

INSTALLATION GUIDE

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1. PRE- INSTALLATION

- 1.01. Assemble all tools, equipment, required documents and copy of specifications and project drawings.
- 1.02. Clear work area providing adequate work space and protect all surfaces not receiving repairs with plastic sheeting.
- 1.03. Fabric for small installations not requiring use of saturator may be pre-cut and stored flat or on a roll of no less than 8-inch radius (200mm)
- 1.04. MSDS' s, Safety and emergency instructions to be posted at all times.

- 1.05. Protective clothing and equipment to be worn for duration of job.
- 1.06. Refer to section 3.02 of manufacturers specifications for environmental conditions.

2. SURFACE PREPARATION

2.01. CONCRETE

1. Unsound areas of the concrete substrate (such as broken pieces, delaminated areas, etc.) must be removed to reveal sound material.
2. If corrosion of the existing steel reinforcement exists, the steel and concrete must be repaired before installation of the FRP. Any deteriorated concrete or corroding reinforcing steel must be repaired per ICRI Guideline #03730. **DO NOT COVER CORRODING REINFORCING STEEL WITH FRP.**
3. Voids in the concrete substrate greater than 0.50 in (500 mm) in depth must be filled with an appropriate repair mortar. The repair material shall be selected per ICRI Guideline #03733 and the project requirements. 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).
4. 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.
5. Prior to initiating surface preparation procedures, the Contractor shall first prepare a representative sample area. The sample area shall be prepared in accordance with the requirements of this Specification, and shall be used as a reference standard depicting a satisfactorily prepared substrate.
6. Uneven concrete surface irregularities (offsets) must be ground and smoothed to less than 0.04 in (1 mm).
7. 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.
8. When bond of the FRP 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.
9. When structural performance relies only on the bond of the FRP to itself at lap splices, the substrate must be cleaned of any dust, debris, or laitance.

2.02. MASONRY

1. 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.

2. Care must be taken to avoid excessive removal of mortar during abrasive blasting.
3. Uneven surface irregularities (offsets) must be ground and smoothed to less than 0.04 in (1 mm).
4. 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.

2.03. PLASTER

1. Although not recommended, FRP shall be applied to plaster ONLY when specified by the designer, and only in contact critical applications, never in bond critical applications.
2. Surface materials (laitance, surface lubricants, broken plaster 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.
3. Voids, missing plaster etc shall be patched with an appropriate patching compound.
4. Uneven surface irregularities (offsets) must be ground and smoothed to less than 0.04 in (1 mm).
5. 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. SATURATOR SETUP

- 3.01 Saturator must be placed on a level surface with a minimum 4' (1.2M) working area all around.
- 3.02 Gap in upper rollers to be set to 0.02" (0.5mm) for carbon and 0.04" (1mm) for glass.
- 3.03 Saturator resin bath and all rollers shall be cleaned with an appropriate solvent at least once during each work day and at the end of each work day. Clean up shall be initiated at first sign of resin 'gel' in resin bath and must be completed before cure.
- 3.04 Carbon fabric shall be routed under hold down bar in resin bath and come UP through upper rollers and be taken up on a PVC roll until the required length is reached.
- 3.05 Glass fabric shall be routed under hold down bar in resin bath and come DOWN through upper rollers and be taken up on a PVC roll until the required length is reached.

- 3.06 Cut and saturated fabric on PVC rolls shall be stored in a clean area free from dust and direct sunlight until applied to the surface (max 15 min).

4. APPLICATION OF FRP PRIMER

- 4.01. All surfaces must be clean, dry and free of all dust and debris.
- 4.02. Prepare epoxy primer in accordance with manufacturers instructions. Mix only the quantity of primer 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.
- 4.03. To avoid allowing primer to cure prior to FRP application, apply primer only to surfaces, which will be laminated within 3 hours.
- 4.04. 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.
- 4.05. Apply primer to repair surfaces with a medium nap roller or non-shedding brush. Apply 2nd coat, if needed, to areas, which have thoroughly absorbed the 1st coat.
- 4.06. Using a brush, stipple primer into any voids, bug holes etc.
- 4.07. When priming masonry, particular attention must be paid to priming the mortar.

