GRAND STREET BRIDGE
(Bridge No. 4250)
Grand Street, spanning Pequonnock River
Bridgeport
Fairfield County
Connecticut

HAER No. CT-148

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
Philadelphia Support Office
U.S. Custom House
200 Chestnut Street
Philadelphia, P.A. 19106

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Location:	Grand Street, spanning Pequonnock River Bridgeport Fairfield County, Connecticut USGS Bridgeport Quadrangle UTM Coordinates: 18.651810.4561180
Date of Construction:	1919
Engineer: Fabricator: Contractor:	Strauss Bascule Bridge Company Penn Bridge Company Edward DeVoe Tompkins, Inc.
Present Owner:	City of Bridgeport, Connecticut 45 Lyon Terrace Bridgeport, Connecticut 06604
Present Use:	Not in Use
Significance:	Grand Street Bridge is significant as an example of a bascule bridge, a technology that saw substantial innovation and development in the early 1900s. This specific form, the Strauss Underneath Counterweight type, was one of the period's major bascule designs. The bridge was built in response to the tremendous industrial expansion that occurred in Bridgeport during World War I. It improved both street-level and river access to the Bridgeport Brass Company, the former plant of which occupies the west bank of the river.
Project Information:	This documentation was undertaken in accordance with a Memorandum of Agreement between the Federal Highway Administration and the Connecticut State Historic Preservation Office. The bridge is to be demolished.

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Description

Grand Street Bridge is a double-leaf deck-girder bascule connecting Grand Street and Artic Street across the Pequonnock River, a navigable waterway flowing southward into Bridgeport Harbor. The general vicinity of the bridge was at one time an intensely developed industrial area. Today, however, the enormous plant surrounding the bridge on the west side of the river, formerly owned by the Bridgeport Brass Company, stands mostly derelict, and the lumber yards and woodworking factories on the east side are marked only by the remnants of their docks lining the river bank.

The bridge was begun in 1916 (the date given in the state bridge log) but because of disagreements between the City of Bridgeport and the contractor, it was not actually ready for traffic until 1919. In addition to the two bascule leaves, each 48 feet long, the bridge includes two deck-girder approach spans at each end of the structure, each 69 feet long, for an overall length of 372 feet. The girder spans are somewhat wider than the bascules, measuring 40 feet on center and 37 1/2 feet on center respectively. Angle-iron outriggers carry 7 1/2-foot sidewalks on both sides of the bridge, yielding an overall width of 55 feet. The roadway is carried about 18 feet above the water level; when closed, the bridge provides about 13' of clearance where the two leaves of the bascule meet above the center of the channel.

The bridge was designed by the Strauss Bascule Bridge Company of Chicago, Illinois, and employs the company's patented Underneath Counterweight design. Except for the locking mechanism, which is only on the west leaf, the two bascule leaves are identical. The riveted-plate girders, which have an overall length of 58 feet, taper in depth from 8 1/2 feet at their pivots to 4 1/2 feet in the center of the bridge. The girders are connected by three transverse floor beams, 40 inches in depth, also of plate-girder construction. The current floor system consists of open steel grating laid on 14-inch I-beam stringers and dates from 1965; the original floor was of wooden blocks atop planking, with somewhat smaller stringers. The cross-bracing of 3-by-5-inch angles is a 1984 replacement in kind.

The leaves pivot on large trunnions located 10 feet in from the ends of the girders. The counterweights, large reinforced-concrete masses measuring 5 1/2 feet high by 11 1/2 feet wide, are carried on pivots at the ends of the girders.

The counterweights contain an internal lattice girder, the ends of which protrude from the concrete to accommodate the counterweight trunnions and also link arms that run between the counterweights and the main trunnion supports; the link arms are offset 1' toward the channel and 3' 9" vertically, thereby forming a parallelogram with a line running between the centers of the counterweight trunnion and the main trunnion. Riveted to the bascule girders are large rack-gear quadrants that raise the bridge.

