The New Bedford-Fairhaven Bridge

An innovative and elegant truss design was used on this historic bridge that enabled a shift in the area's economic base from whaling to manufacturing.

FREDERICK M. LAW

Seventy miles south of Boston on the west side of the mouth of the Acushnet River lies the city of New Bedford, Massachusetts. Approximately 150 years ago, New Bedford was known as the "Whaling Capital of the World," the city of Herman Melville's *Moby Dick*. A little over 100 years ago, however, after the collapse of the whaling industry, New Bedford realized that its economic viability depended on having a new bridge that would not only link it to the east side of the Acushnet River but would, at the same time, permit the passage of ocean-going ship traffic. For this reason, in 1893, a city engineer by the name of William Fish Williams was recruited and charged with the task of getting such a bridge built.

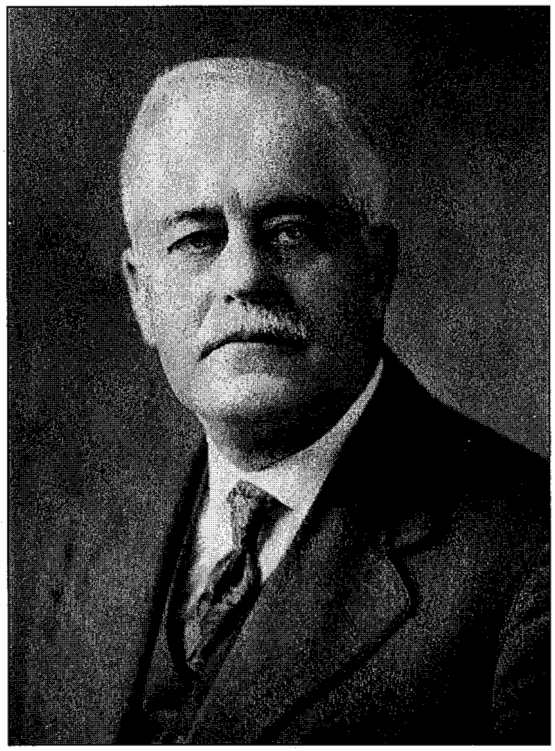
The Engineers

William Fish Williams was, coincidentally, the son of a New Bedford whaling ship captain. He was born at sea and grew up on-board ship and on both coasts of the United States. In 1881 he graduated from Columbia University with a degree in Civil Engineering. Prior to his appointment as City Engineer of New Bedford in 1893, he practiced engineering in Hartford, Connecticut. After directing the construction of the New Bedford-Fairhaven Bridge, Williams directed the construction of the Cape Cod Canal and later became the Commissioner of Public Works for the Commonwealth of Massachusetts.[1]

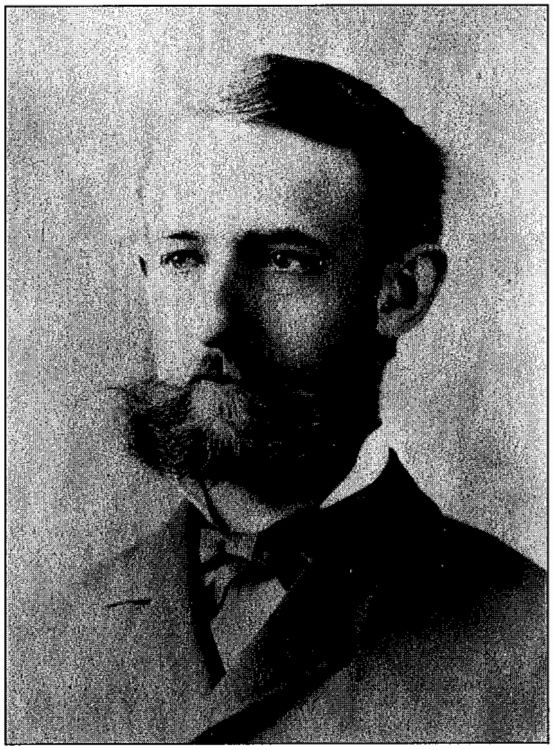
To actually design the New Bedford-Fairhaven Bridge, Williams enlisted the aid of a structural engineer named George Filmore Swain. Swain was also from a New England whaling family, but unlike Williams, he grew up in New England. At age 16 he entered the Massachusetts Institute of Technology (MIT) and graduated in 1877 with a degree in Civil Engineering. A few years later he returned to MIT to become a member of the faculty and by 1887 had risen to the rank of full professor and chair. Professor Swain served as structural engineer for at least ten major bridges, including the New Bedford-Fairhaven Bridge while at MIT. In 1909, he accepted the Gorden McKay Professorship of Civil Engineering at Harvard University and in 1913 was elected president of the American Society of Civil Engineers.[2]

