

WALDO-HANCOCK BRIDGE
Spanning Penobscot River at U.S. Route 1
Bucksport Vicinity
Hancock County
Maine

HAER NO. ME-65

HAER
ME
5-BUCK.V,
1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Department of the Interior
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Washington, D.C. 20240

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HAER No. ME-65

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Location: Spanning the Penobscot River. Carries Route 1 between Prospect, Waldo County and Verona Island near Bucksport, Hancock County, Maine.

Date of construction: 1931; opened to traffic November 16, 1931.

Designer/Fabricator: David B. Steinman, Robinson and Steinman, designer; American Bridge Company (superstructure) and Merritt-Chapman & Scott Corp. (substructure), fabricators.

Present Owner: Maine State Department of Transportation (Bridge No. 2973)

Present Use: Vehicular bridge

Significance: The Waldo-Hancock Bridge was the first long-span suspension bridge erected in Maine, as well as the first permanent bridge across the Penobscot below Bangor.

Technologically, the Waldo-Hancock Bridge represents a number of firsts. It was one of the first two bridges in the U.S. (along with the St. Johns Bridge in Portland, Oregon, completed in June, 1931) to employ Robinson and Steinman's prestressed twisted wire strand cables, which were first used on the 1929 Grand Mère Bridge over the St. Maurice River in Quebec. The prefabrication and prestressing of the cables decreased the number of field adjustments required, saving considerable time, effort, and money. As an additional experiment in efficiency, the Waldo-Hancock cables were marked prior to construction, ensuring proper setting. This method had never been used before and proved successful in this instance. These innovations, invented and pioneered by Steinman, were a significant step forward for all builders of suspension bridges.

The Waldo-Hancock was also the first bridge to make use of the Vierendeel truss in its two towers, giving it an effect that Steinman called "artistic, emphasizing horizontal and vertical lines." This attractive and effective truss design was later used in a number of important bridges, including the Triborough and Golden Gate bridges.

The Waldo-Hancock Bridge was noted at the time for its economy of design and construction. It cost far less than had been appropriated by the State Highway Commission, which enabled the construction of a second

bridge between Verona Island and Bucksport. As part of U.S. Route 1, it remains in active use today, nearly 70 years after its completion..

Specifications:

2040' long with a clear span of 800' between towers. One span of 800', two of 350' each, 20' roadway with 2 3-1/2' sidewalks, stiffening trusses 9' deep, each cable 9-5/8" in diameter consisting of 37 strands of 37 wires. Deck is 135' above water level to allow passage of large ships. Total cost: less than \$850,000.

Historian:

Katherine Larson Farnham, HAER Historian, November 1999

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ADDENDUM TO:
WALDO-HANCOCK BRIDGE
Spanning Penobscot River at U.S. Route 1
Bucksport vicinity
Hancock County
Maine

HAER ME-65
HAER ME,5-BUCK.V,1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
NORTHEAST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
U.S. Custom House, 3rd Floor
200 Chestnut Street
Philadelphia, PA 19106

HISTORIC AMERICAN ENGINEERING RECORD

Addendum to WALDO-HANCOCK BRIDGE

This is an addendum to a 2-page report transmitted to the Library of Congress about 1999 and four 1994 photographs.

Location: Spanning Penobscot River at U.S. Route 1, Bucksport vicinity,
Hancock County, Maine
USGS Bucksport Quadrangle, Universal Transverse Mercator
Coordinates: 19.515733.4934151

Date of Construction: 1930-1931; opened to traffic November 16, 1931.

Designer/Builder: David B. Steinman, Robinson & Steinman, designer.

Present Owner: Maine State Department of Transportation (Bridge No. 3008)

Present Use: Vehicular bridge

Significance: The bridge was the first long-span bridge in Maine. As the first all-weather crossing of the Penobscot River below Bangor, it did much to promote tourism and commerce in the Downeast region of the state. It was one of the earliest suspension bridges in the U.S. to use prefabricated, prestressed bridge strand for the main cables, which significantly reduced construction cost and time. The towers represent the first use of the Vierendeel truss for towers.

Project Information: Based on deterioration of the main cables discovered in 2003, the Maine Department of Transportation made the decision to replace the bridge because it was not prudent and feasible to rehabilitate it. This documentation was completed to fulfill stipulations in the Memorandum of Agreement between the ME SHPO and Maine Division, Federal Highway Administration for Bridge No. 3008.

