



LOCTITE TYFO ANCHOR SYSTEMS

**ADVANCED COMPOSITE SOLUTIONS FOR
STRUCTURAL STRENGTHENING**





DUKTIL FRP ANCHOR PLATES

Duktil FRP Anchor Plates are hybrid steel/FRP plate systems engineered to provide an alternate load delivery from externally bonded FRP into concrete. The system bonds directly to the LOCTITE Tyfo Composite systems using LOCTITE Tyfo S epoxy. It is then anchored into the concrete substrate using conventional wedge anchors or screw anchors.

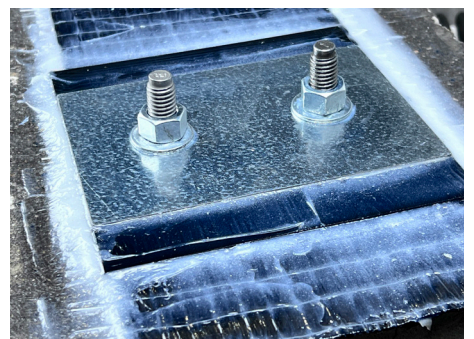
The system was developed to improve the overall performance of FRP Systems when used in retrofitting structures. The system provides an increased performance beyond traditional FRP bonding and anchorage provided by conventional FRP anchors.

While improved strength is the primary objective, the plates also provide ductility given the deformation and slotting of its metallic components. The plates and anchors will deform at ultimate loads, making the anchorage system easy to inspect after loading events.

The Duktil FRP Anchor Plate system has been extensively tested to ensure its structural performance. To date, it has proven to be the most effective method to anchor externally applied FRP systems to concrete. Minimum design properties have been evaluated and are now building code approved as per ICC-ESR 2103, ICC-ESR 3663 reports and IAPMO UES ER 595.

As the need to anchor FRP materials continues to increase to overcome the “debonding” strain, the Duktil FRP Anchor Plate system provides a solution that can be readily implemented into FRP designs. The installation process is simple and saves time compared to using conventional FRP anchors. The field quality control procedures are simple, and the post-installation inspection is straightforward.

The result is a game-changing anchor detail that improves FRP performance and reduces installation costs.



The Duktıl FRP anchor plate systems have been tested by independent laboratories to validate their performance. Both small-scale component testing and large-scale assembly testing has been completed.

Both Virginia Tech and the University of Auckland in New Zealand have completed large-scale diaphragm strengthening tests using LOCTITE FRP anchors and Duktıl FRP anchor plates. The results have indicated that in many applications the anchor plates provide superior performance when compared to fiber anchors.



LOCTITE TYFO FIBER ANCHOR SYSTEMS

The Facts

The fiber anchor concept was created by Fyfe. LOCTITE Tyfo Fiber Anchors, also referred to as FRP anchors are unidirectional reinforcing carbon fiber rovings saturated with two-part epoxy resin materials (LOCTITE Tyfo S Epoxy). They are designed to improve FRP detailing by developing the tension capacity of the LOCTITE Tyfo Composites, enhancing bond between LOCTITE Tyfo Composites and substrates, and providing shear transfer capacity. When anchors are used to develop tension capacity of the LOCTITE Tyfo Systems, they can be used as a splice anchor or as an embedded anchor to fully develop the tension of the LOCTITE Tyfo Systems.

- › Develop tension forces through obstacles
- › Develop tension and shear forces by embedment
- › Improve Structural performance of beam and wall shear designs
- › Improve Structural performance of beam and slab flexural designs
- › IAPMO UES ER-595 Code Listed Product

Composite Gross Laminate Properties

Property ²	ASTM Method	ACI 440.2 Properties ¹
Ultimate Tensile Strength	D3039	131,000 psi (903 MPa)
Tensile Modulus		14.6 × 10 ⁶ psi (100.7 GPa)
Elongation at Break		0.9%
Ultimate Shear Strength		50,000 psi (345 MPa)
Bond Shear Strength in uncracked concrete		3,000 psi (20.7 MPa)
Bond Shear Strength in cracked concrete, crack width = 0.012"	E488	2,300 psi (15.9 MPa)
Bond Shear Strength in cracked concrete, crack width = 0.020"		1,600 psi (11.0 MPa)

¹ Strength is defined as the mean strength minus 3 standard deviations. Modulus is defined as the reported mean modulus, and elongation is defined as the calculated strain from the design strength and modulus.

