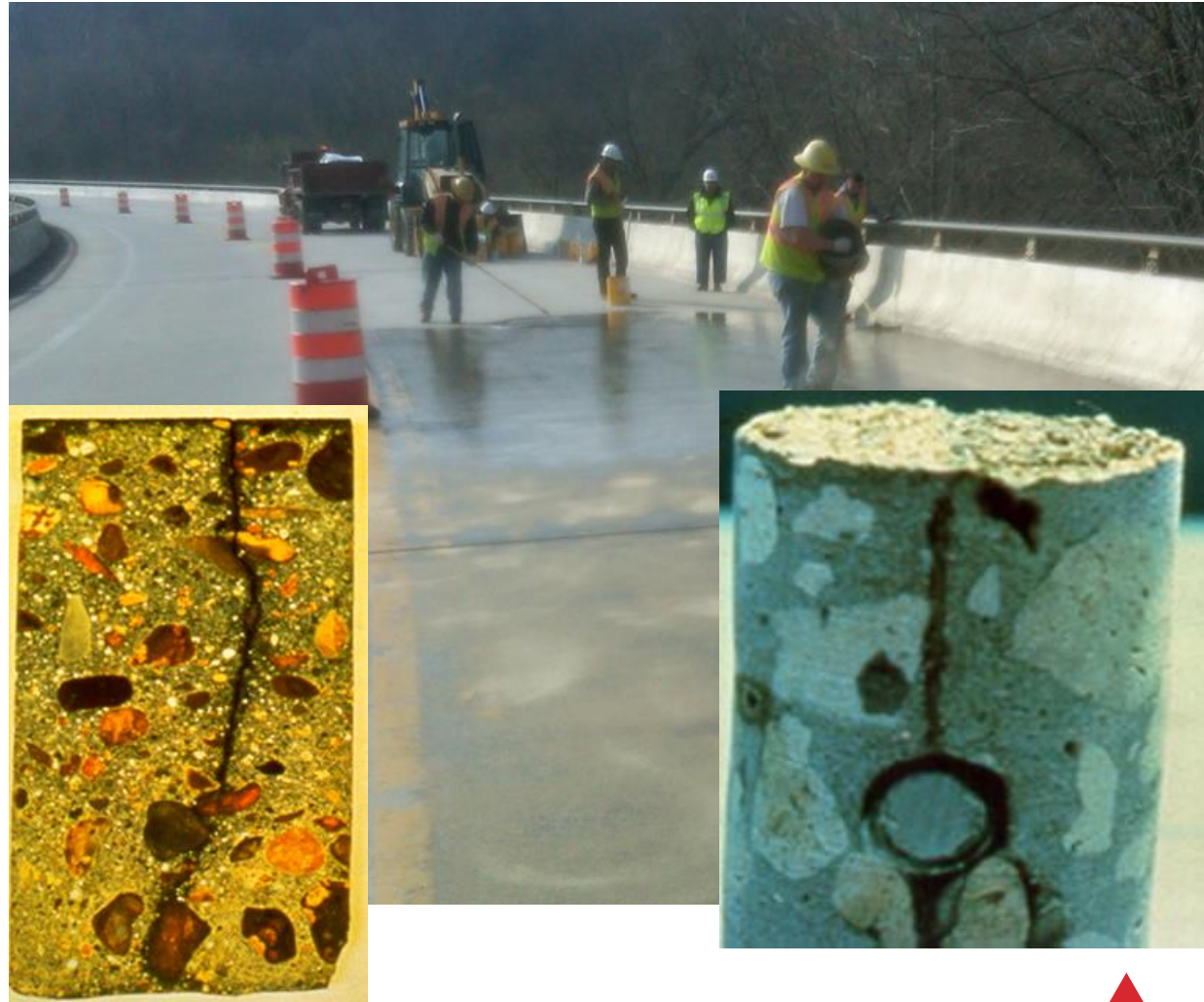
# FLOOD & FILL - MATERIALS

Sikadur 55 SLV

Sikadur 57

SikaPronto 19 4K

- Thin surface layer will wear away under vehicular traffic
- Resin in the cracks will remain permanently
- Dust/debris may prevent full penetration, but resin still blocking most chlorides and water from entry





# SELECTING CRACK REPAIR METHOD

- ❑ Improve the appearance
- ❑ Protect concrete/steel
- ❑ Stop leakage
- ❑ Structurally restore

