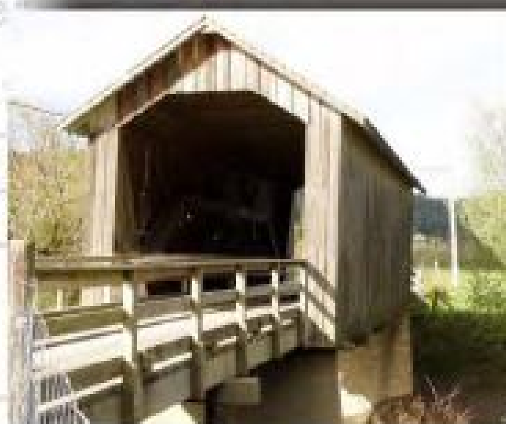
# Caltrans Historic Bridges Inventory Update: Timber Truss, Concrete Truss, and Suspension Bridges



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Cover Images: (Top to bottom, left to right)
Bridge 04C0048, Zane's Ranch Road over Elk River, Humboldt County;
Bridge 53C0996, Vasquez Canyon Road over Bouquet Creek, Los Angeles County;
Bridge 02C0049, Canyon Creek Road over Scott River, Siskiyou County;
Bridge 47C0012, Cunningham Lane over West Walker River, Mono County;
Bridge 42C0551Z, Elkhorn Road over Murphy Slough, Fresno County;
Background Detail from Original Plans, Bridge Near Zanes on Branch Route No. 32 Over Elk River, 1936, Courtesy of the Humboldt County Public Works Department.

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# Caltrans Historic Bridge Inventory Update: Timber Truss, Concrete Truss, and Suspension Bridges

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**April 2004**

## SUMMARY OF FINDINGS

JRP Historical Consulting (JRP) prepared this report for the State of California Department of Transportation (Caltrans) Environmental Program at Caltrans Headquarters in Sacramento, as part of the department's program to update its historic bridge inventory. Caltrans intends to use this report to request concurrence from the State Historic Preservation Officer (Office of Historic Preservation, OHP) on the National Register eligibility of 25 timber truss, concrete truss, and suspension bridges built in California prior to 1960. These determinations will be used to assist the Federal Highway Administration (FHWA) and Caltrans in compliance with environmental and historic preservation laws and regulations as these pertain to historic properties. The historic bridge inventory update will, most importantly, help in compliance with Section 106 of the National Historic Preservation Act and the California Environmental Quality Act (CEQA).

Caltrans completed its initial historic bridge inventory in 1986. The original inventory included the survey of all known examples of timber truss, concrete truss, and suspension bridges with an emphasis on evaluating structures constructed prior to 1936. The timber truss bridges were part of the original truss survey, including both metal and timber structures, and the concrete truss and suspension bridges were part of the original survey that included all bridge types other than trusses. Caltrans began updating it historic bridge inventory in 2002. Caltrans architectural historians and its consultants prepared the various components of the inventory. The inventory included preparation of a historic overview covering the period 1936 to 1959, which was not addressed in the initial bridge survey. Fieldwork and evaluations of bridges were divided by bridge type. For the concrete arch and metal truss, moveable, and steel arch portions of the update inventory, Caltrans decided to continue use of the numeric point rating system that had been developed for the initial bridge survey. For other types of bridges, including timber trusses, concrete trusses, and suspension bridges, Caltrans elected to utilize standard qualitative evaluation techniques given that the survey populations of these types were small and did not require the statistical qualitative numeric system useful for the larger survey population. Accordingly, JRP inventoried and evaluated sixteen timber truss bridges, four concrete truss bridges, and five suspension bridges built before 1960. JRP prepared DPR 523 forms for the eighteen structures that were not previously determined eligible or already listed in the National Register of Historic Places. JRP field checked the other seven structures in the survey population that were previously determined eligible for or listed in the National Register. JRP assessed the significance and historic integrity of each previously eligible or listed bridge and included a discussion of continued eligibility in this report.

This document is divided into sections that provide information on the inventory and evaluation update process as well as historical background. The project description section provides information on the initial Caltrans bridge inventory and details on the current survey. This is followed by a description of the field and research methods used during this survey. Next is an historical overview that provides the historic themes and context by which appropriate evaluations can be made of the survey population. This is followed by a description of the survey population and the findings and conclusions of this study. The final component provides the preparer's qualifications and a list of works cited. Appendix A includes letters received from the interested public during the public participation process, Appendix B has map figures, and Appendix C contains DPR 523 Primary Record and Building, Object, and Structure forms for the eighteen bridges evaluated/re-evaluated. Appendix D has photographs of bridges previously found eligible or listed in the National Register.

Figure 1 (Appendix B) illustrates the counties in which this survey was conducted and the total number of timber truss, concrete truss, and suspension bridges inventoried in each county. Figure 2 (Appendix B) provides a set of regional maps of California, based on Caltrans Districts, showing the location of each bridge. The DPR 523 forms in Appendix C provide descriptions and photographs of each bridge, location data, and historic evaluation information.

Of the 25 bridges studied for this report, the seven structures previously listed or determined eligible for listing in the National Register retain historic integrity and retain their current National Register status, and the remaining eighteen structures do not appear to meet the criteria for listing in the National Register. The seven eligible or listed structures include the four concrete trusses in the survey population, two of the five suspension bridges, and one of the sixteen timber truss bridges. These seven structures are considered historical resources for the purposes of CEQA. All of the timber trusses, except for the Oregon Creek covered bridge, and three of the suspension bridges do not appear to be eligible for National Register listing, and are not considered historical resources for the purposes of CEQA.

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# 1. PROJECT DESCRIPTION – HISTORIC BRIDGE INVENTORY UPDATE

## 1.1. Background

Caltrans completed its first comprehensive historic bridge inventory in 1986. Caltrans prepared reports and documentation, on behalf of the Federal Highway Administration, in order to consult with and obtain concurrence from the California State Historic Preservation Officer (California Office of Historic Preservation or OHP) regarding the eligibility of the state's roadway bridges for listing in the National Register of Historic Places. OHP concurred with the findings of the bridge inventory between 1985 and 1987, and Caltrans subsequently published bridge logs that listed the National Register eligibility for all bridges within its jurisdiction, including both those owned by the state and by local agencies. Caltrans created two lists of bridges, those on state highways (including interstate highways, US routes, and state routes) and those on local agency roads, i.e. county or city roads / streets. Each list was organized by county name and bridge number. The historic eligibility categories were assigned as follows: 1) Listed in the National Register; 2) Eligible for the National Register; 3) Possibly Eligible for the National Register; 4) Historic Significance Not Determined; and 5) Not Eligible for the National Register.

From 1987 until the mid-1990s, Caltrans, local agencies, and others relied on the determinations cited on the historic bridge logs to indicate the historic significance of roadway bridges in California. These determinations were used, as applicable, for compliance with environmental and historic preservation statutes and regulations as they relate to historic resources, most often for compliance with Section 106 of the National Historic Preservation Act, National Environmental Policy Act, and California Environmental Quality Act.

By the mid-1990s, Caltrans began re-evaluating bridges (or requesting re-evaluations of bridges) on an individual basis as it became evident that the accuracy of the original survey was diminishing. First, bridges built in 1936 or later had not been 50 years old at the time of the first survey and now needed to be addressed under National Register criteria without consideration of exceptional importance. This accounted for hundreds of bridges that were built during a period when California's transportation system grew enormously in the late 1930s, 1940s, and early 1950s. Second, many older bridges, including timber trusses for example, had been replaced so that the population comparison of similar properties had been markedly reduced. Third, there were also several innovative bridge types and technologies introduced for use on California's roadways during the 1930s, 1940s, and 1950s that had not been addressed in the 1980s survey. Case by case, project by project, evaluations continued throughout the late 1990s and into the 2000s. This method of re-evaluation, however, was generally inefficient and was, at times, inconsistent. Thus in 2002, Caltrans decided to conduct a thorough update of the 1980s survey. This is important for producing more consistent and defensible results because it permits holistic, context-based evaluations to occur with state-wide comparisons of similar properties and a thorough examination of new and innovative bridge types and technologies from the 1930s, 1940s, and 1950s.

### 1.2. Current Project

The Environmental Program at Caltrans Headquarters in Sacramento began the project to update the Caltrans historic bridge inventory in 2002. Caltrans architectural historians reviewed and assessed the 1980s inventory, collecting all records related to the survey and evaluation process. They carefully considered what elements of the previous inventory could be re-used and which elements needed to be revised. Caltrans and OHP agreed that the Historic Bridge Survey Update would include bridges constructed prior to 1960 so that individual bridge reevaluations will not be necessary until 2010. Caltrans staff then assembled a database from the Office of Structures Maintenance and Investigation bridge logs, both for state bridges and local agency bridges, along with the logs listing the historical significance of bridges, to help derive a list of structures to be surveyed and evaluated. The database included information on the location, type, material, and construction date of each bridge. Caltrans architectural historians also examined other maintenance records, previous historical survey records, and recent historic evaluations to compile the survey population for the update project. Once the lists of bridges by type were completed, information on each bridge was collected, including rating sheets from the original survey, photographs, and bridge reports archived at Caltrans Office of Structure Maintenance and Investigation. Caltrans staff also contacted local historical societies and other interested parties to assure compliance with the public participation requirements of Section 106. Caltrans architectural historians and consultants conducted the field inventory work and historic evaluations for the update. As a part of the update project, JRP prepared a historical overview for all roadway bridges constructed in California between 1936 and 1959, and conducted a survey and evaluation program for metal truss, steel arch, movable, concrete arch, timber truss, concrete truss, and suspension bridges.

This report is part of the larger 2002-2004 Caltrans Statewide Historic Bridge Survey Update project that includes re-evaluations of all extant bridges surveyed and evaluated in the original 1986 Historic Bridge Inventory as well as evaluations of other roadway bridges built before 1960. This report deals specifically with timber truss, concrete truss, and suspension bridges and provides assessments of which structures appear eligible for listing in the National Register of Historic Places. Of the eight pre-1960 suspension bridges remaining in California, only five were surveyed and evaluated for this report. The Golden Gate Bridge (27 0052) and the west spans of the San Francisco-Oakland Bay Bridge (34 0003) have both been extensively evaluated in past reports and were therefore not re-evaluated in this report. The third pre-1960 suspension bridge not included in the survey population is the Middle Fork Feather River Bridge (12P001). This structure is located in Curry Bidwell State Park and does not serve vehicle traffic. This bridge was moved to its current location in 1974 after being dismantled and stored in 1954. Bridges that were determined eligible in the original survey, or in individual evaluations since that time, remain eligible because they have not lost historic integrity.

## 2. FIELD AND RESEARCH METHODS

### 2.1. Compilation of Information and Research

Caltrans provided JRP with a list of twenty-five timber truss, concrete truss, and suspension bridges, along with information on each individual bridge including sheets from the original survey, copies of photographs, and bridge reports. JRP organized these records into field research sets. JRP located all bridges subject to the survey on road and street maps and collected field research sets into units based on location of bridges, generally by groups of counties and/or by Caltrans district.

JRP also conducted historical research for the bridges prior to and/or after conducting fieldwork, to help assess the possible significance survey population bridges may have under National Register criteria. For the evaluation process, JRP consulted the original 1980s bridge inventory, the context statement prepared for the evaluation of bridges built between 1936 and 1959, as well as conducting research at the Caltrans Transportation Library, Sacramento, the California Room of the California State Library in Sacramento, Shields Library at the University of California, Davis, and local repositories as necessary. In addition, JRP also took into account the results of the public participation effort.

