Workshop W4 – FRP Composite Bridge Materials: Design, Build, Strengthen

2018 International Bridge Conference®
Gaylord National Resort & Convention Center, National Harbor, MD

Part I: Using FRP Composites to Design, Build and Strengthen Bridges for a More Resilient Infrastructure

Tuesday, June 12, 2018 - 1:00 – 4:30 p.m.
Magnolia 1

Presented by: American Composites Manufacturers Association

FRP composites are a proven innovative and durable material that has been used in over 500 bridges in North America for over 20 years. Composites are faster to install and require minimal disruption while in service to extend the service life of bridge structures. Composites features such as lightweight and prefabrication have reduced assembly and installation time resulting in lower installation costs and delivery for new construction. Standards and specification development provide civil/structural engineers with much needed tools to design and specify with composites. However, it is becoming very important to build bridge structures that are more resilient to natural and man-made disasters.

***How do I make my bridges more resilient to the damaging effects of natural disasters? FRP materials could be the answer* -** David White, P.E., Sika Corporation

FRP composite materials have been used successfully for retrofitting, repairing and strengthening bridges around the world for over 25 years. Their key attributes, including high strength, excellent durability, light weight and corrosion resistance, makes them uniquely qualified to assist bridge owners and engineers in providing long term solutions to maximize the service life of new and existing bridges. These same attributes also make FRP composite materials an excellent choice to improve the resiliency of bridges and our infrastructure when subjected to the damaging effects of floods, hurricanes, seismic events and other natural disasters. This presentation will highlight various projects where FRP systems have been used to provide resiliency on bridges, allowing them to recover rapidly from disruptive events.

***Overview of AASHTO Design Specifications for GFRP-RC Bridges; 2nd Edition* -** Marco Rossini, PhD., University of Miami; Steven Nolan, P.E., Florida Department of Transportation; Fabio Matta, PhD, P.E., University of South Carolina; Antonio Nanni, PhD, P.E., University of Miami

Glass fiber-reinforced polymer (GFRP) bars are a viable corrosion-resistant reinforcement for concrete bridge structures. This technology is becoming increasingly attractive, especially in aggressive environments as coastal areas or cold regions where de-icing salts are used, with more than 500 bridges utilizing GFRP reinforcing in the last 20 years in North America. Design principles for GFRP-reinforced concrete (RC) are well established. Guidelines have been published in USA, Canada, Europe, Russia, and Japan. In Canada, the use of GFRP bars is specified in the Canadian Highway Bridge Design Code. In the US, the design of GFRP-RC decks and traffic railings is specified in a guide that was published by the American Association of State Highway and Transportation Officials (AASHTO) in 2009. The need for a comprehensive national standard for bridge applications, is paramount to facilitate the deployment of durable GFRP-RC structures. To respond to this demand, a task force of researchers and practitioners has developed a draft for the second edition of the AASHTO guide specifications to be submitted for consideration and adoption by AASHTO. This presentation illustrates the salient contents of the document, covering relevant bridge superstructure and substructure components. Compared to the first edition, significant changes were introduced to reflect the state-of-the-art from the archival literature. The goals were making the provisions more rational, offsetting the over-conservativeness of some requirements, and harmonizing the design philosophy with that of authoritative national and international standards.

***Rehabilitation of East Lynn Lake Bridge, WV* -** Hota GangaRao, Ph.D., P.E., F.ASCE, F.SEI and Ray Liang, Ph.D. Constructed Facilities Center, Statler College of Engineering and Mineral Resources, West Virginia University

Composite rehabilitation approach offers great potential for strengthening a wide range of timber, steel and concrete structures. A novel and cost-effective rehabilitation approach of severely corroded steel H-piles on East Lynne Lake Bridge, WV was undertaken in 2014, demonstrating glass fiber reinforced composite advantages including: 1) design flexibility, 2) innovation, 3) rapid deployment, 4) cost-effectiveness, and 5) outstanding structural performance.

Beyond Halls River Bridge: FRP-RC/PC Infrastructure Solutions - Steven Nolan, P.E.; Felix Padilla, P.E.; Sam Fallaha, P.E.; Chase Knight, PhD., Florida Department of Transportation

FDOT recently implemented their first major Fiber-Reinforced Polymer (FRP) composites bridge replacement project over Halls River in Citrus County, Florida. Moving beyond this milestone with the goal of broad deployment in coastal marine environments, FDOT has further refined their Construction & Material Specifications, Standard Plans, FRP Design Criteria and is developing new Design Tools for the engineering community. This presentation will highlight recent advancements in the delivery of FRP composites infrastructure by FDOT and their strategy for adoption of uniform standards, broad deployment, continued growth and advancement of FRP technologies within the transportation infrastructure environment.

Light Weight Wind Fairings for the Lift Span on the Sarah M. Long Bridge - Scott Reeve, Composite Advantage

FRP wind fairings provide a light weight solution to stabilize the lift span of the Sarah M. Long Bridge during severe weather conditions, eliminate detrimental dynamic responses, and ensure the resiliency of this critical connection between Portsmouth, NH and Kittery, Maine. The bridge has 200-foot tall concrete towers and a 300-foot long steel box girder lift span. The lift span serves vehicle traffic in its resting position and raises for large water vessels to pass under while lowering for railroad crossings. Both sides for the lift span have 13-foot tall FRP fairings bolted to the exterior girders. The L-shape of the fairing modifies wind flow over the lift span. The light weight of FRP minimizes dead load on the lift span and the mechanical lift system. Inside the fairing is an FRP catwalk for inspection of the lift span.

New FRP Products for Repair of Bridge Piling and Corroded Culverts - Mo Ehsani, PhD, PE, SE, *Professor Emeritus of Civil Eng., U. of Arizona, and President, QuakeWrap, Inc.*

This presentation describes two new Fiber Reinforced Polymer (FRP) products developed for applications in rehabilitation projects. The first product is a new type of pre-cured glass or carbon FRP laminate that is about 2-3 times stronger than steel. The jacket provides significant confinement, flexural and shear strength for the repaired column. Independent tests by the US Army Corps of Engineers, Caltrans, Texas DOT and Nebraska Dept. of Roads have verified the unique contributions of this product to rehabilitation of timber, steel and concrete piles. Among the features of the new system is its adaptability that eliminates long delays to order and manufacture jackets of specific size and shape. Applications presented include several bridges in U.S., Australia, and the repair of submerged piles in Pearl Harbor, Hawaii and the Port of Seattle. The second product is a new sandwich construction FRP pipe that received the 2016 ASCE Innovation Award as the world's first green and sustainable pipe. The technology was used to repair an 80-ft long, 60-inch diameter culvert in a remote site more than a 1000 mile north of Brisbane, Australia in July 2015. The light-weight pipe could be installed with no need for jacking equipment on the remote site, resulting in significant cost savings. The repairs were successfully completed in 4 days with no traffic disruption.