Mary Elizabeth McCahon
Lichtenstein Consulting Engineers, Inc.
One Oxford Valley Mall #818
Langhorne, PA 19047

Summary of Historical and Technological Significance

When completed in 1931, the Waldo-Hancock suspension bridge that carries US Route 1 over the Penobscot River at Bucksport was the first, long-span bridge in Maine. Its 800'-long main span was two-and-one-half times the length of any single span of a then-existing bridge in the state. The bridge was an important link on the principal coastal highway, and it did much to promote tourism and commerce in that region of the state. Noted consulting engineers Robinson & Steinman of New York, one of the two prominent designers of suspension bridges in the country,¹ designed the bridge. It represents a genre of mid-length suspension bridges that became technically and economically feasible after J. A. Roebling's Sons Company developed and perfected manufacturing of prefabricated, prestressed bridge strand cables in 1928. Their prestressed bridge strand was one of the most important advances in the suspension bridge field because it significantly reduced construction costs for 700'- to 1200'-long suspended main spans like that of the Waldo-Hancock Bridge. Prior to Roebling's process for prestressing bridge strand cables, the wire cables on most suspension bridges, large and small, consisted of parallel wires installed individually by spinning the cable at the site. On shorter suspension bridges, this proved to be an expensive procedure that left them at an economic disadvantage in comparison with cantilever through truss or steel arch bridges. Prefabricated, prestressed cables saved both construction cost and construction time. The cables launched a whole new class of mid-span length suspension bridges that were frequently noted for their economy and reliability and promoted largely by Robinson & Steinman. The first such bridges built using Roebling's prefabricated, prestressed main cables were Robinson & Steinman's 1929 Grand 'Mere bridge at Quebec, the 1931 St. Johns Bridge at Portland, Oregon, and the 1931 Waldo-Hancock Bridge at Bucksport, Maine.²

Beyond its historical and technological significance, the bridge represents what many, including noted structural historian Carl Condit, consider the "most impressive type of bridge in appearance ... the nearest thing to a public monument that contemporary building has produced [by 1961]. As pure empirical form, there is nothing that can

¹ New York-based Othmar Ammann (1879-1965) was Steinman's rival. Ammann's commissions included many of the groundbreaking and spectacular suspension bridges of the 20th century including the 1931 George Washington Bridge and the 1964 Verrazano-Narrows Bridge.

² R. Boblow, "Stringing Rope-Strand Cables Features St. Johns Bridge Construction," *Engineering News Record*, Vol. 107 (Nov. 12, 1931), p. 779.

quite match them.”³ He notes that the clarity of function is so simple that anyone can understand its workings. Richard Scott in his remarkable book, *In the Wake of Tacoma*, speculates that part of the appeal of the bridge type is due in part to its rarity and that it is generally used for only the long spans. Yet a suspension bridge is a juxtaposition of simplicity in appearance with sophisticated and complicated engineering and of visual delicacy with strength.⁴

Setting and Context

The 2040'-long prefabricated, prestressed cable suspension bridge with an 800'-long main span was designed by the noted consulting engineers Robinson & Steinman of New York City. In 1929, Maine voters approved a state-owned toll bridge over the Penobscot River at Bucksport to be financed by adoption of a constitutional amendment authorizing a special \$1.2 million bond issue. The bridge was constructed between August, 1930 and November, 1931 under the authority and direction of a special commission composed of directors appointed by Governor William Tudor Gardiner. Albert T. Nickerson represented Waldo County, Frederic S. Blodgett represented Hancock County, and the state at large was represented by Irving W. Case of Lubec and Zelma M. Dwinal of Camden. Technical expertise was provided by the Maine State Highway Commission (SHC), and Frank A. Peabody, chairman of the State Highway Commission, was elected chairman of the Board of Directors of the Waldo-Hancock Bridge. Lucius D. Barrows, chief engineer of the SHC, was elected secretary. Robinson & Steinman was chosen by the directors as the consulting engineer firm, no doubt based on its demonstrated ability to produce economical yet aesthetically pleasing suspension bridges.