² Design values may require additional reduction factors based on expected exposure conditions, type of application, and design life assumptions.

LARGE SCALE ANCHOR STRUCTURAL TESTING

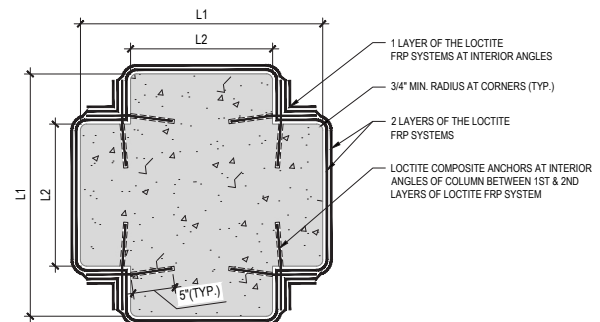
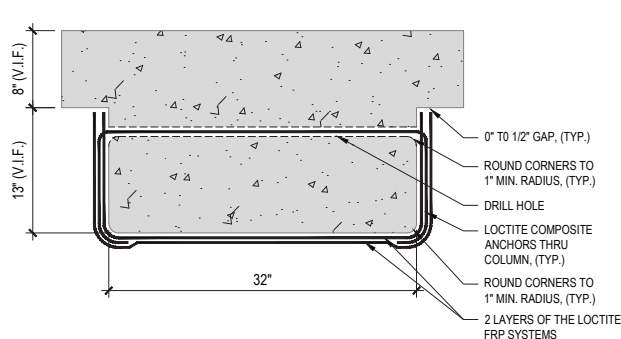
The FRP anchors are required in many applications due to unique conditions and different performance goals. Many full- and large-scale component and assembly tests have been completed.

Large-scale wall testing has been completed at Carleton University and the University of Concordia.

Large-scale beam testing has been completed at the University of Texas at Austin, the University of California, Irvine, University of California, San Diego, University of Canterbury in New Zealand and elsewhere.

Large-scale column testing has been completed at North Carolina State University.

Idaho State University has tested full-scale applications of the LOCTITE systems to provide shear transfer across the joint between existing shear walls and floor diaphragms. These configurations are substantially enhanced when using the LOCTITE FRP anchors.



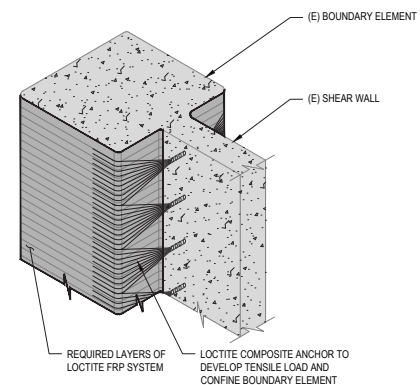
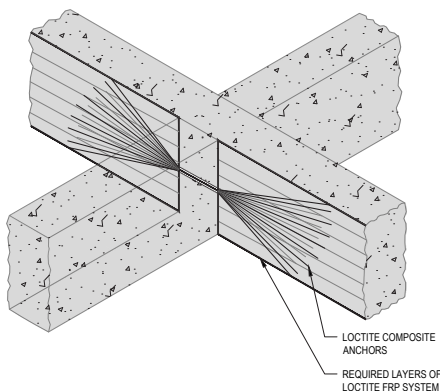
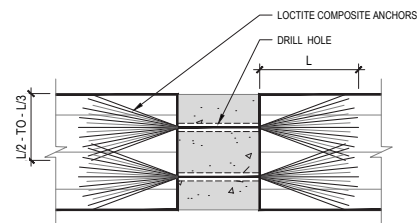
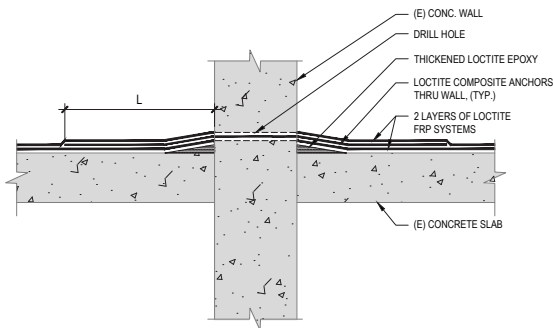
SPLICE ANCHOR APPLICATIONS

