Brooklyn's Other Bridge

BY JIM TALBOT

IN DECEMBER OF 1903, 20 years after the opening of the famous Brooklyn Bridge, the slightly longer and much stronger Williamsburg Bridge opened to carriage and pedestrian traffic.

A steel suspension bridge, it also crosses the East River, connecting Manhattan to Brooklyn several miles north of the Brooklyn Bridge. At the time, *Scientific American* called it "an engineer's bridge pure and simple." Critics considered it utilitarian but unsightly, with a complete lack of beauty and grace. While designed for rail traffic, trains did not run on the bridge until 1908 because of disputes between greater New York and private rail companies.

When it opened, the Williamsburg Bridge was the longest suspension bridge in the world, with a span of 1,600 ft and a total length between approaches of 7,308 ft. Its two all-steel towers reach a height of 310 ft, supporting four steel 18-in.-diameter main cables. Steel arches, not the cables, support the side spans. Massive 40-ft-deep steel stiffening trusses carry the decks.

Construction took only seven years, half the time it took to build Brooklyn Bridge. Its final cost came to $24.2 million, including land and approaches. Despite the increased costs, economics guided much of the design. Since the main cables don't support the relatively short (300 ft) side spans, they were made to be shorter and lighter. The towers, made from less expensive and lighter steel rather than masonry, required smaller foundations. Steel-supported approaches also reduced construction time and expense.

Currently, the Williamsburg Bridge still represents a major crossing of the East River. It carries eight lanes of traffic divided by two rapid transit tracks for subway lines. Daily, about 140,000 motorists and 92,000 transit riders cross the bridge. These are supplemented by 600 bikers and 500 pedestrians who cross on upper pathways.

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Building (the case for) a Bridge

Early in the 20th century, first- and second-generation Irish and German settlers populated the Williamsburg section of Brooklyn, which was not yet part New York City. They began agitating for a bridge once it became clear that the Brooklyn Bridge was contributing heavily to growth, trade and prosperity of its surroundings further south. But powerful ferry interests and many officials in New York City did not want the new bridge.

Finally, a commission received appropriations and came to terms with Frederick Uhlmann, a railroad owner who had acquired a prior charter to build crossings at the site. The new commission appointed Leffert L. Buck as the chief engineer. He announced plans for the new $7 million bridge in an 1896 issue of *Engineering News*. Construction began that November.

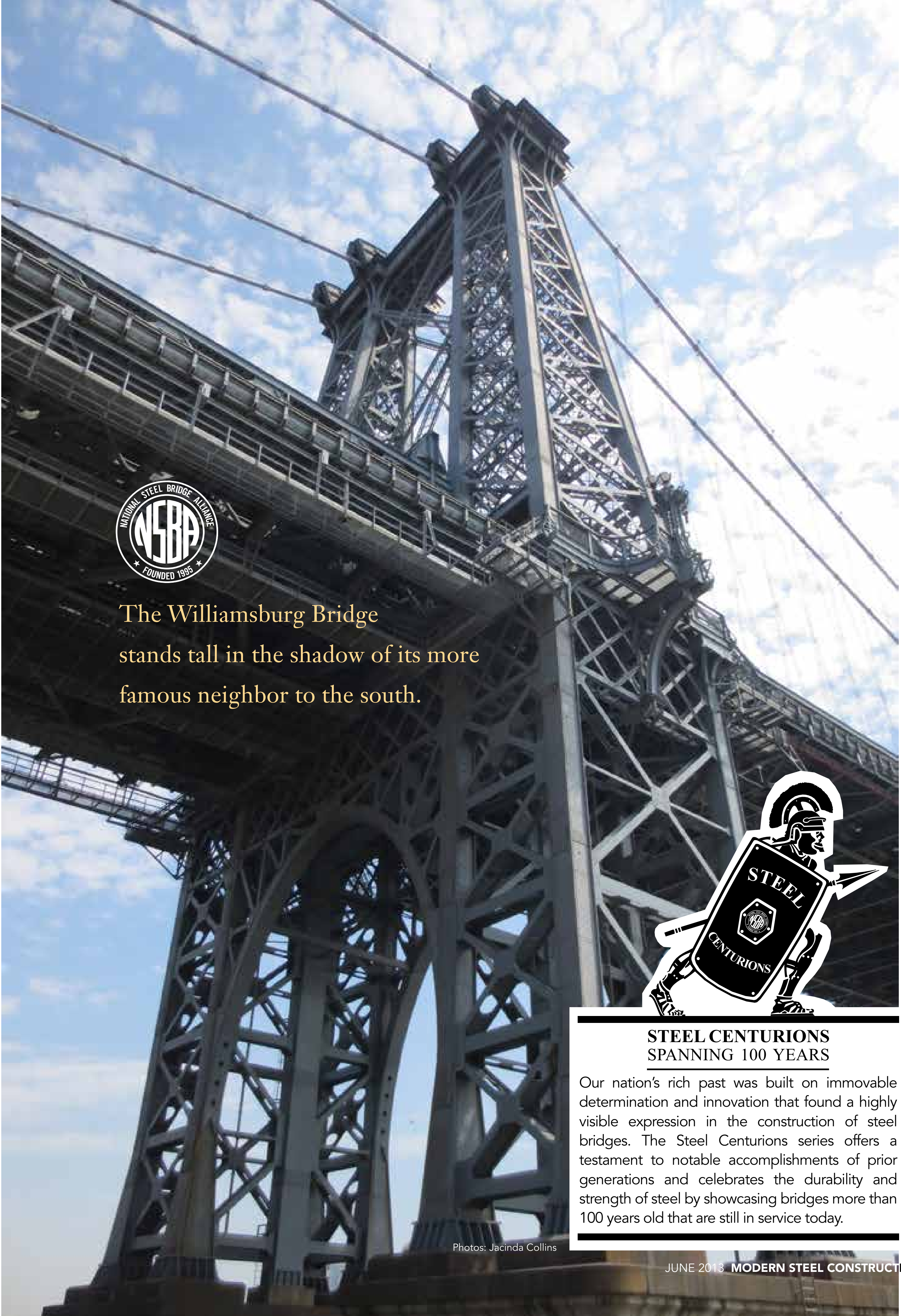
The East River at this site was about 60 ft deep at high tide and the current flowed at six miles an hour. Like the Brooklyn Bridge, the piers reached down to bedrock using large wooden pneumatic caissons. According to a magazine report, each caisson weighed nearly 2,000 tons and required nearly "3,000 wagon loads of concrete to sink it."

