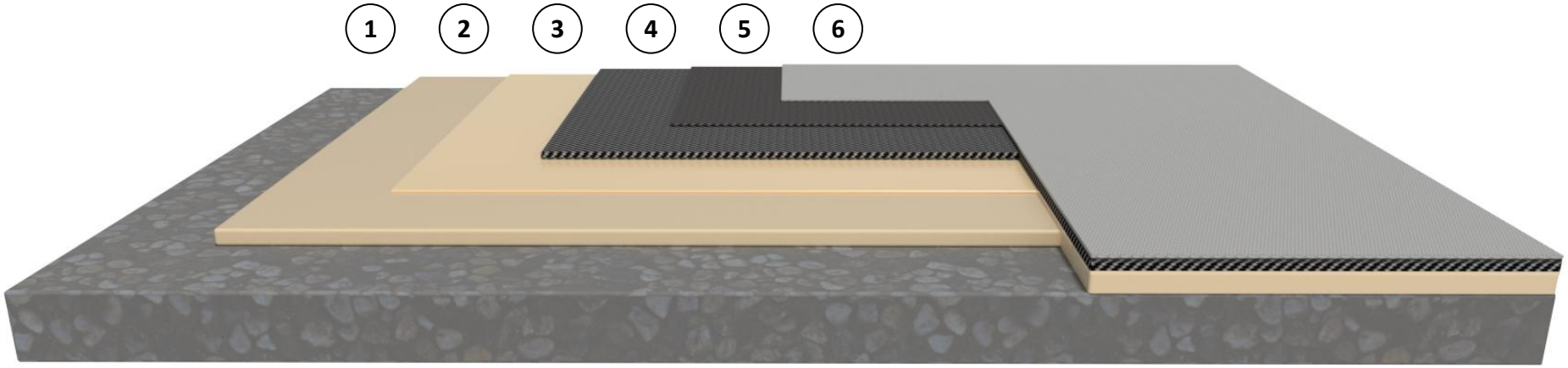
TuffWrap

Structural Strengthening Systems: 300UD, 600UD, 1200UD, 300MD, 600MD, 300GF, 600GF, TuffStrips



1| Concrete- It is preferred to have an ICRI profile of CSP 1. Surface can be profiled, cleaned, and prepared for CFRP application with TuffPrep cleaner. EnviroClean may be used for cleaning any dirt, grease, or oil build up.

2| TuffPatch VOH or TuffPaste – Used as needed.

3|TuffSat saturant– Dry layup SAT should be applied @ 40-50 sf per gallon.

4| TuffWrap sheets shall be cut beforehand into prescribed lengths. Sheets shall be lapped in longitudinal direction 6 inches minimum or as indicated on the Drawings. Note: no lapping is required of the sheets parallel to the direction of fiber orientation. Apply FRP sheets fiber side down to the concrete over the fresh saturant using a ribbed roller and squeegee to remove any air bubbles.

4| TuffWrap–(cont.)

5| TuffSat – 2nd coat should be applied @ 100 sf per gallon

6| TuffCoat – Top coat should be applied @ 130-150 sf per gallon.

Column Repairs

With the TuffWrap System

1| TuffPoxy 9

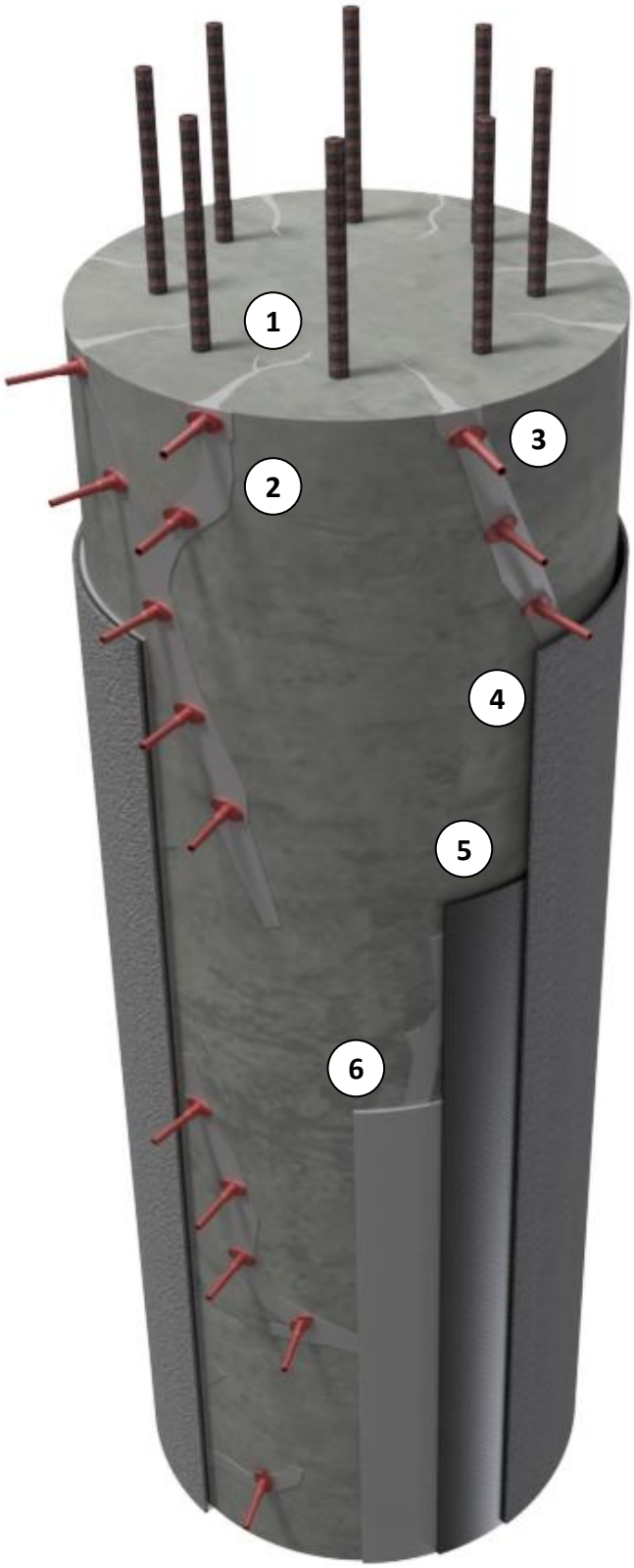
2| TuffPorts

3| TuffPoxy 3 FS or TuffPoxy Paste

4| TuffSat Saturant

5| TuffWrap 300 UD CFRP Fabric

6| TuffCoat UV Top Coat



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POLY-TUFF SYSTEMS INTERNATIONAL
HIGHWAY DIVISION

TuffWrap CFRP Installation Guide

Table of Contents:

1. PRE- INSTALLATION

- **a.** Manufacturer training prior to CFRP installation may be required. Ensure training has been received, and at least one certified installer is on site at all times.
- **b.** Assemble all tools, equipment, required documents and copies of specifications and project drawings.
- **c.** Clear work area and provide adequate workspace.
- **d.** Protect all surfaces not receiving repairs with plastic sheeting.
- **e.** SDS's, safety, and emergency instructions to be posted at all times and easily assessible.
- **f.** Protective clothing and equipment should be worn at all times for duration of the job.

2. SURFACE PREPARATION

a. CONCRETE

- **i.** Unsound areas of the concrete substrate (such as broken pieces, delaminated areas, etc.) must be removed to reveal sound material.
- **ii.** If corrosion of the existing steel reinforcement exists, the steel and concrete must be repaired before installation of the CFRP. Any deteriorated concrete or corroding reinforcing steel must be repaired per ICRI Guideline #03730. DO NOT COVER CORRODING REINFORCING STEEL WITH CFRP.
- **iii.** Voids in the concrete substrate greater than 0.50 in (500 mm) in depth must be filled with an appropriate repair mortar. If required, the bond strength of the repair material to the existing concrete may be verified with pull testing per ASTM D 4541. Minimum direct pull-off strength required is 200 psi (1.4 MPa).
- **iv.** Cracks in the concrete substrate greater than 0.010 in (0.25 mm) wide must be injected with epoxy or similar material approved by the Engineer of Record.
- **v.** Uneven concrete surface irregularities (offsets) must be ground and smoothed to less than 0.04 in (1 mm).
- **vi.** When fiber reinforcement is run around outside corners or edges, these corners must be rounded to a radius of no less than 0.5 in (15 mm). Application of fiber reinforcement around inside corners shall be avoided. No detailing is required if fiber is run parallel to corners.

vii. When bond of the CFRP to the concrete substrate is required for structural performance, the surface of the concrete substrate must be profiled using abrasive blasting and/or disc grinding to a minimum ICRI CSP 3 (refer to ICRI Guideline #03732). Surface materials (laitance, surface lubricants, broken mortar pieces, paint coatings, staining, etc.) must be removed by abrasive blasting and/or disc grinding. Dust generated from surface grinding must be removed using a clean air blower or other suitable means. If the dust has been removed by means of water washing, the surface must be thoroughly dried.

viii. When structural performance relies only on the bond of the CFRP to itself at lap splices, the substrate must be cleaned of any dust, debris, or laitance.

b. MASONRY

i. Surface materials (laitance, surface lubricants, broken mortar pieces, paint coatings, staining, etc.) must be removed by abrasive blasting and/or disc grinding. Dust generated from surface grinding must be removed using a clean air blower or other suitable means. If the dust has been removed by means of water washing, the surface must be thoroughly dried.

ii. Care must be taken to avoid excessive removal of mortar during abrasive blasting.

iii. Uneven surface irregularities (offsets) must be ground and smoothed to less than 0.04 in (1 mm).

iv. When fiber reinforcement is run around outside corners or edges, these corners must be rounded to a radius of no less than 0.5 in (15 mm). Application of fiber reinforcement around inside corners shall be avoided. No detailing is required if fiber is run parallel to corners.

