Commodore Schuyler F. Heim Bridge

HAER No. CA-HEIM

Location: The Commodore Schuyler F. Heim Bridge (Heim Bridge) spans the Cerritos Channel, carrying State Route (SR) 47 (SR-47) (part of the Terminal Island Freeway) between the mainland and Terminal Island. The Cerritos Channel connects the Inner Harbor, Port of Los Angeles, Wilmington, Los Angeles County, California, to the Port of Long Beach, Los Angeles County, California. The bridge is within the boundaries of the Port of Long Beach.


Present Owner: California Department of Transportation (Caltrans).

Present Use: Freeway Bridge (Caltrans Bridge No. 53-2618).¹

Significance: The location of the Cerritos Channel between two major international ports dictated the use of a movable bridge design for the Heim Bridge that would allow for large ship traffic between the two ports. The U.S. Navy was the major proponent of the bridge during World War II because of its need for more efficient transportation between the naval base on Terminal Island and the mainland. The bridge was to support the increase in national defense activities on Terminal Island that had occurred during the war.² Heim Bridge was built immediately after the war.

The Heim Bridge is a rare example of a movable bridge (of any type) in southern California. The scale marks it as an important engineering achievement. In terms of the

¹ State of California, Business, Transportation and Housing Agency, Department of Transportation (Caltrans), 2008 Named Freeways, Highways, Structures and Other Appurtenances in California (Sacramento: Caltrans, 2009), 118.
² Diane Kane, Commodore F. Schuyler Heim Bridge, DPR 523 Forms: Building, Structure, and Object Record, Submitted to State Office of Historic Preservation, Sacramento, California, April 1997, 2.
vertical lift span (125’ high) and width of the roadway (six lanes for automobile traffic); it is one of the largest vertical span bridges in the western United States (i.e., California, Oregon, and Washington).3 The character-defining features of the bridge are a 240’-long vertical lift and a Warren through truss supported by two cross-braced steel towers with suspended cables and trunnion counterweights. The Heim Bridge was determined eligible for listing on the National Register of Historic Places under Criterion C (Design) in 1998.

Historians: Christina Chiang, Jeremy Hollins, and Melanie Lytle of URS Corporation.

Project Information: The Commodore Schuyler F. Heim Bridge Level II Historic American Engineering Record (HAER) recording project is part of the mitigation for the Schuyler Heim Bridge Replacement and SR-47 Expressway Project proposed by the Alameda Corridor Transportation Authority (ACTA), in cooperation with the Federal Highway Administration (FHWA) and Caltrans. The project was conducted in 2009 and 2010 by URS Corporation, on behalf of Caltrans. Other cooperating organizations included ACTA and the FHWA.

The project was completed under the direction of Jeremy Hollins, Architectural Historian. Christina Chiang and Melanie Lytle, Architectural Historians, completed the field work, research, and drafting of the historic report. Historic Architect Charles Arthur reviewed the measured drawings provided by Caltrans and identified those that would be useful for submission with the HAER package. Large-format photography was completed by Stephen Schäfer of Schäfer Photo.

Historic research conducted for the historic report included research at various archives and depositories, including the National Archives and Records Administration, Pacific Region at Laguna Niguel; the Wilmington Historical Society; City of Los Angeles Library; engineering publications, such as Southwest Builder and Contractor and

---

3 The dimensions are from “Lift Bridge Provides 175-Ft. Clearance,” Engineering News-Record, April 15, 1948: 96. In comparison, the Hawthorne Bridge in Portland, Oregon has a 110-foot vertical lift span and the Sacramento River Bridge (Tower Bridge) has four lanes for automobile traffic according to Richard L. Cleary, Bridges, (New York: W.W. Norton & Company, 2007), 304, 309-10.
Engineering News-Review; Sanborn Fire Insurance Maps; newspaper accounts (*Los Angeles Times*); and previous surveys and reports.
PART I. HISTORICAL INFORMATION

A. Physical History

1. Date of Construction: The bridge was constructed from March 1946 to January 1948. It was dedicated and opened to traffic on January 10, 1948.  

2. Engineers/Supervisors: The bridge was designed by the California State Division of Highways (now Caltrans) under the direction of F. W. Panhorst, State Bridge Engineer, and John W. Green, Southern Representative of the Bridge Department.  

Frederick W. Panhorst, B.S., graduated from the University of Illinois in 1915. He earned his C.E. degree in 1936. Mr. Panhorst worked for the Pennsylvania Railroad, Anaconda Copper Mining Company, the U. S. Navy, and the State of Washington as a bridge designer before he became a construction engineer of bridges for the California State Division of Highways in 1927. From 1931 to 1960, he served as acting Bridge Engineer of the Division of Highways, which included oversight of the Bixby Creek Bridge (1931-32), a concrete single-arch span highway bridge south of Carmel, California. In 1937, he was formally promoted to Chief of the Bridge Section of the California Division of Highways. He served in this position until 1960. Mr. Panhorst was also a National Director of the American Society of Civil Engineers (1946-48).  

John W. Green, B.S., graduated from Oregon State College in 1916 with a degree in civil engineering. He worked in a variety of engineering positions before he joined the U.S. Army during World War I. Following the war, he was employed as an assistant bridge engineer for the State of Washington and as an associate highway bridge engineer for the U.S. Bureau of Public Roads. In 1930, he was employed in the California State Division of Highways, where his responsibilities primarily included reporting on the San Francisco-Oakland Bay Bridge. In 1939, he was promoted to oversee all state highway construction.

---

4 Though the construction dates recorded in written sources vary, January 1948 appears to be the correct completion date. For instance, Caltrans, “District 7 Historic Bridge Inventory-State Bridges (Sacramento: Caltrans, 2009) lists the bridge as constructed in 1946, and the article “Beauty Award Given to Navy’s Harbor Bridge,” Los Angeles Times, July 24, 1949: 18, lists 1947. It is known, however, that the dedication ceremony was held on January 10, 1948 based on “Cerritos Bridge in Service Today,” Los Angeles Times, January 10, 1948: A1, a date which is supported by the plaques on the bridge that state the construction dates as “March 1946 to January 1948.”


9 Caltrans, 2008 Names Freeways, Highways, Structures and Other Appurtenances, 194; University of Illinois Archives, “Frederick W. Panhorst Papers Description.”
bridge work in Southern California. Besides working on studies and reports for the San Pedro-Terminal Island project, he also worked on the San Diego-Coronado Crossing.¹⁰

Other staff involved in the planning and management of the Heim Bridge project included Spencer VanZandt Cortelyou, State Highway District Engineer at Los Angeles, and A.D. Griffin, Assistant District Engineer. The two men coordinated with the railroads and oil companies for the right-of-way.¹¹

Capt. H. E. Wilson, Civil Engineer Corps (CEC), U.S. Navy Public Works Office, was in charge of construction until October 1947. Capt. Wilson was a U.S. Navy veteran of over 20 years and had previously spent two years in the South Pacific building the naval operating base at New Caledonia.¹² Capt. C. W. Coryell, CEC, U.S. Navy (USN), oversaw construction from October 1947 to completion.¹³

3. Builders/Contractors/Suppliers: The contract for construction of the bridge was awarded to the United Concrete Pipe Corporation in a co-venture with Ralph A. Bell. The project manager was Comdr. J. W. Frorath, CEC, USN. The supervisor was Capt. G. Lloyd, CEC, USN Retired, and the superintendent was Milton C. Shedd. Subcontractors included the American Bridge Company (machinery and equipment for lift system, construction of bridge), Columbia Steel Company (structural steel), Proctor & Kuhn (pile driving), and Consolidated Rock Products Company (pouring of footings).¹⁴ The large fog bell on the South Tower was cast by Pacific Brass Company (San Francisco), based on the makers mark on the bell.

