Naval Supply Annex Stockton, Daggett Road Bridge (Bridge No. 528) Daggett Road Traversing the Burns Cut Off Stockton San Joaquin County California

HABS CAL 39-STOCK, 33AI-

HABS No. CA-2682-AI

# PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Buildings Survey
National Park Service
Western Region
Department of the Interior
San Francisco, CA 94107

# HISTORIC AMERICAN BUILDINGS SURVEY NAVAL SUPPLY STOCKTON ANNEX DAGGETT ROAD BRIDGE (Bridge No. 528) HABS No. CA-2682-AI

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Location:

Rough and Ready Island (south central point), just west of the City of Stockton, crossing the Burns Cut-Off, San Joaquin County,

California

USGS Stockton West Quadrangle (15') UTM Coordinates: E644200, N4200400

**Date of Construction:** 

1902

Engineer:

F.C. Quail, County Surveyor

Builder:

The San Francisco Bridge Company

Present Owner:

U.S. Naval Communication Station, Stockton

Present Occupant:

U.S. Naval Communication Station, Stockton

Present Use:

Unused, kept in an open position for several decades.

Significance:

Built in 1902, the Daggett Road Bridge is significant on a statewide basis as the oldest existing movable highway bridge in California. Since the early 1850s, the moveable span bridge in California was designed to allow railroad or highway traffic to proceed across a navigable river or harbor under most conditions as well as allowing water-borne traffic to proceed unimpeded whenever the need arose. The bridge type offered a solution to a state which had been settled with navigable waterways, but later developed with railroads and highways. The bridge is considered a contributing structure to the property defined as the Naval Supply Annex Stockton Historic District that has been determined eligible for listing in the National Register of Historic Places.

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Date:

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## I. DESCRIPTION

The Daggett Road Bridge is a through truss swing bridge, with symmetrical 75' spans at either side of the center pivot. It was built at the south central point of Rough and Ready Island, just west of the City of Stockton, crossing Burns Cut-Off, a slough that borders Rough and Ready Island on the south and west. The bridge was built by San Joaquin County in 1902, when Rough and Ready Island was a privately-owned agricultural area. During World War II, the island was taken over by the Navy and has been a government-owned area since that time. The bridge served the traffic of Daggett Road, a road the begins on Rough and Ready Island and continues to Roberts Island on the south. It connects with State Highway 4, the major east-west road through the San Joaquin Delta, providing access to Stockton to the east and the cities of the San Francisco Bay Area to the west. For several decades, the bridge has been kept in an open position, parallel to the flow of Burns Cut-Off. Photograph 1 gives a general view of the bridge. This view is taken from Navy land on Rough and Ready Island. Photograph 2 offers a general view from civilian lands south of the bridge. Photograph 3 is a view of the bridge in the context of the navigational channel. It will be observed that the navigational channel exists only on the north side of the movable span. Although regarded as a navigable waterway, this channel is rarely used except by recreational vessels.

The Daggett Road Bridge is a structurally simple swing bridge, with a 75' Pratt truss at either side of the center pivot, as well as additional horizontal members linking the top chords of the side spans and vertical members on either side of the center pivot. The major steel members -- top chord, end posts, vertical and diagonal members, as the portal struts -- are latticed members, i.e. tied together with a web of small, diagonal steel pieces. This latticework is shown in **Photograph 4**. The bridge elements are "pin-connected," i.e. held together with large bolts. (**Photograph 17** is a detail view of a "pin.") Adjustable tension bars on the movable span are found only at the top of the bridge, extending diagonally between the corners of the top chords. The adjustable members on the movable span may be seen most clearly in **Photograph 12**. On the pony truss approach span, the adjustable members are diagonal members on the sides of the trusses. The pony truss also includes steel outriggers extending from the steel floor beams. The outriggers on the pony truss may be seen most clearly in **Photograph 5 and 7**.

The center pier is a large-diameter steel cylinder, fitted with a series of gears that connect with gears below the center of the movable structure. These gears are accessible from the deck of the movable span. The bridge was opened and closed manually. A large metal T-handle with a socket at the bottom was inserted through an opening in the deck above the center pivot. The socket was connected to the upper gear and the T-handle cranked in the appropriate direction. When last operated, the bridge required four men to turn the crank and move the bridge. The gears and wheels of the center pivot are shown in detail in **Photographs 15 through 17.** Three sets of gears were used to connect the motion of the operators with the span.

