

POINT BONITA LIGHTHOUSE SUSPENSION BRIDGE  
Golden Gate National Recreation Area  
Point Bonita Light Station  
Sausalito vicinity  
Marin County  
California

HAER CA-2289  
*HAER CA-2289*

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD  
PACIFIC WEST REGIONAL OFFICE  
National Park Service  
U.S. Department of the Interior  
1111 Jackson Street, Suite 700  
Oakland, CA 94607

**HISTORIC AMERICAN ENGINEERING RECORD**  
**POINT BONITA LIGHTHOUSE SUSPENSION BRIDGE**

**HAER No. CA -2289**

- Location:** Point Bonita Historic District, Golden Gate National Recreation Area, Marin Co. CA
- Present Owner:** National Park Service
- Present Use:** Pedestrian access to Point Bonita Light Station
- Significance:** The suspension bridge is a critical contributing element to the oldest cluster of historic structures, known as the Point Bonita Light Station, in the Point Bonita Historic District. Located on a rocky promontory overlooking the Pacific Ocean and the entrance to the San Francisco Bay this bridge provides the only access to the Lighthouse and Fog Signal buildings both of which remain critical to marine navigation through the hazards of the Golden Gate. The presence of this bridge, spanning a landslide, embodies the continual efforts required throughout the history of the Point Bonita Light Station to ensure its mission to assist safe passage into the San Francisco Bay.
- Historian:** Daniel Eilbeck, Wiss, Janney, Elstner Associates, Inc. under the direction of the National Park Service, Denver Service Center, June 2011.
- Project Information:** This documentation is being prepared as mitigation for demolition and replacement of the Point Bonita Wood Suspension Bridge under Section 106 of the NHPA. The bridge has become unsafe to use, cannot be repaired and must be replaced. The Point Bonita Light Station was listed in the National Register of Historic Places (NRHP) in 1991. Subsequently, the Point Bonita Wood Suspension Bridge was determined by NPS-GGNRA, and CA SHPO concurred with the determination, to be a contributing element to the Point Bonita Historic District's period of significance (1855 – 1966). This determination was carried out by virtue of NPS-GGNER's Cultural Landscape Inventory: Point Bonita Historic District 2005. The NPS-GGNRA and the California SHPO signed a Memorandum of Agreement (June 6, 2011) that stipulated HAER documentation as mitigation for the undertaking.

## Part I. Historical Information

### A. Physical History:

**1. Date of Construction:** 1954

**2. Engineer:** United States Coast Guard, Civil Engineering Section, 12th CG District: Glen E. Logan, Supervising General Engineer, F. W. Decker Senior Civil Engineer, George Hammer, foreman.

**3. Builder:** Bos Constructing Company

**4. Original Plans and Construction:** The original plans were prepared in 1940 by the US Coast Guard. The 1940 plans appear to have consisted of three sheets of drawings and details based on the sheet number identification adjacent to the title block, however only sheets 1/3 & 2/3 were found in the archives. The plans were revised in 1954 immediately before construction and on sheet 2/3 the denominator was overwritten suggestion that only two original sheets existed. The available plans depict the location, size, and construction details of the bridge and are largely consistent with the in-place structure.

The plans were prepared in response to landslides that occurred initially in the winter of 1937 and followed by additional larger slides in the winter of 1939/1940. The 1939/40 landslides caused a 150 foot section of the paved, on-grade, walkway over the original land bridge to the light station to slough away, resulting in an irreparable gap in the access trail to the light station. A wooden trestle and a single cable breeches buoy with “A” frames were erected as a temporary measure in 1940<sup>1</sup>.

Requests for emergency funding for the new bridge were not available in 1940. Bids were obtained for the work in early 1942 but the cost was considered too high and the work was postponed. Ultimately funding was secured in 1954 for a project consisting of constructing the suspension bridge; and widening and realignment of the access trail. Bos Constructing Company was awarded a contract that included \$28,000 for the suspension bridge and \$9,625 for the trail work, totaling \$37,625. Additional trail alignment work was added into the contract after an August 1954 slide occurred approximately midway between the living quarters and the light<sup>2</sup>.