## Rout & Seal

- Flexible sealing

## Rout & Fill

- Solid filling

## Flood & Fill

- Solid filling

## Epoxy Injection

- Structural repair

## Urethane Injection

- Active leak sealing

## Sealers & Coatings

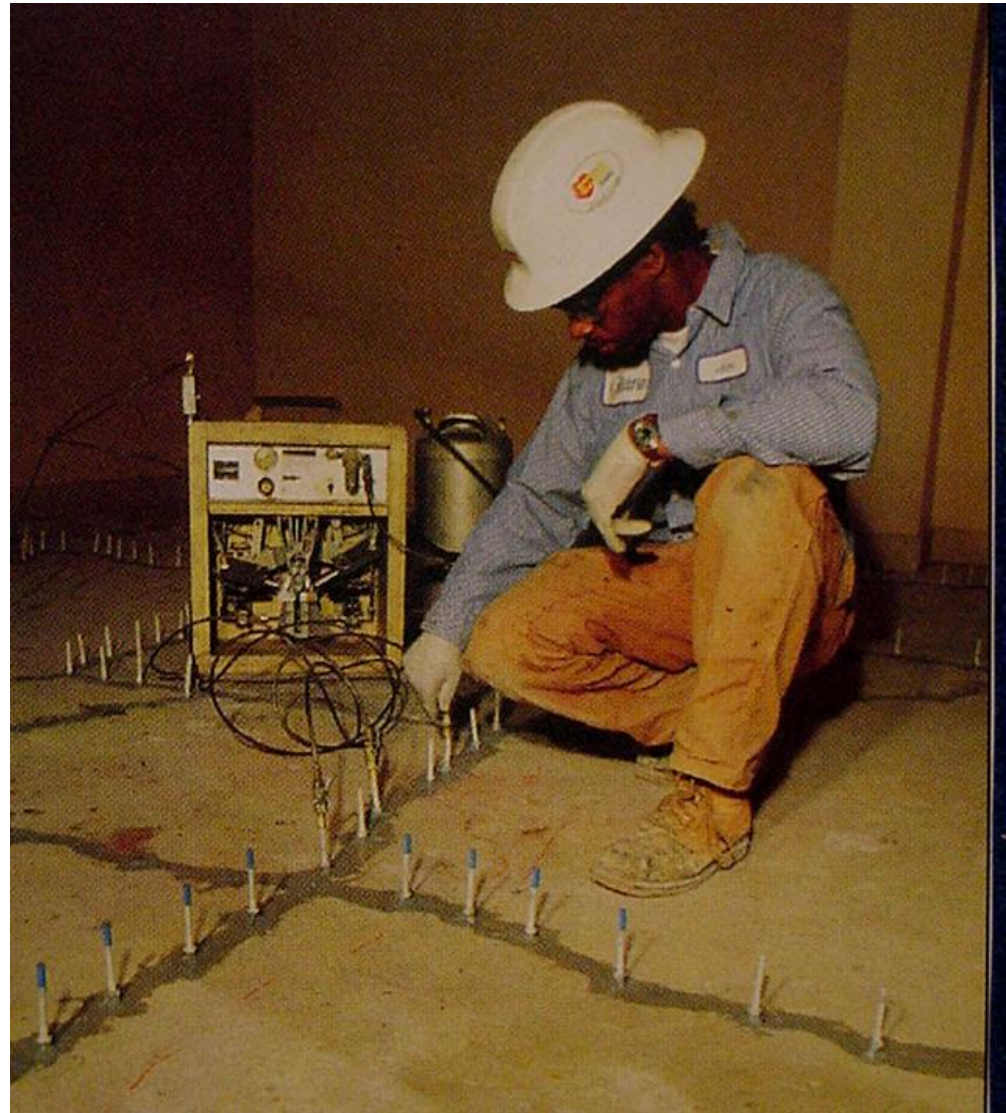
- Aesthetic protection





# EPOXY INJECTION

- Structural crack repair as pressure forces full penetration
- Crack is welded/eliminated
- Waterproofing and protective
- Fine (2 mils) to ¼" wide cracks
- Permanent life expectancy
- Can be coated
- Time consuming
- Expensive



# EPOXY INJECTION - PREPARATION

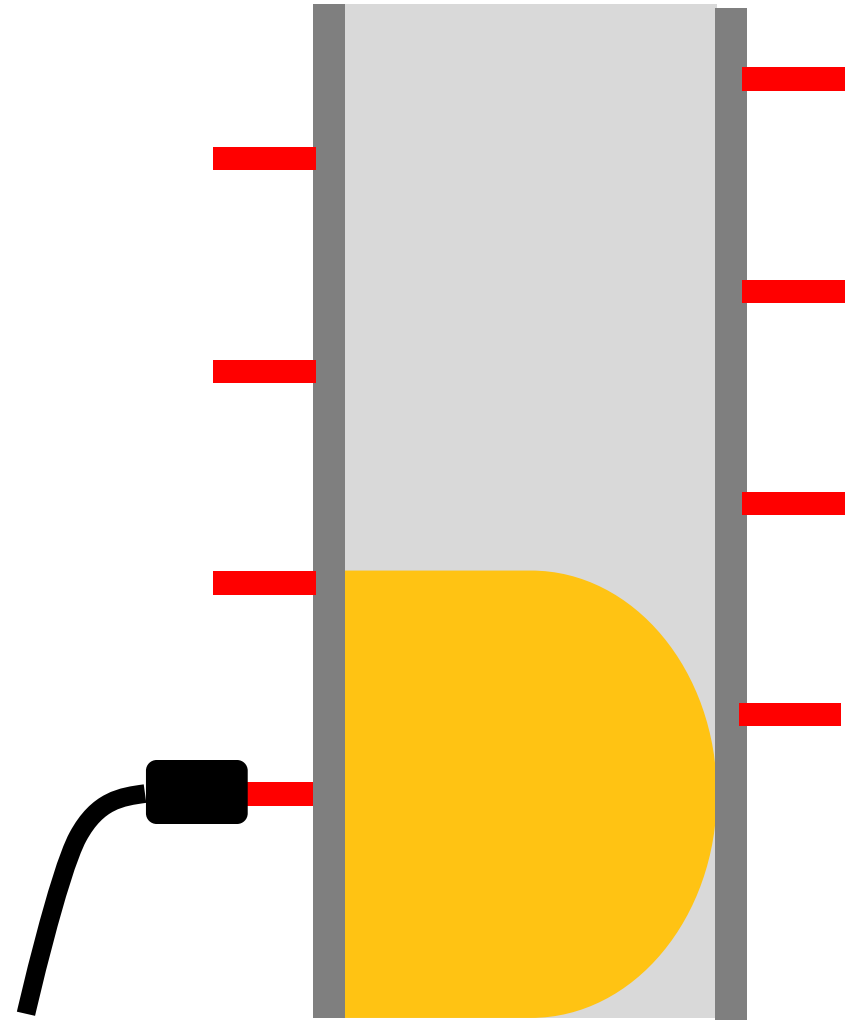
- Clean and open pores of surface for the cap seal to adhere
- Apply cap seal to secure ports and withstand injection pressure
- Use surface mounted ports to avoid potentially packing dust in cracks from drilling for embedded ports



# EPOXY INJECTION - PREPARATION

## Port Spacing Factors

- Width of crack
- One side or both sides sealed
- Depth of crack
- Commonly 6", 9", or 12" and not more than depth of crack





# EPOXY INJECTION - MATERIALS



## Sikadur 31 Hi-Mod Gel

- Good working time
- Inject next day
- Economical

## Sikadur 33

- Rapid setting
- Inject in 1 hour
- Considerable odor

## Sika AnchorFix-1

- Cartridge packaging
- Inject in 1 hour
- Considerable odor



# EPOXY INJECTION - EQUIPMENT



- Many types of ports
- Surface mounted ports
  - Avoid packing dust
  - Easier to center
  - Improve finished appearance
- Ensure proper connection to injection line
- Have closing mechanism