The Bridge

The bridge that these two distinguished engineers created for New Bedford is the 289-foot



William Fish Williams (1889).



George Fillmore Swain (1885).

long, rim-bearing, thru-truss, swing bridge now known as the New Bedford-Fairhaven Bridge (see Figures 1 and 2). The chords of the trusses of this bridge consist of two 20-inch deep steel plates, 20 inches apart, joined by angles and lattice bars. Almost all of the verticals consist of two 12-inch channels, 12 inches apart, joined by lattice bars. The diagonals and counters are double eye bars ranging in depth from 3.5 inches to 7.5 inches. All the joints of the trusses are pin connected, with pins ranging in size from 3.5 inches to 8.5 inches in diameter.

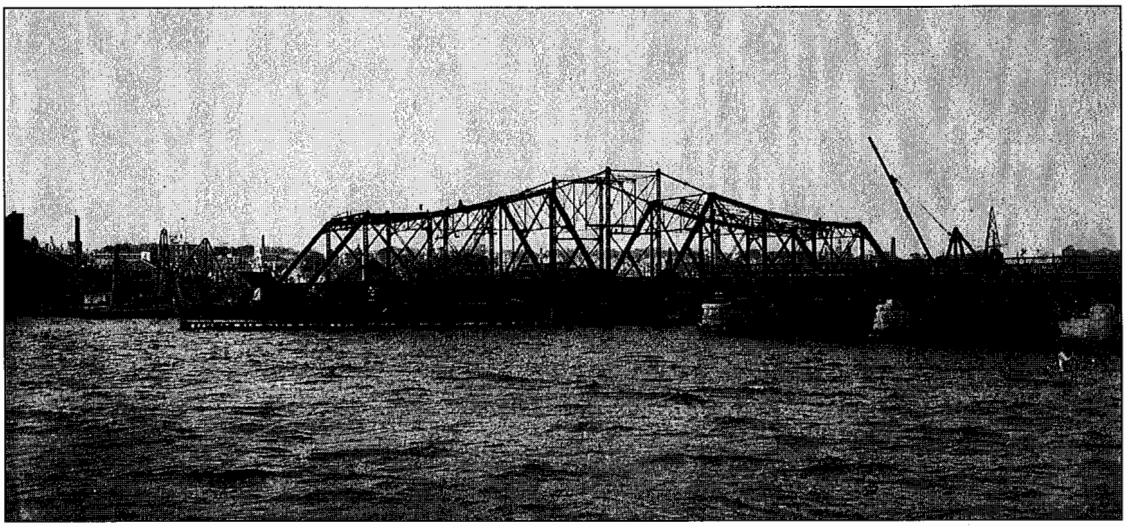


FIGURE 1. The New Bedford-Fairhaven Bridge in open position during construction (1898).

