BAYONNE BRIDGE
Bayonne
Hudson Co., New Jersey

HAER NO. NJ-66

HAER
NJ
9-BAYO,
1-

PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
NATIONAL PARK SERVICE
Department of the Interior
P.O. Box 37127
Washington, D.C. 20013-7127

United States Department of the Interior
National Park Service
Washington, D.C. 20240

HISTORIC AMERICAN ENGINEERING RECORD
SITE DATA FORM

HAER NJ, 9-BAYO 1-

STATE	COUNTY	TOWN OR VICINITY
New Jersey	Hudson	Bayonne

HISTORIC NAME: Bayonne Bridge

HAER NO.: NJ-66

SECONDARY OR COMMON NAMES

COMPLETE ADDRESS (DESCRIBE LOCATION FOR RURAL AREAS)
Spans Kill Van Kull between Bayonne, NJ and Port Richmond, Borough of Staten Island, New York

DATE OF CONSTRUCTION: completed 1931

ENGINEER, BUILDER, OR FABRICATOR
Chief Engineer-O.H. Ammann, Consulting Architect-Cass Gilbert
Consulting Engineer- George W. Goethals

SIGNIFICANCE (TECHNOLOGICAL AND HISTORICAL, INCLUDE ORIGINAL USE)
(1) World's longest steel bridge for nearly half a century
(2) First use of manganese steel (for main arch ribs and rivets)
(3) use of falsework for construction of an arch span of this size never previously done

STYLE (IF APPROPRIATE)

MATERIAL OF CONSTRUCTION (INCLUDE STRUCTURAL SYSTEMS)
steel

SHAPE AND DIMENSIONS (SKETCHED FLOOR PLANS ON SEPARATE PAGES ARE ACCEPTABLE)
1675 feet-length of span; width of bridge-85 feet; channel clearance at midspan-150 feet; height of arch above water at crown-325

EXTERIOR FEATURES OF NOTE
aesthetically pleasing arch

INTERIOR FEATURES OF NOTE (DESCRIBE MECHANICAL SYSTEMS, MACHINERY OR EQUIPMENT)

MAJOR ALTERATIONS AND ADDITIONS WITH DATES

PRESENT CONDITION AND USE
excellent — vehicular traffic

OTHER INFORMATION AS APPROPRIATE
American Society of Civil Engineers's Landmark

SOURCES OF INFORMATION (INCLUDING LISTING ON NATIONAL REGISTER, PROFESSIONAL ENGINEERING SOCIETY LANDMARK DESIGNATIONS, ETC.)
All information taken from American Society of Civil Engineers' Nomination Form (which is included in Field Records).

COMPILER, AFFILIATION	DATE
Bill Lebovich, HAER	May 21, 1987

ADDENDUM TO:
BAYONNE BRIDGE
(Kill van Kull Bridge)
Spanning Kill Van Kull between Bayonne & Staten Island
Bayonne
Hudson County
New Jersey

HAER NJ-66
HAER NJ,9-BAYO,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

BAYONNE BRIDGE

This report is an addendum to a one-page report previously submitted to the Library of Congress in 1988.

Location: Spanning Kill Van Kull between Bayonne and Staten Island, Bayonne, Hudson County, New Jersey

UTM: 43-427554-4499359
Quad: Elizabeth, NJ, 7.5', 2011

Date of Construction: 1931

Designers: Chief Engineer, Othmar. H. Ammann; Consulting Architect, Cass Gilbert; Consulting Engineer, George W. Goethals

Present Owner: Port Authority of New York and New Jersey

Present Use: Vehicular traffic

Significance:

1. Aesthetically striking steel arch span bridge designed by prominent bridge designer and engineer, Othmar H. Ammann
2. World's longest steel bridge for nearly half a century
3. First use of manganese steel (for main arch ribs and rivets) in bridge construction
4. First use of falsework for construction of an arch of this span