The bridge consists of a 4-foot 6-inch wide wood framed deck with two timber framed trusses supported by galvanized steel wire cables spanning 156 feet to timber “A” framed towers supported on concrete foundations with concrete cable anchorages. The deck is laterally stiffened for wind loads with 2-inch by 3-inch diagonal steel angles and wind cables on each side of the deck.

---

<sup>1</sup> Glen E. Logan, “Point Bonita Light Station Suspension Bridge and Access Trail Construction,” *The Engineer’s Digest* (September/October 1956).

<sup>2</sup> Logan, “Bridge and Trail Construction.”

Several modifications were made to the original design based on the material available in stock in 1954:

- Main Cable & Wind Cable: the specific wire strand configurations were modified; the specified diameters remained the same.
- Suspenders Cables: 3/4-inch diameter steel rods were substituted for the specified 1/2-inch diameter cables.
- Wind cable connection to deck stringers: 1/2-inch diameter cable 6 x7 plow steel.
- Relocation of the east end wind cable anchorages 5 feet back to more stable ground.
- Addition of 2-inch by 3-inch angles for diagonal bracing under the bridge deck.

**5. Alterations and Additions:** There were significant repair projects performed on the bridge in 1978-79 and in 1989. The current overall configuration of the structural system is the same as shown in the 1940 drawings but many of the steel components were replaced in the 1978-79 work.

The work in 1978 was very extensive and is documented in As-Built Drawings prepared by the US Coast Guard. The work generally consisted of:

- Replacing the two main cables with 1 1/4-inch steel strand
- Replacing both wind cables with 1 1/4-inch steel strand
- Replacing wind cable struts at the west end
- Replacing the steel hardware for the connection of the wind cables to the bridge deck
- Replacing all suspender rods, cable bands, and clevis pins. The new rods were specified at 7/8-inch diameter vs. the original 3/4-inch diameter
- Replacing essentially all steel connection hardware in the wood trusses including: truss rods, bolts, and bent straps at top chord splices
- Replacing diagonal bracing angles below bridge deck
- Replacing all bolts and steel connection hardware in bridge towers

The repair work in 1989 is outlined in an investigation report dated May 2, 1989, prepared for the National Park Service by Ace Pacific Co. of San Francisco. The evaluation found that the bridge was structurally sound and the recommended work was focused on cleaning and coating metal components of the bridge to address corrosion, and replacement of miscellaneous decayed wood components<sup>3</sup>. Records in the Golden Gate National Recreation Area archives show the work was performed by a contractor named E. J. Hackett over an 18 month period beginning in late 1989.

---

<sup>3</sup> Ace Pacific Co., *Pt. Bonita Lighthouse Bridge, Report on Structural Condition with Recommendations for Maintenance*, Presidio Park Archives & Records Center: National Park Service, 1989.

**B. Historical Context:**

**Point Bonita Historic District:** The Point Bonita Historic District is located in the Marin Headlands just north of the Golden Gate, the narrow strait that forms the entrance to the San Francisco Bay from the Pacific Ocean. The Historic District is composed to three primary clusters of structures distinguished by location, function and period of development<sup>4</sup>. The Point Bonita Light Station suspension bridge is located within the Light Station cluster of structures which is the oldest cluster dating back to 1872.

Initially a fog signal, the first one established on the west coast, was located at the site in 1874, but this was ultimately replaced with a new structure in 1903 and which has remained to this date. The original light house was first established in 1855 on Point Bonita Ridge, above its current location, to provide a navigational aid through the Golden Gate for the numerous ships attracted to San Francisco by the gold rush of 1849. The second order Fresnel lens and its housing were subsequently moved to their current location in 1877 to address the unique nature of the summertime fog conditions that occur along the California coast and the entrance to the Bay.

The Light Station is located on a steep, rocky, peninsula that projects into the Golden Gate. The highly fractured serpentine and pillow basalt that form the peninsula are highly prone to slumps and landslides which have plagued the site since its establishment<sup>5</sup>. No less than nine slides are documented between 1872 and 1954, including the 1874 slide that destroyed the first fog signal building and the series of slides between 1872 and 1876 that led to the abandonment of the cliff side gallery and construction of the tunnel<sup>6</sup>. Landslides during the winter of 1937 and 1939-40 damaged the land bridge connecting the Light Station to the road, and necessitated construction of the suspension bridge.

