6. Newburgh-Beacon Bridges (New York, USA)

Owner: *New York State Bridge Authority*
Engineer: *Modjeski and Masters*
Principal Contractors:
North (Original) Bridge
Substructure: *Snare-Dravo (Joint Venture)*
Superstructure: *Bethlehem Steel Company*
South Bridge
Substructure: *Steers, Spearin, Yonkers, Buckley (Joint Venture)*
Superstructure: *United States Steel Corporation (American Bridge Division)*
Construction Period: *North Bridge – 1960-1963; South Bridge – 1977-1980*

General

In 1743, King George II of England granted a charter to private interests for the operation of a ferry service across the Hudson River between the Towns of Newburgh and Beacon, New York as part of a toll road route between Pennsylvania and New England. Proposals for bridge crossings at this location reportedly date back to 1801, but it was not until the planning of I-84 in the 1950's that the first positive action for constructing a bridge was taken. The two-century old ferry service was finally replaced in 1963 with a high level, two-lane roadway, high traffic volume bridge at a cost of $19,870,000. The total length of the bridge between abutments is approximately 2,395 m which consists of a series of approach girder spans and deck truss spans leading to a cantilevered main span of 305 m providing navigation clearances of 232 m horizontal and 41 m vertical (Fig. 1). Stage completion of I-84 and ever-increasing traffic resulted in the Federal Government agreeing in 1973 to assume 90 percent of the cost of a south crossing having a three lane roadway. The remainder of the cost was underwritten by the New York State Bridge Authority. This new bridge, a look alike but totally different, modern, parallel structure, was completed on schedule in the fall of 1980 at a cost of $94,087,000.

A $43.5 million renovation of the older north crossing is now underway, with all traffic detoured to four lanes on the south crossing. Ultimately, there will be three lanes eastbound on the South Bridge and three lanes westbound on the reconditioned North Bridge.

Substructure

Extensive sub-surface investigations, general topography plans and soils investigations were made for the North Bridge. These were later supplemented using as-built foundation information from the first bridge for the foundation designs for the parallel structure. For the North Bridge, beginning at the west (Newburgh) abutment and proceeding eastward, there is a variety of types of substructure construction in the following order: one concrete abutment and six concrete piers supported by cast-in-place concrete bearing piles; two concrete land piers founded on rock; one concrete river pier supported by open cofferdam tremie seal concrete foundation; eight concrete river piers supported by open-dredged, caisson type concrete foundation; two river piers supported by steel H-beam bearing piles; four concrete land piers founded on rock and a concrete abutment supported by cast-in-place concrete bearing piles.

By comparison in the same order for the South Bridge; the Newburgh approach west abutment and concrete piers (four only) are founded on rock; one concrete land pier supported by steel H-beam bearing piles and one concrete land pier supported on rock; one concrete river pier supported on H-beam bearing piles; four concrete river piers supported by caisson type concrete foundations; six river piers supported by steel H-beam bearing piles; and four concrete land piers and the east abutment supported on rock. The major significant foundation change between structures, other than supporting most South Bridge land piers on rock, occurred in the river where long pile foundations were substituted for four caisson piers, as well as for one cofferdam-tremie seal pier. These foundation changes resulted

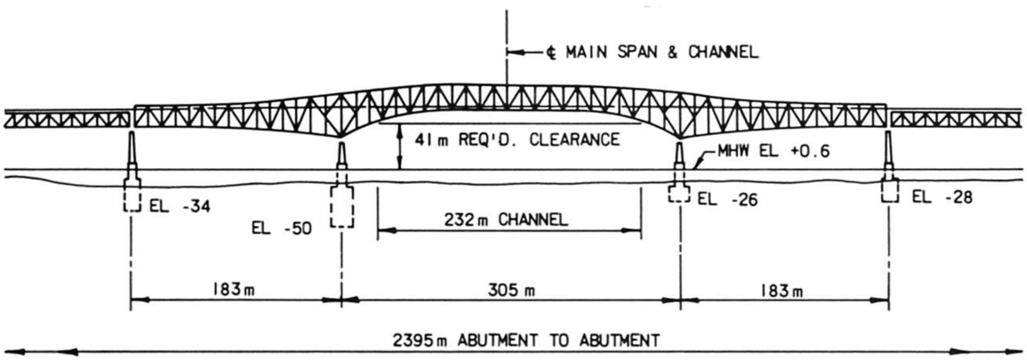

Fig. 1 Elevation main span. North and south bridges

in significant economic benefits. The maximum size caisson (South Bridge) was 20 m by 33 m which was sunk through a maximum river depth of 13 m to a founding elevation of-50 m. The eleven concrete river piers of both bridges are girded with granite masonry as a deterrent against erosion due to ice flow.

