ACI RAP 2
CRACK REPAIR BY GRAVITY FEED WITH RESIN

OCTOBER 16, 2018

SCOTT DISTEFANO

BUILDING TRUST

AGENDA

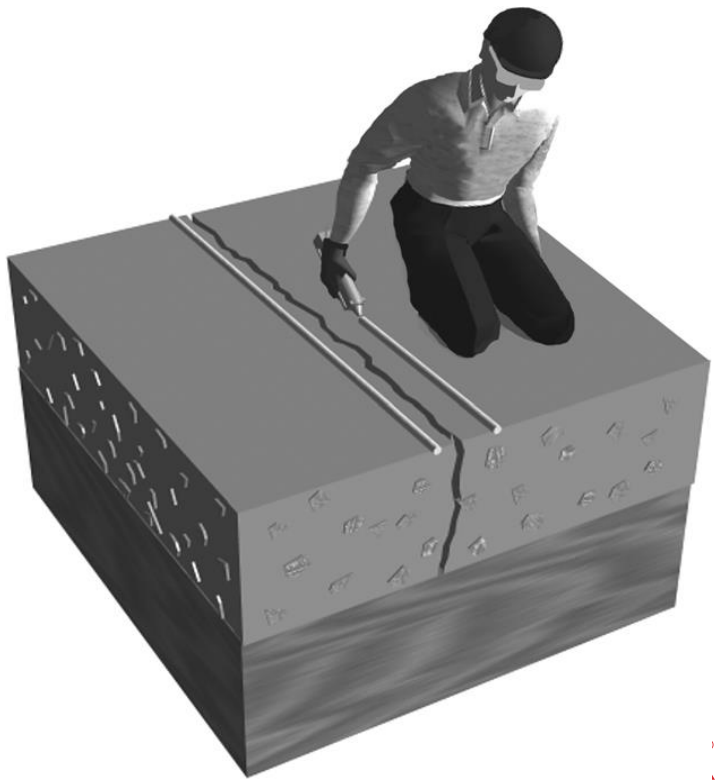
- Introduction
- Purpose of Repair
- When to Use
- Proper Preparation
- Selecting Materials
- Equipment
- Safety
- Repair Procedure
- Evaluation

INTRODUCTION

- Life, Death, Taxes and Cracks!

FIELD GUIDE TO
CONCRETE REPAIR
APPLICATION PROCEDURES

Crack Repair by Gravity Feed with Resin



INTRODUCTION

- Causes may include:
  - Steel corrosion
  - Freezing & thawing
  - Sulfate attack
  - Alkali aggregate reaction
  - Poor construction practices
  - Improper joint spacing
  - Load imbalances
  - Many others. . .

PURPOSE OF REPAIR

- Restore structural integrity
- Resist moisture penetration (0.002 in. width and greater)

- Form a plug to keep out:
  - Chlorides
  - Carbon dioxide
  - Sulfates
  - Aggressive chemicals

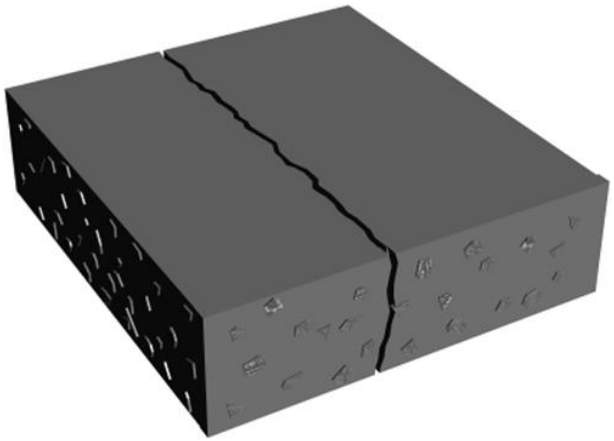
- Reduces future or further deterioration

WHEN TO USE GRAVITY METHOD

- Large horizontal cracks
  - Individually treat

- Many small horizontal cracks
  - Treat as a whole, “healer/sealer”

