



A Tale of Two Bridges

How FRP bridge decks solved a pair of construction challenges

By Susan Keen Flynn

Composite Advantage in Dayton, Ohio, has provided FRP bridge decks for seven pedestrian bridges in the past four years. Scott Reeve, president of the company, is upbeat about the outlook for composites in the infrastructure segment. “We’re getting to the point where engineers, designers and procurement are letting us go head-to-head against concrete,” he says. “In the past, we were either excluded because they only considered traditional options or we had to do a lot of work to be a special demo case.”

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Shirley Contracting Company, Lorton, Va.

However, Reeve admits that progress is slow. “I tell my employees, ‘It took 30 years for steel to replace wood in bridges. It will take longer than we want for composites to replace concrete,’” he says. “You have to keep working at it.”

One way that Composite Advantage has made inroads in infrastructure is by providing products that help solve construction challenges and highlight the advantages of composites. That’s the case for the two bridge projects presented here: One required accelerated construction, while

the other was a highly-engineered bridge. Both utilized prefabricated FRP bridge decks.

The decks were manufactured using the company’s FiberSPAN™ molded sandwich construction, which employs fiberglass top and bottom skins and closely-spaced internal webs that function like a series of I-beams. The fibers in the webs are oriented at $\pm 45^\circ$ angles and infused with resin to form very strong, stiff shear webs for the sandwich cross-section. The closely-spaced webs provide good crushing resistance to concentrated loads, and there is no local skin deflection since the skins are well supported by the webs.

Bridge Project: North Bank Bridge

Location: Boston

Challenge: Pedestrian bridge had to fit into a tight space amid other structures.

Built in May 2012, the 690-foot long North Bank pedestrian bridge connects two parks on the Charles River across from downtown Boston. The \$9.5 million bridge project was funded through the American Recovery and Reinvestment Act. At the grand opening, Massachusetts Governor Deval Patrick called the bridge “an investment for generations to come.”

Every detail of the gently sloped S-shaped bridge is designed to be aesthetically pleasing, down to the wear surface – an epoxy aggregate non-slip coating – that matches the color of the steel superstructure and guardrails. While people running and rollerblading along the bridge are sure to admire the views, they aren’t likely to appreciate the construction challenges.

“The bridge was built next to a road, under the Zakim Bridge, around a historic building and over a T commuter rail line, a small river and a ramp for Duck tour boats,” says Reeve. Composite Advantage supplied 8,280 square feet of FRP bridge deck, including curbs and expansion joints. The FRP deck contributes to superstructure properties, and deck panels were molded in five different shapes to contribute to the curvilinear nature of the bridge.

“In most cases, concrete and FRP decks are there to support people or vehicles. The steel structure really carries the load to the ground,” says Reeve. “In the North Bank pedestrian bridge, aside from supporting people the deck actually helped connect all the steel pieces together and transfer load within the superstructure.” Composites made this possible: The deck achieves higher structural properties with the addition of more – and thicker – fiberglass skins. Plus, more fibers are oriented at $\pm 45^\circ$ angles.

Bridge Project: Wolf Trap National Park

Location: Vienna, Va.

Challenge: Fully-assembled truss bridges needed to be erected rapidly to reduce road closure time.

Wolf Trap National Park for the Performing Arts hosts a variety of shows at its outdoor amphitheaters, ranging from jazz concerts to dance recitals. To walk from one facility to another, thousands of spectators often filed along a narrow curb over a vehicle bridge. The park put an end to this potentially dangerous situation by completing construction of a pedestrian bridge in April 2012.

The bridge, which crosses over a 10-lane highway leading to Dulles International Airport, was designed by the



The North Bank pedestrian bridge winds under the iconic Leonard P. Zakim Bunker Hill Memorial Bridge. Each 10.3 x 12-foot bridge panel includes curbs and expansion joints.

Federal Highway Administration (FHWA). The FHWA required accelerated construction to reduce lane closures that would hamper access to the busy airport. Composite Advantage's FRP bridge decks offered the ideal solution. The deck panels were prefabricated, including the wear surface, curbs and expansion joints. This reduced on-site construction time. More importantly, the FRP bridge deck is 80 percent lighter than a concrete deck, making it faster to lift, move and place by crane.

Composite Advantage supplied 57 prefabricated deck panels measuring 15.5 x 8.3 feet. Each panel weighed only 880 pounds. The panels were assembled on three spans ranging from 138 to 170 feet long alongside the highway. Installation took place on three consecutive nights at 1 a.m., when traffic was light. Each assembled truss – including the steel, FRP deck and fencing – was towed to its position on the adjacent vehicle bridge. Then the contractors stopped traffic and two cranes lifted the truss into place, where it was bolted down. The highway was only closed for 15 minutes each evening. For two weeks following installation, construction workers finished the detail work, such as sealing joints, completing the railing and finishing the ends of the fencing.

The contractor on the project, Shirley Contracting Company LLC, Lorton, Va., never worked with composite decks before. It experienced some hiccups, such as matching the curbs and filling the joints, but was able to correct those issues after the bridge was in place. But the benefits outweighed the glitches.

Learn More About FRP Bridges

COMPOSITES 2013, held Jan. 29-31 in Orlando, Fla., features two education sessions on FRP bridges. Scott Reeve of Composite Advantage will delve into how FRP composite decking contributes to the Accelerated Bridge Construction (ABC) Initiative. Dan Richards of Zellcomp will present a case study about replacing an old steel grid deck with a lightweight FRP deck.

In addition, two other sessions will feature input about ABC from representatives of the Federal Highway Administration and the insurance industry. Visit compositesshow.org today to sign up for COMPOSITES 2013.



Nighttime construction has become commonplace to minimize the impact of lane and road closures. Composite Advantage supplied FRP bridge decks for a 3-span steel superstructure at Wolf Trap National Park. Here, the third span is lifted into place. The road was only closed for 15 minutes on three consecutive nights to accommodate the installation of each span.

“We were able to install the entire deck in about three days. A traditional concrete deck, given the location, would have taken at least four weeks,” says John A. Majane III, senior structural project manager for Shirley Contracting Company. “[Another benefit] was the ability to assemble the deck off site, which reduced costs and the risk associated with working over traffic.”

Majane admits that cost is a factor when it comes to using FRP bridge decks. But he would consider composites for future projects. “This pedestrian truss bridge over traffic was a perfect application for the product,” he says.

Susan Keen Flynn is managing editor of *Composites Manufacturing* magazine. Email comments to sflynn@keenconcepts.net.



The superstructure of the Wolf Trap pedestrian bridge was a steel truss with longitudinal beams spaced 4.25 feet apart. Mechanical fasteners and Z clips provided the deck-to-beam connection.



Visit compositesmanufacturingblog.com and click on “CM Interviews” for an online exclusive interview with Benjamin Oltmann, P.E., from the Federal Highway Administration, who helped design the Wolf Trap National Park pedestrian bridge.