The trunnions are supported on heavy box-girder posts on either side of each bascule girder. The trunnion posts are braced in the longitudinal direction by plates and a channel that angle down to form a wide base for the post and in the lateral direction by additional box-girder columns connected to the outside trunnion posts by angle cross-bracing. Each set of inside trunnion posts are braced by the large girder that runs between them and to which the operating mechanism is affixed.

Although most of the electrical system was replaced in a 1936 rehabilitation, the arrangement of motors and gearing duplicates that shown in the original drawings. Each leaf has its own operating mechanism, which was supplied by the Earle Gear and Machine Company of Philadelphia. The motor drives a series of reduction gears that turn a shaft running parallel to the girder on which the mechanism is mounted. At the trunnion posts, an additional reduction gear engages a pinion that moves the rack quadrant, thereby raising the bridge. In the center of the shaft, bevel gears can be engaged so as to allow manual operation from the surface of the roadway; the opening for the manual-operation shaft appears to have been paved over. The west bascule carries an additional mechanism near the end of the leaf to operate the end locks: it is powered by a smaller motor and consists of reduction gearing that powers a transverse shaft, to which operating arms are attached with cams. When the shaft rotates, the arms push locking blocks against the face of the east bascule, thereby securing the bridge. The end locks also have a provision for manual operation. Both the end-lock and main motors have solenoid brakes which, in the case of the end-locks at least, appear to have been wired to limit switches. Most of the electrical controls, however, including everything in the operator's house, has been destroyed by fire or removed by vandals.

The operator's house is mounted on a platform on the south side of the second west approach span, adjacent to the bascule. It is a small hip-roofed wood-frame structure with a stuccoed exterior and dates from 1936, when the original building was replaced. The operator house is currently open to the elements and has been partially burned. The original structure was similar in size and shape but was more ornately detailed; it was intended to accommodate a public comfort station as well as the bridge crew. Although the plans called for a second comfort station diagonally opposite, where there is now an open platform, it is likely that this was never built, since newspaper photographs from the 1930s show only the structure on the west side.

The approach spans are nearly identical and consist of two large plate girders, 6 feet in depth, between which run 4-feet-deep plate-girder floor beams, with angle-iron cross-bracing. The easternmost span has replacement girders similar to the original in size but of welded construction.

Both sides of the bridge have a ornamental metal railing, each section of which has a repeating criss-cross design with a plain disk ornament at the center where the bars come together. The sections of railing are supported by square cast-iron posts with simple capitals and orb finials.

The bridge's abutments and piers are of reinforced concrete construction, with the cylindrical river piers, each 10 feet in diameter, finished in an ashlar of large granite blocks. The piers have been transversely connected by concrete walls, apparently a relatively recent modification. The piers are protected by wooden fenders, some of which are highly deteriorated. There currently is no ready access to the piers or to the underside of the bridge, but the original plans show stairways leading down from the sidewalks. Along the underside of the bridge are ladders and catwalks giving access to the various mechanical components.

The bridge is somewhat deteriorated, particularly the concrete sidewalks and approach-span paving, and electrical conduits appear to have corroded to the point of uselessness. Although the bridge has not been operated for the last few years, all the major components (except for the controls in the interior of the operator's house) are intact and relatively unaltered. The bridge has undergone three major rehabilitations: in 1936, the southwest pier and trunnion support were replaced, along with the electrical system, operator's house, and floor; in

1965, the present steel-grate deck was introduced and the girders in the easternmost approach span were replaced; and in 1984, there were minor repairs to the steel and masonry, and the northwest trunnion post was reconstructed in kind.

Historical Background

In the early 20th century, Bridgeport was Connecticut's leading industrial city, the home of several large manufacturers making sewing machines, cartridges, machine tools, and numerous other kinds of consumer and industrial goods. With the onset of World War I and the collapse of the European economies, the city's fortunes rose even higher. As more and more of Bridgeport's factories turned to war-related production, employment skyrocketed and the city came to be known as the "Essen of America," referring to the center of German munitions production.

At the urging of the U.S. War Department, the City of Bridgeport undertook a number of bridge projects intended to improve access to the various centers of war-related production, including three movable bridges across the Pequonnock River. Movable bridges were needed because the city's plants relied on waterborne shipping for raw materials and for coal to power their steam engines.

