Composite Bridge Decking
Highways for LIFE Technology Partnerships 2010 Award  $495,983

Project Status
The project is complete. Allegany County maintenance crews removed steel grating and installed the modular composite decking system on the bridge's closely-spaced steel stringers. Because the five inch thick deck weighs 17 pounds per square foot, it’s use helped avoid a weight restriction.
Final report: http://www.fhwa.dot.gov/hfl/partnerships/composite_bridge/
Video: http://www.youtube.com/watch?v=YCECK5VPIAY&feature=youtu.be
Webinar: FRP Composite Bridge Decking, recorded on July 23, 2013 at https://connectdot.connectsolutions.com/n134083201307/

Need for Innovation
Bridge owners have expressed a need for a light-weight, solid-surface deck and these needs can be met with composite materials. Solid-surface lightweight decks can alleviate weight restrictions on a bridge, save a historic bridge that has been compromised over time, or replace older light decks on bridges that cannot support a concrete one. On moveable bridges, elimination of weight can reduce the consumption of energy and complexity of mechanical devices required to lift spans. Older decks used in this situation traditionally have had a relatively short service life due to corrosion, fatigue or rot. Frequently, they contribute to the degradation of the structure as a whole because the deck does not protect structural steel from the elements.

Project Overview
Composite materials are ideal for bridge decks because of their high strength to weight ratio and resistance to corrosion but the initial cost and some problems with the wearing surface have deterred widespread use. This project refined the materials and fabrication methods used to produce a fiber reinforced polymer (FRP) composite bridge deck that was developed by the University at Buffalo for New York State Department of Transportation (DOT).

Installation
In August 2012, prefabricated deck panels were attached by bolting from below with no penetrations on top. They measured 7.5 feet x 11 feet and weighed 17 pounds per square foot.

Field Joints
Laboratory testing performed at Penn State demonstrated that a flexible epoxy grout provided a strong but pliable joint. The photo illustrates crushed stone being added to the top of the joint as part of a double wearing surface.

Proof Test
The response of the bridge was initially checked using two heavily loaded dump trucks. The deck is currently in its second winter, with 16 months of service.

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Integrated Materials and Applied Computing, Inc., LeTourneau University, Penn State University, XC Associates, Inc., and public sector partner Allegany County NY

Design
The deck was designed for a broad spectrum of new and retrofit scenarios using an Abacus finite element model consisting of 31,857 nodes and 38,892 elements. Results were validated by physical testing.

Manufacturing
Panels were fabricated by wrapping pultruded composite tubes (pictured here) with an FRP laminate. The configuration of the tubes allows for weight and stiffness to be optimized for site conditions.

Testing
Full scale panels were subjected to testing in flexure, shear, bearing, fatigue, and taken to ultimate failure, verifying that the panels meet serviceability requirements while carrying factored HL-93 loading.

Fire Test
A full size panel survived 20 minutes of open flames reaching over 1,500°F. Damage was confined to the outer wrap layer and deflection was minimal under a superimposed load.

Typical Application
Historic trusses can benefit from using hi-tech materials to solve age the old problems of rust and fatigue, often with no additional weight.