3. APPLICATION OF FILLER / ADHESIVE (Where needed)

a. Prepare TuffPaste putty epoxy filler/paste in accordance with manufacturer's instructions. Mix only the quantity of filler that can be used within its batch life. Batch life will be reduced in higher temperatures and when mixed in higher volumes. Adjust batch size accordingly. Do not use any epoxy, which has exceeded its batch life.

b. Constituent parts must be accurately metered and thoroughly mixed for between 2 and 3 minutes. For large batches (over 1 gallon) use a mechanical mixer.

c. Apply filler to surface voids using a steel or stiff plastic spreader. Ensure all voids and offsets are thoroughly filled and excess filler is removed.

d. Only the mortar lines need be filled on masonry, except for large offsets.

4. MANUAL APPLICATION OF CFRP REINFORCEMENT (Dry lay-up)

a. All surfaces must be prepared per surface preparation guidelines and when filler such as TuffPaste putty has been utilized, it must be tack free prior to installation of CFRP.

b. The direction of structural strengthening for CFRP uni-directional fabric will always be the direction that the fabric is rolled. The Chevrons should always face the applicator and not the substrate. Always install fabric in the direction of the plans and specification indicated.

c. Prepare TuffSat epoxy saturating resin in accordance with manufacturer's instructions. Mix only the quantity of epoxy that can be used within its batch life. Batch life will be reduced in higher

temperatures and when mixed in higher volumes. Adjust batch size accordingly. Do not use any epoxy, which has exceeded its batch life.

d. Surface substrate should remain 5 degrees plus or minus. Dew point to ensure moisture/dew does not accumulate on the substrate during installation. Temperature, humidity and dew point levels should be monitored during installation.

e. Using a roller, apply a coat of mixed resin to the concrete substrate. Lay pre-cut fabric onto resin coat and press down with a soft plastic spreader. Apply more resin to the fabric and spread evenly until fabric is fully covered and saturated thoroughly with resin. Allow to sit for 1 minute, applying more resin if needed. Squeegee off excess resin if necessary.

f. Orient fibers as detailed in project drawings and within specified tolerances. Fibers shall be laid taut and without wrinkles. Using soft plastic spreaders and (suitably protected) hands, smooth out wet fabric ensuring full contact with the surface and to remove trapped air. Fibers must be straight and aligned correctly. Apply additional saturating resin, if needed, during the smoothing out process to assist in handling.

g. To join ends of fabric; overlaps in the longitudinal direction must be a minimum of 6". Additional saturating resin can be used to ensure complete bonding between layers and lack of voids. No overlap is needed between adjacent bands of fabric. Overlaps must be staggered for multiple layers.

h. For applying additional layers, Follow/Repeat procedures

i. Check applied laminates after 30 - 45 minutes and again prior to gel stage to ensure that no voids or delamination's are present.

j. The installed composite must be protected from rain, direct sunlight, dust, sand etc. for 24 hrs.

k. Install TuffCoat UV per manufacturers recommendations for UV Protection.

5. FIELD QUALITY CONTROL

a. Supervision

i. A trained field supervisor shall observe all aspects of onsite preparation and material application including surface preparation, resin component mixing, application of primer, application of resin and fiber sheet, curing of composite, and the application of protective coatings.

ii. Newly installed CFRP composite materials shall be visually inspected to ensure complete saturation, full contact between layers and to substrate, proper fiber orientation, and lack of wrinkles, bubbles, and voids.

b. Inspection for Voids/Delamination's

i. After allowing at least 24 hours for initial resin cure to occur, perform a visual and acoustic tap test inspection of the layered surface.

ii. Large delamination shall be marked for repair. Small delamination less than 2 in2 (1300 mm2) in size and which are not localized do not require corrective action.

iii. Large delamination should be repaired by either injection with resin, or by removing delaminated area and patching with new fabric, allowing a 6" overlap all around the repair. This is at the discretion of the inspector.

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HIGHWAY DIVISION

6. REPAIR OF DAMAGED OR DEFECTIVE AREAS

- **a.** Repair of all the defective work after the minimum cure time for the CFRP laminates shall comply with material and procedural requirements as provided by PSI according to the type of defect, the type of application, and the materials used.
- **b.** Repair all defects in a manner that will restore the system to the designed level of quality. Removal of defective sections shall be replaced and properly spliced with non-damaged areas. Splice locations shall be prepared for bond by abrading cured surfaces. Voids shall be prevented.
- **c.** The Owner's representative shall approve repair procedures for conditions that are not specifically addressed in this specification. All repairs and touch up shall be made to the satisfaction of the Owner's representative and Engineer of Record.

7. APPENDIX A: RECOMMENDED EQUIPMENT LIST

1. Surface preparation tools
2. Plastic sheeting
3. Work tables
4. Weight scale
5. Mixing pots and buckets
6. Brushes, rollers and roller trays
7. Trowels, plastic and metal
8. Scissors & utility knives
9. Solvent and cleaning cloths
10. Garbage containers and bags
11. Disposable gloves (latex and rubber)
12. Disposable outer suits
13. Safety glasses
14. Safety equipment as per installer's policy
15. Disposable and NIOSH respirators
16. First aid kit
17. Non-toxic hand cleaner (citrus based)
18. Marking pens
19. Note pads & production forms
20. Glass (or suitable) sheets for witness panels
21. Grinders and grinding discs
22. Electric drills
23. Mixing sticks and mixing fixture for drill
24. Power source or portable generator
25. All needed electrical cords
26. Hand tools
27. Temperature and humidity meter
28. Tape measures
29. Ladders and scaffolding as needed
30. Storage container
31. Syringes for repairs & anchors
32. PSI fabrics as specified
33. PSI TuffPaste & TuffSat laminating resins (A & B)
34. PSI TuffCoat UV coating
35. TDS & SDS and all required documents

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INTERNATIONAL
HIGHWAY DIVISION

TECHNICAL DATA SHEET

TuffPoxy™ 9

Crack Injection Epoxy

1.01 DESCRIPTION

TuffPoxy™ 9 is a plural component, unique formula developed for structural concrete repair by crack injection, gravity feed or patching. It can be used as a liquid binder for sand, aggregate or any other mineral filler to patch or resurface damaged concrete slabs. This material may be used to repair masonry, wood, and other rigid construction materials. TuffPoxy™ 9 is 100% solids, VOC free and Butyl Glycidyl Ether (BGE) free. Please use the correct product grade that complies with VOC regulations as per federal, state, statutory bodies, county and city regulations/codes at the place of installation of product.

1.02 USES

- Pressure-injection of cracks in structural concrete, masonry & wood
- Gravity-feed of cracks in horizontal concrete and masonry
- Epoxy resin binder for epoxy mortar patching
- Seal concrete from water, chlorides, and mild chemical attacks

1.03 ADVANTAGES

- 100% solids
- No Volatile Organic Compounds (VOC's)
- No Butyl Glycidyl Ether (BGE)
- Low viscosity
- Friendly 2:1 mix ratio
- Excellent adhesion
- High strength
- Longer working time

1.04 STANDARDS

TuffPoxy™ 9 meets or exceeds the ASTM C881, Types I and IV, Grade 1, Class C standard.

1.05 COLOR

Clear to Amber

1.06 PACKAGING

450 ml pre-packaged cartridge
1-gallon kits: 2/3 gallon (2.52 liters) can of Side A and 1/2 gallon (1.89 liters) of Side B
3-gallon kits: 2 gallons (7.56 liters) of Side A and 1 gallon (3.78 liters) can of Side B
15-gallon kits: 10 gallons (37.8 liters) pail of Side A and 5 gallon (18.9 liters) pail of Side B
165-gallon kits: 110 gallon (416.4 liters) drum of Side A and 55 gallon (208.2 liters) drum of Side B

1.07 COVERAGE

1 gallon (3.78 liters) yields 231 cuin (0.0037 cum) of adhesive
1 gallon (3.78 liters) of adhesive when mixed with 5 gallon of kiln-dried aggregate, yields approximately 808.5 cuin (0.0132 cum) of epoxy mortar.

1.08 PREPARATION

To achieve excellent adhesion, the substrate should be free of all loose and foreign material and should be clean. Oils, grease, waxes, or other contaminates must be removed prior to application. Be sure the crack is open where ports are placed. Set ports with Putty.

1.09 MIXING

Mix 2 parts Side A resin to 1 part Side B hardener for 3 minutes using a "Jiffy" Mixer and a slow speed drill. Mix at slow speed (less than 850 rpm) to avoid air entrainment. Do not mix more material than can be used within the stated working time. At higher temperatures, you will have less working time at higher temperatures.

1.10 APPLICATION

Open and clean cracks. Set ports between 4-6 inches (10-16-14.24 cm) using putty. Open all ports before beginning. Fill cracks to each port using Putty. Let Putty cure. Using proper application methods, i.e. dual cartridges, slowly pump **TuffPoxy™ 9** into lowest port until **TuffPoxy™ 9** flows from next port above the first. Close port and remove cartridge from first port and move to next port, always move UP so that all air escapes. Remove until you have filled and closed all ports.