4. Original Plans: The Heim Bridge was designed as a steel-frame, three-span, vertical-lift bridge with concrete approaches. The bridge is four-sheave and tower drive with counterweights inside the towers. The center lift span is supported by two rectangular steel towers. The ends of the towers feature large cross girders with center rectangular gusset plates; the towers are topped by a steel strip of recessed squares. The sides of the towers feature five cross girders with the same strip of recessed squares on top. Another layer of rectangular beams, which hides the cable shafts along the sides and sheaves at the top of the towers, is situated over the rectangular outlines of the towers. The highway is supported by a steel-plate girder Warren through truss, with center hangers that extend through the traffic separation barrier. The bridge is supported by

---

¹¹ “Construction Progress,” 20; “Navy to Build Vertical Lift Bridge and Approaches at Cost of $5,000,000,” Southwest Builder and Contractor, September 7, 1945, 52.
¹³ “Lift Bridge Provides,” 98.
¹⁴ “Construction Progress,” 18-22, 30; Letter from Paul Hendren, Rear Admiral, to Mr. Taubman, 1948, General Subject File (GSF) (General Correspondence 1940-1947), Commandant’s Office, 11th Naval District (ND), Naval Operating Base, Long Beach, 1948-1953, Records of the Naval Districts (ND) and Shore Establishments (SE), Record Group (RG) 181, Box 41, National Archives and Records Administration (NARA) - Pacific Region (Laguna Niguel [LN]).
reinforced concrete columns under the towers and at the ends of the Warren truss. The approach spans are supported by concrete piers and, further out from the bridge, concrete bents.\textsuperscript{15}

The highway, on the bridge and approaches, consists of two 35'-wide roadways with three lanes each, divided by a 5' strip, with two 3' sidewalks for maintenance crews. The plans called for the lift span, walks, platforms, and sidewalks to be paved with open steel grating consisting of 5" I-beam open-floor commercial units. Control houses and hydraulically operated passenger elevators are located in each tower.\textsuperscript{16}

The lift span was equipped with special equipment to regulate highway traffic and control water traffic in the channel. At the time of construction, the equipment included a public address system for directing traffic; an intercommunicating system; an electrically operated crossing gate (gate was to be painted with black and yellow traffic warning striping), and traffic barriers of the net type designed to stop a 10-ton truck at 20 miles per hour within a distance of 20'. The lighting system was installed as a steel pole system with alabaster glass globes equipped with luminaries of 6,000 and 4,000 lumen powers at 6.6 amperes.\textsuperscript{17}

Waterproofing used on the project consisted of three-ply membrane waterproofing over construction joints.\textsuperscript{18} The exterior of the bridge steel work was painted with aluminum paint. Preparatory coats consisted of one primary coat and a second coat of red lead-based paint.\textsuperscript{19}

5. Alterations and Additions: Despite repairs performed due to foundation subsidence, modernization for safety, and some refurbishment, the Heim Bridge retains its historic integrity, and its essential engineering features are intact and functioning. Below is a summary of the key alterations and additions that have taken place since the bridge was completed in 1948.

1951-60 Repairs due to subsidence damage. For example, parts of the bridge were lifted due to the towers twisting at the base and leaning southward toward the center of the area of subsidence and toward each other. The frogs and expansion plates on the bridge and approach spans were cut to provide clearance for movement of earth for at least one year; guard rails were foreshortened and pier footings were raised. Work was completed by the Long Beach Harbor Department.\textsuperscript{20}

\textsuperscript{15} Caltrans, Bridge Inspection Records Information System, drawings and documentation file for Bridge 53-2618, provided electronically to URS by Caltrans.
\textsuperscript{16} Caltrans, Bridge Inspection Records Information System; “Navy to Build,” 48, 52.
\textsuperscript{17} Caltrans, Bridge Inspection Records Information System; “Navy to Build,” 52.
\textsuperscript{18} “Navy to Build,” 48, 50.
\textsuperscript{19} Ibid., 52.
\textsuperscript{20} Kane, 
Commodore Schuyler F. Heim Bridge, 2; “Shuffle of Bridges Considered for L.B.,” Los Angeles Times, January 10, 1960, SC1, 4; “Long Beach Sink Remedies Studied,” Los Angeles Times,
1975-78  Reconstruction of expansion joints and Bent 45 backwall. Work was completed by Caltrans; Engineer James Roberts signed the drawings. 21

1972  Reconstruction of the North and South elevators; installation of a new safety rail to 42’ along top of piers, catwalk, and north and south machinery floor; installation of machinery guards around the machinery in the machinery floors in the North and South Towers; extension of fenders; repair of spalled concrete, and miscellaneous electrical repairs. 22

1980  Repair of trusses. 23

1981-82  Replacement of traffic gates; installation of automatic alarm system that sounds a siren, illuminates a warning sign and turns blinkers from yellow to red when it senses that an approaching truck exceeds the 15’ height limitation; and installation of crash cushion. Work was completed by Caltrans; Engineer Bill Jones signed the drawings. 24

1985  Installation of catwalks under bridge; repairs to counter weights; installation of pipe railing at ladder; installation of vehicle crash cushion. 25

1987  Replacement of original cable safety netting with vertical bar; pop-up barricade system embedded in deck; access catwalks constructed underneath the truss spans in the northbound and southbound sides. Work was completed by Caltrans; various engineers signed the drawings. 26

1988-91  Driving of new wooden piles into the bottom of Cerritos Channel; installation of new steel grating on the deck; installation of computerized operation system to allow the span to be lifted and lowered by the push of a button; repairs to elevators, replacement and/or repair of fenders. Work was completed by Caltrans; various

October 16, 1952, 4.

21 Caltrans, Bridge Inspection Records Information System, pdf #907.
23 Email from Elaine Silvestro, ACTA, to Melanie Lytle, URS, Nov. 19, 2010.
24 Email from Elaine Silvestro, ACTA, to Melanie Lytle, URS, Nov. 19, 2010; Caltrans, Bridge Inspection Records Information System, pdf #777; the automatic alarm system description is from Chris Woodard, “Caltrans Begins $2-Million Project to Shore Up Aging Drawbridge in Harbor,” Los Angeles Times, October 27, 1988, 1, which states that the alarm system was installed before 1988; Caltrans, Bridge Inspection Records Information System, pdf #786 documents that the over-height detector was budgeted in supplemental funds in 1981.
26 Caltrans, Bridge Inspection Records Information System, pdf #502, 727.
engineers signed the drawings.  

1991 Expansion of the operator control house on the South Tower to nearly double its original size. Work was completed by Caltrans; various engineers signed the drawings. Based on field observation, when the control house addition was constructed, it interfered with the original ladder that rose from the control house level to the machinery floor at the top of the tower in the northeast corner of the South Tower. The ladder was cut off at the roof of the addition and a new door inserted in the shaft to provide access from the Switch Room level.

1997 Installation of lightweight bridge deck. The 65 weldless deck panels are 35’ x 8’ and were bolted to the bridge. Work was completed by Caltrans; Engineer Michael Lee signed the drawings.

