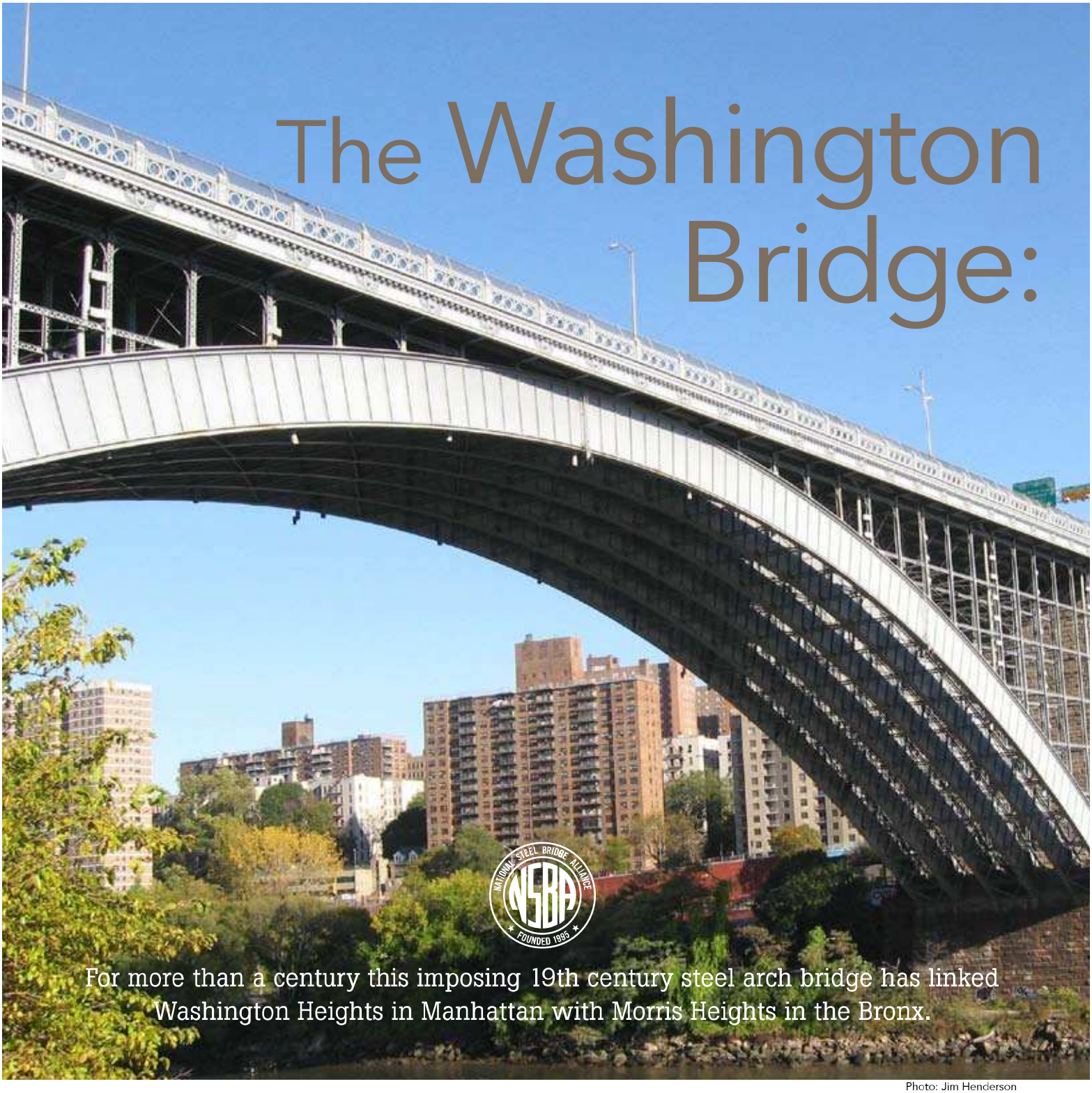
The Washington Bridge:



For more than a century this imposing 19th century steel arch bridge has linked Washington Heights in Manhattan with Morris Heights in the Bronx.