### 2.2. Fieldwork

JRP conducted the fieldwork survey in two person field crews. Each of the twenty-five bridges was field checked and recorded. This included photographing each bridge, examining any alterations to the structure, reviewing alterations to the setting, and assessing the potential for the bridge to be considered part of a historic district or historic landscape. Caltrans specified that JRP take high-quality digital photographs of each bridge in the survey population. JRP used Olympus C-720 cameras, taking three mega pixel photos at 1984x1488 pixel resolution.

## 2.3. Public Participation

In April 2003, Caltrans sent letters to the planning departments of each county in California, nine cities, and 58 historical societies and historic preservation organizations, informing them of the statewide historic bridge survey update and inviting their comments. Caltrans received one response for continued consultation, from the Tuolumne County Historical Society.

Draft copies of this report were sent on February 10, 2004 to the Tuolumne County Historical Society and architectural historian Don Napoli of Sacramento. Mr. Napoli responded on March 5, 2004. His letter, and Caltrans' response, are included in Appendix A.

## 3. HISTORICAL OVERVIEW

The following section provides the background and details regarding the historic themes and historic contexts with which timber truss, concrete truss, and suspension bridges built in California before 1960 may be associated. Emphasis has been placed on collecting information regarding the historic context of bridges that were not previously listed or determined eligible for listing in the National Register, particularly from the period between 1936 and 1959, which was not covered by the original Caltrans bridge survey in the 1980s. This historic overview is intended to provide the basis for the evaluation of bridges in this study's survey population whose significance is either being re-evaluated or evaluated for the first time. The first part of this section deals with important events and trends in transportation history before 1960 and the role bridges played within that context. The second part of the section provides information on the engineering, design, and construction of bridges in California prior to 1960.

### 3.1. Important Events and Trends in Transportation Development

Until the end of the nineteenth century, roadway bridge building in California was largely conducted by private companies or individuals, with little input from local or state government. Around the turn of the twentieth century, the state began to create legislation enabling counties to take over the role of establishing and maintaining roads and bridges. County officials continued to be the dominant players in bridge construction until the voters passed a series of bond measures beginning in 1910 that led to the creation of the California Highway Commission (later renamed the California Division of Highways). With the growing demand for bridges resulting from an increase in motor vehicle use, bridge design and construction methods changed, and designers and builders sought innovative solutions to meet the changing requirements of the state's roadway system. Improved bridge design and construction methods helped provide safer more efficient roadways and highways in the state, required by the increasing volume of private and commercial vehicle traffic. Highway and bridge engineers developed the necessary infrastructure to service regional markets and to provide the means to transport local resources widely for manufacturing and the public's consumption. Over time and throughout the mid-twentieth century, first and second generation bridges dating from the nineteenth or early twentieth century were replaced as the state, counties, and local communities sought ways to provide appropriate transportation corridors to connect burgeoning towns and cities while accommodating the demands of an expanding state economy and growing population. During World War II and in the postwar years, bridges also became crucial links in a transportation system that expanded to manage the movement of military personnel and equipment between the new military facilities located throughout the state. Naturally, bridges played a critical role in the state's roadway and highway system that continued in the 1940s and 1950s, as the nation's defense and growing transportation needs required reliable bridges in California to carry increasingly heavy loads and traffic volumes.

In general, timber truss and timber suspension bridges were built during this period in rural locations where simple designs were adequate. These designs often utilized local materials and well-established methods of construction. The concrete truss bridges represent variations on combining steel and concrete technologies that were employed in both urban and rural settings. These bridges were part of larger bridge building efforts occurring at this time across the state.

The following discussion divides the period 1880 to 1959 into six chronological periods. The first period addresses the changes that occurred at the turn of the twentieth century that brought county surveyors and engineers to the forefront of bridge building. The second period details the shift of bridge building responsibility from the county officials to the newly created bridge department of the California Division of Highways. The third period addresses roadway bridge building by the state government as California emerged from the Great Depression. The fourth period details bridge construction and maintenance during World War II, a period when there was relatively little new bridge construction. The fifth period focuses on the decade immediately following World War II, when the state implemented its expansive plans for freeways and improved highways throughout the state, constructing hundreds of new bridges to meet the demands of the rapid economic and population growth of the period. The last section explores the enormous influence that the Federal Highway-Aid Act of 1956, and subsequent legislation, had on California's bridge program. This general information is provided to put into relative context the local and modest nature of most of the bridges in this survey population.

### 3.1.1. County Era: 1880 to 1909

Until the 1880s, highway bridge building in California was a predominantly private endeavor. An example of this is the Oregon Creek covered bridge (16C0017) in Yuba County, built in 1860 to serve miners traveling to the Comstock Lode silver mining boom. The structure was washed downstream and rebuilt at its current location in 1883. While a few counties built public bridges as early as 1855, it was not until 1874 that the state legislature adopted a comprehensive program through which counties could establish road districts, road commissioners, and property taxes reserved for road construction. The ability of counties to undertake bridge construction was further enhanced by an 1893 state law mandating each county to seek the advice of its county surveyor on bridge design. This law had the effect of helping professionalize the office of county surveyor and attract trained bridge engineers to the office.[1] Though counties typically built trusses and covered bridges early in this period and then shifted to reinforced concrete structures, the bridges built in each county often reflected the local traditions and preferences of the county surveyor.

### 3.1.2. Early State Era: 1910 to 1929

The passage and approval of the State Highway Act in 1909-1910 provided funding for the construction and acquisition of a system of state highways. The California Highway Commission (later renamed the California Division of Highways) was created in 1911 to oversee this work and maintain the highway system. Though during much of this period many of the structures were still the responsibility of the counties, the state began to have increased influence on the design and construction of bridges throughout California. Beginning in 1912, the commission required that all structures built as part of the state highway project be designed by competent engineers, and that plans, specifications, and workmanship be subject to the inspection and approval of the Highway Engineer.[2] The increase in workload caused by the design and approval requirements led to the creation of a Bridge Department within the Highway Commission.

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[1] Paul Bryan Israel, "Spanning the Golden State: a History of Highway Bridges in California," (Masters Thesis, University of California, Santa Barbara, 1980).

[2] Israel, "Spanning the Golden State," 56-60.

Although some communities successfully built bridges to meet growing demands, often hiring private engineering firms, others were less successful. Reliance on the counties to furnish bridges led to the bridgework lagging behind road construction on state highways. This led to all bridge design and construction on the state highway system to come under the direction of the Bridge Department beginning in 1923.[3]

During this period, the state and counties began building larger structures that were considered civic monuments, which were placed at prominent locations. The City of Modesto built the Lion Bridge (38C0023) over the Tuolumne River at the city's southern entrance in 1916. Other bridges of this period were also considered civic monuments, albeit on a smaller scale. The City of Monterey built the Larkin Street Bridge in 1914, a canticrete structure, as a means of enhancing the visual quality of even this minor crossing. These efforts are examples of ways the City Beautiful movement, a movement inspiring urban beautification in architecture, landscaping, and city planning through the use of classical architectural details that was popular in the United States from the 1890s through the 1920s, influenced bridge building in California during the early twentieth century.

Other bridges were built to meet the growing demands of increased recreational and commercial traffic. In rural or mountainous and commercial areas, counties were able to build modest structures, often using local materials. Examples of these bridges include the small A-frame timber bridges in Los Angeles County, 53C0935 built in 1923, and 53C0939 built in 1926, constructed to improve local roads for residents and recreational traffic.

### 3.1.3. Depression Era 1930 to 1940

Following the worst part of the Great Depression in the early 1930s, bridge construction in California became an integral part of state and federal plans for economic recovery through public works projects. Government employment relief programs helped spur this recovery, and the federal government provided much of the funding for bridges constructed in the state during this period. Infused with New Deal money, the California Division of Highways added new

[3] Israel, "Spanning the Golden State," 70.

highways, built new bridges, and upgraded county roads into the state highway system. During this period, the state struggled to deal with its “old bridge problem” replacing inadequate often pre-automobile structures to accommodate a growing volume of vehicular traffic and to address new safety issues.[4] An example of this type of project is the timber Howe covered truss bridge over the Elk River in Humboldt County, the Zanes Ranch Road Bridge (04C0048) built in 1936. County Surveyor Frank E. Kelly designed this structure and the Works Progress Administration (WPA) provided both funding and labor for its construction.

Despite the poor economy of the 1930s, recreational and commercial traffic continued to grow, warranting new road and bridge construction in both urban and rural settings. During this period, and into the 1940s and 1950s, the Los Angeles County Public Works Road Department built many more A-frame truss bridges. Many of these bridges were built as part of a larger effort to improve the roads within the Angeles National Forest to improve fire protection and monitoring. A construction division was created by the county and over the next few years, firebreak and road construction became a top priority. In the 1920s, the county developed a set of standard plans for A-frame truss bridges, with span lengths varying from thirty-two to fifty feet. These “shop drawings,” essentially identical in appearance, were used by county road building crews to quickly erect these simple, light-duty bridges in remote locations and could also be used for more complex structures such as Howe trusses.[5] An example of one of the bridges built as part of this effort is the Cattle Canyon Creek Bridge (53C0972) built in 1932, shown in Photograph 1.

[4] “Agency History,” Department History File, 1927-1971, California Department of Transportation Library.

[5] Los Angeles County Department of Public Works, Bridge Plans, drawings 690888 through 690894; personal communication with Mr. Aki, retired Los Angeles County Department of Public Works engineer, February 11, 2002.

Photograph 1: Cattle Canyon Creek Bridge (53C0972)

Similar efforts were also occurring at this time in rural areas of northern California. The United States Forest Service improved transportation routes, or encouraged their improvement, through the Klamath National Forest in Siskiyou County, particularly to thwart seasonal fire threat. The construction of numerous lookout posts and guard stations required access roads. This, in turn, opened the forest to further development for timber harvest, recreation, and tourism.[6] An example of this effort is the bridge over Canyon Creek in Siskiyou County (02C0049), which was constructed in 1938 (rebuilt in 1998).

[6] Alison T. Otis, et al., *The Forest Service and the Civilian Conservation Corps: 1933-1942* (Washington, D.C.: USDA Forest Service, August 1986), 10; *Chronological History of the Klamath National Forest: People, Places, Programs and Events,* Vol. IV, 74-77; SiskiyouHistory.org, http://www.siskiyouhistory.org; Richard White, *It's Your Misfortune and None of My Own,"* Norman: University of Oklahoma Press, 1991, 475.

### *3.1.3.1. The "Old Bridge Problem"*

In the 1930s, the Division of Highways Bridge Department recognized the need to replace the state's first- and second- generation highway and roadway bridges, lightly built for horse and buggy, as they became obsolete in the face of increased automobile and truck traffic. This problem became one of statewide importance as the Division of Highways took over control of an increasing number of county and local roads across the state. In 1933, the Division of Highways took over secondary roads that included 1,235 bridges, thirty percent of which needed immediate repairs or required imposition of load limits. While many bridges were adequate, there was a distinct need for improved structures on highways used by trucks, which regularly damaged the old bridges, many of which were metal through trusses. Sometimes collisions led to collapse. Moreover, for newer vehicles, approaches were too narrow or too curved, bridge floors were not strong enough, and guardrails inadequate. During the 1920s and 1930s, trucks had increased not only in volume on California highways, but also in size and load. This led to the construction of bridges like the Harden Flat Road bridge (32C0053) constructed in 1933 on State Route 40 to improve access into Yosemite National Park. It replaced an earlier, much smaller bridge. By the late 1930s, semi-trailers were in common use, and other large vehicles crossed California bridges applying loads beyond their design limits. Motorists demanded wider and safer bridges permitting higher speeds and straighter roadways. Statewide inspections of structures were limited at the time, and many older structures were coming to the end of their effective life. Despite an influx of federal funding into the state for roads and bridges, there were still insufficient funds to replace or upgrade all the bridges that needed improvement. In October 1939, the head of California's Division of Highways Bridge Department, Frederick W. Panhorst, presented a paper to the Bridge Committee of the American Association of State Highway Officials (AASHO)[7] entitled "The Old Bridge Problem." Panhorst summarized the issues California faced as its first and second generation highway and roadway bridges, built for horse and buggy, became obsolete in the face of increased automobile and truck traffic. Panhorst's paper advanced the need to establish more efficient bridge types with greater economy and to build bridges that could safely stand decreased maintenance.