In addition to the main span, the bridge includes a small Pratt pony truss on its northern approach, i.e. on Rough and Ready Island. It is carried on a concrete abutment at the edge of the island and on steel cylinders (or caissons) in the channel. The concrete-filled steel cylinders are shown most clearly **Photographs 7 and 17**. The approach span and the movable span include timber decks systems. The deck is carried on steel floor beams and timber stringers; the deck itself is built of timber 2" x 4", nailed vertically. Thick timber guard rails and driving boards extend longitudinally along the length of the bridge. The deck system has failed at the north approach and has deteriorated badly on the movable span. In other respects, the bridge appears to be in fair structural condition. The deck system may be seen most clearly in **Photographs 6 and 7**.

The Daggett Road bridge is unusual among known historical swing bridges in California in the manner in which the two symmetrical trusses are tied together. Like most swing bridges, the Daggett Road Bridge is essentially two symmetrical trusses, joined at the pivot point. With most swing bridges, the two trusses are joined by a tall central tower, taller than the trusses, from which diagonal members descend to link with the top chord of the two side trusses. The Daggett Road Bridge is unusual in that the towers over the pivot are the same height as the adjoining trusses, linked to the trusses by thin tension members. The manner in which the side trusses are linked to the center pivot is shown in detail in **Photograph 12** and in the general views, **Photographs 1 through 4**.

The bridge is also unusual in that it does not include temporary piers in the channel to support the bridge in an open position. With most known historic swing spans in the state, two groups of piers (almost always timber pilings) were built in the channel at 90° from the abutments, paralleling the line of the shipping channel. These piers provide a resting place for the bridge in an open position, to relieve stresses from the dead weight of the structure. There is no indication, however, that the Daggett Road Bridge ever had such temporary support. It is now permanently in an open position without any such support; the weight of the bridge is supported only by the trusses. The bridge has been left open because the Daggett Road crossing is unneeded, either by the Navy or the County. The bridge could likely be closed, although with some difficulty owing to debris and rust on the gears.

## II. HISTORIC CONTEXT

### Daggett Road Bridge in the Context of Movable Bridges in California

The Daggett Road Bridge is significant on a statewide basis as the oldest movable highway bridge in California. Built in 1902, it is nine years older than the second leading contender for that distinction.

The movable bridge occupies a special place in the history of transportation in California. Mid-19th century California, like most frontier regions, was settled first by sea and river traffic and only later developed effective railroad and highway networks. The California laws of navigation reflected this fact of historical priority. No railroad or highway crossing was allowed to block river navigation, giving priority to river-borne traffic. The movable bridge represented an engineering compromise between the demands of both modes of transportation. A movable span allowed the railroad or highway traffic to proceed across a navigable river or harbor under most conditions but also could allow water-borne traffic to proceed unimpeded whenever the need arose.

Not surprisingly, some of the earliest highway bridges built in the state were movable spans. The earliest known movable span in the state was Lisle's Bridge in Sacramento across the American River. Built in 1851, it was also one of the first known bridges of any sort to be constructed in the state.<sup>2</sup> It was a timber structure with a series of small Queen post pony truss spans flanking a center vertical lift span. This bridge survived only for a brief period of time. The movable bridge, while it solved important conflicts between vehicular and boat traffic, was very expensive to build and operate.<sup>3</sup> A movable bridge is the product both of the structural and the mechanical engineer. Like any other bridge, a movable bridge must be designed to carry the live and dead loads of itself and its traffic as well as withstand the forces of wind, earthquakes, and other natural stresses. Typically, movable spans are also long bridges, simply because they were built only on substantial navigable streams. Beyond live and dead loads, however, a movable bridge must also be able to open in such a manner as to allow navigation to proceed. While there are three ways for a bridge to move -- these are discussed below -- any movable bridge must deal with three problems unique to movable bridges. First, it must have a means of staying in balance while it is moving and in an open position. Second, it must include some practical method of being moved. And third, it must include some protections against accidental

A general context for the history of movable spans in California may be found in: Bernard C. Winn, *California Drawbridges*, 1853-1995: The Link to California's Maritime Past. San Francisco: Incline Press 2, 1995. For a discussion of the movable bridge in the larger context of the highway bridges of California, see: Stephen D. Mikesell, *Historic Highway Bridges of California*. Sacramento: California Department of Transportation, 1990.