1.11 CLEAN-UP

TuffPoxy™ 9 and sealing pastes, before they are fully cured (hard), may be removed from tools with warm soapy water.

1.12 LIMITATIONS

Always test a small amount to insure that the product is mixed thoroughly and that the material will harden properly before proceeding. Do not thin with solvents. Minimum age of concrete must be 3-7 days, depending on curing and drying conditions.

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1.13 CAUTION

Avoid breathing of vapors. Forced local exhaust is recommended to effectively minimize the exposure. NIOSH approved, organic vapor respirators and forced exhaust are recommended in confined areas, or when conditions (such as heated polymer, sanding, etc.) may cause high vapor concentrations. Do not weld on, burn or torch the **TuffPoxy™ 9** or any epoxy material. Hazardous vapor is released when an epoxy is burned. Avoid skin or eye contact. Wash skin with soap and water if contact occurs. If eye contact occurs flush with water for 15 minutes and obtain medical attention. Read and understand all caution on can labels and material safety data sheets before using this material.

READ SDS PRIOR TO USING PRODUCT. KEEP OUT OF THE REACH OF CHILDREN.

1.14 PHYSICALS	
Mix Ratio by Volume	2:1
Viscosity	100-500 cps
Gel Time (60 g mass)	45 minutes
Tack Free Time (73°F or 23°C)	3 to 5 hours
Tensile Properties (ASTM D638) 7 day cure Tensile Strength: Tensile Elongation:	 10,000 psi (69.0 MPa) 1.2%
Bond Strength (ASTM C882) 2 day cure: 14 day cure:	 2,100 psi (14.5 MPa) 2,200 psi (15.2 MPa)
Compressive Properties (ASTM D695) 7 day cure Compressive Strength: Compressive Modulus:	 11,000 psi (75.9 MPa) 300,000 psi (2,070 MPa)
Shear Strength (ASTM D732)	6,000 psi (41.4 MPa)
Flexural Strength (ASTM D790)	7,500 psi (51.7 MPa)
Shrinkage on Cure (ASTM D2566)	0.001
Thermal Compatibility (ASTM C884)	Pass
Heat Deflection Temperature (ASTM D648)	123°F (50°C)
Water Absorption (ASTM D570)	0.3% (24 hr)

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POLY-TUFF SYSTEMS
INTERNATIONAL
HIGHWAY DIVISION

TECHNICAL DATA SHEET

TuffPoxy™ 3FS

Doweling, Pasting, & Anchoring Epoxy

1.01 DESCRIPTION

TuffPoxy™ 3FS is a two component, high strength moisture insensitive, high modulus, multi-purpose, non-sag, structural epoxy system designed to offer exceptional strength in anchoring, pasting, and bonding applications. Please use the correct product grade that complies with VOC regulations as per federal, state, statutory bodies, county and city regulations/codes at the place of installation of product.

1.02 USES

- Setting injection ports & sealing cracks prior to epoxy injection
- Anchoring dowels, bolts, reinforcing steel and threaded rods
- Vertical and horizontal structural bonding and patching

1.03 ADVANTAGES

- Clean and easy to use and reuse
- 100% solids
- No Volatile Organic Compounds (VOC's)
- Non-sag gel consistency
- Friendly 1:1 mix ratio
- Excellent adhesion
- Fast setting, high strength, high modulus
- Easy dispensing
- Made in America
- Moisture Tolerant

1.04 TECHNICAL DATA

TuffPoxy™ 3FS meets the current ASTM C881 and AASHTO M235 Types I, II, IV & V Grade 3, Classes B & C specifications. It has passed 4 million cycles of simulated seismic tension test. It meets current ICC-ES AC308 for both uncracked and cracked concrete anchoring application in dry hole, damp hole, water-filled hole, and underwater.

1.05 COLOR

Concrete Gray

1.06 PACKAGING

250 ml uni-cartridge
600 ml side-by-side cartridge
1500 ml side-by-side cartridge
1-gallon kit: 1/2 gallon (1.89 liters) of Side A and 1/2 gallon (1.89 liters) of Side B
2-gallon kits: 1 gallon (3.78 liters) of Side A and 1 gallon (3.78liters) of Side B
10-gallon kits: 5 gallon (18.9 liters) of Side A and 5 gallon (18.9 liters) of Side B

1.07 COVERAGE

Please see **TuffPoxy™ 3FS** Installation section 1.08 for doweling and pasting.

1.08 PREPARATION

Surface Preparation: Surfaces to be bonded must be clean and structurally sound. Remove all oil, grease, dirt, laitance, curing compounds, and any other foreign matter by sandblasting, mechanical abrasion or hydro blasting.

Hole Preparation: Bolts, rebar or threaded rod should be free of dirt, grease, oil of other foreign material. DRILL hole to specified diameter and depth; BLOW dust from the bottom of the hole with oil-free compressed air for at least four seconds; BRUSH clean with a nylon brush removing all dust and loose material; BLOW again from the bottom of the hole for at least four seconds. REPEAT BRUSH and BLOW procedures when necessary.

1.09 MIXING

Insert the cartridge into the dispensing gun. Remove the plastic caps and dispense a small amount of material until an even flow of black and white material is achieved. Place the mixing nozzle onto the cartridge then slide the nut over the nozzle and thread the nut onto the cartridge. To achieve maximum flow, break off the tip of the mixing nozzle to the largest diameter that will fit into the hole or screen. Dispense into a disposable container until a uniform gray is achieved with no streaks.

1.10 APPLICATION

Bonding: Apply the **TuffPoxy™ 3FS** neat and work into the substrate. The glue line should not exceed 1/8" (0.3cm).

Anchoring: For dry or damp hole, fill the hole 1/2 to 2/3 full from bottom up with **TuffPoxy™ 3FS**. For water-filled hole, fill hole completely full from bottom up. Insert clean anchor turning slowly until the anchor contacts the bottom. DO NOT DISTURB anchor until **TuffPoxy™ 3FS** has fully cured. The hole depth should be approximately 9 times the bolt diameter. The hole diameter should be approximately 1/8" (0.3 cm) larger than the threaded rod diameter. Ensure the holes are properly prepared, (drilled, brushed and blown out) prior to preparing the epoxy cartridge.

Into Concrete: Dispense the material from the bottom of the hole. Fill approximately 5/8 of the hole depth while slowly withdrawing the nozzle. Insert the bolt, or dowel by turning it slowly during insertion. After insertion, the hole should be completely filled with **TuffPoxy™ 3FS** and devoid of all air pockets or voids. Do not disturb or bolt up until cured. ***Into Hollow Block:*** The cartridge is prepared as for concrete. The mixing nozzle is inserted into the bottom of the screen. Completely fill the screen while withdrawing the nozzle. Insert the epoxy filled screen into the hole. Insert the threaded rod to the bottom of the screen while turning slightly clockwise. Do not disturb or bolt up until **TuffPoxy™ 3FS** and devoid of all air pockets or voids. Do not disturb or bolt up until cured.

1.11 CLEAN UP

Uncured **TuffPoxy™ 3FS** can be removed from tools and equipment with PSI's **EnviroClean™** or Isopropyl alcohol, xylene, or mineral spirits.

1.12 STORAGE AND SHELF LIFE

The material should be stored between 40–95°F (4–35°C) in a cool, dry area away from direct sunlight. Shelf life of properly stored, unopened containers is 24 months. Excessive temperature differential and/ or high humidity can shorten the shelf life expectancy.

1.13 LIMITATIONS

Minimum substrate temperature is 40°F (5°C). Precondition **TuffPoxy™ 3FS** to 65–95°F (18–35°C) for easy-dispersing. Always test a small amount of **TuffPoxy™ 3FS** to verify that the product has been thoroughly mixed and will harden properly before proceeding. Do not thin with any solvent.

1.14 CAUTION

Avoid breathing of vapors. Forced local exhaust is recommended to effectively minimize the exposure. NIOSH approved, organic vapor respirators and forced exhaust are recommended in confined areas, or when conditions (such as heated polymer, sanding, etc.) may cause high vapor concentrations. Do not weld on, burn or torch the **TuffPoxy™ 3FS** or any epoxy material. Hazardous vapor is released when an epoxy is burned. Avoid skin or eye contact. Wash skin with soap and water if contact occurs. If eye contact occurs flush with water for 15 minutes and obtain medical attention. Read and understand all caution on can labels and safety data sheets (SDS) before using this material.

DO NOT EXPOSE TO OR APPLY NEAR FIRE OR FLAMES. FOR WELL VENTILATED OR EXTERIOR USE ONLY! KEEP OUT OF REACH OF CHILDREN.