**Construction:** Requests for emergency funding for the new bridge were not available in 1940. In early 1942 bids were obtained for the work but the cost was considered too high and the work was postponed. Funding priorities shifted during World War II and the project remained in the files. After the war the project was placed in the Coast Guard's Acquisition Construction and Improvement program but remained dormant. Ultimately, funding was secured in 1954 for a project consisting of constructing the suspension bridge and widening and realignment of the access trail. Additional trail alignment work was added into the contract after an August 1954 slide occurred approximately midway between the living quarters and the light<sup>7</sup>.

**Alterations:** The Point Bonita Light station and suspension bridge are located in one of the most exposed locations along the California coast. The narrow, barren peninsula projects out into Open Ocean offering little protection from the constant winds, salt spray and dense fog that characterize the summer weather pattern. In the winter the arctic storms sweep ashore with gusts commonly

---

<sup>4</sup> *Cultural Landscapes Inventory - Point Bonita Historic District - Golden Gate National Recreational Area*, National Park Service, 2005.

<sup>5</sup> *Cultural Landscapes Inventory*.

<sup>6</sup> *Cultural Landscapes Inventory*.

<sup>7</sup> Logan, "Bridge and Trail Construction."

reaching to 70 knots. These conditions are extremely corrosive to steel structures, requiring replacement of essentially all metal components within the first twenty-five years after construction and again thirty-two years later. To address the harsh environment the bridge is currently scheduled to be dismantled and replaced with a new structure of similar design using materials more resistant to corrosion.

**Suspension Bridges:** Humans have been using suspension bridges for many centuries, initially as pedestrian structures made from vines and wood. Suspension bridges are light-weight and the technology requires no false work and minimal access from below the bridge; allowing suspension bridges to span difficult terrains. The suspension bridge spans are primarily limited by the strength of the main suspender cables.

By the beginning of the 1800s suspension bridges with spans up to 200 feet and capable of supporting horse drawn wagons were being constructed using suspender cables of wrought iron chain. The use of chain limited the cable strength to that of the weakest link, and this was exacerbated by the use of wrought iron which was prone to material defects. The advancement of wire-cable technology in the 1820s, and wire rope technology by John Augustus Roebling using mild steel and multi-strand construction mitigated the impact of material flaws and permitted significantly higher forces in the suspender cables and construction of longer bridge spans, up to 1,200 feet by the 1870s, and then 1,596 feet with the construction of the Brooklyn Bridge in 1883. The next great milestone for suspension bridge technology came with the completion of the Golden Gate Bridge in 1937. The 4,200 foot main span across the Golden Gate was the longest of its time, and not surpassed until 1964.

The use of suspension bridge technology for the Point Bonita Light Station Bridge was a natural choice for the Coast Guard. The rugged site made access from below extremely difficult and the narrow, slide-prone trail hindered transport of materials to the site. Also, the Coast Guard was accustomed to using suspension type cables, in the form of the breeches buoy, to transport persons and materials ship to ship or ship to shore. In fact, a breeches buoy was used to access the light station between 1940 when the land bridge collapsed and 1954 when the suspension bridge was ultimately constructed<sup>8</sup>.

## Part II Structural/Design Information

### A. General Statement:

**1. Character:** Point Bonita is the only lighthouse in the United States approached by a suspension bridge<sup>9</sup>. The use of timber framed cable support towers and stiffening trusses is reminiscent of a mid-1800s suspension bridge design, but appropriate for the site and intended pedestrian use.

---

<sup>8</sup> Logan, "Bridge and Trail Construction."

<sup>9</sup> James P. Delgado, *National Register of Historic Places - Inventory Nomination Form - Point Bonita Lighthouse Complex*, 1991.

**2. Condition of Fabric:** Poor, the harsh environment has caused widespread corrosion of the metal components and decay of the wood components of the bridge. The bridge is scheduled to be replaced by a new structure of similar design and appearance in late 2011.

**B. Description:** The bridge consists of a 4-foot 6-inch wide wood framed deck with two timber framed trusses supported by galvanized steel wire cables spanning 156 feet to timber “A” framed towers supported with concrete foundations and concrete cable anchorages. The deck is laterally stiffened for wind loads with 2-inch by 3-inch diagonal steel angles and wind cables on each side of the deck.