PROPER SURFACE PREPARATION

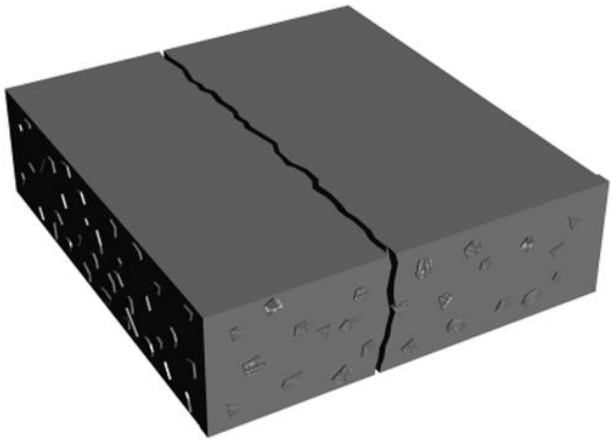


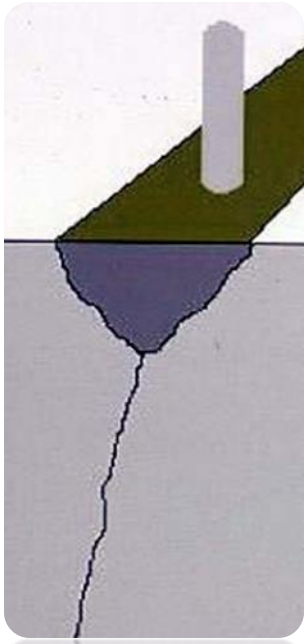
- ½” wide on each side
- Wire brush
  - Grinders may fill crack with dust
- Pressure washer
  - Allow to dry, at least 24 hrs
  - Moisture tolerant epoxy
- Compressed Air (oil free)
- Power Vacuums