LOCTITE Tyfo Fiber Anchor Systems can be used to develop a tension force through an intersecting element and act as a splice for FRP applications.

Splice anchors, also referred to as Through anchors may be installed through wall, slab or beam elements.



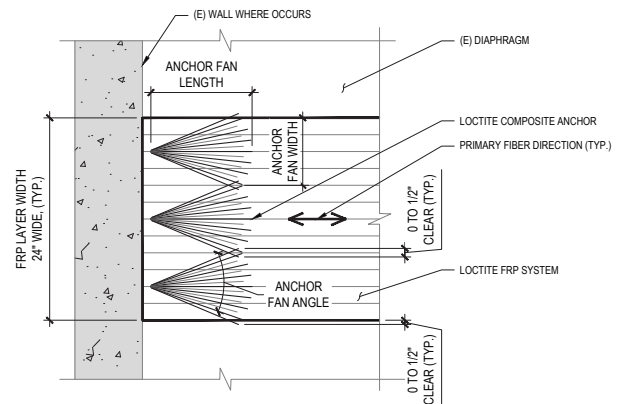
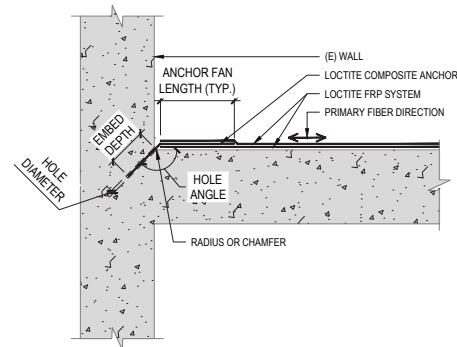
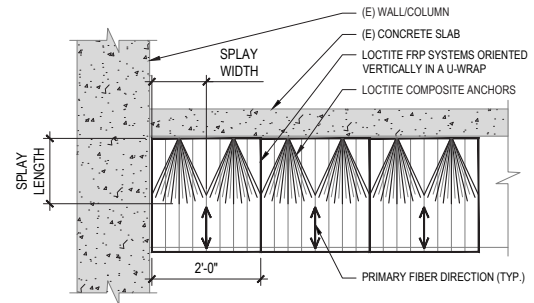
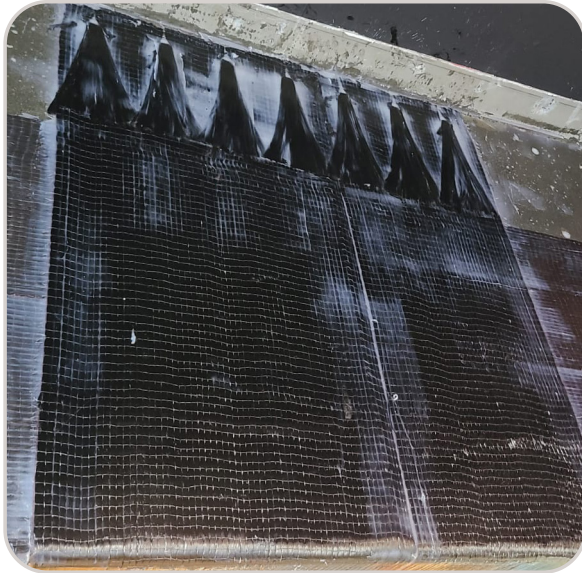
LOCTITE Tyfo SCH composite Anchors to develop tension through obstacles to provide negative moment strengthening.