The design was based on a maximum wind load, either horizontal or uplift, of 30 pounds per square foot of exposed structure, assuming a maximum wind speed of 90 knots. The safe maximum design live loads were 2 tons for equipment or a uniform load of 150 pounds per lineal foot. The concrete anchorage weights were designed to be twice the calculated vertical component of the main cable tension force under fully loaded conditions.

The as-designed component sizes are noted below. Minor changes to the main cable, wind bracing cable and the suspender cable materials or sizes were made during construction due to availability of those materials<sup>10</sup>.

- Main Cables: 1 3/8-inch diameter 7 x 19 galvanized steel bridge strand, 75 ton strength.
- Wind Bracing Cables: 3/4-inch diameter 7 x galvanized steel bridge strand, 24.4 ton strength.
- Suspender Cables: 1/2-inch diameter galvanized Siemens Martin, 7 strand. Breaking strength 12,100 pounds.
- Towers: Timber “A” frames, 20 feet tall supporting cables at 6 foot spacing with cast steel saddles ground to fit cables and graphited. The tower legs are 8 x 8 timbers with 3 x 8 diagonals and a 6 x 12 bearing block. Standard timber connections are accomplished with 5/8-inch diameter bolts.
- Anchorages:
  - Main cables: 36 tons of concrete on west anchorage and 30 tons for the east anchorage, supporting “adjustable closed bridge sockets shackled to eyebars secured to a 10-inch x 25-pound steel channel in the reinforced concrete”.
  - Wind cables: The west end wind cables were secured to the same anchorage as the main cables. The east end wind anchorage consisted of independent 5 ton concrete blocks buried into the rock.
- Timber Trusses: Five foot deep trusses consisting of thirteen - 12-foot bents with 6 x 8 wood stringers suspended from the main cable. Top chord and diagonals are 4 x 6 timbers, with 6 x 6 vertical posts and 3/4-inch vertical tension rods; the bottom chord is a 2 x 10 joist spiked to the posts and spliced with steel plates. The trusses are supported out-of-plane with 3 x 8 knee braces at each post.

---

<sup>10</sup> Logan, “Bridge and Trail Construction.”

- Deck: 2x10 joists at approximately 24-inch spacing with 2x4 decking boards spaced 1-inch apart. Lateral diagonal bracing below the deck consists of 2-inch by 3-inch x 3/8-inch angles.

**C. Site Information:** The light station is located on a narrow barren rocky peninsula that juts southward roughly one half mile into the Pacific Ocean immediately north of the Golden Gate. From a functional perspective the site is ideal for use as a navigational aid. At an elevation of 118 feet it is below the fog canopy that dominates the summertime weather along the California coast and the peninsular land orientation and lack of vegetation enables the light to project through a roughly 270 degree arc.

From an operational perspective the site is very problematic. The serpentine and pillow basalt rock formations that underlie the peninsula are very steep and prone to sliding. Creating and maintaining access to the light station facilities has required great effort, necessitating construction of four bridges and a tunnel to circumvent ongoing slides, sloughing, and rockfalls that regularly occur, typically during the winter rainy season.

The suspension bridge technology used to access the light house is uniquely appropriate for such an inhospitable site located in the shadow of the world's most famous suspension bridge.

### **Part III Sources of Information:**

#### **A. Primary Sources**

Ace Pacific Co., *Pt. Bonita Lighthouse Bridge - Report on Structural Condition with Recommendations for Maintenance*, Presidio Park Archives & Records Center: National Park Service, 1989.

Glen E. Logan, "Point Bonita Light Station Suspension Bridge and Access Trail Construction," *The Engineer's Digest* (September/October 1956).

U.S. Coast Guard - San Francisco District, *Point Bonita California Suspension Footbridge for Point Bonita Lighthouse*, Drawings Dated February 1940, Revised June 1941, Revised June 1954, 2 sheets.

U.S. Coast Guard - 12th District San Francisco CA, *Point Bonita Light Station, Suspension Bridge Repairs*, Drawings Dated August 2, 1978, Last Revision July 17, 1979 As Built, 4 sheets.