This bridge would have been especially useful. Grand Street bisected the 10-acre plant of the Bridgeport Brass Company, a huge facility producing brass sheet, strip, and tube, items that in turn became the raw materials for the city's producers of finished metal goods. By continuing Grand Street across the river to join up with Arctic Street, the bridge would have provided Bridgeport Brass with easy access to city's east side, where the majority of Bridgeport's industrial workers lived. Moreover, it would have directly linked the brass mill with the city's largest consumer of brass, the Remington-Union Metallic Cartridge Company, a munitions factory that grew from 16 acres of floor space in 1914 to 40 acres (in 313 buildings) in 1916; the Remington-Union Metallic Cartridge plant stood less than a mile to the east on Artic street.

However, delays in completing the bridge prevented it from opening until 1919, after the war had ended. The contractor for the bridge, Edward DeVoe Tompkins, Inc. of New York City, was dismissed from the project partway through and another firm was hired to complete the bridge. The City claimed that

Tompkins was incompetent and uncooperative, while Tompkins faulted the City for failing to clear the site on time and for not responding to its concerns about the design. Shortages of steel brought on by the war also played a part. The piers were a particularly contentious item, both in regard to the adequacy of the piling and the method of pouring the concrete in the presence of water. The contractor also noted the difficulty brought on by having the design engineers in Chicago; apparently, there was a succession of resident engineers on site, none of whom exercised sufficient authority to resolve critical questions. Tompkins sued the City for breach of contract and prevailed, winning the full value of the contract as damages.[1] By the time the bridge opened, the City (which administered the contract through a special Grand Street Bridge Commission) had already undertaken two additional bond issues.

The bridge's troubles did not end with the Connecticut Supreme Court, however, but rather in the court of experience. It soon became apparent that the problem-plagued piers were undergoing excessive settling, and by 1932 the bridge had reached a crisis point: it was determined that the southeast bascule pier had settled four inches in just the previous two years. Consequently, a substantial renovation was undertaken, this time by the Connecticut Highway Department with the assistance of federal work-relief funding. The bascule leaves were removed and the pier completely replaced, including new piling; the flooring and electrical system also had to be renewed. When once again a war-time economy threw Bridgeport's industrial sector into high gear, the Grand Street Bridge was ready to serve.

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[1]As a consequence of the litigation, the construction of the Grand Street Bridge is probably one of the most thoroughly documented projects of the period. The more than 1,500 pages on record for the case include testimony, depositions from experts, and 400 pages of correspondence among the engineers, contractor, steel provider, and city officials. See Edward DeV. Tompkins, Inc. vs. City of Bridgeport, Connecticut Supreme Court, January Term, 1920, <u>Records and Briefs</u>, vol. 215.

Technological Significance

As a consequence of the numerous natural and human-formed shipping channels that ran through the city proper, Chicago was the center of development of the modern bascule. Three of the period's major types of bascules originated in Chicago--the simple single-trunnion design known as the Chicago type, developed by John Ericson and others in the City Engineer's office; the Scherzer rolling-lift design; and the various types created by the Strauss Bascule Bridge Company, one of which is exemplified by the Grand Street Bridge. Although at first glance the Strauss designs seem very different in appearance and operation, some having overhead counterweights and others having entirely separate counterweight structures, they share a single principle, that of balancing the bridge with a pivoting counterweight linked so as to form a parallelogram with pinions at the vertices. The consequence of this arrangement was greater freedom in the basic geometry of the bascule; the placement of the counterweight, particularly as regards its center of gravity, could be more flexible with a pivot and linkage.

In the Grand Street bridge, the counterweight moves downward and then slides forward, all the while maintaining its basic horizontal orientation; because it is pinned, there is no effect on the bascule from the shifting of the counterweight's center of gravity. Moreover, the size, shape, and movement of the counterweight is such that it clears both the underside of the roadway and the surface of the water. Many designs of the period required the counterweight to move below the water level of the channel, thereby necessitating an expensive watertight counterweight pit. The alternative, having the counterweight above the roadway, also entailed expensive structures and potentially introduced a vertical clearance restriction. The Strauss Underneath Counterweight design thus provided a highly suitable and potentially economic bridge (had the City not had to pay for it twice) for the site.