The success of the 1927 Carlton Bridge over the Kennebec River between Bath and Woolwich (a two-level, railroad and vehicular vertical lift span) and the subsequent benefit of faster and safer traffic along the Atlantic coast provided the impetus for an all-weather crossing at Bucksport. Located nineteen miles south of the Brewer-Bangor Bridge, formerly the first bridge crossing the Penobscot River, the Waldo-Hancock Bridge reduced the trip between Belfast and Ellsworth by 37 miles and an estimated forty-five minutes in 1931 travel time. Prior to completion of the bridge, the crossing was accomplished by a seasonal ferry that had operated since about 1810, but that trip was slow, and motorists often opted to make the trip by way of Bangor rather than rely

³ Carl Condit, *American Building Art: Twentieth Century*, (New York: Oxford University Press, 1960), p. 129.

⁴ Richard Scott, *In the Wake of Tacoma*. (Reston, Virginia: ASCE Press, 2001), p. x.

on the ferry. In the years just prior to completion of the bridge, the ferry service was not able to keep up with demand at the crossing.

It became apparent early in the planning process for the bridge that the desired, direct link across the river between Prospect and Bucksport was not going to be possible given the overall length of such a crossing and the \$1.2 million available for construction. The eventual site selected for the suspension bridge was between Prospect and Verona Island. The high river banks made it possible to access the bridge with easy grades, and the site was best suited for a high-level bridge. Long spans were required given the depth of the channel and currents, which mandated a wide navigable channel. The selected scheme had the west end of the bridge located about 1200' below Fort Knox and crossing the main channel of the river to Verona Island (photograph ME-65-5). This required reconstructing the existing bridge between the island and Bucksport to modern standards. Robinson & Steinman also designed that bridge – a 22'-wide, 1120'-long, 16-span, steel stringer bridge that was also constructed in 1931. Each span was 70' long. It was subsequently replaced in 1988. Both bridges were financed by \$950,000 state funds from the bond issue, which was to be repaid by the tolls, and \$340,000 in federal-aid funds.

American Suspension Bridges ca. 1930

The Robinson & Steinman design for the Waldo-Hancock Bridge reflects the confidence in the economic and aesthetic doctrines that dominated suspension bridge engineering in the late 1920s and 1930s – America's heyday of large-bridge construction. In addition to massive spans like the 1927-1931 George Washington Bridge, the San Francisco-Oakland Bay Bridge (opened in 1936), and the Golden Gate Bridge (opened in 1937), there was a proliferation of small- to medium-span suspension bridges. By 1929, a convergence of new alloy steels like nickel steel, new analytical methods that culminated in designs based on the deflection theory, and the need for long-span, vehicular bridges (that require a considerably lighter load capacity than railroad bridges) returned suspension bridges to a position of prominence.⁵ The deflection theory, a method to accurately assess the interaction between main cables and suspended trusses or girder-floorbeams, resulted in much shallower stiffening structures and slender, flexible towers that flexed with longitudinal movement of the cables from expansion, contraction, and live loads.⁶ The deflection theory was first applied to suspension bridge design by Leon Moisseiff at the 1901-1909 Manhattan Bridge over the East River, and it revolutionized thinking about suspension bridges,

⁵ *Ibid.*, p. 13.

⁶ *Ibid.*, pp. 15-17.

laying the groundwork for the frenetic period of suspension bridge building in the late 1920s and 1930s.

The main considerations that prevented the pre-1929 use of bridge strands (twisted wires) for suspension bridge cables, sometimes called helical cables or rope cables, were the lack of uniformity and dependability of the strands' elastic properties and their lower modulus of elasticity. Wire twisted into strand has a much lower modulus of elasticity value compared to the individual wires. Bridge strand, by definition is very elastic, and in suspension bridges accurate lengths of cables and definite and uniform elastic properties are important so that the cables, and thus the bridge, do not fail.⁷ These disadvantages had to be overcome before bridge strand could be successfully applied to suspension bridges.

Structural stretch is the elongation that occurs over and above the true elastic stretch for any given tension, and it does not show full recovery upon release of tension introduced by dead and live loads. The prestressing process removes structural stretch (caused by lengthening of rope lay, compression of the center, and adjustment of the wires and stands to the load) by subjecting the strand or rope to a predetermined load for a sufficient length of time to permit adjustment of the component parts to that load thus definitely establishing its elastic properties.