1999 Replacement and/or repair of fenders.

2002 Replacement of lift span deck grating with new open steel grating; replacement and/or repair of fenders. Work was completed by Caltrans; Engineer T. Bolla signed the drawings. Additional alterations were observed during the field work for which the exact dates of completion are not known. These alterations are summarized below.

- Addition of square, rubber traction pads to the rooftop of the control house addition to add traction (post-1991 - date of control house addition).
- Replacement of original lighting on the deck with cobra-head lighting fixtures.
- Addition of cylindrical concrete capitals to some of the bents, several of which have drain pipes through the circular masonry (the original drawings do not include the capitals).
- Construction of wood fenders atop pilings below the bridge to guide boats in the channel between the two tower piers (the fenders do not match those in the original drawings).

---

27 Email from Elaine Silvestro, ACTA, to Melanie Lytle, URS, November 19, 2010; Woodard, “Caltrans Begins,” 1.
28 Ibid.
30 Email from Elaine Silvestro, ACTA, to Melanie Lytle, URS, November 19, 2010.
• Bolting and riveting of connections and gussets on the underside of the deck, particularly between bents 22 and 23 and between bents 24 and 25.

• Seismic improvements, such as seat extenders and steel keepers, between bents 22 and 23 and numerous other areas.

B. Historical Context

The Heim Bridge is located in San Pedro Bay, in the Port of Long Beach and near the boundary of the Port of Los Angeles. The Port of Long Beach and the Port of Los Angeles were formed from San Pedro Bay at the turn of the twentieth century. A significant amount of dredging and land reclamation during the last century has resulted in the current configuration and use of San Pedro Bay as a deep-water harbor.

Early History of San Pedro Bay

Portuguese explorer Juan Rodriguez Cabrillo recorded sighting San Pedro Bay in 1542. He described it as an “excellent harbor” and named it Bahia de los Fumos (Bay of Smokes) after seeing the smoke from hunting fires lit by the native Tongva-Gabrieliño people who occupied the area prior to European arrival. Sixty years later, Sebastian Vizcaino dropped anchor off the site and reported the bay as a cove “with shelter from the northwest, west and southwest winds with a small island in it.” The small island, about a half-mile east of a promontory on the western shore, was later named Deadman’s Island. To the north, a set of sand dunes called Rattlesnake Island were present; these sand dunes protected the small channels and sloughs of the inland harbor from ocean waves. Between the islands lay an 18’ bar of sand and rock. Vizcaino renamed the bay the San Andres. In 1734, Spaniard Cabrera Bueno renamed the bay San Pedro, the name that has persisted.32

The first permanent European settlement of the region occurred in 1769, when Spanish soldiers and priests arrived to colonize California. Mission San Gabriel, about 40 miles inland from the bay, was established in 1771. The Spanish set up a system of large land grants, and the Nieto and Dominguez families controlled the waterfront lands at San Pedro.33

Trade during the Spanish period was forbidden except with Spanish ships. Driven by the need for more regular supplies and trade, residents developed a thriving cargo-smuggling industry, which was supported by the small town established at San Pedro. After Mexico declared independence from Spain in 1822, the new Mexican government lifted the trade restrictions and San Pedro became a robust commercial center. Lands along the bay remained in the possession of the Spanish land grantees.34

33 Ibid., 2.
California came under the control of the United States in 1848, during the Mexican-American War. Two years later, California became a state in the Union. A young American, Phineas Banning, who arrived in the region in 1851, saw the potential for improving the harbor and its facilities to accommodate the increasing cargo shipments arriving in the rapidly developing region. Banning eventually became known as the “Father of the Los Angeles Harbor” for his many ventures, which included the establishment of a freight and passenger transportation business that served five states, the founding of the small town of Wilmington, and the introduction of the first railroad bill to the California Legislature. Banning solicited Congress successfully for the first improvements to the harbor. This included the dredging of the main channel in 1871 to a depth of 10’ and the construction of a breakwater between Rattlesnake Island (now Terminal Island) and Deadman’s Island (no longer present). The railroad industry became the dominant transportation agent for the thousands of tons of cargo that moved through the port.  

During the 1880s, the population of the city of Los Angeles increased from less than 15,000 to over 50,000, placing increasing strain on the small San Pedro harbor to handle the cargoes of lumber for construction and coal for the railroads and building. Beginning in the early 1880s, the Southern Pacific Railroad Company (Southern Pacific) attempted to monopolize trade in the region by promoting a deep water harbor in Santa Monica. The Southern Pacific tried to capture the entire Senate Commerce Committee appropriation of $250,000 planned for improvements to San Pedro harbor. However, in 1896, Congress granted the appropriation to San Pedro as originally panned, thereby laying the foundation for the modern ports of Los Angeles and Long Beach.  

### Establishment of the Ports of Los Angeles and Long Beach

By the turn of the century, the population of Los Angeles had doubled to more than 100,000, resulting in increasing demands for building supplies and other cargo to support the growing metropolis. With that in mind, the city annexed a 16-mile strip of land on the outskirts of the communities of San Pedro and Wilmington in 1906 for a port (both towns became part of the city of Los Angeles three years later). A permanent Los Angeles Board of Harbor Commissioners was created in 1907 to oversee the port. By 1911, the first 8,500’ section of the harbor breakwater was completed and the main channel was widened to 80’ and dredged to 30’.  

Meanwhile, in 1909, the Los Angeles Dock and Terminal Company purchased 800 acres of sloughs and salt marshes at the mouth of the Los Angeles River adjacent to the south of the Port of Los Angeles, to develop a port off of the city of Long Beach. The

---

35 Board of Harbor Commissioners and the City of Los Angeles, “Virtual History Tour.”
State of California officially granted the tideland areas to the City of Long Beach for port operations in 1910. The City of Long Beach continued the dredging project commenced by the Los Angeles Dock and Terminal Company after the company declared bankruptcy in 1916.  

The opening of the Panama Canal in 1914 sparked a boom in shipping to the Los Angeles and Long Beach ports. The need for deeper channels as well as extended breakwaters led to considerable dredging and land reclamation efforts in the ports during the twentieth century. Just fifteen years after its first development, Long Beach attained “deep water” port status, handling more than 1 million tons of cargo and 821 vessel calls in 1926.  

In 1936, oil was discovered in Long Beach’s harbor (the oil field is known as Wilmington Field), which led to the construction of the first oil well there in 1938. By 1943, the oil drilling program was producing 17,000 barrels a day and generating $10 million a year in oil revenues. Unfortunately, as early as 1939, the oil extraction appeared to be causing subsidence.  Although dikes were built in 1945 for flood control at high tide, by 1957, a 16-square-mile area of the north harbor sank between 2’ and 24’. The solution, Operation “Big Squirt,” a water injection program that was undertaken in 1960, seemed to halt the subsidence.  

**Terminal Island and the U.S. Navy**

Terminal Island, a strip of land partially within the Port of Los Angeles and partially within the Port of Long Beach, was subjected to considerable land reclamation efforts through the twentieth century, eventually resulting in a large land mass that was important to port operations as well as to the U.S. Navy. Rattlesnake Island, as it was formerly known, became known as Terminal Island after the Los Angeles Terminal Railroad Company laid track in 1911 that ran to the east side of the island. The relatively primitive railroad jetty crossing from the mainland to the island was the first of the Terminal Island bridges. For decades, private ferry service remained the primary transportation mode for getting workers, residents, and supplies to the island.  