<sup>&</sup>lt;sup>2</sup> Mikesell, 1990, PP. 3-4. It would be very difficult to establish with certainty the first bridge to be built in what is now California. Part of the problem pertains to the definition of a bridge. By custom, engineers treat a bridge as a structure with a main span of 20 feet or more; smaller structures are treated as culverts. Using this definition, it is unlikely that any true bridges were built in California before 1846. Pursuing this logic, the Lisle's Bridge was among the earliest bridges in the state.

<sup>&</sup>lt;sup>3</sup> The long-term alternative to a movable bridge is a high-span structure, capable of allowing all river traffic to pass below it unimpeded. For various reasons, high spans were infeasible technologically and economically until well into the 20th century.

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closing while navigational traffic is passing by, or accidentally opening while vehicles are in transit.<sup>4</sup>

Over time, three basic movable bridge types have been developed: swing bridges, bascules, and vertical lift bridges. Although rare exceptions exist, virtually all movable bridges were also metal trusses: in most important respects, a movable bridge is simply a metal truss that can move. The swing bridge is the oldest of the three forms and was likely built in the greatest number in California. A swing bridge, sometimes called a center-pivot movable span, includes a central pier with equal spans to either side of it. A swing bridge moves on a pivot at the central pier, typically coming to rest on temporary piers, 90 degrees offset from its abutments. The swing bridge had some advantages but many more disadvantages in relation to the other bridge types, a fact that helps explain its disappearance over time. The greatest advantage was initial cost. A swing bridge was similar in many respects to other metal truss bridges. It was also relatively simple to operate. Its three major disadvantages were: it was slow to operate; it required a large pier in the center of the shipping lane; and it had to be fully opened to allow even a very small craft to pass by.

A bascule bridge is any movable span that pivots on a side hinge, or trunnion, being pulled upward and inward toward the source of power behind the trunnion. Although ancient examples exist, modern bascule design dates only to the 1890s. Numerous bascule bridges built on the Chicago River in Chicago showed the way nationally and internationally for the utility of this bridge form. The bascule had the advantage of requiring no central piers and could be opened partially or in full in response to different sizes of craft. Its only disadvantage was that it was a more complicated machine and was more costly to build.

The vertical lift requires two towers that span the shipping channel. The towers are used to lift the central span to the height required to allow a craft to pass beneath. Again, very old examples exist; the 1851 Lisle's Bridge, for example, was technically a vertical lift span. The modern vertical lift bridge, however, was, like the modern bascule, perfected in Chicago in the 1890s. It had the advantage of eliminating center piers and the capability to be opened partially or in whole in response to different sizes of crafts. Its only major drawback was its costs; it was the most expensive type of movable bridge available.

Although very useful, movable bridges were never built in great numbers in California because they were expensive to build and operate. It is not known how many such bridges have been built over time but the number is likely less than 100. In 1984, the California Department of Transportation (or Caltrans) conducted a comprehensive inventory of bridges owned by

<sup>&</sup>lt;sup>4</sup> George A. Hool and W. S. Kinney, eds. *Movable and Long Span Steel Bridges*. New York: McGraw-Hill, 1923. There are other considerations as well, not the least of which is the cost to build and operate.

California cities, counties, or the State of California.<sup>5</sup> At that time, there were 39 movable bridges owned by local or state agencies; that number accounts for the vast majority of all such bridges in the state. These bridges were very localized. As noted, these expensive bridges were built only when absolutely necessary, and were restricted in most cases to the crossings of major highways and shipping channels, or when a large tract of land was otherwise inaccessible because it was surrounded on all sides by navigable streams. The latter condition, for example, explains why the Daggett Road Bridge was built: Daggett Road was not a major thoroughfare but was essential for the owners of land on Rough and Ready Island, who had no land access to the rest of California until this bridge was built. These conditions were present most often along the Sacramento and San Joaquin rivers as well as on the islands of the Sacramento-San Joaquin Delta. Of the 39 movable bridges present in 1984, 27 were found in Sacramento and San Joaquin counties (some of these bridges also touched down in neighboring counties). The same proportions held true for bridges that were found to be eligible for listing in the National Register; twelve bridges were found to be eligible for listing in the National Register, nine of which were in Sacramento and San Joaquin counties. The other three National Register-eligible movable bridges were in port areas: two in San Francisco and one in Los Angeles.