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[7] The American Association of State Highway Officials is now known as the American Association of State Highway and Transportation Officials.

In the years preceding World War II, bridge construction demand grew as the country mobilized for possible war. The importance of infrastructure improvements was fully demonstrated in 1940 when the War Department demanded improvements to the state highway system as part of the national defense effort.[8]

### 3.1.4. World War II Era: 1941 to 1946

Preparations for entry into World War II created new challenges for the California Division of Highways as mobilization required immediate and widespread highway and bridge improvements. Even before the war began in Europe, the Division of Highways, in conjunction with the federal Public Roads Administration, began planning and surveying to develop a program linking California with the National Defense Highway System in order to effectively move military personnel and heavy equipment across the country. California's climate, Pacific Coast location, and available undeveloped land made it an attractive site for military training and war industries. The period of wartime construction and building material shortages / restrictions lasted through 1946.

Scarcity of personnel and materials halted much of the scheduled repair and maintenance needed on bridges, and federal restrictions on use of structural steel, reinforcing steel, timber, and hardware practically stopped new bridge construction for all bridges except those needed for defense purposes. While most of the wartime bridges were on highways considered important to the National Defense Highway System, there were some small local bridges funded and built. These small bridges were usually important transportation links that provided continued and adequate access to areas of the state important for the harvesting or production of raw materials used in the war effort. An example of this is the Horse Creek Bridge (02C0008) built in western Siskiyou County in 1944. The project was the combined effort of the county and the U. S. Forest Service to provide adequate access to the Klamath National Forest, which held important timber resources used in war production. Although the Horse Creek (suspension) Bridge was not used for logging trucks, it helped in the administration of the National Forest and protection and monitoring of forest fires.

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[8] Division of Highways, *Twelfth Biennial Report*, 1940, 25.

As major bridge replacement projects faltered during the war years, the Bridge Department focused its limited resources on reducing its backlog of deferred maintenance. As discussed above, the state had taken over many local and county roads during the 1930s and found many of the bridges in need of repair or replacement. Most of these older bridges had not been regularly inspected or maintained by their former owners. During the war, the Bridge Department prepared inspection reports on each bridge within the state highway system. Based on the reports, all bridges were classified into groups, depending on their load capacities and structural safety. Maintenance and repair of steel truss bridges, for example, was divided into three classes: regular maintenance to preserve the structure; repair of accidental damage; and strengthening and improving clearances.[9]

During the war years, the division not only concerned itself with the national defense readiness of California's roads, but it also began long-range planning for postwar expansion and construction in partnership with the federal government. This was part of a government-wide effort to face the issues of postwar recovery. Starting in 1943, the Reconstruction and Reemployment Commission began planning and implementing a comprehensive program for transition to a peacetime economy. The influx of workers to defense industries in both northern and southern California, combined with the anticipated flood of returning service personnel, created a potential postwar unemployment problem. The commission identified a highway public works program, with bridge construction, as a key component of economic development in the postwar era as the labor-intensive construction projects could absorb much of the surplus manpower. In response, the Division of Highways developed a plan to modernize the state highway system that included replacing many of the state's aging bridges. Passage of the Federal Aid Highway Act in 1944 assured California of approximately $67 million of federal funds to be spread over a three-year period for highway construction. Of primary importance, the act provided for the development of a national system of interstate highways, which in California totaled 2,820 miles, connecting major metropolitan centers. It also provided funding

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[9] F.W. Panhorst, "700 Bridges on Federal Military Highway Network," 2-3; and J.S. McClelland and W.J. Yusavage, "California Bridges, Cost and Volume of Bridge Construction: 1934-1952," *California Highways and Public Works*, January-February 1953, 31; Harvey D. Stover, "State Highway Bridge Maintenance Involves Care of 4,633 Structures," *California Highways and Public Works*, March-April, 1944, 12; and R.J. Israel, "Bridge Maintenance Practice on California Highway System," *California Highways and Public Works*, May-June, 1945, 4.

for construction and maintenance of a secondary or feeder network of highways designed to connect rural areas to urban centers, complementing the primary interstate highway system.[10]

### 3.1.5. Postwar Period: 1947 to 1959

Following World War II, California and the United States began a period of enormous prosperity and expansion. Perhaps more than any other state in the country, California linked its fate to its transportation infrastructure. The progress was most vivid in California's metropolitan areas and encouraged the shift in population and wealth to the state's urban centers. Both in response and as a contributor to the economic recovery and growth of the period, the state built hundreds of miles of highways and thousands of bridges. Federally sponsored programs provided low interest housing loans that resulted in vast suburban construction programs typically on land beyond the reaches of the existing public transportation infrastructure, thus necessitating highway and freeway construction as commuter thoroughfares. Furthermore, automobiles and trucks continued to supplant railroad passenger travel and freight shipment during this period as Californians chose to ride in their cars, eschewing buses and trains, and companies chose to truck goods from point to point over the state's highways. Finally, some of the same attitudes that attracted the military to California, its natural resources, climate and scenery, induced tourists to visit and enjoy the state's natural beauty on remote scenic highways along the California coast or in its mountains. All of these historic events and trends had profound effects on highway and bridge construction in California during the decade following World War II.[11]

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[10] Division of Highways, *Fifteenth Biennial Report*, 1946, 19-23, 45-51; Division of Highways, *Thirteenth Biennial Report*, 1942, 16-17; California Department of Public Works, Division of Highways, *Fourteenth Biennial Report*, 15; and California Department of Public Works, Division of Highways, *Fifteenth Biennial Report*, 14.

[11] Andrew F. Rolle, *California A History*, (New York: Crowell, 1969), 595, 598, 602; Warren A. Beck and David A. Williams, *California: A History of the Golden State*, (New York: Doubleday, 1972), 435; Ralph J. Roske, *Everyman's Eden*, (New York: Macmillan Company, 1968), 529; and Richard B. Rice, William A. Bullough, Richard J. Orsi, *The Elusive Eden: A New History of California*, 2nd ed., (New York: McGraw Hill, 1996), 498; William H. Chafe, *The Unfinished Journey: America Since World War II,* (New York: Oxford University Press 1986), 117, 123; Richard L. Forstall, "California Population of Counties by Decennial Census: 1900 to 1990," Population Division, US Bureau of the Census, March 27, 1995, accessed October 2002 online at: www.census.gove/population/cencounts/ca 190090.txt; Kenneth T. Jackson, *Crabgrass Frontier: The Suburbanization of the United States*, (New York: Oxford University Press, 1985), 112, 123, 233, 241; Tom Lewis, *Divided Highways: Building the Interstate Highways, Transforming American Life*, (New York: Penguin Group, 1997), 85.

#### *3.1.5.1. Funding for Postwar Bridge Construction*

The Division of Highway and local agencies needed substantial and stable sources of funding for street, road, highway, and bridge construction programs to meet the demands of the spectacular urban-industrial growth in the state following World War II. California continued to receive some federal funds from the Federal-Aid Highway Act of 1944, but with uncertain future federal funding, the state legislature established two committees in 1945 to study the state's transportation funding needs. The work of these committees resulted in passage of the Collier-Burns Act of 1947. The act became one of the most influential pieces of state legislation for California's highway system as it was the first concise, dependable, and large scale capital investment program for highway and bridge construction in the state's history.[12] Its passage reflected a strong commitment by Californians to improving the state highway and roadway network. The funds raised were largely dispersed directly to cities and counties for road construction and maintenance, with one third of the total allocated to the state. The Collier-Burns Act also provided funding for long term planning, and directed the reorganization of the Division of Highways. In 1949, the first full fiscal year after passage of the Collier-Burns Act, cities received an increased allocation of highway, road, and bridge funds that was three times greater than received previously. Furthermore, the act provided that the state take over responsibility for state routes within city limits, thereby reducing the number of streets under the cities' supervision. Because each city had more money to spend on fewer streets, the quality of urban streets and bridges rose. Cities and counties were able to focus on other important routes, and urban highways and bridges were built to the state's increasingly unified design and construction practices. In the 1950s the supplemental legislation advanced the development of California's highways, building on the foundation provided by the Collier-Burns Act.[13]

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[12] Eleanor N. Wood, "California: Mud to Megalopolis: A History of the Division of Highways," Department History File, 1927-1971, California Department of Transportation Library, 13; and David W. Jones, "California's Freeway Era in Historical Perspective," (Berkeley: Institute of Transportation Studies, University of California, 1989), 189-192.

[13] *Third Annual Report to the Governor of California by the Director of Public Works*, Jan. 1950, 67; David W. Jones, "California's Freeway Era in Historical Perspective," 195; Jeffery Brown, "Statewide Transportation Planning in California: Past Experience and Lessons for the Future" discussion paper California Transportation Futures Conference. Institute of Transportation Studies, University of California, Los Angeles (November 13, 2000), 18.

At the same time the state began funding highway and bridge construction on a large scale. Through the Colliers-Burns Act, the Division of Highways and counties were able to build new bridges to address growing demands at the local level. The Federal Aid Highway Act of 1944 and the state's County Highway Aid Act of 1945 provided counties funding to replace structurally inadequate bridges, which accounted for roughly half of the bridges located on county roads at war's end. The state helped counties select the optimal bridge sites and designs and encouraged, but did not require, the use of uniform statewide standards. The Division of Highways reviewed county plans, estimates, and specifications and helped resolve construction problems and maintenance issues. Counties prepared bridge plans using their own engineers or consulting engineers. Most of these bridges were constructed to allow passage for the newer larger trucks and other heavy loads not permitted on older structures. In rural and forested counties, many of the replacement bridges constructed at this time were built to help improve transportation of agricultural and timber products or livestock to market, and in urban areas, cities and counties built new bridges to improve transportation routes in industrial areas. In remote rural areas, counties replaced older structures with improved bridges, though many continued to be relatively small, such as the Stone Coal Bridge (03C0092) in Modoc County built in 1953. The county built this camelback timber truss bridge to improve access for timber harvest and for area ranchers. Counties built some bridges to improve links between new suburban residential areas to city and town centers. The state, cities, and counties built other bridges as grade separations at railroad crossings, as bypasses around downtown streets, or with movable spans over navigable waterways. To a lesser degree, counties at this time were also considering improved access to recreational areas, exhibited by the construction of the Gleason Canyon Creek Bridge (53C1021) built in the San Gabriel Mountains in Los Angeles County in 1956, which improved access to the Angeles National Forest and local recreation areas.[14]

*3.1.5.2. Ascension to the Freeway Era: 1956 to 1959*

While hundreds of bridges had been built along the state's roads, highways, and freeways in the late 1940s and early 1950s, the next fifteen to twenty years proved to be the largest bridge

[14] C.L. Hollister, "California Counties Launch Construction of 55 Bridges to Cost Approximately $5,575,000," *California Highways and Public Works*, March-April 1947, 1-8.

building period in California's history. The chief impetus of this surge was the massive increase in federal funding for highway construction starting, most importantly, with the Federal-Aid Highway Act of 1956, which put into place the funding to construct the country's interstate highway system. This surge was further bolstered by the Division of Highway's freeway master plan developed in 1958. By the mid-1950s, most bridges in the state were built as undercrossings or overcrossings on highways. Timber truss and suspension bridges were not used in those capacities, though they were used at small crossings in rural areas, albeit infrequently.