1.15 PROPERTIES	
Mix Ratio (A:B)	1:1
Mixed Color	Gray
Viscosity	Gel/Paste
Gel Time (ASTM 881)	12 Minutes
CURED PROPERTIES	
Initial Cure Time (73°F or 23°C)	2 to 3 hours
Final Cure	3 Days
Compressive Strength (ASTM D-695)	12,250 psi (84 MPa)
Compressive Modulus (ASTM D-695)	300,000 psi (2068 MPa)
Bond Strength at 1 Day (ASTM 882)	1,925 psi (13 MPa)
Bond Strength at 7 Days (ASTM 882)	2,850 psi (19 Mpa)
Elongation (ASTM D-638)	1.58%
Water Absorption (ASTM D-570)	0.1%
Heat Deflection (ASTM D-648)	140°F (60°C)
Viscosity	1/4 inch (0.65) no-sag gel
Gel Time (60 g mass)	10 minutes
Tensile Strength	7,559 psi (51.7 MPa)
Tensile Elongation:	1.59%
Shear Strength (ASTM D732)	2,800 psi (19.3 MPa)
Shrinkage on Cure (ASTM D2566)	0.001
Thermal Compatibility (ASTM C884)	Pass
Heat Deflection Temperature (ASTM D648)	140°F (60°C)

Poly-Tuff Systems International Corporation November 2018

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POLY-TUFF SYSTEMS
INTERNATIONAL
HIGHWAY DIVISION

TECHNICAL DATA SHEET

TuffPaste™

Bug Hole & Bonding Epoxy

DESCRIPTION

TuffPaste™ is a two-component, 1:1, non-sag, high modulus, high strength, 100% solids, moisture-tolerant, solvent free, structural epoxy adhesive developed specifically for use as a matrix with the TuffWrap Structural Strengthening System.

USE:
- Level small surface defects & bug holes
- Provide a smooth surface to apply FRP
- Sealing of cracks and injection port setting
- Bonding of concrete, metals, wood
- Grout bolts, dowels, and pins.

FEATURES:
- Excellent adhesion to most substrates
- Ideal for Vertical & Overhead repairs
- Pick proof sealant
- Fast Set or Extended pot life available
- High abrasion and shock resistance.

TECHNICAL DATA:
TuffPaste™ conforms to ASTM C-881, Type I, II, IV, and V, Grade 3, Classes B & C, & AASHTO M-235

COVERAGE GUIDE:
CFRP Laminates: 100 sq.ft per gallon
Flat Bonding: 125 sq.ft per gallon
Crack Pasting: 50 sq.ft per gallon
1 gallon yields: 231 cu. in. of paste adhesive

PREPARATION:
Maximum adhesion is obtained when surfaces to be bonded are free of oil, grease, rust, loose particles, and other contaminants. Abrasive blast cleaning and mechanical removal methods are recommended.

MIXING:
Before blending **TuffPaste™** Resin and Hardener, stirring may be necessary, especially in case of filled materials. Place 1 Side A (Resin) and 1 Side B (Hardener) into a clean cylindrical container according to the specified MIX RATIO. Mix for 2-1/2 to 3 or until thoroughly blended using either the **PSI Rapid Pail Mixer** "or" a 1/2+ HP heavy-duty, variable speed drill with the **PSI Mortar Paddle** utilizing the **PSI 1 Man Stand**. Mix at slow speed (less than 850 rpm) to avoid air entrainment. If hand mixing, periodically scrape the walls and the bottom of the container to avoid unmixed material which will result in soft spots after curing. For room temperature cure systems, once the Resin and Hardener are mixed together, an exothermic reaction takes place developing some heat which accelerates the process of cure. The viscosity of such a self-heating system first decreases then, at the end of the GEL TIME, increases until the material gels. At this moment the temperature of the product keeps rising, and in the case of large batches can result in overheating with unpleasant fumes and smoke. Do not mix more material than you are able to apply in one step. Remember, you will have less working time at higher temperatures.

PLACEMENT:
TuffPaste™ can be applied by putty knife, trowel, or bulk caulking gun. Filling bug holes, use very thin layers and work into the hole thoroughly in order to prevent bridging the holes rather than filling. As a structural adhesive. Apply the neat mixed **TuffPaste™** to the prepared substrates. Work into the substrate for positive adhesion. Secure the bonded unit firmly into place until the adhesive has cured. Glue line should not exceed 1/8". To seal cracks for injection grouting, place the neat mixed material over the cracks to be pressure injected and around each injection port. Allow sufficient time to set before pressure injecting. For routed vertical and overhead patching: place the prepared mortar in void, working the material into the prepared substrate, filling the cavity. Strike off level. lift line should not exceed 1/8".

CURING/DRY TIME:
Tack Free Time: 2-3 hours
Initial Cure 24 hours
Final Cure 7 days

CLEAN UP:
Uncured **TuffPaste™** can be removed from tools and equipment with **EnviroClean™**, Isopropyl alcohol, xylene, or mineral spirits. Dispose of in accordance with local, state, and federal disposal regulations. Mechanical removal is necessary for cured material.

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PACKAGING:
2, 10 gallon units & 22 oz. dual cartridge

COLOR:
Concrete Gray
Special colors available on request

STORAGE:
Store **TuffPaste™** in its original containers and keep tightly closed. Do not allow the accumulation of water, dirt or other contaminants. Store at 40°F – 90° F (4°C -35°C).

SHELF LIFE:
The shelf life of properly stored **TuffPaste™** is two years from date of manufacture in original unopened container.

LIMITATIONS:
Do not thin with solvents, as this will prevent cure. Not recommended for any application where there may be a sustained tensile load, including overhead applications. Not designed to stop seeping or flowing water. Remove standing water before applying in moist or damp conditions. Always test a small amount to insure that the product is mixed thoroughly and that the material will harden properly before proceeding. Minimum age of concrete must be 3-7 days, depending on curing and drying conditions.

CAUTION:
Avoid breathing of vapors. Forced local exhaust is recommended to effectively minimize the exposure. NIOSH approved, organic vapor respirators and forced exhaust are recommended in confined areas, or when conditions (such as heated polymer, sanding, etc.) may cause high vapor concentrations. Do not weld on, burn or torch the **TuffPaste™** or any epoxy material. Hazardous vapor is released when an epoxy is burned. Avoid skin or eye contact. Wash skin with soap and water if contact occurs. If eye contact occurs flush with water for 15 minutes and obtain medical attention. Please read the Safety Data Sheet (SDS) before use of this or any other Poly-Tuff Systems International product.

KEEP OUT OF REACH OF CHILDREN.

IMPORTANT NOTE:
While all reasonable care is taken in compiling technical data on the Company's products, all recommendations or suggestions regarding the use of such products are made without guarantee, since the conditions of use are beyond the control of the Company. It is the user's responsibility to satisfy himself that each product is fit for the purpose for which he intends to use it, that the actual conditions of use are suitable, and that the information relating to each product has not been altered or superseded.

WARRANTY:
Due to the use of this product beyond our control, we assume no liability for damages of any kind, and the user accepts the product "as is" and without warranties, expressed or implied, from either **Poly-Tuff Systems International** or its agents. The suitability of the product for an intended use shall be solely up to the user. Our only obligation shall be to replace any material proved defective, with our liability limited to the purchase price of materials supplied by us.

TYPICAL PROPERTIES:	
Mix Ratio	1:1
Mixed Color	Gray
Viscosity	Gel/Paste
Gel Time (ASTM 881)	12 Minutes
TYPICAL CURED PROPERTIES	
Initial Cure Time (73°F or 23°C)	2 to 3 hours
Final Cure	3 Days
Compressive Strength (ASTM D-695)	12,250 psi
Compressive Modulus (ASTM D-695)	300,000 psi
Bond Strength at 1 Day (ASTM 882)	1,925 psi
Bond Strength at 7 Days (ASTM 882)	2,850 psi
Elongation (ASTM D-638)	1.58%
Water Absorption (ASTM D-570)	0.1%
Heat Deflection (ASTM D-648)	140°F
Viscosity	1/4 inch no-sag gel
Gel Time (60 g mass)	10 minutes
Tensile Strength	7,559 psi (51.7 MPa)
Tensile Elongation:	1.59%
Shear Strength (ASTM D732)	2,800 psi (19.3 MPa)
Shrinkage on Cure (ASTM D2566)	0.001
Thermal Compatibility (ASTM C884)	Pass
Heat Deflection Temperature (ASTM D648)	140°F (60°C)

Please read all information in the General & Safety Guidelines, Technical Data Sheets, Guide Specifications and Safety Data Sheets (SDS) before applying material. PSI Products are for "Professional Use Only" and preferably applied by professionals who have prior experience with the PSI Products or have undergone training in application of PSI Products. Published technical data and instructions are subject to change without notice. Contact your local PSI representative or visit our website for current technical data, instructions, and project specific recommendations.

LIMITED WARRANTY
PSI warrants its products to be free of manufacturing defects and that they will meet PSI current published physical properties. PSI warrants that its products, when properly installed by a state licensed waterproofing contractor according to PSI guide specifications and product data sheets over a sound, properly prepared substrate, will not allow water migration for a period of 12 months. Seller's sole responsibility shall be to replace that portion of the product which proves to be defective. There are no other warranties by PSI of any nature whatsoever expressed or implied, including any warranty of merchantability or fitness for a particular purpose in connection with this product. PSI shall not be liable for damages of any sort, including remote or consequential damages resulting from any claimed breach of any warranty whether expressed or implied. PSI shall not be responsible for use of this product in a manner to infringe on any patent held by others. In addition, no warranty or guarantee is being issued with respect to appearance, color, fading, chalking, staining, shrinkage, peeling, normal wear and tear or improper application by the applicator. Damage caused by abuse, neglect and lack of proper maintenance, acts of nature and/or physical movement of the substrate or structural defects are also excluded from the limited warranty. PSI reserves the right to conduct performance tests on any material claimed to be defective prior to any repairs by owner, general contractor, or applicator.