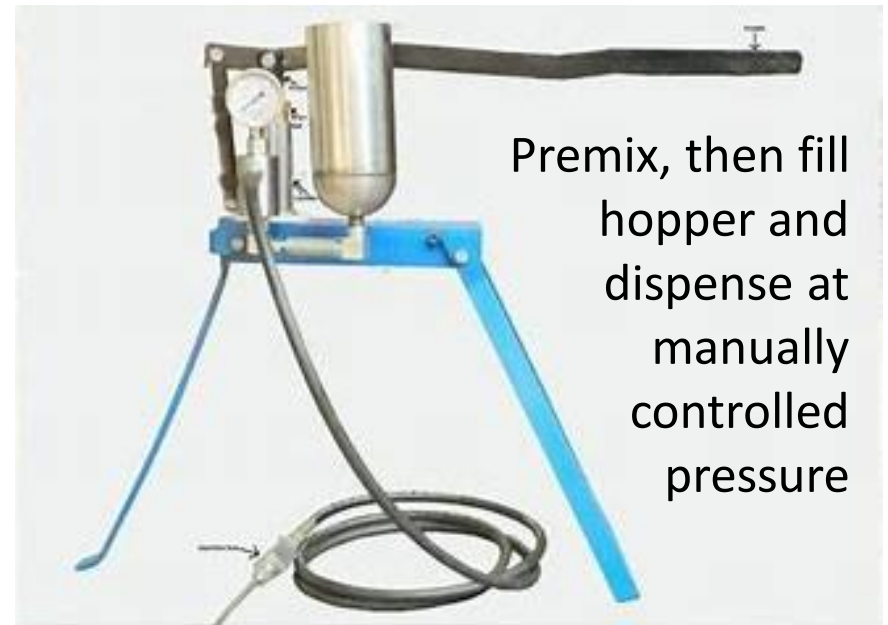


# EPOXY INJECTION - EQUIPMENT

Meter, mix,  
and dispense  
at controlled  
pressure



Premix, then fill hopper and  
dispense at controlled pressure



Premix, then fill  
hopper and  
dispense at  
manually  
controlled  
pressure



# EPOXY INJECTION - MATERIALS

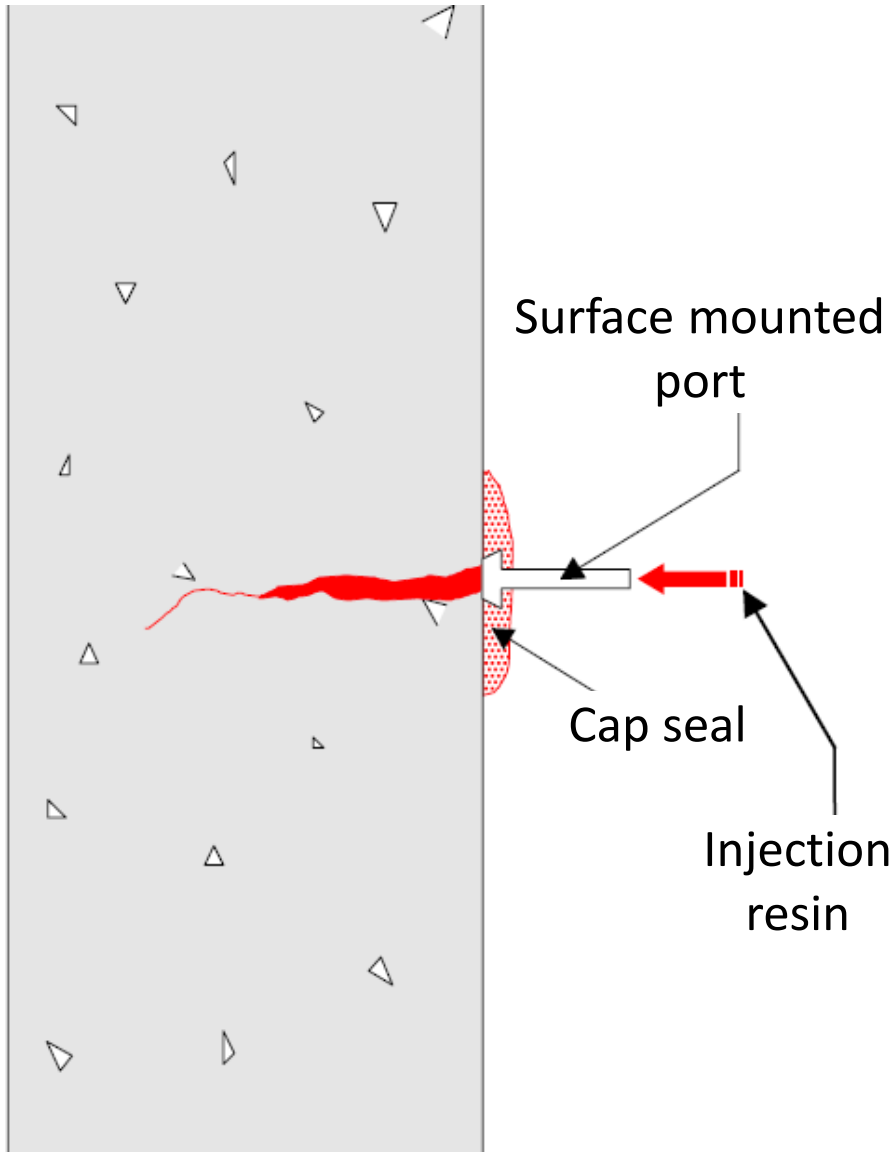


## CAP SEALS

**Sikadur 31 Hi-Mod Gel** (bulk, slow)

**Sikadur 33** (bulk, fast)

**Sikadur AnchorFix-1** (Cartridge, fast)



## INJECTION RESINS

**Sikadur 35 Hi-Mod LV** (375 cps)

**Sikadur 52** (200 cps)

**Sikadur 55 SLV** (105 cps)

**Sikadur Injection Gel**

# EPOXY INJECTION - MATERIALS



**Sikadur 35 Hi-Mod LV (375 cps)**

**Sikadur 52 (200 cps)**

**Sikadur 55 SLV (105 cps)**

**Sikadur Injection Gel**



- Leave all ports open
- Inject starting from bottom
- Normal pressure range is 100-200 psi
- Monitor strokes for volume injected
- Use ports to visually verify filling
- Close filled ports and move up
- Have rapid setting cap seal ready to seal any leaks
- Retain some injection resin



# EPOXY INJECTION - MATERIALS



**Sikadur 35 Hi-Mod LV (375 cps)**

**Sikadur 52 (200 cps)**

**Sikadur 55 SLV (105 cps)**

**Sikadur Injection Gel**



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- Retain some injection resin





# EPOXY INJECTION - MATERIALS



Structural integrity completely restored



# EPOXY INJECTION - MATERIALS



Even the finest of cracks can be penetrated and restored to full structural integrity

# EPOXY INJECTION - MATERIALS

- Cartridge systems provide convenience

**Sikadur AnchorFix-1** - Gel consistency, fast curing, cap seal resin mixes in static mixing tube during extrusion

**Sikadur CrackFix** - Low viscosity, structural epoxy resin mixes in static mixing tube during extrusion (Sikadur 35 Hi-Mod LV)