As noted, there were twelve National Register-eligible movable bridges in California at the time of the 1984 Caltrans Historic Bridge Inventory. Of those twelve, six were bascules, five were swing bridges, and one was a vertical lift span. Among the bascules, the oldest bridge was built in 1916. The oldest swing bridge was built in 1906. The lone vertical lift span -- the Tower Bridge in Sacramento -- was built in 1933. Of those 12, only one bridge has since been demolished; it was the 1906 Bacon Island Bridge south of Stockton, which, among the city, county and state bridges. was the oldest swing span and also the oldest movable span. The second oldest movable bridge (also a swing span) was the I Street Bridge in Sacramento, built in 1911. It is still in place and in use.

The Daggett Road Bridge was excluded from the Caltrans Historic Bridge Inventory for two reasons: it is owned by a Federal agency and it is not in service. It is possible that other movable bridges were also excluded from the inventory, although the chances of that are somewhat remote. Barring some unexpected discovery, it may be concluded that the Daggett Road Bridge is the oldest movable highway bridge in California. The second oldest movable highway bridge in the state is the aforementioned I Street Bridge in Sacramento, which is nine years younger.

<sup>&</sup>lt;sup>5</sup> Mikesell, 1990. The survey was restricted to city, county, and state-owned bridges. The Daggett Road Bridge was not treated in this inventory because it was owned by the Federal government. The survey also did not treat movable bridges owned by railroads; there are likely dozens of such structures in the state.

<sup>6</sup> Winn includes a very large list of movable bridges in the state, reported to be comprehensive. He lists no highway bridge older than the Daggett Road Bridge and only one railroad bridge that is older, that being the 1898 Southern Pacific Railroad bridge at Tehama. Some care should be exercised, however, in using the data from this publication. The date of construction for the Daggett Road Bridge, for example, is erroneously given as 1906.

# Daggett Road Bridge in the Context of Metal Truss Bridge Design and Fabrication in California

The Daggett Road Bridge is also important from the standpoint of engineering, as an unusual movable bridge design and as an example of the work of a pioneering bridge fabrication company in San Francisco. Metal truss bridge fabrication was a localized operation, particularly in California, throughout the nineteenth century. More than a dozen relatively small California companies fabricated metal trusses throughout the nineteenth century, most of which had plants in San Francisco. The metal-working industry of San Francisco had gotten an early boost from demand for mining equipment, in which most San Francisco metal-working companies specialized. Most of the major metal fabricators were diversified, however, building mining equipment as well as a wide variety of other metal products. This group of manufacturers included several that had the word, "bridge," in their title: the Pacific Bridge Company, San Francisco Bridge Company, Thompson Bridge Company, and Dundon Bridge Company. Most of these companies, however, manufactured a wide variety of metal products. Many were also general construction contractors.<sup>8</sup>

The turn of the century organization of the American Bridge Company as a subsidiary of U.S. Steel, put an end to most of these San Francisco metal bridge manufacturers, and to small bridge companies throughout the United States. From 1900 through the 1940s, the giant American Bridge Company dominated metal truss bridge construction and drove from the field nearly all of the small bridge fabrication firms, including those in San Francisco. Beginning in about 1940, the market for metal truss bridges disappeared as cities, counties, state transportation agencies, and railroad turned to alternative bridge types, especially reinforced concrete girders and slabs for spans that previously had been crossed with metal trusses.<sup>9</sup>

The construction of the Daggett Road Bridge provides an interesting case study of how metal bridges were designed and built in 1900-03, a period in which local bridge companies were still viable in California. The initial drive to have this bridge built began in late 1900, when local property owners, including William Daggett, petitioned the county for construction of a bridge to Rough and Ready Island. In November of 1900, the county supervisors directed the county surveyor to seek permission from the War Department to build a bridge over this navigable

<sup>&</sup>lt;sup>7</sup> Lynn R. Bailey, Supplying the Mining World: The Mining Equipment Manufacturers of San Francisco, 1850-1900. Tucson: Westernlore Press, 1996.