Beyond its particular design, the Grand Street Bridge shares the general advantages of bascules compared with other movable types, such as swing and lift bridges. Bascules operated faster than other types, could be partly opened, and provided a built-in barrier to vehicular traffic (particularly double-leaf designs); although their initial cost was somewhat higher, their operating cost were generally lower than for other types. They could be made in almost any width, and the roadway could be subsequently widened by adding an additional parallel bascule, something not possible with swing bridges. Bascules could be built in long lengths so that a single leaf and a single operating mechanism would suffice. However, by making the bridge a double leaf, the moving parts were smaller and much lighter, yielding not only the safety by-product noted above but also faster operating times and less susceptibility to wind effects. Although Grand Street Bridge is probably typical of the size and scale of the bascules of this type, they could be built much larger; the record for a double-leaf Strauss Underneath Counterweight design was 252 feet (Burnside Bridge, Portland, Oregon).

The Strauss Bascule Bridge Company was founded by Joseph B. Strauss (1870-1938), an original thinker who contributed much to American engineering in the early 20th century. The child of artists, Strauss studied engineering at the University of Cincinnati, where he received his Civil Engineering degree in 1892. After a few years working for the New Jersey Steel and Iron Company as a draftsman in the bridge design department, he came to Chicago and worked for the City Engineer, where he was assigned the task of reviewing and refining early bascule designs. In 1902 he established a practice as an independent consulting engineer and quickly made a mark for himself with his own designs. He is said to have been among the first to design bascule bridges with concrete counterweights rather than the then-prevalent iron counterweights. While bulkier than iron, concrete was much cheaper and easier to form into the complex shapes needed to clear the structure and operating mechanism. Strauss also introduced the pivoting counterweight, which he developed into several variations patented between 1906 and 1916; the Underneath Counterweight type was specifically addressed in Patent No. 1,124,356 (applied for in 1906 but not granted until 1915). Strauss founded the Strauss Bascule Bridge Company (later named the Strauss Engineering Corporation) to promote his ideas and design bridges; the actual fabrication and construction was undertaken by others. Strauss's company was highly successful. Writing in 1926, Hovey estimated that more bascules had been built to the Strauss designs than any other type, among which were at least three Underneath Counterweight bridges built in Bridgeport. Strauss was credited with more than 400 bridges of all types at the time of his death in 1938.[2]

As railroads and cities completed their rebuilding of earlier movable bridges, the market for bascules gradually diminished, Strauss, however, was far from finished. Partly due to the reputation he established as a movable-bridge innovator, he was chosen as planning consultant and then chief engineer for one of the 20th-century's aesthetic and engineering masterpieces, the Golden Gate Bridge in San Francisco, a project with which Strauss was associated from 1918 until it opened in 1937. Strauss also distinguished himself with other notable designs, such as the 1930 Longview Bridge in Washington State, at the time the longest cantilever span (1,200 feet) in the world. As though designing pioneering bridges were not enough, Strauss invented a revolving high-rise restaurant and published poetry and numerous literary essays.

Although it may not figure prominently in an account of the career of Joseph B. Strauss, Bridgeport's Grand Street bridge stands as an example of the engineer's early bread-and-butter designs, work that brought him prosperity and established his reputation as a bridge designer of national importance.

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[2]From the correspondence included as evidence in the lawsuit, it is apparent that, although many individuals worked on the drawings, both Joseph B. Strauss himself and the company's Chief Engineer, F. W. Leonhard, were substantially involved in the Grand Street project.