5. APPLICATION OF FILLER / ADHESIVE (Where needed)

- 5.01. All surfaces must be primed. Primer, which has cured for over 24hrs, must be abraded with a light sand sweep, sandpaper or abrasive pad.
- 5.02. Prepare epoxy filler/paste in accordance with manufacturers 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.
- 5.03. To avoid allowing filler to cure prior to FRP application, apply primer only to surfaces, which will be laminated within 1 hour.
- 5.04. 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.
- 5.05. 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.
- 5.06. Only the mortar lines need be filled on masonry, except for large offsets.

6. MANUAL APPLICATION OF FRP REINFORCEMENT

- 6.01. All surfaces must be primed and, where needed, filled. Primer & filler, which has cured for over 24hrs, must be abraded with a light sand sweep, sandpaper or abrasive pad unless still tacky to the touch.

- 6.02. Prepare epoxy saturating resin in accordance with manufacturers 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.
- 6.03. Fabric should be pre cut to required lengths and widths and clearly labeled.
- 6.04. Using a roller, apply a coat of mixed resin to a suitable worktable, which has been protected with plastic sheeting. 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 and roll fabric onto a PVC plastic tube with approx 4" diameter.
- 6.05. Apply saturated fabric to repair surface. 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 to assist in handling.
- 6.06. To join ends of fabric; overlaps in the longitudinal direction must be a minimum of 6". Additional saturating resin can be used to insure complete bonding between layers and lack of voids. No overlap is needed between adjacent bands of fabric. Overlaps must be staggered for multiple layers.
- 6.07. For applying additional layers, follow items 3 through 6.
- 6.08. Check applied laminates after 30 - 45 minutes and again prior to gel stage to ensure that no voids or delaminations are present.
- 6.09. The installed composite must be protected from rain, direct sunlight, dust, sand etc for 24 hrs.

7. APPLICATION OF PRE-SATURATED FRP REINFORCEMENT

- 7.01. All surfaces must be primed and, where needed, filled. Primer & filler, which has cured for over 24hrs, must be abraded with a light sand sweep, sandpaper or abrasive pad unless still tacky to the touch.
- 7.02. Roll saturated fabric onto repair surface using PVC roller. 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 to assist in handling.
- 7.03. To join ends of fabric, overlaps in the longitudinal direction must be a minimum of 6". Additional saturating resin can be used to insure complete bonding between layers and lack of voids. No overlap is needed between adjacent bands of fabric. Overlaps must be staggered for multiple layers.
- 7.04. For applying additional layers, follow items 3 through 6.
- 7.05. Check applied laminates after 30 - 45 minutes and again prior to gel stage to ensure that no voids or delaminations are present.

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

8. INSTALLATION OF ANCHORS (if required)

- 8.01 Clearly mark all areas to be anchored. Anchors should be installed between FRP layers.
- 8.02 Drill a 15 mm hole 1 cm deeper than cured section of anchor.
- 8.03 Clean hole of all dust and prime with pre mixed epoxy primer.
- 8.04 Using a syringe filled with adhesive paste, fill _ of hole with adhesive.
- 8.05 On a clean, plastic covered table, saturate anchor ensuring dry fibers are thoroughly saturated.
- 8.06 Insert cured end of anchor fully into hole & remove excess adhesive.
- 8.07 For anchoring a sheet to a flat surface, evenly flare out saturated fibers around 360° ensuring fibers lay flat against surface. For anchoring a wall to footings or to an overhead slab, evenly flare out saturated fibers to 90°, ensuring fibers lay flat against surface.
- 8.08 Apply next layer of FRP in accordance with section 6 or 7 above.

9. FIELD QUALITY CONTROL

9.01. Supervision

1. 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.
2. Newly installed FRP composite shall materials shall be visually inspect to insure complete saturation, full contact between layers and to substrate, proper fiber orientation, and lack of wrinkles, bubbles, and voids.

9.02. Inspection for Voids/Delaminations

1. After allowing at least 24 hours for initial resin cure to occur, perform a visual and acoustic tap test inspection of the layered surface.
2. Large delaminations shall be marked for repair. Small delaminations less than 2 in² (1300 mm²) in size and which are not localized do not require corrective action.
3. Large delaminations 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.

10. REPAIR OF DAMAGED OR DEFECTIVE AREAS

- 10.01. Repair of all the defective work after the minimum cure time for the FRP laminates shall comply with material and procedural requirements defined in manufacturers specification or as provided by the manufacturer according to the type of defect, the type of application, and the materials used.
- 10.02. 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.
- 10.03. 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.

APPENDIX A. EQUIPMENT LIST

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