WILLIAMSBURG BRIDGE
REHABILITATION
CONTRACT 8

100-year-old Steel Bridge Ready for 100 Years More

A casual glance today at the Williamsburg Bridge reveals just what you would expect to see—the majestic form of a century-old structure, virtually the exact image found in antique black-and-white photographs taken when trolley cars and horse and buggies used the crossing. But in fact nearly every component of the 1903 structure has been replaced or refurbished in a daunting 18-year rehabilitation project, which by its expected completion in 2008 will have incorporated approximately 29,000 tons of structural steel, millions of hours of labor provided by hundreds of ironworkers and other skilled craftspersons, and more than $1.2 billion in construction costs.

The rehabilitation efforts got started in 1988 when inspecting engineers discovered significant deterioration in the existing structure due to weather, increased traffic loads, and negligent maintenance practices. The New York City Department of Transportation (NYCDOT) temporarily closed the bridge and assembled a technical advisory committee, charging it with developing options for dealing with the compromised span. The committee submitted three. The first simply suggested closing the bridge permanently, but this would divert traffic to other already congested crossings. The second option proposed building a new bridge, but this would require

© KAREN DIEMER

OPPOSITE Ironworkers replaced the bracing members on the intermediate towers.

ABOVE Ironworkers on the roadway

“One of the amazing things about this project is that we literally had to touch every inch of the bridge.”

ABOVE AND OPPOSITE Rehabilitation efforts included replacing vehicle and pedestrian roadways, shoring up the main towers with steel plates fabricated to fit existing rivet holes, and erecting box columns to support new bearings.

BOTTOM RIGHT: © KAREN DIEMER; REST: © NYC DOT DIVISION OF BRIDGES

© NYC DOT DIVISION OF BRIDGES

finding a new approach, acquiring the property for it, and patching the existing bridge in the meantime. The third option involved rehabilitating the existing bridge while simultaneously maintaining the usual daily flow of 107,000 motorists, 92,000 subway and bus riders, 600 bikers, and 500 pedestrians. “Usually it would be cheaper to take the bridge down and put up a new one,” explains Hasan Ahmed, director of NYCDOT’s East River Bridges division. “But because this is New York City, the cost to users that would result from such a closure outweighs the additional price of a repair. So we decided on rehabilitation.”

To repair the bridge while keeping it functional the NYCDOT broke the work into phases, each of which was contracted separately. The first of these, Contract 4 (The New York State Department of Transportation, which used to manage the East River bridges, had already issued three contracts on the Williamsburg Bridge when NYCDOT took over responsibility for the crossings in the late 1980s), cost approximately $90 million and got started in 1991. It covered rehabilitating the main roadway support cables and suspenders. Contracts 5 and 7 tackled the south and north inner and outer roadways, respectively. Costing a combined total of $494 million, Contracts 5 and 7 repaired or replaced the roadway framing and replaced the crumbling concrete deck with a lighter and longer-lasting steel orthotropic deck system. Contract 6 cost $167 million and replaced the J, M, and Z subway tracks that cross the bridge.

Each contract included major steel work and each used millions of pounds of structural steel, mostly Grade 50, though some Grade 36 was employed. Field engineers carefully inspected every single existing member (a process that is repeated every two years), and if there was any doubt about the member’s integrity it was replaced. “One of the amazing things about this project is that we literally had to touch every inch of the bridge,” says Ahmed.

While organizing the contracts was important to minimize inconvenience to the bridge users, completing all this work on time was essential. The NYCDOT established incentives, basically cash bonuses, for contractors who finished work on schedule. In each instance the contracts were completed early. The city also initiated its Partnering Program in 1994 while work was underway on the bridge, which further streamlined the process by bringing all of the major players—the owners, designers, engineers, construction managers, etc.—into one room to discuss their common goals.

© KAREN DIEMER

OPPOSITE Koch Skanska erected temporary work decks at the base of the main towers.

The city's final contract in the Williamsburg Bridge rehabilitation efforts, Contract 8, got under way in 2003 and includes five main jobs: painting the bridge trusses, finishing the cable work, reinforcing the main towers, rebuilding the intermediate towers, and replacing the original truss bearings. Parsons Transportation Group completed design on this contract, with Greenman Pedersen as the resident engineer and Koch Skanska as the general contractor.