In 1918, the City of Long Beach transformed the Cerritos Slough, the body of water between the mainland and Terminal Island, into a 200'-wide channel to connect the inner harbor of Los Angeles and the Port of Long Beach, renaming the body of water the Cerritos Channel.  As commerce to the ports increased and more companies moved their operations to the railroad terminus on Terminal Island, it became obvious that a more reliable crossing to Terminal Island than the ferry service and railroad jetty crossing was needed. As a result, the Badger Avenue (Henry Ford) Bridge was constructed in  

---

40 Ibid.
41 Bob Gettemy, “Sea Snarls at Man as Land Subsides,” *Los Angeles Times*, December 6, 1953: H1, S.
42 Port of Long Beach, “History.”
43 Ibid. Note, the Los Angeles Terminal Railway's final stop was the East San Pedro Station at the edge of the Island. The Terminal line was absorbed by the San Pedro, Los Angeles & Salt Lake Railroad Company.
1924. Designed by Joseph Strauss, the bridge was a double-leaf bascule type, which operated like a drawbridge that lifted from the center. It provided sufficient through-clearance for ship passage in the channel between the two ports. The structure carried two sets of tracks, one for railroad freight and the other for street railway passengers.45

Terminal Island became important to the U.S. Navy (Navy) in the 1920s, though the Navy did not have a substantial presence on the island until the beginning of World War II. In 1927, Allen Field, a commercial airport, was built on an expanded portion of Terminal Island and the Navy began to use it almost immediately. A Naval Reserve training center was established at the field as well. The Navy eventually took over the field and renamed it Naval Air Base San Pedro (Reeves Field). Because of the field’s large seaplane ramp, the island became the primary operating base for seaplanes assigned to ships of the Pacific Fleet.46

As World War II began in Europe and Asia, the Navy began planning to accelerate national defense activities at the base. In 1941, the Long Beach Naval Station (Roosevelt Base) was established adjacent to the airfield. The next year, the Naval Reserve Training Facility was relocated to Naval Air Station Los Alamitos, so Naval Air Base San Pedro was renamed Naval Air Station Terminal Island. Naval Air Station Terminal Island equipped and performed flight tests on military aircraft produced at nearby plants and arranged for delivery of the aircraft. Reeves Field also continued to serve as a training field for those who had recently completed Naval Air Navigation School. During the war, over 80 percent of the petroleum shipped to the Pacific went through Terminal Island.47

In 1942, Commodore Schuyler Franklin Heim was assigned to oversee the entire Naval Operating Base on Terminal Island. He managed the massive expansion of the facility from a $19 million project to a $100 million project. The expansion included facilities for ship maintenance and repair, a naval hospital, a naval air station, a reserve aviation base, a small craft training center, a naval supply depot, a fuel annex, and a net depot.48

Expansion during World War II and Planning for a Bridge
During World War II, Terminal Island was a hub of activity that resulted in traffic bottlenecks to and from Terminal Island. In addition to the Navy facilities, oil wells, warehouses, shipyards, and the Ford Motor Company assembly plant were present on the island.49 The increase in industrial factories, shipbuilding, and naval base expansion on

45 Queenan, The Port of Los Angeles, 71. For engineering details on the elevation of the Badger Avenue Bridge to repair the damage done by subsidence, see Los Angeles Board of Harbor Commissioners, Annual Report, 1949, Los Angeles: Board of Harbor Commissioners, 1949, 35.
46 California State Military Museum “Naval Air Station Terminal Island,” http://www.militarymuseum.org/NASTerminalIsland.html (accessed January 13, 2010). Reeves Field as a Naval Air Station was disestablished in 1947, though Naval Station Long Beach continued to use the air field until the 1990s. The Terminal Island land was then provided to the Port of Los Angeles for port expansion to the south.
48 Ibid.
Terminal Island for the war effort led to heavy traffic from the neighborhoods of San Pedro and Long Beach to Terminal Island. Modifications to the Badger Avenue Bridge in the late 1930s had resulted in replacement of one of the sets of track with roadway to allow automobile traffic, but the bridge was proving to be inadequate as ship size and bridge traffic increased. 50

By 1941, the Navy had concluded that the Badger Avenue bascule bridge and small ferry system could not handle the estimated 25,000-30,000 workmen needed to develop Terminal Island. 51 A new link across the Cerritos Channel was declared to be an urgent priority. The concept of the permanent bridge over the Cerritos Channel was "conceived in the darkest days of the war, when quick access to the facilities at the Naval Base was of paramount importance." 52 Various other solutions, like a tunnel and ferry system, were proposed to alleviate traffic; however, any kind of ferry system was considered inadequate, and a tunnel was rejected because of time and cost. 53 In 1942, the industrial companies on Terminal Island, such as the Bethlehem steel plant, California Shipbuilding Corporation, and Columbia Construction Company, had to put their employees on staggered shifts and encourage them to carry the full amount of passengers in automobiles because of the limited access. To further reduce traffic, the Navy also removed all residents and "unessential" companies from Terminal Island. 54 However, the traffic problem persisted because most employees still drove to Terminal Island. In 1945, Captain H. E. Wilson, the officer in charge of construction for the base on Terminal Island, estimated that 95 percent of the civilian work force commuted in cars and buses into Terminal Island. 55

By 1941, the Navy had chosen the vertical lift bridge and highway access across the Cerritos Channel as the solution to accommodate ship traffic in the channel and automobile traffic between the mainland and island. The plans for the permanent bridge were prepared by the State of California, Department of Public Works, Division of Highways under the supervision of State Bridge Engineer F. W. Panhorst. 56 Additionally, around 1935, a study was completed in which the engineers of the State Division of Highways, under District Engineer S. V. Cortelyou, had drawn design plans for a freeway accessible from Seaside Avenue on Terminal Island. 57 On February 28, 1941, the State

53 "Study of Terminal Island Bridge Project Disclosed."
54 Letter from Richard B. Coffman to the Commandant, April 23, 1942, N2 Highways 1942, GSF, Commandant's Office, 11th ND, Records of ND and SE, RG 181, Box 149, NARA-Pacific Region (LN).
55 Letter from H. E. Wilson to Chief of the Bureau of Yards and Docks, October 12, 1945 (stamped), N14-4 Pontoon Bridges 1945, GSF, Commandant's Office; 11th ND, Records of the ND and SE, RG 181, Box 154, NARA-Pacific Region (LN).
56 "Navy to Build," 19; Memo from Chief of the Bureau of Yards and Docks to Secretary of the Navy (Chief to Secretary), Nov. 20, 1944, N14 Bridges 1945, GSF; Commandant's Office, 11th ND, Records of ND and SE, RG 181, Box 153, NARA-Pacific Region (LN).
57 "Navy to Build" 19; Letter from Chief to Secretary, Nov. 20, 1944, GSF, Commandant's Office, 11th ND, Records of ND and SE, RG 181, Box 153, NARA-Pacific Region (LN).
Division of Highways applied to the Secretary of War for a permit to construct a bridge across the Cerritos Channel on a Navy Access Road and indicated that plans were being prepared using Federal Aid Secondary Funds. On April 5, 1941, the Secretary of War approved the plans for a vertical lift bridge.