## 3.2. Engineering, Design, and Construction

Bridges were built in great numbers on California roads and highways starting in the late nineteenth century. The county engineers and contractors responsible for the choice of design for each bridge considered the location, traffic volume, and available materials, as well as the cost. The majority of bridges in this survey population are on rural roads and low traffic areas. After the end of World War I, newer materials and designs, especially concrete arches and girders were increasingly used.[15] The following discussion is divided into sections regarding the designs of timber truss, concrete truss, and suspension bridges.

### 3.2.1. Timber Trusses

California's earliest bridge builders constructed bridges in timber, as it was typically the only available material. By the late nineteenth and early twentieth century, engineers increasingly opted for steel and concrete bridges rather than timber as a result of the growing demands of automobile use and advances in bridge designs.[16] Although engineers preferred steel and concrete for roadway bridges, they continued to construct timber bridges, mostly on secondary roads, in the 1930s, 1940s, and 1950s. During the early 1930s, the Division of Highways built several timber arch and truss spans, including a bridge over Dolan Creek on Highway 1 in Monterey County, completed in 1934. Featuring a 180-foot arch span with two timber stringer

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[15] Carl W. Condit, *American Building Art: The Twentieth Century*, (New York: Oxford University Press, 1961), 207-211.

[16] Duwadi, Sheila Rimal and Michael A. Ritter, "Timber Bridges in the United States," *Public Roads On-Line*, Winter 1997, online at: http://www.tfhrc.gov/pubrds/winter97/p97wi32.htm, (accessed December 3, 2002).

spans and thirteen 19-foot trestle spans, the Dolan Creek Bridge was pre-fabricated near Monterey and constructed in sections at the site. The Dolan Creek Bridge was among the first bridges built by the Division of Highways to use new European timber connectors. These connectors, or interconnected metal rings which transfer the weight from one piece of wood to another, improved the strength of the timber joint, the weakest section of any timber structure.[17] The redwood Dolan Creek Bridge was a victim of the moist sea air, however, and was replaced in 1961.[18] No timber arch bridges were again built in California, but timber was used on smaller structures.

Four types of timber bridges were built in California between the 1920s and 1930s: slab, stringer, truss, and suspension. Douglas fir, grown in California as well as Oregon and Washington, and California redwood were most commonly used for timber bridges in the state, although some counties used California red fir and ponderosa pine. The California Division of Highways typically did not use California red fir or ponderosa pine except when constructing temporary bridges. During this period, the Division of Highways commonly used creosote pressure-treated wood, but also used untreated Douglas fir.[19] Most of California's timber bridges built during this period are timber stringer or girder bridges. Only a small number of timber slab and timber truss structures were built during this period. Like other timber bridges, timber trusses, for example, were largely built by counties in rural areas such as those found in Los Angeles or Humboldt counties.

#### *3.2.1.1. Timber Truss Types*

In general, truss bridges are classified by the position of the deck, or roadway, in relation to the trusses. Through truss bridges carry the deck on the lower chord, or support, with lateral supports overhead. The through truss configuration was used for large structures with long spans, but because it was closed overhead, the vertical clearance was restrictive. A variation on the through bridge is the pony truss bridge which carries the deck on the lower chord, but has no

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[17] Stewart Mitchell, "New Type Timber Arch Bridge Spans Dolan Creek Gorge on Coast Highway," *California Highways and Public Works*, February 1935, 26.

[18] California Department of Transportation, *Historic Highway Bridges of California*, 146.

[19] Stewart Mitchell, "The Engineering of Timber Highway Structures." Paper presented at the 30th Annual Road School Purdue University, January 26, 1944, 3.

lateral overhead supports. Pony trusses were more commonly used for smaller bridges with short spans. Some covered bridges are built with a pony truss structure and a timber frame gable roof "house" around them. The structure of some historic covered bridges, not in this survey population, integrate the structural truss and house frame. Deck truss bridges carry the roadway on the top chord with the truss extending below the deck level. Deck trusses were increasingly used during the 1930s, 1940s, and 1950s, as they could be built to carry greater loads and caused no problem with vertical clearance.

#### 3.2.1.1.1 A-FRAME/KING POST/QUEEN POST TRUSSES

The A-frame truss is also known as a "King Post truss" and is a traditional truss type with its origin in the Middle Ages. It was introduced in the United States by Theodore Burr, who used it alone and in combination on a larger structure that became known as the Burr truss. Photograph 2 shows a basic A-frame truss. A-frame trusses form the basis for the more complicated truss designs, such as the Howe truss, which is formed in part from a combination of A-frame trusses with other supporting members.[20] Another form derivative of the A-frame is the Queen Post truss. There are two Queen Post truss in California, bridge 10C0134 located in Mendocino and the Wawona Bridge (40U0038), a modified Queen Post truss located in Yosemite National Park. Neither of these bridges are in the current survey population. Mendocino County built bridge 10C0134 after 1960, and the Wawona Bridge (40U0038) was constructed in 1896 but is located on federal land. Los Angeles County developed a set of standard plans in the 1920s for A-frame truss bridges. At least thirteen A-frame truss bridges were constructed by Los Angeles County from 1926 to 1959.[21] Bouquet Creek Bridge (53C0996) is an example of a simple A-frame truss, while Gleason Canyon Creek Bridge (53C1021) and Cattle Cannon Creek Bridge (53C0972),

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[20] Some sources distinguish between A-frame and King Post trusses in that the King Post truss has two diagonal members which connect from the center of the lower chord at the base of the vertical tension post to the center of timber truss members, whereas the A-frame only has a vertical tension post. American Technical Society, *Cyclopedia of Civil Engineering*, Fredrick E. Turneaure, ed. (Chicago: American Technical Society, 1908), 12-13; Harry Parker, *Simplified Design of Roof Trusses for Architects and Builders* (New York: John Wiley and Sons, Inc., 1941), 132. See also http://www.du.edu/~jcalvert/tech/truss.htm ; H. Haupt, *General Theory of Bridge Construction* (New York: D. Appleton & Co., 1851).

[21] Los Angeles County Department of Public Works, Bridge Plans, drawings 690888 through 690894; personal communication with Mr. Aki, retired Los Angeles County Department of Public Works engineer, February 11, 2002.

Howe trusses also located in Los Angeles County, are more complicated examples of the use of A-frame trusses.

Photograph 2: Cayucos Creek Bridge (49C0248). A-Frame truss built in 1940.

3.2.1.1.2 HOWE TRUSSES

William Howe, a Massachusetts carpenter, understood that in order to add substantial strength to the truss, employing an iron rod that connected the opposing vertices of the A-frames of the wooden diagonals would maintain the rigidity of the truss. Patented in 1840 and actively promoted by Howe's brother-in-law, Amasa Stone, the Howe truss became one of the most commonly used truss types in nineteenth century bridge construction. Other bridge builders began to use to the design, and the Howe truss became especially popular for railroad bridges as it could carry heavier loads.[22] There are three Howe truss bridges in the survey population. They are the Gleason Canyon Bridge (53C1021) built in 1956 and shown in photograph 3, Cattle Canyon Creek (53C0972) built in 1932 and shown in Photograph 1 on page 12, and Harden Flat

[22] Stephen Johnson and Roberto T. Leon, P.E. Ph.D., *Encyclopedia of Bridges and Tunnels*, (New York: Checkmark Books, 2002), entry for Howe Truss, 162.

Road Bridge (32C0053) built in 1933. The last of these, bridge 32C0053, is a variation on the traditional Howe truss. The Harden Flat Road Bridge is a Howe scissors truss. This deck style bridge design was employed because it was likely the most economical form that could be used in the rocky gorge in which it was built. Few Howe scissor trusses were ever built in California.

Photograph 3: Gleason Canyon Bridge (53C1021). Howe pony truss constructed in 1956.

#### 3.2.1.1.3 HOWE COVERED TRUSSES

Covered bridges were constructed with walls and a roof to protect the truss timbers from the elements. Most were built in rural areas which had an abundance of wood. While the majority of these bridges were constructed prior to World War II, communities have continued to build them to recapture the romance of times gone by.[23] Although covered bridges throughout the country were typically built using the Burr, Howe, and Warren trusses, California's existing

[23] The Brookwood Bridge was privately built in Humboldt County in 1970 and turned over to the county to be added to the public road system. Also located in Humboldt County is the Oregon City Covered Bridge constructed in 1984 at the entrance of Oregon City. "Covered Bridges," *Beacon* August 18, 1970; "Covered Bridges of California Counties," www.thetimesharebeat.com/yourworld.calbridges.htm .

covered bridges all have Howe trusses. There are a total of seven covered bridges on public roads; three of these bridges are in the survey population. Zane's Ranch Bridge (04C0048) and its sister bridge Berta's Ranch Road Bridge (04C0047), shown in Photograph 4, were both built in 1936, while the Oregon Creek Bridge (16C0017) was built in 1860.

Photograph 4: Berta's Ranch Road Bridge (04C0047). Howe truss covered bridge built in 1936.

3.2.1.1.4 CAMELBACK TRUSSES

There are two timber camelback truss bridges, Stone Coal Bridge (3C0092) and Cunningham Lane Bridge (47C0012), built in 1953 and 1951 respectively, remaining in California. The camelback truss is a variation of the Parker Truss that was developed by C. H. Parker in the mid-nineteenth century and based on the Pratt truss. Believed to be the "first scientifically designed truss," the Pratt truss was patented in 1844 and within several years variations of this design developed, all bearing improvements that allowed longer spans and greater loads.[24] Early Pratt and camelback trusses made use of both metal and timber materials; however, by the early

[24] Carl W. Condit, *American Building Art: The 19th Century*, (New York: Oxford University Press, 1960), 109.

twentieth century, with ever increasing popularity of the automobile as well as the advances in bridge designs, timber structures gave way to the more modern steel and concrete truss designs. Unlike the Pratt truss, the Parker employed a polygonal top chord created from irregularly sized pieces, thus giving the bridge greater strength. Similarly, the camelback truss's arched top chord is formed by five slopes, rather than a single chord as in the Pratt, or multiple arched top chords, used in the Parker truss. Economical to construct and with a better stress distribution that allowed for longer spans and heavier loads than its predecessors, the camelback gained popularity throughout the nation during the early twentieth century.[25] It was likely the economic benefit that led to Modoc County to decide to select the camelback design for Stone Coal Bridge (3C0092), shown in Photograph 5, for example, which carries Stone Coal Road, an unpaved county road, over the Pit River. With the sparsely populated valley, the Stone Coal Road had low traffic volumes; still, the stress distribution of the camelback could allow for the heavy weight of logging trucks that at times used this route to the main highway.

[25] T. Allan Comp and Donald Jackson, *Bridge Truss Types*, *A Guide to Dating and Identifying*, (American Association for State and Local History Technical Leaflet 95, History News, Vol. 32, No. 5, May 1977), n.p.

Photograph 5: Stone Coal Bridge (3C0092). Camelback truss built in 1953.