<sup>&</sup>lt;sup>8</sup> These companies are profiled in Mikesell, 1990, p. 10. A contemporary description is found in: Mercantile Illustrating Company, *San Francisco*, *the Imperial City*. San Francisco: Mercantile Illustrating Company, 1899.

<sup>&</sup>lt;sup>9</sup> The role of the American Bridge Company in the demise of small bridge companies nationally is discussed at length in: Victor C. Darnell, *A Directory of American Bridge-Building Companies*, 1840-1900. Society for Industrial Archaeology, Occasional Publication No. 2, 1984. The impact of the American Bridge Company was felt more immediately on the East Coast than in California, owing to differences in shipping costs.

stream, and to begin preparation of plans and specifications. By August, 1901, all permits had been secured, plans and specifications completed, and the bridge was advertised.<sup>10</sup> The plan for the bridge was developed by the county surveyor, F. C. Quail. As discussed below, Mr. Quail designed a number of swing spans for use in his county, including another bridge (since demolished) that was nearly identical to the Daggett Road Bridge.

The county received four bids, for fabrication of the metal truss as well as the northern metal truss approach span and incidental other construction. The four bidders were: the American Bridge Company; the San Francisco Bridge Company; M. B. White; and Timelty & Sons. Little is known about the latter firms; they were likely general contractors from the local area. The American Bridge Company, as noted, was a subsidiary of U. S. Steel and was, at that time, competing for bridge construction jobs throughout the United States. The San Francisco Bridge Company, the low bidder, was, of course, a San Francisco firm that specialized in bridge fabrication. It was also extensively involved in mining equipment manufacture.<sup>11</sup>

It is not known how many bridges the San Francisco Bridge Company built. The only other known remaining examples are metal truss bridges in Amador and Trinity County, built in 1895 and 1901, respectively. Neither of these bridges is a movable span. The fact that the San Francisco Bridge Company successfully competed for this job illustrates two points. First, a movable metal bridge, particularly a swing span, is structurally similar to any other through metal truss bridge. A company that could fabricate a fixed metal truss bridge could likely also build a metal truss swing bridge. Second, the success of this company in winning this contract shows that the local truss fabricators were still viable in 1901, despite the aggressive competition from the American Bridge Company, which would ultimately drive most of them out of the business. Work on the bridge progressed without incident, except for a small change order substituting concrete for the originally planned steel cylinders, presumably on the southern approach, a change that was made at the suggestion of the bridge company and which did not increase the cost. The bridge was accepted by the county on February 3, 1903. 12

This account is derived from the minutes, or "Record," of the Board of Supervisors, San Joaquin County, California. These minutes are maintained by the County Historical Museum. The decision to advertise is recorded in Book O, page 541, August 6, 1901. The information about construction of this bridge was pieced together entirely from county records. There are no known plans for this bridge, other than one detail sheet, identified as "Sheet 3," indicating that there were at least two additional plan sheets. This detail sheet is held by the public works section of the Naval Communication Station, Stockton, and is reproduced as **Figure 1** in this documentation. This appears to be a detail of the pony approach span because of the presence of a diagonal adjustable tension bar, which is found only on the approach. This detail sheet offers an excellent summary of the timber and steel decking system.

<sup>11</sup> It will be observed, however, that the rolling marks for the steel are from "Carnegie." The U. S. Steel Corporation was assembled from many independent mills and companies, the most important of which was Carnegie.

Record, Book O, page 689 (February 3, 1902) for the change order; Book P, page 430 (February 3, 1903) for acceptance of the bridge.

