SPECIAL SPECIFICATION

4143

Carbon Fiber Reinforced Polymer (CFRP) for Concrete Confinement

1. Description. Furnish and install a Carbon Fiber Reinforced Polymer (CFRP) concrete confining system in accordance with the Plans and this Special Specification.

2. Materials. Materials, which are pre-approved under this specification, are listed below. Regardless of pre-approval, the materials used for this project will meet all material requirements and specifications defined herein. Pre-approved products are:

<table>
<thead>
<tr>
<th>Producer</th>
<th>Product Name</th>
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</thead>
<tbody>
<tr>
<td>Master Builders</td>
<td>Mbrace CF 130</td>
</tr>
<tr>
<td>Sika</td>
<td>SikaWrap Hex 103C</td>
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</tbody>
</table>

Substitutions will be allowed subject to approval by the Engineer.

3. Contractor Submittals. Submit the following documentation and obtain approval before work commences:

A. Contractor Qualifications. Provide a Manufacturer's certification of technical training, for the CFRP system selected, for the Project Supervisor, and documentation showing the Contractor has been certified or approved by the supplier of the CFRP system. A Contractor specializing in the supply and installation of CFRP repair systems will perform the work. A trained Project Supervisor will remain at the work site at all times to instruct the work crew in the CFRP application procedures.

B. Material Supplier and Manufacturer Qualifications (not required if the above listed pre-approved systems are used). Provide documentation to show that the Manufacturer of the proposed carbon fiber reinforcing system has a program of training, certifying, and technically supporting specialty.

C. Contractors. Provide documentation to demonstrate a 3 year track record of successful performance with CFRP concrete repairs confirmed with four project installations to include a list of each project contact person(s) and phone number(s).

D. Product Data. Provide Manufacturer's product data including physical and chemical characteristics, material specifications for each component, limitations on use of the system, construction or application specifications, maintenance instructions and general manufacturer's recommendations regarding each system. Include product data on the proposed primer, putty, resin, saturant, and carbon fiber. Provide testing information on the combination of the proposed carbon fiber reinforcement and epoxy when used together as a system. Provide certifications by the producers of the materials that all
materials supplied comply with all the requirements and standards of the appropriate ASTM and other agencies. Provide Manufacturer's MSDS for all materials to be used.

E. Shop Drawings (not required if the above listed pre-approved systems are used). Provide shop drawings signed and sealed by a Professional Engineer. Shop drawings will include the following: Details of the number, thickness, and orientation of carbon fiber layers proposed; locations of splices and corresponding lap lengths; proposed sequence of construction; and, list of materials to be used. Include signed and sealed calculations with the shop drawings indicating that the proposed system provides an equal level of confinement as the listed materials.


A. General. Inspect the structural members specified to be strengthened with Carbon Fiber Reinforced Plastic (CFRP) on the contract drawings. Inspect cracks and existing conditions of concrete components to be strengthened.

A pre-installation conference will be conducted with the Contractor's Project Supervisor, the Manufacturer's Field Representative and other trades involved to discuss the work for each system.

Protect the work from damage such as impact, marring of the surfaces and other damage.

B. Handling of Materials. Deliver CFRP components in original, unopened (except carbon fabric or strips) containers clearly marked with the manufacturer's name, product identification, and batch numbers. Store and handle the products in accordance with the Manufacturer's recommendations and instructions.

Do not use components which have exceeded their shelf life.

C. General Preparation. Locations of CFRP reinforcement are as shown on the plans.

Do not apply CFRP sheet when the ambient temperature is lower than 40 degrees.

Do not apply auxiliary heat to raise the surface and air temperature to a suitable range.

Apply the CFRP system a minimum of 24 hours after the cracks have been sealed with caulk.

Do not apply CFRP when rainfall or condensation is anticipated.

D. Surface Preparation and Application of CFRP Systems. Ensure all substrates are clean, sound and free of surface moisture and frost. Complete surface preparation, crack sealing and water proofing before application of the CFRP system. The Engineer and the manufacturer's technical representative must both approve any changes to the application methods proposed by the Contractor.

E. Quality Control and Inspection. Establish a quality control program that includes, but is not limited to the following: Inspection of all materials to assure conformity with contract requirements, and that all materials are new and undamaged; Inspection of all surface preparation before the CFRP application; Inspection of work in progress to
assure work is being done in accordance with established procedures and established Manufacturer's instructions and specific Engineer instructions; and Inspection of all work completed includes sounding all repairs to check for debonding and correction of all defective work.

F. **Quality Assurance.** Provide samples for testing in accordance with ASTM D3039 test procedure to verify material properties.

G. **Testing.** After allowing at least 24 hours for initial resin saturant cure to occur, perform a visual and acoustic tap test inspection of the layered surface. Repair all voids, bubbles and delaminations in accordance to Manufacturer's recommendations.

H. **Repair of Defective Work.** Repair the defective work after the minimum cure time for the CFRP laminates. Comply with material and procedural requirements defined in this specification. Repair all defects in a manner that will restore the system to the designed level of quality in accordance with the Manufacturer's recommendations. Obtain approval for procedures and conditions that are not specifically addressed in this specification. Make all repairs and touch ups to the satisfaction of the Engineer.

5. **Measurement.** This Item will be measured by the square foot of area confined, as indicated on the plans.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2. Additional measurements or calculations will be made if adjustments of quantities are necessary.

6. **Payments.** The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “CFRP for Concrete Confinement.” This price is full compensation for all materials, labor, equipment, supervision, and related services necessary for strengthening of the concrete as detailed in the plans and specified herein. If an alternate CFRP system is used, this price will include all engineering, design, technical services, and as submittals as specified herein.

Surface preparation and crack sealing will be paid for under Item 429 Concrete Structure Repair.