In 1928, J. A. Roebling's Sons Company, the company long associated with advances in wire, strand, rope, and cable, developed the prestressed and prefabricated galvanized wire bridge strand cables for the footbridges (later cut and used for the suspenders) of the George Washington Bridge then under construction. The genius of the "Roebling idea," as the prestressing process was identified in period literature, was that the strands or ropes were stressed at the factory to eliminate structural stretch and to stabilize the elastic properties of the galvanized wires.⁸ Since the operation of building the cables was done at the shop while work at the bridge site preliminary to cable erection was in progress, considerable time was saved over the parallel wire method. Without Roeblings' prestressing process for bridge strand, Robinson & Steinman's mid-size suspension bridges like the Waldo-Hancock Bridge would not have been able to compete price wise. The prefabricated, bridge strand cable was particularly economical for span lengths of about 1200' or less with the savings over

⁷ Boblow, *op. cit.*, pp. 779-781.

⁸ For the technical explanation of prestressed bridge strand, see C. C. Sunderland's article "Manufacturing High-Modulus Footbridge Ropes for Fort Lee-Hudson River Bridge," in *Suspension Bridges A Century of Progress* privately published by John A. Roebling's Sons Company about 1934.

parallel wire cables increasing as the length of the span decreased.

Robinson & Steinman

The Waldo-Hancock Bridge is very much the product of the noted consulting engineers Robinson & Steinman of New York, the firm most associated with economical yet aesthetically pleasing suspension bridges all around the world. The firm was established in 1920 when Holton D. Robinson plucked the brilliant theorist David B. Steinman (1886-1960) from academia to partner with him on an eye-bar suspension bridge design for a competition at Florianopolis, Brazil. Steinman had previously worked with Gustav Lindenthal on his two great railroad bridges: Hell Gate in New York and Sciotoville over the Ohio River. He had long dreamed of designing bridges on his own, and he jumped at the chance offered by Robinson, who had considerable practical experience that balanced well with Steinman's theoretical abilities. The Florianopolis bridge established Steinman's suspension bridge reputation, and the partnership of Robinson & Steinman lasted and flourished without a written contract until Robinson's death in 1945. The 1927-29 Mount Hope Bridge in Rhode Island (described by Steinman as taking the Island out of Rhode Island) was their first major suspension bridge in America, and it also reflected Steinman's attention to aesthetic considerations and his driving ambition, both hallmarks of his work.⁹ In the late 1920s, in particular, Steinman sought out work with toll bridge commissions, just like the one that would build the Waldo-Hancock Bridge.

Steinman became one of the most distinguished suspension bridge engineers of the 20th century, rivaled only by Othmar Ammann, designer of the influential George Washington Bridge. He was also an early and influential proponent of the deflection theory for suspension bridges. In 1913 his English translation of Austrian Josef Melan's tome provided the first accurate means to design suspended trusses and account for deflection of the superstructure from actual variations in live loads. In 1922 he published *A Practical Treatise on Suspension Bridges: Their Design, Construction, and Erection*, and he simplified the deflection theory making it easier to use. Never content to not compete for suspension bridge commissions throughout the nation and world, Steinman was a tireless self promoter who was prolific, confident, dynamic, innovative, and successful. His firm is associated with many of the important suspension bridges including the 1954-57 Mackinac Bridge, which is longer in suspended span than the Golden Gate bridge by nearly 1000' and considered by him as his "crowning achievement." Steinman worked for passage of registration laws for engineers and continued his theoretical studies and articles, particularly aerodynamic considerations

⁹ Henry Petroski, *Engineers of Dreams*, (New York: Alfred A. Knopf, 1995), pp. 320-334.

following the Tacoma Narrows bridge failure in November, 1940 and the numerous problems associated with flexible plate girder suspension spans like his 1939 Deer Isle-Sedgwick bridge in Maine. When he died in 1960, he left plans for a great suspension bridge across the Straits of Messina in Italy on his drafting table. He was truly one of the great bridge engineers of the 20th century.

A Maine native and University of Maine-trained engineer also figured prominently in the design of the Waldo-Hancock Bridge. Ray M. Boynton, a 1920 graduate of Maine's civil engineering program, joined Robinson & Steinman in 1928, and he was "in charge of the office work on the plans and specifications."¹⁰ C. H. Gronquist, a Rutgers University-trained engineer who joined the firm in 1927, was resident engineer. Both men remained with Steinman for their entire professional careers, and in 1960, in recognition of their talent and contributions to the firm's success, they were named partners in the firm then styled Steinman, Boynton, Gronquist & London. David B. Steinman died about six months after creating the partnership.¹¹ Gus Arango, who joined the firm in 1949 and rose to become its president, remembers Boynton as an intelligent engineer and very professional manager who handled many of the firm's administrative matters.¹² A memorial scholarship at the University of Maine's engineering school was established in honor of Ray M. Boynton in 1988.

