STATE HISTORIC BRIDGE INVENTORY AND EVALUATION

2024 UPDATE

STATE OF HAWAII
Department of Transportation
Highways Division

STATE HISTORIC BRIDGE INVENTORY AND EVALUATION 2024 UPDATE

Prepared for
STATE OF HAWAII
Department of Transportation
Highways Division

Prepared by
WSP USA

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2024

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ACRONYMS AND ABBREVIATIONS

- AASHO American Association of State Highway Officials (before 1973)
- AASHTO American Association of State Highway Transportation Officials (1973 to present)
- ACHP Advisory Council on Historic Preservation
- BPR Bureau of Public Roads
- C.F.R. Code of Federal Regulations
- CLG Certified Local Government
- CPL Commissioner of Public Lands
- DLNR Department of Land and Natural Resources
- DOT Department of Transportation (Federal)
- DPW Department of Public Works
- FAP Federal Aid Primary (route)
- FHWA Federal Highway Administration
- HAER Historic American Engineering Record
- HDOT State of Hawaii, Department of Transportation, Highways Division
- HHF Historic Hawaii Foundation
- HRS Hawaii Revised Statutes
- HRHP Hawaii Register of Historic Places
- H-1 Hawaii Interstate Highway, designation H-1
- H-2 Hawaii Interstate Highway, designation H-2
- H-3 Hawaii Interstate Highway, designation H-3
- IHS Interstate Highway System
- KHPRC Kauai Historic Preservation Review Commission
- LRFD Load and Resistance Factor Design
- MCRC Maui Cultural Resources Commission
- MOA Memorandum of Agreement
- NBI National Bridge Inventory
- NCHRP National Cooperative Highway Research Program
- NEPA National Environmental Policy Act
- NHPA National Historic Preservation Act
- NRHP National Register of Historic Places
- PRA Public Roads Administration
- SAFETEA-LU Safe, Equitable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
- SHBIE State Historic Bridge Inventory and Evaluation
- SHPD State Historic Preservation Division
- SHPO State Historic Preservation Officer
- SPW Superintendent of Public Works
- STURAA Surface Transportation and Uniform Relocation Assistance Act
- THD Territorial Highway Department
- TMK Tax Map Key
- U.S.C. United States Code

EXECUTIVE SUMMARY

This project provides an update to and replaces the 2013 State Historic Bridge Inventory and Evaluation (SHBIE) which identified 707 bridges throughout Hawaii that are eligible for listing or have been listed in the Hawaii Register of Historic Places (HRHP) or National Register of Historic Places (NRHP). The goal for the State of Hawaii, Department of Transportation, Highways Division (HDOT) is to utilize this inventory to aid in future project planning that may involve historic bridges.

Through coordination with HDOT, WSP USA, Inc. has reevaluated 100 "Priority Bridges" from the 2013 SHBIE that HDOT has identified for near-term project work. In addition, WSP USA, Inc. provided evaluations for previously unevaluated bridges constructed from 1968 through 1977 (totaling 196), updated the SHBIE's historic context, included information on bridges substantially altered since 2013 and not otherwise covered by HDOT's Priority Bridges list, and provided new inventory forms with additional information for both National Historic Preservation Act (NHPA) Section 106 and Hawaii Revised Statutes (HRS) § 6E compliance. This SHBIE Update also includes 2013 survey forms for bridges that have not been updated, bridge identification information, historic context to 1987, and report appendices.

This project was prepared by staff at WSP USA, Inc. who meet the Secretary of the Interior's Professional Qualifications Standards for Architectural History and History (36 C.F.R. Part 61, Appendix A).

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1.0: INTRODUCTION

1.1 OVERVIEW

The Hawaii Department of Transportation (HDOT) is tasked with maintaining and managing bridges throughout the State of Hawaii, along with individual County departments of transportation. Many of these bridges meet or are approaching an age that warrants consideration as a historic property pursuant to state and federal historic preservation law. Projects that utilize state or federal funding must consider alternatives that are feasible and prudent before adversely affecting a historic property through undertakings that may include alterations, repair, and/or replacement of historic bridges. In the 1980s and 1990s, historic bridge inventories have been prepared for each island and combined into one document in 2008. Because of the volume of bridges in Hawaii, an efficient process for identifying bridges that are eligible for listing in the Hawaii Register of Historic Places (HRHP) and National Register of Historic Places (NRHP) was developed in 2013 through efforts that resulted in the 2013 State Historic Bridge Inventory and Evaluation (SHBIE) by MKE Associates LLC and Fung Associates, Inc.

Since publication of the 2013 SHBIE, HDOT has utilized the inventory to aid in project planning by identifying known historic bridges that may be affected by HDOT activities. This 2024 update builds upon the information from the 2013 SHBIE and an earlier bridge report completed by The Heritage Center in 2008 under the supervision of Spencer Leineweber of Honolulu, Hawaii. The current scope of work did not involve re-visiting the already developed bridge historic contexts or other major elements of the previous bridge inventories. Where possible, efforts were made in this 2024 SHBIE update to carry forward all relevant and useful information from the 2013 report. The following has been largely carried over from the 2013 report: Chapter 2, Chapter 3 (sections 3.0-3.7 with edits to text and footnotes where necessary), 2013 survey forms for bridges not receiving updated forms, Appendix E, and Appendix F. The SHBIE has been updated to include State and County bridges constructed from 1968 to 1977, identifies bridges that may have been substantially altered since the 2013 SHBIE, and reevaluates 100 bridges HDOT identified as “Priority Bridges” as part of future project planning activities. Of these 100 “Priority Bridges,” all but two were state-owned. The SHBIE update also provides a historic context for 1968-1987 (section 3.8) to cover the completion of Interstate H-1 and the beginning of construction for Interstate H-3.

1.2 REGULATORY BACKGROUND

STATE LAW

Hawaii Revised Statutes (HRS), Chapter 6E (1976)

Chapter 6E of the HRS regulations requires the “development of a statewide survey and inventory to identify and document historic properties.”[1] The State Historic Preservation Officer (SHPO) is required to coordinate the activities of the political subdivisions of the state in accordance with the state plan for historic preservation. Further, HRS § 6E-8, Review of effect of proposed State and County projects, requires HDOT to provide the State Historic Preservation Division (SHPD) with an opportunity for review

[1] State of Hawaii, *§6E-3 Historic Preservation Program*, under Hawaii Revised Statutes Chapter 6E, http://www.state.hi.us/dlnr/hpd/hpfctsht.htm (accessed April 1, 2013).

and must receive a written concurrence before a project can proceed.[2] In HRS § 6E-2, a "project" is defined as any activity directly undertaken by the State or its political subdivisions or supported in whole, or in part, through appropriation, contracts, grants, subsides, loans, or other forms of funding assistance from the State or its political subdivisions or involving any lease, permit, license, certificate, land use change, or other entitlement for use issued by the State or its political subdivisions (Hawaii Senate Bill SB 3010).

Hawaii Administrative Rules (HAR), § 13-275

The HAR "Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-7 and 6E-8, HRS" includes a review process that is "designed to identify significant historic properties in project areas and then to develop and execute plans to handle impacts to the significant historic properties in the public interest." Pursuant to HAR § 13-275-2, a historic property means, "any building, structure, object, district, area or site, including heiau and underwater site, which is over fifty years old." A significant historic property means, "any historic property that meets the criteria of the Hawaii register of historic places."[3] A significant historic property shall possess integrity of location, design, setting. materials, workmanship, feeling, and association and shall meet one or more of the following criterion:

a. Be associated with events that have made an important contribution to the broad patterns of our history;

b. Be associated with the lives of persons important in our past;

c. Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, or possess high artistic value;

d. Have yielded, or is likely to yield, information important for research on prehistory or history; or

e. Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts--these associations being important to the group's history and cultural identity.

Federal Law

National Historic Preservation Act (NHPA) of 1966, 54 United States Code (U.S.C.) §300101

The NHPA recognizes the Nation's historic heritage and establishes a national policy for the preservation of historic properties. The project is an undertaking subject to compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA) (54 United States Code (U.S.C) § 300101 et seq.) and its implementing regulations (36 Code of Federal Regulations (C.F.R.) Part 800). Specifically, Section 106 of the NHPA requires that the responsible federal agency consider the effects of its actions

[2] State of Hawaii, *§6E-8 Review of effect of proposed State and County projects*, under Hawaii Revised Statutes Chapter 6E, http://www.state.hi.us/dlnr/hpd/hpfctsht.htm (accessed March 28, 2013).
[3] "Administrative Rules Pertaining to Historic Preservation in Hawai'i," State of Hawaii, State Historic Preservation Division, accessed January 5, 2024,https://dlnr.hawaii.gov/shpd/rules/.

on historic properties and provide the Federal Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the undertaking.

Historic properties are defined as prehistoric and historic sites, buildings, structures, districts, and objects listed in or eligible for listing in the National Register of Historic Places (NRHP), as well as artifacts, records, and remains related to such properties. Section 106 requires the lead federal agency, in consultation with the SHPO, to develop the Area of Potential Effects (APE), identify historic properties (i.e., NRHP-listed and NRHP-eligible) in the APE, and make determinations of the proposed project's effect on historic properties in the APE. Section 106 regulations require that the lead federal agency consult with the SHPO and identified parties with an interest in historic resources during planning and development of the proposed project. The ACHP may participate in the consultation or may leave such involvement to the SHPO and other consulting parties who have a demonstrated interest in historic preservation. In this case, ACHP has declined to participate and the SHPO will be provided an opportunity to comment on the proposed project and its effects on historic properties. The SHPO and other consulting parties may participate in developing a Memorandum of Agreement or Programmatic Agreement to avoid, minimize, or mitigate adverse effects as applicable.

As part of the Section 106 process, agency officials apply the NRHP Criteria for Evaluation to identify historic properties. As established in the NHPA, to be listed in the NRHP or be determined eligible for listing in the NRHP, properties must meet certain criteria to determine historic significance. A property is eligible for the NRHP if it is significant under one or more of the following Criteria for Evaluation defined in 36 C.F.R. § 60.4, which states "the quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that:

> A: Are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B: Are associated with the lives of persons significant in our past; or
>
> C: Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> D: Have yielded, or may be likely to yield, information important in prehistory or history."

Built resources are typically evaluated under Criteria A, B, and C; Criterion D applies primarily to archaeological resources.

If a property is determined to possess historic significance, its integrity is evaluated using the following seven aspects of integrity to determine if it conveys that historic significance: location, design, setting, materials, workmanship, feeling, and association. If a property is determined to possess historic significance under one or more criteria and retains integrity to convey its significance, the property is determined to be eligible for listing in the NRHP.

The National Register Bulletin "How to Apply the National Register Criteria for Evaluation" (National Park Service 1997) describes the aspects of integrity and their relevance to the NRHP Criteria for Evaluation. The seven aspects of integrity are explained in the bulletin as follows:

> **Location** is the place where the historic property was constructed or the place where the historic event occurred. The relationship between the property and its location is often important to understanding why the property was created or why something happened. The actual location of a historic property, complemented by its setting, is particularly important in recapturing the sense of historic events and persons.
>
> **Design** is the combination of elements that create the form, plan, space, structure, and style of a property. It results from conscious decisions made during the original conception and planning of a property (or its significant alteration) and applies to activities as diverse as community planning, engineering, architecture, and landscape architecture. Design includes such elements as organization of space, proportion, scale, technology, ornamentation, and materials. A property's design reflects historic functions and technologies as well as aesthetics. It includes such considerations as the structural system; massing; arrangement of spaces; pattern of fenestration; textures and colors of surface materials; type, amount, and style of ornamental detailing; and arrangement and type of plantings in a designed landscape.
>
> Design can also apply to districts, whether they are important primarily for historic association, architectural value, information potential, or a combination thereof. For districts, significant primarily for historic association or architectural value, design concerns more than just the individual buildings or structures located within the boundaries. It also applies to the way in which buildings, sites, or structures are related. The bridges along the Hamakua Coast on the Island of Hawaii demonstrate this aspect of integrity through their innovative and unique construction involving repurposing of former railroad trestles.
>
> **Setting** is the physical environment of a historic property. Whereas location refers to the specific place where a property was built or an event occurred, setting refers to the character of the place in which the property played its historical role. It involves how, not just where, the property is situated and its relationship to surrounding features and open space. Setting often reflects the basic physical conditions under which a property was built and the functions it was intended to serve. In addition, the way in which a property is positioned in its environment can reflect the designer's concept of nature and aesthetic preferences.
>
> The physical features that constitute the setting of a historic property can be either natural or manmade, including such elements as: topographic features (a gorge or the crest of a hill); vegetation; simple manmade features (paths or fences); and relationships between buildings and other features or open space. These features and their relationships should be examined not only within the exact boundaries of the property, but also between the property and its surroundings. This is particularly important for districts, such as the Hana Belt Road, where the road's historic bridges conform to the topography and blend with the lush surroundings.
>
> **Materials** are the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property. The choice and combination of materials reveal the preferences of those who created the property and indicate

the availability of particular types of materials and technologies. Indigenous materials are often the focus of regional building traditions and thereby help define an area's sense of time and place. A property must retain the key exterior materials dating from the period of its historic significance. If the property has been rehabilitated, the historic materials and significant features must have been preserved. In Hawaii, lava rock is an important material used for construction of many early bridges.

Workmanship is the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory. It is the evidence of artisans' labor and skill in constructing or altering a building, structure, object, or site. Workmanship can apply to the property as a whole or to its individual components. It can be expressed in vernacular methods of construction and plain finishes or in highly sophisticated configurations and ornamental detailing. It can be based on common traditions or innovative period techniques. Workmanship is important because it can furnish evidence of the technology of a craft, illustrate the aesthetic principles of a historic or prehistoric period, and reveal individual, local, regional, or national applications of both technological practices and aesthetic principles. Decorative treatments, often applied to historic bridge parapets, help demonstrate this aspect of integrity.

Feeling is a property's expression of the aesthetic or historic sense of a particular period of time. It results from the presence of physical features that, taken together, convey the property's historic character.

Association is the direct link between an important historic event or person and a historic property. A property retains association if it is in the place where the event or activity occurred and conveys that relationship to an observer. Like feeling, association requires the presence of physical features that convey a property's historic character.

According to guidance found in "How to Apply the National Register Criteria for Evaluation," different aspects of integrity may be more or less relevant for specific historic properties in relation to their significance. For example, a property that is significant for its historic association (Criteria A or B) is eligible if it retains the essential physical features that made up its character or appearance during the period of its association with the important event, historical pattern, or person(s). A property determined eligible under Criteria A or B ideally might retain some features of all aspects of integrity, although aspects such as design and workmanship might not be as important.

A property important for illustrating a particular architectural style or construction technique (Criterion C) must retain most of the physical features that constitute that style or technique. A property that has lost some historic materials or details can be eligible if it retains the majority of features that illustrate its type and/or style in terms of the massing, spatial relationships, proportion, pattern of windows and doors, texture of materials, and ornamentation. The property is not eligible, however, if it retains some basic features conveying massing but has lost the majority of the features that once characterized its type or style. A property significant under Criterion C must retain those physical features that characterize the type, period, or method of construction that the property represents. Retention of design, workmanship, and materials will usually be more important than location, setting, feeling, and association.

Location and setting will be important for those properties whose design is a reflection of their immediate environment, such as designed landscapes.

For a historic district to retain integrity, the majority of the components that make up the district's historic character must possess integrity even if they are individually undistinguished. In addition, the relationships among the district's components must be substantially unchanged since the period of significance.

Department of Transportation (DOT) Act of 1966, 23 U.S.C. § 138

This act includes a special provision, referred to as Section 4(f) and now codified at 23 C.F.R. § 138, that stipulates the Federal Highway Administration (FHWA) and other DOT agencies cannot approve the use of land from publicly owned parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless the following conditions apply:

- There is no feasible and prudent alternative to the use of land, and
- The action includes all possible planning to minimize harm to the property resulting from use.

"Use" of a property protected under Section 4(f) may be defined as a) permanent incorporation of land, b) temporary occupation of land if that temporary occupancy meets certain criteria, or c) by effect of proximity where noise, visibility, or other like conditions substantially impair the protected features of the property.

In 2005, as part of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU, Public Law 109-59, Aug. 10, 2005), Congress amended Section 4(f) to provide an alternative method of approving the use of protected resources where the impact is *de minimis*. The *de minimis* impact determination provides the basis for the U.S. DOT to approve the minor use of a Section 4(f) property without identifying and evaluating avoidance alternatives, thus streamlining the approval process. The Section 4(f) regulations are located at 23 C.F.R. Part 774.

National Environmental Policy Act (NEPA) of 1969, 42 U.S.C. §§ 4321-4347

NEPA requires Federal agencies to identify and consider the environmental impacts of Federal actions and includes consideration of impacts on cultural resources. As required by the NHPA and NEPA, every Federal agency must provide for the identification and consideration of historic properties prior to undertaking any action that may potentially affect these resources. This applies to state agencies that receive Federal funds.

Surface Transportation and Uniform Relocation Assistance Act of 1987, Public Law 100-17, April 2, 1987

This bill, which addresses highway improvement, planning and research throughout the United States, also declares that States are required to identify historic bridges listed in the National Bridge Inventory. Furthermore, it requires the Transportation Research Board to review and develop rehabilitation standards for historic bridges, as well as setting forth minimum allocations for each state for the purposes of transportation planning and research.

Program Comment for Common Post-1945 Concrete and Steel Bridges

The Program Comment issued by the ACHP addresses undertakings that affect a number of common concrete and steel bridges and culverts located throughout the country and whose construction was generally standardized in the years after 1945. A Program Comment is an alternative to Section 106 review that allows a Federal agency to request the ACHP to comment on a category of undertakings in lieu of conducting individual reviews under Sections 800.4 through 800.6 of the Section 106 regulations (36 CFR Part 800). This guidance provides instructions for the use of the "Program Comment for Common Post-1945 Concrete and Steel Bridges" issued by the ACHP for compliance with Section 106 of the NHPA for certain common types of bridges or culverts that were built after 1945 and approach or exceed 50 years old.

The following types of bridges fall within the scope of Program Comment: reinforced concrete slab bridges, reinforced concrete beam and girder bridges, steel multi-beam or multi-girder bridges, and culverts and reinforced concrete boxes. The Program Comment does not apply to bridges and culverts that are already NRHP-listed or NRHP-eligible; less common bridge types such as arch bridges, truss bridges, bridges with moveable spans, suspension bridges, cable-stayed bridges, or covered bridges; bridges and culverts on the Bridge Program Comment Excepted Bridges List published by the FHWA, and bridges and culverts on tribal lands.

Exemption Regarding Historic Preservation Review Process for Effects to the Interstate Highway System

In 2005, the ACHP published the "Exemption Regarding Historic Preservation Review Process for Effects to the Interstate Highway System," which effectively excludes the majority of the 46,700-mile Interstate Highway System (IHS) from consideration as a historic property under Section 106 of the NHPA. The exemption is not applicable for (1) elements that are at least 50 years old, possess national significance, and meet the National Register eligibility criteria; (2) elements that are less than 50 years old, possess national significance, meet the NRHP eligibility criteria, and are of exceptional importance; and (3) elements that were listed in the NRHP or determined eligible for the NRHP prior to 2005 or elements constructed prior to June 30, 1956, that were later incorporated into the IHS, possess state or local significance, and meet the NRHP eligibility criteria.

In Hawaii, interstates H-1 and H-2 on Oahu are exempt from further consideration. This exemption applies to bridges, culverts, flyovers, ramps, and other features constructed as part of those highways. However, a portion of H-3 was identified as exceptionally significant: the Trans-Koolau Route segment from milepost 4.2 to 7.9 was constructed in 1997 and identified as having national significance and exceptional importance under item (2) listed above.

In addition to the broad IHS exemption, the SAFETEA-LU includes a provision (Section 6007) that exempts the bulk of the IHS from consideration as a historic property under Section 4(f) of the Department of Transportation Act. With these two exemptions in place, Federal agencies are no longer required to consider the vast majority of the IHS as a historic property under Section 106 and Section 4(f) requirements.

Historic Bridges Programmatic Agreement

Pursuant to 36 C.F.R. § 800.14(b), HDOT, in coordination with the FHWA, is currently developing a Programmatic Agreement (PA) to address Federal-aid Highway Program projects specific to historic

bridges throughout Hawaii. The program PA, entitled the *Programmatic Agreement among the Federal Highway Administration, U.S. Army Corps of Engineers Honolulu District, the Hawaii State Historic Preservation Officer, and the Advisory Council on Historic Preservation regarding Hawaii Historic Bridge No Adverse Effect Projects* (Historic Bridges PA or PA), seeks to make the Section 106 compliance process more efficient for certain types of projects that affect historic bridges as identified in this SHBIE.

1.3 HISTORIC BRIDGE IDENTIFICATION AND EVALUATION METHODS

Since the 1980s, several studies have been prepared to document Hawaii's historic bridges. These bridges were first identified in the following reports: *Historic Bridge Inventory: Island of Oahu* prepared by Bethany Thompson in June 1983; *Historic Bridge Inventory and Evaluation: Island of Hawaii*, prepared by Patricia Alvarez in July 1987; *Historic Bridge Inventory: Island of Kauai* prepared by Spencer Mason Architects in October 1989; and *Historic Bridge Inventory and Evaluation: Islands of Maui and Molokai* prepared by The Hawaii Heritage Center in September 1990. In 2008, the Heritage Center, School of Architecture, and UH-Manoa combined these reports into a comprehensive *Historic Bridge Inventory and Evaluation* for HDOT in order to form a comprehensive perspective across the islands.[4]

In 2013, MKE Associates LLC and Fung Associates, Inc. prepared the *Hawaii State Historic Bridge Inventory and Evaluation* (SHBIE) that identified and evaluated 707 bridges constructed between 1894 and 1968 on the islands of Kauai, Oahu, Maui, Molokai, and Hawaii. The 2013 SHBIE established a precedent for regular updates of the historic bridge inventory.

2008 SHIBE Draft Report

The draft 2008 report first examined the multiple property listings for Historic Highway Bridges of Hawaii (1894-1941) which is based upon inventory surveys completed for each county between 1983 and 1990.[5] The County surveys identified and evaluated 379 bridges constructed prior to 1941: 127 on Oahu, 119 on Hawaii Island, 51 on Kauai, and 82 on Maui. The bridges were ranked, based on numerical ratings, under one of the following categories:

- Category I – those with high historical significance
- Category II – those bridges that have considerable historic significance but not enough research available to warrant being placed in Category I, or
- Category III – those bridges with little, or no, historical significance.

[4] Patricia Alvarez, *Historic Bridge Inventory and Evaluation: Island of Hawaii* (Honolulu, 1987); Hawaii Heritage Center, *Historic Bridge Inventory and Evaluation: Islands of Maui and Molokai* (Honolulu, 1990); Bethany Thompson, *Historic Bridge Inventory: Island of Oahu* (Honolulu, 1983); Spencer Mason Architects, *Historic Bridge Inventory: Island of Kauai* (Honolulu, 1989); The Heritage Center, School of Architecture at the University of Hawaii at Manoa, *State of Hawaii Historic Bridge Inventory and Evaluation*, Prepared for the State of Hawaii Department of Transportation, Highways Division, in cooperation with the U.S. Department of Transportation Federal Highway Administration (Honolulu, 2008).

[5] Patricia Alvarez, *Historic Bridge Inventory and Evaluation: Island of Hawaii* (Honolulu, 1987); Hawaii Heritage Center, *Historic Bridge Inventory and Evaluation: Islands of Maui and Molokai* (Honolulu, 1990); Bethany Thompson, *Historic Bridge Inventory: Island of Oahu* (Honolulu, 1983); Spencer Mason Architects, *Historic Bridge Inventory: Island of Kauai* (Honolulu, 1989).

Previous County surveys were each completed by a different consultant to HDOT and utilized a different rating system, which resulted in apparent inconsistencies. For example, only 3% of Maui County bridges were placed in Category I, while the Kauai inventory included 31% of its bridges in Category I. Criteria were revised for improved consistency, and the bridges were reevaluated within a statewide historical context in the draft 2008 inventory and utilized new statewide criteria.

2013 SHBIE Report

Upon request from the HDOT and in response to the ACHP's Program Comment regarding post-1945 bridges, the 2013 SHBIE utilized and revised information provided in the draft 2008 report to reflect a more detailed current analysis of historic bridges in Hawaii. From the draft 2008 report, approximately 550 additional bridges were added to the overall inventory to include County-owned bridges and bridges built prior to 1968. Community members were asked for their input to help identify bridges that may have historical significance, and they provided valuable insight into the final selection of bridges determined to be eligible and of "high preservation value."

The 2013 SHBIE included individual inventory forms for each bridge as well as a bridge list that categorized 707 bridges and identified each bridge's NRHP status. The list includes a brief description of character-defining features (if any) for each bridge. Historic status of the bridges were organized into five categories:

- *Eligible – High Preservation Value:* Bridges within this category included those that were identified as generally unique or possessed characteristics of a type and exhibited high degrees of historic integrity. These were recommended for listing in the HRHP or NRHP. The 2013 SHBIE identified 208 of 707 bridges as "High Preservation Value."

- *Eligible:* Bridges which under this category included those that were not the best example of a type and were not unique. The report recommended HDOT consider maintaining bridges in this category, as through attrition, these may become rare examples of a type at some point in time. The 2013 SHBIE identified 176 of 707 bridges as NRHP-eligible.

- *Not Eligible:* Bridges considered not eligible for listing included those that had lost considerable historic integrity or did not exhibit any qualities that conveyed historic significance. The 2013 SHBIE identified 94 of 707 bridges as not eligible.

- *Non-Contributing:* Several bridges were identified as non-contributing, which were bridges within a historic district that did not contribute to the significance of the historic district, either by lack of historic integrity or construction outside of the historic district's period of significance, for example. The 2013 SHBIE identified 10 of 707 bridges as non-contributing; these bridges received individual forms.

- *Program Comments:* Post-1945 bridges of common construction methods and materials, as well as bridges associated with the interstate highway, fell under the Program Comments designation. The 2013 SHBIE identified 219 of 707 bridges in this category.

The 2013 SHBIE also involved an extensive community outreach effort and included convening a Historic Bridge Committee that acted in an advisory capacity for the project.

2024 SHBIE Update

This 2024 SHBIE update includes the 2013 SHBIE baseline of 707 bridges constructed between 1894 and 1968 and adds to the list 196 bridges constructed between 1968 and 1977. The scope of work for the update also included:

1. Updating the historic context through the 1980s
2. Reevaluating bridges identified as HDOT's 100 Priority Bridges
3. Identifying changes since the 2013 SHBIE including bridge replacements or major alterations
4. Providing clear and concise evaluations using the NRHP Criteria for Evaluation and aspects of integrity

As part of this update, bridges identified in the 2013 SHBIE as "High Preservation Value" have been reclassified as NRHP-listed or NRHP-eligible, or as a significant historic property under 6E, as appropriate, and in accordance with state and federal historic preservation terminology. "High Preservation Value" holds no legal meaning and lacks a standard definition, obfuscating NRHP evaluation and Section 106 compliance. Bridges designated as "High Preservation Value" in 2013 that are not receiving an updated inventory form will be redesignated as eligible within the bridge lists with a footnote indicating their former "High Preservation Value" status.