Historian(s): Kate Lemos McHale, Beyer Blinder Belle Architects & Planners

Project Information: The Port Authority of New York and New Jersey (PANYNJ) sponsored this Addendum to the 1987 HAER NJ-66 documentation of the Bayonne Bridge. Beyer Blinder Belle Architects & Planners, LLP, prepared this Addendum, following a Section 106 Review of the proposed Bayonne Bridge Navigational Clearance Program (BBNCP) which identified the Bayonne Bridge as a historic property, eligible for listing on the National Register of Historic Places. This HAER Addendum has been produced as part of the required mitigation of the proposed BBNCP, stipulated in the Programmatic Agreement among the U.S. Coast Guard; the

New Jersey Department of Environmental Protection and Historic Preservation; the New York State Office of Parks, Recreation and Historic Preservation; the Advisory Council on Historic Preservation; and PANYNJ, executed on May 2, 2013.

Physical Description of the Historic Property

The Bayonne Bridge spans the Kill van Kull between New Jersey and New York, connecting the City of Bayonne, NJ, with the Borough of Staten Island, NY. Designed by renowned bridge engineer Othmar Ammann, with consulting architect Cass Gilbert, the Bayonne Bridge was the longest span arch bridge in the world when it opened in 1931, and remained so for nearly 50 years. The steel structure rises 325 feet above water and features a span of 1,675 feet, with a width of 85 feet and a mid-span channel clearance of 150 feet. Its construction featured the first application of manganese steel in bridge construction, as well as the first use of falsework, or temporary structure during construction, for an arch span of its size.

The bridge orientation follows a previously existing ferry crossing from Bayonne, NJ to Port Richmond, Staten Island, spanning the Kill van Kull at a 58-degree angle rather than a more typical 90-degree angle. In doing so, its construction conformed to existing urban plans and infrastructure on either side of the 1,000-foot channel, related to the historic ferry route. The bridge features a tapered arched steel truss, a shape favored by Ammann as aesthetically appropriate in its low-lying industrial landscape, with a suspended roadway that is supported on either side of the arch by viaducts composed of monumental concrete arches. The 1,675-foot span, combined with the 6,600 feet of approach viaducts, carry the roadway for half a mile.

The Bayonne Bridge's steel arch comprises two trussed arches that run parallel to the outside of the suspended roadway and are connected across it with spandrel braces. The bottom cords of the arch form a perfect parabolic arch; the composite form is deepest at the abutments, where it measures 67 ½ feet high, and gracefully becomes shallower towards the center, where it measures 37 ½ feet. According to Amman, this feature of the design was created "principally for its pleasing appearance."

The clean, pure form of the steel arch, combined with the monolithic concrete arches of the viaduct leading to it, cut a dramatic profile above the landscape of this active industrial connection between New York and New Jersey.

Historic Precedents and Inspiration to the Original Design

In 1927, the New Jersey Legislature enacted a law providing partial financing for the Bayonne-Staten Island Bridge. The states of New Jersey and New York contributed $4 million to the construction of the new bridge; the balance of $12 million was raised through bond sales. The Port of New York Authority began a study for a bridge at the Kill van Kull crossing.

The Bayonne Bridge would join two bridges already connecting New Jersey and Staten Island, constructed in 1928 and designed by Waddell and Hardesty, Consulting Engineers: the Outerbridge Crossing Bridge and the Goethals Bridge. Together these three bridges would create a new network of highways connecting New Jersey to New York City and Long Island, providing vehicular access for residents in bedroom communities in New Jersey to jobs in New York City, as well as connections to the metropolitan area's airports, and transportation linkages around the city. Unfortunately, plans to construct a tunnel under the Verrazano Narrows were not realized, and over 30 years would pass before the bridges from New Jersey could connect traffic through Staten Island all the way to Brooklyn. The Verrazano Narrows Bridge, Ammann's last great New York City bridge project, opened in 1964.

