

**Product Description:** Fortress Carbon Fiber Staple Anchors are the first commercially available FRP anchoring system designed to effectively supplement the bond of externally applied FRP laminates by transferring textile loads through the staple and into concrete and masonry substrates including beams, columns, walls, and slabs. Fortress Carbon Fiber Staple Anchors are comprised of high tensile strength carbon fiber encapsulated in a thermal-set resin. The anchor is 6 inches wide with 2 inch legs, and has a diameter of 9/16 inches. In addition to FRP anchoring, the Staple Anchor is also manufactured in a slightly modified form as a crack repair staple for critical application crack repair.

## PRODUCT APPLICATIONS

### Target Applications:

- Anchoring FRP U-wraps for shear strengthening
- Anchoring FRP laminates for flexural strengthening
- Where bonded-only FRP systems do not provide enough strength increase
- Where a reduction in FRP system layers is desired especially for overhead and vertical applications
- To reduce peeling onset of bonded-only FRP systems
- Seismic and blast retrofit anchoring
- Where minimal working space is available
- Large crack repair (Slightly flattened for easier installation)

### Structural Benefits

- Higher shear and flexural strengths achieved compared to bonded-only FRP systems
- Lightweight
- Moisture resistant
- Extended service life of FRP systems



### Key Features

- Exceeds capacities provided by “spike” anchors
- Reduces the number of FRP textile layers
- Notable increase of FRP textile system strength
- Exceptional performance when compared to other anchoring products
- Enhances serviceability of concrete and masonry structures

## PRODUCT SPECIFICATIONS

**Base Material** 24K Carbon Fiber

**Shelf Life** Unlimited

**Color Carbon** Black

**Filament Diameter, in (µm)** 2.76E-4 (7.0)

**Textile fiber density, lb/in<sup>3</sup> (g/cm<sup>3</sup>)** 0.064 (1.78)

**Carbon Filament Tensile Strength, ksi (MPa)** 711 (4,900)

**Carbon Filament Tensile Modulus, ksi (MPa)** 36,300 (250,000)

**Carbon Filament Rupture Strain** 0.020

**Nominal Weight per unit, oz (grams)** 2.0 (55.5)

	Minimum Tensile Strength <sup>1</sup> ksi (MPa)	Minimum Modulus of Elasticity <sup>2</sup> ksi (MPa)	Minimum Transverse Shear Strength <sup>2</sup> ksi (MPa)	Fiber Content	Ultimate Strain at Rupture in/in (mm/mm)
Design Values <sup>3</sup>	198 (1,365)	18,000 (124,100)	18.0 (124.1)	65 percent	0.011

Laminate results at room temperature using SKRS Room 77°F curing epoxy resin

<sup>1</sup>ASTM D3039 <sup>2</sup>As required by ACI 440.6R <sup>3</sup>Design values are statistically based as recommended by American Concrete Institute, ACI 440.2R

# USAGE INSTRUCTIONS

**Tools Required:** Rotary hammer, compressed air (oil free source), tape measure, marking pencil

**Preparation.** Protect the work area from standing water and inclement weather. Surfaces may be damp. Surfaces must be clean and sound. Spalling or other damaged concrete must be removed to solid material. Mark the location where the Fortress Carbon Fiber Staple Anchor will be installed. Drill two, 3/4-inch diameter holes at 6-inch on-center spacing. Clean holes by brushing, oil-free compressed air, or other methods to remove dust and loose material.

**For FRP Anchoring Placement.** First, install the FRP textile or other system to be anchored onto a prepared substrate. Leave at least 6 inches of excess FRP textile beyond the staples located at the ends of the FRP textile and extend neatly in the direction of placement. Please note 6 inches is considered a minimum as the design professional may call for “doubling back” for some distance beyond if service conditions demand. Apply Fortress Xtreme 4070 or equivalent epoxy into the drilled holes, coat the two legs and bottom surface of the staple with epoxy, and place over the FRP textile and into the drilled holes. Coat the outer surface of the end staple with epoxy and wrap the excess textile carefully around it, pulling firmly to the staple edge and back over the first layer, ensuring air bubbles are not introduced in between the two layers. Finally, work the textile into place, pushing any air bubbles out from between the textile layers as necessary. Fortress Carbon Fiber Staple Anchors placed at intermediate locations along the FRP textile should be bonded with at least a 12-inch length of FRP textile placed parallel to the first layer(s) and centered over the staple.

Where directed by the design professional, one additional pair of holes may be provided 3 inches before the last staple in the textile extension. This staple should be placed at and over the middle of the 6-inch excess noted above (three inches from the end staple). A staple placed at this location will provide additional anchoring and enhanced stress distribution within the textile terminus.

**For Crack Repair:** Use staple to measure spacing of holes. Staple should be aligned perpendicular to the crack. A saw cut the width of the stall may be made between holes for flush surface mounting. Fill holes and saw cut with a structural epoxy and insert staple. Staple may be covered following curing of epoxy. It is recommended that cracks are filled with a big compression cementitious material or structural epoxy prior to installation.

**Precautions.** Protect the work area from standing water and inclement weather. Use oil-free compressed air to remove any dust debris immediately prior to application of epoxy resins. Keep Fortress Carbon Fiber Staple Anchors from contamination in a clean and dry area away from direct sunlight. Maintain staples in original packaging until installation and protect from physical damage. Remove moisture, dust, dirt, and any other foreign materials just prior to installation. Remove grease, wax, oil, or any other liquids of these types with an appropriate solvent and wipe free with a clean rag.

**Applications.** For horizontal, vertical, and overhead applications use either the dry or wet lay-up application methods when installing textile laminate systems such as Carbon Tow Sheets. See appropriate product data-sheets for application instructions.

**Qualifications.** Except for standard Fortress installations by Fortress qualified installers, each structural and life safety application requires the design and certification of a licensed, professional engineer. See the Fortec Warranty for more details.

**Cautions.** Installation should be performed only by a Fortress trained and approved installer. Caution must be used when handling Fortress Carbon Fiber Staple Anchors. Gloves should be worn to protect against carbon dust skin irritation and exposed fiber ends. Use of an appropriate, properly fitted NIOSH approved respirator is recommended. As with any cutting and adhesive operation, proper eye protection should be used. Always follow OSHA and site safety requirements.

## **Keep Out of Reach of Children - Keep Container Tightly Closed – Not for Internal Consumption – For Industrial Use Only**

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