Photo: Jim Henderson

THE WASHINGTON BRIDGE is an imposing, beautiful structure, and especially interesting as a perfect example of the arched style of bridge architecture. Completed in 1889, it currently carries six lanes of traffic (plus 6-ft sidewalks on both sides) over the deep valley of the Harlem River. Sometimes confused with the George Washington Bridge on the west side of Manhattan, it connects the Washington Heights section of upper Manhattan to the Morris Heights section of the Bronx. Despite its Centurion status, about 50,000 vehicles a day cross the 2,375-ft-long Washington Bridge.

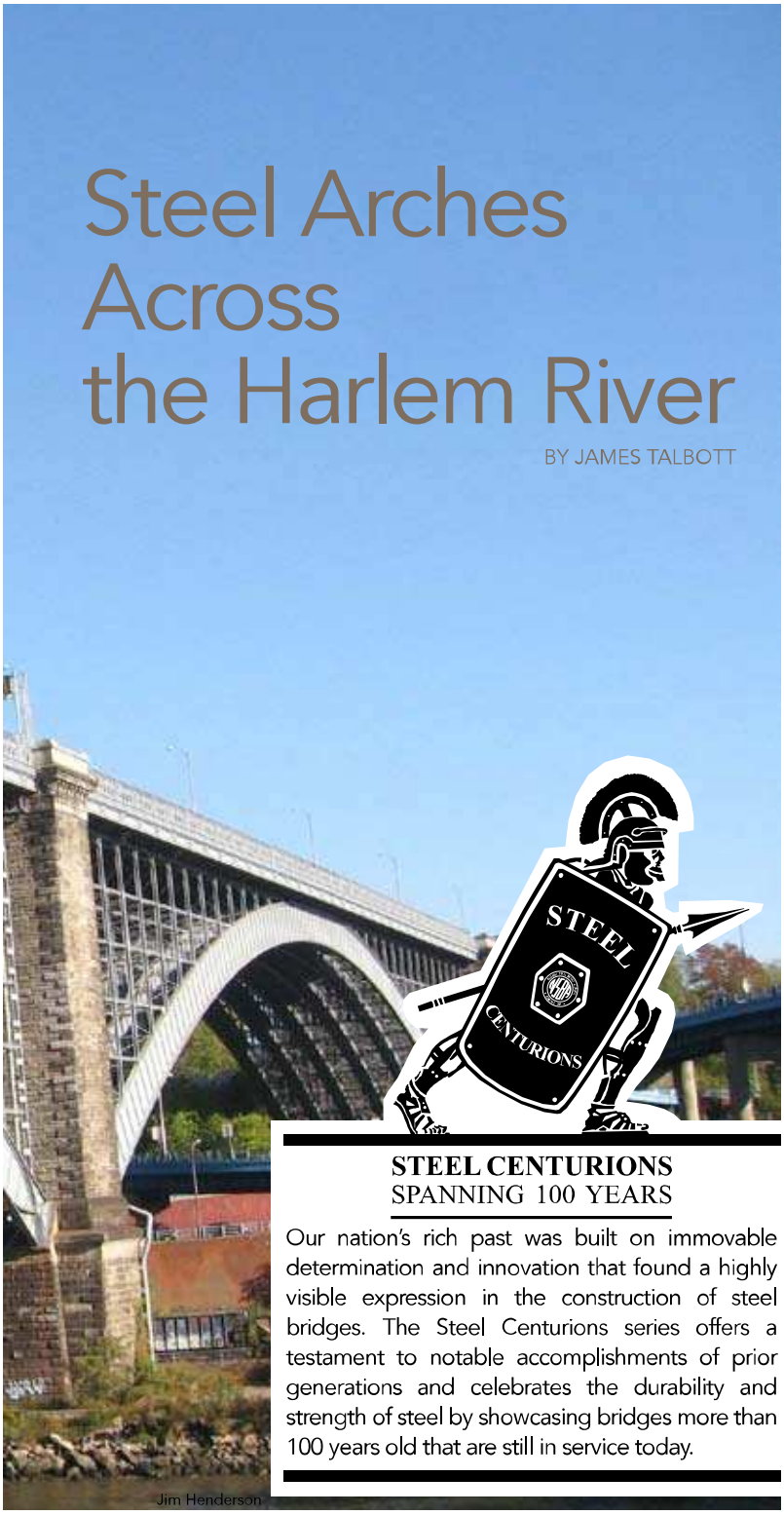
Manhattan Expansion

In the latter part of the 19th century, Manhattan's population was rapidly advancing northward. The city of New York absorbed the towns of Harlem, Yorkville, Manhattanville, Carmansville and others further up the island. The city then annexed a portion of Westchester County, beyond of its island limits.