Building the Waldo-Hancock Bridge

Bids for the substructure and superstructure were received by the Board of Directors in August of 1930, and work on the substructure commenced shortly thereafter. Merritt-Chapman Corporation of New York was the successful bidder for the substructure work that continued through the 1930-31 winter. Because of the terrain and absence of good roads, docks had to be constructed so that construction material could be delivered by barge. By early spring 1931, American Bridge Company-fabricated superstructure steel began to arrive at the site. During the spring and summer the towers, prefabricated prestressed cables, stiffening trusses, bridge deck, approach spans, and

¹⁰ David B. Steinman and C.H. Gronquist. "Building First Long-Span Bridge in Maine: Waldo-Hancock Suspension Bridge," *Engineering News-Record*, Vol. 108 (March 17, 1932), p. 389.

¹¹ Petroski, *op. cit.*, pp. 365-372.

¹² Gus Arango, former president of Steinman, Boynton, Gronquist & Birdsall, Personal Interview with Mary E. McCahon, June 16, 2004.

toll house were completed, and by November, 1931, the toll bridge was open to vehicular traffic.¹³ The tolls were removed October 31, 1953.

The 2040'-long bridge is composed of an 800'-long suspended main span with suspended 350'-long side spans and nine, 60'-long, continuous, girder-floorbeam approach spans on flexible, built-up column bents that accommodate all expansion and contraction. Three approach spans are on the west side of the suspended spans and six are on the east side. The 20'-wide roadway is flanked by narrow safety walks.

Of particular success is the simple, "artistic" design of the towers with their emphasis on vertical and horizontal lines. The towers are upright Vierendeel trusses so they are devoid of the conventional diagonal bracing that characterized most earlier suspension bridge towers (photograph ME-65-10). Steinman's goal was for the towers to defer to, and blend harmoniously with, the rugged natural setting and "stern lines" of Fort Knox, an uncompleted federal fortification started in 1846.¹⁴ A Vierendeel truss is basically a succession of rigid frames with no diagonals in which the posts are joined to the chords with rigid connections. The light vertical members between the posts of the Vierendeel truss panels are primarily for aesthetic considerations, but they do add some rigidity to the structure. The truss was invented in 1897 by Belgian engineer A. M. Vierendeel and was used in the United States for the substructure bents of the Erie Railroad's famous 1900 rebuilding of the Kinzua Creek Viaduct (McKean County, Pennsylvania). It was used sporadically thereafter with the Waldo-Hancock Bridge towers being one of the more well-known applications.

The 206'-high, built-up, cellular, steel towers are founded on partially stone-faced, concrete piers that rise 29' above the mean water and extend 45' below it. They are designed in accordance to the deflection theory, and their overall dimensions were predetermined by requirements at the top to receive the saddles for the main cables

¹³ A detailed, technical account of the construction of the bridge and the reasons supporting design decisions is found in the 1931 Steinman and Gronquist article in *Engineering News-Record* previously cited. The same basic article is also found in other professional publications like *Civil Engineering*, *Public Works*, and *Professional Engineer*. Ray M. Boynton's hand-written notes (undated) for an article to be placed in "semi-technical" publications illustrates how the firm repackaged basic project information to aggressively promote their work to a wide audience. Boynton's copy, which was reviewed by Steinman and Robinson, cites taking sections of the article directly from a Steinman article. The manuscript was in the possession of Parsons Transportation Group in December, 2003.

¹⁴ Steinman and Gronquist, *op. cit.*, p. 386.

(photograph ME-65-15), by the batter (to incline a face) of the towers, and by the necessity of obtaining a column that resists compressive forces. The inside lines of the tower legs are parallel in order to achieve the desired verticality; only the outer lines are battered. A low, flat arch used for the tower portals is meant to "give the impression of width to the relatively narrow bridge (20-ft. roadway and 3 ½-ft. sidewalks)." The sidewalks are finished with what Steinman called "wire-mesh rail guards."¹⁵

