UHPC for Bridge Preservation and Repair

Every Day Counts
Innovation for a Nation on the Move

Ultra-high performance concrete (UHPC) offers enhanced durability and improved life-cycle cost performance for bridge preservation and repair.

Keeping bridges in a state of good repair is essential to keeping the transportation system operating efficiently. Agencies at all levels can deploy UHPC for bridge preservation and repair to maintain or improve bridge conditions cost effectively.

STRONGER REPAIRS, EXTENDED SERVICE LIFE

UHPC is a fiber-reinforced, cementitious composite material with mechanical and durability properties that far exceed those of conventional concrete materials. This has made it popular for bridge construction, especially for field-cast connections between prefabricated bridge elements (PBE). Bridge infrastructure preservation and repair (P&R) is a new application of UHPC that offers enhanced performance and improved life-cycle cost over traditional methods. Because of its strength and durability, UHPC can be an optimum solution for some repairs. UHPC can be used in situations that normally use conventional concrete or repair mortars, and in some cases those that use structural steel. Some UHPC mixes gain strength rapidly, so bridges could be opened to traffic 24 hours after completing the necessary repairs. Additionally, UHPC repairs are long lasting and resilient, requiring less maintenance and fewer follow-up repairs than conventional methods. In some cases, they can outlive and outperform their conventional counterparts—UHPC repairs could be the strongest and most durable part of the bridge.

APPLICATIONS

A few examples of UHPC P&R applications include bridge deck overlays, girder end repairs, expansion joint repairs, PBE construction joint repairs, and column or pile jacketing. Some applications, such as bridge deck overlays and replacing expansion joints with UHPC link slabs, can extend the service life of bridges well beyond that of traditional repair strategies and are more cost-efficient than bridge replacement.

Repair of a deteriorated steel bridge beam end using UHPC.
Source: University of Connecticut

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BENEFITS

- **Versatility.** UHPC can generally be used anywhere other types of concrete would be used, and due to its strength and durability, it can be the optimum material for many applications.
- **Durability.** UHPC-based repairs are long-lasting and require less maintenance and fewer follow-up repairs.
- **Cost Savings.** UHPC repairs can outlive and outperform their conventional counterparts, resulting in life-cycle cost savings. UHPC bridge deck overlays and link slabs can extend the service life of bridges well beyond that of traditional preservation and repair strategies.
- **Accessible.** UHPC-based solutions can be used by both local and State transportation agencies, and although some new knowledge is required, designers and contractors will be able to leverage their existing skillsets to deploy this solution.

STATE OF THE PRACTICE

State departments of transportation (DOTs) and other highway agencies have repaired or strengthened more than 20 bridges using UHPC in recent years, with half of these completed in 2019. These projects used multiple repair techniques and strategies to return the bridges to a state of good repair and extend service life. Examples are listed below.

- **Bridge Deck Overlays:** Iowa DOT, Buchanan County (Iowa), Delaware DOT, New York State DOT.
- **Link Slabs:** New York State DOT, Maryland DOT, New Jersey DOT.
- **Beam End or Girder Repair:** Connecticut DOT, Rhode Island DOT, Florida DOT, St. Clair County (Michigan) Road Commission.

To see more examples of UHPC deployments, visit the interactive map on the Turner-Fairbank Highway Research Center website.

Replacement of an expansion joint with a UHPC link slab.
Source: New York State Department of Transportation

Installation of a UHPC overlay. *Source: FHWA*

RESOURCES

FHWA EDC-6 UHPC for Bridge Preservation and Repair

Advancing Bridge Repair and Preservation Using Ultra-High Performance Concrete, Aspire, Spring 2019

FHWA TechNote: UHPC for Bridge Deck Overlays (February 2018)

North American Deployments of UHPC in Highway Bridge Construction

U.S. Department of Transportation
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