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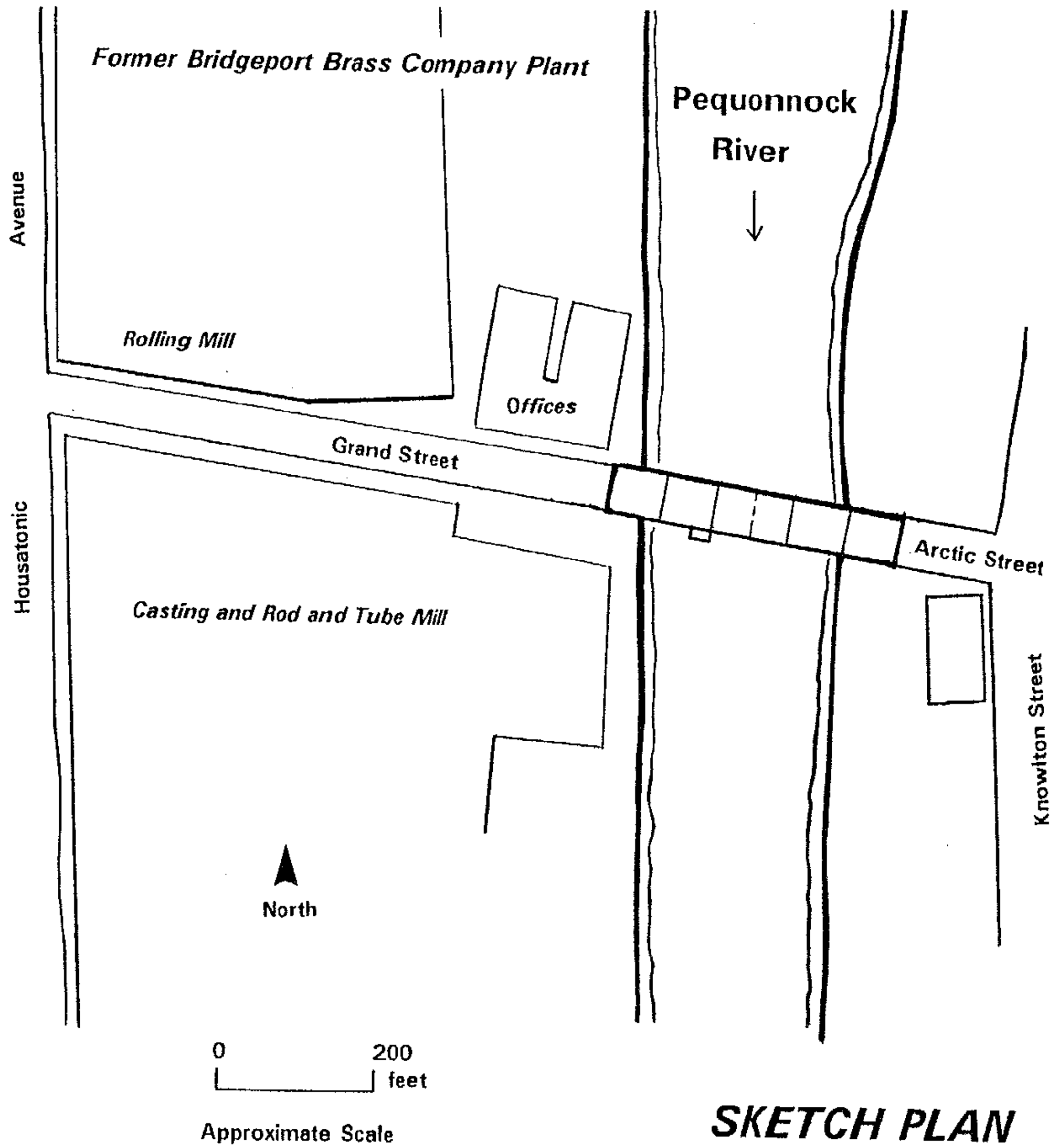
Note on historical photographs: the following repositories were investigated: Bridgeport Public Library, Historical Collections; Connecticut Department of Transportation; Connecticut Historical Society; Connecticut State Library. Other than the low-resolution photographs in newspaper clippings, none was found.


Former Bridgeport Brass Company Plant
Pequonnock
River
Avenue
Rolling Mill
Offices
Grand Street
Housatonic
Arctic Street
Casting and Rod and Tube Mill
Knowlton Street
North
0
200
feet
Approximate Scale

SKETCH PLAN