Major bridge construction in the New York metropolitan region had primarily been of the suspension bridge type, including the iconic Brooklyn and Manhattan Bridges spanning the East River, and the George Washington Bridge over the Hudson River, designed and constructed concurrently with the Bayonne Bridge, also by Othmar Ammann.

Inspiration for the design of the Bayonne Bridge, a steel arch bridge supported by abutments on either side of the channel and connected to viaducts on either side of the span, came from the Hell Gate Bridge, which was designed by Gustav Lindenthal and opened in 1917. Othmar Ammann had been chief assistant to Lindenthal during the construction of this two-and-a-half-mile long railroad bridge, which included viaducts, trestles, two small-span bridges, and the Hell Gate Bridge. The bridge carried four pairs of tracks, and connected Manhattan, Queens and the Bronx over the East River, Randall's Island and Ward's Island. It featured a steel arch with heavy masonry abutments on either side of the waterway, and viaducts featuring monumental masonry arches.

Original Project Team

Swiss engineer Othmar Ammann designed the Bayonne Bridge, the second in a series of major long-span bridges he designed in the New York metropolitan area – his first was the George Washington Bridge, from 1927 to 1931. He would go on to become the great bridge builder of the mid-20th century, designing the Bayonne Bridge in 1929-1931, the Triborough (now Robert F. Kennedy Memorial) Bridge in 1936, the Bronx-Whitestone Bridge in 1939, the Throgs Neck Bridge in 1961 and the Verrazano-Narrows Bridge in 1964.

Ammann had worked in the office of Gustav Lindenthal, the great bridge designer who designed the Hell Gate Bridge in Queens, the construction of which Ammann was closely involved. He and his mentor had a serious disagreement over the design and location of the first Hudson River Bridge, what would eventually become the George Washington Bridge. Ammann left to start his own firm in March 1923, became Chief Engineer of the newly formed Port of New York Authority, and eventually designed the George Washington Bridge.

Similar to the George Washington Bridge, Ammann was the chief designer and engineer for the Bayonne Bridge. Also like his previous commission, he received architectural assistance from Cass Gilbert, the well-known, early-20th century architect who had designed the Woolworth and West Street Buildings and the Thurgood Marshall Court House in lower Manhattan, and the U.S. Supreme Court in Washington, DC.

Design and Construction of the Bridge

Othmar Ammann said in 1931, "The Port Authority recognized the fact that its structures must not only be useful, but they must also conform to the aesthetic sense. This was one of the motives for the selection of an arch spanning the entire river in one sweeping graceful curve."

Ammann and Gilbert first considered a suspension bridge for the Bayonne Bridge, a form the team was developing already for the George Washington Bridge. In the original stages of the design, rail transportation across the bridge was also under consideration. A suspension form and an arch form were both developed, and cost estimates undertaken. When asked to accommodate rail as well as vehicular traffic, the structural requirements for each type of bridge caused the cost estimates to diverge considerably; stiffening a suspension bridge would cost significantly more than it would an arch bridge. Additionally, the geography of the site favored an arch bridge, since the abutments could be constructed on solid bedrock on either side of the channel, rather than the need to construct towers within the river bed. Finally, Ammann preferred the clean, geometric form of the steel arch bridge in this relatively flat, low-lying industrial landscape.

When constructed, the bridge carried four lanes of vehicular traffic, but was structurally designed to accommodate two lines of light rail and a possible expansion of the roadway, if needed. Though the bridge design anticipated expansion, none was needed in the early years of the bridge's life, due to low traffic until the Verrazano Narrows Bridge connected the network of highways beyond Staten Island into Brooklyn and beyond.

The structural and aesthetic form of the bridge draws a great deal from the Hell Gate Bridge, which Ammann had worked on with Gustav Lindenthal. The design intent for the Bayonne Bridge, seen in early drawings by Cass Gilbert, was that the open structure of the arch would terminate in heavy, masonry abutments, similar to the Hell Gate Bridge. This aesthetic juxtaposition would create an expression of monumentality. However, the monumental abutments would be just that, aesthetic: structurally, they needed to rise only barely above the ground.