New York City parks commissioner Andrew H. Green, an advocate of Greater New York, conceived of the idea for the Washington Bridge, originally called the Harlem River Bridge. Green believed that once housing and streets were laid out in Washington Heights, pressure would build for a link to carry traffic across the river between Manhattan and what later became

Steel Arches Across the Harlem River

BY JAMES TALBOTT



Jim Henderson

STEEL CENTURIONS
SPANNING 100 YEARS

Our nation's rich past was built on immovable determination and innovation that found a highly visible expression in the construction of steel bridges. The Steel Centurions series offers a testament to notable accomplishments of prior generations and celebrates the durability and strength of steel by showcasing bridges more than 100 years old that are still in service today.

Looking up and across Harlem River Drive from near water level at the Washington Bridge.

known as the Bronx. The Washington Bridge, along with the first subway connection across the river in 1904, persuaded many thousands of immigrants in Manhattan tenements to move to spacious new apartments in the Bronx.

Settling on a Design

The Board of Commissioners of Central Park conducted studies about the possibility of building a bridge across the Harlem River as early as 1868. In 1870 the city purchased land for this purpose at a site about 2,000 ft north of High Bridge, which is part of the Croton aqueduct across the river.

While several designs were considered, nothing further happened until 1885. That year, to kick-start the project, the mayor, comptroller and the president of the Board of Aldermen of New York City appointed three commissioners as the authority for bridge design and construction. They required that the new authority complete the bridge within three years. The authority organized a design contest for the new bridge.

The winning design for the arches by Charles Conrad Schneider was modified by William Rich Hutton and Edward H. Kendall to reduce costs. The main spans consist of two steel arches that each have 510 ft of clearance between piers. The main arch stretches over the river while the secondary arch crosses over railroad tracks and an expressway. The layout called for two 15-ft-wide walkways flanking the main roadway, bringing the total bridge width to 80 ft. A grassed mall graced the center of the carriage roadway between the opposing lanes.

Heavy balustrades of iron and bronze framed the sidewalks. An iron cornice and frieze covers the ends of the main floor-beams. The arches provided 134 ft of vertical clearance and 354 ft of horizontal clearance for marine navigation. The bridge opened to pedestrians in December of 1888 and to vehicles, which is to say carriages, about a year later. In 1906 it was opened to automobile traffic.

In April of 1886, the commissioners opened 10 proposals for earth and masonry work and five for metal work. All were rejected because the commissioners wanted the entire project let in one contract. After much wrangling, the commissioners in July signed a contract with the Passaic Rolling Mill Company and Myles Tierney to construct and complete the bridge according to preliminary plans for $2,055,000, of which $845,000 was for the metal work.

While the designs for the metal spans were relatively complete and acceptable, the commissioners considered those for the masonry and approaches only partly satisfactory. But 13 months of the three-year requirement for completion of the bridge had

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▲ The north side of the Washington Bridge with Manhattan in the background circa 1970.

elapsed, and the commission planned to modify them during construction. Work on the substructure commenced immediately.

Substructure

Excavations for the end piers began quickly in the summer of 1886. Solid rock occurred at or near the surface on both sides. The west side, for example, required only removal of the earth and shaping of the rock to receive the masonry.

The center pier, however, required the building of a caisson. The authority approved plans for the caisson in early September. Built in place, the timber caisson measured about 105 ft by 54 ft by 13 ft. The depth of bedrock below the caisson varied from 17 ft to 40 ft below the mean high water level. Sinking of the caisson began in mid-November. It reached its final depth of 40.6 ft below mean high water in April of 1887. By mid-July of that year the masonry for the center pier rose to the top of the skewbacks, 52.2 ft above mean high water.

Superstructure

Six steel ribs form each arch. The piers' granite-faced skewbacks backed by concrete resist the thrust and weight of the arch ribs. The main piers are 40-ft thick at the springing line of the steel arches and 98-ft long. They rise about 100 ft above the skewbacks to support the roadway. Three semicircular arches of masonry continue the roadway beyond each end pier, each having a 60-ft span.