DISCLAIMER
All guidelines, recommendations, statements, and technical data contained herein are based on information and tests we believe to be reliable and correct, but accuracy and completeness of said tests are not guaranteed and are not to be construed as a warranty, either expressed or implied. It is the users responsibility to satisfy himself, by his own information and test, to determine suitability of the product for his own intended use, application and job situation and user assumes all risk and liability resulting from his use of the product. We do not suggest or guarantee that any hazard listed herein are the only ones which may exist. Neither seller nor manufacturer shall be liable to the buyer or any third person for any injury, loss or damage directly or indirectly resulting from use of, or inability to use, the product. Recommendations or statements, whether in writing or oral, other than those contained herein shall not be binding upon the manufacturer, unless in writing and signed by a corporate officer of the manufacturer. Technical and application information is provided for the purpose of establishing a general profile of the material and proper application procedures. Test performance results were obtained in a controlled environment and PSI makes no claim that these tests or any other tests, accurately represent all environments.

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POLY-TUFF SYSTEMS
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HIGHWAY DIVISION

TECHNICAL DATA SHEET

TuffSat™

Structural Epoxy Encapsulation Impregnating Resin

1.01 DESCRIPTION

TuffSat™ is a two-component, Hi-modulus, low viscosity, high strength, 100% solids structural epoxy adhesive for use with PSI Structural Strengthening Systems. TuffSat™ provides a long working time for application with no offensive odor. TuffSat™ is a high elongation material which gives optimum properties as a matrix for the TuffWrap™ System Please use the right product grade that complies with VOC regulations as per federal, state, statutory bodies, county and city regulations/codes at the place of installation of product.

1.02 USES

- Developed specifically for the PSI TuffWrap™ Systems
- Impregnating resin to FRP laminate
- Fire & Blast resistance
- Damage to structural components
- Increased live loads
- Seismic strengthening
- Column wrapping
- Masonry walls
- Aging construction materials
- Vehicle impact repair
- Change in structural system
- Removal of walls or columns

1.03 FEATURES

- Non-corrosive
- Alkali Resistant
- High Strength
- Light Weight
- Lo-Modulus, Low Viscosity, High Strength
- Extended pot life and long working time
- Excellent adhesion to concrete, steel, masonry, wood and other structural materials

1.04 TECHNICAL DATA (??? WHAT IS ON PHYSICALS CHART???)

Material & Curing conditions @ 73°F (23°C) & 50% R.H.:
Viscosity mixed: Approx. 500 cps
Tack Free: 14-16 hours
Mixing Ratio: Mix entire unit, do not batch
Reactivity: 6-7 Hours
Heat Deflection Temp: (ASTM D-648) 7 day
(fiber stress loading solution = 264 solution (1.8MPa) 120°F (50°C):
-40°to 140°F (40° to 60°C)

1.05 COVERAGE

The first coat can be applied at a rate 2-2 1/2 gallons/sqft (0.8-1 liter/sqm) or 40-50 sqft/gallon. Additional coats can be applied at the rate of 1 gallon/100 sqft (0.41 liter/sqm) or 100 sqft per gallon.

1.06 PREPARATION

Surface must be clean, dry, and structurally sound and must be free of moisture and frost. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles, disintegrated materials and other bond inhibiting materials from the surface. Existing uneven surfaces must be filled with an appropriate repair mortar. Minor imperfections can be filled with **TuffPaste™**. The adhesive strength of the concrete should be verified after surface preparation by random pull-off testing (ACI 503R) at the discretion of the engineer. Minimum tensile strength, 200 psi (1.4 MPa) with concrete substrate failure.

1.07 MIXING

Mix entire units, do not batch mix. Mix for 2 1/2 to 3 or until thoroughly blended using either the PSI's **Rapid Pail™** Mixer or a 1/2+ HP heavy-duty, variable speed drill with a "Jiffy" mixer or our PSI's **Mortar Paddle™** utilizing the PSI's **1 Man Stand™**. *See Equipment Data Sheet.

Mix at slow speed (less than 850 rpm) to avoid air entrainment. In case of hand mixing, periodically scrape the walls and the bottom of the container to avoid unmixed material (which will result in soft spots after curing. Mix thoroughly for 3 minutes with until uniformly blended. Mix only quantities that can be applied within the product's pot life.

1.08 INSTALLATION

Dry Layup: Spread **TuffSat™** at a rate 2-2 1/2 gallons/sqft (0.8-1 liter/sqm) or 40-50 sqft/gallon with a brush or roller over the clean and dry concrete surface. Immediately afterward, lay in or apply the **TuffWrap™** fabric while ensuring the proper orientation of fibers by accurately flattening it by hand (protected by rubber waterproof gloves) and rollers. Squeegee and draw the air pockets out towards the edges. Roll out or squeegee all entrapped air and ensure that each individual layer is firmly bedded and adhered to the preceding layer or substrate. Apply a second coat of **TuffSat™** 1 gallon/100 sqft (0.41 liter/sqm) or 100 sqft per gallon.

Wet Layup: On larger projects, the impregnation process for **TuffWrap™** may be accomplished using a mechanically driven fabric saturating device. The **TuffWrap™** fabric may also be manually saturated by hand on

a polyethylene covered work table using a roller prior to placement. In either case, installation of this system should be performed only by a specially trained contractor.
(See guide specifications for complete applications.)

1.09 PROTECTIVE COATINGS
TuffCoat™ UV resistant top coat can be applied when the surface has become tack free. In the case of a cementitious or plaster final coating, apply sand by hand for better bonding surface while the final coat of epoxy is still tacky. If paint is to be the final coating, paint between 24 and 72 hours after final application of epoxy. If more than 72 hours after application, prepare the surface of the final coat of epoxy by light sandblast or hand sanding to slightly etch the surface.

1.10 PACKAGING
10-gallon kit: 5 gallon (18.9 liters) pail Side-A and 5 gallon (18.9 liters) pail Side-B
11- gallon kit: 55 gallon (104 liters) drum Side-A and 55 gallon (105 liters) pail Side-B
550-gal kit: 275 gallon (520 liters) tote Side-A and 275 gallon (520 liters) tote Side-B

1.11 COLOR
Clear to Light Amber

1.12 STORAGE & SHELF LIFE
Store dry at 40°F – 90°F (4°C – 35°C)
Condition material to 65°F – 75°F before using (18°C – 24°C)
Shelf life of properly stored, unopened containers is 24 months.

1.13 CLEAN UP
Ventilate area. Confine spill. Collect with absorbent material. Dispose of in accordance with current, applicable local, state and federal regulations. Uncured material can be removed with approved solvent. Cured material can only be removed mechanically.

1.14 LIMITATIONS
PSI recommends design calculations be made by a certified independent licensed PE. Encapsulation of Concrete with **TuffWrap™** is not recommended in freeze/thaw zones, as the system is a vapor barrier.

1.15 SAFETY
Eyes: Hold eyelids apart and flush thoroughly with water for 15 minutes.
Skin: Remove contaminated clothing. Wash skin thoroughly for 15 minutes with soap and water.
Inhalation: Remove person to fresh air.
Ingestion: Do not induce vomiting. In all cases, contact a physician immediately if symptoms persist. Obtain, read, and understand the Safety Data Sheet (SDS) before use of this or any other Poly-Tuff Systems International product. With **TuffWrap™**, gloves are recommended to be worn to protect against skin irritation. When cutting **TuffWrap™** fabric protect against airborne carbon dust generated by the cutting procedure, by the use of an appropriate, NIOSH approved respirator.

READ SDS PRIOR TO USING PRODUCT. KEEP OUT OF THE REACH OF CHILDREN.

1.16 PHYSICALS		
Viscosity		100-500 cps
Gel Time (60 g mass)		45 minutes
Tack Free Time (73°F or 23°C)		3 to 5 hours
Tensile Properties (ASTM D638)		
7 day cure	Tensile Strength:	10,000 psi (67.0 MPa)
	Tensile Elongation:	1.2%
Bond Strength (ASTM C882)		
	2 day cure:	2,100 psi (14.5 MPa)
	14 day cure:	2,200 psi (15.2 MPa)
Compressive Properties (ASTM D695)		
7 day cure	Compressive Strength:	11,000 psi (75.9 MPa)
	Compressive Modulus:	300,000 psi (2,070 MPa)
Shear Strength (ASTM D732)		6,000 psi (41.4 MPa)
Flexural Strength (ASTM D790)		7,500 psi (51.7 MPa)
Shrinkage on Cure (ASTM D2566)		0.001
Thermal Compatibility (ASTM C884)		Pass
Heat Deflection Temperature (ASTM D648)		123°F (50°C)
Water Absorption (ASTM D570)		0.3% (24 hr)

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POLY-TUFF SYSTEMS
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TECHNICAL DATA SHEET

TuffWrap™ 300UD

Stitch-Bonded Uni-Directional FRP Fabric For PSI Structural Strengthening System

1.01 DESCRIPTION

TuffWrap™ 300UD is a 300 gram lightweight, high tensile strength, stitch-bonded, uni-directional carbon fabric that is produced from our continuous, tow-carbon fiber. It easily wets out with TuffSat™ saturate resin and can be installed using either the "wet lay-up" or "dry lay-up" technique. The light weight of the fabric allows dry application to TuffSat™ epoxy coated surfaces followed with a saturating with coat of TuffSat™, and finally by TuffCoat™ anti-carbonization and UV resistant topcoat significantly simplifying field application. PSI TuffWrap™ Systems are used to obtain a bonded FRP (fiber reinforced polymer) field laminate reinforcement system that will strengthen and enhance the performance of structural elements once installed. Please use the right product grade that complies with VOC regulations as per federal, state, statutory bodies, county and city regulations/codes at the place of installation of product.