**Sikadur Crack Repair Kit** – includes everything but the caulking gun to inject about 10' of crack.





# EPOXY INJECTION - MATERIALS



Sikadur CrackFix being injected and reaching the next port

# EPOXY INJECTION - MATERIALS

**Sikadur Crack Repair Kit** – ultimate in convenience



Simple to attach ports

Fan tip attachment for easy cap sealing



Simple closing sturdy ports  
Anti-fatigue flexible hose

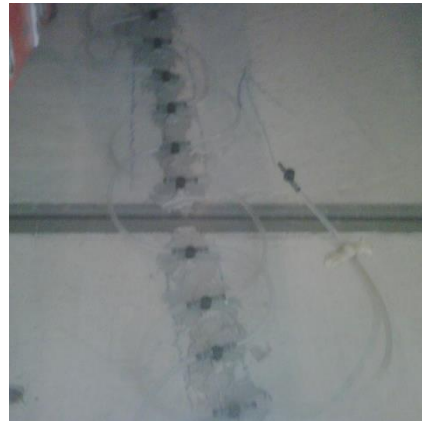
# EPOXY INJECTION - MATERIALS



- Set ports
- Complete cap seal
- Wait 30 – 60 minutes
- Inject



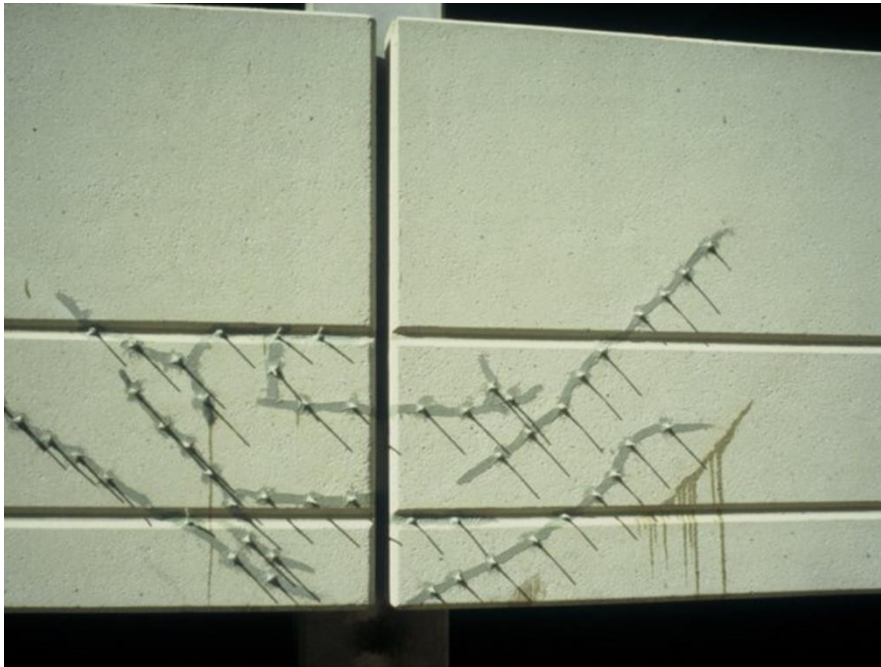
# EPOXY INJECTION



Low  
pressure  
alternatives  
for easy to  
remove cap  
seals



Cap seal can be carefully grinded/sanded to minimize visibility





# SELECTING CRACK REPAIR METHOD

- ❑ Improve the appearance
- ❑ Protect concrete/steel
- ❑ Stop leakage
- ❑ Structurally restore

## Rout & Seal

- Flexible sealing

## Rout & Fill

- Solid filling

## Flood & Fill

- Solid filling

## Epoxy Injection

- Structural repair

## Urethane Injection

- Active leak sealing

## Sealers & Coatings

- Aesthetic protection



# URETHANE INJECTION

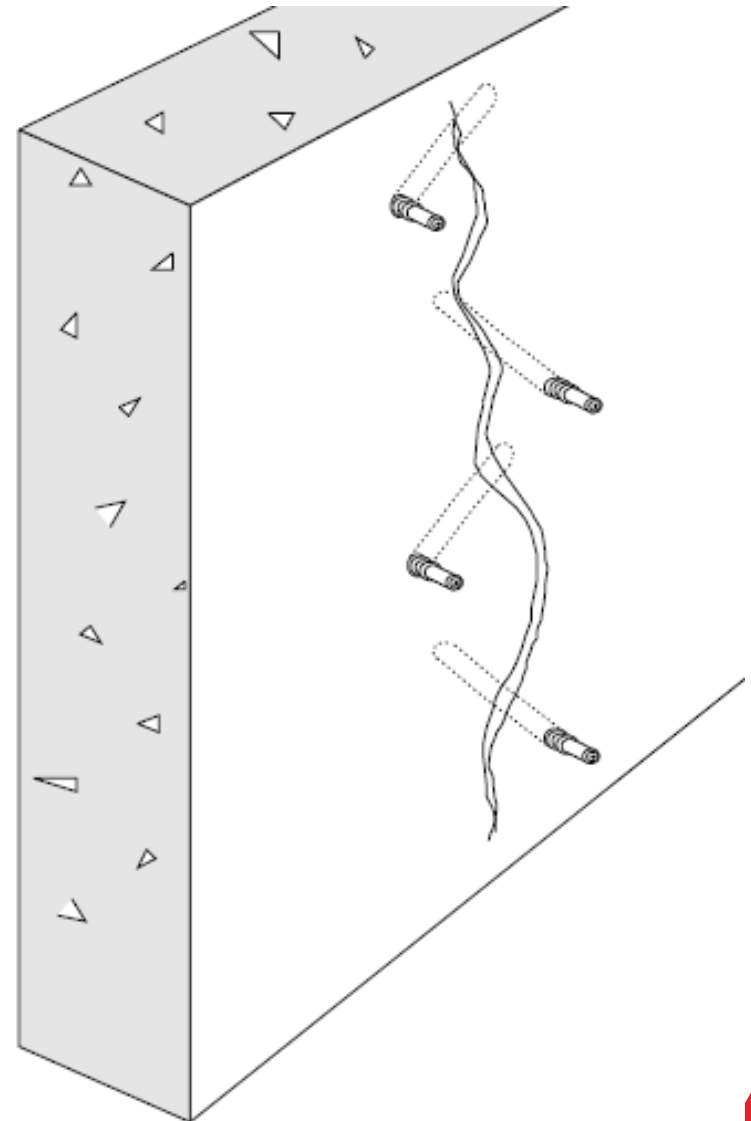
- Waterproofing and protective
- Effective negative side waterproofing
- Works even with very active leakage
- Allows for some movement
- Fine to wide cracks and joints
- Good life expectancy
- Can be coated
- Time consuming
- Expensive





# URETHANE INJECTION - PREPARATION

- Drill holes for packers at 45-degree angle to insect crack at midpoint of wall/slab
- Crack should be wet, inject water first if necessary