- For large areas, consider power sanding or shotblast

- “V” groove or notch

PROPER SURFACE PREPARATION



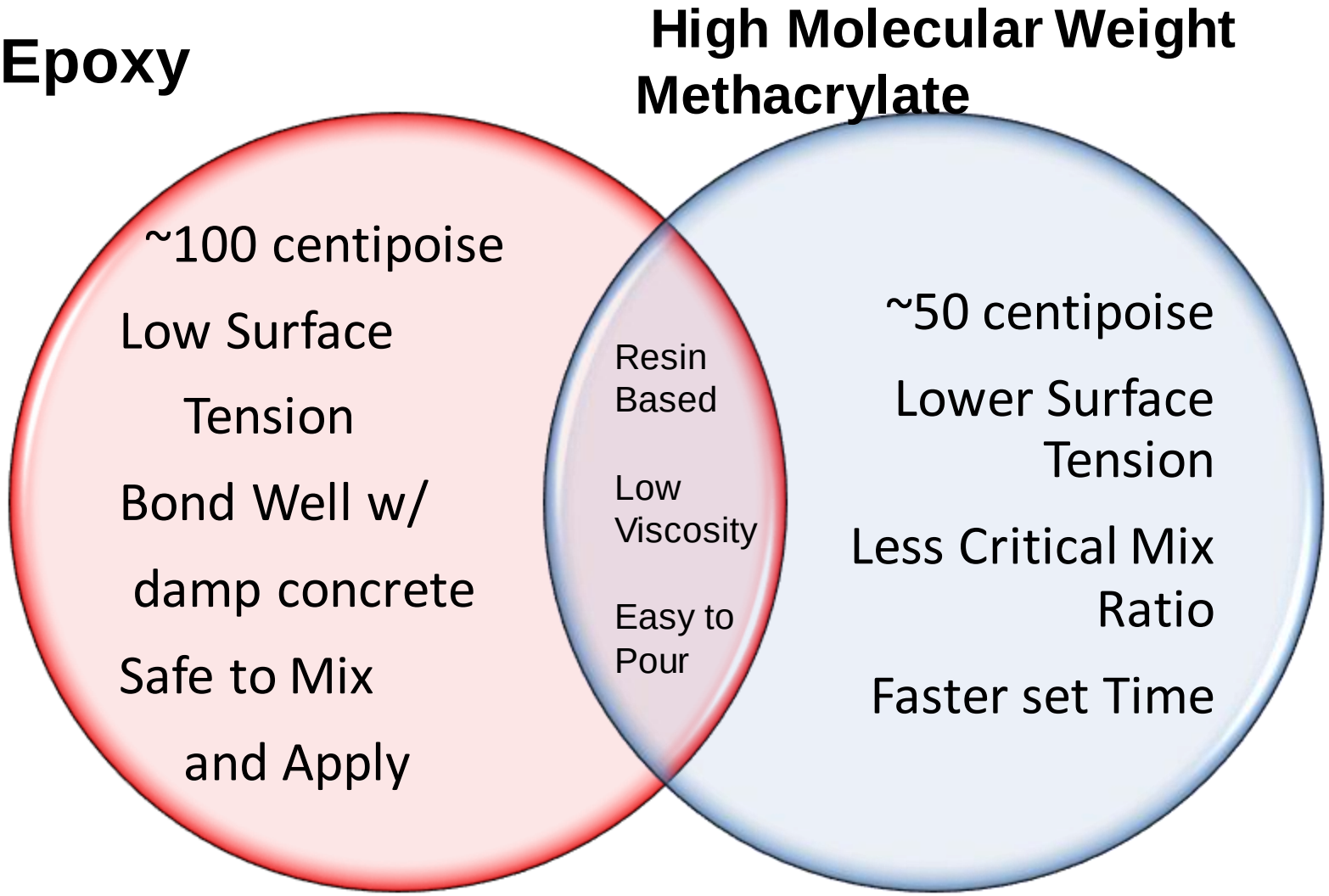


SELECTING THE CORRECT MATERIALS

- 2 most common resins
  - HMWM
    - Lower viscosity & surface tension
    - Less critical mix ratios
  - Epoxies
    - Moisture tolerant
    - Safer to mix & apply

- Low Viscosity & Low surface tension is very important
  - Typical requirement, <200 cps
  - Epoxies tend to be <100cps
  - HMWM's tend to be <50 cps
  - Both have been documented <0.006" cracks

SELECTING THE CORRECT MATERIALS



SELECTING THE CORRECT MATERIALS

- ASTM C881 identifies basic criteria

- Other considerations include:
  - Modulus of elasticity (rigidity);
  - Working life;
  - Moisture tolerance;
  - Color
  - Compressive, flexural, and tensile strengths.

Table 1—ASTM C 881 requirements for epoxy resins that are used to bond hardened concrete to hardened concrete

	Type I*	Type IV†
Viscosity, centipoise		
Grade 1 (low-viscosity), maximum	2000	2000
Grade 2 (medium-viscosity), minimum	2000	2000
Maximum	10,000	10,000
Consistency, in.		
Grade 3 (non-sagging), maximum	1/4	1/4
Gel time, min.	30	30
Bond strength, minimum, psi		
2 days, moist cure‡	1000	1000
14 days, moist cure	1500	1500
Absorption, 24 h maximum, %	1	1
Heat deflection temperature		
7 days minimum, °F	—	120
Linear coefficient of shrinkage		
On cure, maximum	0.005	0.005
Compressive yield strength		
7 days minimum, psi	8000	10,000
Compression modulus, minimum, psi	150,000	200,000
Tensile strength, 7 days minimum, psi	5000	7000
Elongation at break, minimum, %	1	1

*Type I: for use in non-load-bearing applications.

†Type IV: for use in load-bearing applications.
Source: ASTM C 881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

‡Moist-cured systems should be tested by assembling the sections to be bonded before immersing in water.

PROPER EQUIPMENT

For small to midsize projects (up to 10,000 ft2 [930 m2]):

- Mixing buckets, drills, mixing paddles;
- Flat rubber squeegees, brooms, or rollers;
- Small cans or squeeze bottles for pouring into individual cracks; and
- Grinder and air compressor.

For large projects (over 10,000 ft2 [930 m2]):

- Mixing buckets, drills, mixing paddles;
- Mixing tanks with spray bar (low pressure pumps, no atomization);
- Flat rubber squeegees, brooms, or rollers;
- Sand spreaders or blowers; and
- Grinder and air compressor.