The 2024 SHBIE update did not reevaluate all 707 bridges from the 2013 SHBIE. However, of the total number of bridges now included in the SHBIE, the 2024 SHBIE update reviewed and/or provided an evaluation or information on 350 bridges constructed in 1977 or earlier in the following categories:

- *Priority Bridges*: These are 100 previously identified NRHP-eligible or NRHP-listed bridges that HDOT has prioritized for future projects. All HDOT priority bridges were reevaluated on updated inventory forms and are included in this 2024 SHBIE update. 98 out of 100 priority bridges were state-owned and 2 out of 100 priority bridges were county-owned.

- *Potentially Altered*: These are 47 NRHP-eligible or NRHP-listed bridges constructed before 1977 but altered since 2013. Review determined if the alterations potentially changed the bridge's eligibility status and warranted an update to the 2013 inventory form. Two of 47 bridges underwent alterations that changed the bridge's eligibility status; these bridges received an updated inventory form.

- *Previously Unevaluated*: These 196 bridges were constructed between 1968 and 1977 and cover the expanded context of the 2024 SHBIE Report. Unless evaluation of these bridges determined otherwise, the majority fell under the post-1945 bridges Program Comment and/or IHS exemption and did not receive inventory forms, consistent with the approach taken in the 2013 SHBIE.

- *Replaced Historic Bridge*: These include 13 NRHP-eligible and NRHP-listed bridges previously evaluated in 2013 that have been replaced by new bridges. Two of these 13 bridges fell within Kauai Belt Road (North Shore Section) and received updated inventory forms.

Bridges that did not receive updated inventory forms have had their 2013 SHBIE inventory forms carried over into this 2024 SHBIE. Bridge inventory forms have been organized into appendices by island with accompanying matrices and will appear in the following order:

Appendix A – Island of Kauai

Appendix B – Island of Oahu

Appendix C – Islands of Maui and Molokai

Appendix D – Island of Hawaii

Each appendix is divided into three sections, 1) 2024 Updated Bridge Matrix (State- and County-Owned), 2) 2013 State Bridge Matrix, and 3) 2013 County Bridge Matrix

Two additional appendices, Appendix E and Appendix F, provide additional information and documentation carried over from the 2013 SHBIE and was updated when necessary.

Appendix E – Supplemental Information, is carried over from the 2013 SHBIE and includes a glossary of terms, a list of significant bridge designers, and bridge rehabilitation guidelines. The 2024 SHBIE has included the preservation plans for Kuhio Highway and Hana Highway in Appendix E.

Appendix F – National Register Nominations, Historic Districts and District Recommendations, includes NRHP nomination forms organized by island. These forms have been carried over to this inventory, except for bridges that have been replaced, in addition to NRHP nomination forms that have been prepared after 2013. Appendix F also includes matrices for NRHP historic districts and 2013 SHBIE proposed historic districts.

DATA ANALYSIS AND INVENTORY FORM UPDATES

For this update, investigation methods included review of bridge inspection reports and previous bridge inventory surveys; information obtained through HDOT records, online records, and local repositories; Historic American Engineering Record (HAER) and NRHP documentation; and photographs from HDOT Districts and County DOTs.

Like the 2013 SHBIE, this 2024 SHBIE update used inventory forms providing both technical and historical information for each bridge. These inventory forms are organized similar to the 2013 SHBIE inventory forms and include additional information where requested by HDOT or other stakeholder organizations or agencies. Information provided on each inventory form includes the following (when available):

- *General Information*: Bridge Number, Tax Map Key, Common Name, Historic Name, Feature Crossed, Feature Carried, Island, Milepost, Latitude/Longitude, Ownership, Photograph, Location Map

- *Construction Information*: Bridge Type, Construction Date, Designer/Engineer, Builder/Contractor, Alteration Date(s), Alteration Description

- *Historic Information*: NRHP Status, NRHP Criteria, NRHP Registration Number; HRHP Status, SIHP Number; 6E Status, 6E Criteria; Aspects of Integrity; Historic District Status, Contributing/Non-Contributing Status; Current Function, Historic Function; Areas of Significance, Period of Significance, Supplemental Documentation (When Appropriate); Narrative Description; Statement of Significance; Historic Images and Drawings (when available); References; Additional Photographs.

COMMUNITY OUTREACH

The 2024 SHBIE update included early meetings with FHWA on February 9, 2022, and with SHPD on February 15, 2022. An additional meeting occurred with the Historic Hawaii Foundation (HHF) on July 11, 2023, and two stakeholder meetings with a broader group that included HHF were held on August 16, 2023. The stakeholder meetings were organized to explain proposed changes and updates to the SHBIE and provide instructions for coordinating stakeholders to photograph bridges. Invited stakeholders included:

- HDOT
- FHWA
- County DPWs
- State Historic Preservation Division
- HHF
- Pulamai a Kona Heritage Preservation Council
- County of Maui, Cultural Resources Commission
- Kauai Historic Preservation Review Commission
- County of Kauai Planning Department
- Hanalei Roads Committee
- Kauai Historic Society
- DLNR Aha Moku Advisory Committee
- Department of Hawaiian Home Lands
- Office of Hawaiian Affairs
- Aha Moku O Kahikinui
- Aha Moku O Kula Makai
- Aha Moku O Maui
- Association of Hawaiians for Homestead Lands
- Council for Native Hawaiian Advancement
- Friends of Mokuʻula
- Kululoiʻa Lineage - I Ke Kaiʻo Kululoiʻa
- Na Aikane O Maui
- Nekaifes Ohana
- Paukukalo Hawaiian Homes Community Association
- Waiehu Kou Phase 3 Association
- Members of the Public

2024 SHBIE Update Summary

The number of bridges included in the SHBIE now totals 902. The following tables summarize bridge information included in this update.

Table 1. Summary Table of All Bridges in 2024 Matrices

Island	Listed	Eligible	Not Eligible	Program Comments	Total
Kauai 2024 State Updated	5	5	2	0	12
Kauai 2024 County Updated	0	0	0	0	0
Kauai 2013 State	0	10	10	21	41
Kauai 2013 County	0	14	5	0	19
Kauai Total	***5***	***29***	***17***	***21***	***72***
Oahu 2024 State Updated	0	28	6	0	34
Oahu 2024 County Updated	0	0	0	0	0
Oahu 2013 State	0	48	102	114	264
Oahu 2013 County	0	53	18	113	184
Oahu Total	***0***	***129***	***126***	***227***	***482***
Maui and Molokai 2024 State Updated	41	5	2	0	48
Maui and Molokai 2024 County Updated	0	0	0	0	0
Maui and Molokai 2013 State	0	16	10	14	40
Maui and Molokai 2013 County	0	20	11	10	41
Maui and Molokai Total	***41***	***42***	***23***	***24***	***129***
Hawaii 2024 State Updated	0	5	3	0	8
Hawaii 2024 County Updated	0	2	0	0	2
Hawaii 2013 State	0	41	22	46	109
Hawaii 2013 County	0	73	1	26	100
Hawaii Total	***0***	***121***	***26***	***72***	***219***
Overall Total	**46**	**320**	**192**	**344**	**902**

The following bridges on HDOT's Priority Bridge list were previously determined eligible in the 2013 SHBIE and have been reevaluated and determined not eligible. These bridges have updated forms in the relevant appendix.

TABLE 2. BRIDGES DETERMINED NOT ELIGIBLE

Island	Bridge Number	Bridge Name
Kauai	007056000400161	Kapaa Temporary Bypass Road - Kainahola Stream Bridge
Oahu	003000990402053	Kalauao Springs (Eastbound)
Oahu	003000990402054	Kalauao Springs (Westbound)
Oahu	003000830300869	Paumalu Stream
Oahu	003000830301059	Waialee Stream
Oahu	003000830302242	Waimanana Stream
Maui	009000300304184	Papanahoa Bridge
Maui	009003400500004	Waiehu Twin 12 ft. Culvert
Hawaii	001000110310346	2-Metal Pipe Culvert
Hawaii	001000110310424	2-Metal Pipe Culvert
Hawaii	001000110310410	3-Metal Pipe Culvert

The following bridges were previously determined eligible in the 2013 SHBIE and have been reevaluated and determined not eligible due to substantial alterations. Because of the nature of these alterations, these bridges have updated inventory forms in the relevant appendix.

TABLE 3. BRIDGES ALTERED AFTER 2013

Island	Bridge Number	Bridge Name
Kauai	007000500001694	Eleele Pedestrian Overpass
Oahu	003000830301255	Kuilima-Oio Stream

Since 2013, the following bridges have been constructed and replaced previously identified historic bridges. Unless noted otherwise, these forms have been removed from the relevant appendix.

TABLE 4. BRIDGES REPLACED AFTER 2013

Island	Bridge Number	Bridge Name
Kauai	007005600500397	Waipa Stream Bridge (Replaced bridge 007005600500396) *Since the original bridge was located in the NRHP-listed Kauai Belt Road (North Shore Section), a new inventory form has been prepared.*
Kauai	007000500301632	Hanapepe River Bridge (Replaced bridge 007000500301631)
Kauai	007000560300986	Kapaa Stream Bridge (Replaced bridge 007000560300985)

Island	Bridge Number	Bridge Name
Kauai	007000500403272	Nawiliwili Stream Bridge (Lihue Mill) (Replaced bridge 007000500403271)
Kauai	007420201142006	Opaekaa Bridge (Replaced bridge 007420151142001)
Kauai	007420201144002	Puuopae Bridge (Replaced bridge 007440111144001)
Kauai	007005600500428	Waikoko Stream Bridge (Replaced bridge 007005600500427) *Since the original bridge was located in the NRHP-listed Kauai Belt Road (North Shore Section), a new inventory form has been prepared.*
Oahu	003000830301358	Hoolapa Stream-Nanahu (Replaced bridge 003000830301357)
Oahu	n/a	Kaipapau Stream (003000830302099) *This bridge replacement is ongoing. No new bridge number will be assigned prior to its initial inventory inspection.*
Oahu	003000830301141	Kawela Stream Bridge (Replaced bridge 003000830301140)
Maui	009000310900001	Kulanihakoa No. 76 (Replaced 009000310900001)
Hawaii	001000110306490	Hilea Stream Bridge (Replaced 001000110306489)
Hawaii	001000110306601	Ninole Stream Bridge (Replaced 001000110306600)

1.4 USING THE 2024 SHBIE UPDATE WITH THE HISTORIC BRIDGES PA

Information in this section is being provided to incorporate the concurrent effort to execute the Historic Bridges PA. The PA relies on the Historic Bridge List originally developed in 2013 and updated in this SHBIE to identify historic bridges in Hawaii that may be covered by the PA. Early in project development, HDOT staff or its consultants, should review the information in this SHBIE prior to developing plans for bridge projects. Inventory forms provide information for previously surveyed historic bridges and identify original and character-defining features, alterations, significance, and integrity. The Historic Bridges PA does not apply to bridges that are not historic as identified in the Historic Bridge List.

PROJECT REVIEW USING THE HISTORIC BRIDGES PA

Once a bridge is identified as a historic bridge through review of the SHBIE and early in the project planning process, proposed improvements may fall within one of the three tiers described in the Historic Bridges PA. If a bridge project does not fall within one of the tiers, then the standard Section 106 process will apply to the project. Regardless of application of the Historic Bridges PA, HDOT staff and its consultants must consult the SHBIE for any bridge project. A Best Practices Manual has been developed that describes application of the SOI Standards for the Treatment of Historic Properties as they apply to historic bridges. This manual further assists HDOT and its consultants during project development in understanding appropriate treatments that will retain a historic bridge's character-defining features and thus its significance and integrity. Application of the Historic Bridges PA requires documentation on a Historic Bridges PA Compliance Form with supporting information and documentation as required.

The Historic Bridge PA has developed tiers of projects with varying levels of review requirements.

Tier 1: Activities with No Potential to Cause Effects

Activities in this tier are those that would cause minimal changes to historic bridges and includes, but is not limited to, certain cleaning and painting activities, minor asphalt repairs, certain utility repairs, in-kind repair or replacement of existing non-structural bridge components, and some non-destructive material sampling, testing, or sensor placement.

Tier 2: Activities with No Adverse Effects Pending Application of Guidance in the Best Practices Manual

Activities in this tier must follow the Best Practices Manual's Tier 2 guidance and requires consistency with the SOI Standards for the Treatment of Historic Properties. Work covered by Tier 2 includes and is not limited to masonry and mortar repair and cleaning, concrete sealing and repairs, in-kind replacement of structural members, vegetation clearing, scour repair, utility repair or replacement, replacement of wearing surfaces, minor repairs to railings or parapets, sidewalk repairs and maintenance, cleaning with spray or brushes, and repainting of entire structures.

Tier 3: Activities with No Adverse Effects Pending Application of Guidance in the Best Practices Manual and with Approval of an SOI-Qualified Professional

Activities in this tier require involvement of an SOI-qualified professional to assess a project's effects on the historic bridge and determine whether the project qualifies for review under the Historic Bridges PA. Tier 3 activities must follow the Best Practices Manual's Tier 3 guidance and requires consistency with the SOI Standards for the Treatment of Historic Properties. Projects that occur within potential, eligible, or listed historic districts automatically fall under Tier 3.

Work covered by Tier 3 includes and is not limited to more extensive masonry and mortar repair and cleaning using chemicals, concrete sealing using epoxy and in-kind repairs that replicate sculptural reliefs or designs, extensive in-kind replacement of structural members or addition of new structural members, vegetation clearing that also requires masonry removal, new scour repair, installation of new utilities, evaluation of remnant bridge structures or components, replacement of wearing surfaces with new materials that differ from existing, major repairs to railings or parapets that may involve changing the original appearance, sidewalk modifications for accessibility or installation of new pedestrian paths, cleaning with high-pressure spray or application of anti-graffiti coatings, and painting of previously unpainted structures.

If any activities within Tier 3 may result in an adverse effect on a historic bridge, as determined following review by an SOI-qualified professional, then the Historic Bridges PA will not apply, and the project must go through the standard Section 106 process.

2.0: BRIDGE IDENTIFICATION

FEDERAL DEFINITION

The Federal government defines a bridge as a structure erected over a depression or an obstruction with a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or springlines of arches (23 C.F.R. § 650.403). This definition is used as a criterion for eligibility to use Federal funds and includes all bridges that are inspected every two years. Due to this definition, HDOT does not maintain the same records for the bridges or culverts less than 20 feet. Pedestrian and other non-vehicular bridges were sometimes included in the inventory when listed on the National Bridge Inventory (NBI). Counties can opt to place a pedestrian bridge on the NBI to qualify for Federal funding.

IDENTIFICATION OF BRIDGE COMPONENTS

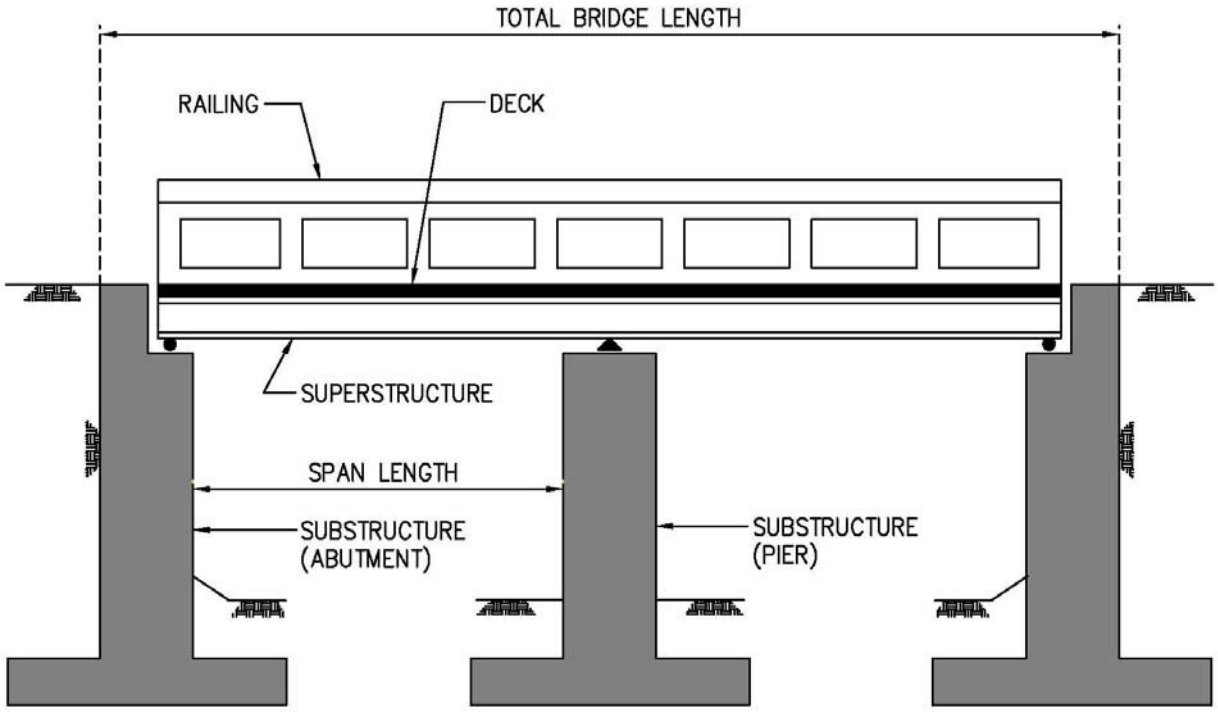


FIGURE 1. BRIDGE COMPONENTS. SOURCE: MKE ASSOCIATES LLC, 2013.

SUMMARY OF BRIDGE TYPES IN HAWAII[6]

Bridge type is defined by the form or method in which the structure functions. It is not exclusively determined by any of the following: materials, method of connection, type of span, or if the bridge structure exists above or below the grade.

[6] The following bridge descriptions are drawn from the following source: Parsons Brinckerhoff and Engineering and Industrial Heritage, *A Context for Common Historic Bridge Types, NCHRP Project 25-25, Task 15*, prepared for the National Cooperative Highway Research Program, Transportation Research Council, National Research Council (October 2005).

The historic bridges of Hawaii are composed of several different material and structural types: masonry arch bridges (frequently constructed of local basalt, often referred to as lava rock); steel truss and stringer bridges; timber stringer bridges; and concrete solid-and open-spandrel arch bridges, deck girder bridges including tee beam types, flat slab bridges, and rigid-frame bridges. The most prevalent construction material for Hawaii's existing bridges is reinforced concrete since the corrosive nature of the salt air from the Pacific Ocean and the presence of insects makes the maintenance of steel and wooden bridges less practical than in the continental United States. Stone, sand, gravel, and lime are found in abundance in the islands; however, reinforcing steel was imported from the U.S. mainland.

MASONRY ARCH BRIDGES

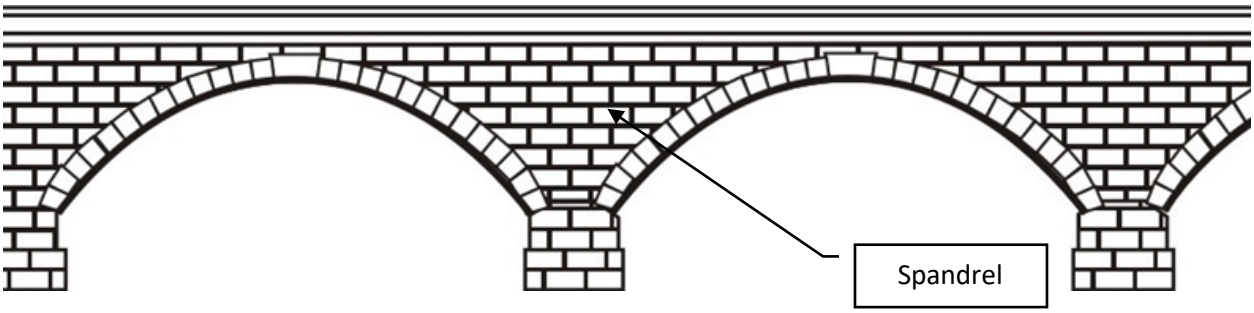


FIGURE 2. MASONRY ARCH BRIDGE.

Description

Unreinforced masonry arch bridges are the most common remaining nineteenth-century bridge building technology and was among the first permanent bridge type constructed in the islands. Masonry arch bridges were constructed in Hawaii from approximately 1840, when the first recorded bridge was built, to 1904, when the Territory made it standard practice to use reinforced concrete for bridge building. These bridges were generally constructed in residential areas over small or intermittent streams along important transportation arteries. The remaining masonry arch bridges in Hawaii are generally small, single-span circular arches with solid spandrels, a span of fifteen to thirty feet and a relatively low-rise over the stream bed. Although usually quite narrow (eight to twelve feet) for wagon traffic, some examples are quite wide (such as the thirty-foot wide Mamalahoa-Pukihae Bridge and Mamalahoa-Kalalau Bridge), demonstrating forethought uncommon for its time. Masonry arch bridges in Hawaii are constructed of local basalt also known as lava rock. This material was commonly used as basalt rubble set in an ashlar pattern for the spandrel walls and parapets. Occasionally, carefully cut blocks with dressed margins were utilized for the parapets. Coursed blocks, twelve to twenty-four inches in diameter, were used for the arch ring, although rare examples of concrete or brick arch rings remain.

Significance

Stone was abundant in Hawaii, and stone arches at Nuuanu and Waikiki on the island of Oahu were among the first bridges constructed by the Kingdom of Hawaii's Interior Department in the 1840s. However, no known bridges constructed by the Kingdom remain. Masonry arch bridges continued to be constructed by the Republic of Hawaii, which was established between the overthrow of the Hawaiian monarchy and the annexation of Hawaii by the United States (1893-1898), and by the early Territorial government prior to the establishment of the county governments (1898-1904). The nineteenth-century bridges, built by the Republic of Hawaii, were generally constructed by prison labor and were part of the

upgrading of the Hawaii belt roads that had begun in King Kalakaua's reign (1874-1892). After annexation in 1898, the practice of letting contracts to professional builders was used more widely in the islands.

Several masonry arches remain along the Mamalahoa Highway on the island of Hawaii, and on the Hana Highway on Maui. These routes were once the primary transportation arteries in their regions. The Mamalahoa and Hana Highways are characterized by narrow, winding lanes and innumerable streams and gulches. The Mamalahoa Highway was bypassed by the construction of a new belt road in the 1930s, leaving intact a high concentration of historic bridges. The numerous single-lane bridges of the Hana district have been preserved due to the lack of development along this remote region of Maui.

Unlike timber, or later concrete and steel bridges, masonry-arch bridges utilized locally available construction materials. However, construction of stone bridges, which employed arch building technology imported from the United States and Europe, required skilled labor which was scarce in the islands. The Hawaiians were skilled in laying stone and had a long tradition of dry masonry-rubble construction, a technique utilized for heiau (temples), house platforms, walls, and agricultural terraces. Unfortunately, by the mid-1800s, the decimation of the native population by disease resulted in a chronic shortage of labor. After 1885 imported labor, particularly Portuguese and Japanese masons, oversaw the construction of masonry arch bridges.

Important builders involved in the construction of masonry arch bridges include Louis M. Whitehouse and John H. Wilson. Whitehouse was one of Hawaii's most prolific early contractors. In partnership with Wilson (who later served six terms as Mayor of Honolulu), he built the first section of the Nuuanu-Pali Road on Oahu, part of the Belt Road on the island of Hawaii, and several masonry arch bridges, including the Mamalahoa-Pukihae, Mamalahoa-Laupahoehoe and Nuuanu Avenue arch bridges. With another partner named Hawxhurst, he built the 1903 Waiakea and Wailuku River steel bridges in Hilo (both since replaced).

Masonry arch bridges are generally eligible under National Register Criterion A and C. Masonry arch bridges are eligible under Criterion C as notable examples of the use of vernacular building materials and the artisanship of local craftsmen. The local basalts which compose the lava rock used in bridge construction are unique to Hawaii and the islands of the Pacific; thus, these masonry arch bridges may be the only representatives of this type in the United States.

Eligibility Requirements

The bridge must retain its integrity of location. Since masonry arch bridges were constructed as permanent structures, all extant examples are in their original location. The setting of the bridge must remain relatively unchanged; by-passing the original transportation artery with a new highway does not necessarily exclude a property if the bridge’s immediate surroundings retain its historic qualities.

The design of the bridge, particularly the arch sub-structure and the spandrel walls, must also retain its integrity. Alterations that may be considered acceptable include those that occurred early in the bridge’s history (i.e., within the period of significance) and in such a way that the alterations are reversible without diminishing the significant historic characteristics of the original bridge (by widening or lengthening the bridge by the construction of an adjacent concrete culvert, for example).

The bridge's original materials, particularly the basalt or brick used in the arch ring and vault, must not be adversely affected by alterations or additions. The quality of the original workmanship must remain apparent, with substantial evidence of artisan's labor and skill. The bridges must retain a high degree of historic feeling, and their associations must be apparent to the informed or casual observer.

METAL BRIDGES

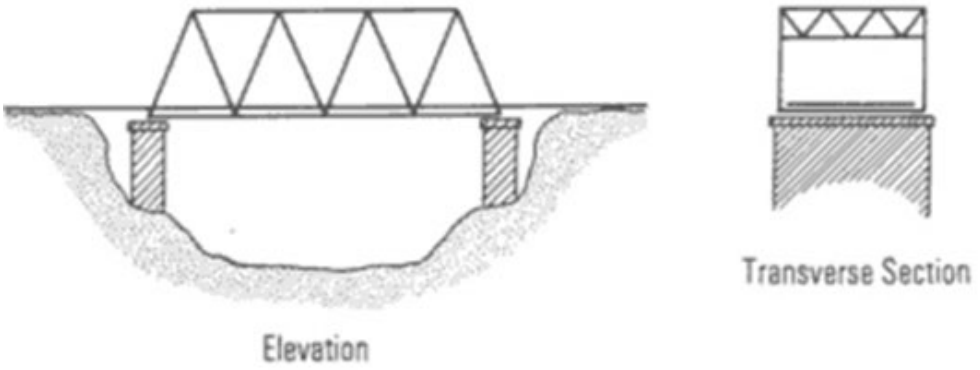


FIGURE 3. THROUGH TRUSS BRIDGE.

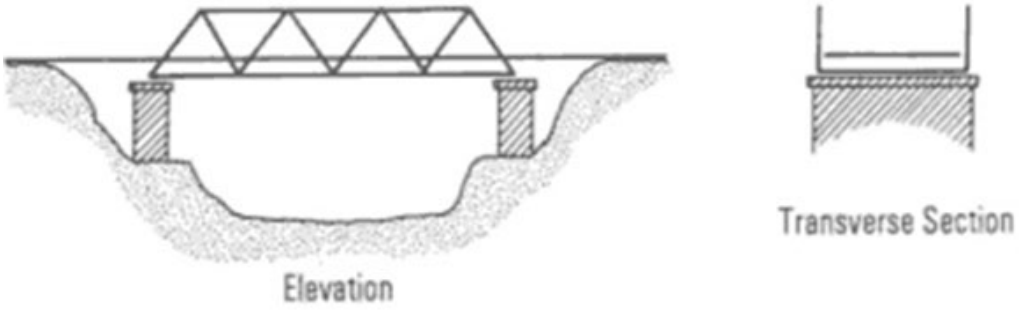


FIGURE 4. PONY TRUSS BRIDGE.