### 3.2.2. Suspension Bridges

Suspension bridge technology in California dates from the gold rush period and was widely used in the nineteenth and early twentieth century to bridge the mountain canyon terrain of the goldfields where suspended bridges could hang above swiftly moving rivers. The wire cable industry in California and its association with suspension bridge development is linked through Andrew Smith Halladie, a gold rush immigrant, who first worked with wire cable designed to pull ore carts. In 1857, Halladie established the first wire cable manufacturing facility in California, which he located in San Francisco, and in 1867, he took out his first patent for the invention of a rigid wire cable suspension bridge. In the ensuing years, numerous Halladie designed and manufactured wire cable suspension bridges were purchased and erected in the steep canyons of Northern California. Halladie's work in wire cable included the 1871 invention of the cable car system of San Francisco. Thus from an early period, suspension bridges were an integral component of nineteenth century infrastructure supporting development in California's mining districts and linked to the innovative industries representative of nineteenth century

California.[26] Unfortunately, no examples still remain in California representing this period of suspension bridge technological development. The Bidwell Bar Bridge (12P0001) in Butte County, built in 1856 and predating Halladie's association with suspension bridge technology is the only remnant of nineteenth century suspension bridges. Rebuilt in 1974, the bridge no longer suspends; instead it is supported by a series of wooden bents as it crosses over a dry ravine. It also no longer carries vehicle traffic. The rebuilt cables and tower are ornamental, not structural in nature. Renovation and rebuilding rendered the bridge ineligible for listing in the National Register of Historic Places and destroyed the integrity of this remaining example of nineteenth century technology.

Suspension bridge construction became relatively rare in California following the innovative period of the nineteenth century. In the early twentieth century, bridge building technology transitioned to experimenting with the new building material, concrete, and county surveyors and public works officials assumed more of the responsibilities of designing local bridges. Increasingly, material and construction costs as well as site suitability and local preferences, dictated local bridge design. Suspension bridges, such as the Mosquito Bridge (25C0061) shown in Photograph 6, were among the well-established designs available to counties for construction in remote areas where light traffic did not require a more substantial structure.

Local labor, under the direction of the county surveyor, could erect the simple structures, essentially using nineteenth century-era technology. Few were built though, as they were relatively expensive, especially as other bridge types became increasingly available and affordable during the mid-twentieth century.

While California has no major suspension bridges from the earlier period, the lessons learned helped guide construction of two of the worlds most successful suspension bridges, the Golden Gate Bridge, built in 1937 and the west span of the San Francisco-Oakland bay Bridge built in 1936. These two structures represent California's largest suspension bridges and were

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[26] Edgar Myron Kahn, "Andrew Smith Hallidie," originally printed in the *California Historical Society Quarterly,"* XIX, 2 (June 1940), reprinted online by the Cable Car Museum, http://www.cablecarmuseum.com/Library/HallidieBio.htm.

constructed during an era of major public works in the 1930s. Both bridges were previously determined eligible for listing in the National Register.

Photograph 6: Mosquito Bridge (25C0061). Timber suspension bridge built in 1939.

### 3.2.3. Concrete Trusses

Concrete was first used as a building material in Europe in the 1840s. Reinforcing concrete proved to strengthen the material and provided greater design flexibility. By the mid-1880s, European bridge designers began applying concrete to traditional bridge designs, such as the truss. E.L. Ransome built the first American concrete bridge in San Francisco in 1888. To build the Alvord Lake Bridge, Ransome used twisted reinforcement bar which he had developed. Many innovations in concrete construction were produced in California.

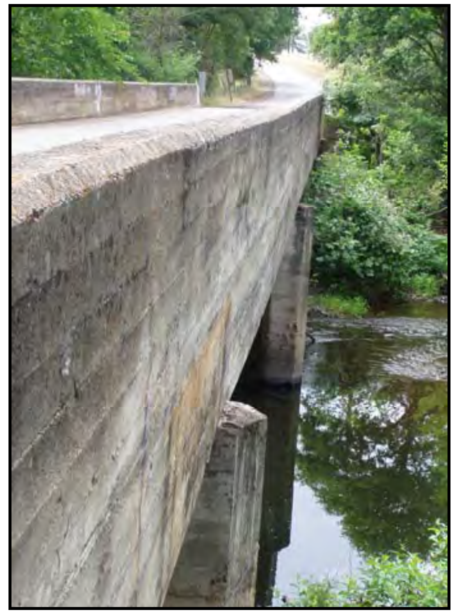
Reinforced concrete was increasingly used for bridges in California from the 1910s onward. Construction of concrete structures with steel embedded rods, first invented for building construction in warehouses, for example, had proved to be an extremely effective means of improving concrete's natural tensile weakness. While concrete was recognized for its strength when placed in compression, without steel support concrete tended to crack when placed in tension. Reinforced concrete was thus greatly beneficial in bridge construction, which required increasingly higher load capacities as motor vehicle use increased during the early twentieth century. By the mid-1930s, reinforced concrete bridges accounted for a majority of new bridges that the Division of Highways and local agencies constructed in California. Before reinforced concrete was built into bridges in the form of slabs, tee beams, and girders, it was used in the form of concrete trusses and arches.

Most reinforced concrete was built using the cast-in-place method, where liquid concrete was poured into wooden forms built at the bridge's location. Pre-cast methods were developed during the mid-twentieth century, where reinforced concrete could be poured elsewhere and moved into place after it was set. While there are a variety of concrete bridge designs, the current survey population includes two early forms of concrete bridge design, canticrete and reinforced concrete truss.

#### *3.2.3.1. Canticrete*

New forms of reinforcing concrete for bridge use continued to be developed in the twentieth century. John Buck Leonard (1864-1945), a California Bridge designer, invented the reinforcing process called canticrete during the 1910s. Like the early European reinforced concrete Melan system, canticrete utilized a cantilevered steel truss which was encased in fluid concrete.[27] The steel provided the shape and strength to support the heavy concrete structure, rather than having metal rods or cables in board poured concrete. Leonard, as part of the Leonard and Day design firm, was the designer of the three surviving canticrete bridges. Both the Mahle Bridge (16C0025, Photograph 8), transversing the South Honcut Creek between the counties of Butte and Yuba, and the Larkin Street Bridge (44C0082), located in Monterey County, were built in 1914. The third bridge, the Seventh Street Bridge (38C0023, Photograph 7), also known as the Lion Bridge, was built in the county of Stanislaus in 1916. Although designed by the same firm, the styles of these bridges vary, as do the communities they serve.

[27] California Department of Transportation, *Historic Highway Bridges of California*, 72 and 102.



Photograph 7 (left): Seventh Street Bridge (38C0023), also known as the Lion Bridge. Photograph 8 (right): Mahle Bridge (16C0025) crossing South Honcut Creek, built in 1914.

*3.2.3.2. Reinforced Concrete Truss*

The only example of a reinforced concrete truss bridge in California is the bridge once known as Murphy Slough Bridge (42C0551Z) of Fresno County. Built in 1916, Murphy Slough Bridge, shown in Photograph 9, is a Pennsylvania Petit pony truss constructed by the county to carry Elkhorn Avenue over Murphy/Fresno Slough. Designed during a period when the rise in automobile traffic demanded wider and stronger bridges, it is an example of the various ways bridge designers applied reinforced concrete to the new requirements. The Murphy Slough Bridge is unique, as the designer applied a standard railroad truss design to an automobile bridge.

Photograph 9: Murphy Slough Bridge (42C0551Z), constructed in 1916.

The Pennsylvania Petit truss was a popular truss style in the last quarter of the nineteenth century and into the early twentieth century. This truss is based on the Parker truss with the addition of sub-struts.[28] The design is complex and labor intensive to create as a concrete structure likely resulting in truss forms rarely being executed in reinforced concrete. The alignment for Elkhorn Avenue has been altered to bypass Murphy Slough Bridge, which no longer carries vehicle traffic. A few feet away a seven span concrete slab bridge, Fresno Slough Bridge (42C0600), was constructed in 1991. The Murphy Slough Bridge is listed in the National Register and is still maintained for pedestrian and bicycle traffic.[29]

### 3.2.4. Engineers, Designers, and Builders

Unlike other design endeavors, bridge design and construction is often an interwoven collective effort that includes government employees, private sector contractors, and public participation.

[28] Allan T. Comp and Donald Jackson, "Bridge Truss Types: a guide to dating and identifying" American Association for State and Local History Technical Leaflet 95, *History News* Vol. 32, No. 5, May 1977.
[29] Caltrans Database.

In the early twentieth century, cities and counties built most bridges hiring consultant engineers. Concrete trusses, including cantricrete structures, were among the relatively complex designs for which consulting engineers were used. John Buck Leonard was one of the most important consultant engineers working in California during the early twentieth century. After working for several different firms, including the American Bridge Company and Healy-Tibbetts & Company, Leonard became an associate editor of *The Architect and Engineer of California* in 1905. The position of editor of the reinforced concrete section of the journal provided Leonard influence and prestige. His career was greatly advanced as his own bridges were frequently featured. As he promoted the use of concrete in bridges and buildings, Leonard continued to design important bridges both in concrete and in metal. In 1911, the Fernbridge (04 0134), considered to be Leonard's masterpiece, was constructed with a total length of almost 2,500 feet. At the time of its completion, the Fernbridge's seven spans were the longest spans of any concrete bridge in the world and the bridge itself was the largest concrete highway bridge in the United States. A few years later, Leonard collaborated with William P. Day in writing a book entitled, *The Concrete Bridge: A Book on Why the Concrete Bridge is replacing other forms of Bridge Construction*. Leonard and Day then established a combined practice. One of Leonard's important contributions was his invention of the "cantricrete" structural system, which used a cantilevered steel truss to provide a structure of sufficient strength to support fluid concrete as it was placed. The truss then became the reinforcement for the reinforced concrete bridge. This system was designed to cut construction costs because falsework was not needed. This was an important example of the various designs employed during the early twentieth century as engineers sought ways to improve the use of concrete bridges by combining it with steel. Leonard left private practice for an appointment as superintendent of building inspection for the City of San Francisco in 1928, but returned as a consulting engineer in 1934 and continued until his death in 1945. Leonard was among the more influential engineers in this state. He successfully promoted the use of concrete in bridges. This practice led to construction of hundreds of concrete slab, arch, truss, and girder bridges in California in the early twentieth century, greatly enhancing the quality of the state's roadway system.[30]

[30] Paul Bryan Israel, "Spanning the Golden State: A History of the Highway Bridge in California," (M.A. thesis, University of California Santa Barbara, 1980), 47-50 and 153-155.

By the mid-1930s, a majority of bridge design in California had shifted to state or county employees. This shift was particularly true during World War II when most private engineers were occupied in the military or defense industries. While the Division of Highways Bridge Department designed many of California's bridges during the 1930s, 1940s, and 1950s, particularly along state routes and freeways, many local bridges were the result of county engineer involvement or counties employing consulting engineers. Bridge manufacturers had established common bridge truss types that could be employed in a variety of situations, and concrete designs became increasingly standardized. While each bridge was designed for its specific location and loads, many formulas and bridge types could be repeated. State or county engineers could rely on a bridge manufacturer's standard truss design. For constructing bridges, the state and counties commonly hired private contractors, many of whom worked in specific regions where they constructed a variety of bridges and other projects.

County engineers examined requirements for bridges and weighed different designs for specific uses. They in turn, consulted bridge manufacturers or state Bridge Department engineers to make final bridge design selections, often using standard bridge forms and components. Some counties did not have engineers on staff and hired consulting engineers, such as Harold B. Hammill, W.E. Emmett, or Clair A. Hill, to provide bridge design services. Design of timber truss and suspension bridges were usually handled on the local level. Los Angeles County, for instance, developed a set of standard plans for timber truss bridges in the 1920s. These plans were repeatedly used throughout the 1920s and through the 1950s.

## 4. DESCRIPTION OF SURVEY POPULATION

The survey population for this report consists of twenty-five bridges: sixteen timber truss, four concrete trusses, and five suspension bridges. To comprehend their known or possible historic significance, they have been studied in various ways. The following discussion provides categorical descriptions of the survey population properties including their location, age, type, size, and decorative elements. There is also an overall assessment of the historic integrity of the survey population.