The steel arches rise about 90 ft at crown. The steel rib webs are 13-ft deep and ⅜-in. thick with double flanges at top and bottom. Iron stiffeners are spaced at about 5-ft intervals. Each rib consists of 34 segments. Vertical steel posts that carry the roadway stand on top of the segment joints and are spaced at nearly 15 ft between centers. Lateral bracing connects the ribs on both top and bottom flanges; sway-bracing steadies the segment joints. All bracing consists of latticed beams and angles.

Flange-plates of the outer ribs are 20-in. wide, varying in thickness from 2 to 3 in. The flange plates of the inner ribs measure 12-in. wide and ¾-in. thick. Angle stiffeners at segment ends are riveted together to join the arch segments. Additionally, splice plates join the flanges.

Each rib rests at its ends on cylindrical pins of forged steel that are 34-in. long and 18 in. in diameter. The span between pin centers is about 509 ft. The pins lie in steel bearings carried on steel pedestals bolted to granite skewbacks.

The transverse floor-beams, spaced at about 15 ft, consist of plates and angles 2.5-ft deep under the roadway. The beams under the sidewalks are about 4-ft deep. Posts rise from the tops of the arch ribs to support the floor beams. The posts consist of two 10.5-in. iron channels latticed on the sides. The posts rigidly attach to the rib flanges, struts, and to the floor-beams. Pin-connected horizontal struts and diagonal ties brace the posts transversely.

The floor beams carry longitudinal stringers spaced about 3 ft between centers. The stringers are rolled I beams—15-in. deep under the roadway and 10.5-in. deep under the sidewalk. Steel plates that are 15 ft by 3 ft are riveted to the top of the stringers to form the flooring. The plates, called buckle plates, are slightly arched to increase rigidity. The entire flooring forms one rigid surface. While the floor is fixed to the arch at the middle of the span, it can slide at both ends on the masonry to compensate for contraction and expansion caused by changing temperatures.

Construction

The erection of the two spans took place between September 1887 and May 1888, employing about 200 workers. Travelers lifted the rib segments from trucks, setting them in place on falsework for bolting to adjacent segments. Lateral and sway bracing was then connected. Workers set the segments to a curve 3 in. higher at the crown to allow for the compression of the steel when supports were removed. The land span was completed first, then the travelers were removed and set up on the river span. Smaller hoists served to erect topworks for the land span.

Beginning at the crown, workers erected and braced the supporting posts, the transverse floor-beams, the longitudinal stringers and plate flooring. Then they filled all cracks and open joints with a cement of lead and iron filings. Drain holes were cut in all pockets where water could lodge. The final cost of the bridge was about $3 million.

The Bridge Today

During the late 1940s and early 1950s, the roadway deck was modified to accommodate increased vehicular traffic. The grassed center mall was removed to accommodate a 66-ft-wide roadway and the walkways reduced to 6-ft widths.

The bridge was added to the National Register of Historic Places in 1982. Over the years it has undergone extensive rehabilitation to ensure its structural integrity into the future. For example, in 1992 a $33 million project commenced to repair the bridge's deck, sidewalks, railing and supporting steel.

When the George Washington Bridge over the Hudson River was completed, in 1931, traffic coming off the bridge initially travelled into the Bronx over the Washington Bridge. The Alexander Hamilton Bridge over the Harlem River was built nearby to accommodate a second level added to the George Washington Bridge. When the Alexander Hamilton Bridge was completed, in 1963, it greatly relieved the heavy traffic levels carried by the Washington Bridge. Still, about 50,000 vehicles cross the Washington Bridge every day. MSC

Much of the information for this article is from The Washington Bridge over the Harlem River at 181st Street, New York City, *by William R. Hutton, published by Leo Von Rosenberg, New York, 1890.*

Wages (per day) on Construction of the Washington Bridge

Foreman (General)	$7.00 to $8.00
Foremen	$4.00
Masons	$3.50
Stonecutters	$3.50
Drillers	$2.00
Laborers	$1.75
Blacksmith	$2.50
Blacksmith helper	$2.00
Engine drivers	$2.50
Carpenters	$3.00
Foreman of painters	$2.50
Painters	$1.75
Carts	$3.00