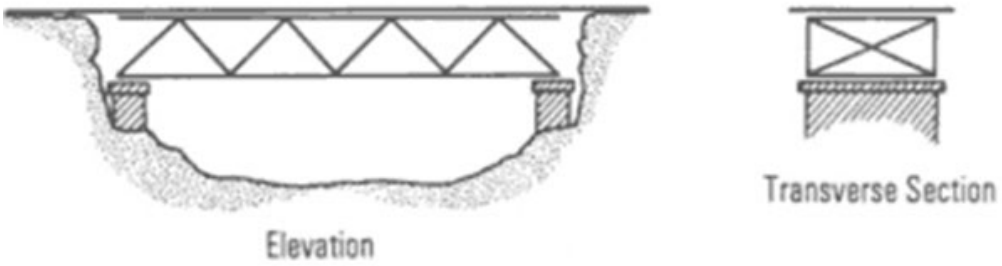


FIGURE 5. DECK TRUSS BRIDGE.

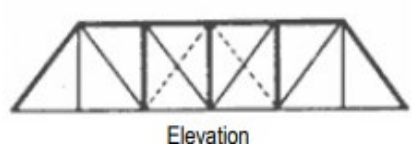


FIGURE 6. PRATT TRUSS (DIAGONAL) BRIDGE.

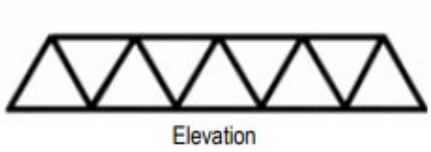


FIGURE 7. WARREN TRUSS BRIDGE.

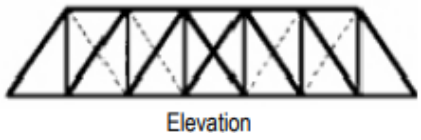


FIGURE 8. HOWE TRUSS BRIDGE.

Description

Although metal bridge construction was prevalent in Hawaii around the turn of the century, only steel stringer bridges continued to be built through the first half of the twentieth century. Due to the extremely corrosive nature of the marine environment in Hawaii, there are only a handful of metal bridges that remain. These extant metal bridges are of three basic types: steel and wrought iron trusses, steel stringer bridges, and steel trestle railroad bridges.

Steel and Iron Trusses

Steel and wrought iron trusses were commonly utilized in Hawaii until 1904, when the territorial government advocated the construction of more durable concrete bridges. Metal trusses were fabricated by British and American manufacturers and shipped to the islands to be erected by local contractors. Consequently, truss types were similar to those found in the United Kingdom and the United States (Pratt, Warren and Howe types). The Pratt trusses are distinguished by thick vertical members acting in compression and thin diagonal members in tension. This design reduced the length of the compression members to prevent them from bending or buckling. The Warren design is basically triangular with the diagonals alternately in compression and tension. A *through truss* carries its traffic load level with the bottom chords of the truss. A *pony truss* is a through truss with no lateral bracing between the top chords.

In 1884, ten metal truss bridges were shipped to Hawaii by the Pacific Bridge Company, with offices in Portland and San Francisco, for erection in the Hilo district on the island of Hawaii. The islands' largest and most expensive nineteenth-century metal truss bridge was erected at the mouth of the Wailua River on Kauai in 1890. The bridge was manufactured by Alex Findlay & Co. of Motherwell, Scotland. In 1919, one Warren truss segment of this bridge was utilized to construct the Opaekaa Stream Bridge #1 on Kauai. The Opaekaa Stream Bridge #1, listed on the NRHP in 1983, is the only remaining iron truss bridge of British manufacture in the United States. Only two twentieth-century trusses remain in the state: the 1932 Karsten Thot Bridge, a Warren truss erected in Wahiawa, Oahu; and a Pratt truss segment from the

1924 Wailuku River Railroad Bridge which was scavenged for reuse in the Kolekole Highway Bridge after the 1946 tsunami in Hilo. The 1912 Hanalei Bridge, a twentieth-century Pratt truss that crosses the Hanalei River on Kauai, was rehabilitated in 2003 in accordance with the Secretary of the Interior's Standards for Rehabilitation; this bridge remains on the NRHP as a contributing resource of the Kauai Belt Road.

FIGURE 9. STEEL STRINGER ELEVATION (DRAWING PROVIDED BY MKE ASSOCIATES LLC, 2013).

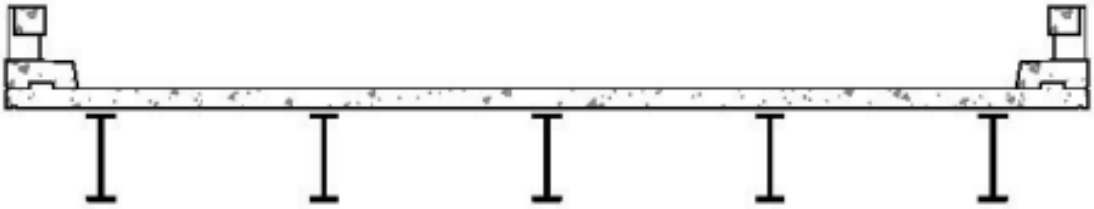


FIGURE 10. STEEL STRINGER SECTION (DRAWING PROVIDED BY MKE ASSOCIATES LLC, 2013).

Steel Stringer

Steel stringers were constructed in Hawaii primarily for industrial and railroad bridges. Ornamentation, if any, is usually limited to the pattern of the railings. The two extant examples from the period of significance were constructed over railroad lines in Maui and Kauai. One is the the Waiale Drive Bridge on Kaahumanu Avenue in Wailuku, Maui. This bridge was constructed with U.S. Works Program Grade Crossing funding, which provided federal money without the usual match requirement, to build bridges separating railroad and road grades. The use of steel, uncommon in Hawaii due to the extreme marine environment, may reflect the requirements of the U.S. Grade Crossing Program. Since very little steel is used for bridge construction in Hawaii, this may be considered an unusual structural type. It should be noted that there are numerous steel stringer bridges that feature wood plank decks and wood railings. If still extant, these bridges are addressed as timber bridges since their appearance to the general public is wood.

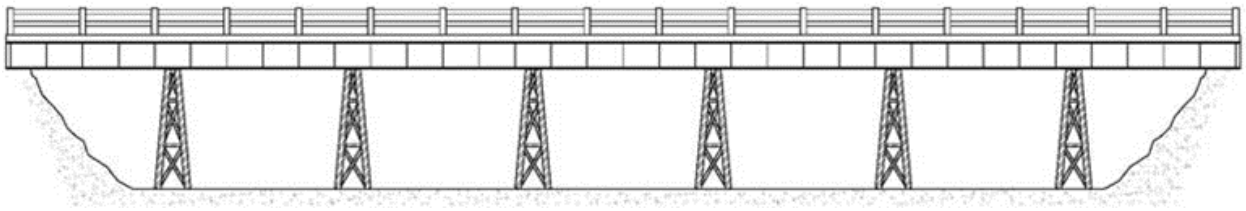


FIGURE 11. STEEL TRESTLE BRIDGE (DRAWING PROVIDED BY MKE ASSOCIATES LLC, 2013).

Steel Trestle Railroad Bridges

Fourteen steel trestle railroad bridges were constructed in 1911 for the Hilo Railroad Company. Five of these (Hakalau, Nanue, Kapue, Paheehee, and Umauma) were reconstructed as territorial highway bridges between 1951 and 1953, the remaining nine were salvaged for use in the reconstruction. The reconstructed steel trestle structures are topped with a concrete and asphalt highway deck. During their conversion, the bridges were widened for highway use by the addition of members from other railroad bridges. The simple horizontal concrete railings were added during the 1951-53 renovations.

Significance

The period of significance for metal truss and stringer bridges begins in 1912, when the earliest remaining example was erected, and ends in 1957. The period of significance for steel trestle railroad bridges begins in 1911, when they were first constructed, and ends in 1953, after their conversion to highway bridges. Metal bridges are eligible under Criterion A if they contributed in a meaningful way to the settlement and development of a geographically definable area, facilitated major passage to or through a region, or been significantly integral to the development of an effective transportation system. Metal truss bridges in Hawaii are significant as representative examples of the expanding capital investment and control that American manufacturers had gained over their British and German rivals as a consequence of the U.S. annexation of the islands in 1898. The steel stringer bridges are significant for their association with the railroads of the sugar industry. They were built with U.S. Works Program Grade Crossing funding which provided federal money, without the usual match requirement, to build bridges separating railroad and road grades. The erection of metal truss and stringer bridges was a deliberate effort by the territorial government to construct permanent public works improvements requesting the latest technology.

The remaining metal truss and stringer bridges are eligible under Criterion C as rare survivors of a once common bridge type and as representative examples of the work of important engineers and builders. These include Joseph H. Moragne of the Kauai Department of Public Works, who oversaw the construction of the Hanalei River Pratt Truss in 1912 (replaced in 2003). James L. Young was responsible for building the Karsten Thot Warren truss over the North Fork of the Kaukonahua Stream in Wahiawa, Oahu in 1932. Young, the founder of J. L. Young Engineering Company, was "in the literal sense of the phrase, a builder of Hawaii."[7] Young was trained as a civil engineer and an architect. He designed and constructed the first two reinforced-concrete fireproof buildings in Honolulu, the Pantheon Block and the laboratory building at the Bishop Museum. Between 1922 and 1925, Young built over forty-one buildings in Honolulu, including Palama Settlement, the Library of Hawaii (Hawaii State Library), and the

[7] George F. Nellist, "The Story of Hawaii and Its Builders," *Honolulu Star-Bulletin*, 1925, 911-912.

"new library building at the University of Hawaii," the present-day George Hall.[8] He also constructed buildings on many military bases, including Fort Shafter, Fort Ruger, Fort Kamehameha and Schofield Barracks.

The most significant steel stringer bridges were designed by William Bartels, chief designer for the Territorial Highways Department. Bartels arrived in Hawaii from Germany in 1932, working as a bridge engineer for the Territory until his retirement in 1952. He was responsible for the largest and most sophisticated bridge construction projects in Hawaii during this time.

The converted steel trestle and girder railroad bridges have potential National Register significance under criterion A and C. The railroad line played a major role in the development of the Hilo and the Hamakua Coast by providing transportation to the harbor for the island's sugar production. The Hilo Railroad Company was founded by Benjamin Franklin Dillingham and figures significant in the history of the Hawaiian Islands. The railroad and its numerous bridges together have been called the "greatest engineering feat in Hawaii." The railroad advertised its scenic route as "the greatest engineering feat in Hawaii."[9] Another commentator noted that the completion of the railroad marked nothing less than "an era in the development of the Islands."[10] In addition, the converted railroad bridges are the remains of the only standard gauge rail line erected in the islands and can tell us much about early twentieth century steel manufacturing. The bridges represent the Work of a Master: John Mason Young, designer of the original railroad line and bridges; as well as William R. Bartels, of the Territorial Highways Department, who engineered their conversion from railroad to highway use in the 1950s.

Eligibility Requirements

Metal truss, stringer and trestle bridges must retain their integrity of location. However, relocation of the structure within the period of significance is interpreted as part of the history of the bridge. The design of the bridge, particularly the superstructure and connections, must also retain its integrity. Alterations may be considered acceptable if they were completed early in the bridge's history (within the period of significance) and they are reversible without diminishing the significant historic characteristics of the original bridge (e.g. the addition of a completely independent additional truss to support the weakened original structure or widening with members salvaged from identical spans). The setting of the bridge must remain relatively unchanged; by-passing or realignment of the original transportation artery does not necessarily exclude a property if the bridge's immediate surroundings retain its historic qualities. The bridge's original materials must not be obscured by alterations or additions. The quality of the original workmanship must remain apparent, particularly from a technical rather than aesthetic standpoint, with substantial evidence of the builder's labor and skill. The bridges must retain a high degree of historic feeling, and their associations must be apparent to the informed or casual observer.

[8] Ibid.
[9] *Paradise of the Pacific*, December 1922, 8.
[10] Thomas Thrum, *Hawaiian Almanac and Annual* (Honolulu: Hawaiian Gazette Company, 1914), 142.

CONCRETE ARCH BRIDGES

Description

Concrete arches constructed in Hawaii are of two basic types: solid and open spandrels. The solid spandrel type are generally arch deck bridges, in which the traffic decks sit upon the arch. These were generally constructed in two periods in Hawaii: the early solid spandrel arch bridges date from c.1904 to 1915, and the later solid-spandrel arch bridges date from c.1916-1929. There are two types of open spandrel arch bridge construction: the most common is the arch deck open-spandrel, first constructed on Maui in 1911; the second type is the Rainbow or Marsh arch, a through-arch constructed during the 1920s and 1930s, in which the traffic deck is suspended from the bottom or lateral chord of the arch.

The first reinforced-concrete bridge in America was built in 1889, but the material remained in an experimental phase until the early 1900s. Reinforced-concrete arch bridges were built in Hawaii after 1904, when the territorial government made it their policy to erect strong, low-maintenance bridges. Concrete could be produced locally from crushed coral or stone aggregate and lime produced by burning the coral reefs. Other materials like cement and reinforcing steel were imported.

South Hilo Road Supervisor Norman K. Lyman voiced public opposition to the Territorial DPW policy of building concrete arch culverts. He was quoted in the Hilo Tribune as saying that he "would rather have a stone bridge than a concrete culvert as the former would give employment to more voters, whereas the cement and other materials required for concrete work was all imported from the [west] coast."[11] The newspaper bolstered his argument by pointing out that "stone is plentiful near Hilo and just the kind for bridges and culverts."[12]

This conservative policy was not adopted. In fact, the last known mention of stone arch culverts or bridges is in a 1903 letter of Assistant Superintendent of Public Works, Merton Campbell, with regard to the Mamalahoa-Pukihae Bridge in Hilo. While stone was cheap and locally available, construction of stone arches was labor intensive and seemed to have died quickly with the advent of concrete. This corresponds to developments in the U.S. mainland where concrete had largely replaced masonry by the turn of the century. Further confirmation that concrete was the prevailing bridge material of the era is apparent in the decision made by the Loan Fund Commission, set up in 1911 to oversee a special construction fund established by the Legislature. The commission announced that "Steel was unanimously discarded. Concrete will be used as far as funds permit, the absence of repairs offsetting the large first cost, but it is possible that wood may be used on some spans over forty feet, if funds get low."[13]

[11] *Hilo Tribune*, November 14, 1905, 2.
[12] Ibid., 2.
[13] *Hilo Tribune*, January 16, 1912, 2.

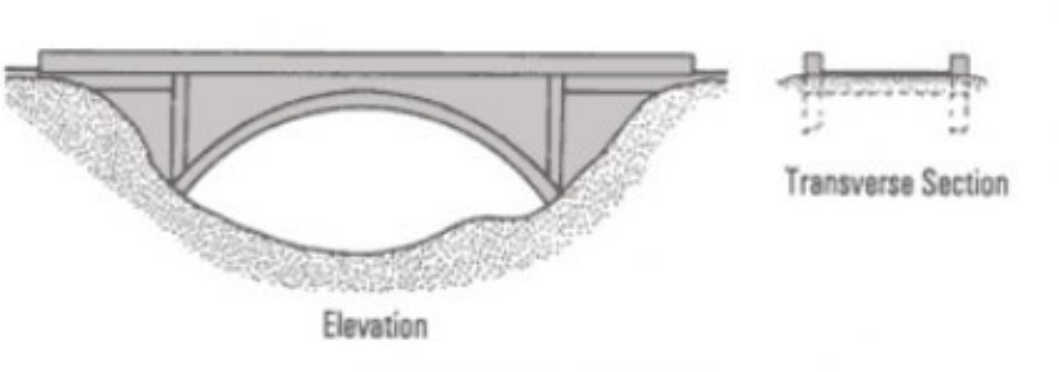


FIGURE 12. CLOSED SPANDREL ARCH BRIDGE.

The various types of concrete arch bridges are described as follows:

Closed (Solid-Spandrel) Concrete Arch Bridges

Reinforced-concrete solid-spandrel arch bridges were constructed in two periods in Hawaii. The earliest all-concrete bridges were built in 1904-1906 to standardized plans as a result of territorial policy, although extant examples of solid-spandrel arches of this type date from as late as 1912 (Mamalahoa-Pahoehoe Bridge on the Hawaii Belt Road). Since the first concrete arches echoed the design and form of earlier masonry arch bridges, these utilize concrete, a new material, in a fairly conservative manner from an engineering perspective. Nonetheless, reinforced concrete was a material requiring skilled designers and builders.

These first reinforced-concrete arch bridges were constructed in lieu of masonry arches, generally in residential areas over small or intermittent streams bisecting major transportation arteries. The arches of these early bridges are circular and earth filled. The rise of the arch is typically eight feet and the span approximately thirty-two feet. The parapets are of reinforced cast concrete, approximately four to six inches thick and three feet high, with a peaked concrete rail cap. The bridges are quite narrow, usually twelve or thirteen feet. Important examples of early concrete arch bridges include a series of concrete arch bridges in Hilo and Pepeekeo, such as the Mamalahoa-Kapue Bridge with its fifty-six-foot span, and the Mamalahoa-Puuokalepa Bridge.

Concrete, previously used for the arch ring of masonry bridges or the capping of parapets, was used for bridge construction after the territorial government made construction of strong, low-maintenance bridges its stated policy shortly after annexation. Previously bridges had been built of timber, stone, or metal, but the new Superintendent of Public Works (SPW), C.S. Holloway, strongly recommended concrete arches for small spans. His assistant, J.H. Howland, sent prints of several of these types of bridges to Hawaii Road Engineer G.H. Gere to encourage the Hawaii Road Boards to adopt this type of bridge:

> I strongly recommend that concrete arches be built wherever the span is not too great and that particular attention be paid to the foundations for the piers and abutments, so that whatever work is undertaken, will be of a permanent nature and capable of standing heavy pressures due to excessive flow of water during the rainy season...I would avoid as far as possible the

> construction of steel bridges, especially on the windward sides of the Islands and near the sea. Bridges of wooden construction will last much longer and require less maintenance. Several of the steel bridges are in exceedingly bad condition.[14]

According to the 1905 report of the Assistant SPW, the foundations of all bridges and culverts, were to be "constructed that they are good for all time."[15] The report went on to state that:

> Wherever practicable, bridges have…been built of concrete, and where the span was too great so as to make the cost excessive, timber bridges (treated with creosote) have been designed preferably to steel structures which we have found...to be the most expensive to maintain and keep in repair.[16]

Between 1904 and 1906, contracts were let for the construction of at least six concrete arches, including those in Ewa and Waianae (both on Oahu), Mamalahoa-Puuokalepa and Mamalahoa-Waiaama, and the Chong Drive-Waipahoehoe Avenue Bridge on the Saddle Road in Hilo on the island of Hawaii. Holloway was correct in his assessment of their longevity, in that, all but one of these original concrete arches still stands today. The construction of solid-spandrel concrete arches was the first step towards modern transportation infrastructure; the development of open-spandrel arches pushed the engineering limits of the new material and construction technology.

The second period of reinforced-concrete solid-spandrel arch construction occurred between 1916 and 1929, simultaneously with the development of the technologically innovative open-spandrel arch. Later solid-spandrel arch bridges achieved greater spans and further refinement of detail and ornamentation, particularly at parapets and end rails, than earlier examples. Art-deco styling and neo-classical detailing, such as scrolled volutes, embossed diamond-shaped panels, resulted in the construction of the most ornate bridges in the state. These later solid-spandrel arches were intended to be significant civic statements reflecting Hawaii's aspirations for beautiful and urbane public works projects. The World's Colombian Exposition in Chicago in 1893 served as the inspiration for the City Beautiful movement and the ensuing neo-classical revival in the United States. The City Beautiful movement reached its height on the U.S. mainland between 1900 and 1910 but affected Hawaii somewhat later. This movement is characterized by an attempt to create beautiful and functional cities. Aesthetic principles such as beauty, order, system, and harmony found physical realization in urban design. Architecture and public works projects, such as road and sewer systems, became civic statements which strengthened the identification of Hawaii to the U.S. mainland. The improved physical environment would persuade urban dwellers, many of them recent immigrants to Hawaii from Asia, to become imbued with civic patriotism and better disposed toward community needs.

[14] *Hilo Tribune*, March 19, 1904, 4.
[15] *Fifth Annual Report of the Superintendent of Public Works to the Governor of the Territory of Hawaii for the Year Ending June 30, 1905*, Hawaii (Territory), Department of Public Works (Honolulu: Honolulu Publishing Co., Ltd., 1905), 72.
[16] Ibid., 72.

FIGURE 13. OPEN SPANDREL ARCH BRIDGE (PARSONS BRINCKERHOFF, A CONTEXT FOR COMMON HISTORIC BRIDGE TYPES, 3-68).

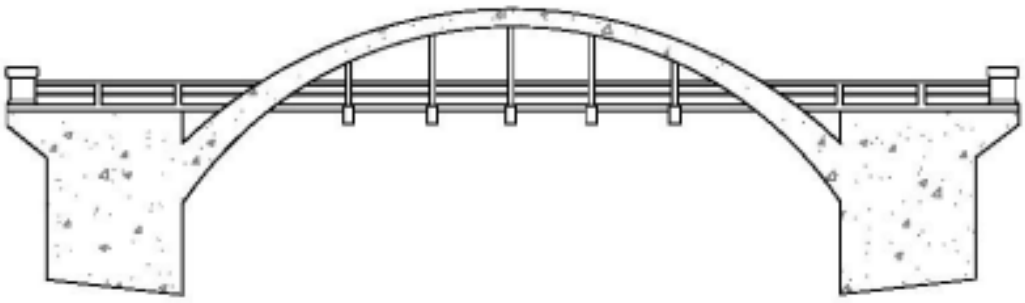


FIGURE 14. RAINBOW ARCH BRIDGE (DRAWING PROVIDED BY MKE ASSOCIATES LLC, 2013).

Open-Spandrel Concrete Arch Bridges

These types of bridges were technologically innovative and are considered to be engineering breakthroughs. Open-spandrel bridges do not contain fill material and deck loads are carried to the arch ribs by spandrel columns. The first open-spandrel bridges were constructed along the Mamalahoa Highway at Honolii on the Island of Hawaii and along the Hana Highway at Koukouai (Kaukauai) on Maui in 1911. The open-spandrel bridge, with its technical innovations, was capable of spanning hundreds of feet. Island engineers had multiplied their arch-spanning capacity by a factor of ten and refined the casting of concrete to create slimmer, lighter looking structures. They retain their historic associations and feeling due to their rural location, ornamental nature, and now uncommon structural type.

Rainbow Arch Bridges

This type of bridge, also known as “Marsh Arches” after their designer and patentee James B. Marsh, are a sub-set of the open-spandrel arch type. This distinctive form of reinforced through-arch bridge construction was also used extensively in portions of the mid-west from 1912 (the patent date) through the early 1930s. Many Marsh arch bridges were constructed in Hawaii at important crossings over major rivers in populated regions. However, only two examples remain: 1) A double-span arch with reinforced-concrete top lateral bracing was constructed over the Anahulu Stream in Haleiwa on Oahu in 1921, and 2) A single-span, pony through-deck arch, was erected over the Wailuku River in Hilo on the island of

Hawaii in 1938. Marsh arches were capable of spanning several hundred feet, however the prohibitive cost of large single spans resulted in the construction of several individual or multiple span arches.

Significance

The period of significance for reinforced-concrete arch bridges begins in 1904, when the first example was constructed, and ends in 1938 when the last concrete arch bridge was constructed. Concrete arch bridges are eligible under Criterion A if they contributed in a meaningful way to the settlement and development of a geographically definable area, facilitated major passage to or through a region, or have been significantly integral to the development of an effective transportation system. The construction of reinforced-concrete bridges in place of timber and metal bridges is representative of the commitment of the territorial and county governments to implement permanent public works improvements. The construction of these bridges required the mobilization of skilled labor and significant public funds. Many of these bridges were often extremely prominent, both in style and location, and made a significant "civic statement" regarding the technical and aesthetic sophistication of the communities in which they were built. In addition, some of these bridges have survived significant historic preservation battles between the concerned citizenry and governmental transportation agencies or private developers.

Reinforced-concrete arch bridges are eligible under Criterion C as the earliest examples of concrete bridge construction in the state. They also represent a span of engineering innovation and a visual timeline of construction technology. Concrete arch bridges often evidence a high degree of detailing and workmanship and are examples of exceptional work by important local builders. The few remaining examples are rare survivors of this once common bridge type. Reinforced-concrete arch bridges also serve as examples of exceptional work by an important engineer, architect, or builder. Prominent designers include William H. Chun, En Leong Wung, both of County of Hawaii Engineer's Office and William R. Bartels, chief designer for the Territorial Highways Department. The builders of these important early structures include Louis M. Whitehouse, Peter and Charles Arioli, Hisato Isemoto, and Moses Akiona.

Eligibility Requirements

Since reinforced-concrete arch bridges were constructed as permanent structures, the bridge must retain its integrity of location in order to be considered eligible. The design of the bridge, particularly the arch sub-structure, the spandrel walls and parapets, must also retain its integrity; although alterations early in the bridge's history (i.e., within the period of significance) and in such a way that the alterations are reversible without diminishing the significant historic characteristics of the original bridge (by widening or lengthening the bridge by the construction of an adjacent concrete culvert, for example) are acceptable. The setting of the bridge must remain relatively unchanged; by-passing the original transportation artery with a new highway does not necessarily exclude a property if the bridge's immediate surroundings retain its historic qualities. The bridge's original materials must not be adversely affected by alterations or additions. The quality of the original workmanship must remain apparent, with substantial evidence of the artisan's labor and skill. The bridge must retain a high degree of historic feeling, and its associations must be apparent to the informed or casual observer.

CONCRETE DECK BRIDGES

Description

Concrete construction technology rapidly advanced in the early decades of the twentieth century. Early twentieth century bridges built with county funds often consisted of new simple concrete decks built over the original nineteenth-century stone abutments. Slab bridges are known to have been used in Hawaii since about 1908. However, concrete girders and tee beam types came to dominate Hawaii's early twentieth-century bridge designs. As their strength and economy became apparent, concrete deck girders replaced concrete arches and open- spandrel arches for short spans. Like their contemporary flat slab bridges, early concrete girder bridges tend toward plain solid parapets and little or no ornamentation. Simple girder bridges were constructed as late as 1935 for short spans on secondary roads, since they did not have the load carrying capacity of the more recently developed concrete tee beam bridges.

This common bridge type built after 1945 is the subject of the program comment discussed in Chapter 1 under Regulatory Background, Federal Law.