SAFETY CONSIDERATION

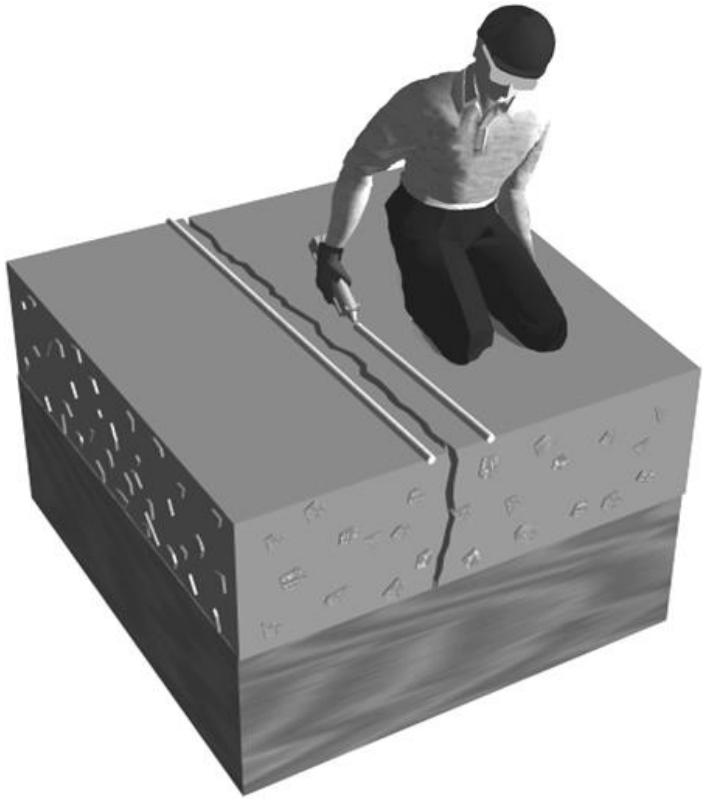
- User must document safety practices:
  - Having Material Safety Data Sheets (MSDS) available on site;
  - Wearing protective clothing and protective eyewear
  - Wearing rubber gloves or barrier creams for hand protection
  - Having eye wash facilities available;
  - Wearing respirators where needed;
  - Providing ventilation of closed spaces;
  - Secured storage of hazardous materials;
  - Having necessary cleaning materials on hand; and
  - Notifying occupants of pending repair procedures.

  - SPECIAL NOTE ON HMWM – NEVER MIX INITATOR AND PRMOTER DIRECTLY!

REPAIR PROCEDURE

1. Mix the resin

- After prep, mix according to manufacturer.
- A sealant can be used on individual cracks to create a reservoir