1.02 USES

- Increase load bearing properties in columns, walls, beams and slabs
- Rehabilitate structural integrity due to impact or deterioration
- Changes or increases in design criteria
- Increase seismic ductility and axial loads on concrete columns and elements
- Strengthen concrete bridges, silos, tunnels, parking garages and warehouse
- Blast mitigation
- Repair of structures damaged by fire

1.03 ADVANTAGES

- Easy installation
- Lightweight/ high strength to weight ratio
- Low impact aesthetics
- Flexibility to conform to shape variances
- High strength, alkali resistant, non-corrosive

1.04 TECHNICAL DATA

Complies with NSF/ANSI Std. 61 Requirements

1.05 COVERAGE

See under section 1.10 of this Technical Data Sheet coverage rates.

1.06 PREPARATION

Surface may be dry or damp, but free of standing water and frost. Surface should be sound with no loose materials. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles, disintegrated materials and other bond inhibiting materials from the surface. Consult **TuffWrap™** Systems technical data sheets for additional information on surface preparation. Existing uneven surfaces must be filled with an appropriate repair mortar like **TuffPaste™** Epoxy or **TuffPatch™ VOH** concrete repair. The adhesive strength of the concrete should be verified after surface preparation by random pull-off testing (ACI 503R) at the discretion of the engineer. Minimum tensile strength, 200 psi (1.4 MPa) with concrete substrate failure. Use shotblast, blast clean, **GlassBlast™** or another approved mechanical means to provide an open roughened texture. Some applications are at the engineer's discretion; the contact between the substrate and the fabric may be determined to be non-critical. In these cases, a thorough cleaning of the substrate using low pressure sand or water blasting is sufficient.

1.07 MIXING

Ready to use, no mixing required.

1.08 INSTALLATION

TuffWrap™ 300UD is only applied as a component of the **TuffWrap™** System.

1. The **TuffWrap™ 300UD** material should be cut to the proper dimensions specified using heavy duty shears or a utility knife.
2. Cut sections of **TuffWrap™ 300UD** can be temporarily stored by carefully rolling fabric into a tight roll. Do not fold or crease the fabric. Fabric should be kept free of dust, oils, moisture and other contaminants at all times.
3. Apply the **TuffWrap™ 300UD** fabric directly into uncured **TuffSat™** saturate applied on the substrate. There is no need to "pre-wet" the **TuffWrap™ 300UD** fabric with **TuffSat™** saturate prior to applying the fabric against the substrate.
4. Using a rib roller or squeegee, press the fabric against the substrate until visual signs of **TuffSat™** saturate are observed bleeding through the fabric. The rib roller or squeegee should only be run along the direction of the primary fibers in the fabric.
5. Apply a layer of **TuffSat™** saturate over the top of the **TuffWrap™ 300UD** fabric to completely encapsulate the fabric. Consult with the **TuffSat™** saturate data sheet on details for applying **TuffWrap™** saturate. If Required: Apply a second layer of fabric while the saturate is still tacky. When tack free, coat the exposed surface of final fabric layer using a protective layer of **TuffCoat™**.

1.09 CURING/DRYING TIME

Varies with temperature and humidity.

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1.10 PACKAGING
Roll Sizes:

- 12.5" x 300' Roll (312.5 sqft: 28.9 sqm)
- 25" x 300' Roll (625 sqft: 58 sqm)
- 50" x 300' Roll (1250 sqft: 116 sqm)

1.11 COLOR
Black

1.12 STORAGE AND SHELF LIFE
Store in a dry facility between 40-95°F (5-35°C) away from direct sunlight and sources of heat.Shelf life of properly stored, unopened containers is 24 months. Clean tools and equipment with Xylene or PSI's **EnviroClean™**.

1.13 LIMITATIONS
Poly-Tuff Systems International recommends design calculations be made by a certified independent licensed PE. Encapsulation of Concrete with **TuffWrap™** is not recommended in freeze/thaw zones OR as the system is a vapor barrier.

1.14 SAFETY
Obtain, read, and understand the Safety Data Sheet (SDS) before use of this or any other PSI product. With **TuffWrap™ 300UD**, gloves are recommended to be worn to protect against skin irritation. When cutting **TuffWrap™ 300UD** fabric protect against airborne carbon dust generated by the cutting procedure by use of an appropriate, NIOSH approved respirator.

1.15 CERTIFICATION:
Installation of **TuffWrap™** products should be performed only by Poly-Tuff Systems International specially trained & certified contractors. **TuffWrap™** Fabrics are manufactured in accordance with PSI's written and published data. A Certificate of Conformance is provided with each shipment.

1.16 PHYSICALS	
0° Carbon Fiber: TuffWrap™ 300D	9.24 oz/sqy (313 g/sqm)
A-Glass Veil: C-LA 0912	1.20 oz/sqy (41 g/sm)
Polyester Stitch 167dtex	0.50 oz/sqy (17 g/sqm)
Total Fabric Weight	10.94 oz/sqy (371 g/sqm)
Fabric Construction:	
Stitch Length	0.13 in (3.2 mm)
Stitch Pattern	Tricot
Dry Thickness	0.019 in (0.48 mm)
Standard Roll Length	345 ft (105 m)
Dry Roll Width	50 in (1270 mm)
Typical Fiber Properties (Dry):	
Tensile Strength (ASTM D4018)	735 ksi (5,064 MPa)
Tensile Modulus (ASTM D4018)	35.3 Msi (243 GPa)
Ultimate Elongation at Break (ASTM D4018)	2.09%
Composite Average Properties*	
Tensile Strength (ASTM D3039)	211 ksi (1,455 MPa)
Tensile Modulus (ASTM D3039)	15.0 Msi (104 GPa)
Elongation at Break (ASTM D3039)	1.4%
Composite Design Properties**	
Tensile Strength (ASTM D3039)	180 ksi (1,237 MPa)
Tensile Modulus (ASTM D3039)	13.5 Msi (93 GPa)
Ultimate Elongation at Break (ASTM D3039)	1.3%

** Average values shown. Typical fiber Volume Fraction (FVF) is 40.5% values shown are TuffWrap™ 300UD without protective coating.*
*** Based on ACI 440.2R Document; Average - 3 Standard Deviations*

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POLY-TUFF SYSTEMS
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TECHNICAL DATA SHEET

TuffCoat™ UV

Structural Strengthening UV Protective Topcoat

DESCRIPTION

TuffCoat™ UV forms a weatherproof barrier against nature's harsh extremes. Steel and concrete structures expand and contract in response to the weather and structural stresses. Unlike typical exterior coating, this coating fills and bridges hairline cracks, helping to prevent damaging water penetration. It passes Federal Specification TT-C-555B, sec. 3.3.3, withstanding 98 mph wind-driven rain. This premium quality coating provides UV protection as well as aesthetic benefits. It is available in white and dove gray, and can be tinted to many custom colors to match existing substrates.

USES:

- Waterproof masonry coating.

FEATURES:

- High-Build Coating
- 100% Acrylic Polymer
- Bridges Hairline Cracks
- Lifetime Flexibility – Won't Crack or Peel
- Superior Alkaline Resistance
- Gives Mold, Mildew, & Algae Resistant Coating
- Withstands Wind-Driven Rain
- Self-Priming
- Superior Adhesion on Any Surface
- UV Resistant
- Apply as Low as 35°
- Soap & Water Clean-up

COVERAGE GUIDE:

Smooth Surface: 130 sq.ft /gal.
Rough: 90 sq.ft /gal.
At: 16 mil wet, 7 mil dry

PREPARATION:

Apply coating to clean, sound surfaces. Large cracks, crumbling areas or water damage may need professional repair.
Cleaning the Surface: Old or existing surfaces; remove dirt, grease, mildew, algae, efflorescence and loose, peeling coating. **TuffCoat™ UV** should be applied within 48 hours of final application of **TuffSat™**.
Filling in Cracks and Patching: Hairline cracks (1/16'' or less) can be covered with this product.

MIXING:

Prior to use, mix **TuffCoat™ UV** at slow speed with drill and mixing paddle to ensure uniform color and aggregate disbursement and to minimize air entrapment. In multi-pail applications, mix the contents of each new pail into the partially used previous pail to ensure color consistency and smooth transitions from pail to pail.

PLACEMENT:

Roller is the preferred method of application: For best results, use a quality 1'' to 1-1/4'' nap synthetic roller cover. Always roll with a fully loaded wet roller (never dry roll).
Do not stretch this coating: Be sure all low spots and gaps are covered. It is normal for painted surfaces to show roller marks.
Airless Sprayer: Use 1-2 gallons per minute; capacity pump at 2500 psi minimum with a 0.025 tip. Adjust pressures to suit your needs. Always follow spray application by back-rolling with a wet applicator. This will ensure that the coating is worked into the surface. Thin with water for spray application (no more than 8 oz. per gallon), if needed.
Brush on is not recommended: Use brush only for small touch-ups.

Paint only when surface and air temperatures are between 35°F – 90°F (2°C – 32 °C). Use a paint paddle to stir coating up from the bottom of pale. Intermix containers of the same color only. Apply this product heavily to achieve best weatherproofing characteristics.