**Steel Truss and Vertical Lift Bridge Technology**

Heim Bridge was designed as a three-span, Warren-type through-steel truss, four-sheave, tower-drive, vertical lift bridge. The bridge was engineered to have a clearance of 50’ above high water when the lift was at roadway grade and a maximum clearance above water of 175’ when the span was raised to its maximum lift. With the channel itself at a depth of 35’, most modern cargo vessels could be accommodated. Additionally, center hangers were incorporated into the plans to provide additional clearance for ships. The longitudinal trusses were to be 86’ apart, which would usually require large floor beams to support the lift span that carries the deck; however, large floor beams would have meant less clearance for ships passing underneath the bridge, so hangers consisting of 14’ wide flange beams that extended through the center traffic separation barrier were used to connect the overhead trussed bracing with the center of the floor beams. The lift was designed to go from a closed to open position in an average of two minutes and fifteen seconds.

A truss is composed of structural triangles joined together with pinned or riveted connections. Structural members resist forces through compression and tension. The arrangement of the main pieces determines the specific truss type. Americans experimented with different forms of trusses, but standardization by government engineering departments in the twentieth century led to the dominance of the Pratt, Parker, and Warren-type trusses.

State Highway engineers became the primary managers of the highway bridge systems by the 1920s, a responsibility previously handled by local and regional governments and private corporations such as railroads.

The Warren Truss, like that used for the Heim Bridge, was patented in England in 1848.
Commodore Schuyler F. Heim Bridge
HAER No. CA-HEIM
(Page 15)

by James Warren and Theobald Willoughby Monsani. It consists of diagonal members, alternately placed in tension and compression, forming a “W” pattern. With the Warren Truss, diagonals carry both compressive and tensile forces. Verticals serve as bracing for triangular web system. Common variants on the basic design include the addition of vertical members and intersecting diagonal braces, such as that found in Heim Bridge. In the 1920s and the 1930s, the Warren truss surpassed Pratt-type designs as the truss of choice for steel highway and railroad bridges.

By the 1940s, steel, like that used for Heim Bridge, was the primary building material for large-span, mechanized, and heavy load-carrying-capacity bridges. The use of steel for bridges had begun in earnest after the Civil War, soon after the Bessemer Process was introduced in 1858, which made mass production of steel far more affordable and efficient. Additionally, the railroad companies, some of the largest entities involved in bridge building in the nineteenth century, required that bridges be built rapidly, be inexpensive to construct, and could carry the increasing load of railroad locomotives. In comparison to the time-consuming and expensive traditional masonry arch bridges, steel truss bridges were a far less costly investment for railroads and thus were commonly constructed.

Though steel truss bridges were common in the United States in the late nineteenth and twentieth centuries, the vertical lift-type bridge, like the Heim Bridge, was rare. This type was developed in the late nineteenth century as an improvement on the swing span (moves horizontally) or bascule (tilts up) movable bridge types, because it was less obstructive and operated at a faster pace. As described in A Context for Historic Bridge Types, “Vertical lifts usually are found in flat terrain where the cost of long approaches to gain high-level crossings is prohibitive. Advantages included speed of operation, adjustable openings depending on the size of the vessel, and the ability to build in congested areas adjacent to other bridges.” The first design for a vertical lift bridge was patented by Squire Whipple in 1872. It was intended to have a short span and lift a modest distance. It was not until 1893 that the first large-scale vertical lift span in the United States was designed and patented by J. A. L. Waddell (1854-1938).

Vertical lift bridges constructed in the first half of the twentieth century are usually composed of two towers located on either side of a waterway with a truss span between them. As A Context for Historic Bridge Types describes them, “The truss span is lifted by cables that are attached at the ends of the span and run over pulleys at the tops of the towers down to counterweights on vertical runways within the towers. The truss remains

---

65 Clearly, Bridges, 243.
66 Ibid., 13-14.
in a horizontal position throughout the operating cycle, and can be raised far enough to provide clearance for the largest ships or boats. Many of the surviving vertical lift structures are railroad bridges.

The Heim Bridge is a four-sheave, tower-drive, vertical-lift bridge. There are a few variations in vertical-lift bridge design. The lift bridge can be either a four-sheave or an eight-sheave design. Four-sheave towers have a sheave at each corner and cables that bend 180 degrees between the lift span and counterweight. The sheaves are supported by four columns or two towers. Eight-sheave towers have a sheave at the four columns of each tower, for a total of eight sheaves, and cables that bend 90 degrees. The cables bend over two sheaves between the span and counterweight. A vertical lift bridge can be a span-drive, tower-drive, or span-tower design. With a span-drive vertical-lift bridge, the drive machinery is located on the lift span, whereas with a tower-drive bridge, the drive machinery is located on the tops of the towers. The drive machinery on a span-tower bridge is located on a platform between the towers, above the lift span.

**Construction of the Commodore Schuyler F. Heim Bridge**

Material shortages during World War II deferred the start of construction of the Heim Bridge. The project required large amounts of steel and construction equipment for the construction of ships and other production deemed higher priority for the war effort.

The initial project approval called for construction to begin on April 5, 1942 and end on April 5, 1944. However, the schedule was revised so that construction would begin on April 5, 1943 and end on April 5, 1945. The Division of Highways requested a further extension on the project in 1943, asking that the construction period stretch from April 5, 1945 to April 5, 1947.

In the meantime, the Navy reached a temporary solution for the traffic congestion by constructing a timber swing bridge with a steel plate girder span and timber fender, parallel to the Badger Avenue Bridge, in 1941. However, traffic was still a problem and was projected to increase because, in 1943, the U.S. Naval Drydocks on Terminal Island was authorized to be expanded. Meanwhile, the idea of the tunnel was still being

---

68 Ibid.
69 Ibid.
72 Letter from Chief of the Bureau of Yards and Docks to Commandant, April 2, 1942, N14 Bridges 1942, GSF, Commandant's Office, 11th ND, Records of the ND and SE, RG 181, Box 153, NARA-Pacific Region (LN).
73 Letter from Thomas Robins, Acting Chief of Engineers, to War Department, March 5, 1942, #75, Los Angeles District, Navigable Waterway Files (Permits), 1904-77, RG 77, Box 2, Records of the Office of the Chief of Engineers, NARA-Pacific Region (LN).
74 “Navy to Build,” 20; Caltrans, Bridge Inspection Records Information System, pdf # 1276.
discussed as a solution.\textsuperscript{76} By 1944, the traffic burden had so increased that a third bridge, a pontoon type, was built across the Long Beach harbor entrance channel between the east end of Terminal Island and Long Beach.\textsuperscript{77} Because the bridges restricted navigation in the Los Angeles and Long Beach ports, the Navy built them on the condition that they were to be removed as soon as a permanent solution became available.\textsuperscript{78}

During WWII, the Navy completed many projects in the Los Angeles-Long Beach Harbor area. In January 1945, the Navy committed a total of $44 million to public works in the area ($17 million of work had already begun), which included funds for the bridge. Captain H. E. Wilson supervised the Navy work in the harbor area, which encompassed a Naval Supply Depot, Navy housing project, Navy machine shops, sewage disposal at the base, a breakwater extension, a pier at the naval dry docks, pier extensions, a concrete storage warehouse, portal cranes, an extension to the U.S. Naval Hospital, Waves barracks and Navy dependents wards at the hospital, and expansion of laundry facilities at the disciplinary barracks.\textsuperscript{79}