REPAIR PROCEDURE

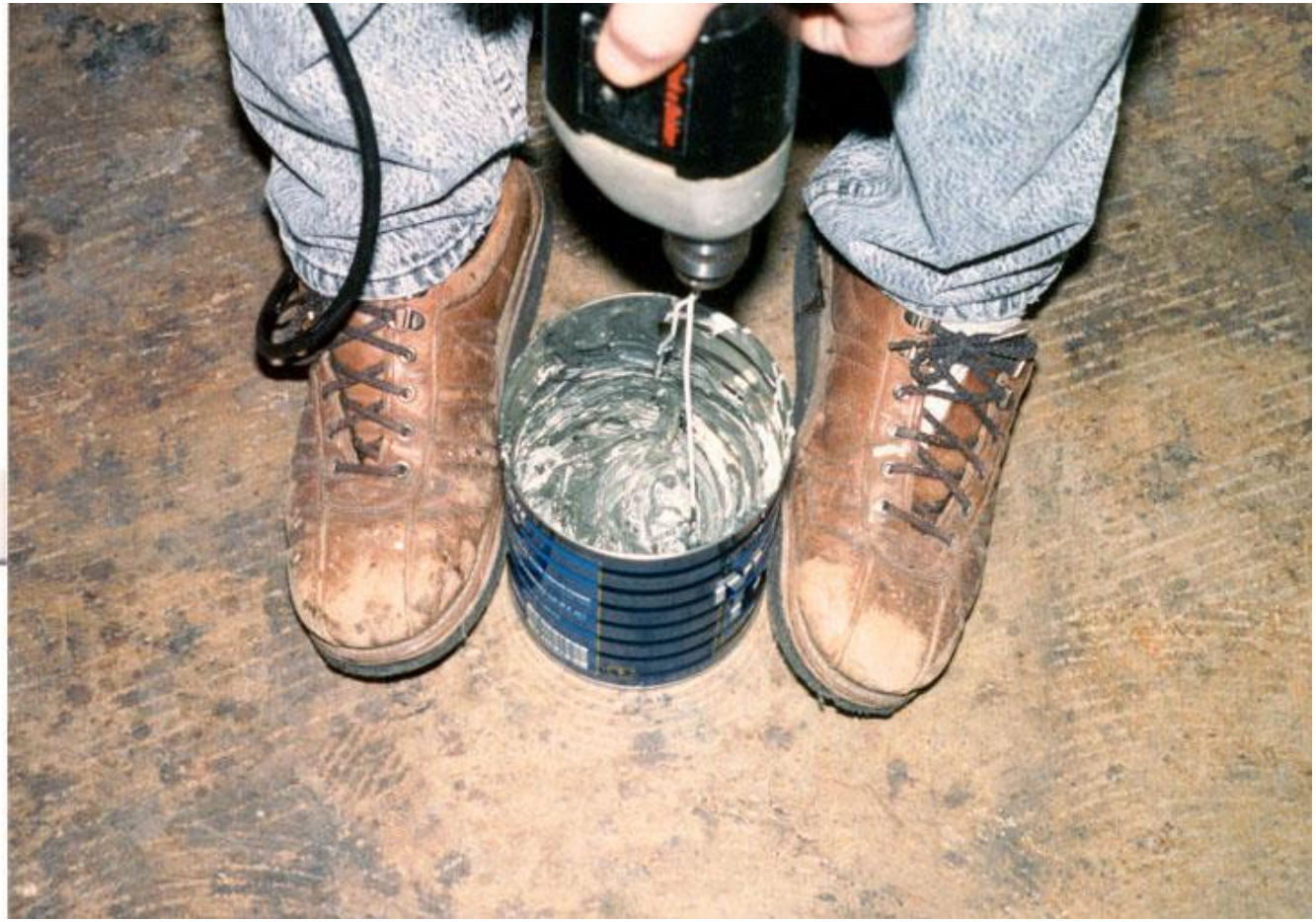
1. Mix the resin

REPAIR PROCEDURE

1. Mix the resin – NOT LIKE THIS!

REPAIR PROCEDURE

1. Mix the resin – OR THIS!



REPAIR PROCEDURE

1. Mix the resin – OR THIS!

REPAIR PROCEDURE

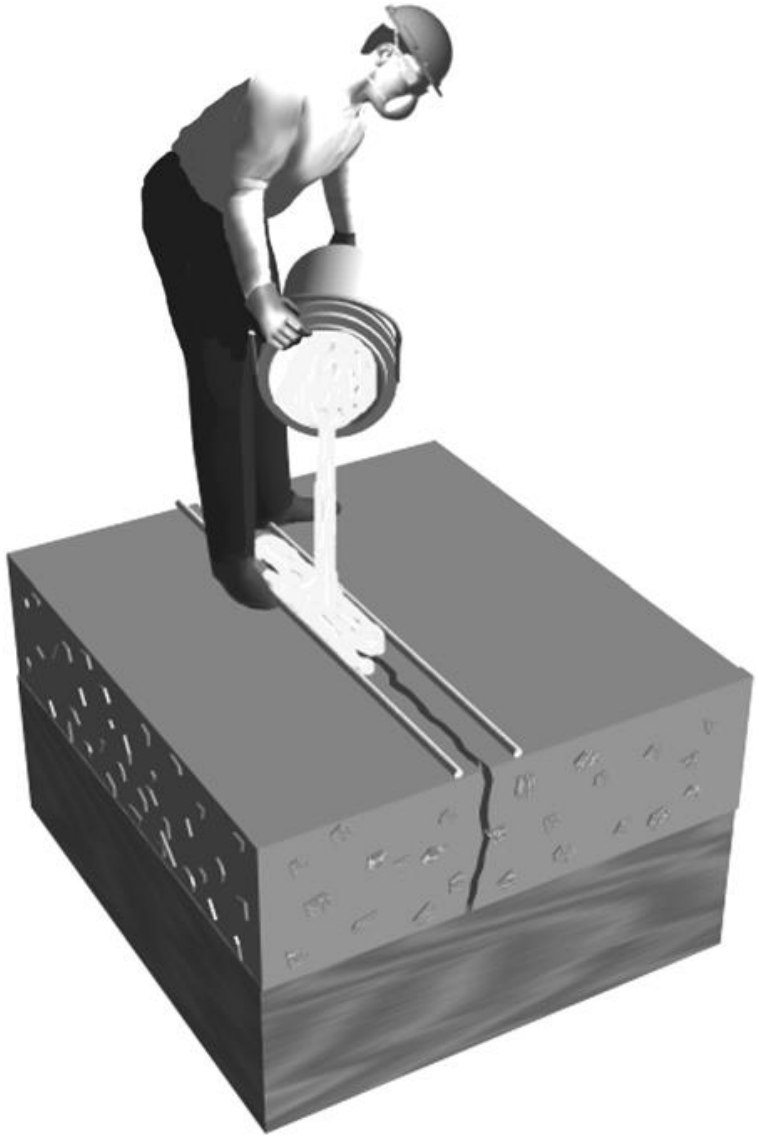
1. Mix the resin – AND ESPECIALLY NOT LIKE THIS!