As shown in Figures 1 and 2 (Appendix B), these bridges are located in thirteen of the state's fifty-eight counties in a variety of topographical and cultural settings. Half of the bridges are located in the north part of the state scattered in six Caltrans Districts, 1, 2, 3, 5, 9, 10, with the bridges located in the southern part of the state in Districts 5, 6 and 7. Most of the survey population bridges are in rural or mountainous settings, though a few are located in urban and suburban areas. There are no bridges in this survey population in Districts 4, 6, 8, 11 or 12.

The survey population bridges were constructed between 1860 and 1956. Table 1 shows the distribution by date of construction periods of the entire survey population.

Table 1: Number of Bridges from Periods of Construction

| **Date of Construction** | **Number** | **Percentage of Total** |
|---|---|---|
| Pre-1900 | 1 | 4 |
| 1900-1909 | 0 | 0 |
| 1910-1919 | 4 | 16 |
| 1920-1929 | 4 | 16 |
| 1930-1945 | 13 | 52 |
| 1946-1956 | 3 | 12 |
| **Total** | **25** | **100** |

The age, sub-types, relative sizes, and decorative elements of the survey population are discussed in the following sections regarding the three types of bridges studied in this report.

### 4.1. Timber Trusses

There were 37 timber truss bridges in the original statewide survey of 1986, as well as four timber truss bridges that were listed on the National Register prior to that survey. Of the total population of timber truss bridges in 1986, almost half (19 of 41) have been removed since that time. All 19 of the bridges that have been removed were ineligible for National Register listing. They were all built between 1924 and 1959, and located primarily in the state's coastal counties, from Humboldt to San Diego. This group included a variety of truss types, but was primarily made up of King Post and Queen Post trusses.

Of the 22 timber truss bridges remaining in California, 16 are included in this report. The other six bridges do not have Caltrans bridge numbers, as they are now used as pedestrian bridges and do not carry or cross motor vehicle roads. These six bridges include the four that were listed on the National Register prior to 1986, all of which are covered bridges built in the nineteenth century, and two other nineteenth century covered bridges which have been determined eligible for National Register listing. These six bridges are: the Honey Run Bridge in Butte County; the Felton, Glen Canyon, and Paradise-Masonic Bridges in Santa Cruz County; the Knight's Ferry Bridge in Stanislaus County; and the Wawona Bridge in Yosemite National Park.

The sixteen timber truss bridges included in this report are located on local roads, city streets, and state highways in seven counties: Modoc, Humboldt, Yuba, Tuolomne, Mono, San Luis Obispo, and Los Angeles. The bridge truss types and configurations are important to categorize so that one can understand the technological achievement embodied in each example. The survey population includes examples of both pony and deck roadway configurations as well as covered bridges. Half of the bridges in this survey population are A-frame truss bridges, seven of which are in Los Angeles County and one in San Luis Obispo County. There are six different categories of timber truss or construction types represented in the survey population. Table 2 lists the number of each truss type and its percentage within the survey population along with a total number of each type within the Caltrans system, built both before and after 1960.

Table 2: Truss or Construction Types

| Truss / Construction Type | Total Number in California | Number in survey | Percentage of type in Survey Total |
|---|---|---|---|
| A-frame/King/Queen Post | 9 | 8 | 50 |
| Howe Pony | 3 | 2 | 12 |
| Howe Scissors (Deck) | 1 | 1 | 6 |
| Howe Covered | 7 | 3 | 19 |
| Howe Through | 2 | 0 | 0 |
| Camelback | 2 | 2 | 13 |
| **Total** | **24** | **16** | **100** |

Photographs of each type are provided in Section 3.2. While the size of the timber truss spans in the survey population vary in size, they are generally small as compared to other bridge types as they all have span lengths that are under 100 feet. The spans of these bridges range from twelve feet to sixty-three feet in length. Of the various truss types, the Howe trusses in the survey population have the longest spans, they are all over fifty feet. The Howe Scissor truss type has one of the shortest spans of the survey population with a single twenty-one foot span. All of the timber truss bridges are built with utilitarian designs that do not exhibit architectural qualities as may be seen on some metal trusses or concrete arches. Some have aesthetic appeal relative to the appropriateness of their design to their setting. This is particularly true of the three covered bridges. A minority of the timber trusses in the survey population retain a high degree of historic integrity. Of the sixteen bridges, only five retain a high degree of integrity. The remaining eleven structures have all been altered since they were originally constructed. Alterations to the bridges include widenings, deck replacements, strengthening, and replacement of the entire structure.

### 4.2. Suspension Bridges

There are a total of fourteen suspension bridges on California roadways, eight built before 1960 and six constructed after 1960. As discussed, three of the eight pre-1960 suspension bridges are not part of the survey population. They are bridges 12P0001, 340003, and 270052. Bridge 12P0001 is the Bidwell Bridge and is maintained by the California Department of Parks and Recreation. Bridges 34 0003 and 27 0052 are the suspension spans of the Oakland Bay Bridge and the Golden Gate Bridge, respectively. Both of these large structures have been previously inventoried and evaluated. Two suspension bridges have been removed since the original bridge survey of 1986, one in Trinity County and one in Mendocino County. They were built in 1939 and 1940, and both were ineligible for National Register listing.

Five bridges comprise the survey population of suspension bridges. These five can be classified as small suspension bridges, compared with the Oakland Bay Bridge and Golden Gate Bridge, all of which were built between 1925 and 1944. The two oldest survey population suspension bridges are the Mattole River Bridge (04C0075) constructed in 1925 and the Yankee Jims Bridge (19C0002) constructed in 1930. Both of these structures are comprised of steel structure components. The remaining three bridges, constructed in 1938, 1939, and 1944 are 02C0049 Buker Bridge on Canyon Creek Road, 25C0061 Mosquito Bridge, and 02C0008 Horse Creek Bridge, respectively. These structures are timber bridges and both the Mosquito and Horse Creek Bridges replaced earlier structures using some components of their predecessors. Siskiyou County rebuilt the Buker Bridge in 1998 using laminated glue timbers adhering to the structure's original design. All suspension bridges in the survey population are county owned and located in the northern portion of the state in mountainous, rural settings. Three are located in the far northern counties of Siskiyou and Humboldt and two are located in the Sierra Nevada Foothill counties of Placer and El Dorado. Four of the five bridges span canyon settings and have main spans ranging in length from 36.58 meters (120 feet) up to 64.1 meters (210 feet). The Mattole River Bridge, though, spans a river located in a meadow setting and has the longest main span, 70.10 meters (230 feet).

The Mattole River Bridge (04C0075) and the Yankee Jim Bridge (19C0002) were determined eligible for the National Register in 1986. By the very nature of their structural design and location, the five bridges comprising the suspension bridge population, all have aesthetic appeal. The steel suspension bridges retain a higher degree of historic integrity than do the timber suspension bridges. While all three timber suspension bridges generally retain their original designs, they have all been modified with timbers replaced to varying degrees.

### 4.3. Concrete Trusses

California has four concrete truss bridges in the Caltrans system. All four were included in the original bridge survey of 1986, and no concrete truss bridges have been removed since the original survey. Three of these bridges, the Mahle Bridge (16C0025), the Larkin Street Bridge (44C0082), and the Seventh Street Bridge (38C0023), are "canticrete" structures built between 1914 and 1916. The well-known engineering firm of Leonard & Day designed all three structures. John Leonard invented the "canticrete" structural system. All three bridges have the outward appearance of concrete arch bridges, but structurally they are steel trusses cantilevered from the bridge abutments encased by solid spandrel walls that form the appearance of an arch. The fourth bridge is the Murphy Slough Bridge (42C0551Z) built in 1916. It is a Pennsylvania Petit pony truss built in reinforced concrete construction and is completely comprised of reinforced concrete. This bridge no longer carries vehicular traffic but is still maintained for pedestrian and bicycle use. All four concrete truss bridges have previously been determined eligible for listing in the National Register.

# 5. FINDINGS AND CONCLUSIONS

## 5.1. Evaluation Criteria

Bridges in California are usually evaluated under two National Register criteria: Criterion A, for their role in local or regional history, especially their contribution as links within the transportation system, and Criterion C, relating to possible significance in the field of engineering. Bridges are infrequently, if ever, found to be significant under Criteria B or D. Important historic persons associated with bridges are usually involved with their design, thus making them significant as a "work of a master" under Criterion C. Historic structures, such as bridges, can occasionally be recognized for the important information they might yield regarding historic construction materials or technologies making them significant under Criterion D. Bridges in California built during this period, however, are extremely well documented, so they are not themselves principal sources of important information in this regard.

Under Criterion A, California roadway bridges are potentially significant if they are importantly associated with trends and/or events in transportation development, regional or local economic development, community planning, or military history. Establishing this fact, though, should be done with certain principles in mind. Bridges, like other infrastructure, are inherently vital to communities as they are critical elements of essential city or regional planning, and they substantially impact communication and the distribution of people, goods, and services that affects development on both the local and regional levels. These common effects of bridge construction do not typically provide sufficient evidence to demonstrate how a structure may be deemed significant for its association with an important historic context; otherwise virtually any bridge would be shown to be important in this way. To be eligible for listing in the National Register, resource types such as bridges and other infrastructure must have demonstrable importance directly related to important historic events and trends, with emphasis given to specific demand for such facilities and the effects the structure had on social, economic, commercial, and industrial developments locally, regionally, or nationally. In this way, bridges may be significant as physical manifestations of important transportation and community planning developments on the local, regional, state, or national level. In this analysis, for example, a bridge that is the first in its location would be inherently more significant than one that is the second or third constructed at that location.

The most common instance in which a bridge might be considered under Criterion A would be if it were the first bridge at its site, thus providing expanded transportation opportunity and advancing economic development into previously isolated areas. Bridges that are possibly significant under Criterion A were likely built to meet specific demands, and their construction brought immediate and / or substantial effects to a geographic location. While this level of importance typically can be associated with the initial bridge at a particular location, it can be true of subsequent bridges in some cases. Bridges may also be important for their association with specific historic properties or events.

Under Criterion C, California roadway bridges are possibly significant for their importance within the field of bridge engineering and design. This significance derives from a bridge embodying distinctive characteristics of its type, period, or method of construction, or representing the work of a master engineer, designer, or builder. The historic significance of bridges within the field of bridge engineering and design has been studied in great detail in California and other states as a result of dozens of historic bridge inventories sponsored by the Federal Highway Administration during the 1970s, 1980s, and 1990s. While bridge types and inventory methods varied from state to state, the many historic bridge inventories have generally established salient attributes that help define significance of structures within the field of bridge engineering and design. These attributes are as follows:

- Rarity – the number of remaining examples of a bridge construction type;
- Innovative design techniques or use of construction methods that advanced the art and science of bridge engineering;
- Boldness of the engineering achievement – representing the measures taken to overcome imposing design and construction challenges related to load, stress, and other engineering and environmental complexities;
- Aesthetics – the visual quality achieved in a bridge's individual design or with its appropriateness within the natural or man-made setting.

These attributes contribute to the evaluation of a bridge's type, period, or method of construction and are combined with an assessment of a bridge's association with possible historically significant engineers and/or builders.

In order to be listed in the National Register, a bridge must have historical and/or engineering significance as well as historic integrity. Loss of integrity, if sufficiently great, will overwhelm the historical significance a bridge may possess and render it ineligible. Likewise, a bridge can have complete integrity, but if it lacks significance, it must also be considered ineligible. Integrity is determined through applying seven factors defined by National Register guidelines. Those factors are location, design, setting, workmanship, materials, feeling, and association. These seven can be roughly grouped into three types of integrity considerations. Location and setting relate to the relationship between the property and its environment. Design, materials, and workmanship, as they apply to historic bridges, relate to construction methods and engineering details. Feeling and association are the least objective of the seven criteria and pertain to the overall ability of the property to convey a sense of the historical time and place in which it was constructed.

