Composite Bridge Decking

Highways for LIFE Technology Partnerships 2010 Award $495,983

U.S. Department of Transportation
Federal Highway Administration
HIGHWAYS FOR LIFE
Accelerating Innovation for the American Driving Experience.

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=YCECKSVPkAY&feature=youtu.be*

Webinar: FRP Composite Bridge Decking, recorded on July 23, 2013 at *https://connectdot.connectsolutions.com/n1340832013O7/*

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).

Contact Information

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Project Team

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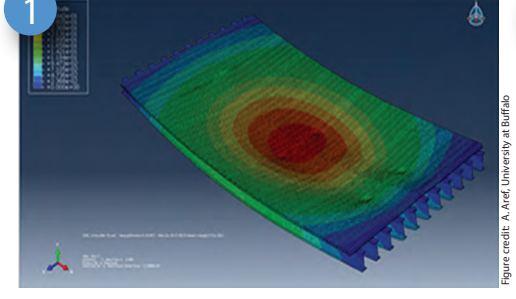

Figure credit: A. Aref, University at Buffalo

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.

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Photo credit: J. O'Connor, Bridge Composites, LLC

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.

3

Photo credit: M. Lopez de Murphy, Penn State University

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.

4

Photo credit: J. O'Connor, Bridge Composites, LLC

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.

5

Photo credit: J. O'Connor, Bridge Composites, LLC

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.

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Photo credit: J. O'Connor, Bridge Composites, LLC

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.

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Photo credit: M. Lopez de Murphy, Penn State University

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.

8

Photo credit: J. O'Connor, Bridge Composites, LLC

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.