Fourteen million dollars ($10 million from the Navy and $4 million of federal funds for defense) was granted for the construction of the permanent bridge and a freeway to Terminal Island.\textsuperscript{80} Captain Wilson decided that, instead of the State Highway Department, the Navy should supervise construction of the bridge to ensure that Navy scheduling needs would be met.\textsuperscript{81} Interestingly, in November 1945, the Navy withdrew its support for the Terminal Island Access Freeway and Bridge project, saying that it was not urgent anymore; however, the project was reinstated by the beginning of the following year.\textsuperscript{82}

In 1946, the Navy began construction of the bridge and its approaches.\textsuperscript{83} The approaches were part of the approximately 3-mile-long Terminal Island Freeway, which was built entirely with federal funds.\textsuperscript{84} The Public Roads Administration, Federal Works Agency, tasked the California Division of Highways with acquisition of the right-of-way and the construction of the northernmost section of the highway and reimbursed them from the

\textsuperscript{76} Letter from B. Morrell, Chief of Bureau of Yards and Docks, to Thomas H. MacDonald, Commissioner, Public Roads Administration, June 25, 1943, N2 Highways 1943, Commandant’s Office, 11\textsuperscript{th} ND, Records of the ND and SE, RG 181, Box 150, NARA-Pacific Region (LN).

\textsuperscript{77} Letter from Chief to Secretary, November 20, 1944, GSF, Commandant’s Office, 11\textsuperscript{th} ND, Records of ND and SE, RG 181, Box 153, NARA-Pacific Region (LN).

\textsuperscript{78} Ibid.

\textsuperscript{79} “Navy Reveals.”

\textsuperscript{80} “Navy to Build,” 20.

\textsuperscript{81} Letter from H. E. Wilson to B. M. French, Bureau of Yards and Docks, January 2, 1945, N14 Bridges 1945, GSF, Commandant’s Office, 11\textsuperscript{th} ND, Records of the ND and SE, Box 153, RG 181, NARA-Pacific Region (LN).

\textsuperscript{82} Letter from L. B. Combs, Acting Chief of Bureau, to Thomas M. MacDonald, Commissioner, Public Roads Administration, November 27, 1945 (stamped), N14 Bridges 1945, GSF, Commandant’s Office, 11\textsuperscript{th} ND, Records of the Naval Districts and Shore Establishments, RG 181, Box 153, NARA-Pacific Region (LN).

\textsuperscript{83} “Lift Bridge Provides,” 98.

\textsuperscript{84} California Highways and Public Works, March/April 1952: 13.
$4 million of access funds. With the Navy funds, the Bureau of Yards and Docks, Navy Department, handled the construction of the bridge, approaches, and section of the highway near the southern terminus near Seaside Avenue. The bridge itself cost about $5 million to build. Built parallel and to the east of the Badger Avenue Bridge, the bridge provided a direct route for the Terminal Island Freeway across the Cerritos Channel to Terminal Island. The Badger Avenue Bridge stayed in place but was reserved for rail traffic once the Heim Bridge opened. The temporary swing bridge that had been constructed during the war was removed.

During construction, subsidence, believed to have been caused by nearby oil drilling in on Port of Long Beach lands, resulted in horizontal displacement of the bridge. During job staking in 1946, the distances between reference stakes did not agree with previously recorded distances taken in 1944. The width of the channel had decreased some 3 inches in about seventeen months. Engineers and designers allowed for future movement by devising a plan to shorten the main span up to 12" and each side span up to 9". The shortening was accomplished by adjusting the brake shoes and lift span supports as required. Bridge expansion joints were also designed for more than normal movement. Besides allowing for horizontal bridge movement, the design provided for plumbing the towers, in case of differential settlement, by jacking the legs and installing steel shims under bearing plates.

In February 1947, while the bridge was still under construction, the City of Long Beach adopted a resolution requesting that the bridge be named in honor of Commodore Heim. Heim had had a distinguished Navy career of 43 years, of which the previous several years had been devoted to serving as the commander of the Naval Operating Base on Terminal Island (1942-46).

The bridge was dedicated on January 10, 1948 at 10 A.M. and Commodore Heim delivered the dedication speech. Representatives from the local, state, and federal agencies involved were invited to the dedication, which also provided a means to generate positive press for the Navy. The Assistant Chief of the Bureau of Yards and Docks, J. F. Jelley, traveled from Washington D.C. to attend the ceremony. After the
bridge was completed, the City of Long Beach operated and maintained the bridge until 1974. Currently, the bridge is maintained by Caltrans.

The Heim Bridge quickly became a landmark in the area after its completion. It was recognized in engineering publications primarily for its scale and was advertised as the “largest vertical lift bridge in the West.” The bridge was also noted for its design. In 1949, the American Institute of Steel Construction awarded an honorable mention to the Heim Bridge in a competition for the most beautiful bridges built in the United States in 1947.
PART II. STRUCTURAL/DESIGN INFORMATION

A. General Description

The Heim Bridge is a reinforced concrete and steel truss, four-sheave and tower-drive vertical-lift bridge. It is comprised of three truss spans and approach spans. The total length of the bridge, including approaches, is approximately 4,000’.

Approach Spans

The approach spans, which include on- and off-ramps, are comprised of twenty-six spans on the south and sixteen spans on the north. The bents of the understructure each have various numbers of poured-in-place, reinforced concrete columns, depending on their placement under the approaches. The columns rest on continuous footings, most of which are below grade. The square columns measure 3.6’ x 3.6’ and vary slightly in design. For instance, some columns feature a pedestal or a capital and others do not. The corners of the columns are slightly beveled, though at various depths. In addition, the concrete columns consist of various concrete pebble aggregates. Wood grain impressions are visible in some columns, illustrating that the columns were poured in place. Some of the columns feature large circular capitals, not shown in the original drawings or early photographs, that appear to have been added at a later time. Several columns on the north side contain drain pipes that extend from the bridge deck through the circular masonry capital, further supporting the conclusion that the capitals are later additions.

A traffic control sign, attached to one of the columns, is present beneath the north approach, and four gumball pendant-style lights are mounted from the girders above. The placement of the sign and lights may indicate the former presence of a maintenance road (a roadway marked as “Navy Road” is shown on the original drawings in this general area) or a staging area. An arm-mounted, closed-circuit television camera and infrared illuminator are present at bent 26.

The approach spans are constructed of steel plate girders on reinforced concrete columns.98 The bents support steel plate girders and the concrete roadway. A small gap in the roadway is present between the southbound lanes and the northbound lanes.99

Truss Spans Understructure

The three truss spans are supported by four reinforced-concrete four-post bents, referred to in the engineering drawings as Truss Pier 26, Tower Pier 27, Tower Pier 28, and Truss Pier 28 (south to north). The piers rest on continuous footings and 35’ piling.100 The two truss piers, which support the south and north ends of the fixed truss spans, are arched below and taper up on the sides in a series of stepped parapets. The truss piers measure 20 ½’ x 109’ at the top; each leg is 15’ x 20 ½’ resting on a footing block 20 ½’ x 118’

100 Ibid.
and 6' thick. The east side of Truss Pier 26 and west side of Truss Pier 28 contain stairwells within an interior shaft which provide access from the ground level, at the sides of the canal, to the deck above. The stairwell in Truss Pier 26 provides the primary access to the bridge. Plaques commemorating the construction of the bridge are mounted on the deck-level platform of each of the truss piers.

Access catwalks situated underneath the truss spans, one to the south of Tower Pier 27 and one to the north of Tower Pier 28, are accessible from the deck level and provide access to the traffic barrier, consisting of bollards with counterweights, that is embedded in the roadway.