Ammann and Gilbert studied a series of options for creating an artificial superstructure to take on the appearance of large masonry abutments. Constructed during the Depression, however, funds for the masonry necessary to create the monumental abutments were withheld by the bridge's supervisors, and eventually these elements were not constructed. Instead, steel armatures rise

from concrete abutments to support the roadway at each end of the arched span, beyond which massive concrete arches support the viaduct on land.

The steel arch itself is composed of 40 truss segments, which were fabricated off site. The bottom cords of the truss are the span's principal structural members, carrying its weight and stresses to the concrete abutments. The top cords and braces were constructed of plate steel and provide stiffening for the arch. The bottom cords are larger in section than the top cords and are made of manganese steel, a lighter material.

The original design and construction of the bridge included the pedestrian walkway on the west side of the span, with pipe railings. Stairways located at West 4th Street in Bayonne, and south of Innis Street in Port Richmond, provide access to the sidewalk, which remains.

When the bridge opened in 1931, its design as well as the economic efficiency of its construction were both commended; New Jersey Governor Morgan F. Larson remarked at the opening ceremony, that, "it cost 14 percent less to build than was budgeted and appropriated." Amman, in his remarks, responded, "The huge abutments of the arch, which are yet exposed in their crude construction, are eventually to be marked by massive pylons, and will thus further enhance the structure in its setting and landscape." Gilbert and Amman, along with the engineering community, pushed for the completion of the stone abutments to be completed long after the bridge opened, but the Port Authority did not take action. The somewhat spindly looking terminations of the span exist today, and though they are not what the bridge's designers intended, they are part of the original construction and historic appearance of the Bayonne Bridge.

Subsequent Improvements to the Bridge

The original bridge construction featured a small administration building on the Staten Island side, and toll booths on both sides of the bridge. The toll booths were updated in the 1950s on the New Jersey side, and in the 1960s on Staten Island. In 1970, one-way toll collection was implemented at the Port Richmond Plaza, in Staten Island. Physical changes to the bridge have been few; they include security enhancements, and the replacement of historic lighting standards with cobra lights.

Available architectural and engineering plans of the Bayonne Bridge maintained by the Port Authority of New York and New Jersey have been reviewed as part of this study. Several repair projects have been carried out during the lifetime of the bridge, mostly structural repairs to bridge steel or approach structures. In addition to these repair projects, the following architectural and engineering projects are documented:

- Staten Island Plaza and Viaduct Widening (1966): This included alterations to the Staten Island toll plaza, including replacing the historic toll booths with a single arrangement of

six lanes of toll booths, and widening the viaduct in the area of the toll plaza. The project also included electrical modifications and the installation of new cobra lights.

- In 1995, a closed circuit TV (CCTV) security system with cameras and new lighting was installed along the bridge, plazas, and approaches. Improvements were also made to the Morningstar Road off-ramp, under a separate contract.

- A 1999 set of drawings documents the comprehensive rehabilitation of the bridge structure. As part of this project, the roadway pavement was removed, the concrete deck, expansion joints and scuppers of both approaches were replaced, the concrete deck, joints and scuppers of the central span were repaired and a latex modified concrete pavement was laid on the roadway. The superstructure steel members and concrete piers of the entire bridge were repaired. In this same year, permanent maintenance and construction platforms were constructed beneath the roadway and the approaches.

- Construction of a Parking Lot at Walker Street and Morningstar Road (2000)

- In 2001, miscellaneous improvements were made to the CCTV system and lighting, including new navigational lights, aviation lights, and street lamps. The New Jersey abutment was rehabilitated.

Historic Significance

The Bayonne Bridge is historically significant as a work of renowned bridge engineer Othmar Ammann, as well as for the iconic design and brilliant engineering of its steel arch span over the Kill van Kull. The only one of Ammann's six major bridges that is not a suspension bridge, it was the longest span arch bridge in the world when it was constructed, and remained so for 50 years. It represents the first use of manganese steel in bridge construction—impressive for its high strength and high impact resistance. It was also the first use of falsework, or temporary structure, in the construction of an arch span of its size.