## 5.2. Bridges in Historic Districts and Historic Landscapes

Bridges can also be eligible for listing in the National Register as contributors to a significant historic district. This occurs when the structure is associated with the significant period of development of the adjacent properties. Bridges have been included in districts in California, along with adjacent buildings, as gateways to towns and as important transportation links to their regions. There are also bridges that are listed in the National Register as part of a historic district completely composed of bridges.

Bridges may also be eligible for listing in the National Register as part of historic landscapes, also referred to as cultural landscapes. Historic landscapes that include structures are geographic areas that have undergone past modification by human design, were used in identifiable patterns, or were the sites of a significant event. They can be designed landscapes that present a conscious work of creation based on design principles of landscape architecture. Bridges along a parkway, for instance, could be eligible as part of the designed plans for that roadway. Historic landscapes that include structures can also be vernacular landscapes that have evolved through time. These reflect human activities or occupancy from a certain time. Of the two types of historic landscapes that can include structures, vernacular landscapes are more difficult to define and find eligible. Designed landscapes can be compared with original design intent, whereas the boundaries, significance, and integrity of vernacular landscapes can be difficult to distinguish. Nevertheless, it is possible that timber truss, concrete truss, and suspension bridges that may or may not appear eligible under evaluation in this survey could be eligible as part of a historic landscape. This could occur, for instance, in a rural area where there is not the concentration of buildings or structures to indicate the presence of a historic district. Rather, the bridge would be part of the visual character of an open space, perhaps agricultural, with no concentration of buildings or structures. To find a bridge eligible as part of a historic landscape, its contributing significance would need to be explicitly stated. Such a conclusion would occur only if the structures could not be otherwise understood as an individual structure or as a structure within a local, regional, or statewide transportation as examined in this survey. JRP did not identify any bridge within the survey population that would be significant as part of a historic landscape.

### 5.3. Eligibility for Listing in the National Register of Historic Places

Of the twenty-five bridges studied for this report, seven were previously listed in or determined eligible for listing in the National Register. The other eighteen had previously been found not eligible. Beyond this historic bridge inventory, some bridges in California have been determined significant by methods other than the National Register criteria. These include designations by the American Society of Civil Engineers (ASCE) and by local cities or counties. The ASCE designates important engineering features across the country as National Historic Civil Engineering Landmarks. These include both individual bridges as well as bridges that are components of important highways. Most, if not all, bridges designated as civil engineering landmarks in California have also been listed in or determined eligible for listing in the National Register for their important design qualities. The ASCE designation does not have official status within the National Historic Preservation Act Section 106 process, but is useful in indicating structures of particular importance within the field of civil engineering.

Many cities and counties in California have local historic preservation ordinances that buildings and structures listed as local landmarks. These local lists include a wide range of resources and some include bridges. Local authorities apply varying levels of protection to these resources. Some lists are honorary designations while others seek to physically protect the historic resources. Sonoma County and the cities of San Francisco, San Jose, and Los Angeles are among the local agencies to have designated bridges as local historic landmarks. These local designations do not have any direct bearing on the Section 106 process, but they do become an issue when Caltrans seeks to comply with the California Environmental Quality Act (CEQA) as it pertains to impacts to historical resources. Buildings and structures that are listed, or determined eligible for listing, in the National Register are automatically eligible for listing in the California Register of Historical Resources, and are historical resources for the purposes of CEQA. In addition to resources listed in or determined eligible for listing in the California Register, CEQA also takes into account locally designated resources. Such resources are also usually considered historical resources for the purposes of CEQA. Therefore, it is possible that a bridge determined not eligible as a result of this report could be a historical resource for the purpose of CEQA. Caltrans will need to clarify local designations of bridges on a project by project basis.

5.3.1. Bridges previously listed or determined eligible for the National Register

JRP examined the seven bridges in the survey population that were previously listed or eligible for the National Register. Each was field checked and photographed. Current photographs of these bridges are printed in Appendix D. They all retain sufficient historic integrity to continue meeting the criteria for listing in the National Register:

Table 3: Bridges previously listed or determined eligible

| County | Bridge # | Road / Street | Feature Intersected | Year Built | Truss Or Bridge Type |
|---|---|---|---|---|---|
| Humboldt | 04C0075 | Lindley Road | Mattole River | 1925 | Suspension Bridge |
| | | | | | |
| Yuba | 16C0017 | Alleghany Road | Oregon Creek | 1860 | Timber Howe Covered Truss |
| | 16C0025 | Honcut Road | South Honcut Bridge | 1914 | Concrete Canticrete |
| | | | | | |
| Placer | 19C0002 | Colfax-Forrest Hill Road | North Fork American River | 1930 | Suspension Bridge |
| | | | | | |
| Stanislaus | 38C0023 | Seventh Street | Tuolumne River | 1916 | Concrete Canticrete |
| | | | | | |
| Fresno | 42C0551Z | Pedestrian/bicycle crossing (next to Elkhorn Avenue) | Fresno Slough (Murphy Slough) | 1916 | Reinforced Concrete Truss |
| | | | | | |
| Monterey | 44C0082 | Larkin Street | Hartnell Gulch | 1914 | Concrete Canticrete |

TOTAL: 7 bridges

5.3.2. Bridges that do not appear to meet the criteria for National Register listing

The following table lists the eighteen bridges in the survey population that do not appear to meet the criteria for listing in the National Register.

Table 4: Bridges that do not appear eligible for listing in the National Register.

| County | Bridge # | Road / Street | Feature Intersected | Year Built | Bridge or Truss Type |
|---|---|---|---|---|---|
| Siskiyou | 02C0008 | Horse Creek Road | Klamath River | 1944 | Suspension Bridge |
| | 02C0049 | Canyon Creek Road | Scott River | 1938 | Suspension Bridge |
| | | | | | |
| Modoc | 03C0092 | Stone Coal Road | Pit River | 1953 | Timber Camelback Pony Truss |
| | | | | | |
| Humboldt | 04C0047 | Berta's Ranch Road | Elk River | 1936 | Timber Howe Covered Truss |
| | 04C0048 | Zanes Ranch Road | Elk River | 1936 | Timber Howe Covered Truss |
| | | | | | |
| El Dorado | 25C0061 | Mosquito Road | S. Fork American River | 1939 | Suspension Bridge |
| | | | | | |
| Tuolumne | 32C0053 | Hardin Flat Road | S. Fork American River | 1933 | Timber Howe Scissors Truss |
| | | | | | |
| Mono | 47C0012 | Cunningham Lane | West Walker River | 1951 | Timber Camelback Pony Truss |
| | | | | | |
| San Luis Obispo | 49C0248 | Cayucos Creek Road | Cayucos Creek | 1940 | Timber A-Frame Truss |
| | | | | | |
| Los Angeles | 53C0935 | Lake Vista Drive | Malibou Lake | 1923 | Timber A-Frame Truss |
| | 53C0939 | Old Topanga Canyon Road | Garapatos Creek | 1926 | Timber A-Frame Truss |

| County | Bridge # | Road / Street | Feature Intersected | Year Built | Bridge or Truss Type |
|---|---|---|---|---|---|
| | 53C0967 | Little Tujunga Canyon Road | Buck Canyon | 1928 | Timber A-Frame Truss |
| | 53C0969 | Little Tujunga Canyon Road | Pacoima Creek | 1931 | Timber A-Frame Truss |
| | 53C0971 | Shinn Road | San Antonio Creek | 1950 | Timber A-Frame Truss |
| | 53C0972 | Camp Bonita-Prairie Forks Road | Cattle Canyon Creek | 1932 | Timber Howe Truss |
| | 53C0975 | Jessen Drive | Earl Canyon | 1940 | Timber A-Frame Truss |
| | 53C0996 | Vasquez Canyon Road | Bouquet Creek | 1942 | Timber A-Frame Truss |
| | 53C1021 | Aliso Canyon Road | Gleason Canyon Creek | 1956 | Timber Howe Truss |

TOTAL: 18 bridges

*5.3.2.1. Evaluation of Timber Truss Population*

There are sixteen timber truss bridges in the survey population. Of these there is only one bridge, Oregon Creek Covered Bridge (16C0017) that is listed in the National Register. The remaining fifteen bridges do not appear eligible for listing on the National Register. Each of these eighteen structures has been individually inventoried and recorded on a DPR 523 form. These forms are in Appendix B.

Under Criterion A, the survey population timber truss bridges do not demonstrate sufficient importance in community planning and development, transportation systems, agriculture, ranching, tourism, or the timber industry in California. Bridges, like other infrastructure, are inherently vital to communities as they are often part of essential city or regional planning, and they considerably impact communication and the distribution of people, goods, and services that facilitates development on both the local and regional levels. These common effects of bridge construction do not typically provide ample substance to demonstrate how the resource may be associated with its historic context in an important manner. To be eligible for listing in the National Register, bridges and other infrastructure type resources must be shown to have particular importance directly related to events and trends in community development and transportation, with emphasis given to the specific demand for such facilities and the cause and effect relationship of its construction.

The survey population includes three bridges which replaced bridges on an established transportation system. The A-frame truss bridge (49C0248) crossing Cayucos Creek in San Luis Obispo, for example, replaced a smaller bridge in 1940 to provide greater access to a growing community. Similarly, the Pit River Bridge (03C0092), one of two camelback truss bridges in the survey population, was constructed in 1953 to replace a bridge that was washed out by a flood. The third replacement bridge in the survey population is Bouquet Creek Bridge (53C0996), constructed in 1942 in Los Angeles County. The remaining thirteen bridges were the first at their locations. These bridges provided access to new or expanding communities, such as the Malibou Lake Bridge (53C0935). Others improved access to National Forests, such as Cattle Canyon Creek Bridge (53C0972), and or other recreational areas in Los Angeles County. Although these bridges may have provided support to the local economy and growth, the historic evidence for fifteen of the timber truss bridges does not appear to support its eligibility for listing in the National Register under Criterion A.

Under Criterion C, a timber truss bridge would need to be significant for its importance within the field of bridge engineering and design. This significance derives from a bridge embodying distinctive characteristics of its type, period, or method of construction, or representing the work of a master engineer, designer, or builder. The general attributes that help define significance in the area of bridge engineering are the uses of new or innovative design and construction methods, the rarity of the structure type, the boldness of the engineering achievement, and the aesthetic value of the structure in its setting. In terms of the bridge's significance within the field of bridge engineering, the A-frame truss bridges, Howe and Howe covered truss bridges, and the camelback truss bridges do not appear to represent either innovative designs of significant method of construction or bold engineering achievement. The timber A-frame trusses, for example, represent the implementation of old technology during a period when counties and the state Division of Highways were implementing new designs to meet the growing demands of California's roadway and highway system.

Modern truss bridge design dates to the mid-nineteenth century, when various patented forms of trusses were developed, chiefly to serve the burgeoning railroad construction business. The earliest truss bridges were combinations of wood and iron, with major compression members in wood and the smaller tension members in iron. A series of variations were developed in rapid succession in the 1830s and 1840s, each with a proper name, usually reflecting its inventor. Such patents began a long trend of assigning proper names to truss bridge forms, an unusual development that did not occur with respect to other types of bridges. In time, three truss designs dominated wooden truss bridge construction: the Howe truss, used most commonly in covered bridge construction, and the Warren and Pratt trusses, used more commonly in exposed through truss design, but also in pony truss bridges as well.[31] However, for simple, short spans, the A-frame truss remained in the bridge builder's design kit. Comp and Jackson, in their treatise on truss bridges, noted that the A-frame was an ancient design, but "their modern day descendants can still be seen in very short bridges on some back country roads."[32] The bridges located in Los Angeles County, for example, illustrate this. These bridges were built from general plans drawn up for the most part by county engineers and are not important examples of their work. The bridges lack aesthetic qualities that would constitute sufficient importance to make it significant under Criterion C. Additionally, few of the bridges retain historic integrity, as many of them have been widened or otherwise altered to handle modern transportation demands.