Workers with picks, drills and shovels excavated the bottom. Dynamite blasted loose boulders and large rocks. Men pushed the water, mud, clay and stones toward flexible tubes that carried the excavated material to the surface by air pressure. The caissons descended at a rate of about 4 in. a day. As they descended, the men worked fewer hours a day and received higher rates of pay.

Tower Construction

Each of the bridge's two steel towers sit on two separate masonry piers. Contractors built a 125-ft-high wooden temporary tower between the two piers and assembled large derricks on top. The derricks set huge steel castings, weighing nearly 25 tons apiece, onto the piers to carry the weight of the main steel tower posts. Large steel bolts anchor each tower to its piers.

The derricks continued to assemble the columns, struts and braces, taking the towers to the level of the deck. Workers then built a steel beam-supported platform at this level, took down the wooden temporary tower and reassembled it on top of the platform. Work then continued, connecting the steel parts until the towers reached their full height, about 100 ft higher. Meanwhile contractors constructed the riveted steel arches that reach from the towers over land and water to the anchorages.



The Williamsburg Bridge stands tall in the shadow of its more famous neighbor to the south.

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Photos: Jacinda Collins

Saddles atop the towers support each of the four 4,344-ton main cables. Each cable consists of 37 strands of 208 wires, and nearly 17,500 miles of wire in the cables suspend the bridge 135 ft above the river. Buck specified that the wires not be galvanized. While this made them less susceptible to hydrogen embrittlement, it laid them open to possible rusting. Once a cable's wire was all in place, workers tightly clamped it into a cylindrical bundle, which was waterproofed and covered with a plate steel shell.

In 1902 a severe fire in a worker's shack above one of the towers damaged some of the main cable wires, creating some doubts about the bridge. But Roebling Company, which provided the wire rope and wove the cables, simply spliced new wires into the burned-out section with wires of even greater strength. That same year Gustav Lindenthal became chief engineer of the Williamsburg Bridge. He stressed its strength—twice that of the Brooklyn Bridge—rather than its design.

Once the bridge opened, it greatly influenced the migration of ethnic groups. By that time Brooklyn had become part of New York City, and many Manhattanites from the densely populated lower east side moved into the Williamsburg section of Brooklyn.

Modifications and Repairs

In 1910 the city banned tolls as a way to finance bridge construction and maintenance. Shortly thereafter, engineers noticed some sagging under the increasing weight of locomotives, cars and trucks. Originally, Buck had designed the bridge for lighter vehicles. To accommodate these and future traffic conditions, contractors added additional supports to the side spans and more steel to the deck. Reconfiguration of the bridge took place in the early 1920s to provide eight lanes for road traffic.

Over the next few decades the bridge fell into disrepair. At one time in the 1960s, a newspaper reported that rust was raining down on pedestrian and cycling walkways; the city closed these walkways in the 1970s after a maintenance worker was mugged. In April of 1988 an inspection revealed severe corrosion throughout the bridge's cables and steel supports. The city shut the bridge to all traffic for two months to make temporary repairs and initiated a study on whether to replace or repair the bridge.

A panel of design experts reviewed several replacement designs as well as rehabilitation plans. By November of 1988 the New York City Department of Transportation (NYCDOT) decided to repair the bridge while keeping it open to minimize disruption to traffic patterns and surrounding communities. What followed was a 15-year, $1 billion reconstruction project with design and engineering support by Parsons Brinckerhoff. The rehabilitation work included:

- Replacement of existing stringers and pedestals along the suspended span, as well as addition of reinforcement plates for the floor beams and vertical hangers
- Replacement of both the north and south roadways with lighter and stronger orthotropic steel decks as well as a completion of the upper pedestrian-bicycle path
- Added supports and new approaches for the two subway tracks; about 100,000 daily transit riders had to find alternative crossings for several months during 1999
- Reconstruction of a viaduct to connect the bridge with Interstate 278 (the Brooklyn-Queens Expressway)

By 2002, all eight lanes were open to traffic and final work began in 2003 and finished up just last year. This project involved the rehabilitation of the tower bearings, the truss system, the steel structure of all the towers and painting of the stiffening trusses. Additional work included the updating the interiors of anchorage houses, restoration of decorative lighting and installation of an Intelligent Transportation System to better understand the how commuters use the bridge and increase its transit efficiency.

All of these major projects will preserve the bridge as a major part of New York City's infrastructure—perhaps for even more than another 100 years. MSC