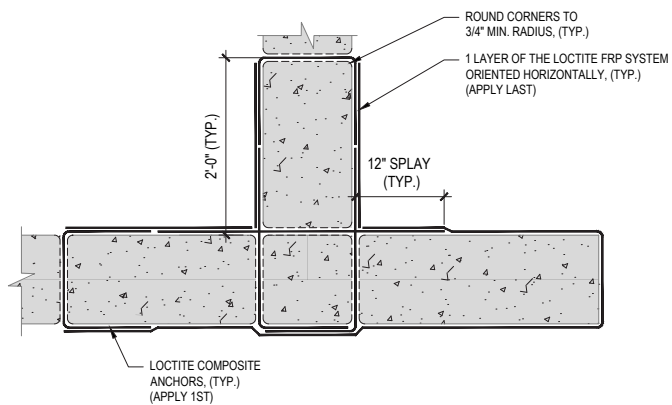
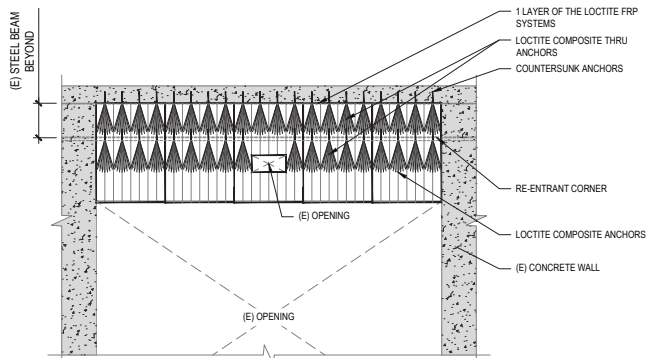
EMBEDDED ANCHOR APPLICATIONS

LOCTITE Tyfo Fiber Anchor Systems can be used to fully develop a tension force into a structural element for proper FRP application detailing and load path considerations. Embedded anchors may also be used to provide shear transfer enhancement at wall to diaphragm connections.

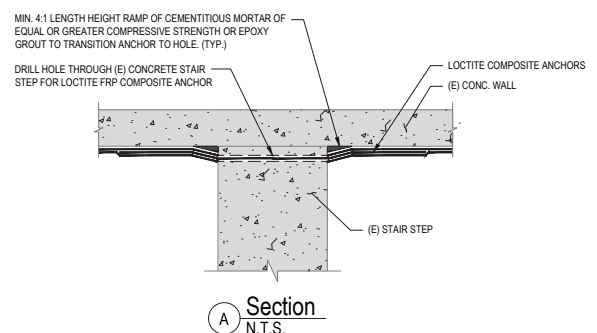
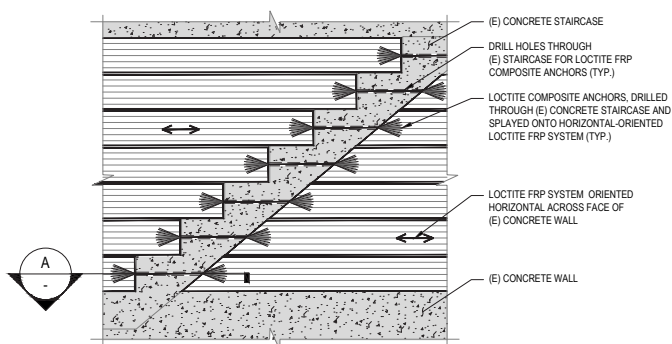
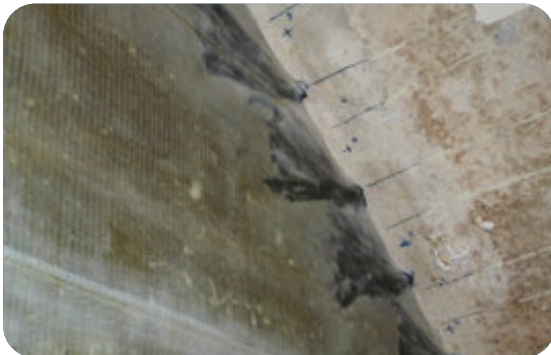
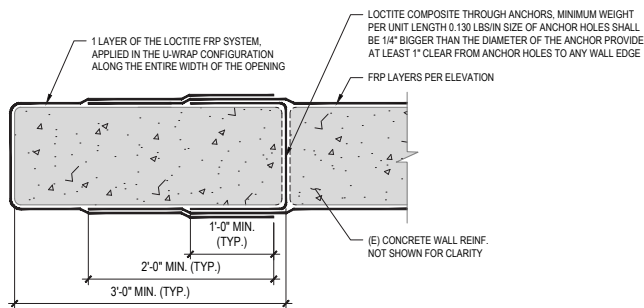
Embedded anchors may be installed into walls, slabs, beams, columns or joints.