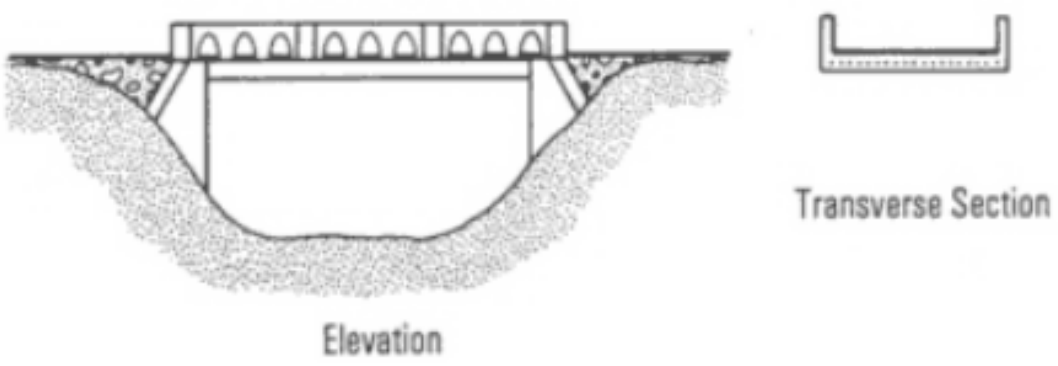


FIGURE 15. FLAT CONCRETE SLAB BRIDGE.

Flat Slab

Simple reinforced-concrete slab bridges were an alternative to metal or timber stringer structures. Concrete flat slab bridges were constructed in Hawaii from 1908, when the oldest remaining example was built (Mokulehua Bridge on the Hana Highway), until approximately 1937, when moment-resisting concrete rigid-frame bridges became common. Early flat slab bridges built with county funds often consisted of new simple concrete decks built over the original nineteenth century stone abutments. The slabs were cast on site, with formwork built by local carpenters. The plain appearance of this functional design was augmented by a variety of railings, which ranged from solid parapets to open balustrades. These bridges typically had spans of twelve to sixteen feet. However, the 1911 Waioli Bridge was constructed with a maximum span of twenty-eight feet; a technological achievement that would not be surpassed until the Keaiwa Stream Bridge (replaced in 2001), in Kau on the island of Hawaii, was built in 1937 with a span of thirty feet.

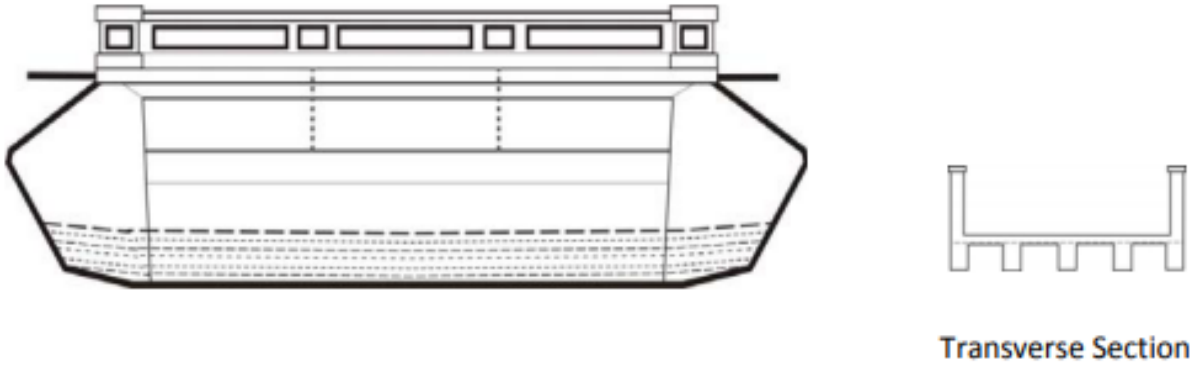


FIGURE 16. CONCRETE GIRDER BRIDGE.

Concrete Girder

Another common early concrete bridge type utilized cast concrete girders in order to extend the length of the spans. As their strength and economy became apparent, concrete deck girders replaced concrete arches and open-spandrel arches for short spans. Many of these inexpensive bridges were built by the county governments c. 1911-1912 and numerous examples of this bridge type remain along the Hana Highway on Maui and the Mamalahoa Highway on the island of Hawaii. The most notable early concrete girder bridge is the 200-foot-long Hanapepe Bridge built in 1911. Like their contemporary flat slab bridges, early concrete girder bridges tend toward plain solid parapets and little or no ornamentation. Simple girder bridges were constructed as late as 1935 for short spans on secondary roads, since they did not have the load carrying capacity of the more recently developed concrete tee beam bridges.

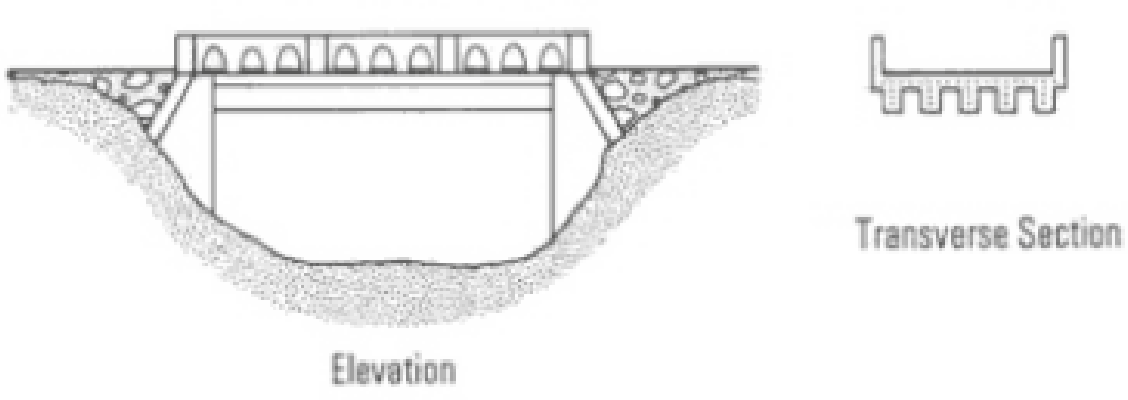


FIGURE 17. CONCRETE TEE BEAM BRIDGE.

Concrete Tee Beam

The concrete tee beam is the most common remaining type of pre-WWII bridges in the state of Hawaii. Although, the majority of concrete tee beam bridges were built by the Territorial Highways Department using local contractors after 1925, many early examples, dating from 1911-12, remain throughout the islands. These bridges are virtually indistinguishable from concrete girder bridges in appearance, differing only by the number of longitudinal beams and the pattern of steel reinforcing. Later tee beam bridges achieved remarkable spans and are among the longest and highest bridges in the state. This height and length was achieved by utilizing continuous tee beam sections. Continuity allowed for greater spans and the elimination of expansion joints in the deck. They typically feature one of the several standard rail patterns used by the Territorial Highway Department, either "Greek-cross," arched, or simple rectangular voids and a reinforced-concrete rail cap.

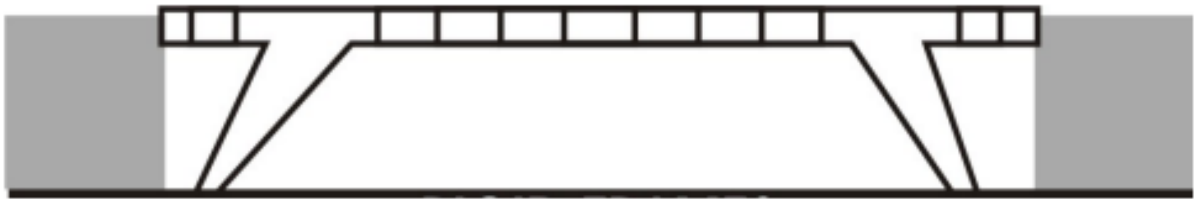


FIGURE 18. CONCRETE RIGID FRAME BRIDGE.

Concrete Rigid Frame

The most sophisticated of the pre-WWII bridges, from an engineering perspective, are those utilizing rigid-frame technologies. Concrete frame bridges are characterized by the construction of abutments and deck as one solid piece of concrete. This milestone design eliminated the need for steel bearings between deck and abutments and was more economical than plain slab construction. It also enabled the slab bridge to double or triple its previous span of 20 feet. Rigid-frame construction was a very economical and swift method for building bridges where costs had to be minimized. The earliest rigid-frame bridges were built in the United States between 1922 and 1930. However, this technology was not used in Hawaii until 1936, when William Bartels of the Territorial Highway Department developed the plans for the Wahiawa Bridge on Kauai and the Kaahumanu-Naniloa Overpass in Wailuku, Maui. These were followed the next year by the construction of two concrete rigid-frame bridges in the Kau District on the island of Hawaii and another on Oahu. Rigid-frame bridges are generally single-span structures and utilize the standard rail patterns of the Territorial Highways Department.

Significance

The period of significance for reinforced-concrete deck bridges begins in 1908, when the first example was constructed, and ends in 1977, the cut-off date for the survey. Concrete deck bridges are eligible under Criterion A if they contributed in a meaningful way to the settlement and development of a geographically definable area, facilitated major passage to or through a region, or been significantly integral to the development of an effective transportation system. Concrete deck bridges are representative of important public works projects initiated by the territorial and county governments. They were generally constructed at important crossings along a major transportation route or belt road.

Many of the later concrete deck bridges were constructed with federal work relief programs funds during the Depression era. The early flat slab and girder bridges are an excellent example of the early period of twentieth-century bridge design when new materials and design methods were being tried. Concrete flat slab and girder bridges are early examples of the progressive Territorial Highway System in Hawaii and among the first use of formal engineering expertise in bridge making by the new territorial government, shortly after the annexation of Hawaii by the United States. The road bridges played a major role in the development of each county's belt road plan by connecting previously isolated communities with a paved highway.

Reinforced-concrete deck bridges are eligible under Criterion C if they are the earliest, sole surviving, longest span, or most intact example of their type, or if they exhibit notable engineering or decorative details. They may also serve as examples of exceptional work by an important engineer, architect, or builder. Later concrete bridges, such as tee beams and rigid frames, demonstrate the rapid advances in engineering technology in the early decades of the twentieth century.

Prominent designers include Joseph H. Moragne of the Kauai DPW, who oversaw the construction of the early slab and girder bridges built in the Hanalei area of Kauai in 1911-12; and William Bartels, chief designer for the Territorial Highway Department (THD), who was responsible for the design of many later concrete bridges, such as tee beam and rigid-frames. Important builders include George Ewhart, George Freitas, George Mahikona, and the Hawaiian Contracting Company. See information on these designers in Appendix B.

Eligibility Requirements

Since reinforced-concrete deck bridges were constructed as permanent structures, the bridge must retain its integrity of location. The design of the bridge, particularly the sub-structure, the spandrel walls and parapets, must also retain its integrity. Alterations may be considered acceptable if they were completed early in the bridge's history (i.e. within the period of significance) and in such a way that they are reversible without diminishing the significant historic characteristics of the original bridge. The setting of the bridge must remain relatively unchanged; by-passing the original transportation artery with a new highway does not necessarily exclude a property if the bridge's immediate surroundings retain its historic qualities. The bridge's original materials must not be adversely affected by alterations or additions. The quality of the original workmanship must remain apparent, particularly from a technical rather than aesthetic perspective, with substantial evidence of a builder's labor and skill. The bridges must retain a high degree of historic feeling, and their associations must be apparent to the informed or casual observer.

TIMBER STRINGER BRIDGES

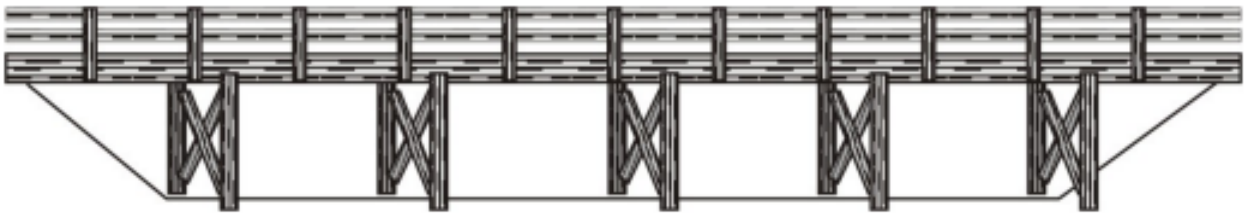


FIGURE 19. TIMBER STRINGER BRIDGE.

Description

Simple timber stringer spans constitute the only extant wood bridge type in Hawaii. Timber had been used for bridge construction since 1840 when the first bridges were built in the islands. Timber bridges were susceptible to washouts and decay, thus the earliest surviving bridge dates from 1924. The remaining examples of wood bridges are constructed of timber girders, often with masonry (basalt) pier footings and abutments, wood cribbing or trestles, and open horizontal wood board railings. Stringer spans usually measure twenty-five feet or less. Larger timber stringer bridges are generally located in the dryer areas over deep gulches and date from the immediate pre- and post-WWII period (c. 1937 to 1947). The failure of the Territorial Legislature to match federal funds led to a significant reduction in funds available for bridge construction by the end of the decade. Consequently, less expensive wood bridges were built. The older, smaller wood bridges were generally constructed on secondary roads. Very few of these timber bridges remain in the islands as a result of a deliberate policy by the THD and county DPWs to replace timber bridges with permanent, low-maintenance concrete structures.

Significance

The period of significance for timber stringer bridges begins in 1924, when the first remaining example was constructed, and ends in 1949, when the last timber bridge was constructed. Timber bridges are eligible under Criterion A if they have contributed in a meaningful way to the settlement and development of a geographically definable area, facilitated major passage to or through a region, or were significantly integral to the development of an effective transportation system. Timber stringer bridges are representative of public works efforts by the territorial and county governments for transportation infrastructure primarily located in rural homestead areas.

The majority of Hawaii's timber was (and still is) fir or pine imported from the Pacific Northwest, although early records show a preference for rare local tropical hardwoods. During the early twentieth-century, older timber bridges were periodically replaced with simple concrete spans in efforts to upgrade the highways. The relative impermanence of timber, compared to other bridge types, diminished the desirability of timber bridges. However, timber was frequently used for small bridges on little-traveled roads because this material was less expensive in the short run. Budget constraints impacted bridge construction beginning in 1937, when the Territory no longer matched incoming federal funds. Bridges built around this period were often of inexpensive timber with fairly short spans. Further, concrete and steel were in short supply due to the military construction boom as World War II approached. During this time, locally abundant masonry (“lava-rock”), which was not previously used on Federal Aid bridges, made an appearance in footings and abutments. Today, the governmental transportation agencies no longer construct timber bridges and, in fact, are reluctant to maintain existing ones. Consequently, the few remaining timber stringer bridges stand as rare survivors of this once common bridge type. Because these bridges have few character defining features, those timber bridges that feature superstructures re-constructed with concrete or steel girders at a later date do not meet integrity criteria.

Eligibility Requirements

Timber bridges must retain their integrity of location. The design of the bridge, particularly the wood sub- structure, must also retain its integrity. Alterations within the period of significance that do not diminish the significant historic characteristics of the original bridge (such as material replaced in-kind)

are acceptable. The setting of the bridge must remain relatively unchanged. By-passing the original transportation artery with a new highway may not necessarily exclude a property if the bridge's immediate surroundings still retain their historic qualities. The bridge's original materials must not be adversely affected by alterations or additions. The quality of the original workmanship must remain apparent, particularly from a technical rather than aesthetic perspective. The bridges must retain a high degree of historic feeling and their historic associations must be apparent to the informed or casual observer.

Bridge Parapet/Railing Types

SOLID PARAPET DESIGN	
Concrete Solid	 Farrington Highway, Hunehune Stream Bridge (1941) County of Honolulu: 003924001100001
Concrete Solid with Cap	 Hanapepe Bridge (1911) County of Kauai: 007190071119004

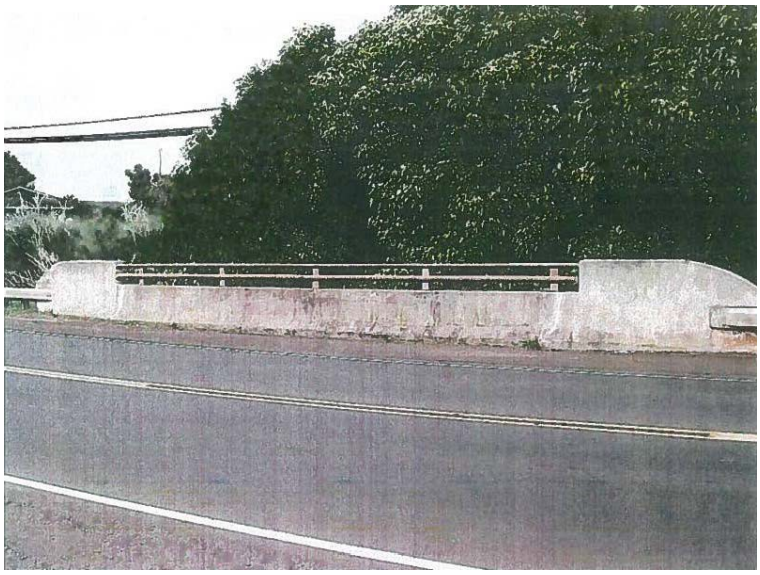
Concrete Solid Panel	 Hanamaulu Stream (Maalo Road) Bridge (1927) Kauai State: 007005830500004
Concrete Solid Panel with Cap	 Waikomo Stream (Koloa Road Bridge) (1928) County of Kauai: 007270100828001

Concrete Solid Decorative	 Ala Wai Canal County of Honolulu: 003083181400074
Masonry Rock	 Kawa Stream Bridge (1939) Oahu State: 003063001400065

Masonry Rock with Cap	 Nuuanu Stream Bridge County of Honolulu: 003083471400113

OPEN PARAPET DESIGN	
Concrete Open Horizontal	 Mana Bridge No. 1 (1900) County of Kauai: 007120061112002
Concrete Open Vertical	 Kapalaau Stream Bridge (1940) Oahu State: 003009300501414

Concrete Open Arched	 Waihohonu Stream Bridge (1934) Kauai State: 007000500302613
Concrete Open Greek Cross	 Waimea River (1940) Kauai State: 007000500301039

Concrete Open Decorative	 Puuhaoa No. 22 Bridge (1910) County of Maui: 009003600904386
Concrete and Metal	 Gulch (Kailua) Structure No. 50 (Sam Kalama) (1930) County of Maui: 009003650700070

Concrete and Metal Picket	 Palolo Stream Bridge County of Honolulu: 003083531400155
Concrete and Metal Decorative	 Kapalama Canal (1938) County of Honolulu: 003062081400134

Metal Horizontal	 Kula Kolea Pedestrian Overpass (1960) Oahu State: 003000630000234
Metal Picket	 Vineyard Blvd (Central Intermediate Pedestrian Overpass) (1957) Oahu State: 003098001400116

Metal Thrie Beam	 Anakaluahine Stream Bridge No.69 (1924) Maui State: 009000300303899
Metal Decorative	 Keolu Drive Bridge-Hele Drainage Channel (1957) County of Honolulu: 003427001100001

Wood	 Maili Stream Bridge (1900, replaced in kind in 1974) County of Hawaii: 001260001100003
No Railing/Parapet	 Opaekaa Bridge (1900) County of Kauai: 007420151142001

3.0: HISTORIC CONTEXTS[17]

3.1: DESIGN AND CONSTRUCTION OF BRIDGES AND ROADS IN THE HAWAIIAN ISLANDS, PRE-CONTACT TO THE 1960S

Overview

The Hawaiian Archipelago is a chain of rugged islands, coral reefs, and rocky shoals located in the North Pacific Ocean. The archipelago consists of approximately twenty islands and islets curving more than 1,600 miles southeast to northwest. The archipelago extends over a vast area of the Pacific Ocean but has limited land area. This chain is crossed by the Tropic of Cancer and is located 2,100 nautical miles west of the mainland of the United States. The islands of Hawaii are the worn tops of volcanoes which first erupted from the bottom of the ocean millions of years ago. The land mass that makes up the Hawaiian Islands is comprised almost entirely of basaltic rock. Stream erosion, resulting from the island's copious rainfall, and the constant action of the sea have carved large amphitheater-headed valleys and great sea cliffs, called *pali*, thousands of feet high in some places. This mountainous terrain drops steeply to a plain which slopes gradually to the shore. The steep mountains, deep valleys and circuitous coastline of the islands, have resulted in the completion of many dramatic bridge construction projects. The State of Hawaii is composed of eight principal islands; only the four largest (Hawaii, Maui, Oahu and Kauai) have the geography and population necessary for significant bridge construction. Due to the intensive development experienced in the Hawaiian Islands in the post-war period, few stretches of roadway retain a significant concentration of earlier historic bridges; the Hana Highway on Maui, Kuhio Highway on the north shore of Kauai and the Old Mamalahoa Highway on the Island of Hawaii with their numerous spans remain exceptions. The Pali Highway on Oahu has a significant concentration of historic bridges from the 1950s to 1969.

Historical Background

Hawaii's socio-political history may be divided into five general time periods:

1. Polynesian (Pre-Western Contact, 500 CE to 1778)
2. European Discovery (1778-1810)
3. Hawaiian Monarchy (King Kamehameha I to Queen Liliuokalani, 1810-1893)
4. Provisional Government, Republic of Hawaii, Territorial Status (1893-1959)
5. Statehood (1959-Present)

Initially, road and bridge-building in Hawaii developed in conjunction with the westernization of the islands in the early nineteenth century. Examination of the archival materials and government documents of the Hawaiian Kingdom reveals very limited information. Considering the dramatic social and political upheavals of Hawaiian history, it is not surprising that few early records about bridge building were retained. After the illegal overthrow of the Hawaiian monarchy in 1893, the Independent Republic of Hawaii looked to the United States for annexation and Hawaii became an American territory in 1898. Several bridges remain from this transitional period, including masonry arches built by the Republic of Hawaii – such as the Mamalahoa-Kalalau, Mamalahoa-Kaumoalii, and Mamalahoa-

[17] Sections 3.0-3.7 have been carried over from the 2013 SHBIE. When necessary, edits have been made to the text and corrections have been made to the footnotes.

Laupahoehoe Bridges on the Island of Hawaii. The majority of the remaining historic bridges in Hawaii were constructed by the county and Territorial governments. Hawaii achieved Statehood in 1959, resulting in a shift in policy and procedure for highway and bridge construction throughout the state.

Bridge and Road Construction in the Kingdom of Hawaii to 1893

Native Roads (Prior to 1810)

Traditionally, the Hawaiians had highly developed canoe-making and paddling skills, and the preferred means of travel was by water. Although there are few direct accounts by early Hawaiian informants discussing pre-contact trails or roads, physical evidence of a rudimentary native trail system remains. In addition to native footpaths constructed parallel to the coastline, there were less traveled routes to the uplands within each ahupuaa (a pie-shaped native land division stretching from the mountains to the sea) and shortcuts over the mountains. Occasionally, more substantial roads were built by Hawaiian chiefs for warfare and as a symbol of their unifying power, including the “King's Highway” near Makapuu Point on Oahu and Maui's Kiha-a-Piilani “Highway” which ran all the way from Wailuku to Hana, a distance of approximately sixty miles. The latter was laboriously constructed of hand-fitted, adze-trimmed basalt blocks about two feet on a side, and laid in a mosaic to form paths four to six feet wide. There is no remaining evidence of ancient Hawaiian bridge construction, although carved steps which may date from pre-contact Hawaii are found on several valley walls, such as those adjacent to the Koukouai Gulch Bridge in Kipahulu, Maui.

Kingdom of Hawaii (1810-1893)

Prior to 1846, the islands lacked a comprehensive system of interior roads or paths which made overland travel difficult and necessitated travel by sea. The Reverend Titus Coan, an early missionary, wrote “for many years after our arrival [in 1835] there were no roads, no bridges, and no horses…and all my tours were made on foot.”[18] A typical highway was “a simple trail, winding in a serpentine line, going down and up precipices, some of which could only be descended and ascended by grasping the shrubs and grasses.”[19] Reverend Coan went on to enumerate the several ways he used to ford the streams and rivers; these included wading, jumping from rock to rock with the help of a stick, riding the shoulders of a strong Hawaiian, throwing a rope to the other side, and holding on to the shoulders of a chain of Hawaiian men stretched across the water.

The introduction of horses to the islands in 1803 aided land transportation. By the mid-nineteenth century, the increasing use of horses and wagons necessitated a better system of interior roads. In 1846, the Kingdom of Hawaii established the Department of the Interior with a Superintendent of Internal Improvements (later Public Works) to oversee the construction and maintenance of piers, harbors, government buildings, roads, and bridges. The expenditures of the Bureau of Internal Improvements or of the Department of the Interior as a whole were, with only a few exceptions, the largest item in the Kingdom's budget. The governors of the various islands were charged with carrying out the king's wishes by using prisoners or those liable for the labor tax. This tax required all able-bodied male Hawaiians who

[18] Titus Coan, *Life in Hawaii: An Autobiographic Sketch of Mission Life and Labors (1835-1881)*, rev. 2nd ed. (1882; reprint Mesa, Arizona: Scriptoria Books, 2013), 21.
[19] Ibid., 21.

were "'vassals or tenants of a landlord or without an art or profession' to work on any of the king's road or bridge projects on certain designated days or to pay a commutation fee of 12 ½ cents per

day."[20] However, the Kingdom's road building, according to noted historian Kuykendall, consisted of little more than clearing a right of way, doing a little rough grading and putting up wooden bridges which were routinely washed away during heavy rains. Most of the Kingdom's scarce funds were absorbed by the repair and maintenance of existing roads.

Historian Ralph Kuykendall faulted the government for "the lack of general understanding of the importance of good roads, the lack of over-all planning and co-ordination between different districts, the lack of engineering skill and competent supervision, and the lack of funds with which to finance a thorough-going road program."[21] These conditions prevailed until the last decades of the nineteenth century. As late as 1886, Minister of the Interior Charles Gulick had to admit:

> A country like ours, for the most part mountainous and cut by deep gorges, which in the wet season are filled with impossible torrents, and widely separated districts with sparse population, present at a glance the most prominent difficulties in the way of substantial road making in this Kingdom. In other words, to speak comparatively, we have a hundred dollars' worth of work to be done and, say, ten dollars to do it with. This general condition has not materially changed since them first public highway was built in the Kingdom.[22]

In 1887, King David Kalakaua transferred much of the Kingdom's responsibility for internal improvements to local road boards financed by a road tax. These boards were semi-autonomous and charged with the construction of public highways in their taxation districts. Generally, road construction was undertaken by prisoners and day laborers. The public works system of the Hawaiian Kingdom remained undisturbed by the overthrow of the monarchy in 1893, and no major changes were noted until the time of annexation by the United States in 1898.