Superstructure

The superstructure design was influenced by the required vertical clearance over the main channel and the appearance and economy of design and construction. The type of structure selected for the North Bridge dictated the configuration provided later for the parallel structure. The North Bridge was built during the era of shop riveting and field bolting. The structure soars across the Hudson River beginning at the west (Newburgh) abutment through a series of short spans of continuous rolled beam construction and simple deck girder spans, to the river crossing which consists of a series of multiple cantilevered deck truss spans, one span 104 m and two spans of 135 m, a cantilever through truss having equal anchor arms of 183 m each and a main span of 305 m including a 152.5 m suspended span over the river navigation channel, a series of eight multiple cantilevered deck truss spans, seven at 135 m and one at 104 m leading to three short spans of continuous deck girder construction. The bridge deck is 9.1 m from curb ot curb with two narrow refuge walks back of each curb. The deck type roadway, except where it passes between the trusses, gives the motorist an unobstructive view of the Hudson River Valley and surrounding mountains for the full length of the bridge. This structure received an Award of Merit presented by the American Institute of Steel Construction for Long Span Bridges.

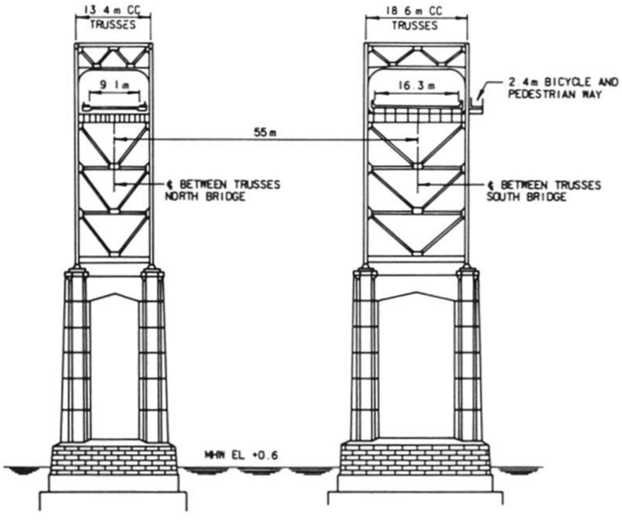

Fig. 2 Cross section of main spans

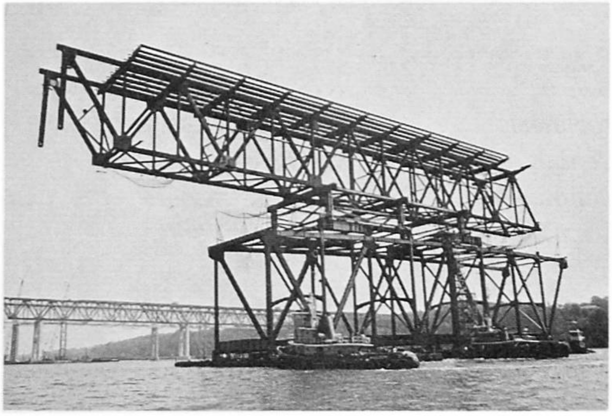

Fig. 3 South bridge. Off-site truss erected on barges being moved upstream for final erection in structure

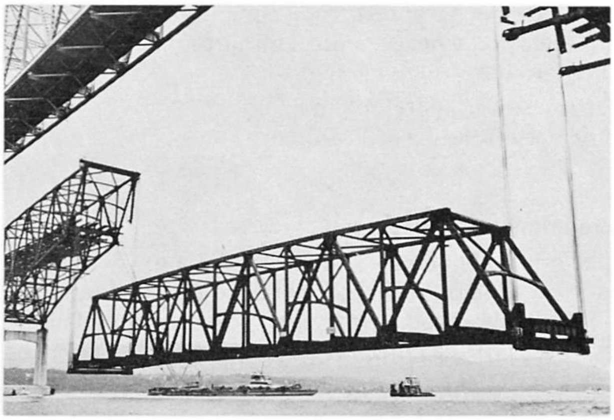

Fig. 4 South bridge. Suspended span (152.5 m) free of barges being hoisted by block and tackle into final position

Although the South Bridge is a look alike structure, its design features are entirely different. The bridge is wider 16.3 m from curb to curb, and carries a cantilevered 2.4 m wide bicycle and pedestrian way along the south face (Fig. 2). Weathering steel was used throughout and fabrication was by shop welding and erection by field bolting. Whereas the erection of the North Bridge employed standard cantilever techniques for the continuous deck truss spans and the main bridge, erection of the South Bridge took advantage of river access to incorporate innovative methods in the construction of major portions of the structure. A span of the superstructure was first preassembled on barges in a nearby fabrication yard (Fig. 3). The unit was then floated into position and after positioning the barges were partially sunken until the span rested on its permanent pier bearings and adjacent span hangers and the barges could be removed. The 1,635 metric ton suspended span of the new South Bridge was hoisted 46 m by block and tackle from floating river barges into its final position (Fig. 4). The total metric tons of structural steel in the North Bridge was 14,480 and for the South Bridge 21,910.

(Chester F. Comstock)