

Fiber-Reinforced Polymer Reinforcement

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Fiber-reinforced polymer (FRP) reinforcement consists of a continuous fiber, such as a glass, carbon, or aramid, embedded in a resin matrix, such as epoxy, polyester, vinyl ester, or phenolics. FRP reinforcement may be used as reinforcing bars, prestressing strand, or post-tensioning tendons. These types of reinforcement do not corrode, can be nonconductive, and are lighter to ship and install than steel reinforcement. However, tests have shown that some FRP bars can lose tensile strength in a highly alkaline solution.

Nonprestressed Reinforcement


In a 2016 survey, 17 of 42 transportation agencies in the United States and Canada reported that they had used FRP reinforcement in cast-in-place concrete bridge decks. However, its use is not mainstream; epoxy-coated steel reinforcement continues to be the dominant material for deck reinforcement.

Prestressing Strand

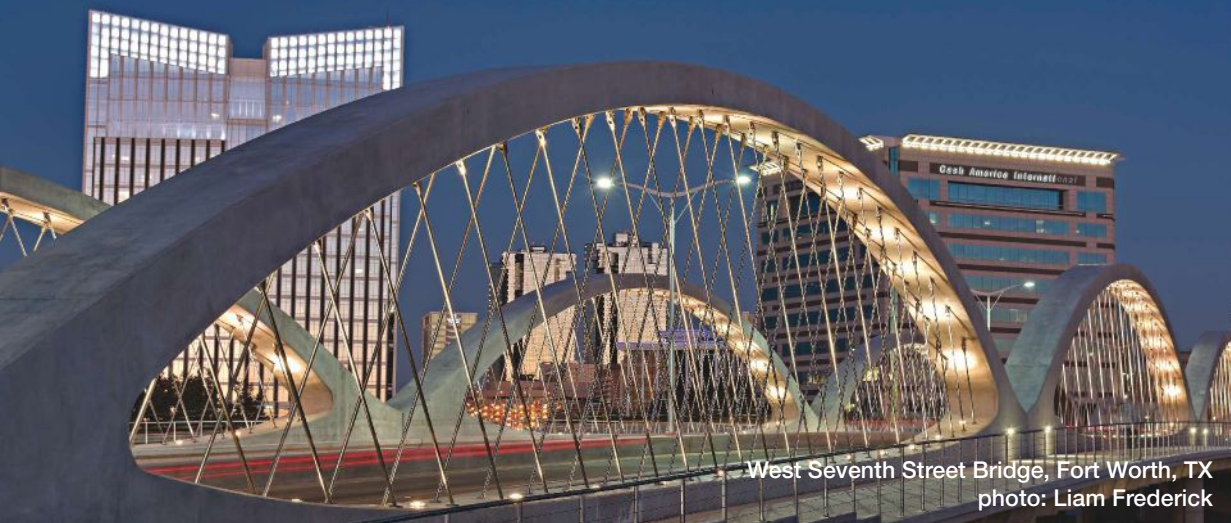
Several demonstration projects have shown the potential of FRP prestressing applications in bridges, but its use has not become generally accepted. One hurdle has been the lack of a design document by the American Association of State Highway and Transportation Officials. This challenge should be remedied now that National Cooperative Highway Research Program Project 12-97, *Guide Specifications for the Design*

of Concrete Bridge Beams Prestressed with Carbon Fiber-Reinforced Polymer (CFRP) Systems, has been completed and approved.

Key Resources

1. American Association of State Highway and Transportation Officials (AASHTO). 2009. *AASHTO LRFD Bridge Design Guide Specifications for GFRP-Reinforced Concrete Bridge Decks and Traffic Railings*. Washington, DC: AASHTO.
2. American Concrete Institute (ACI). 2007. *Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures*. ACI 440R-07. Farmington Hills, MI: ACI.
3. ACI. 2008. *Specification for Construction with Fiber-Reinforced Polymer Reinforcing Bars*. ACI 440.5-08. Farmington Hills, MI: ACI.
4. ACI. 2011. *Prestressing Concrete Structures with FRP Tendons*. ACI 440.4R-04. Farmington Hills, MI: ACI.
5. ACI. 2015. *Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer Bars*. ACI 440.1R-15. Farmington Hills, MI: ACI.
6. Russell, H.G. 2017. *NCHRP Synthesis of Highway Practice 500: Control of Concrete Cracking in Bridges*. Washington, DC: National Research Council, Transportation Research Board. 


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