Composite Advantage

Summer 2017 Newsletter

Waterway Challenges No "Sticky Wicket" For The Superior Performance And Long Service Life of FRP

Taming Troubled Waters

America's rivers have provided a transportation network for goods and commodities for centuries. The Ohio River Basin, [touching five states] covers 204,000 sq. miles east of the Mississippi. The Ohio River [981 miles long] carries the largest volume of water of any of the Mississippi River tributaries.

In 1842 Congress acknowledged the commercial importance of these waterways and authorized the U.S. Army Corps of Engineers (USACE) to remove obstructions on the Ohio and Mississippi. But seasonal changes held sway over safe navigation leading engineers to build a series of locks and dams to create slack water pools. The first lock and dam opened in 1885. In 1910, Congress passed the Rivers and Harbors Act which authorized construction of a system of locks and dams that included wooden wicket gates and a lock chamber 600 ft. by 110 ft.

Today more than half of the approximately 87,000 locks and dams have exceeded their service life, but river traffic is heavier than ever. To prevent shut downs USACE needed a maintenance-free solution that could replace standard wood wicket gates.

The proven performance and commercial adoption of Composite Advantage's Fiber-Reinforced Polymer (FRP) camels, ship separators, bridges and bridge decks offered a hardwearing alternative.

USACE teamed with West Virginia University's Constructed Facilities Center and the Department of Civil & Environmental Engineering to help develop and implement FRP materials for lock and dam structures.

Wood wicket gates have short life spans and are not sustainable.

In 2014, Composite Advantage designed and fabricated three 16 ft. long, 4-ft. wide, 8-in. thick FRP wicket gates. Testing proved the composite gates' performance was superior when compared to wood gates. The product also offers a sustainable option to that of old-growth hardwood, a limited resource. The FRP gates were installed in 2015 at the Peoria Lock & Dam on the Illinois River at Creve Coeur, Illinois.

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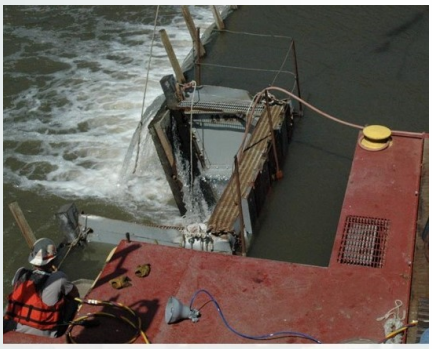
Let's take a look at the steps that led to the successful installation and operation of the nation's first FRP wicket gates in a large navigational waterway application.

Design And Testing

The FRP wicket gate had to match current timber gate dimensions, weight, balance, buoyancy, and center of gravity. It also needed to be able to work with existing steel hardware, support foundations, and installation equipment. FRP gates were tested at WVU to twice the working load of a timber gate.

Installation

River currents are a strong, relentless force. a strong and relentless force. A de-watering dive box was positioned at the timber gates marked for replacement with the new FRP wicket gates. The dive box gave scuba divers a safe zone to guide the composite gates into position as they were lowered with a barge crane. Divers then attached the gates to the support hardware.



(Above) An FRP gate is pulled for closer inspection. (Upper right) De-watering box allows FRP gates to be inspected from both sides. (Bottom) Inspector performs Non-Destructive testing.

Fabrication

FRP can be tailored to product specifications and unique worksite needs. Composite Advantage prefabricated the FRP gates using its signature vacuum infusion process to produce a monolithic component. Multi-directional fiberglass fabric encased foam core architecture before vacuum bagging permeated all reinforcements with thermoset polymer resin.

One FRP gate was equipped with steel angles on the edges similar to that used in testing. Two FRP gates used a yellow high-modulus polyethylene on the sides and face for abrasion protection. Yellow pigment improved visibility. Steel hardware was attached last. Unlike old-growth hardwoods, the limitless supply of FRP stabilizes material costs. Prefabrication produces repeatable structural properties. The unitized shape reduced assembly time and costs. Lighter weight lowered shipping costs and labor hours for installation at the worksite.

Inspection

The composite gates were inspected after 15 months of operation because the gates represented the first large structural waterway application. A de-watering box encasing the FRP wicket gates allowed technicians to inspect both upstream and downstream sides. One composite gate was pulled for close visual examination. Non-Destructive inspection probed for internal damage with a digital tap hammer. No internal damage was found. The FRP wicket gates exhibited no delamination, major surface or structural damage. The Rock Island District acknowledged the FRP composite gates were in excellent condition.

Next Steps

USACE is looking to replace wood gates with FRP at two other river sites. Savings in materials and labor over the span of 50 years nets substantial savings since acquisition costs for FRP is less than wood. These products offer the potential for use by USACE nationwide. Federal agencies are also eyeing FRP composites for myriad navigation and water-controlled structures.

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