# URETHANE INJECTION – EQUIPMENT

## Injection Packers

- Zirk fitting check valve
- Expanding rubber seal
- Bang-in plastic packers



# URETHANE INJECTION - EQUIPMENT

- Always mix with activator first, then use automated or manual pressure pump





# URETHANE INJECTION - MATERIALS

## SikaFix HH+

- Hydrophobic with more expansion

## SikaFix HH LV

- Hydrophobic with lower viscosity and NSF/ANSI 61 Potable Water Approval

## SikaFix HH Hydrophilic

- Hydrophilic with high elongation
- Will shrink during dry periods

## SikaFix Accelerator

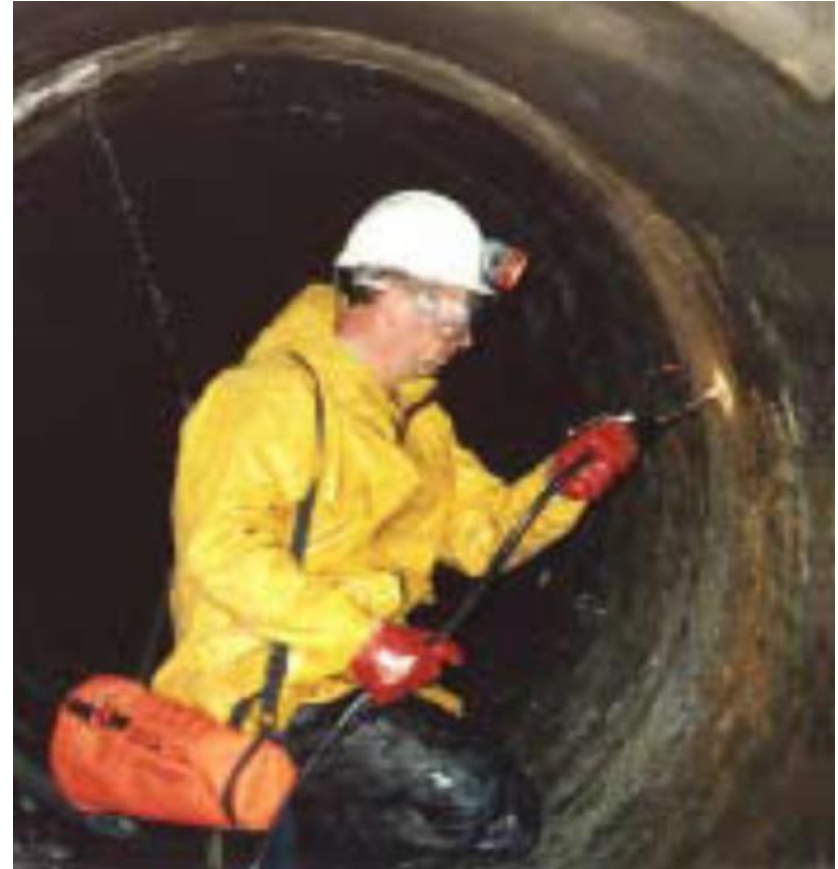
- Used with HH+ and HH LV to control speed of reaction



# URETHANE INJECTION - MATERIALS



- Inject location with highest leakage last
- Expect to chase the leak



# URETHANE INJECTION - MATERIALS



- Injection pressure usually > 200 psi
- First see water flushed out
- Then see bubbling
- Then see diluted urethane flowing

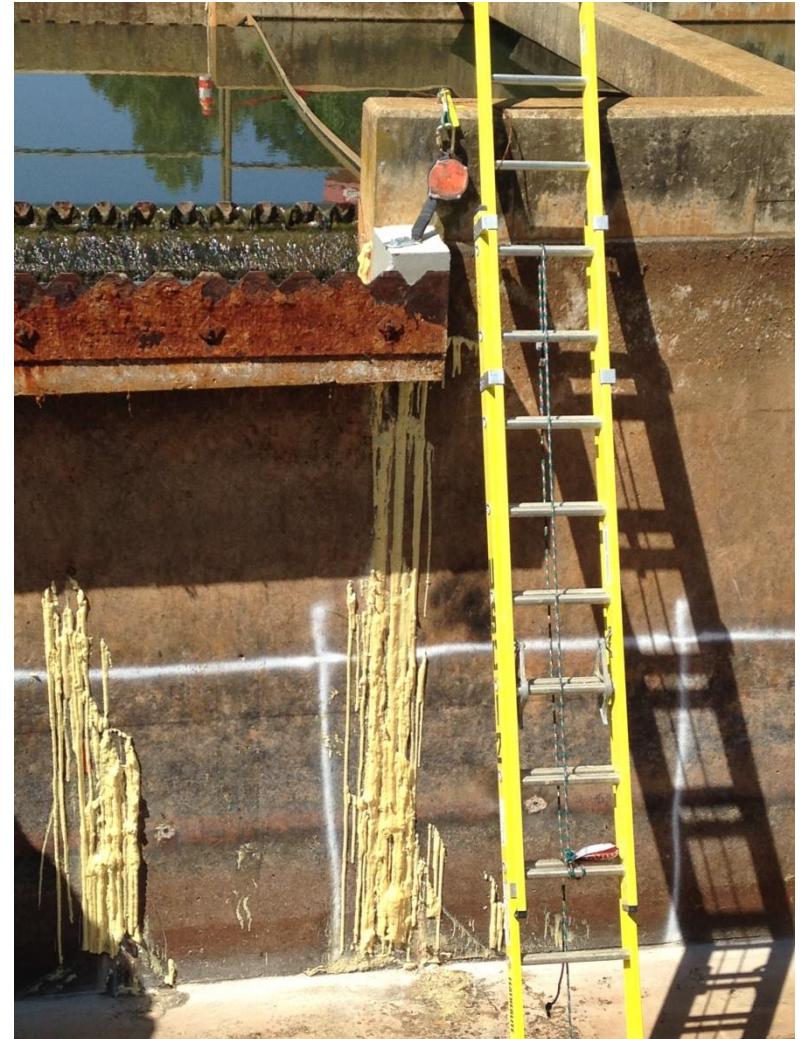




# URETHANE INJECTION - MATERIALS



- Material will react to a flexible foam
- Verify leakage stopped and continuous fill of crack
- Reinject ports
- Inject water into ports
- Leave, or remove ports and plug
- Shave off excess urethane grout