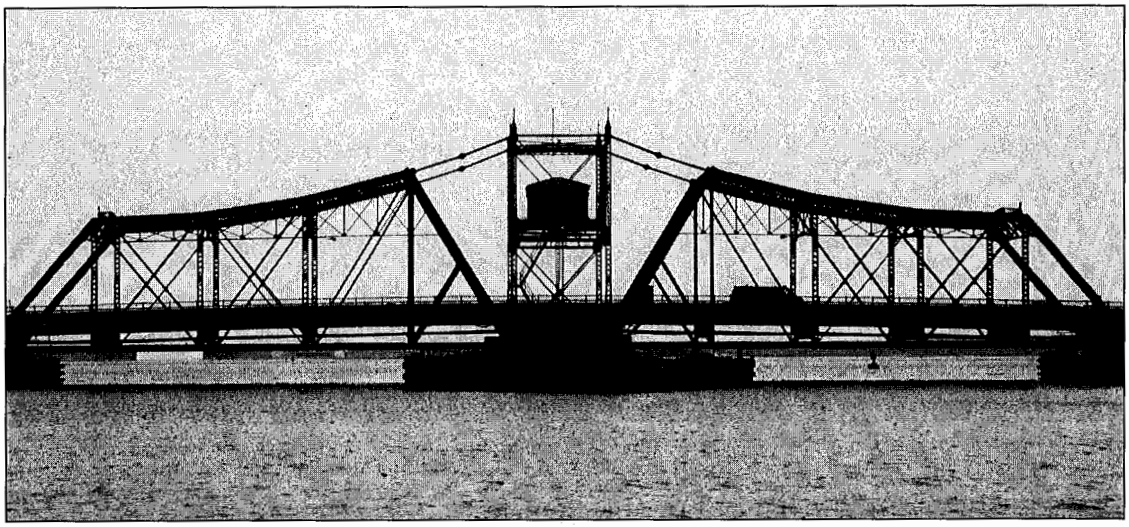


FIGURE 2. The New Bedford-Fairhaven Bridge in the closed position (1998).

The floor of the bridge consists of concrete-filled steel grid deck supported by steel I-beam stringers, which are in turn supported by steel floor beams hung from the verticals of the main trusses.

The fundamental structural action of the bridge depends on whether the bridge is open or closed. When the bridge is open, it rests solely on the center pier and acts as a balanced cantilever. When the bridge is closed, it rests on all three support piers and acts as two simple-span truss bridges with a freestanding tower in the middle.

This complete reversal in the structural action of the bridge is made possible through the innovative use of the hinged upper chord members on either side of the center tower. When the bridge is open, these hinged upper chord members are tensed and carry load. However, when the bridge is closed (and the ends are jacked up slightly), the hinged upper chord members go slack and carry no load (see Figures 3 through 5).

In profile, there is a definite "beauty of form" to the New Bedford-Fairhaven Bridge. In the open position, the bridge is clearly proportioned as a balanced cantilever with the depth of the structure that decreases from the center tower toward the outer ends. In the closed position (through the innovative use of the hinged upper chord members), the bridge becomes two simple-span truss bridges, each of which is appropriately proportioned with a depth of structure that rises from the piers toward the center of each span, albeit not symmetrically. As St. Thomas Aquinas has stated, "The senses delight in things duly proportioned!"

There is also an extraordinary lightness and laciness to the trussing of this bridge. This lightness gives the bridge an almost "gossamer" quality — a quality that is certainly rare in bridges today.

The Reviews

In 1897, when the bridge was nearly completed, the local newspaper, the *New Bedford Standard Times* proclaimed that, "The draw span of the New Bedford and Fairhaven bridge will be one of the longest and finest in New England and one of the greatest draw bridges of the county. Nothing this side of New York will equal it, in some respects it will be the only one of its kind."[3]

In 1990, almost one hundred years later, when the New Bedford-Fairhaven Bridge was selected for the Historic American Engineering Record, historians (perhaps choosing their words more carefully) described the bridge as "noteworthy for its tremendous size and its innovative truss design."[4]

The year 1998 marks the one-hundredth year the bridge has served the city of New Bedford. Many residents of the city embrace this