DRY TIME:

1 Hour to Touch, 4 Hours to recoat at 77F @ 50% Relative Humidity.

CLEAN UP:

Clean all tools and equipment immediately with water or **PSI Enviro-Clean™**. Cured material may be removed by mechanical means.

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PACKAGING:
1 gallon cans – 4 per carton, 5 gallon pails, 55 gallon drums

COLOR:
Available in a broad range of colors and textures for design versatility upon request.

STORAGE:
The material should be stored between 40°-95°F (4°-35°C) in a cool, dry area away from direct sunlight.

SHELF LIFE:
Shelf life of properly stored, unopened containers is 24 months. Excessive temperature differential and or high humidity can shorten the shelf life expectancy.

LIMITATIONS:
- Do not freeze.
- Keep container closed when not in use.
- Do not transfer contents to other containers for storage or disposal.
- In case of spillage, absorb with inert material such as sand or kitty litter.
- Dispose of contaminated absorbent, container and/or unused contents in accordance with local, state, and federal regulations.

IMPORTANT NOTE:
While all reasonable care is taken in compiling technical data on the Company's products, all recommendations or suggestions regarding the use of such products are made without guarantee, since the conditions of use are beyond the control of the Company. It is the user's responsibility to satisfy himself that each product is fit for the purpose for which he intends to use it, that the actual conditions of use are suitable, and that the information relating to each product has not been altered or superseded.

WARRANTY:
Due to the use of this product beyond our control, we assume no liability for damages of any kind, and the user accepts the product "as is" and without warranties, expressed or implied, from either **Polytuff System International** or its agents. The suitability of the product for an intended use shall be solely up to the user. Our only obligation shall be to replace or pay for any material proved defective, with our liability limited to the purchase price of materials supplied by us.

TYPICAL PROPERTIES:	
Vehicle Type	Acrylic Polycarbonate Resin
Sheen	0-6 Units @ 60° angle
Solids by Volume	43%
Solids by Weight	56%
Weight per gallon	10.8 lbs/gal
VOC	Less than 50g/L
Viscosity	104 – 110 Krebs Units
To the Touch	1 hour
Recoat	4 hours
Tensile Strength	325 psi
Elongation (%)	800 psi

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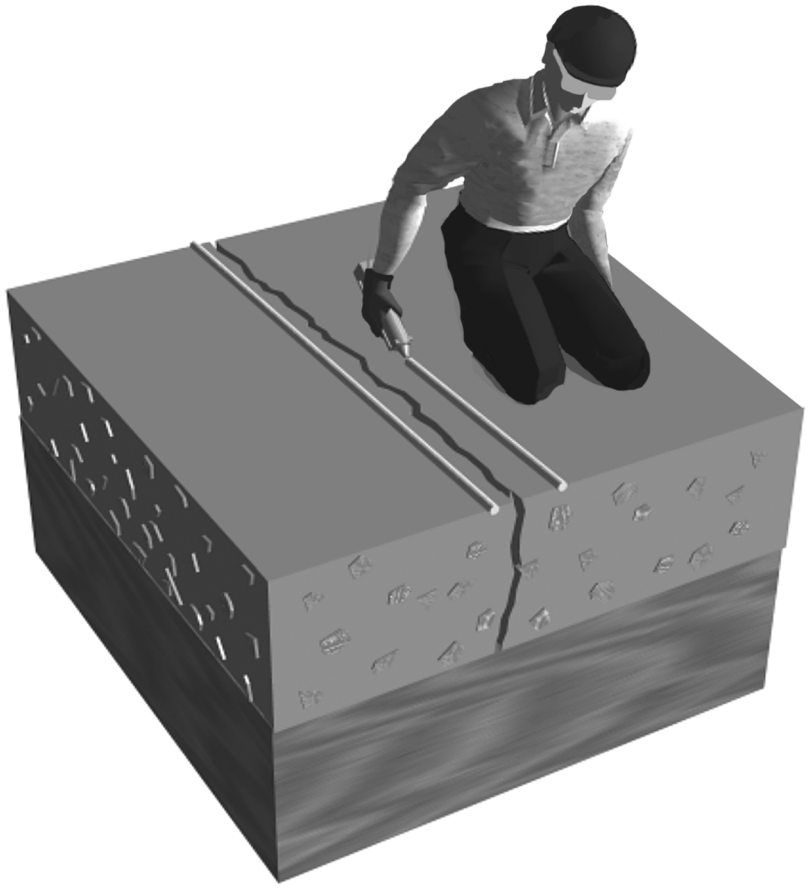
Advancing concrete knowledge

ACI RAP Bulletin 2

FIELD GUIDE TO
CONCRETE REPAIR
APPLICATION PROCEDURES

Crack Repair by Gravity Feed with Resin



Field Guide to Concrete Repair Application Procedures

Crack Repair by Gravity Feed with Resin

Reported by ACI Committee E706

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ACI Repair Application Procedure 2.

Introduction

This topical application for crack repair uses a thin polymer resin to fill the crack. Penetrating by gravity alone, the resin fills the crack and forms a polymer plug that seals out water, salts, and other aggressive elements. In some cases, a structural repair of the crack can be achieved.

Before any concrete is repaired, the cause of the damage must be assessed and the objective of the repair must be understood.

Typical causes of concrete cracking include steel corrosion, freezing and thawing, sulfate attack, and alkali-aggregate reaction (AAR). Poor practices during the original construction can cause excessive shrinkage or settlement in the structure. Improper joint spacing and load imbalances also contribute to cracking.

What is the purpose of this repair?

The primary objective of this repair is to fill the crack and structurally bond the concrete on both sides of the crack. This repair is to seal cracks that are not moving—for example, shrinkage cracks, and settlement cracks that have stabilized. By penetrating and filling the cracks, the resin is able to form a polymer plug that seals the crack, keeping out water, chlorides, carbon dioxide, sulfates, and other aggressive liquids and gases.

This repair method is, therefore, a way to reduce possible future deterioration caused by freeze-thaw cycles, steel corrosion, and chemical attack of the concrete.

A common secondary objective of this repair is the protection of the entire deck or floor with a penetrating sealer. Instead of gravity feeding individual cracks, a flood coat on the entire deck or floor is often done to seal the concrete surface, in addition to "healing" the cracks. This is why the term sealer/healer is often associated with this application and material.

Finally, it is occasionally an objective to achieve a structural repair of the cracks using this method. Consult a qualified structural engineer if it is determined that a structural repair is needed. While many of these resin materials exceed the strength of the concrete, ensuring a structural repair with full depth penetration by gravity is difficult. Special care must be taken in these instances to ensure the cracks are open, clean, and not contaminated with any bond-inhibiting materials such as oil and grease, which can often be the case on horizontal decks and floors exposed to traffic. If a structural repair of the crack is critical, pressure injection may be a preferred option (see RAP 1).

When do I use this method?

This repair can only be applied to horizontal concrete elements such as bridge and parking decks, floor slabs, plaza decks, and similar surfaces.

Gravity feed of resin is not effective for repairing moving cracks. This is because the materials are unable to act as a flexible joint material. In these cases it is most often necessary to rout and seal the crack to create a joint capable of movement.

Likewise, gravity feed of resin should not be viewed as a long-term solution to cracking caused by corrosion, sulfate attack, or AAR. At best, this repair will keep out water, chlorides, and sulfates, which may slow the progress of future damage around the crack, but it certainly will not stop it indefinitely. In these situations, a complete repair and protection approach is required to address the entire area affected, not just the cracks.

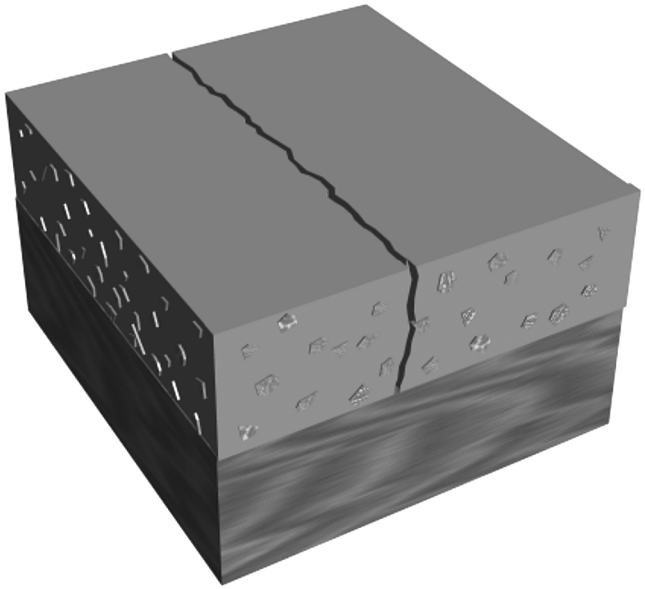

Fig. 1—Cracks must be clean and free of debris.

How do I prepare the surface?

Proper preparation of the cracks for gravity feed of resin is essential to a successful repair. All potential barriers to penetration must be removed. Clean away all dirt, oil, grease, paints, striping, curing compounds, and sealers. To prepare large areas for flood treatments, consider dry sand- or shot-blasting.

For cleaning individual cracks, begin with wire brushes and wheels, followed by high pressure, oil-free compressed air to remove dust from the surface of the crack.

If the crack surface is packed solid with dirt and/or debris, remove it prior to applying the resin. In this case, remove the debris by routing the crack surface with crack-chasers or grinders and follow up with compressed air to remove fines. This routing of the crack has the advantage of producing a wider surface opening. Vacuum cleaning of cracks can prevent dust from getting packed into the crack, which can hamper resin penetration.