From the standpoint of design, the bridge is somewhat unusual in the manner in which the two symmetrical trusses are tied together. Like most swing bridges, the Daggett Road Bridge is essentially two symmetrical trusses, joined at the pivot point. With most swing bridges, the two trusses are joined by a tall central tower, taller than the trusses, from which diagonal members descend to link with the top chord of the two side trusses. The Daggett Road Bridge is unusual, but by no means unique, in that the towers over the pivot are the same height as the adjoining trusses, linked to the trusses by thin tension members. A nearly identical bridge was built across the Mokelumne River at New Hope Landing, also in San Joaquin County. This bridge design was apparently appropriate and adequate for relatively short spans; the taller towers are needed to support the longer side spans.

The bridge is also unusual in that it does not include temporary piers in the channel to support the bridge in an open position. With all other National Register-eligible swing spans in the state, two groups of piers (almost always timber pilings) were built in the channel at 90° from the abutments, paralleling the line of the shipping channel. These piers provide a resting place for the bridge in an open position, to relieve stresses from the dead weight of the structure. There is no indication, however, that the Daggett Road Bridge ever had such temporary support. It is now permanently in an open position without any such support; the weight of the bridge is supported only by the truss itself. We have no record of why the county surveyor, Quail, did not design the bridge to include temporary piers. It may have been a matter of economics. It may also have reflected his confidence that the relatively short side spans could be carried by the trusses.

<sup>13</sup> That bridge is illustrated in Winn, p. 108. Winn gives its date of construction as 1905; the bridge no longer exists.

## **LOCATION MAP**



#### III. SOURCES

- Bailey, Lynn R. Supplying the Mining World: The Mining Equipment Manufacturers of San Francisco, 1850-1900. Tucson: Westernlore Press, 1996.
- Darnell, Victor C. A Directory of American Bridge-Building Companies, 1840-1900. Society for Industrial Archaeology. Occasional Publication No. 2, 1984.
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- Naval Communication Station. Stockton. Detail sheet, identified as "Sheet 3." indicating that there were at least two additional plan sheets. This detail sheet is held by the public works section of the Naval Communication Station, Stockton.
- San Joaquin County Records. "Minutes, or 'Record,' of the Board of Supervisors. San Joaquin County, California," maintained by the County Historical Museum.
- Winn, Bernard C. California Drawbridges, 1853-1995: The Link to California's Maritime Past. San Francisco: Incline Press 2, 1995.

## IV. PROJECT INFORMATION

The Secretary of the Navy has been authorized by Special Legislation, approved February 1996, to transfer lands, buildings, and facilities from NCS Stockton, Rough and Ready Island via the Department of Transportation. Maritime Administration (MARAD), to the Port of Stockton. The conveyance is a public benefit conveyance for port development as defined in Section 203 of the Federal Property and Administrative Service Act of 1949 (40 U.S.C. 484). For decades, the navy has been leasing most of this facility to others. As part of the Navy's effort to reduce overhead, NCS Stockton will be relinquishing all hosting responsibilities becoming a tenant itself and leasing only a few of the structures on Rough and Ready Island in order to continue its mission of providing communications for the command, operational control, and administration of the Naval establishment.

The Port of Stockton has no long range plans to alter the National Register eligible property. However, changes may occur from time to time as the Port attracts new industries. New requirements for future industries might cause changes to existing buildings and structures altering their appearance. Because of this, the Port wishes to have the flexibility to demolish or otherwise alter buildings as the need arises. In consideration of the above and pursuant to Section 106 of the National Historic Preservation Act, the Navy determined that the transfer of NCS Stockton property on Rough and Ready Island may result in an adverse effect on the Naval Supply Annex Stockton Historic District and Daggett Bridge. Because the Navy could not assure the historic integrity of these National Register eligible properties once conveyed to the Port, the Navy proposed to record them in accordance with Section 110(b)(2) of the National Historic Preservation Act. Pursuant to the Advisory Council's regulation for the "Protection of Historic Properties" a Memorandum of Agreement was negotiated and signed between the Navy and the California State Historic Preservation Officer stipulating the recordation of the Naval Supply Annex Historic District and Daggett Bridge in accordance with the standards of the Historic American Buildings Survey and Historic American Engineering Record (HABS/HAER) prior to the transfer of the historic property. The Memorandum of Agreement was accepted by the Advisory Council.

Key Project Manager for the recordation was Stephen D. Mikesell of JRP Historical Consulting Services in Davis, California. The photographer was William B. Dewey of Santa Barbara, California.