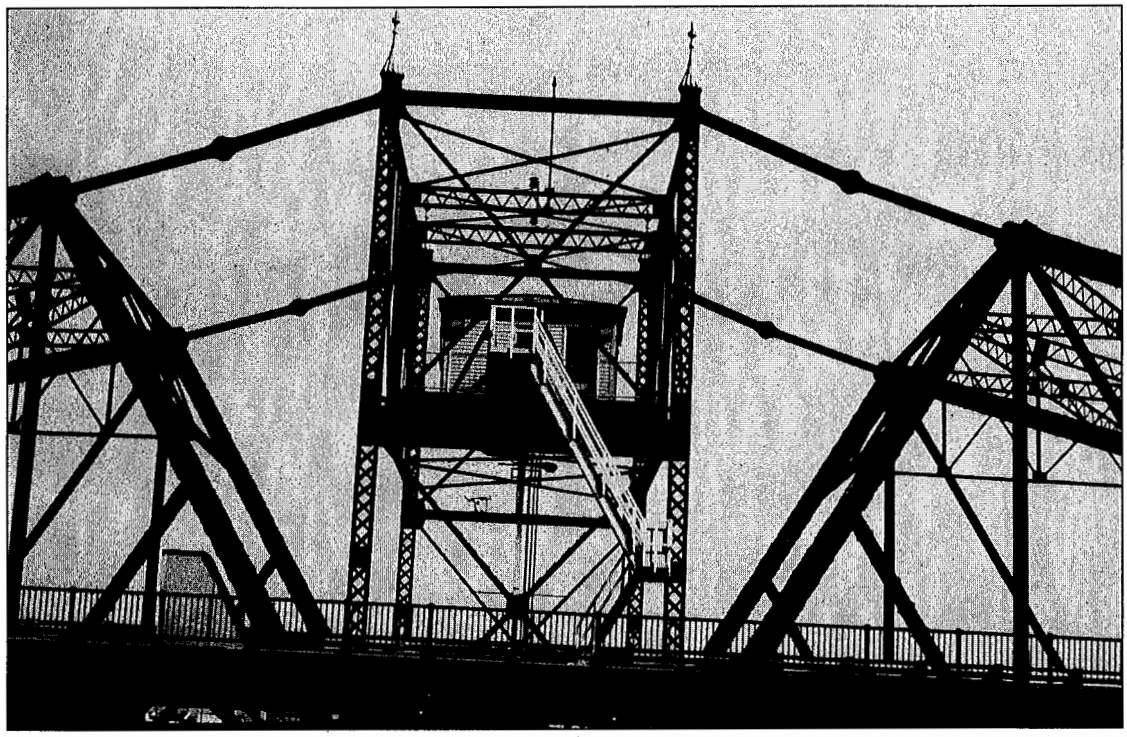


FIGURE 3. The center tower.