Fenders are present in the channel below the bridge to guide boats between the two tower piers. The fenders are atop wood pilings and are constructed of wood with catwalks. They do not appear in the location shown on the original engineering drawings and have been repaired and/or replaced on several occasions, including in 1989, 1999, and 2002.

**Truss Spans Superstructure**

The three truss spans are of steel truss design of the Warren through-truss subdivided type with split-panel points. The two fixed-truss spans on either side of the lift truss span are 207' in length. The lift truss span is 240' in length between bridge seats. Two rectangular, steel truss towers rise from Tower Piers 27 and 28 on either side of the lift span. The towers measure 103' in width and 34' in depth. The towers rise to a height of 186' above the piers, with a total height of 236' above high water. Including the closed-position height of 50' above high tide, a full clearance of 175' is possible at maximum lift of the lift span.

The roadway on the truss spans consists of two 35'-wide lanes (six lanes total) divided by a 5'-wide strip, and edged by two 3'-wide sidewalks for maintenance crews. The sidewalks have steel railings on the canal sides that measure 2'4" in height. A steel pipe-type handrail has been welded to the top of the original railing, thereby raising the current railing height to approximately 4'. Also, at one point on the south fixed-truss span, large metal screens have been mounted on the exterior of the rails. Several cobra-head lights are fastened irregularly to diagonal posts of the truss.

The decks of the truss-span roadways and sidewalks (between the towers) are laid with open-steel grating. In the plans, the units were to be composed of a combination of specially rolled 5"-wide carrying beams, intersected at right angles by the main 3"-on-center transverse cross bars, which, in turn, support two supplementary longitudinal bars.

---

101 Ibid.
102 Email from Elaine Silvestro, ACTA, to Melanie Lytle, URS, Nov. 19, 2010.
103 "Construction Progress," 20.
105 Ibid., 48.
equally spaced between the main carrying beams. The roadway open-steel grading has been replaced at least twice, in 1997 and 2002.

The two cross-braced steel towers each contain cables, a massive concrete trunnion counterweight for the lift span, and the operational and machinery floors. The ends of the two towers feature large cross girders with center rectangular gusset plates. The towers are topped by a steel strip of recessed rectangles. The sides of the towers feature five cross-girders and a similar strip of recessed rectangles on top. Over the rectangular outline of the towers is another layer of rectangular beams that further hides the cable shafts present along the sides and the sheaves at the top of the towers.

**Raised Walkways**

Four raised walkways (two on each tower), located two levels above the deck, span the roadway. The walkways are laid with the same type of open-steel grating used on the maintenance sidewalks below.

The walkway on the north side of the Tower Pier 27 contains access to the elevator, access to the Switch Room and Storage Room, access to a vertical ladder that extends to the Machinery Floor, a large fog bell (embossed with “USN” “Pacific Brass Foundry”), an historic-period horn mounted on the eastern guardrail (facing east) beside the entrance to the elevator, and an unidentified piece of machinery at the middle of the span. The walkway leads to the roof of the South Control House addition on the east side, which contains antennas and air conditioning equipment. Rubber non-slip squares have been placed on the roof, and the entire area is surrounded by a rail. The roof of the Control House addition also has a door that leads to the ladder for the machinery floor far above. The south side of the South Control House exterior contains a drain pipe and scupper.

**Staircases and Elevators**

Interior and exterior stairways, used for access to the various levels (deck level, control house level, and switch room level), are located in both towers. In addition, two hydraulically operated passenger elevators, one in each tower, provide access from below deck to the machinery floors at the tops of the towers. The elevators are located in the east leg of Tower Pier 27 and in the west leg of Tower Pier 28, respectively. The original plans dictated that each elevator car was to have a carrying capacity of 1,200 pounds and move at 100’ per minute. The elevators contain an originally installed metal intercom. The elevator doors are metal clad.

**Operating Rooms**

Tower Pier 27 contains the main operating rooms, including the South Control House, switch room, room for transformers, and store room. Original plans also called for the tower to contain the compressor unit, transformer vault, and submarine junction boxes.

---

109 Ibid., 52.
though limited access meant that it was not possible to verify whether this equipment is still present.

Tower Pier 28 contains the North Control House.

_Control Houses (North and South)_
The bridge has two Control Houses, one each in Tower Piers 27 and 28. In Tower Pier 27, the Control House is situated in the northeast leg of the pier. In Tower Pier 28, the Control House is situated in the southwest leg of the pier. The Control Houses are slightly elevated above the roadway, so the operator may have a clear view of the highway and the channel at all times. Between 1988 and 1991, Caltrans nearly doubled the size of the South Control House by expanding it to the east, outside of the tower structure, and slightly to the north. The North Control House has been gutted and is no longer in use.

The exterior walls of the Control Houses, stairs, and storeroom are covered with sixteen-gauge galvanized metal sheets with 1 ½" corrugations. Walls and ceilings of the Control Houses were to be constructed of quarter-inch-thick, cement-asbestos board, light gray in color. The wall and ceiling cladding in the South Control House appears to have been replaced with vinyl cladding (the interior of the North Control House was not accessible to verify the construction materials used). The floors of the Control Houses were to be constructed of fourteen-gauge cellular steel; it appears that the South Control House has since been clad with vinyl flooring consisting of a pattern of slightly raised contiguous circles. Windows were to be metal-framed with wire screens and 1/4"-thick plate glass. It is assumed that the windows were replaced with metal-frame sashes when the South Control House was expanded. The South Control House now contains a kitchenette, thermostat used for climate control, and modern equipment.

Industrial intercoms are mounted throughout the bridge, including in the South Control House, the south elevator, the switch room, and on the machinery floor. Cellular steel roofing is used on both Control Houses and in all elevator passageways.

_Switchroom and Storage Room_
The switchroom and storage room are housed in Tower Pier 27, one level above the Control House. The narrow, low-profile structure straddles the deck between the two sides of the tower. The structure has a flat roof and is clad in corrugated metal panels, some of which have been patched with newer corrugated metal panels on the exterior. The narrow, horizontal windows near the ceiling contain metal sashes. The electrical equipment housed in the switchroom was upgraded at some point, probably during the 1988-91 work that resulted in computerization of the bridge operation.

_Machinery Floors_
Machinery floors are located at the top of each tower. The machinery floors are reached by elevator, which ascends to a level below the machinery floor near the top of each tower. A short walkway and stairway, composed of open-steel grating, provide access to

---

110 Ibid.
the machinery floor above. Original lighting and metal window sashes are present. Each machinery floor contains a series of plates down the center of the room that can be lifted to reach to the counterweight tucked in the tower hood below. Extra weights for insertion in the counterweight are stored throughout each machinery floor. The machinery contained in each machinery floor is discussed in greater detail in Subsection C, below.

1. **Character:** The scale of the Heim Bridge marks it as an important engineering achievement. In terms of its vertical lift span (125’ high) and width of the roadway (81’), it is one of the largest vertical span bridges in the western states (i.e., California, Oregon, and Washington).