*5.3.2.2. Evaluation of Suspension Bridge Population*

Taken individually, three of the five suspension bridges included in the survey population do not appear to demonstrate sufficient importance within the context of the development of mining, agriculture, or the lumber industry in Northern California to be eligible for the National Register under Criterion A. As stated, to be eligible for listing in the National Register under Criterion A, resource types such as bridges must have demonstrable importance directly related to important historic events and trends, with emphasis given to specific demand for such facilities and the

[31] A "through" truss is a bridge with full height trusses, joined with bracing at the top. A "pony" truss includes trusses that are much shorter and are not joined at the top.

[32] T. Allan Comp and Donald Jackson, "Bridge Truss Types: A Guide to Dating and Identifying." AASLH Technical Leaflet 95, n.p.

social, economic, commercial, and/or industrial effects their construction had locally, regionally, or nationally. The historic evidence for the mid-twentieth century suspension bridges do not appear to support eligibility for listing in the Nation Register under Criterion A. Two of the three bridges replaced previous bridges on established transportation routes. The Horse Creek Bridge (02C0008) served the community of Horse Creek, originally a mining community dating from the late nineteenth century. Several previous bridges provided access across the Klamath River at this point aiding the development of surrounding countryside in both its agricultural and recreational potential. The present Mosquito Road Bridge (25C0061) replaced a nineteenth century suspension bridge over the south fork of the American River, which provided the community of Mosquito relatively direct access to the county seat of Placerville. The Buker Bridge on Canyon Creek Road (02C0049) constructed in 1938 was the first in its location. It facilitated the expansion of the recreational development in the Scott River area of the Klamath National Forest as well as enhancing the local transportation network for area farmers. Bridging the mountain canyons with suspension bridges contributed to the development of nineteenth century mining and agricultural communities by adding to the improvement of transportation systems, a practice that continued into the twentieth century. However, as integral components in larger transportation systems, bridges are not necessarily important in and of themselves. This bridge was part of a wider set of improvements in and around the Klamath National Forest and did not directly foster development, nor was it significant for its association with the transportation system of Siskiyou County.

Under Criterion C, the three suspension bridges re-evaluated for this report would need to be significant for their importance within the field of bridge engineering and design. This significance derives from a bridge embodying distinctive characteristics of type, period, or method of construction or representing the work of a master engineer, designer, or builder. These bridges do not appear to possess or be important for their attributes of rarity, innovative design techniques, or methods of construction and aesthetics. Suspension bridge technology in California dates from the gold rush period and was widely used in the nineteenth and early twentieth century to bridge mountain canyon terrain where suspension bridges could hang above swift moving rivers and away from the danger of being swept away during the spring snow thaw. While examples of mid-twentieth century small suspension bridges in California are relatively rare, these bridges do not represent innovative designs or construction methods nor do they constitute bold engineering achievements. These designs are among the variety of timber structures, truss and suspension, built in mountainous or rural areas of the state during the mid-twentieth century. In general, timber structures were built at these locations because of the availability of building materials and because importing materials for concrete or steel structures would have been more expensive. These mid-twentieth century timber structures were generally built using well-established designs that do not present innovative technological feats or innovative methods of construction from their period. Of the attributes listed above, though, these bridges do attain a relatively high aesthetic quality. This aesthetic quality is not only achieved in the bridge's design itself, but also in the appropriateness and integration of that design to its natural setting. Yet without technical significance, aesthetics alone does not make this bridge significant. Thus these bridges do not embody distinctive engineering characteristics. They also do not represent distinguished achievements by master bridge engineers or builders. These bridges also lack historic integrity to some degree. All have had timbers replaced and their designs have been modified. Siskiyou County replaced all of the timbers on the Horse Creek Bridge (02C0008).

Therefore, lacking historic and engineering significance, plus the degradation of their historic integrity, Bridges 02C0049, 25C0061, and 02C0008 do not appear to meet the criteria for listing in the National Register.

*5.3.2.3. Evaluation of Concrete Truss*

The three canticrete bridges and one reinforced concrete truss bridge in the survey population have all been previously found eligible for listing in the National Register. All retain sufficient integrity to remain eligible for the National Register. Under Criterion C, concrete truss bridges in California would need to be significant for their importance within the field of bridge engineering and design. This significance derives from a bridge embodying distinctive characteristics of type, period, or method of construction or representing the work of a master engineer, designer, or builder. The canticrete bridges (44C0082, 16C0025, and 38C0023) are associated with the major bridge designer John Leonard, who is distinguished for his innovative work in concrete, such as the creation of the canticrete design. Murphy Slough Bridge

(42C0551Z), the only reinforced concrete truss bridge in California, exemplifies the creative solutions bridge engineers attempted by applying new and improved materials to traditional forms. During a period of innovation in the use of concrete to create stronger and larger bridges to support the growing automobile demands, the remaining three canticrete structures and the sole remaining reinforced concrete truss bridge illustrate the transition between historic and modern bridge design, as well as the changing American environment due to the automobile revolution. Field checks found both the canticrete bridges and the reinforced concrete truss bridge have maintained integrity in the field of bridge engineering. The bridges have not undergone any structural changes that have altered their original appearance.

## 6. PREPARERS' QUALIFICATIONS

Principals Rand Herbert and Stephen Wee directed this project. Mr. Herbert (M.A.T. in History, University of California at Davis), and Mr. Wee (M.A. in History, University of California, Davis) have more than 27 years experience each in conducting historic resources inventory and evaluation studies. Based on their levels of education and experience Mr. Herbert and Mr. Wee qualify as historians and architectural historians under the United States Secretary of the Interior's Professional Qualification Standards (as defined in 36 CFR Part 61).

JRP senior architectural historian Christopher McMorris was the general project manager / lead historian for the project. Mr. McMorris directed research and field survey crews, data management and graphics production, and prepared the contextual statement and evaluations. Mr. McMorris holds a M.S. in Historic Preservation from Columbia University in New York. He has been with JRP since 1998, conducting historic survey and evaluation studies and other historic preservation projects. Mr. McMorris also qualifies as historian and/or architectural historian under the United States Secretary of the Interior's Professional Qualification Standards (as defined in 36 CFR Part 61).

Staff historians for this project were Amanda Blosser, Kathleen Kennedy, and Toni Webb. Staff historians conducted the field surveys of historic bridges, performed research and contributed to the evaluation analysis, as well as data management. Staff historians also contributed to the production of the narrative context developed for the study area. Ms. Blosser received a M.S. in Architecture from Texas Tech University with a specialization in historic preservation and has over three years of experience in public history and historic preservation. Ms. Kennedy received a M.A. in History from California State University, Sacramento and has two years experience in public history. Ms. Webb received a B.F.A. in Historic Preservation from the Savannah College of Art & Design and has over four years of experience in public history and historic preservation. Ms. Blosser and Ms. Webb also qualify as historians and/or architectural historians under the United States Secretary of the Interior's Professional Qualification Standards (as defined in 36 CFR Part 61).

Research assistants and technicians on this report were Brandon De Lallo, Stacie Ham, Susan Hotchkiss, Eric Johnson, Nella Cornwall, Cindy Toffelmier, and Andrew Walters. The assistants and technicians assisted with field survey and research tasks, as well as with data management, graphics production, and preparing content statements and evaluations. Many of the research assistants at JRP are recent graduates or current students of the Public History program at California State University, Sacramento. Others are graduates of the University of California, Davis or California State University, Sacramento, with bachelor degrees in history or related fields.

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# ATTACHMENTS

# APPENDIX A:
# LETTERS FROM
# THE INTERESTED PUBLIC

# APPENDIX B:

# FIGURES

# APPENDIX C:

## DPR 523 FORMS

Bridges that do not appear eligible for listing in the National Register

| Bridge # | Road / Street | Feature Intersected | Year Built | Bridge or Truss Type |
|---|---|---|---|---|
| 02C0008 | Horse Creek Road | Klamath River | 1944 | Suspension Bridge |
| 02C0049 | Canyon Creek Road | Scott River | 1938 | Suspension Bridge |
| 03C0092 | Stone Coal Road | Pit River | 1953 | Timber Camelback Pony Truss |
| 04C0047 | Berta's Ranch Road | Elk River | 1936 | Timber Howe Covered Truss |
| 04C0048 | Zanes Ranch Road | Elk River | 1936 | Timber Howe Covered Truss |
| 25C0061 | Mosquito Road | S. Fork American River | 1939 | Suspension Bridge |
| 32C0053 | Harden Flat Road | S. Fork American River | 1933 | Timber Howe Scissors Truss |
| 47C0012 | Cunningham Lane | West Walker River | 1951 | Timber Camelback Pony Truss |
| 49C0248 | Picachio Road | Cayucos Creek | 1940 | Timber A-Frame Truss |
| 53C0935 | Lake Vista Drive | Malibou Lake | 1923 | Timber A-Frame Truss |
| 53C0939 | Old Topanga Canyon Road | Garapatos Creek | 1926 | Timber A-Frame Truss |
| 53C0967 | Little Tujunga Canyon Road | Buck Canyon | 1928 | Timber A-Frame Truss |
| 53C0969 | Little Tujunga Canyon Road | Pacoima Creek | 1931 | Timber A-Frame Truss |
| 53C0971 | Shinn Road | San Antonio Creek | 1950 | Timber A-Frame Truss |
| 53C0972 | Camp Bonita-Prairie Forks Road | Cattle Canyon Creek | 1932 | Timber Howe Truss |
| 53C0975 | Jessen Drive | Earl Canyon | 1940 | Timber A-Frame Truss |
| 53C0996 | Vasquez Canyon Road | Bouquet Creek | 1942 | Timber A-Frame Truss |
| 53C1021 | Aliso Canyon Road | Gleason Canyon Creek | 1956 | Timber Howe Truss |

# APPENDIX D:

## PHOTOS

## Bridges previously listed or determined eligible for the National Register

| Bridge # | Road / Street | Feature Intersected | Year Built | Truss Or Bridge Type |
|---|---|---|---|---|
| 04C0075 | Lindley Road | Mattole River | 1925 | Suspension Bridge |
| 16C0017 | Alleghany Road | Oregon Creek | 1860 | Timber Howe Covered Truss |
| 16C0025 | Honcut Road | South Honcut Bridge | 1914 | Concrete Canticrete |
| 19C0002 | Colfax-Forrest Hill Road | North Fork American River | 1930 | Suspension Bridge |
| 38C0023 | Seventh Street | Tuolumne River | 1916 | Concrete Canticrete |
| 42C0551Z | Pedestrian/bicycle crossing (next to Elkhorn Avenue) | Fresno Slough (Murphy Slough) | 1916 | Reinforced Concrete Truss |
| 44C0082 | Larkin Street | Hartnell Gulch | 1914 | Concrete Canticrete |


Bridge 04C0075, Lindley Road, Mattole River, February 2003

Bridge 16C0017, Alleghany Road, Oregon Creek, May 2003

Bridge 16C0025, Honcut Road, South Honcut Bridge, May 2003

Bridge 19C0002, Colfax-Forrest Hill Road, North Fork American River, March 2003

Bridge 38C0023, Seventh Street, Tuolumne River, May 2003

Bridge 42C0551Z, Pedestrian/Bicycle Crossing, Fresno Slough, May 2003

Bridge 44C0082, Larkin Street, Hartnell Gulch, June 2003