Allow the repair area to dry for at least 24 hours before applying the resin. Moisture within the cracks and the concrete pores can prevent penetration because the resin materials are very thin and are not able to easily displace water.

How do I select the right material?

The two most common polymer materials used for gravity feed crack repairs are epoxies and high molecular weight methacrylates (HMWM). Both must be formulated to have a very thin consistency (low viscosity) and low surface tension to enable them to easily penetrate fine cracks by gravity alone. Viscosities below 200 centipoise (cps) should be a minimum requirement. Many epoxies are available with viscosities below 100 cps. Most HMWMs have viscosities below 50 cps.

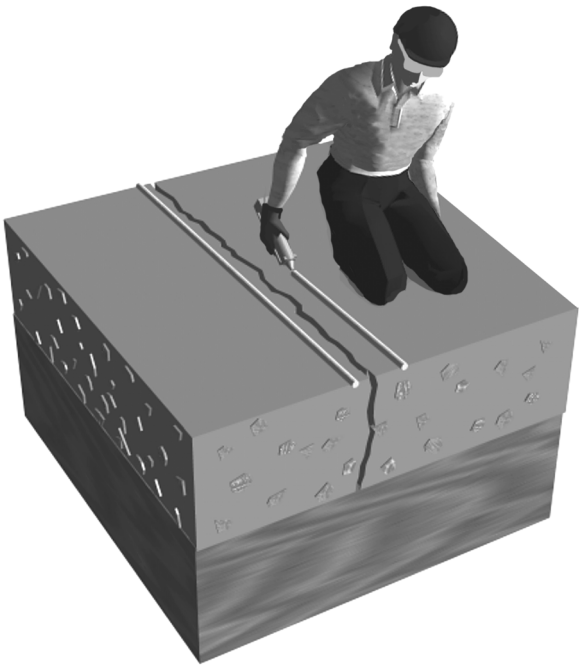

Fig. 2—On individual cracks, a sealant can be used to create a reservoir.

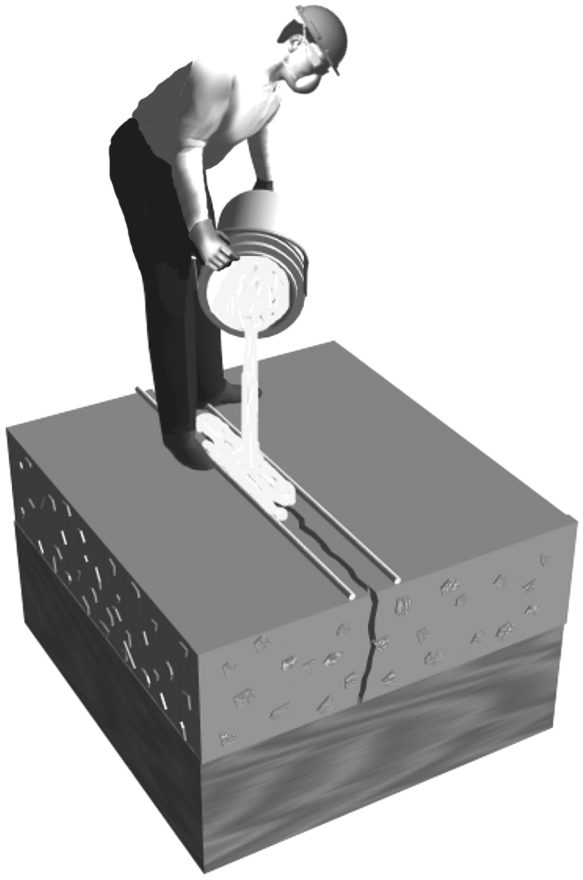

Fig. 3—Continue to gravity-feed the resin and "top off" until crack is completely filled.

While both resin types are able to form the desirable polymer plug within the crack, they do have their differences. The epoxies tend to bond better when moisture is present within the concrete pores and they are easier and can be safer to mix and apply. HMWMs are generally lower in viscosity and surface tension and have less critical mixture ratios than epoxies. They can also be formulated to set faster. Successful applications of both polymer types have been documented in concrete cracks less than 0.006 in. (0.15 mm) wide.

What equipment do I need?

For small to midsize projects (up to 10,000 ft^2 [930 m^2]):

- 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 ft^2 [930 m^2]):

- 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.

What are the safety considerations?

Epoxies and HMWMs are hazardous materials and should be treated as such. Job-site safety practices should include, but are not limited to, the following where applicable:

- Material Safety Data Sheets (MSDS). Adhere to all manufacturer recommendations for special safety equipment and requirements;
- Protective clothing. Cover the body fully and use adequate footwear;
- Protective eyewear. Face shields are recommended as a minimum;
- Wear rubber gloves for hand protection;
- Have eye wash facilities available;
- Take special precautions with flammable or combustible materials;
- Ventilate closed spaces. Wear appropriate masks to protect against fumes;
- Store hazardous materials in a secured area;
- Have necessary cleaning materials on hand; and
- Notify occupants within the structure being repaired prior to beginning work.

It is the responsibility of the user of this document to establish health and safety practices appropriate to the specific circumstances involved with its use. ACI does not make any representations with regard to health and safety issues and the use of this document. The user must determine the applicability of all regulatory limitations before applying the document and must comply with all applicable laws and regulations including, but not limited to, United States Occupational Safety and Health Administration (OSHA) health and safety standards.

Special note regarding HMWM mixing: These polymers utilize a two-part catalyst usually consisting of an initiator (such as a peroxide) and a promoter (such as cobalt napthanate). These two materials must never come into direct contact with one another or a violent reaction may occur. It is important that the promoter first be added to the

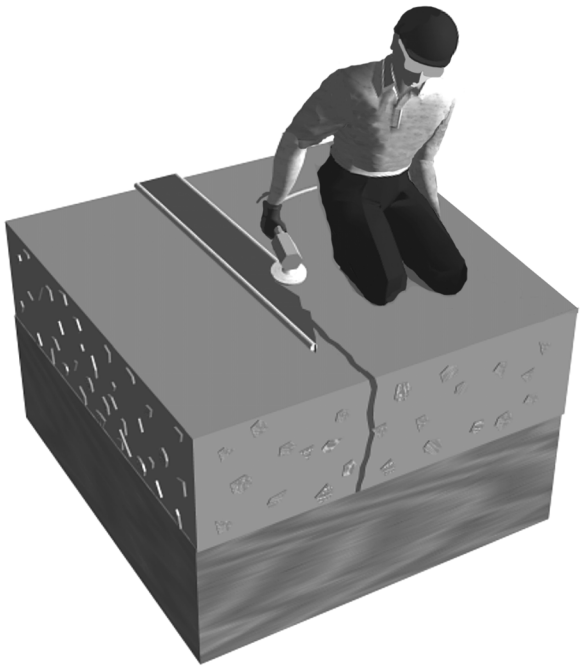

Fig. 4—Removal of sealant and grinding of excess resin.

HMWM monomer and mixed uniformly throughout before adding the initiator. Some formulations are available as a two-component system (pre-promoted) to avoid this potentially dangerous situation. Always refer to the material manufacturer's instructions.

Preconstruction meeting

Prior to proceeding with the repair, a preconstruction meeting is recommended. The meeting should include representatives from all participating parties (owner, engineer, contractor, materials manufacturer, etc.) and specifically address the parameters, means, methods, and materials necessary to achieve the repair objectives.

Repair procedure

1. Mix the resin.

After preparing the surface, mix the resin according to the manufacturer's instructions. If cracks run all the way through and the underside of the deck or slab is accessible, seal the underside of cracks at least temporarily to prevent resin loss (see RAP 1).

2. Pour the resin.

Pour the mixed material (within the pot life of the resin) over the top of the cracks and allow it to penetrate. Keep filling the cracks until they will no longer accept resin.

For flood coat applications, distribute the resin evenly over the deck initially and then puddle the resin over the cracks. On smooth surfaces, use flat rubber squeegees; on tined or irregular surfaces, use brooms or rollers.

3. Inspect the filling.

Look for signs of penetration such as air bubbles escaping from the cracks as the resin displaces the air.

ALLOW TIME FOR PENETRATION. Twenty to 30 minutes should be a minimum. Also, be aware that several minutes may pass before resin has fully penetrated tight cracks and more resin may still be required.

4. Remove excess resin.

Once all cracks have been filled to refusal, remove the excess surface resin with a flat rubber squeegee.

5. Apply sand.

For safety purposes, lightly broadcast sand into the remaining resin to produce a skid-resistant surface. Apply about 1 to 2 lb/yd^2 (0.5 to 1.0 kg/m^2) of an ordinary 8/20 blasting sand (or similar) within 20 to 30 minutes after the last application.

6. Finish smooth (if desirable).

After the polymer has fully cured, remove sealant and grind smooth. Be careful not to inhale vapors during the grinding of the polymers.

How do I check the repair?

Quality control tests should be taken on site to verify:

- Resin properties—taken in the form of cured prisms (ASTM D 495 type) to be checked for compressive strength as an indicator of proper mixture ratio and cure;
- Penetration depths—verified by cores taken at regular intervals. For very fine cracks, the cores may be analyzed under "black light" to highlight resin penetration depth within the cracks; and
- For structural repair checks, take cores and follow ASTM C 496, "Splitting Tensile Test."

Sources for additional information

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