Another technological innovation that made construction of the Waldo-Hancock Bridge possible within its limited budget was the prefabricated, prestressed, bridge wire strand or wire rope cable developed by J. A. Roebling's Sons Company in 1928 under the leadership of C. C. Sunderland, Chief Engineer of Bridges. The cable design had been used successfully on two earlier suspension bridges designed by Robinson & Steinman, and on bridges by other consulting engineers as well. It resulted in saving money and time while yielding greater strength with equal rigidity in comparison to parallel wire cables. Each of the 9 3/8"-diameter main cables consists of 37, 1 3/8"-diameter bridge wire strands, and each strand consists of 37 wires varying in diameter from .192" to .194" and six filler wires .080" in diameter. Each bridge strand was manufactured using a two-part process with the inner core 19 wires being closed with a 11" lay (the degree of twist) and then the outer 18 wires closed with a 15 ½" lay. The cable was built by alternating the right and left lay so that wires in contact with one another, and thus receiving the bearing of superimposed compressive load, would be parallel instead of crossing at an angle (photograph ME-65-25). For this bridge, the cables were premarked for placement on the cast steel saddles (one at the top of each tower and each leg of the cable bent), the center line of the main span cable, and the location cable bands based on design calculations. Additionally, a continuous color stripe was placed to prevent untwisting of the cables, which were installed using light footbridges, another cost-saving feature. Once in place, the cables were wrapped with soft, galvanized wrapping wire. To facilitate use of a circular-motion wrapping machine, pieces of cedar were cut and used as fill around the cable to reshape it from hexagonal to round. The cables for the Waldo-Hancock Bridge were manufactured by the American Steel & Wire Company, a subsidiary of United States Steel Corporation, apparently using the prestressed process developed by J. A. Roebling's Sons.

The cables pass through the saddles atop the built-up column cable bents with rocker bearings at the outer ends of the suspended side spans. From that point to the anchorage, the main cables are augmented by two more bridge wire strands incorporated into the cables to provide greater tension for the backstays and to "hold-back" and resist longitudinal movement of the rockers. The additional strands are anchored through the cast steel saddles (photographs ME-65-17, ME-65-18, ME-65-

¹⁵ Steinman and Gronquist, *op. cit.*, p. 387.

19). The ends of the cable strands are anchored to plates and encased in concrete. The cable enters the anchorage housing, an approximately 7' by 3' concrete enclosure, through the cable shield that is around the cable band, then through the splay collar that spreads the bridge wire strands ahead of the strand plates and concrete anchorage itself (photographs ME-65-24, ME-65-26, ME-65-27). During construction, the cables were adjusted by using sheaves pinned to the strand plates and a block and tackle. The anchorage is straightforward and small scale because of the size of the cable and bridge.

The 9'-high, steel, Warren with verticals pony, stiffening trusses are traditionally composed and connected to the main cables by non-adjusting suspenders with cast steel sockets located 25' apart at each truss panel point (photograph ME-65-29). The designers believed that adjustable suspenders were not necessary. The trusses were erected using travelers working in both directions from both towers.

The bridge survives with few alterations. Work to it over the years is best characterized as maintenance or enhanced maintenance to repair or replace deteriorated components in kind and to paint the bridge. After the elimination of tolls in 1953, the toll house was removed. The bridge deck was replaced and reconfigured with a 23'-wide roadway and narrow safety walks in 1961 (photograph ME-65-14). It was during a staged, four-phase, \$25 million rehabilitation started in 2001 and intended to extend the service life of the bridge another 75 years, that significant problems with main suspension cables were discovered.

Corrosion, expressed as rust, was first reported to the Maine Department of Transportation in 1959 by Steinman himself, and by 1995, periodic cable inspections performed primarily by Steinman's successor firm found that water was traveling within the cables. In May, 1998, the Department chose to perform an in-depth inspection and rehabilitation feasibility study. Based on the conclusion that the main cables, which were unwrapped and inspected at the sag, were not deteriorated beyond rehabilitation, a staged rehabilitation was planned and begun in 2001 with work starting on the north cable. As work progressed, more and more broken wires were found, and truck use of the bridge was restricted. An acoustic monitoring system on the main cables was operational in July, 2003, and as work on the south cable progressed, the deterioration was found to be worse than expected. On July 11, 2003, use of the bridge was restricted to no vehicle greater than 12 tons, and plans for the cable strengthening needed to keep the bridge open temporarily were accelerated. The supplemental cable designed by Parsons Transportation was installed in the fall and winter of 2003. The decision was also made to replace the bridge, and the cable stay bridge replacement is scheduled to be completed late in 2006, at which time the majestic Waldo-Hancock Bridge will be removed.

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