One of the most fascinating tasks of Contract 8 was reinforcing the main support towers. "Inspection determined that the towers weren't strong enough to handle the current loads, which were pulling the towers toward each other," says Douglas Reese, Greenman Pedersen resident engineer on the project. This increased the compressive force in the inner legs of the towers beyond their design capacity. To relieve the towers of the extra stress the team designed steel plate reinforcements that bolted onto key compression areas of the towers. As with almost every other replacement or reinforcement member used on the bridge, the plates had to be individually measured and drilled to match existing rivet holes. "During installation the plates are bolted at the top and bottom first, with the middle bowed out by a predetermined dimension," continues Reese. "That way when the rest of the plate gets bolted down it goes into compression and relieves some of the load."

Fabricated by Michelman-Cancelliere Iron Works, the plates themselves measure 40 feet high by 28 inches wide by 1 1/2 inches thick and were installed in sets of two, each set weighing 3,000 pounds. Hoisting these massive components into place over live pedestrian and vehicular traffic created obvious safety concerns. In answer, Koch Skanska custom designed a track delivery system that affixed to the sides of the towers, ensuring that the plates would only go up to their intended location, where ironworkers bolted them in place with A325 high strength bolts. "The track system gave the client the confidence they needed to let us do this work without shutting the bridge down," says Terrence Daly, senior vice president of Koch Skanska. The track served its purpose and the plates were successfully installed without incident.

Another fascinating aspect of Contract 8 involved re-bracing of the intermediate towers. Unlike other suspension bridges, the Williamsburg Bridge's end spans are not supported by suspender cables, but by intermediary towers, three on each side, and a fourth within each main tower, known as the "fifth leg." All of the bracing members of the intermediary towers had to be replaced, which the team managed to do by carefully removing a few steel members at a time, while allowing traffic to continue to flow. But Contract 8's most difficult job involved replacing the bridge's 100-year-old main tower bearings, which rested atop the fifth legs, with new multi-directional sliding panel point 30 bearings. "Koch does a lot of bearing work," attests Daly, "but this is by far the most complicated bearing job we've ever been involved with." Ironworkers installed temporary jacking towers around each fifth leg, which supported the bridge surface while the leg was dismantled and replaced by a 6-foot by 4-foot 6-inch by 83-foot 8 1/4-inch welded box column. American Bridge fabricated the box columns in five segments each and Koch Skanska erected them one atop the next as they arrived, bolting each together using interior and exterior splice plates. While replacing the fifth legs, pressure gauges in the temporary jacking towers determined the actual loads at the bearing locations.

Completing the rehabilitation efforts under Contract 8 entailed many more jobs, including repairing the bridge's stiffening trusses, and installing new maintenance travelers, but none was more important than maintaining the bridge's historic profile. The elaborate gate lamps on the main tower balconies and the pedestrian walkway were painstakingly reconditioned. Even the structural steel work played a part: Except in unseen places, such as the fifth leg, the design team took pains to designate new shapes that resembled the originals they replaced. Now New Yorkers will be able to appreciate and use this piece of their heritage for another 100 years. It's a testament to the dedication of the contractors and designers who completed the work, and to the inherent flexibility of steel, which breathed new life into this venerable bridge. ■

WILLIAMSBURG BRIDGE REHABILITATION CONTRACT 8

Owner **New York City Department of Transportation** *New York, NY*
Designer **Parsons Transportation Group** *New York, NY*
Resident Engineer **Greenman-Pedersen** *Babylon, NY*
General Contractor **Koch Skanska** *Carteret, NJ*
Structural Steel Fabricators **American Bridge** *Coraopolis, PA*; **Michelman-Cancelliere Ironworks, Inc.** *Lehigh Valley, PA*; **JA McMahon** *Niles, OH*; **Northeast Structural Steel** *Yonkers, NY*
Structural Steel Erector **Koch Skanska** *Carteret, NJ*
Miscellaneous Steel Fabricators **Hurtt Fabrication** *Marceline, MO*; **Regal Industries** *Painesville, OH*; **Shenandoah Steel Corp.** *Lansdale, PA*; **Wecall, Inc.** *Orwell, OH*; **Francis A. Lee Company** *Hicksville, NY*; **Strocchia, Patsy & Sons Iron Works, Inc.** *Brooklyn, NY*; **Seibel Modern Manufacturing & Welding Corp.** *Lancaster, NY*
Miscellaneous Steel Erector **Koch Skanska** *Carteret, NJ*
Architectural Metal Fabricator **Allen Architectural Metals** *Talladega, AL*
Architectural Metal Erector **Koch Skanska** *Carteret, NJ*
Ornamental Metal Fabricator **Selco Manufacturing Corp.** *West Caldwell, NJ*
Ornamental Metal Erector **Koch Skanska** *Carteret, NJ*