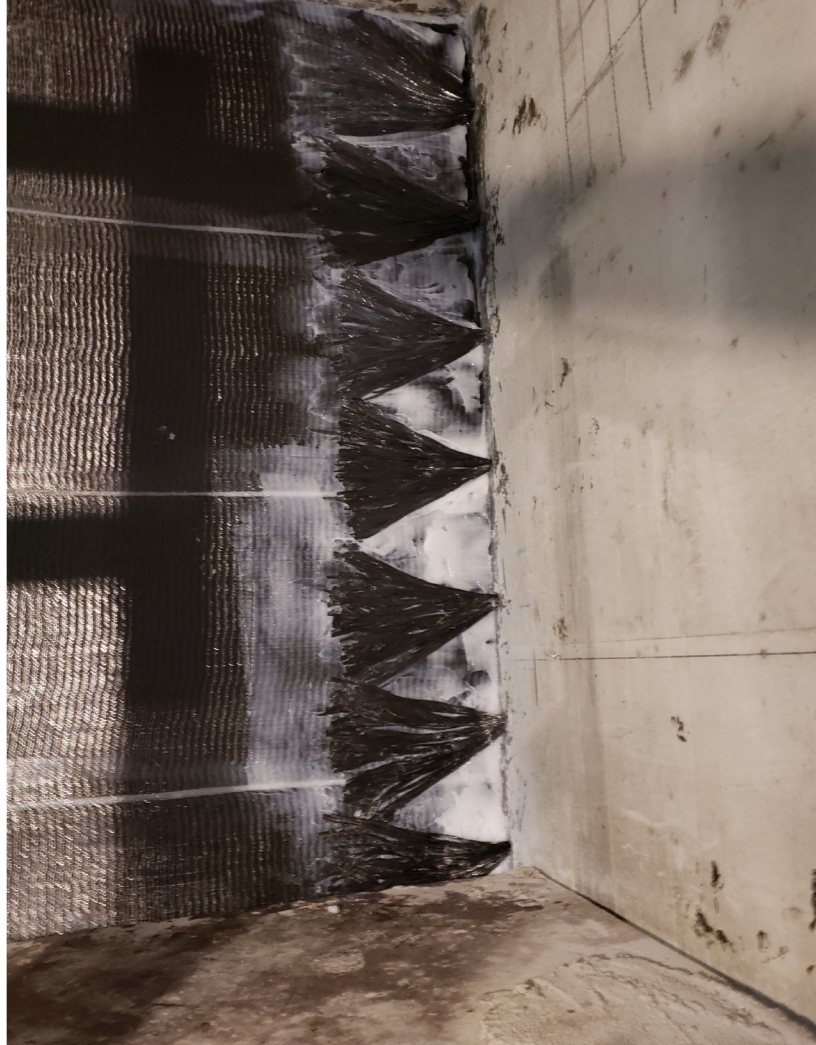


ENGINEERING DRAWINGS AND COMPLETED INSTALLATION



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