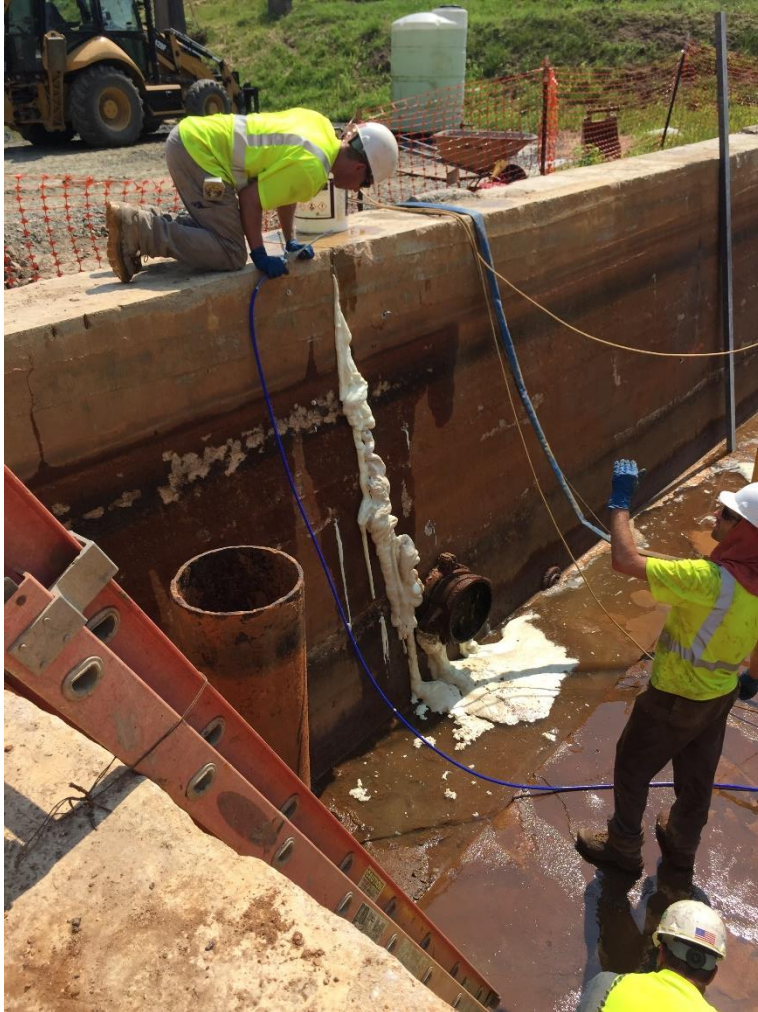




# URETHANE INJECTION - MATERIALS



- Material may expand up to 30 times when unconstrained



# URETHANE INJECTION - MATERIALS



- Some situations may require injecting straight into the crack

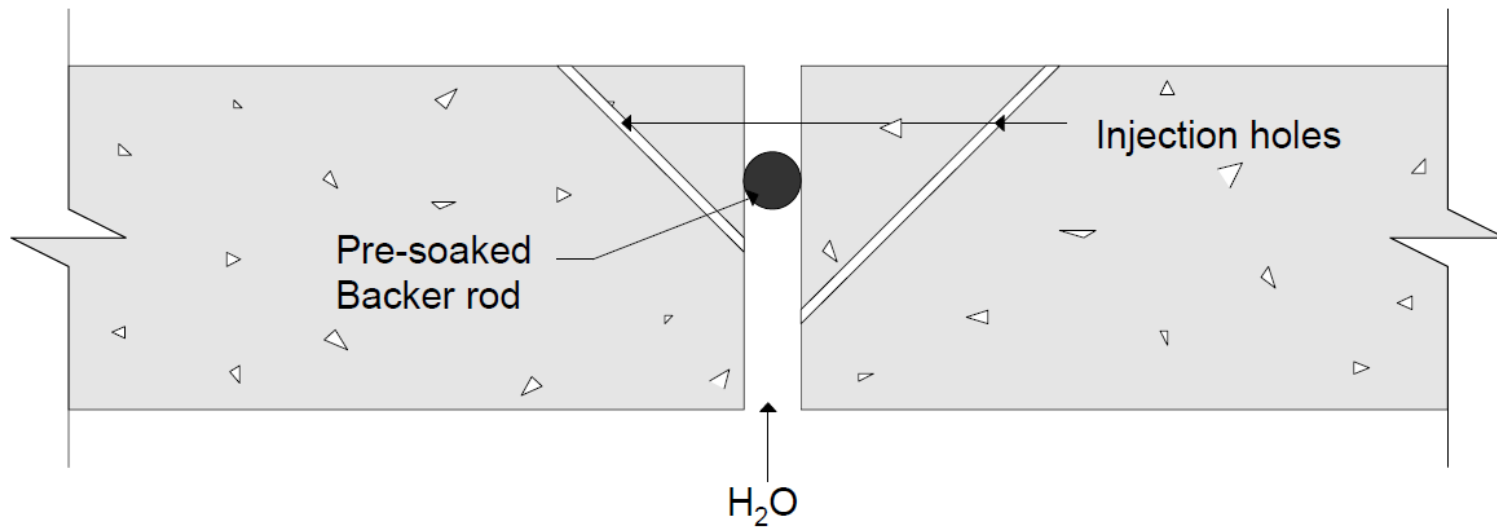




# URETHANE INJECTION - MATERIALS



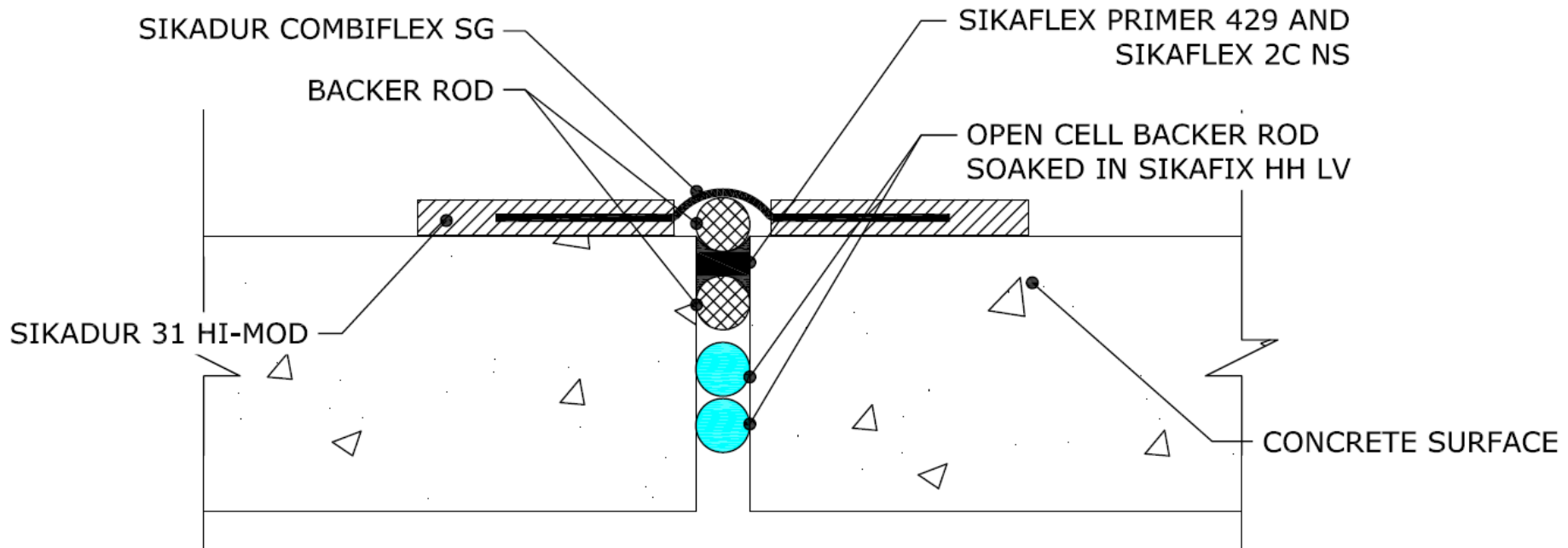
- When there is high flow the urethane grout will be washed out before reacting
- Soak oakum or open-cell backer rod in urethane grout and push into crack or joint to dam and slow leakage
- Then continue with injection



# URETHANE INJECTION - MATERIALS



- Urethane grout is not intended for use as a moving joint sealant
- Often used to stop active leakage and reduce backside pressure
- Then joint sealant can be installed to dry substrate
- Consider Sikadur Combiflex SG for higher moving joints and critical sealing applications



# SELECTING CRACK REPAIR METHOD

- ❑ Improve the appearance
- ❑ Protect concrete/steel
- ❑ Stop leakage
- ❑ Structurally restore

