BRONX-WHITESTONE BRIDGE RE-DECKING

New Steel Roadway Revitalizes an Aging, Overweight Bridge

ABOVE Ironworkers maneuver the new lateral system into place on a temporary construction platform beneath the bridge.

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During its 60-plus years of service, the Bronx-Whitestone Bridge put on a lot of weight, mainly from additions tacked-on to widen the bridge from four driving lanes to six. In the late 1990s, engineers contracted by Metropolitan Transit Authority Bridges and Tunnels (MTABT) determined that the extra pounds were placing undue strain on the aging structure's suspension cables and could cause complications in the foreseeable future. In response, the MTABT hired Weidlinger Associates to design a new deck-stiffening system that would shed some of the bridge's weight and extend its lifespan. Weidlinger's design was implemented in two phases. In 2003, during the first $32.7 million phase of revitalization efforts, Nab Construction of College Point, NY, removed the heavy steel stiffening trusses that were added to the bridge in 1947 and replaced them with lightweight fiberglass wind fairings to improve the bridge's aerodynamics. During the current $136.7 million stage, which will complete the rehabilitation, Perini Corporation and O&G Industries are lowering the bridge's lateral system and replacing the original poured concrete steel grid deck, which had become pock-marked, with a lighter steel orthotropic deck. Overall, the project will shave 4,000 tons off of the bridge, nearly 20 percent of its total weight.

The orthotropic deck system, which consists of 5/8-inch-thick, ASTM 709 Grade 50 steel plates welded to steel ribs, is not only lighter, it is an essential part of Weidlinger's stiffening system. The old deck, which simply rested on sub floor beams, was designed only as a roadway. "Our deck," says Genaro Velez, a Weidlinger structural engineer on the project, "is integrated into the bridge's structural system. It's not only good for traffic, but works with the lateral system to stabilize the span against wind loads."

To accomplish this, Weidlinger used the roadway as a counterpoint to the lateral system, which was replaced and lowered. The existing system was a K-braced frame. The new system, an X-braced frame made from large HSS20X8 rectangular tube sections, bolts to the bottom of the bridge's stiffening girders. The engineers used the orthotropic deck system to brace the top of the stiffening girders. Steel, chosen in part for its ability to create a seamless, rigid surface free of joints, easily bolted into the top flange of the bridge's floor beams, which are 19 feet, 9 inches apart and span the stiffening girders. The resulting formation is a torque tube box. "It works the same as any other box," comments Velez. "When you don't have the lid on you can twist it, but as soon as you put the lid on the box, in this case the new deck system, you can't twist it."

Perhaps the biggest challenge of the re-decking project was to install the new deck system without disrupting the daily flow of 120,000 cars. The MTABT and Perini/O&G, took a lane closure approach. Normally, the bridge has six lanes of traffic, three in each direction. "We were able to take one lane out of service," says Terry Flynn, of Perini, "and replace the deck one lane at a time." To best manage traffic, a movable median barrier designates the greatest number of lanes to the greater flow of traffic—three towards the Bronx and two towards Queens during the morning rush. During the evening rush the opposite arrangement is in effect.

Perini/O&G began by sawing out and removing the existing deck and sub floor system. At night, when traffic was lightest, flatbed trucks brought the orthotropic sections onto the bridge, 68 sections to a lane, and four overhead gantry cranes lifted them into place. Ironworkers then bolted the deck sections to the bridge's floor beams using one-inch-diameter galvanized A325 bolts and welded the sections together to create a seamless surface.

Perini chose full penetration submerged arc welding to join the deck panels, a process not generally used in the field due to the large electrical power requirement. This turned out to be the most economical

ABOVE LEFT A movable median designates the most lanes to the busiest flow of traffic.

ABOVE RIGHT The contractors installed a 4,160-volt temporary power supply to the bridge for welding purposes.

option, despite the additional infrastructure and training required for the entire crew. "We put in a 4,160-volt temporary power supply to the bridge for the welding," says Flynn, "and prior to starting we conducted an American Welding Society certified welding class, in which our people, the ironworkers, the designers, and the MTABT got a good understanding of the process."

To replace and lower the lateral system Perini installed a 275,000-square-foot temporary work platform beneath the bridge. Constructed in panels off site from bar joists and corrugated steel, the platform was barged beneath the bridge, then hoisted into place. Perini/O&G also installed 10,000 linear feet of galvanized steel barrier, which, unlike concrete, minimizes the dead load on the bridge's suspension system.

Overall, the project incorporated 10,000 tons of steel, 4 1/2 miles of full penetration groove weld, and 300,000 high-strength bolts. Construction started in June 2005. To minimize the impact on the public, operations were halted during January and February when winter weather could disrupt the welding, lowering productivity. The deck was finished on time in August and the project is expected to be complete by the end of 2006, leaving the Bronx-Whitestone Bridge leaner and stronger for continued years of service.

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ABOVE Workers operate a submerged arc welding machine, joining the new deck panels.

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ABOVE A gantry crane lifts a new deck panel into place.

WHITESTONE BRIDGE REDECKING

Owner **MTA Bridges and Tunnels** *New York, NY*
Structural Design Engineer **Weidlinger Associates, Inc.** *New York, NY*
General Contractor **Joint venture Perini Corp.** *Framingham, MA*
O&G Industries *Torrington, CT*
Construction Management **GPI/Parsons** *Bronx, NY*
Structural Steel Erecter **Perini/O&G**