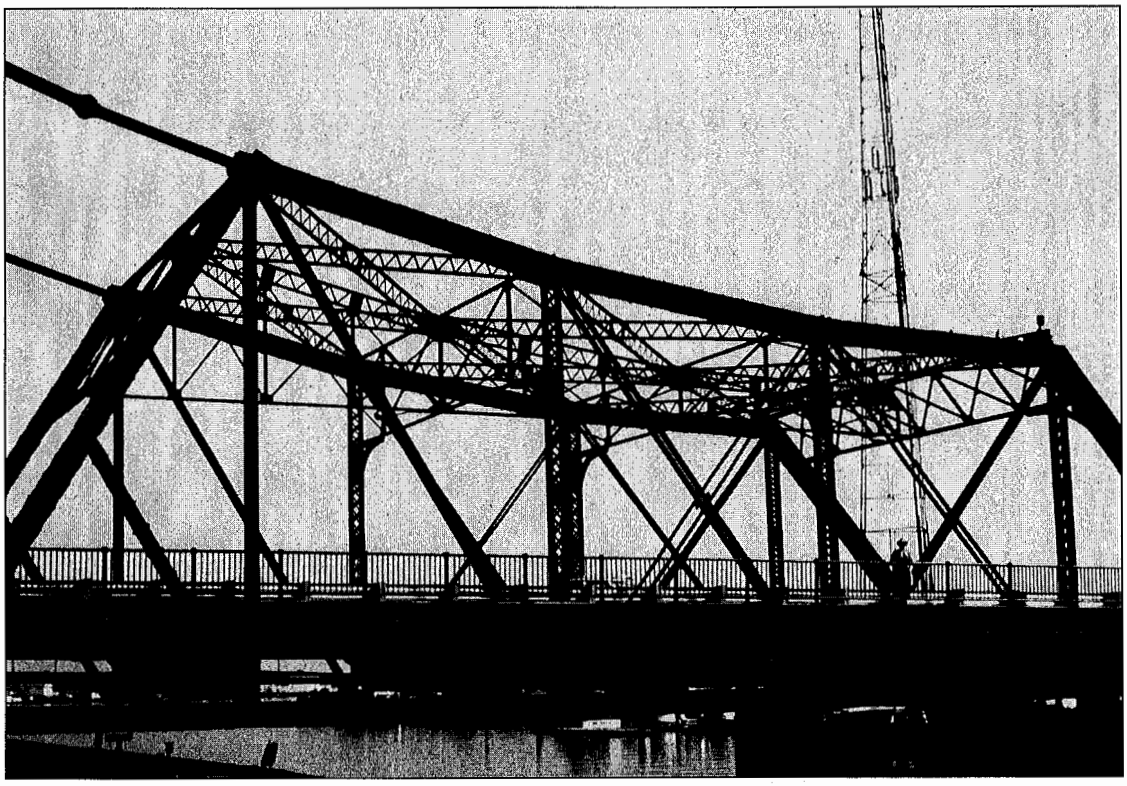


FIGURE 4. The east end of the New Bedford-Fairhaven Bridge.

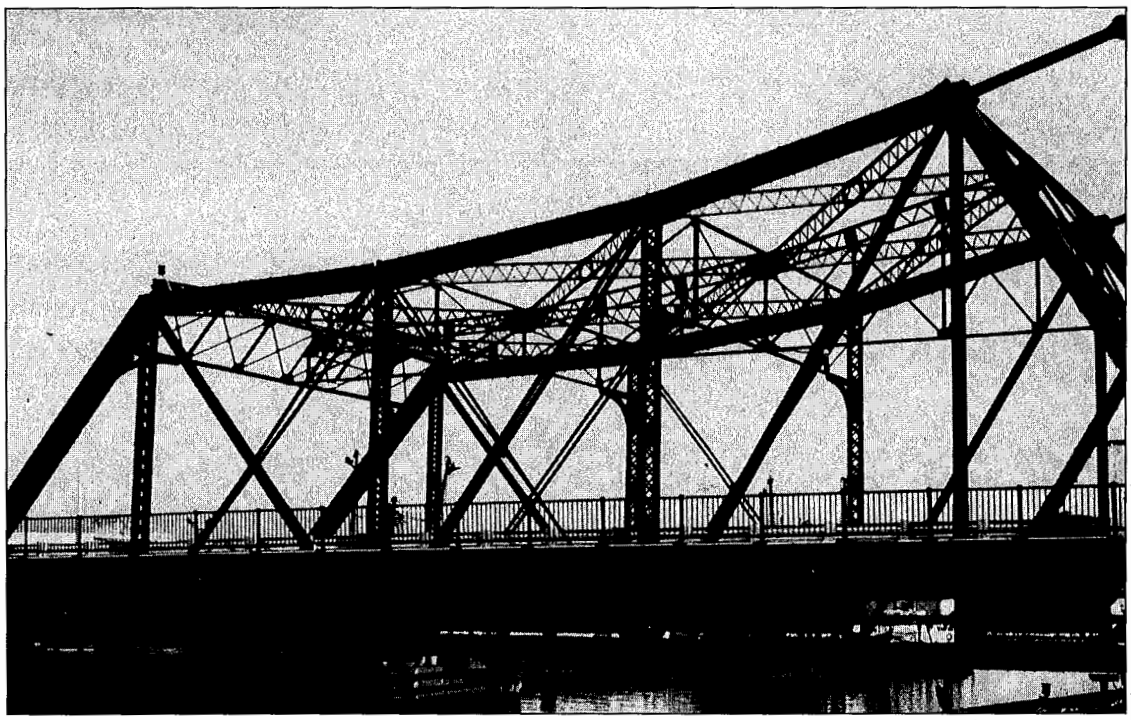


FIGURE 5. The west end of the New Bedford-Fairhaven Bridge.

venerable old bridge for its long service and its historical significance; many residents simply embrace the bridge for its delicate beauty.

NOTE — *Figure 1 is used with the permission of the Board of Trustees of the New Bedford Free Public Library.*

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1. "Memorial to William Fish Williams," *Journal of the Boston Society of Civil Engineers,* Vol. 19, 1932.

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3. "Scrapbook of William Fish Williams," ca. 1890-1900, New Bedford Free Public Library, New Bedford, Mass.

4. "New Bedford-Fairhaven Middle Bridge," *Historic American Engineering Record No. MA-101,* National Park Service, 1990.