2. **Condition of Fabric:** The bridge fabric appears to be in reasonably good condition. However, the concrete columns, retaining walls, and piers show evidence of staining, blistering, flaking, and spalling. The penetration of moisture into the concrete has led to significant spalling around the railing bases. Long cracks and excessive water damage were observed on the concrete approach beds. Evidence of significant repairs to the cracked and chipped concrete was not observed during inspections of the bridge. In addition to the damaged concrete, standing water was observed at the base of Truss Pier 26. Also noted was a significant amount of flaking and blistering of paint (believed to be lead-based) on the steel bridge elements; in some cases, the paint was missing altogether from the steel bridge elements.

**B. Construction**

**H-piles for Piers**
The equipment used for the excavation activities associated with installation of the four channel piers consisted of a 2 ½-yard clamshell bucket operated by a Northwest shovel mounted on a barge, supplemented by a Northwest 1-yard dragline on the shore. All pilings were driven by a subcontractor, Proctor & Kuhn, using three pile-driving rigs. In order to construct the central piers, a 60' x 120' area into which the piers were placed was excavated to final depth. Supporting steel H piles were driven underwater, with the cut-off being approximately 44’ below high-water level. Cofferdams of steel sheet piling were driven around the 60' x 120' area, a 10'-thick tremie plug was then poured, and the cofferdams drained. In an effort to save time, the contractor used a concrete pumping method on the first of the two pours, however, the concrete built up around the pipe, which required pipe set-up changes and leveling work. As a result, on the second cofferdam, the standard hopper and tremie pipe were used.

**Pouring of Concrete by Crane and Trucks**
The equipment used for pouring the columns consisted of a large Manitowoc crane, fitted with a 100’ boom and 10’ jib. Wood forms for the 38’ columns were hoisted by the crane and set down over the reinforcing steel. Footings were poured from Jaeger ready mix.

---

112 “Lift Bridge Provides,” 98.
trucks owned by Consolidated Rock Products Company, and, in accessible places, a Northwest 1-yard crane with Garbro bucket was used.\textsuperscript{113}

**Sections Shop-Assembled and Span Floated into Place**

Plans for construction of the sections required that the trusses and towers be completely assembled in shop. Structural steel for the riveted work was to be Type I and for the bridge steel was to be Grade A. A metal arc process was used for all welding. The truss spans were to be erected on blocking to give the trusses proper camber. The blocking was to be left until the tension chord splices were fully riveted and all other truss connections pinned and bolted. Each pair of the 36" beams constituting the tower columns were to be shop-assembled in sections and completely riveted between splices prior to milling. All bridge seats were to be monolithic with the supporting concrete and extended to a higher elevation than the finished surface. The surfaces were to be stressed by grinding and bush-hammering. The lift span was to be floated into place at an elevation slightly above the closed position. The cladding plates were to be riveted or finally clamped when the full dead load was on the towers and lift span.\textsuperscript{114}

**C. Mechanicals/Operation**

The primary mechanics necessary to the function of the vertical lift bridge are housed in the machinery floors at the tops of the towers. The machinery and equipment for the bridge lift system was engineered and fabricated by the American Bridge Company.\textsuperscript{115}

The lift span is controlled by steel guides that are in contact with rollers located in the towers, and cladding plates. One hundred-horsepower motors on each tower that operate at 585 revolutions per minute are used to lift the span. Four motors initially are used to lift the span, then one motor is cut out and acts as a tie motor to equalize the load. Power is transmitted through a gear train to 14"-diameter cast steel wheels or sheaves, containing 1' 9"-diameter shafts, located at the tower corners. Fourteen 1 7/8"-diameter cables are situated over the sheave to carry the weight of the lift span on one end and the counterweight on the other end. The counterweights are constructed of Class D-2 concrete and are 86' x 10', 2" x 6' 8 1/2". The span rests on cast steel shoes that fit into 6"-diameter square pins on the tower piers.\textsuperscript{116}

The specifications for the lift stated that all load-carrying wires were to be of plough grade steel with a tensile strength of not less than 220,000 pounds per square inch (psi). The complete cable was to be constructed of six strands laid around a hem center impregnated with an approved lubricant. The strands were to consist of nineteen load-

\textsuperscript{113} "Construction Progress," 21.
\textsuperscript{114} "Navy to Build," 52. This article is the only source identified that describes the methods used to move the bridge pieces into position. Notably, the description was written prior to the actual construction, and substitutions of the materials may have occurred once construction began, but this could not be verified.
\textsuperscript{115} "Construction Progress," 21.
\textsuperscript{116} "Navy to Build," 48.
carrying wires and six spacer wires. Sockets were to be forged from solid steel (without welds), and tensile stresses in the metal of the socket were not exceed 60,000 psi. The cable connectors were to consist of cast steel bolted to the span with 3"-diameter bolts, four for the bridge and four for the counterweights. Based on field observations, the original materials specified in the plans are still present. The original operating equipment for the control houses was not observed during field activities. Between 1988 and 1991, Caltrans computerized the operation, allowing for the span to be lifted and lowered from the Control House by pushing a button.

D. Site Information

The bridge carries SR-47 (Terminal Island Freeway) over the Cerritos Channel. The northern approach is located in the city of Los Angeles (the Los Angeles city boundary flanks the bridge to the north and west) and the southern approach is located on Terminal Island (the west half of the island is part of the San Pedro area of the city of Los Angeles, while the rest is part of the city of Long Beach). Local on- and off-ramps for SR-47 are located at the north and south ends of the bridge. A railroad vertical lift bridge of similar height, built in 1996, which also spans the Cerritos Channel, is located directly west of Heim Bridge.

The Heim Bridge is situated within a major harbor. The landscape around the bridge is characterized by flat topography (much of it fill just slightly above sea level), water channels, docks and wharfs, large warehouses for processing cargo, oil rigs, and cargo cranes; very little vegetation is present in the area.

\[117\] Ibid.
PART III. SOURCES OF INFORMATION

A. Primary Sources


California Department of Transportation (Caltrans). Bridge Inspection Records Information System. Drawings and documentation file for Bridge 53-2618. Provided electronically to URS by Caltrans.


National Archives and Records Administration-Pacific Region (Laguna Niguel): NARA-Pacific Region (LN) [Collection moving to Perris, CA].


“Navy to Build Vertical Lift Bridge and Approaches at Cost of $5,000,000.” Southwest Builder and Contractor. September 7, 1945: 18-21, 46, 48, 50, 52.


B. Secondary Sources


California State Military Museum. “Naval Air Station Terminal Island.”


Henry Ford Bridge, Spanning Cerritos Channel, Los Angeles-Long Beach, Los Angeles, Los Angeles County, CA. Historic American Engineering Record, CA. 156.


Lee, Portia. Draft Historic American Engineering Record of Commodore F. Schuyler
**Heim Bridge.** Transmitted by ICF Jones and Stokes to Karl Price of Caltrans, District 7 on July 1, 2008.


*Pittsburgh, Fort Wayne & Chicago Railway, Calumet River Bridge, Spanning Calumet River, East of Chicago Skyway (IL, Chicago, Cook County, IL).* Historic American Engineering Record No. IL-156.


C. Likely Sources Not Yet Investigated

Department of the Navy. Office of the Secretary. (1798 - 09/1947). Record Group 80: General Records of the Department of the Navy, 1804-1983. Archives II Reference Section (Military), Textual Archives Services Division, National Archives at College Park, College Park, MD.

Department of the Navy. Office of the Secretary. Office of Information. (09/18/1947 - ca. 75). Record Group 428: General Records of the Department of the Navy, 1941-2004. Archives II Reference Section (Military), Textual Archives Services Division, National Archives at College Park, College Park, MD.