The Bayonne Bridge has been determined to possess national significance by the New York and New Jersey State Historic Preservation Offices (SHPO). It is an American Society of Civil Engineers' Landmark and eligible for listing on the National Register of Historic Places. In 2001 the New Jersey SHPO determined the Bayonne Bridge eligible for listing on the National Register under Criteria A, for its association with events that have made a significant contribution to the broad patterns of our history; and C, because it embodies the distinctive characteristics of a type, period or method of construction, represents the work of a master, and/or possesses high artistic values. In 2012, the New York SHPO determined that the Bayonne Bridge remains eligible for listing on the National Register.

Character-Defining Features

The historic significance of the Bayonne Bridge, as defined by the NJ and NY SHPOs, is related to its role in the transportation history of the New York City metropolitan era and in the history of bridge design and construction. Architecturally, the bridge is significant as the work of a master bridge engineer, primarily for the design and engineering of its dramatic arched span over the Kill van Kull.

The arch is composed of 40 connected steel trusses, approximately 67 feet deep at the bases of the arch and gradually tapering toward the midspan to a depth of 37 feet. The apex of the arch is at approximately 266 feet above the waterway, and the roadway is suspended by wire rope hangers. The "shoes" of the arch connect to concrete abutments, above which exposed steel towers support the roadway. On either side of the central span, the approach roadways are supported by concrete arches.

Over the years, the bridge has been rehabilitated, including steel structural repairs, and the replacement of the entire roadway at both approaches. Other modifications include the replacement of original light standards and toll booths.

The primary character-defining feature of the bridge is the iconic steel truss arch spanning the Kill van Kull, which is visible for miles from the land, sea and air. Also characteristic of the bridge's original design and use, but less significant architecturally and visually than the central span arch, are the pedestrian walkway, the open steel abutment towers, and concrete arches supporting an elevated roadway at the approach viaducts.

Bibliography & Further Reading

Li/Salzman Architects, PC: "Bayonne Bridge Navigational Clearance Program: Section 106 Review Intensive Level Survey Report", March 27, 2012

Port Authority of New York and New Jersey: Archives of photographs (Please note: the Port Authority lost its main archive of records and drawings when the World Trade Center collapsed on September 11, 2001. Scans of historic photographs of the Bayonne Bridge were provided for research purposes.)

-- "Bayonne Bridge Navigational Clearance Project Brochure," July 2013. http://www.panynj.gov/bayonnebridge/pdf/bayonne-bridge-brochure-env.pdf

Rastorfer, Darl, *Six Bridges: The Legacy of Othmar H. Ammann, (*Yale University Press, 2000).

-- *Bayonne Bridge: A Landmark by Land, Sea, and Air*, (Port Authority of New York and New Jersey in Association with Darl Rastorfer and Associates, 2007)

Troelsch, Henry W: *The Kill Van Kull Bridge Between Bayonne, New Jersey, and Port Richmond New York, Built by the Port of New York Authority, a Description of the Erection of the 1,675 Foot Steel Arch by the American Bridge Company.* (U.S. Steel, 1931) 3.

United States Coast Guard: "Bayonne Bridge Navigational Clearance Program, Final Environmental Assessment", May 2013. Appendix B: Historic and Cultural Resources http://www.uscg.mil/hq/cg4/cg47/docs/BBNCP_Final_EA_-_Chapters_Combined.pdf

Original Engineering Drawings, the Port of New York Authority, Kill Van Kull Bridge, Bayonne-Port Richmond:

The original engineering drawings of the Bayonne Bridge are in the possession of David P. Billington, Jr.
Prints and high resolution digital scans of these drawings are
in the possession of the Port Authority of New York and New Jersey, and the New Jersey and New York State Offices of Historic Preservation.

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