REPAIR PROCEDURE

2. Pour the Resin

- Pour mixed material (within pot life)
- Allow to penetrate, pour until full

- Flood coats:
  - Apply resin evenly
  - Pool over cracks
  - Flat squeegee, broom, roller



REPAIR PROCEDURE

2. Pour the Resin

REPAIR PROCEDURE

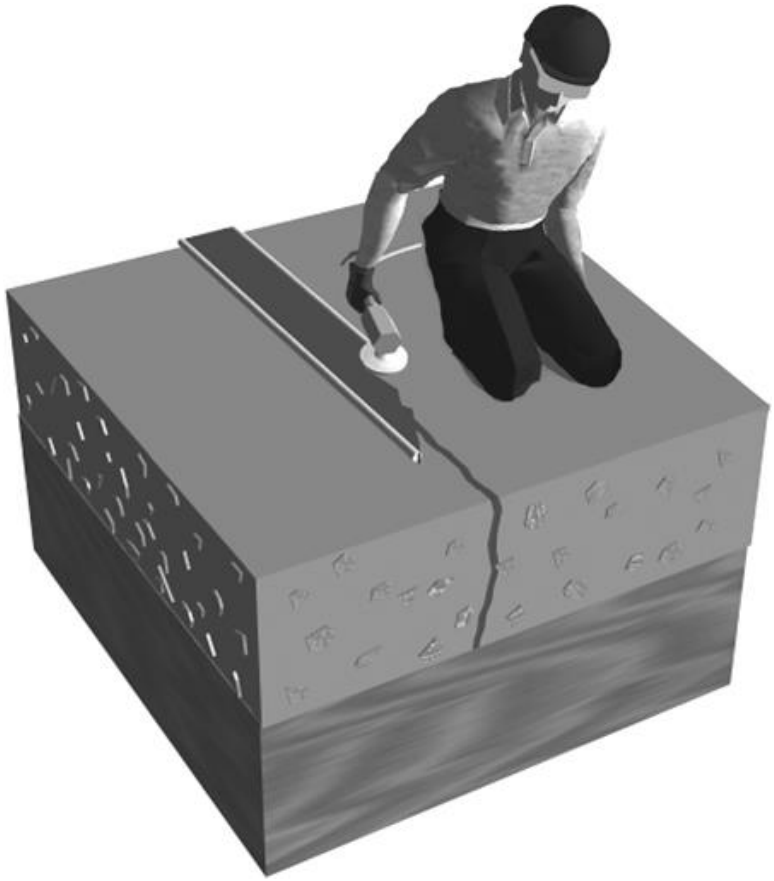
3. Inspect the filling

- Signs of proper penetration
  - Air bubbles
  - Dry spots

- ALLOW TIME!
  - 20-30 minutes min.

REPAIR PROCEDURE

4. Remove Excess Resin
- Flat squeegee

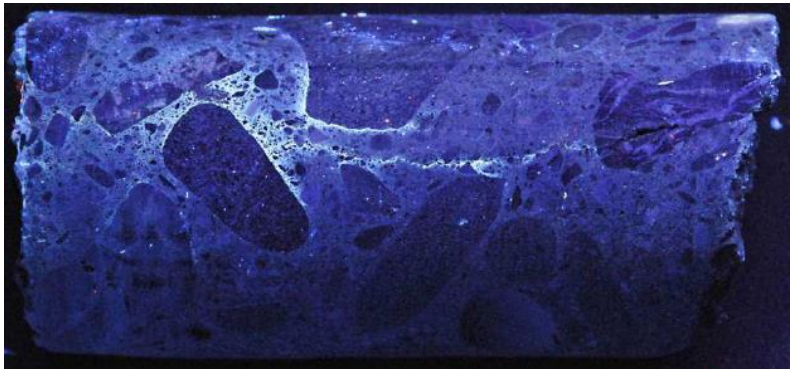


5. Apply Sand
- Safety purposes, non-slip
- Adhesion for coatings

6. Finish Smooth
- Remove sealant and excess polymer if required

HOW TO CHECK THE REPAIR

1. Test cores
   - Engineer should determine location to avoid high stress areas
   - Visual evaluation for penetration depth
   - Must patch with expansive high strength grout (epoxy or cement based)
   - ASTM C492 – Splitting Tensile
2. Resin Properties – ASTM D495
   - Cured Prisms
   - Compressive strength
   - Correctly mixed and cured



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THANK YOU FOR YOUR ATTENTION!

QUESTIONS?

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