THE FIRST BRIDGES (1840-1893)

The first reference to bridge construction, over the Nuuanu Stream along the present Beretania Street in urban Honolulu, appears in 1840. In an article describing "Improvements and Changes in and About Honolulu," *The Polynesian* reported:

> Then we leave Rev. L. Smith's new church [Kaumakapili Church, then located on Beretania Street between Maunakea Street and Nuuanu Avenue]…with a causeway, crossing the river and low ground in the vicinity. [The bridge's] expense exceeded $1200, and it has proved of great utility,

[20] Patricia M. Alvarez, *Historic Bridge Inventory and Evaluation: Island of Hawaii*, Prepared for the State of Hawaii Department of Transportation Highways Division, In Cooperation with the U.S. Department of Transportation, Federal Highway Administration (July 1987), 8.
[21] Ralph S. Kuykendall, *The Hawaiian Kingdom,* Vol. II*, 1854-1874: Twenty Critical Years* (Honolulu: University of Hawaii Press, 1953), 26.
[22] Kingdom of Hawaii, Minister of the Interior, *Biennial Report of the Minister of the Interior to the Legislative Assembly of 1886*, 16, quoted in Dawn E. Duensing, *Hawaʻi's Scenic Roads: Paving the Way for Tourism in the Islands* (Honolulu: University of Hawaiʻi Press, 2015), 1.

> being a great thoroughfare…instead of the long ride through the water as was formerly the case.[23]

Other bridge construction projects followed quickly, although none of these early bridges remain today. In 1845, the first published annual report of the Minister of the Interior noted that "some improvements have been made on the bridges and roads of [Oahu] and other islands."[24] Patricia M. Alvarez, author of the Big Island's 1987 historic bridge survey observed, "[t]imber and stone were the prevailing bridge construction materials at this time. Stone was abundant in Hawaii, and among the first bridges built by the Interior Department were stone bridges at Nuuanu and Waikiki. But construction of stone bridges required skilled labor to build", which was scarce in the islands. "Wood was the cheapest material, and many types were available."[25] R.A.S. Wood, Superintendent of Internal Improvements during the mid-1850s, reported to the Minister of the Interior his evaluations of different types:

> The bridges heretofore built by the government prove beyond all doubt the unworthiness of Oregon pine or fir timber for this purpose. All, with scarcely an exception, are in such a state of decay as to require rebuilding. Our own *ohia* [a native hardwood], for bridge or wharf purposes, is infinitely superior to Oregon pine. Though somewhat more expensive at the first outlay its durability will warrant using it.[26]

These pioneering bridges were unfortunately vulnerable to floods. On April 1, 1847, heavy rainstorms struck Kauai and "all the bridges on the island were carried away."[27] Within the week Oahu suffered the same fate. In 1858, the Oahu Road Supervisor reported that nine bridges were destroyed in his district by a freshet. Twenty years later, the Report of the Minister of the Interior to the Legislative Assembly noted that "the bridges of Hawaii and Kauai were swept away last year."[28] The 1882 Department of the Interior Report carried the lament that "in some districts, owing to the exceptionally wet season, causing heavy freshets in the streams, a good many bridges have been carried away."[29]

In an attempt to provide low-cost, permanent replacements for timber bridges, ten steel Pratt-truss bridges, manufactured by the Pacific Bridge Company in Portland, were ordered by the Kingdom for the Island of Hawaii as early as 1884. For shorter spans, concrete slabs were the preferred solution, but at

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[23] "Improvements and Changes in and About Honolulu," *The Polynesian*, October 17, 1840, 74, quoted in Robert C. Schmitt, "Early Hawaiian Bridges," *The Hawaiian Journal of History* 20 (1986): 152.
[24] Kingdom of Hawaii, Minister of the Interior, *Biennial Report of the Minister of the Interior to the Legislative Assembly of 1845*, 10.
[25] Alvarez, *Historic Bridge Inventory: Hawaii*, 13; Kingdom of Hawaii, Minister of the Interior, *Biennial Report of the Minister of the Interior to the Legislative Assembly of 1848*, 5; Kingdom of Hawaii, Minister of the Interior, *Biennial Report of the Minister of the Interior to the Legislative Assembly of 1846*, 6 [Cleaned up from Alvarez citations].
[26] Alvarez, *Historic Bridge Inventory: Hawaii*, 13-14; Kingdom of Hawaii, Minister of the Interior. *Biennial Report of the Minister of the Interior to the Legislative Assembly Report of the Minister of the Interior to the Legislative Assembly of 1855*, 9.
[27] *The Polynesian* (Honolulu), April 10, 1847, 191.
[28] Kingdom of Hawaii, Minister of Finance, *Report of the Minister of Finance to the Legislature of 1878*, 10.
[29] Kingdom of Hawaii, Minister of the Interior, *Report of the Minister of the Interior to the Legislative Assembly of 1882*, 49.

this date, concrete bridges that could achieve longer spans were beyond the available engineering and construction technology. Nonetheless, maintaining steel bridges proved too costly in Hawaii's corrosive marine environment and they were soon rejected for government roads. None remain from this early steel period.

Bridge and Road Construction in the Republic of Hawaii and the Territorial Era: 1894-1941

BRIDGE CONSTRUCTION DURING THE REPUBLIC OF HAWAII (1893-1898)

During the period of the Kingdom, road and bridge construction was undertaken by day laborers and prisoners. However, in 1896-97, contracts were let for a belt road on the Island of Hawaii, the first time such a system was used extensively, resulting in the construction of hundreds of miles of roads on that island. The masonry (cut basalt or lava rock) arch spans constructed along the Hamakua coast of the island of Hawaii under these contracts are the oldest remaining bridges in the islands. Other significant nineteenth-century bridges include the Opaekaa Stream Bridge which was built from portions of one span of a three-span bridge manufactured in Scotland in 1890 and erected over the mouth of Kauai's Wailua River in 1896. This bridge is significant as the only known British-made iron bridge in the United States and was listed on the National Register of Historic Places in March 1983.

BRIDGE CONSTRUCTION DURING THE EARLY TERRITORIAL PERIOD (1898-1924)

The Hawaiian Islands were annexed by the United States in 1898. The Organic Act of 1900 abolished the Department of the Interior and replaced it with the territorial Department of Public Works (DPW) headed by a Superintendent of Public Works (SPW), which had responsibility for expending territorial funds on road and bridge work. Five years later, the Territorial Legislature established the county governments on the separate islands, granting them taxing and spending powers in their jurisdictions. After the counties were granted independent taxing powers, they still relied on legislative appropriations to supplement county funds for internal improvements, thus the history of county roadbuilding was closely tied to Territorial and Federal government largesse**.** Consequently, throughout much of the early twentieth century, the counties' road and bridge-building could not keep up with the islands' economic development and infrastructure needs. In some cases, government funds were so scarce that public roads were maintained by private business so as not to impede their productivity. For example, the belt road on the windward coast of Maui was maintained by the East Maui Irrigation Company and the roads in Haiku, Maui were maintained by the Haiku Fruit and Packing Company. Increased automobile traffic and damage from heavy rains increased the maintenance cost of these roads and in the 1920s, private planters demanded that the county administration shoulder the burden of the road upkeep.

In response to a chronic shortage of funds for road construction, the 1911 Legislature recommended the issuance of territorial bonds for belt road construction. A Loan Commission, consisting of the SPW, the county Chairman of the Board of Supervisors, and three county residents, was appointed to oversee the fund expenditures. In the 1920s and 1930s, bridge building continued to be financed through the loan fund and legislative appropriation. Prior to the initiation of the Federal Aid Program in 1925, bridges along the belt roads were generally designed by the county engineers using Territorial Loan Funds. Each county had its own bridge design department located within the County Engineer's Office. Many of the bridge engineers were technologically skilled and evidenced high aesthetic sensitivity. J. H. Moragne, on

the Island of Kauai, was responsible for the most technologically innovative work of his time. En Leong Wung and William Hoy Chun of the County of Hawaii designed scores of technologically simple, yet aesthetically sophisticated, bridges along the Hamakua Coast of that island. These bridges were generally short span reinforced-concrete arch, deck girder or flat slab structures.

As horses and carriages gave way to automobiles, trucks, and buses, wider and more durable roads were needed to service these vehicles. Originally, bridges were just wide enough to let one horse and buggy cross at a time and no sidewalks were provided for pedestrians, even in urban areas. A Hilo newspaper writer pointed out that "strictly speaking, a pedestrian has no rights which any one is bound to respect."[30] Bridges on plantation roads were often as narrow as eight or nine feet, those on public roads averaged fourteen or sixteen feet in the first decade of the century. The Loan Fund Commission established eighteen feet as its required road width in 1911, although sixteen feet was commonly used in rural areas. These specifications prevailed until the 1920s when they were expanded to twenty feet. Sidewalks were generally not added until the 1930s, first on one side, then on both sides by the end of the decade.

Bridge railings are another indication of a bridge's period of construction. The earliest bridge railings were rubble masonry (lava rock) constructions, such as those at the Mamalahoa-Kalalau Bridge built on Hawaii Island in 1899. These were followed by simple concrete railings, or parapets, which were generally less than three feet high and capped on top. Examples of these earliest parapets include the Mamalahoa-Puuokalepa Bridge on Hawaii Island and the Waioli Bridge on Kauai. Decorative rectangular inset panels were added to concrete parapets by 1919, such as those of the Waikamoi and Haipuaena Bridges on Maui. In the 1920s, railings became post and beam constructs, usually with a rectangular configuration, such as those found on many of the county-built bridges along the Hana Highway. Occasionally, the railings rose to an artistic level with Italianate posts, such as the Ainako Stream-Waianuenue Avenue Bridge in Hilo. Block-like end piers were added in the 1930s, smaller versions of the decorative pylons which appear on the continental United States bridges of this period. These were typically found on Federal Aid bridges constructed by the Territory of Hawaii. Art Deco motifs and streamlined design, like those found on the Date Street Bridge in Honolulu, were also common to 1930s-era bridges.

From 1900 to 1940, the Hawaiian Islands witnessed rapid economic and population growth. During this time, the population of the islands more than doubled, primarily due to the importation of laborers for the sugar and pineapple plantations, which meant increasing demand for housing, schools, utilities, and physical infrastructure. Only the remote rural areas traditionally isolated by a lack of good roads, such as the Hana district on Maui, Waipio Valley on the Island of Hawaii or Kalalau on Kauai, witnessed a decline in population during this period. The construction of the Panama Canal in 1914 coincided with changing social conditions in Hawaii. Honolulu was eager for the expected economic growth through shipping, trade, and tourism. These prospects mobilized community leaders to increase promotion for Hawaii, improve transportation, and further identification between Hawaiian communities and American cities. The World's Columbian Exposition in Chicago in 1893 served as the inspiration for the City Beautiful movement and the ensuing neo-classical revival in the United States. The City Beautiful movement reached its height on the U.S. mainland between 1900-1910 but affected Hawaii somewhat later. This movement is characterized by an attempt to create beautiful and functional cities. Aesthetic principles

[30] Alvarez, *Historic Bridge Inventory: Hawaii*, 63.

such as beauty, order, system, and harmony found physical realization in urban design. Architecture and public works projects, such as road and sewer systems, became civic statements which strengthened the identification of Hawaii to the U.S. mainland. The improved physical environment would persuade urban dwellers, many of them recent immigrants to Hawaii from Asia, to become imbued with civic patriotism and better disposed toward community needs.[31]

During this period, Hawaii was on the receiving end of mainland technology and the history of its bridge development parallels that of the United States mainland, albeit with some delay. As on the mainland, there was an evolution of bridge types constructed due to changing economic factors and technology. Records for length and sophistication of design were continuously changing; accolades such as "the longest" and "the first" were used repeatedly over the decades to describe the latest achievements. Although Hawaii lagged behind the mainland United States in technological development, it still had its share of landmark bridges.[32]

The bridges constructed with Territorial Loan Funds are among the early examples of the progressive Territorial Highway system in Hawaii. These bridges are also an example of one of the first uses of formal engineering expertise in bridge making by the new territorial government after the annexation of Hawaii by the United States. The bridges played a major role in the development of each county's belt road plan which connected previously isolated communities with a paved highway and a series of steel-reinforced concrete, timber, or steel bridges. The construction of improved modern vehicular roads, especially the up-to-date replacement of older, weak timber bridges by steel truss and reinforced concrete spans, remedied unsatisfactory road and transportation conditions, improved communications, and helped stimulate the economic and social growth of the then relatively isolated communities. The new roads and bridges shortened distances connecting each island's villages, farms and plantations. Supplies, services, and scenic and recreational areas were reached more easily, and the improved transportation stimulated new competition with shipping at each coastal town's pier and landing.

Homesteading, another important movement in Hawaiian history, was also intended to create smaller communities in Hawaii.[33] After the overthrow of the Hawaiian monarchy in 1893, the new provisional government leased out vast tracks of prime government land to sugar plantations. When these thirty-year leases expired in the 1920s, the territorial government made this land available for homesteaders. The counties began to develop new lands for homesteading by installing the needed infrastructure, such as roads and utilities. Construction of roads and bridges was limited by the small and intermittent funding mechanism of assessing homesteaders as they bought the lots. The SPW remained responsible for homestead roads and bridges until 1917 when the responsibility for homestead roads was transferred to the Territorial Commissioner of Public Lands (CPL). In actuality, the County Engineer's Offices remained responsible for the construction of most of the roads and bridges until 1925, because the CPL was "not provided with an engineering force necessary for the direct handling of this work."[34]

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[31] William H. Wilson, *The City Beautiful Movement* (Baltimore: The Johns Hopkins University Press, 1989), 1

[32] Alvarez, *Historic Bridge Inventory: Hawaii,* 1.

[33] Spencer Mason Architects, *Historic Bridge Inventory: Island of Kauai*, prepared for the State of Hawaii, Department of Transportation, Highways Division in cooperation with the U.S. Department of Transportation, Federal Highways Administration (October 1989), 249.

[34] Ibid., 4.

BRIDGE CONSTRUCTION AND THE FEDERAL AID PROGRAM (1925-1941)

The Federal Aid System in Hawaii consists of three types:

1. The Interstate and Defense Highways;
2. The Federal Aid Primary System; and
3. The Federal Aid Secondary System.

Beginning in 1916, in anticipation of its entry into World War I, the United States Congress appropriated funds to assist States in developing their transportation networks. Federal Aid funded roads were intended to upgrade existing highways by providing good drainage, clearly marked lanes, improved alignment, grades that could be negotiated in high gear, wide shoulders, safe and wide bridges, and safe bridge approaches. Belt roads, which circled the island, or roads that linked a seaport to federal property (such as military bases or national parks) were usually selected for Federal Aid in Hawaii. Maintenance of federal roads was to be done by the States from their own funds. Because it was not yet a state, Hawaii was initially excluded from the Federal Aid system although its citizens paid federal taxes. The Hawaiian Legislature passed a Bill of Rights in 1923, demanding equal benefits with the nation's States; this bill was signed into law by President Calvin Coolidge in March 1924.

Hawaii received its first federal funds in 1925 and created the Territorial Highway Department (THD) to oversee the expenditure of the funds as required by the Federal Road Aid Act. Designs for new bridges on designated Federal Aid primary roads were hereafter prepared by this department. Also in 1925, Congress voted to give Hawaii the federal highway funds it had missed since 1917. In the mid-1930s, yearly federal contributions rose to the million-dollar mark with the passage of the New Deal road aid measures such as the National Industrial Recovery Act, the Emergency Relief appropriations Act and aid for secondary road systems. By 1940, approximately sixty-five percent of Hawaii's roads had been built with federal funds.

Bridges were a special concern of the federal highway system, and the THD began a systematic replacement of narrow and hazardous bridges. With ample funds, the THD began to straighten out the belt roads and build long, high bridges across the mouths of the valleys. The federal government started funding secondary or feeder roads in the late 1930s. These were required to be outside of municipalities and be farm-to-market roads or other rural roads of community value which connect with important highways or the Federal Aid primary system. Bridges constructed with Federal Aid dollars have longer spans and were more decorative than county financed bridges. Reinforced-concrete tee beam bridges dominate this period, although a few rare examples of open-spandrel concrete arches remain. Rail design was standardized into a few patterns, such as the “Greek-cross void,” enabling easy recognition of THD bridges. Notable examples include the Hanapepe Highway Bridge on Kauai and the Kipapa Franklin Delano Roosevelt (FDR) Bridge on Oahu.

BRIDGE AND ROAD CONSTRUCTION IN HAWAII: 1941-1977

BRIDGE CONSTRUCTION DURING WORLD WAR II, POST-WORLD WAR II, AND THE NATIONAL DEFENSE HIGHWAY SYSTEM (1941-1960S)

After the outbreak of World War II in December 1941, the military constructed many miles of roads in Hawaii. However, as a Territory of the United States, Hawaii was not entitled to the same level of federal funding given to other continental States for highway building projects, based on the 1944 Interstate

Highway System Act. In 1941, the War Department designated all Oahu's principal highways as part of a "strategic network of highways." The term "strategic network of highways" implicates principal highway traffic routes were of military importance in the Territory of Hawaii. Civilian construction virtually halted as manpower and equipment was requisitioned by the military. The military establishment quickly became the largest employer of civilian workers in the Territory. Highway and bridge construction was restricted to only those projects which materially aided the National Defense System.

Hawaiian delegates used the Department of Defense's designation as "strategic" to argue that Hawaii's military bases and highway networks were key to National defense. In the early 1950s, the Korean War increased National Defense activity in Hawaii due to rising tensions in the Pacific area. This need, as well as the increased use of motor vehicles and the islands' tourism industry collectively increased pressure to meet growing transportation needs. In 1953, Territorial Highway Engineer Ben E. Nutter provided a "Progress Report on Highways" to the Legislature that detailed highway deficiencies in excess of 50 million dollars – or more than ten times the annual construction budget. The report indicated that the 1954 Hawaii Federal Aid Highway System was still about 10 years behind in providing modern highways of adequate design and capacity. In the postwar era a sophisticated survey of the island's roads was completed by the THD. This survey rated roads and bridges on a mathematical "sufficiency rating system."[35] Fewer than half of the Federal Aid system's roads got a passing grade.

In 1959 Hawaii was admitted as the fiftieth state of the United States. The "Hawaii Statehood Transition Bill" of 1959 made millions of federal dollars available for highway improvement and development. The HDOT was established in January 1960. At that time, there were about 633.93 miles of roads to build to fill the gaps in the Federal Aid Highway System. Later, in July 1960, the Interstate Highway System was extended to the State of Hawaii, which allowed the new Federal Interstate Highway fund to be applied to Hawaii's highway and bridge constructions. With Hawaii's significant role in the National Defense system, the Interstate Highway fund was intended to serve both military needs and civilian interstate traffic needs. Hawaii continued to benefit from regular federal aid, such as the Highway Beautification Act of 1965 and aid for secondary roads.

The construction of roads and bridges in Hawaii can be directly linked to the needs of the National Defense system and the military establishment. With adequate federal funds in the post-war era, bridges were usually built as part of large public projects, such as for the construction of new Nimitz Highway and H-1 in East Oahu and in Honolulu, Trans-Koolau Range projects linking Honolulu with windward Oahu with the Pali and Likelike Highways, and the Seismic Wave Damage Rehabilitation Project on the Big Island that converted portions of the abandoned Hilo Railroad to the Hawaii Belt Road. These projects played an important role, tying together military bases and civilian residential districts settled all over the islands. Bridges of this period can be easily recognized by the distinctive post-war style railing, the prevailing decoration for bridges at the time. This railing style is composed of a reinforced concrete balustrade penetrated with horizontal rectilinear voids with concrete rail caps. Other bridges from this period began the first use of metal in guardrail designs. However, during the

[35]Territory of Hawaii, Superintendent of Public Works, "Highways – a Look at the Score," in *Annual Report to the Governor, Fiscal Year Ending June 30, 1953*, 2, https://catalog.hathitrust.org/Record/100157967.

implementation of these federally sponsored projects, many earlier, historic bridges were demolished and replaced by modern constructions.

3.2: THE HANA HIGHWAY, MAUI: PRE-CONTACT TO THE 1960S

HISTORICAL BACKGROUND

Before about 1450 CE, Maui was divided into two separate kingdoms, one with a court at Lahaina and one with a court at Hana. The two were constantly at war, but eventually Piilani of the Maui Ulu line at Lahaina conquered the east and south parts of the island. His rule is remembered as one of peace, prosperity, and the construction of public works, including the largest heiau, or temple, in the Hawaiian Islands. Called Piilanihale, it was built near Honomaele and incorporated massive yet un-mortared stone walls, some up to fifty feet high, as well as an immense stone platform covering nearly five acres. Of greater importance to his reign and to his subjects was the creation of a network of unpaved roads extending throughout Maui, a process that symbolized his unifying power. Each road was laboriously constructed of hand-fitted, adze-trimmed basalt blocks about two feet on a side and laid in a mosaic to form paths four to six feet wide. One of these roads ran all the way from Wailuku to Hana – a distance of approximately sixty miles. In circa 1490 CE, Piilani's son, Kihaapiilani, had the road extended beyond Hana, through Kaupo Gap, and across Haleakala Crater.

The original route to Hana was well maintained for over 250 years, because it was the only land link between the two ends of the island. Around 1759, the king of the Big Island, Kalaniopuu, captured Hana and held it for more than twenty years. During this time, the road fell into disrepair and was purposely closed to thwart incursions from the north. Nonetheless, in about 1780 Kahekili, the King of north Maui (or Maui Iki) retook Hana and reopened the road, which by then needed extensive repairs. Not only was the road cleared, but where stream canyons were deepest wooded bridges were built to replace the old, treacherous staircases painstakingly carved into the cliffs centuries prior. Even so, the roads could support no more than foot traffic, and much of it served that function until 1900, though by then Hana had become a thriving sugar plantation community.

In 1848 Kamehameha III declared the *Mahele*, allowing for the private ownership of lands. Foreigners were allowed to own private property in the islands for the first time. Among them was George Wilfong, a Caucasian sea captain. He capitalized on the needs of the 1849 California gold rush miners by planting sixty acres of sugar cane in Hana, harvesting it with exploited local laborers, and milling it with contract workers in nearby Kauiki. All of the sugar was shipped from Hana Bay, and despite the booming business, there was still no substantial overland trading between the north and south parts of Maui. Prior to this enterprise Kipahulu and its adjoining districts of Hana and Kaupo had retained their traditional Hawaiian culture.

In 1877 fifteen miles of unpaved road was constructed from central Maui to Kailua in order to build the Haiku Ditch, a remarkable engineering feat that watered new cane land on the central Maui plateau. In 1899 the Nahiku Rubber Company planted thousands of experimental rubber trees on the makai (toward the ocean) side of the old road. This enterprise pushed the unpaved road another fifteen miles to Nahiku. East Maui's potential tourism value gave the county a strong incentive to promote the idea of a belt highway to Hana. As early as 1900 the Maui News editorialized in favor of a good wagon road connecting Hana and central Maui. This prompted the building of the first stretch of improved roadway, which followed the old road from Keanae to Nahiku, in 1900. The ancient footpath was widened to

sixteen feet, to accommodate horse-drawn wagons, and was surfaced with cinders. Because of the extreme difficulty of the terrain, however, its cost was prohibitive, and the roads were inadequate for frequent automobile traffic. The 1905 SPW report stated that "very rough country is encountered in these districts. On account of the great expenses of road construction, the road has been made as narrow as possible in order to construct, with the money available, the maximum length of road."[36]

The new road segment functioned so well that there were soon calls to extend it from Kailua all the way to Kipahulu, well past Hana. The Territorial Legislature, however, was unimpressed and in 1903 refused to fund the project. Undaunted, commercial entrepreneurs from Paia to Hana lobbied the legislature heavily, resulting in yet another section being improved, from Kailua to Keanae in 1904. This stretch met significant construction problems, including jungle encroachment, torrential streams and landslides, all of which doubled the original $50,000 cost.

Between 1905 and 1908 concrete bridges were built in the ditch country near Nahiku. Bridge building on Maui surged in 1911, when the Territorial Legislature established a Loan Fund Commission to oversee a special fund for belt roads. Out of the $1,270,000 appropriated by the Commission in 1911, Maui received $370,000. This made possible the building of twenty-one Maui bridges: four on the Hana Belt Road, four on the Piilani Highway south of Hana, six in the upcountry district, six in Central Maui and one in West Maui. Work on the belt road continued depending on the extent of funding. A narrow road with several bridges was built from Kailua to Keanae by 1912 with territorial funds. From Hana, contractors Wilson and McCandless had completed the Nahiku-Keanae section of road by 1915. This road did not link up with the Kailua extension, but instead dead-ended in the Koolau Forest Reserve. The lack of a continuous paved road prompted one Maui legislator to complain that "Maui is the only island on which you cannot traverse by road around it."[37]

In 1914, inspired by the dramatic expansion of the sugar industry at Hana, the County of Maui Board of Supervisors unanimously agreed to press the Territorial Legislature for funding to improve the rest of the old road at least as far as Kipahulu and entertained ambitions to eventually circle the entire island. The road to Hana became part of a grander vision, called the Belt Road. Unfortunately, Territorial Governor Lucius Pinkham was adamantly opposed to the project, and consequently it took until 1923 before belt road planning was resurrected and modifications to the ancient route were given serious consideration.

Until this time, the journey to Hana was made partly over unpaved wagon roads and horse trails, often rendered impassable by damage from frequent rains. An alternative route through the island's south side took the traveler through the drier ranch country ending at Kipahulu. Since both land routes were arduous and slow, the most common means of travel to Hana was by steamer ship. Writer Robert Wenkam stated that:

> When Hana was without a road, and the coastal steamer arrived on a weekly schedule, Hana-bound travelers unwilling to wait for the boat drove their car to the road's end at Kailua, rode horseback to Kaumahina ridge, then walked down the switchback into Honomanu Valley. Friends carried them on flatbed taro trucks across the Keanae peninsula to Wailua cove. By

[36] *Fifth Annual Report of the Superintendent of Public Works to the Governor of Hawaii for the Year Ending June 30, 1905* (Honolulu: The Bulletin Publishing Company, Ltd., 1905), 7.
[37] "Roads First Need View of Fassoth," *Maui News* (Wailuku), February 11, 1921.

> outrigger canoe it was a short ride beyond Wailua to Nahiku landing where they could borrow a car for the rest of the involved trip to Hana. Sometimes the itinerary could be completed in a day. Bad weather could make it last a week.[38]

He added:

> The road was little more than a wide mud and gravel path for many years until paved by a young Hawaiian contractor, Johnny Wilson, who later became Mayor of Honolulu. Even when paved, mudslides plagued the road. The Keanae Chinese store offered overnight rooms to stranded motorists at first, but later it became accepted practice to wait at the mudslide for a car to appear from the opposite direction, then slosh across the intervening gap and offer to exchange cars with the complete stranger on the other side. A handshake would make the temporary trade official, and both parties would agree to meet the next day when the mud had been removed by county work crews, who usually arrived on horseback within a few hours.
>
> Ranchers from the other side of the island also benefited by the road. The ranchers and their friends knew the land well from horseback, but the automobile offered a much easier way to treat guests to a grand tour of the Hana coast. A one-day trip was now possible and small hotels in Hana began receiving their first tourists. The Hana [Road] soon earned a reputation of its own – not as a road to go somewhere on, but as a destination in itself.[39]

By 1922 Hana was the site of the large Kaeleku sugar plantation and mill. The plantation's manager, Mr. Joseph Herscherr, favored the proposed Hana Belt Road as "a wonderful tourist asset." Most of Maui's business interests also favored the construction of a road to Hana but disagreed about the route and means of financing.[40] County Engineer A.P. Low estimated in 1923 that the Hana Belt Road would cost about $692,000. Citing the highway's high cost, Maui businessman A.F. Tavares instead urged funding for a less expensive Kipahulu-Kaupo belt road around Maui's south side. But Maui businessmen objected to all financing proposals which included either county bonds or a special road tax.