## Rout & Seal

- Flexible sealing

## Rout & Fill

- Solid filling

## Flood & Fill

- Solid filling

## Epoxy Injection

- Structural repair

## Urethane Injection

- Active leak sealing

## Sealers & Coatings

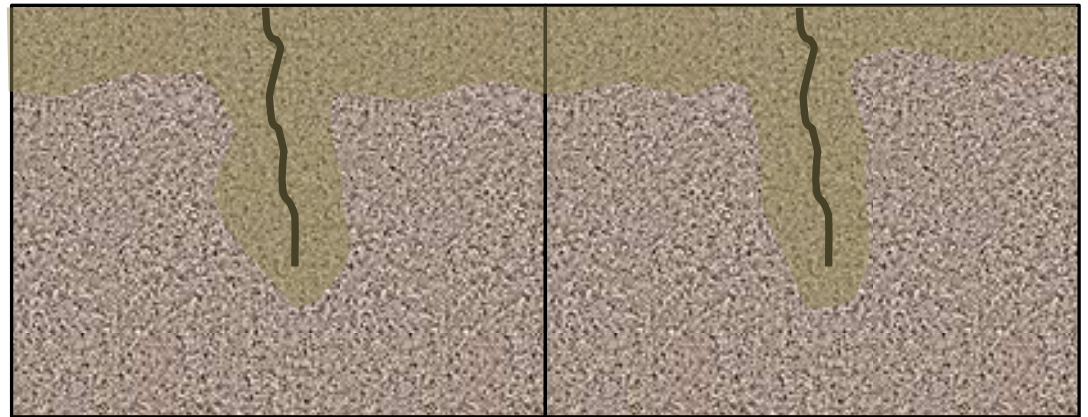
- Aesthetic protection





# PENETRATING SEALERS

- Protective repellent – screens out about 85% of water and chlorides
- No affect on appearance
- Effective on cracks up to 12 mils wide
- 5, 10, 15-year life expectancy
- Easy to apply
- Very economical



# PENETRATING SEALERS - MATERIALS

**Sikagard 705L** – 100% silane, ~ ½” penetration

**Sikagard 740W** – 40% silane, ~ ¼” penetration

- Ideal application rate is 2 coats at 250 sf/gal/coat
- Spray or roll apply



# COATINGS

- The most effective way to conceal cracks is to cover over them
- Rigid crack repairs can be coated with rigid or elastomeric coatings
- Flexible crack repairs are better coated with elastomeric coatings