#### **B. Secondary Sources:**

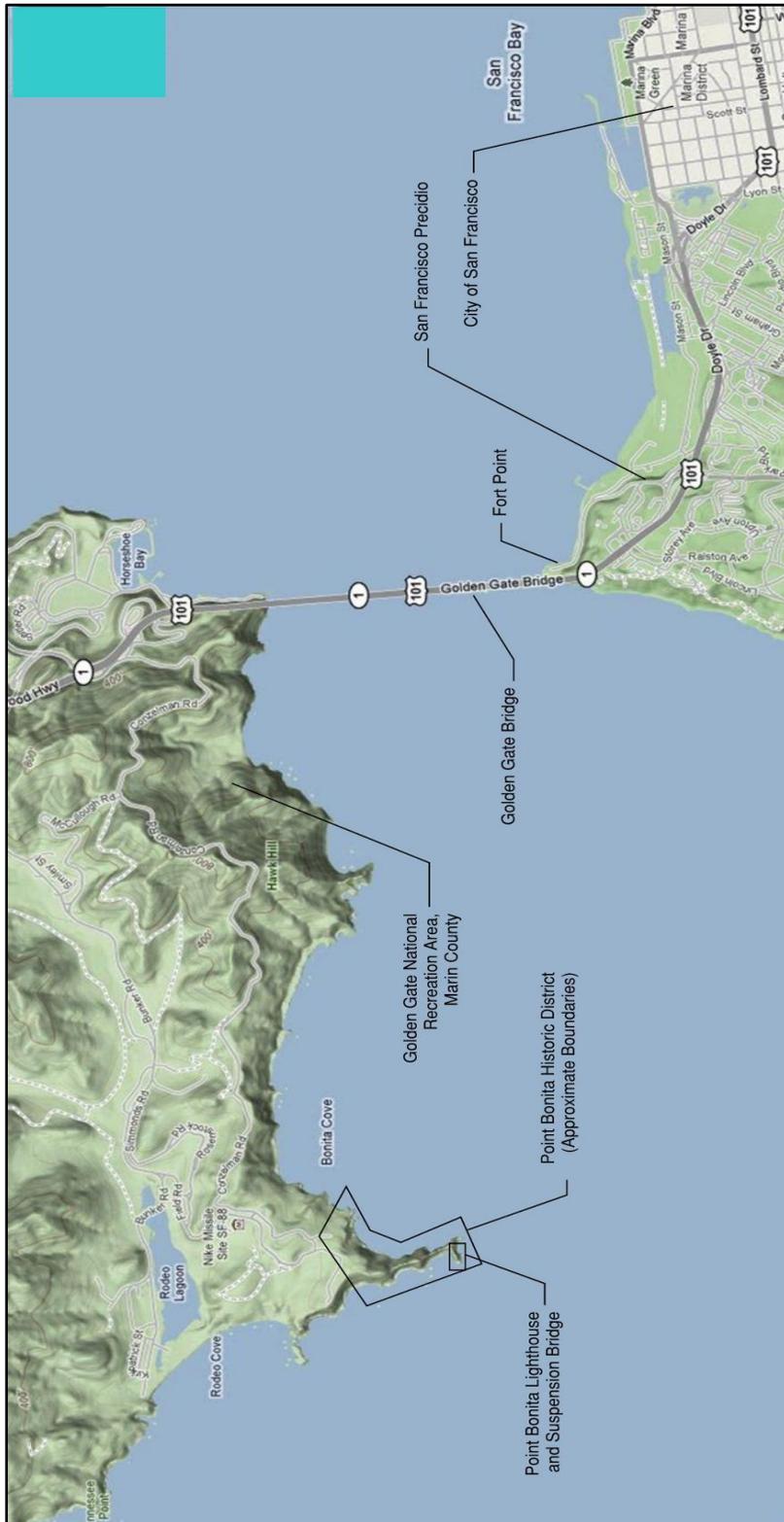
*Cultural Landscapes Inventory - Point Bonita Historic District - Golden Gate National Recreation Area*, National Park Service, 2005

James P. Delgado, *National Register of Historic Places - Inventory Nomination Form - Point Bonita Lighthouse Complex*, 1991.

# POINT BONITA LIGHTHOUSE SUSPENSION BRIDGE

HAER CA-2289

(Page 8)





**Aerial view of the light station and suspension bridge taken in approximately 2005.**



Overall view of suspension bridge and lighthouse looking northwest, June 2011.



**View of south side of suspension bridge looking southwest, June 2011.**



**View of north side of suspension bridge looking south, June 2011.**