Despite its prohibitive cost, the county eventually decided to complete the paved road to Hana. In May 1923, a total of $50,000 was appropriated from the Territorial Legislature for road work, despite the fact that less than twenty years earlier an equal amount had proved inadequate for a much shorter length of road, and that an additional $200,000 had been needed to overcome similar construction difficulties. The more heavily traveled sections from Keanae to Paia, were at least partially paved by 1926, but farther south the road remained unpaved. The worst of the construction problems lay ahead, between Kailua and Kopiliula Falls. Here, the earth would not cooperate as easily as farther north because of a drastic change in soil conditions. The surface soils are highly organic and unstable, so that even very minor roadway excavations trigger mud slides. In July 1926, a massive landslide covering more than thirty acres halted further work. Floods during the winter of 1926-27 washed out embankments constructed not two months earlier. Overruns associated with the already constructed portions left the Territorial Legislature in no position to continue funding the road. Despite these obstacles, Federal Aid

[38] Robert Wenkam, *Maui: The Last Hawaiian Place* (San Francisco: Friends of the Earth, 1970), 65-66.
[39] Ibid.
[40] "Belt Road Bonds Can be Taken Up," *Maui News* (Wailuku), May 5, 1922.

funds were made available to Hawaii in 1925 which provided the necessary relief, and the project pushed its way towards Hana.

To lower costs, the county administration established a prison camp at Keanae, and pressed the hardest criminals into road gangs that eventually turned the remaining barely passable trails leading to Hana into a cinder-paved highway that could handle trucks and cars. Following the road's completion, a celebration was held, one that included a great luau and exuberant schoolchildren waving small American flags and marching down to the old cannery site on Hana Bay.

Keeping the road maintained and open, especially along the perilously unstable area between Nahiku and Kaeleku, was a major undertaking. The Territory, and later the state, hired numerous residents in and around Hana as seasonal workers dedicated to repairing the damage wrought by mud slides, rockfalls, downed trees and erosive floods. Makeshift bridges, often composed of inferior materials, were continually washed out. Forces were enlisted to maintain the road to Hana on a routine basis, and the remaining early wood bridges were replaced by the present-day reinforced concrete bridges. Even so, most of the road remained unpaved or only nominally surfaced. Road construction and maintenance was a fact of life for Hana residents:

> The territorial and, later, state departments of transportation became major employers, supplying cash-jobs residents needed to augment their subsistent lifestyles. The county or state remained a major source of the jobs residents needed to augment their subsistent farming and ranching efforts. Men were anxious to work for the county or state road departments.[41]

A boost for the roadway came in 1934, with the creation of the Hana Coast Civilian Conservation Corps, one of FDR's job programs designed to combat the effects of the Great Depression. By 1940, the highway was substantially complete. In 1946, the Hana Ranch developed the first hotel in Hana to accommodate tourists who made the journey to this previously isolated community by road.

A journalist driving through the ditch country at the time called the Hana Belt Road a "paved trail following the line of the ditch through the wild jungle."[42] It wasn't until 1962 that a reluctant state legislature, still in its infancy, agreed that the newly created HDOT had to take responsibility for the care of the road. An unheard-of $2.2 million was allocated for widening, paving and restoring the highway from beginning to end. When the job was finished in 1964, the "highway" was at last negotiable by even the heaviest vehicles, at least in good weather. Since 1985, a well-planned maintenance program has preserved the road as one of Hawaii's most scenic and treasured drives. Residents have resisted a major upgrading of the roadway since improvements would "result in a tidal wave of visitors and would destroy the fragile balance between being fed by tourism and being consumed by it."[43]

Today, the sixty-mile road to Hana from Wailuku, State Highway 360, offers residents and tourists alike one of the most spectacularly scenic automobile routes in Hawaii. Since 2001, the Hana Highway has

[41] Leonard Lueras and Ron Youngblood, *On the Hana Coast: Being and Accounting of Adventures, Past and Present, in a Land where the Hand of Man Seems to Rest Lightly* (Honolulu: Emphasis International, 1983), 77.
[42] "Writer Takes You Around the Isle – Maui This Time," *Honolulu Advertiser*, April 27, 1940.
[43] Lueras and Youngblood, *On the Hana Coast*, 81.

been listed on the NRHP for its scenic beauty and for its numerous early-twentieth-century concrete girder and slab bridges that spanned valleys, gorges, and waterfalls.[44]

3.3: THE OLD MAMALAHOA HIGHWAY, HAWAII ISLAND: PRE-CONTACT TO 1960S

HISTORICAL BACKGROUND

The Mamalahoa Highway takes its name from the edict of King Kamehameha, the great Hawaiian conqueror who united the Hawaiian Islands. *Mamala hoe* (literally "the way or law of the broken canoe paddle"), popularly known as the "Law of the Splintered Paddle", guaranteed the safety of the highways to all travelers. During his travels on the Island of Hawaii, Kamehameha and his men came upon a fishing village in the Keaau region of the island; one of the fishermen, defending his territorial rights, hit the king with a wooden canoe paddle, shattering it into pieces. The king subsequently issued an edict that all men should be free to travel the roads of the islands unimpeded. An alternative interpretation suggests that *Mamalahoa* (literally "law of the friend") refers to the death of Kamehameha's guard at the hands of the king's supporters after failing to protect Kamehameha from the assault. The guard was killed by pulling a spear back and forth through his body, thus simulating the movement of a canoe paddle. Kamehameha, stricken by the death of his friend, consequently issued the famous edict. Kamehameha's edict established a precedent for contemporary state laws which ensure free access to areas traditionally accessible in pre-contact Hawaii, such as upland trails and coastal beaches.

The Old Mamalahoa Highway was built roughly along the route of an ancient Hawaiian footpath (*Ala Kahakai*) that was to become a nineteenth century horse trail. Pre-contact Hawaiians preferred travel by canoe; however, the coastal trails were used in bad weather and rough seas.

Historian Russell Apple suggests that the coastal trail was the path taken by the ancient Hawaiians during the *Makahiki* celebration. The annual *Makahiki* season, which runs approximately from October to February, was an event of major religious, economic, and political importance. During the *Makahiki*, the image of the god Lono was carried through each island district by priests, and offerings (some suggest "taxes") were collected for the king.

In 1823 the Reverend William Ellis and his party were the first westerners to complete a circuit of the island of Hawaii. Ellis' journal, first published in Boston in 1825, chronicled this trip with detailed observations of geology, botany, population, social and religious customs, political structure, history, and legends. Generally, Ellis' trip followed the Hawaiian Makahiki trail, although some portions, such as the rugged, ravine-cut section between Hilo and Laupahoehoe, were traversed by canoe.

In 1873, the Victorian traveler and writer Isabella L. Bird made the journey from Hilo to Waipio on horseback. She described the trip in a series of letters written to her sister between January and August of that year. Upon leaving Hilo, she wrote:

> The track crosses the deep, still Wailuku river on a wooden bridge, and then after winding up a steep hill...hangs on the verge of lofty precipices which descend perpendicularly down to the sea, dips into tremendous gulches, loses itself in the bright fern-fringed torrents which have cleft their way down from the mountains…Then the track goes down with a great dip [after passing through the sugar plantation of Kaiwiki], along which we slip and slide in the mud to a

[44] Deunsing, *Hawai'i's Scenic Roads*, 170-174, 255.

> deep broad stream…Our accustomed horses leaped into a ferry-scow provided by the Government…and leaped out on the other side to climb a track cut on the side of the precipice, which would be steep to mount on one's own feet.[45]

Continuing beyond Onomea, where Isabella Bird stopped at the plantation of the Austin family, she described her journey onto Waipio Valley on the north-east shore of the island:

> The dimpling Pacific was never more than a mile from us as we kept the narrow track in the long green grass, and on our left the blunt snow-patched peaks of Mauna Kea rose from the girdle of forest…The track for twenty-six miles is just in and out of gulches, from 100 to 800 feet in depth, all opening to the sea, which sweeps into them in three booming rollers.
>
> All the gulches for the first twenty-four miles contain running water. The great Hakalau gulch we crossed early yesterday, has a river with a smooth bed as wide as the Thames at Eton. Some have only small, quiet streams, which pass gently through ferny grottoes. Others have fierce torrents dashing between abrupt walls of rock, among immense boulders into deep abysses, and cast themselves over precipice after precipice into the ocean…A few are crossed on narrow bridges, but the majority are forded.[46]

Bird claimed that the "worst *pali* of all [was] the south side of Laupahoehoe." She stated that "Mr. Brigham in his valuable monograph on the Hawaiian volcanoes…appears as much impressed with these gulches as I am."[47] She quoted Brigham in her journal:

> The road from Hilo to Laupahoehoe, a distance of thirty miles, runs somewhat inland, and is one of the most remarkable in the world. Ravines, 1,800 or 2,000 feet deep, and less than a mile wide, extend far up the slopes of Mauna Kea. Streams, liable to sudden and tremendous freshnets, must be traversed on a path of indescribable steepness, winding zig-zag up and down the beautifully-wooded slopes or precipices, which are ornamented with cascades of every conceivable form. Few strangers, when they come to the worst precipices, dare to ride down, but such is the natures of the rough steps, that horse or mule will pass them with less difficulty than a man on foot who is unused to climbing. No less than sixty-five streams must be crossed in a distance of thirty miles.[48]

After leaving the area north of Laupahoehoe, Bird happily claimed that "There [were] no large gulches on today's journey. The track is mostly through long grass, over undulating uplands."[49] Forty years later, in 1913, after the establishment of the Territory of Hawaii and the county government's initial efforts to

[45] Isabella Bird Bishop, *The Hawaiian Archipelago: Six Months Among the Palm Groves, Coral Reefs, and Volcanoes of the Sandwich Islands*, 1st American ed., reprinted from the 5th English ed. (New York: G. P. Putnam's Sons, The Knickerbocker Press, 1894), 97-98.
[46] Ibid., 118-121.
[47] Ibid., 121.
[48] William T. Brigham, A.M., *Notes on the Volcanoes of the Hawaiian Islands with a History of their Various Eruptions* (Boston: Riverside Press, Cambridge, 1868), quoted in Bishop, *The Hawaiian Archipelago*, 122.
[49] Bishop, *The Hawaiian Archipelago*, 127.

improve the road, Henry Walsworth Kinney described the same journey along the Hamakua coast. Kinney, writing tourism copy for the Hilo Board of Trade, claimed that:

> No visitor to the Island of Hawaii should neglect to see the road which leads north from Hilo to the Hamakua district. One of the most beautiful roads in the island, it presents, as it winds through scores of tropical gulches, a constantly changing panorama of unsurpassable beauty. To autoists the road is a delightful experience, and the ease of the grades and careful construction of the somewhat sharp turns will call forth his unstinted admiration of the road builders of the scenic isle.[50]

Between 1900 and 1905, the Territory undertook the laborious process of obtaining the necessary rights of way for the "Relocating and Reconstruction of the Main Road" and contracts were let for the construction of new concrete bridges and culverts to replace older, weak timber bridges in various locations along the North Hilo and Hamakua coast. In what one historian has termed a deliberate plan to wrest power for the Hawaiian and away from the American Territorial government, county governments were established by the Legislature of 1905. The counties were given the power to appropriate and expend funds through a county Board of Supervisors. However, the counties suffered chronic shortage of funds for road construction, even though money previously allotted to the state departments were being divided amongst the counties of Honolulu, Hawaii, Maui, and Kauai. The governor's message to the 1911 Legislature suggested the issuance of territorial bonds for belt road funding, and $600,000 was subsequently made available to the Big Island from bonds that were floated. Utilizing these funds, the county began the systematic improvement of the island's belt road and bridges.

The first contract from this fund was awarded in 1912 to A.A. Wilson, the Hilo contractor who had worked on Hilo Railroad's Hakalau Extension. His contract was for the reconstruction of the belt road from Wainaku, just outside of Hilo, to Hakalau and included an unspecified number of bridges and culverts. His winning low bid was $98,698.35. The second contract was won by Territorial Senator John Brown the same year. He was to rebuild the belt road and bridges (with the exception of one long span in good condition) from Hakalau to Pohakupuka for $99,587. A third contract went to Lord and Young of Honolulu for the stretch between Kaawalii and Kealakekua, south of Kona, for $106,514.35. Not surprisingly, there were complaints voiced about the expenditure of the funds, the loudest emanating from the Board of Supervisors whose authority was being superseded. Many expected the $600,000 to build a whole new belt road, rather than the short, expensive pieces of road that resulted. Another bond issue in 1917 provided an additional $265,000 for Big Island roads, but the costs and difficulties of construction did not allow for the completion of the belt road until 1933.

At the beginning of the twentieth century, the Hamakua Coast was the site of several major sugar plantation communities with tens of thousands of residents. The Mamalahoa Highway was the main transportation link between the small plantation communities located along this coastline. The rugged terrain of the coast would not allow for the transportation of cane by road, thus elaborate flume systems were devised to get the sugar from the fields to the mills located along the coastline. Sugar was then processed at mills and off-loaded onto barges docked at the few landings for shipment to Honolulu or the Mainland. In many cases, the steep coastal bluffs made landing a ship impossible and necessitated the use of cable and pully systems to load the sugar into the holds of the ships. In 1911-12,

[50] Henry Walsworth Kinney, *The Island of Hawaii* (Hilo: Hilo Board of Trade, 1917), 24.

the Hawaii Consolidated Railroad established a rail line to Paauilo and sugar was transported to Hilo for shipment from its harbor. The rail line brought many changes to the Hamakua coast, including the relocation of many of the mills away from the coast to access the rail service. Trucking sugar to Hilo along the narrow, winding government road (the Old Mamalahoa Highway) was not an economical alternative to the relatively straight run along the rail line.

Bridges Along the Old Mamalahoa Highway

The suggested area for a proposed Mamalahoa Highway Historic Bridge District is comprised of forty-four bridges and thirteen culverts along approximately sixty miles of the Old Mamalahoa Highway on the island of Hawaii. The highway, also noted as the "Old Government Road" begins north of the Wailuku River in Hilo and passes through the districts of South Hilo, North Hilo and Hamakua. It terminates near the town of Kamuela at mile point 52 of the Hawaii Belt Road. The highway was the principal belt road linking the small towns and sugar plantations along the Hamakua coast of the Island of Hawaii. The bridges in this proposed district include the oldest and rarest, as well as the most ornamental and scenic spans in the state.

The first road around the island was begun by the kingdom's Department of the Interior in 1847, however it remained little more than a horse path until the time of King Kalakaua. During Kalakaua's reign (1874-1891) appropriations for public works improvements escalated, and many steel and timber bridges were constructed. Unfortunately, none of these early bridges remain. Roadway and bridge construction was not significantly affected by the overthrow of the monarchy and the establishment of the Republic of Hawaii in 1893. However, after the annexation of Hawaii by United States in 1898, public works improvements, particularly bridge and road construction, became a priority on all islands. The fifty-seven bridges of the proposed Mamalahoa Highway Historic Bridge District were constructed between 1894 and 1933 and date from the Republic and early Territorial periods.

The earliest bridges are the masonry and solid-spandrel concrete arches constructed by the Republic, and later Territory, of Hawaii prior to the establishment of the county governments in 1905 (of which there are nine extant examples). Between 1911 and 1933, the County of Hawaii began to appropriate Territorial Loan Funds for the systematic upgrading of the island's roads and bridges. The highest priority was placed on belt road improvement, and a series of reinforced concrete bridges were planned for stream crossings along the old Government Road. The bridges were designed by the County Engineer's Office and built by local contractors. These county bridges were of two primary types: simple reinforced concrete girder or flat slab bridges for short spans (thirty-three examples); and more ornate and technologically sophisticated open- and solid-spandrel concrete arch bridges for longer, more visible spans (seven examples). The remaining bridges are inexpensive timber girder bridges built during the Depression years (eight examples).

Generally, one parapet end of the reinforced concrete county bridges is inscribed with a number indicating the island district in which it was built followed by the bridge number. The date of construction is inscribed on the other parapet end. The remaining bridges in South Hilo district are numbered from 1 to 29; those in North Hilo district are numbered from 103 to 126; and remaining bridges in the Hamakua district are numbered from 209 to 251. This marking system is unique to the bridges of the Old Mamalahoa Highway. The last county bridge was constructed on the Old Mamalahoa Highway in 1933. Between 1932 and 1958, the THD began to construct a new highway around the

island. The modern highway, called the Hawaii Belt Road, became part of the Federal Aid Primary (FAP) highway system. The new road straightened out, bisected, and often bypassed the circuitous Old Mamalahoa Highway.

Narrative Statement of Significance of Proposed Mamalahoa Highway Historic Bridge District

The bridges in the proposed Mamalahoa Highway Historic Bridge District are eligible under Criterion A as prominent products of the Republic of Hawaii and representative of Territorial and County public works efforts. The bridges in the proposed Mamalahoa Highway Historic Bridge District are significant for their contributions to engineering and transportation in Hawaii. The development of the Old Mamalahoa Highway contributed to the economic development of the island by linking the small towns and sugar plantations along the Hamakua coast with the island's principal port in Hilo. The construction of the bridges was a deliberate investment in permanent public works improvements requiring the mobilization of skilled labor and significant public funds. Thus, these bridges were often constructed at important crossings along major transportation routes. The bridges served as important links in the circum-island transportation system, aiding in the commercial and residential development of Hilo and the Hamakua Coast. Reinforced concrete arch bridges were constructed to replace earlier timber and metal bridges. Many of these bridges were visually prominent, both in style and location, and made significant civic statements regarding the technical and aesthetic sophistication of the communities in which they were built. Concrete deck bridges are eligible under Criterion A for their associations with of the first use of formal engineering expertise in bridge making by the new county governments shortly after the annexation of Hawaii by the United States. These road bridges played a major role in the development of County of Hawaii's belt road plan by connecting previously isolated communities with a paved highway.

The bridges are eligible under Criterion C since they represent a visual timeline of bridge construction technology in Hawaii. Nearly every historic bridge type remaining in the islands is represented along the Old Mamalahoa Highway. The masonry arch bridges are notable examples of the use of vernacular building materials and local craftsmen. Masonry and concrete arch bridges often evidence a high degree of detailing and workmanship, and the few remaining examples are rare survivors of these once common bridge types. Furthermore, the reinforced concrete arch bridges constructed along the Mamalahoa Highway are among the earliest examples of reinforced concrete bridge construction in the state. Concrete deck bridges, including flat slab, girder and tee beam spans, are representative of the most common historic bridge type found in the islands. The majority of county-built bridges, such as the Maili and Kaiwiki Bridges, were of this type as were the subsidiary spans on Mamalahoa-Honolii Bridge. Moreover, many of the bridges are examples of exceptional work by important local builders (the "work of a master") such as Louis M. Whitehouse, Johnny Wilson, Peter and Charles Arioli, and Hisato Isemoto. Prominent designers include William H. Chun and En Leong Wung.

The fifty-seven bridges and culverts that make-up the proposed Mamalahoa Highway Historic Bridge District are evaluated as a group. Together these bridges form an area encompassing the entire sixty miles of the Mamalahoa Highway. Individually, the bridges in this proposed district range from technologically simple timber and masonry arch bridges to the more complex concrete deck girder and flat slab bridges. Together these bridges form a cohesive group built in a relatively short time period that

document the evolution of style, methods and bridge building technology in Hawaii. This group of bridges played a critical role in the development of belt road transportation for the island of Hawaii.

3.4: HAWAII BELT ROAD, HAWAII ISLAND: PRE-CONTACT TO THE 1960S

HISTORICAL BACKGROUND

Many railroads were established in the Hawaiian Islands during the Kingdom, Republic and early territorial periods by private interests in the sugar industry. For the most part, these sugar trains were narrow-gauge lines. However, in 1899, the Hilo Railroad Company (HRC) was established on the Island of Hawaii to carry sugar cane along the rugged Hamakua coast to the port of Hilo and constructed in standard-gauge (4 ft. 8 ½ inches between the rails), unique on the islands. Reorganized in 1916 as the Hawaii Consolidated Railway (HCR), the railroad continued to be colloquially referred to as the Hilo Railroad and operated until 1946, when a tsunami heavily damaged the line.[51] Among the railroad's engineering feats included fourteen large steel trestle railroad bridges were built in 1911-12. In 1950-53, five of these were modified by the Territorial Department of Transportation as part of the Seismic Wave Rehabilitation Project for use as highway bridges and another was constructed utilizing trusses from the span over the Wailuku River.

The plantations of South Hilo, North Hilo, and Hamakua districts were producing raw sugar within a few years after the Reciprocity Treaty of 1876. The treaty allowed Hawaiian sugar to be exported to the American mainland duty-free. The treaty was later expanded to include a clause that allowed the United States to build a Naval Station at Pearl Harbor on Oahu. The sugar industry developed rapidly in the islands; and by 1900, one-quarter of the sugar produced in the Territory was grown on the Hamakua coast. The land above the steep coastal bluffs, at the base of the dormant Mauna Kea volcano, was gently sloping and fertile. Most plantations were from two to three miles deep, their altitudes ranging from 250 feet closest to the sea to 2,000 feet at their upper boundaries; their ocean frontage varied from two to six miles. The rain which produced sugar had also produced the myriad gulches that had for so long kept the area isolated. The only road to Hilo's harbor was the government wagon trail that was almost impassable in the rainy season, and which suffered from constant bridge washouts. As an alternative to using the road, some plantations had railroads with either locomotive or animal power; others used flumes or cable railways to move cut cane from the high fields to the mills which were usually close to the sea. The mills employed a cumbersome method of derricks and pulleys at various landings high above the coast to load their produce on to ships for market.

Hilo was located at the southern end of the long string of sugar plantations on Hawaii's east coast. Large tracks of prime agricultural land lay to the south of the town, awaiting development by entrepreneurs with vision and capital. In 1898, Benjamin Franklin Dillingham, a noted Hawaiian businessman, drew up plans for a large sugar mill at Olaa, eight miles south of Hilo in the previously uncultivated Puna district. Then he applied for a charter for the railroad that would be needed to transport the raw sugar to the wharf in Hilo. The Hilo Railroad Company (HRC) was incorporated in 1899 by Dillingham, Lorrin Thurston

[51] Arthur Y. Akinaka, "Railroad Transportation," in *An Historic Inventory of the Physical, Social and Economic and Industrial Resources of the Territory of Hawaii*, ed. Territorial Planning Board (Honolulu: Advertiser Publishing Co., Ltd.), 284, retrieved from https://catalog.hathitrust.org/Record/002043955; "History of the Hawaii Consolidated Railroad," Laupahoehoe Train Museum, accessed January 4, 2024, https://www.thetrainmuseum.com/history.html.

(the Minister to Washington during the Republic of Hawaii and a former Interior Minister under the monarchy), and Mark Robinson (Minister of Foreign Affairs for Queen Liliuokalani). The charter for the Hilo Railroad, granted by the Republic of Hawaii, was issued on March 28, 1899. Under its charter, the Hilo Railroad was authorized — for a period of fifty years — to build a railroad anywhere on the island of Hawaii, with free use of government lands for the right-of-way, yards, or station areas. Dillingham had just completed a three-foot narrow-gauge Oahu Railway & Land Company (OR&L) and was aware that the popularity of narrow-gauge for trunk lines was on the wane. Consequently, he announced that the Hilo Railroad would be built to standard gauge (4-foot 8 ½ inches), the first and only standard-gauge railroad in the islands.

The railroad barons determined that the wharf in Hilo was inadequate to attract the business of large shipping lines. Freighters anchored in deep water had to use lighters, and the whole operation was relatively unprotected from heavy seas during the storm season. A new wharf, sheltered from the sea by a breakwater, was proposed; but its construction was beyond the means of either the railroad or the Territory of Hawaii. The breakwater, designed by the U.S. Army Corps of Engineers and financed by the U.S. Congress, left the railroad with the responsibility for building the wharf. One of the conditions imposed by the government for the improvement of Hilo's harbor was that the railroad company extend its railroad line north along the coast to service the sugar plantations of Hamakua.

The railroad construction project was a daring engineering feat that crossed the numerous gorges and streams with large steel bridges at the valley mouths and required massive earth cuts for the completion of the comparatively straight roadbed. This was in direct contrast to the more conservative government policy of winding roads and small concrete or timber bridges in the backs of valleys or down sharp grades to sea level. The high cut in the north wall of Hakalau gulch remains as an example of the degree of earth moving accomplished by the railroad engineers. Work on the first section, 12.7 miles from Hilo to the Hakalau Mill, began in 1908 and was completed in 1911. Construction of the second phase, from Hakalau to Paauilo, continued through 1912, with costs of $106,000 per mile, for a total of $3,500,000. The company succeeded in erecting fourteen steel bridges, five wood and steel combination bridges, and twenty-four wooden trestles. These bridges, along with two tunnels and expensive grading, gave the Hilo Railroad "one of the highest per-mile construction costs of any railroad under the Stars and Stripes."[52]

The specifications and design for the bridges were drawn up by John Mason Young, the founder of Pacific Engineering Company of Honolulu and a pioneer faculty member of the College of Agriculture and Mechanic Arts (later the University of Hawaii). Young had been involved in steel bridge design and construction on mainland railroads before coming to Hawaii. The bridges' components were ordered from the New York firm of Hamilton and Chambers (who also fabricated the steel for the Hanalei River Bridge on Kauai the same year) and were erected by W.W. Beers, described by the *Hilo Tribune* as a New York engineer. All of the steel trestle bridges erected by the railroad were of the same type, deep steel girders with 66-to-72-foot spans set on wide steel trestles and masonry (lava-rock) abutments. The bridges were assembled at the Waiakea railroad yards and shipped out to their sites on railroad cars.

[52], John B. Hungerford, *Hawaiian Railroads: A Memoir of the Common Carriers of the Fiftieth State* (Reseda, California: Hungerford Press, n.d.), 55.

FIGURE 20. VIEW OF STEEL TRESTLE BRIDGE ON HAMAKUA COAST. SOURCE: DIGITAL ARCHIVES OF HAWAIʻI, PP-6-1-019, HTTPS://DIGITALARCHIVES.HAWAII.GOV/ITEM/ARK:70111/07S5.

The Hakalau trestle, built in 1911 during the railroad's second phase of construction, was one of the most impressive bridges built by the Hilo Railroad. At 775 feet long and sitting on seven steel towers, the Hakalau Bridge was the second longest bridge on the line, outdistanced only by the Maulua Bridge at more than 1000 feet. After the Maulua Bridge was taken down, Hakalau was converted for use as a highway bridge and was, for several years, the longest highway bridge in the territory until the Kalihiwai Bridge on Kauai and the Pearl City Viaduct on Oahu were built. Hakalau was also among the tallest with a height of 171 feet, only 30 feet shy of the tallest bridge over Nanue Stream. As late as 1981, Nanue was the highest bridge in the state at 207 feet. A higher bridge had been built at Maliko Gulch on Maui, but it was dynamited in 1967.