# COATINGS - MATERIALS



## HARD COATINGS

### Sikagard 615 DPR

- Economical lasting color

### Sikagard 670W

- Anti-carbonation

### Sikagard 575 Aquasol

- Self-cleaning, pollution reducing

## ELASTOMERIC COATINGS

### Sikagard 515 Elastomeric

- Economical lasting color

### Sikagard 550W Elastocolor

- Anti-carbonation

### Sikagard 570

- Anti-carbonation, UV hardened skin



# COATINGS - MATERIALS



Severe  
cracking



# COATINGS - PREPARATION

- Cracks  $\geq$  30 mils (1/32") routed
- Surface clean and dry





# COATINGS - MATERIALS



Before



After



# COATINGS - MATERIALS



- Attractive
- Protective
- Cracks sealed and concealed

# COATINGS

- Severe map cracking through double tee deck leaking water





# COATINGS - MATERIALS

**Sikadur 55 SLV** – flood and fill cracks

**Sikadur 22 Lo-Mod** – traffic coating



- Watertight, protected, and extremely durable



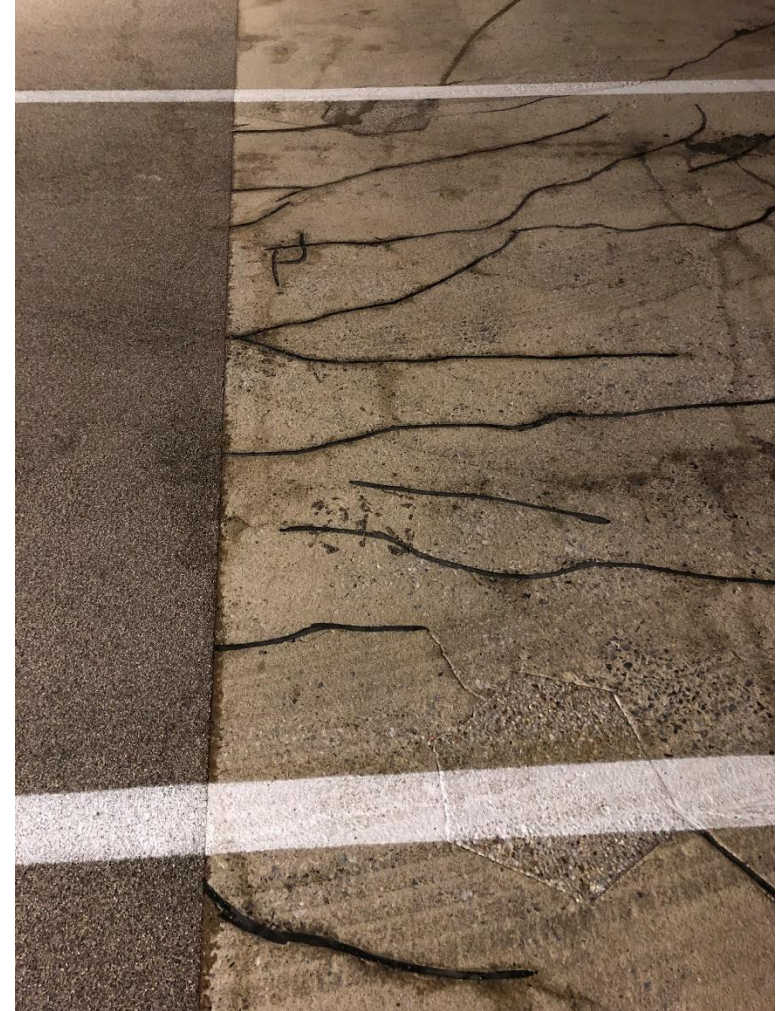


# COATINGS - MATERIALS

**Sikaflex Sealant** – rout & seal cracks  $\geq 1/16$ "

**Sikalastic Traffic Systems** – traffic coating

- Waterproofed, protected, and durable



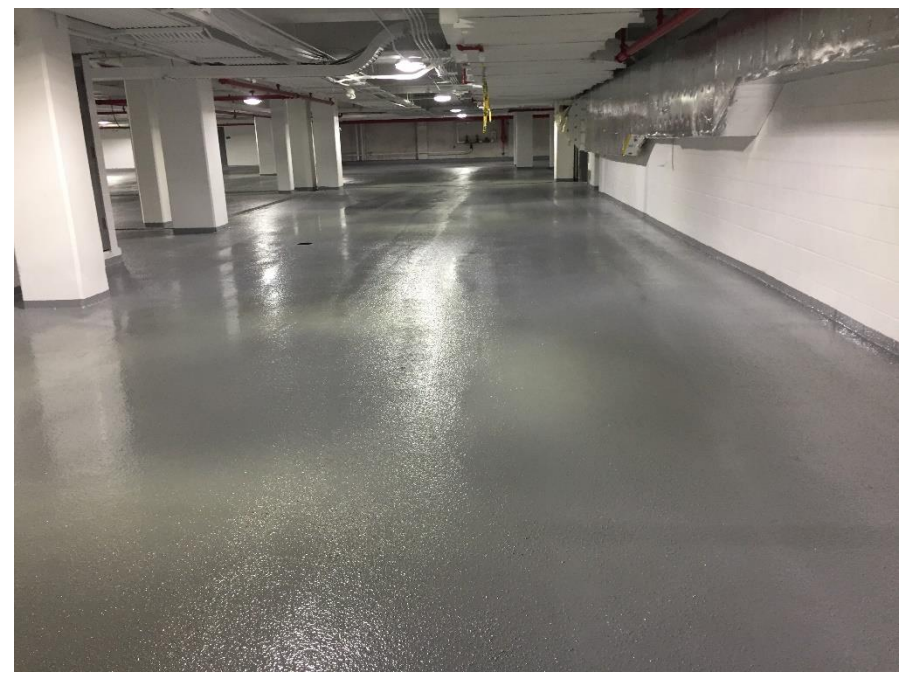
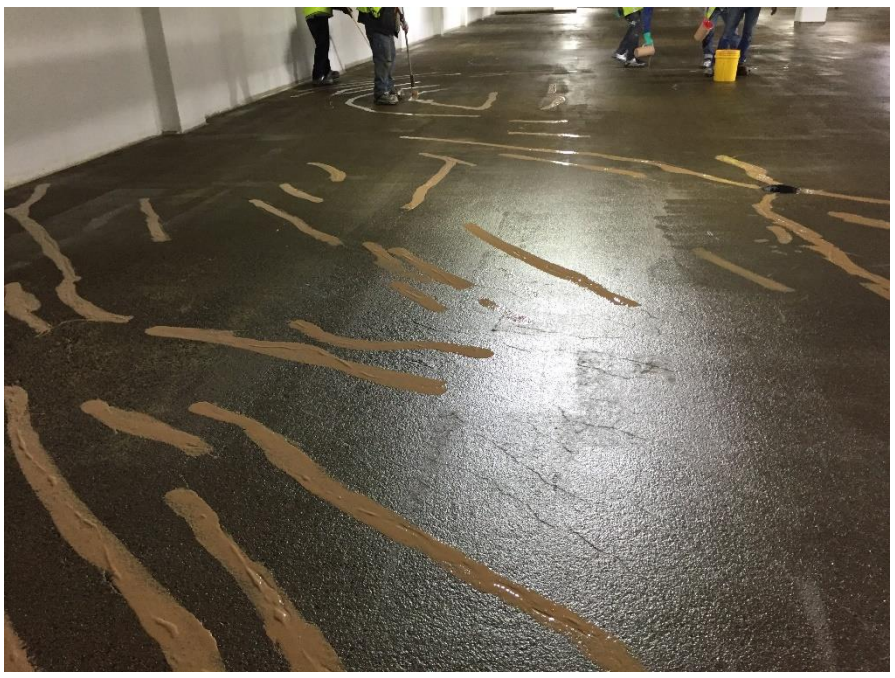


# COATINGS - MATERIALS

**Sikalastic Traffic Systems** – self sealing & concealing of cracks < 1/16”



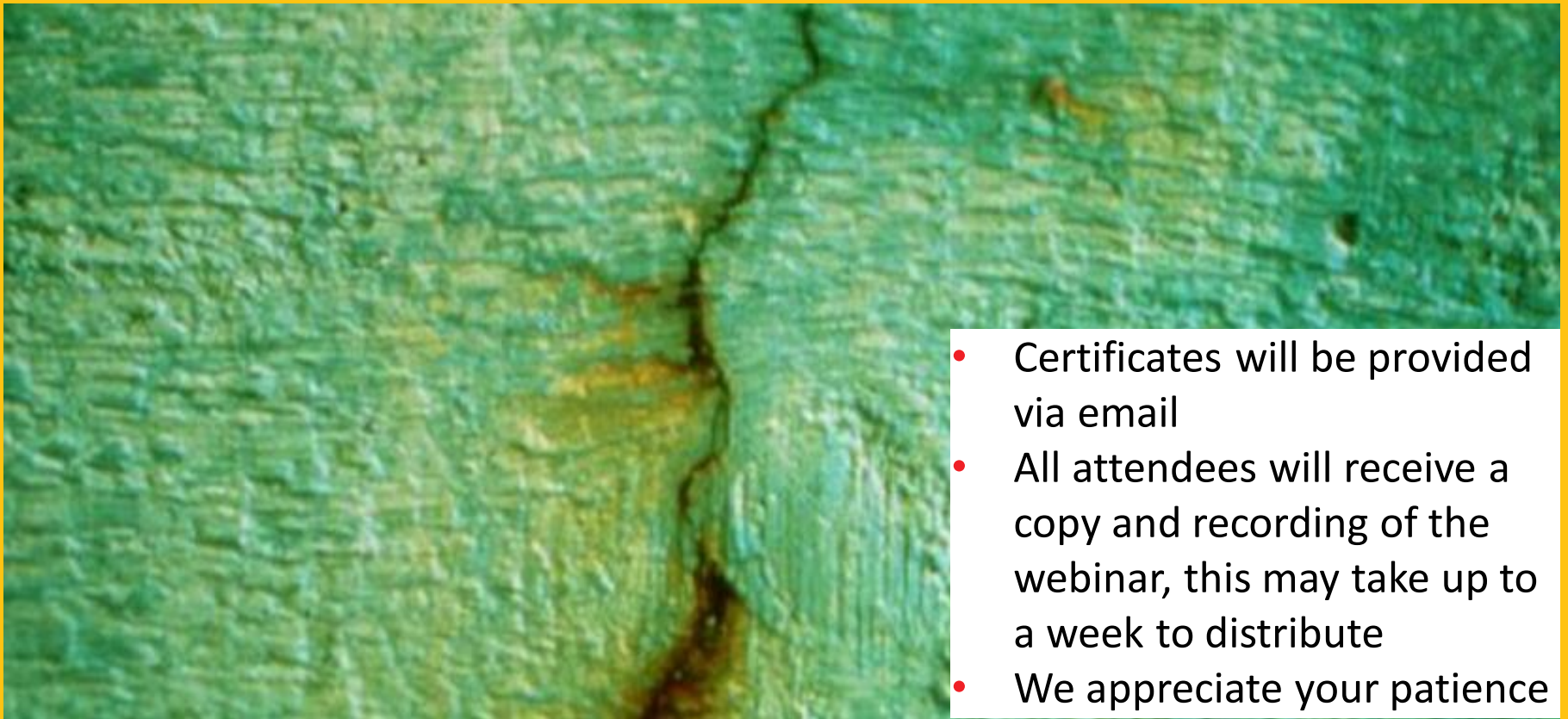
- Waterproofed, protected, and durable





# AVAILABLE RELATED PRESENTATIONS

- ✓ Concrete Repair (Part 1 – Material Selection)
- ✓ Concrete Repair (Part 2 – Preparation & Installation)
- ✓ Crack Repair
- Concrete Protection



- Certificates will be provided via email
- All attendees will receive a copy and recording of the webinar, this may take up to a week to distribute
- We appreciate your patience

# THANK YOU FOR YOUR ATTENTION

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