In addition to the steel trestles built by the Hilo Railroad, two multi-span steel truss bridges were constructed over the Wailuku and Wailoa Rivers. These bridges suffered from their positions close to sea level and were the most problematic for the railroad to maintain. The Wailoa drawbridge was destroyed in 1923 by a tidal wave and was remounted on concrete piers. The Wailuku railroad bridge suffered several mishaps. While it was being erected in 1909, a Porter tank engine slipped over its edge into the

river. Fifteen years later, "it collapsed in a mysterious manner," its piers folding like dominos.[53] The collapse was attributed to the 1923 tidal wave and earthquake and was precipitated by the passage of a loaded passenger train. In 1924, the Wailuku Bridge was replaced by a metal truss bridge of three spans, mounted on concrete piers. These bridges only lasted in place until the 1946 tsunami.

Burdened with debt and unable to meet its obligations, the Hilo Railroad Company was forced into receivership in 1916 and plans for the expansion of the line were abandoned. The railroad was sold for $1,000,000 to the bondholders and reorganized as the Hawaii Consolidated Railway (HCR). In 1920, the new owners bought three additional passenger coaches as part of a program aimed at catering to the tourist business. In cooperation with the steamship companies, sightseeing specials, operating under the name of Scenic Express, were run on the Hamakua Division when passenger ships were in port. Author Gerald Best described his experience traveling along the coast: "We had seen waterfalls cascading down the slopes of Mauna Kea, passed through magnificent groves of tropical trees and entrancing fields of flowers, and looked upon a completely unforgettable vista of sea and mountains. No wonder the tourists who rode the Scenic Express years ago recalled it as the highlight of their visit to Hawaii."[54]

In the 1930s the Depression affected the tourist trade and passenger business dropped off to a low of 16,681 in 1936. Passenger cars were retired, and some cars were converted to haul bagasse (sugar cane after the juice has been pressed out) to the cane manufacturing plant in Hilo. During World War II, passenger business picked up due to gas rationing, and several old coaches were used to transport servicemen from Hilo to Paauilo, en route to the U.S. Marine Corp training camp at Waimea. By the end of 1945, the railroad was making money and would soon be out of debt for the first time in its existence.

On April 1, 1946, a tsunami hit Hilo at 7:01 AM. The Hawaii Consolidated Railroad suffered irreparable damage. Freight cars were floated inland, all of the track along the waterfront was washed out, the Hilo station and the adjacent buildings were in shambles, and the first span of the Wailuku River bridge, a steel truss, was washed hundreds of feet up the river. In spite of the breakwater, freight cars on the docks were washed into the bay, some floating out to sea and others thrown up on shore. Twelve miles north of Hilo, the railroad bridge at the mouth of the Kolekole Stream lost its center span. Facing an estimated repair cost of $500,000, the railroad asked shippers to determine whether they would use the line if it were rebuilt or were intending to ship their raw sugar by truck. Only Theo H. Davies Ltd. voted to retain the railroad; the rest voted to use the existing highways, despite their poor condition. Hawaii Consolidated then offered its entire right-of-way, including all bridges and tunnels, to the THD and to the County of Hawaii supervisors. Both agencies declined the railroad's offer.

The entire railroad was sold as scrap to Gilmore Steel & Supply Company of San Francisco for $81,000. About the time the scrappers had finished pulling up the rails and begun dismantling the steel bridges, the THD decided that the Hawaii Belt Road, along the Hamakua Coast, should be improved by relocating it along the railroad right-of- way and utilizing the railroad trestles as highway bridge supports. In great haste, it made a deal with Gilmore Steel & Supply to buy those bridges still in place, as well as the parts of bridges already trucked to Hilo, for $303,723.53, nearly four times the amount the scrappers had paid to Hawaii Consolidated for the entire railroad.

[53] Thomas Thrum, *Hawaiian Almanac and Annual* (Honolulu: Hawaiian Gazette Company, 1924), 94.
[54] Gerald M. Best, *Railroads of Hawaii: Narrow and Standard Gauge Common Carriers* (San Marino, California: Golden West Books, 1978), 155.

In 1950, the THD, under the direction of William R. Bartels, and the Independent Iron Works of Oakland, California undertook the "Seismic Wave Damage Rehabilitation Project." Plans were developed to adapt the existing steel railroad trestles into highway bridges. Utilizing remnants of railroad trestles and trusses, the roadbeds were widened and strengthened. The Hakalau Bridge, for example, utilized steel girders scavenged from the Kealakaha, Laupahoehoe, and Kaula trestles while the steel bents were taken from the Maulua Bridge. A macadamized concrete deck was laid, and concrete rails installed along both sides of the new highway bridges. The two remaining truss spans of the Wailuku River Railroad Bridge were incorporated into the reconstruction of the Kolekole Highway Bridge. Two concrete piers from the truss bridge remain in use under the present Wailuku Bridge which carries the Hawaii Belt Road (designated FAP 19) over the river.

The steel railroad bridges built by the Hilo Railroad Company lasted the life of the railroad and beyond. However, even after their reconstruction, they have proved to be expensive to maintain. A Department of Transportation maintenance team, the "High Bridge Crew", is dedicated solely to the upkeep of the five remaining steel trestle bridges, while another crew is able to maintain all the other state bridges on the island.

The Hilo-Hamakua Heritage Coastline

The windward part of the Big Island (once known as The Sugar Coast) is a continuous series of plantations linked from Hilo to Honokaa. A railroad hauled sugar to the Hilo piers and provided a lifeline for transporting people and supplies. High trestles spanned the gulches of this part of the island.

This region is Hawaii's wet district, starting at Upolu Point, the northern tip of the island, and running through Hamakua and into the Hilo District, which supported many large sugar plantations. From Niulii in North Kohala, the coast is a series of canyons with rivers pouring out of the Kohala Mountains or off of Mauna Kea. Travel was problematic closer to the coast.

After the tsunami of 1946, construction of the new Hawaii Belt Road (FAP 19) was accelerated. The new road was an engineering feat, containing fifty-six bridges in forty-two miles.

The THD's first postwar priority on the Big Island was the Hamakua Coast Highway. There were several reasons for this immediate attention. The upgrade of the existing roads had been interrupted by the war, and what existed was piecemeal. In addition, the Hawaii Consolidated Railway service to sugar plantations was terminated and plantations were forced to truck their sugar to Hilo on the narrow winding Belt Road. This method was dangerous for the large trucks as there were many hairpin turns and periodic bridge washouts.

Some of the components of the defunct railroad bridges were reused for the upgraded two-lane highway between Hilo and Honokaa. The complete reconstruction of these forty miles of highway was quite expensive, since it was "Hawaii's most bridged highway" with more than one bridge per mile.[55] The original cost estimate for the road was twelve million dollars and included a "Highline" portion of the highway from Pepeekeo to Ookala. The existing route consisted of 340 curves with narrow bridges varying from 12' to 18' wide. The proposed highline portion would have realigned this twenty-four miles of dangerous highway at a higher elevation where the gulches were less wide. The Hamakua "Highline"

[55] Alvarez, *Historic Bridge Inventory: Hawaii*, 2.

proposal was subsequently not adopted, and the cost of this section of highway grew to 17.5 million dollars by the mid-1950s.

Roughly two-thirds of the Hamakua road was finished (a total of thirty-five bridges) during the tenure of Highway Commissioner Robert M. Belt, from 1952-1958.[56]

Post-World War II Hawaii Belt Road Bridges

There are a number of significant bridges constructed after World War II along the Postwar Hawaii Belt Road. Thirteen of these bridges represent the best examples of post-war bridges in the state of Hawaii. Along the same stretch of road, there are an additional six trestle bridges built during the same postwar time period, which are listed on the HRHP. (See Hawaii Belt Road Map, Chapter 6.) The Postwar Hawaii Belt Road is not considered as a district, but bridges are significant as a group of post-war bridges on the Belt Road.

Additionally, many of these bridges are the work of a person of significance. William R. Bartels, Chief Engineer for the THD, was responsible for all major territorial bridge projects from 1932-1956. Bartels was a German born engineer who worked briefly for a sugar plantation on Maui before being hired by the THD in 1932. He designed most of the territorial bridges from then until 1957.

Bartels was responsible for the largest and most sophisticated bridge construction projects in Hawaii during this time and there was a marked shift to large deck girder and rigid frame bridges. Bartels was considered a “cracker-jack” engineer who enjoyed the challenge of a difficult assignment, and his work characteristically utilized the latest technology and involved a high degree of engineering complexity. Nonetheless, his bridges show refined aesthetic sensibility which makes them distinctive from work of other engineers. He ended his tenure as Chief of the Bridge Division at age 70. This was well past the standard age of retirement, but he was kept on by special permission and out of necessity as his abilities were so great. Bridges designed by Bartels have often been hailed for their accomplishment of engineering as well as aesthetics.

3.5: THE PALI HIGHWAY, OAHU: PRE-CONTACT TO THE 1960S

Historical Background

Plans to build a trans-Koolau Range tunnel to link Honolulu and the windward side of Oahu were discussed prior to World War II, but the war forced a postponement. Later, the rapid growth of the city’s population, the development of residential areas on the windward side, as well as the needs of the armed services during World War II convinced public officials that building a tunnel through the Koolau Range was inescapable. With each passing year, it became more and more obvious that the existing, narrow Nuuanu Pali road no longer met the transportation needs of the rapidly growing communities on the windward side, as between 1940 and 1950 Kailua’s population increased four hundred percent, going from 1,400 to more than 7,000.

The only question which remained to be answered was where to place the tunnel. This proved to be not a simple question to answer, as the City and County of Honolulu and the Territory of Hawaii had different thoughts on this matter, the former advocating a tunnel through the Koolau Mountains via

[56] Alvarez, *Historic Bridge Inventory: Hawaii*, 79-80.

Kalihi valley, while the latter preferred following a route through Nuuanu valley. While the City and County was moving ahead with plans for Kalihi valley, in December 1947 Territorial SPW Robert Belt unveiled two alternative plans for converting the existing Pali Road into a four lane highway which in the eyes of Nuuanu residents was, "a 'four lane speedway' running through their neighborhood."[57] In addition to Nuuanu residents, the City and County, led by Mayor John Wilson, also expressed opposition to the highway plans, as they saw them as competing for limited federal funds, which the Mayor hoped to obtain for the construction of the county proposed highway through Kalihi. In the ensuing years the pros and cons of each alternative were repeatedly raised, traffic counts were made, population growth was studied, military opinion was solicited, and financial programs were analyzed in an effort to settle upon one of the routes and throughout the process both governments steadfastly advocated for their proposal. Eventually both highways were built. However, it took over a decade of bickering, courtroom fighting, delays, and squabbling to attain the result.

The issue of choosing between the Kalihi and Nuuanu tunnel routes appeared to be finally settled when the Federal Bureau of Public Roads (BPR), on December 1, 1949, approved federal funding for the Territory of Hawaii's proposed Nuuanu valley tunnel project. The decision came at the end of a two-week, on-site study by the Bureau's Western Region Chief L. I. Hughes, Division 7 Engineer Charles C. Morris, and District Engineer Frank F. Carlson. In their report the federal officials based their finding on the fact that the current Nuuanu Pali road was, "now close to the possible capacity of the highway."[58] The report went on to state that no federal aid would be made available until the Territory of Hawaii and City and County of Honolulu came to a resolution on the highway route between Country Club Road and Reservoir No. 4, as the City and County Planning Commission had refused to amend the City's Master Plan to include the Territory of Hawaii's proposal for a new, realigned Pali Highway. Governor Stainback resolved this issue by executive order three days after the release of the federal report, when on December 3, 1949, he set aside the City and County's master plan with regards to the Pali Highway.

Federal officials also noted that when granting their approval for the proposed highway running up the Ewa side of Nuuanu valley, they did so with the understanding the section of the existing Pali Road between the Carter residence and the Halfway House on the windward side of the island would remain undisturbed as a scenic alternate or detour for tourist or sight-seeing traffic. The report also indicated the Bureau of Public Roads would look favorably upon a request to provide federal aid to a spur road in Kalihi Valley which would run from School Street to the Forest Reserve. The City and County would need to fund any service roads connecting to the federally assisted spur road. The report also noted that while assisting in the development of the Kalihi valley road, that proposed project "should not impair other necessary federal aid construction, that is, the Pali Highway."[59] In conclusion the report noted, "when future traffic needs warrant, this Kalihi route shown by the Planning commission survey will be considered for inclusion in the federal aid system."[60]

As a prelude to the construction of the new Pali Highway, the Territorial DPW opened bids on December 21, 1949, for a new four lane highway which would run from the Kaneohe Ranch office building at the foot of the Pali to the Kailua-Waimanalo Junction. J. M. Tanaka secured the contract for the new, 1.86-

[57] "City Will Protest Nuuanu Road and Ask Fund Delay," *Honolulu Star-Bulletin*, December 17, 1947.
[58] "Federal Officials Approve Nuuanu Valley Tunnel Plan," *Honolulu Star-Bulletin*, December 1st, 1949.
[59] Ibid.
[60] Ibid.

mile highway, with a bid of $963,319. Considered to be "one of the territory's most modern highways" the new four lane divided highway replaced an existing narrow, two lane road, a segment of which is now known as Auloa Road.[61] The new highway followed a completely new alignment, and although only three tenths of a mile shorter than the existing road, eliminated twenty-two curves, supplanting them with two curves, each with a broad radius.

To facilitate this more direct, straight-line route, a hillside was cut resulting in the excavation of over 600,000 cubic yards of dirt, and two bridges were constructed, one over Maunawili Stream and the other over Kahanaiki Stream. In constructing the Kahanaiki Stream Bridge a new technology, involving the driving of sand drains, was employed. In order to overcome the fifteen to forty feet of mud in the stream bed, a sand-filled, fifty-foot-long steel pipe, twenty inches in diameter, with a mushroom like cap at the bottom, was driven into the stream bed. As the pipe was removed the sand inside filled the hole. Over two hundred of these sand drains were placed in the 600-foot stretch of road crossing the Kahanaiki Swamp. The drains allowed settlement, which usually required ten years, to occur within 120 days. In addition, Maunawili swamp was cleared of three to four feet of mud and filled with sand with dirt placed on top and left to settle while other parts of the road were constructed. A pile driver, using an S-8 hammer, drove the Maunawili Stream Bridge piles at the rate of 26,000-foot pounds per blow, with 55 blows a minute. Apparently, the sand drains did not perform as well as expected. On November 1, 1951, Harvey A. Jerome, in a letter to the editor of the *Star-Bulletin*, complained that one of the two new Kailua bridges were under repair following a day and night of heavy rain.

In addition to the Kaneohe Ranch to Waimanalo junction project, the THD let a $371,221 contract to E. E. Black for a four-lane highway between the Kailua-Waimanalo junction and the Kawainui Bridge in Kailua, expediting Kailua residents' journeys to the base of the Pali. With the opening of the two projects on September 3, 1951, Governor Oren E. Long declared the roadway, "the first step in the completion of the road over the pali."[62] He predicted it would encourage many more people to establish homes in Kailua.

The opening of the new roadway increased windward residents' demands for the construction of the new Pali Highway, as a bottleneck formed at the Kaneohe Ranch office where motorists had to merge from two lanes to one. During the morning rush hour between 7 and 8 a.m., 914 automobiles crossed the mountain, including 149 from Kaneohe which merged with the Kailua traffic, causing further delays. Traffic counts revealed that during the course of a 24-hour day, 4,090 Honolulu-bound vehicles made the ascent up and over the Pali. In an effort to reduce the bottleneck, a policeman was placed at the bottom of the Pali Highway to direct the traffic coming from Kaneohe, and an older section of the Pali Highway, which entered the existing road at the Halfway House, was closed to Kaneohe motorists during rush hour. By September 1953 the steep, twisty, windy road was carrying over 11,000 vehicles a day, as compared to about 7,700 in 1951, and 2,899 in 1938. By 1957 this number had climbed to 16,000. According to federal standards, the existing road was considered adequate and safe to handle only 4,000 vehicles a day.

[61] "New Highway to Kailua Will Have Four Lanes, Cost Million Dollars," *Honolulu Advertiser*, August 6, 1950.
[62] "New Kailua Highway Opens for Traffic," *Honolulu Star-Bulletin*, September 3, 1951.

Shortly after the opening of the new Kailua Highway, the Territorial DPW took the first step in its incremental construction of the Pali Highway. Using federal aid moneys matched by the Territory of Hawaii's vehicle fuel tax, the THD awarded contracts as money allowed, thereby not putting the government in debt. The first contract, for $514,373, was awarded to Moses Akiona, who commenced work in February 1952 on the stretch of road between the Kaneohe Ranch office and the old roadway's hairpin turn. This new 1.4-mile section of road would have only three curves including a sweeping horseshoe, as opposed to the existing 22. No bridges were in this section, but there was much cutting and filling, with 560,000 cubic yards of excavation anticipated. Akiona's company dynamited and cut through solid rock, graded down hillsides, and filled in deep canyons to develop a smooth roadway. The cuts through the mountain were deep ones, with one going 150 feet deep into the hillside. To avoid slides, three of the slopes were carved out in stepped terraces, a process known as benching. Delayed by inclement weather, as well as proposed re-designs, this segment of the highway was not completed until December 1953.

The second increment of the highway to be built was a one-mile segment of the four-lane highway from Reservoir No. 4 through the Forest Reserve up to where a proposed tunnel would go through the mountain under the Pali Lookout. In March 1954, J. M. Tanaka, under a $600,000 contract, commenced construction on this fairly straightforward segment and completed construction in April 1955.

Several months after J.M. Tanaka completed Nuuanu Valley's mauka-most segment of the Pali Highway, the THD, on June 22, 1955, awarded the company a second contract, for $1,979,059.90 to construct two tunnels, measuring 22 feet high and 29 feet wide, with one running 1,000 feet in length under the Pali Lookout and the other being a 500-foot bore through a ridge further toward Kailua. In addition, the contract included a bridge to connect the two tunnels. These two tunnels were the first of four to be built and were intended to carry town bound traffic up the Pali and into Nuuanu, thereby alleviating as quickly as possible the steep grade for uphill travelers. The contract was the largest, up to that time, ever awarded by the THD.

Planning for the tunnels had commenced several years prior, as in March 1953 the Territorial DPW awarded a $21,900 contract to Samson & Smock to undertake substrata testing between the hairpin turn and Reservoir No. 4 to determine the nature of the soil and rock through which the new highway had to go. Using a water-cooled, diamond bit the firm drilled 33 holes to gather sufficient materials for analysis, with most of the cores being on the windward portion of the route.

Approximately twenty months after a cave-in had claimed the lives of five men working on excavating the future Likelike Highway's Wilson Tunnel, J.M. Tanaka started work on the Pali Tunnel project on August 1, 1955. In light of the earlier tragedy, contractors bidding on the project had to complete a twelve-page questionnaire to indicate their competency to do the job safely and well.

First an access road to the Kailua side portal of the smaller tunnel had to be cleared and graded. This portal was chosen as the place to begin excavations as the only practical dumping area for excavated materials was on this side. Work on the tunnels was further complicated by a ban on having primed explosives transported to the site via the Pali Road. As a result, the dynamite was hauled up the face of the mountain via an overhead conveyor from the valley below. Blasting started on the 500-foot Pali tunnel on October 26, 1955. The tunnels were designed by Anatol Eremin, a civil engineer who worked for the California State Department of Public Works. He authored *Highway and Railroad Bridges with Simple Continuous Spans* (1956), and following the completion of the Pali tunnels*, Tunnels, Underground*

Structures and Air Raid Shelters (1958). In addition, a number of engineers monitored the tunnel and its progress. Bung Y. Hee was the contractor's engineer, and Charles Peterson was the contractor's tunnel superintendent. Erwin F. Morrison was the Territory's chief tunnel engineer, and Charles Boerner served as a tunnel advisor. Boerner administered the structural engineering branch of the Navy Public Works office's Engineering Division and previously was the engineer in charge of the construction of the Navy's underground fuel storage facility in Red Hill.

Three crews worked around the clock, advancing approximately forty feet a day. Following a routine of detonating 75-pound dynamite packs and then clearing the debris with shovels the workers breached the far side of this shorter tunnel on November 26, 1955. To build the tunnels, the "Top Heading" method was used. First two "drifts," smaller tunnels dug within the intended tunnel, were bored. These allowed the side walls of the tunnel to be built before the entire tunnel was dug out. Once both the drifts breached the far side of the tunnel, concrete footings were poured, which formed the bases for the tunnels barrel vaulted, steel arched ceiling. Working from an elevated platform mounted on a truck, the workers next cut out the top portion of the tunnel and installed supports before finally removing the central core of the tunnel. In the 1,000-foot-long tunnel, workers were confronted with solid rock for the first 550 feet, before hitting softer dirt as they neared the leeward portal.

On May 22, 1956, workers digging from both sides of the longer tunnel, shook hands after shoveling through the last few feet of dirt and rock. Work on the two tunnels, except for the asphalt paving of their roadways was completed by December 13, 1956. Work then commenced on the second set of tunnels, with break through occurring on June 18, 1958. The second set of tunnels was opened to traffic on December 30, 1960. With their opening, the segment of the old road from the Pali Lookout down to the Hairpin Turn was closed off and permanently abandoned, as two ridges on which it sat were cut away.

While J. M. Tanaka was busy at work on the tunnels, a $323,688 contract was awarded to Oahu Construction Company on March 1955 to build the segment of the Pali Highway between Country Club Road to Carter's Corner, a distance of approximately a half mile. This work essentially widened the present road from two to four lanes divided by a median strip. This rather straightforward segment was completed on May 14, 1956. Another contract for the highway segment from Country Club Road down to Laimi was let to J. M. Tanaka and was completed by July 25, 1957, and the segment between Laimi and Coelho Lane went out to bid at that time.

At the end of 1955, J. M. Tanaka, who already held the $1,979,059 contract for the tunnel section, was the low bidder, at $677,415.80, for the half mile, two-lane segment of the new highway from the hairpin turn to the entry of the smaller tunnel. This segment included the excavating of over 30,000 cubic yards of material with several small ridges blasted and bulldozed. In addition, a series of five bridges, supported by poured in place, reinforced concrete piers, some as high as 77 feet, were constructed to bring motorists up to the tunnel entrances. To pour the concrete, mixers had to stop on the existing Pali Road, and from this vantage point pump the concrete down to fill the waiting forms. Looking up from the Pali Golf Course, Gordon Morse declared, "the series of bridges curving up the side of the sheer Pali look like something out of Walt Disney's Fairyland."[63] Making the scene more impressive was his knowing that every three feet of roadway carried by the bridges weighed two tons.

[63] "Need for Pali Tunnel Cited Here Century Ago," *Honolulu Advertiser*, December 2, 1956.

With the completion of the bridges, the windward side of the Pali Highway opened on May 11, 1957 and was declared an "engineering masterpiece" by the newspaper *Honolulu Advertiser* because the new route involved only two sweeping curves instead of the series of former turns.[64] The same paper noted earlier that motorists would be surprised to not have to shift into second to climb the grade, and they would feel like they were "traveling a flat, straight city boulevard but with scenery and without congestion."[65]

Honolulu bound traffic cruised up the mountain, through the tunnels and into Nuuanu valley before bottle necking at Reservoir No. 4. Windward bound traffic drove up Nuuanu valley over segments of two and four lane road to the base of the Pali Lookout where drivers ascended up to the lookout and then down the old road until it intersected the new near the horseshoe turn.

With the first pair of tunnels open and the second under construction, the THD turned its attention to the segment of the new highway which ran from Country Club Road to Reservoir No. 4. Work had been long delayed on this segment as the Territory became embroiled in a contentious legal battle with Lester and Elizabeth Marks over the condemnation of 2.2 acres of their 17-acre estate. The case began in 1949 when the Territory filed a suit in Circuit Court to condemn the property with a condemnation price of $12,000. The case made its way to the Territorial Supreme Court, was remanded to the lower courts and again made its way to the Territorial Supreme Court. While the case still simmered in court, with both sides intimating they intended to go beyond the Territorial Supreme Court, windward drivers agitated for the construction of the new segment as it bypassed a section of their daily commute now known as Nuuanu Pali Drive, which included Morgan's Corner, a dangerous bend in the road. Between December 1949 and June 1955, 187 accidents occurred on this two-mile stretch of road, with 66 injuries and two deaths that both occurred at Morgan's Corner.

Consequently, the Territorial Attorney General authorized the Territorial DPW to negotiate with the Marks for the entire 17-acre parcel. Finally in December 1956 an agreement was reached where the Marks retained ten acres on the west side of the proposed highway, while the Territory purchased the other seven acres, including the Marks' residence, for $624,750. The settlement opened the way for the awarding of a $1,370,014 contract to James W. Glover for the important segment between Country Club Road and Reservoir No. 4. This two-mile stretch of highway included 4,000 feet of two-level road, as Kailua-bound motorists traveled about thirty feet below the parallel Honolulu-bound lanes. A relatively new design concept for Hawaii, it served two purposes: economy by reducing the amount of excavating on the upslope side of the valley, which alleviated the need for benching to reduce the chance of landslides. The Highway Department also pointed out the advantage of this design to reduce driver fatigue by not having to face on-coming headlights. This two-level highway concept previously had been used on Kamehameha Highway between Kipapa and Wheeler Field, which was completed in 1950.

To handle the wet environment of this part of the valley, this new section of the Pali Highway included eight-foot-wide drainage gutters of each side of the highway and required the construction of thirteen box culverts under the highway to permit the water rushing off the Nuuanu cliffs to go its normal way into run-off gullies. In addition, twenty catch basins were built. The largest box culvert was twelve feet by ten feet and drained 240 acres Ewa of the highway. This segment of the highway was completed on

[64] "New Road Opens a New World," *Honolulu Advertiser*, May 11, 1957.
[65] "Straightening the Hair Pin," *Honolulu Advertiser*, August 2, 1953.

March 31, 1959. Two months later, on May 11, 1959, the Kailua-bound tunnels were opened to travelers.

The final stretch of the Pali Highway to be completed was the segment which connected it to the downtown area between Coelho Lane and the intersection of Bishop Street and Beretania Street. Planning for this segment had begun as early as 1953, and at that time Nuuanu Avenue was slated to become a one-way street into Honolulu. Bishop would be extended to connect with Fort Street at Kukui Street, and Fort would become one way in a mauka direction up to Wylie. This preliminary proposal for the Pali Highway's downtown connection underwent revisions, and when presented to the City and County Planning Commission in 1955 for inclusion in the City and County's master plan, it was adopted. In the final proposal Nuuanu Avenue was no longer to be widened as a connector, and instead Fort Street was expanded into a four-lane roadway. Bishop Street became one-way moving in a *makai* direction, while Alakea Street was made one way heading *mauka*. Fort Street merged with a new highway segment above the Honpa Hongwanji.

The Honpa Hongwanji, whose property was bisected by the proposed new segment, requested three of its buildings be relocated and a pedestrian underpass be constructed under the new highway to connect the temple with its school premises. The new segment ran close to the lower slope of Pacific Heights and crossed Nuuanu Stream via a bridge just above Kapena Falls. The project also included over- or underpasses at Wyllie, Pauoa, and School streets, as well as a cloverleaf to allow Nuuanu Avenue traffic to access the new highway just above Wyllie Street. Moses Akiona received the contract for the segment of the highway between Kuakini Street and Wyllie Street and commenced construction.

In addition, a contract was awarded to Hawaiian Dredging & Construction on April 2, 1959, for $3,034,000. This included the section of the Pali from Kuakini to Bishop and Beretania streets and also included the Lunalilo Freeway between Nuuanu Stream and Pele Street. At the time of its issuance this was the largest contract ever let by the THD. This segment included the Islands' first three level grade separation, designed by Law & Wilson, to link the Pali with downtown and the Lunalilo Freeway. The Lunalilo Freeway was to carry the bottom level of traffic, while the top level was an off ramp from the Honolulu-bound lanes of the Pali Highway to the Kaimuki-bound lanes of the Lunalilo Freeway, with the Pali Highway in the middle. It was estimated the new alignment into downtown would save the Territory over two million dollars in rights-of-way expenses when compared with the initial proposal to expand Nuuanu Avenue to Coelho Way.

With the completion of these final links, the Pali Highway officially opened on August 1st, 1961. Running from the Kaneohe Ranch Office to Bishop and Beretania, the 7.9-mile highway allowed speeds up to 45 miles per hour, more than double the speed on the old road. The new, twenty-two-million-dollar thoroughfare reduced the travel time between Kailua and Honolulu to approximately 15 minutes, as compared to the 45-minute trip on the former road during the day and up to 90-minute commute during morning or evening rush hours. When completed, the new highway was designed to carry 25,000 vehicles a day.

Following the opening of the new highway, several safety features made their first appearance in Hawaii on the Pali Highway. In December 1962, a drapery of chain link fencing, designed by State Highways Division engineer Herbert Tateishi, was hung above the Pali Highway on the cliff immediately below Wyllie Street to prevent falling boulders and debris from bouncing onto the highway. The fencing hung from a 110-foot-long, six-inch diameter pipe secured to the top of the cliff. Although used before on the

mainland, this was the first time it was employed in Hawaii. Another Hawaii first transpired in December 1966, when Jersey Barriers were installed by the Royal Contracting Company along the horseshoe turn on the Pali Highway's windward side. Poured in place along the medial strip, the two and half foot high barriers had curved sides to deflect wayward cars back into traffic.

Impacts of the Highway

While the new highway had a direct and positive impact on the commute time between the windward side and downtown Honolulu, it also had many indirect impacts. A 1954 *Honolulu Star-Bulletin* article foresaw the ramifications the proposed Pali Highway would have on the development of the windward side of Oahu, especially Kailua and Kaneohe. The article observed, "Modern roads spur suburban living because they convert commuting from drudgery into a relaxing interlude," and went on to foresee the highway bringing to Honolulu's doorsteps suburbs a mountain range away.[66] With the opening of the first two tunnels, the newspaper referred to the two tunnels as the "Gateway to Tomorrow."[67] It noted that, as "impressive and welcome as this project is, it's still only a chapter in the impressive story of Windward Oahu's development," and went on to predict, "IT'S ONLY THE BEGINNING!"[68]

Indeed, it was only the beginning. Knowing the two new highways were forthcoming, Kaneohe Ranch, which already had Aikahi Hillside under construction in 1957, began planning a 450-house subdivision known as Kalaheo Hillside, 500 houses in Kapunahala, and 2,000 dwellings in the 750-acre Luluku subdivision. Another 700 houses were slated to go up near the intersection of the new Waimanalo Road and recently completed Kailua Road, the first major development between Kailua town and the base of the Pali. In addition, Bishop Estate commenced planning a large subdivision on its lands in the Haiku area and the Hawaiian Home Lands Commission started to open up lands in Waimanalo for residential use. It was anticipated that by 1967 over 10,000 new homesites would be erected on Kaneohe Ranch lands, which was very conceivable considering that during the four years between 1953 and 1957, the company sold a house a day.

To accommodate the anticipated population growth, the Department of Public Instruction commenced construction of a new Kailua High School in 1957 and planned to convert the existing high school into an intermediate school. The Kaneohe Elementary School opened in 1956. The department also programmed for three new elementary schools in Kailua, and King Intermediate School and Haiku]Elementary School in Kaneohe. Also, district parks were constructed in both Kailua and Kaneohe, as well as a number of small neighborhood playgrounds such as at Kaelepulu and Kalaheo. The Board of Public Parks and Recreation also opened the 225-acre Pali Golf Course in 1956, which was designed by Willard Wilkinson. Harold Castle donated half the land for the course, as he desired to preserve the verdant character of the windward side from the Pali Lookout and upon descending from the new highway.

Also, newer, better roadways were constructed to service the two trans-Koolau highways. The Kamehameha Highway between the Pali intersection and Kaneohe Bay Drive, a distance of 2.4 miles, was widened to four lanes, with work starting in 1957. Also, a new three-mile road between Waimanalo

[66] "Breaking the Bottlenecks," *Honolulu Star-Bulletin*, January 30, 1954.
[67] "$100 Million in Housing is Foreseen," *Honolulu Star-Bulletin*, May 10, 1957.
[68] Ibid.

and the Pali Highway intersection, now defined by Castle Hospital, was constructed, while the City and County handled construction of the Kahekili Highway.

Other developments that emerged with the Pali and Likelike nearing completion included the seventy-acre Hawaiian Memorial Park and the forty-bed Castle Memorial Hospital, operated by the Seventh Day Adventist Church. Also, the Windward City Shopping Center at the intersection of the Likelike and Kamehameha Highways joined the already-operating Kailua Shopping Center, which was completed in mid-1954. The latter underwent a dramatic expansion in 1957, including a Times Supermarket. Foodland had opened in Kailua in its own building in 1953.

Thus, the highway not only made the commute from the windward side of Oahu to Honolulu more appealing to the existing motorists, but it also convinced others that the distance from town was not a detriment to living in the country.

3.6: THE FEDERAL AID HIGHWAY SYSTEM AND INTERSTATE HIGHWAY SYSTEM ON OAHU, 1911-1953

HISTORICAL BACKGROUND

Federal Aid in the construction of a system of State and National highways was made available to all the States in the continental United States in 1916. The Federal Aid Highway Act was developed in the 1930s due to building pressure for the construction of transcontinental superhighways. A feasibility study of a six-route toll network in 1938 showed insufficient transcontinental traffic to support a network of toll superhighways. *A Master Plan for Free Highway Development* also recommended in this study a 43,000-kilometer non-toll interregional highway network. On April 14, 1941, a National Interregional Highway Committee was appointed by the president Franklin Delano Roosevelt to investigate the need for a limited system of national highways. In 1943, a report, *Interregional Highways*, recommended an interregional highway system of 63,000 km, designed to accommodate traffic 20 years from the date of construction.

Disagreements in the highway community resulted in an inability to agree on the major changes needed in the post-war era to address accumulated highway needs during the beginning of the Federal Aid Highway Act of 1944. The Public Roads Administration (PRA), as the BPR was now called, began to work with state and local officials and the American Association of State Highway Officials (AASHO) to develop interstate plans and design standards for the interstate system, which were approved in 1945 that address conditions such as traffic, populations density, topography, and other factors.

Even though the PRA announced the designation of the first 60,640 km of interstate highway in 1947, construction of the interstate system moved slowly. Many States did not wish to divert Federal Aid funds from local needs. Others complained that the standards were too high. By July 1950, the United States was again at war in Korea and the focus of the highway program shifted from the civilian to military needs. In 1953, the States had completed 10,327 km of system improvements at a cost of $955 million. Only 24 percent of interstate roadway was adequate for present traffic, which was still far from meeting the traffic expectations for 20 years in the future.

At the end of the Korean War, the nation's highway problems again gained attention. With support from President Dwight D. Eisenhower, the financial funding problem for the interstate highway system was resolved among the federal, state, and local governments by the passing of both the Federal Highway

Act of 1956 and the Highway Revenue Act of 1956. The former called for uniform interstate design standards to accommodate traffic forecasted for 1975 (modified in later legislation to traffic forecasted in 20 years), and the latter provided increased tax and matching federal funds. BPR worked with AASHO to develop minimum standards that would ensure uniformity of design, full control of access, and elimination of highway and railroad-highway grade crossings. These acts resolved several more controversial issues: $1.1 billion was distributed to the various States for the first year of "the greatest public works program in the history of the world."[69] Bertram D. Tallmy was chosen as the head of BPR, with the newly authorized title "Federal Highway Administrator" to manage the program in 1957, so construction of the interstate system was under way. The next 40 years would be filled with unexpected engineering challenges, unanticipated controversies, and unforeseen funding difficulties. Nevertheless, the president's view would prove correct. The interstate system, and the Federal-State partnership that built it, changed the face of America.

Road Construction

Road construction, as a means of communication around the Hawaiian Islands, can be traced back to the early kings and chiefs of the islands. It was said that there was a road around Maui which was about 138 miles long and from 3 to 5 feet wide. Most parts of this road were paved with hard beach stones passed from hand to hand by men. Stones were laid crosswise from the support, not in a solid surface but in an arrangement like the squares of a checkerboard. It is interesting to note that in 1890, under the monarchy, a group of prominent citizens went so far as to volunteer the advancement of amounts necessary to keep a particular highway project going, charging no interest, and trusting the legislature to vote an appropriation.

The catalyst for the great increase in road building in Hawaii after 1920 had its origin in 1924 when the provisions of the Federal Highways Act were extended to the Territory (now the State) of Hawaii by an act of congress in 1924. Since 1926, when the present Federal Aid program was launched in Hawaii, the THD had completed 518.91 miles of highways on the islands of Oahu, Hawaii, Maui, Molokai and Kauai and had maintained these sections. A Federal Aid Highway System upon which projects could be initiated to receive Federal Aid was laid out, consisting of a total length of allowable new construction of 213 miles, of which 118 miles were located on Oahu.

In 1931 and 1932, Congress made emergency appropriations, which resulted in allotments totaling one million dollars to the Territory. This money was to be used to relieve Depression-era unemployment with construction jobs and used in lieu of funds which states typically provided as their portion of the cost of Federal Aid projects. It created an $880,000 Hawaii Special Fund to take the Federal Aid System within the Territory in 1931. This system was selected by the Governor of Hawaii, and agreed upon by the Secretary of Agriculture, on November 18, 1931, and allowed for the construction of new roads totaling 532 miles in length.

Hawaii had accelerated the speed of other highway constructions since the 1940s with the increasing traffic problem and the national defense need. Highway construction in Hawaii experienced a slow start at the end of the World War II because of material and special engineers' shortages and high costs. President Truman pointed out, "By any reasonable standard, our highways are inadequate for today's demands. Future demands will inevitably be greater as business traffic continues to expand, as our

[69] "US Prods Hawaii to Speed Road, Highway Work," *Honolulu Advertiser*, November 14, 1949.

population grows, and as we build roads to reach needed resources now relatively inaccessible."[70] The highway expansion and improvement program was proposed during the late 1940s for the reconstruction, rehabilitation and extension of highways, which would not only provide increased road safety and economic use for motor vehicles, but also ensure the adequacy of roads to serve in time of peace or war.

During the 1950s and 1960s there was a shortage of highways in Hawaii due to the increasing use of motor vehicles and the expanding tourism industry of the islands. Between 1950 and 1958 there was a 36 percent increase in motor-fuel consumption in the State of Hawaii. This average of 4 percent a year was almost the same as the continental increase. The total road mileage in the State of Hawaii had already reached 3,137 miles by January 1958. The island of Hawaii had the most highway mileage of any of the islands and it is also the largest. Most of the mileage of city streets was found on the island of Oahu and in the city of Honolulu. The annual travel on all roads and streets in Hawaii was estimated to be 1,707 million vehicle-miles during 1950-1958. This is based primarily on registration and motor-fuel consumption data. This would amount to an average daily traffic of about 1,530 vehicles on all roads and streets in Hawaii. This compared with similar volumes at the time recorded on all roads and streets of 1,570 vehicles in Connecticut, 1,200 in Delaware, 2,030 in Rhode Island, and an average of 523 for the entire United States.

3.7: MILITARY CONTRIBUTION TO ROAD AND HIGHWAY CONSTRUCTION IN HAWAII, 1959-1970S

HISTORICAL BACKGROUND

Defense activity played a relatively minor role in Hawaii during the first thirty-five years of Territorial status (1900-1935). Hawaii became a Territory of the United States in 1898, when the world was at peace. Only a "token defense force" was considered necessary in Hawaii at that time. World War I was centered in Europe and also had little effect on the military population in Hawaii.

In 1931, a political shift in Japan from a relatively liberal to a militaristic government was followed by a rapid build-up of Japanese forces. Concerns about the intentions of Japan caused a gradual increase in military forces allocated to Hawaii. After Japan's attack on China in July 1937, American defense activity in the Pacific rose sharply, with Hawaii as a focal point. During the prewar defense program of 1939-1941, federal expenditures in Hawaii steadily rose. By 1941, the military establishment had become the largest employer of civilian workers in the Territory. Following the December 7, 1941, attack on Pearl Harbor, President Roosevelt declared martial law, the military government regulated activity throughout Hawaii. Armed forces were concentrated in the island of Oahu with major installations at Pearl Harbor, Barber's Point, Schofield Barracks, and Kaneohe.

With the commencement of World War II, all construction, including highway construction, was restricted to only that which would materially aid National Defense as stated in General Administration Memo No. 148 from the Washington Office of the Public Roads Administration. The military authorities

[70] Harry S. Truman, "Special Message to the Congress on Highway Construction," (February 9, 1948), in *Public Papers of the Presidents of the United States: Harry S. Truman, Containing the Public Messages, Speeches and Statements of the President, January 1 to December 31, 1948* (Washington, DC: United States Government Printing Office, 1964), 133.

approved all Federal Aid highways constructed by the THD as strategic. In some cases, they insisted that roads be built which were of doubtful value to the civilian population but of great value to the Army, such as the Kunia Road from Schofield to Waipahu.

During World War II (1941-1945), defense activities totally dominated the economic life of the islands and profoundly affected social and political life. Tourists and many unemployed residents were evacuated from the islands. Total employment rates rose sharply, with a large percentage of islanders entering the work force for patriotic reasons. War stimulated trade, construction, and income throughout Hawaii due to the extraordinary increase in defense construction and purchases and demands of servicemen on the islands. Military activity in the Territory remained at high levels until the end of 1946 because of Hawaii's role in demobilization and in the disposal of war surpluses.

During this period, many men who formerly worked for the road department changed their positions in working for the army on vital defense projects. Meanwhile, most federal road aid funds went to the War Department for use on roads of military value in Hawaii. All requests for road construction in Hawaii, except those initiated by the Navy, had to be approved by the Commanding General, Army Forces Middle Pacific (previously Pacific Ocean Areas, Central Pacific Area, and Hawaiian Department) before construction was approved and funds allocated for the work by the Federal Works Agency.

The period 1947-50 was one of repeated cutbacks. The defense expenditures in Hawaii declined from $224 million in 1946 to $148 million in 1950. The war that started in South Korea on June 25, 1950, had immediate repercussions in Hawaii. 1950 began with a depression and unemployment crisis and ended with a rapid rise in income and employment which ushered in the boom years of 1951-1952. The Hawaii military establishments for the national defense system were increased due to the Korean War. A total of $1,785,500 was spent in the islands' military construction projects in 1950. In 1951 another $20 million was given to Territory of Hawaii Military. In the early 1950s, the Army decided that a cross-island road was imperative to the defense of Hawaii.

Even after the cessation of military activities in Korea, defense activity in Hawaii continued to rise, due to escalating tensions in the Pacific area. Delegate Farrington's weekly "Report to The People" from Washington declared in 1950 that "recent events have shown that Hawaii is the proper place to build permanent military strength in the Pacific," and that "The life of Hawaii needs to be closely integrated with that of States, in every way, politically as well as economically and culturally. This will all add to our military strength. And this is what the country needs today—and quickly."[71]

For defense in the Pacific, the military establishment maintained in Hawaii a vast system of facilities, service bases and command posts. Defense expenditures increased from $148 million in 1950 to $271 million in 1953. In 1954, Gen. Mark W. Clark urged to create a Pacific defense organization to help maintain those free countries in the Pacific independence against Communist encroachment. As part of President Eisenhower's military "new look" in Asia, Hawaii was headed for an even bigger role in the Pacific defense program. By 1955, defense continued to be the largest source of island income and the greatest employer of Hawaiian manpower. These defense activities had a direct impact on the road and highway construction activities of the islands.

[71] "Effect of Korean War, Farrington Sees Build-Up Here of Defenses for the Pacific," *Honolulu Star-Bulletin*, August 4, 1950.

The National System of Interstate and Defense Highways was designated by the Federal Aid Highway Act in 1944 to primarily serve national defense. The act originally included only the continental United States. States received Federal Aid for highway construction if the projects were regarded as vital to national defense. Hawaii was not eligible for this aid and the convention of the Western Association of State Highway officials refused to pass a resolution that Hawaii be included in the interstate highway system, even though the War Department designated all of Oahu's principal highways as "Strategic" in 1941.[72] The Pacific military command promised support to help pass a resolution. The Defense Department also thought that including Hawaii in the system would greatly influence public perception of the National Defense System.

In 1959, Congress authorized Hawaii's admission to Statehood and plans were underway to remove the 48-State limitation on the Interstate system. This system was extended to the State of Hawaii on July 12, 1960, with the passage of Hawaii Omnibus Bill, Public Law 86-624. The Act provided Hawaii with an initial apportionment of Federal Interstate Highway fund for the 1961-62 fiscal years in the amount of $12,375,000. It also provided that subsequent apportionments to Hawaii be based on estimated cost of completing the system in Hawaii as compared to the estimated cost of completing the system in all States.

Responding to urgent national defense needs in the 1960s, the Territory of Hawaii accumulated highway deficiencies of $50,000,000 which was ten times the annual construction budget. Highways were being developed at a faster rate than the THD could meet. Seeking additional federal aid was seen as a way to reduce time and money loss, and the destruction of lives and property as a result of inadequate roads and streets. John C. Myatt, the first deputy Territorial Highway Engineer said, "If Hawaii were admitted into the interstate system, $1,100,000 on annually would be available for 'strategic highway' construction on a 60 federal-40 local matching basis, increasing the Territory's highway construction funds by $1,800,000 a year… It would also put us in line to share in President Eisenhower's proposed 50-billion-dollar defense highway construction program, if Congress makes it into law."[73]

Compared to the large, flexible construction industry on the mainland, the construction field in Hawaii is small and less varied. In addition, Hawaii is also isolated from the mainland and is subdivided by islands. For these reasons, the impact of defense and military establishment on the road construction in Hawaii over the past several decades has been more vital and direct than on any other activity in the Territory.

The Corps of Engineers, in the United States Army, under assignment by Congress, is charged with the public civil works program to control, regulate, and improve river and harbor resources and to plan and construct flood control works. In addition to civil projects, the Corps is also engaged in extensive construction programs for the United States Army and Air Force. When local interests are unable to resolve a situation, local authorities can petition their representatives in Congress for assistance. If the representatives consider the petition favorably, they can direct the Corps of Engineers to investigate the feasibility and economics of correcting the situation.

Before the Corps of Engineers became involved in the development of the defense activities in the Hawaiian Islands, the Honolulu Engineer District had been in operation for approximately 45 years.

[72] D.F. Balch, *Comparative Report: Nuuanu Valley Tunnel Route vs. Kalihi Valley Tunnel Route* (Honolulu: Territorial Highway Department, 1943).
[73] "Military Backing May Get Federal Aid for T. H. Roads," *Honolulu Advertiser*, October 23, 1954.

While some minor improvement work and surveys were accomplished under the direction of Corps of Engineers as early as 1899 in connection with the improvement of Pearl Harbor, the District office was set up in Honolulu on 14 April 1905 under the direction of Lieutenant John R. Slattery.

District Engineers executed fortification and other military works under the direction of military commanders as prescribed in army regulations or other War Department instructions. On July 1, 1940, the hostilities with Japan became one of great activities for the Honolulu Engineer District in the initiation of and planning of vast and ever-expanding preparations for an emergency. During this period, the construction activities of the Quartermaster Corps were transferred to the Corps of Engineers. In 1942, all engineer troops and military engineering came under the jurisdiction of the Department Engineer. On March 16, 1942, the Commanding General, Hawaiian Department, was granted "complete jurisdiction over, and responsibility for military construction activities in the Hawaiian Department, including administration of existing construction contracts."[74]

The United States Army constructed approximately 240 miles of roads in the Territory of Hawaii during World War II as well as helped the road maintenance and repair during wartime. Due to the labor and material shortages, these roads had not been properly maintained by the city and county. In addition to the army's heavy wartime traffic (these highways and streets were mainly used for military vehicles and heavy trucks engaged in transportation for the army or navy), the military and naval authorities provided financial assistance to cover the cost of road maintenance and reconstruction work to put the highways of the islands in good condition. Today many of these roads are available for civilian use and several have been turned over to the Territory. These highways were built to afford easy access to military reservations because the Army thought that a cross-island road was imperative to the defense of Hawaii in early 1942.

Interstate Route H-1 in Honolulu

The H-1 is the primary and most congested freeway along the south shore of the island of Oahu. It was authorized as part of the Statehood Act of 1960 and is one of three Interstate and Defense Highways in Hawaii to be funded by the US Department of Transportation's Federal Highway Administration. The Interstate-Defense Highway System for Oahu was approved in principle as part of the Statehood Act consisting of the H-1, H-2, and H-3 freeways.

The first section of H-1 in the Mauka Arterial was opened in 1953 near University Avenue. In 1959 at Statehood, part of the Lunalilo Freeway was opened between Punahou Street and King Street. After 1960, it extended both west and east along the south shore until the completion of H-1 in 1986. In 1967, H-1 first appeared on maps, cosigned as Hawaii State Route 72.

Bridges in the Highway System

From a functional standpoint, bridges are part of a seamless national highway surface transportation system. The highway engineering community uses several terms to describe what are commonly called "bridges," such as overpass, separation, and ramp. The bridges to highway miles vary greatly within the various states and are influenced by topography and population. Their boom in the 1950s and 1960s are

[74] US Army Corps of Engineers, *Water Resources Development by the Corps of Engineers in the Hawaiian Islands* (Honolulu: n.p., 1959), 4.

all due to traffic relief efforts and a Cold War defense initiative to move troops and material rapidly across the country in the national interstate highway system that started in the 1950s.

During the late 1960s and early 1970s, a series of disastrous vehicular bridge collapses occurred, causing loss of life throughout the United States. The nation began to focus attention on the decaying state of the civil infrastructure in general, and on the nation's bridges in particular. In 1970 Congress established a special Federal Aid program to provide up to three-fourths of the funds needed to help meet state bridge renewal needs. The initial funds from the Special Bridge Replacement Program became available in late 1972. The Surface Transportation Act of 1978 extended and expanded the Special Bridge Replacement Program, becoming what is now known as the Highway Bridge Replacement and Rehabilitation Program. At the time, $4.2 billion was appropriated from 1979 through 1982 for bridge replacement and rehabilitation.

H-1, when initially conceived, was known as the *mauka* arterial. A tentative route was laid out by Honolulu's planning engineer, Charles Welsh in 1940-41, which was included in the City and County's first master plan of December 1944. The arterial was to take the form of a divided highway, "with all grade-crossings eliminated" and no left turns allowed. Also, pedestrians were not permitted on the highway, thus eliminating the need for pedestrian crossings, and there would be no utility poles other than the tall standards supporting mercury vapor streetlamps.

As laid out by Jack Myatt of the Territorial DPW, the proposed seven-mile highway was to run between Middle Street and Old Waialae Road, and the entire project was expected to take fifteen to twenty years to complete. Grade separation structures (under- or overpasses, i.e., bridges) eliminated intersections and thus allowed traffic to flow unimpeded by traffic lights.

In August 1952, the Territorial DPW awarded the contract for the first phase of the highway, between Old Waialae Road and Isenberg Street, to J. N. Tanaka, and in November 1953 awarded the company a second contract for the section of road between Isenberg and Alexander streets. The *mauka* arterial was the most expensive construction project up to that time in Hawaii, costing $2 million a year (forty percent of the Territory's budget for road construction), with about one third of the costs expended on land acquisition.

The three Ewa bound lanes of the first one-mile segment of the *mauka* arterial opened on November 9, 1953. The new highway segment immediately reduced the previous morning rush hour congestion around King Street and University Avenue. The *Honolulu Advertiser* explained, "A major feature of the new arterial is an overpass spanning University Avenue,"[75] and labeled the overpass "an 'air lift' answer to one of the city's worst traffic snarls."[76] The University Avenue part of the expressway also included the Islands' first on and off ramps allowing Manoa motorists to enter or exit the arterial. The utilization of a bridge to traverse University Avenue was very much a novelty for the people of Oahu, as at the time the Puowaina Bridge was the only bridge on the island to span another road. In addition to the University Avenue bridge, this section of the new highway also included the Palolo-Manoa bridge, which was completed in August 1953. In addition, in July 1956 a pedestrian bridge was opened at Isenberg

[75] "Mayor Asks Chamber Ban Pali Route," *Honolulu Advertiser*, November 3, 1953.
[76] *Honolulu Advertiser*, June 26, 1955, A10.

Street to allow pedestrians safe passage over the arterial, one of the earliest structures in the islands erected for this purpose.

The Kaimuki bound lanes between Old Waialae Road and Alexander Street did not open until January 5, 1954, as they needed to await the completion of an overpass which carried Old Waialae Road over a two-lane ramp taking traffic from the arterial to King Street. In April 1955 the half mile second segment of the highway, between Alexander and Keeaumoku, was opened to traffic, five months ahead of schedule. This segment included a bridge to allow Punahou Street to pass over the expressway. In addition, the bridge carrying McCully Street over the new freeway was completed in July 1956, and in September 1960 the Keeaumoku Street Bridge was completed, in anticipation of the freeway's eventual extension towards downtown.

At the dedication of this segment of the highway, Honolulu Chamber of Commerce President Gilbert W. Root recalled that earlier the community debated whether the *mauka* arterial was needed, but now it was plain that it was, and the only question which remained was "how fast can we finish the job?"[77] Progress on the new highway was bolstered in 1954, when an additional $700,000 in federal highway funds was appropriated for Hawaii in 1954, thanks to President Eisenhower's desire to expand America's highway system. To match the new federal dollars and to have funds to pay back highway bonds Hawaii's gasoline tax was raised from four cents to five, commencing July 1, 1955. Also in July 1955, the Territorial DPW renamed the *mauka* arterial as the Lunalilo Freeway, in honor of the former monarch, following the suggestion of LeRoy C. Bush, the president of Honolulu Construction & Draying Company. The advent of statehood in 1959 led to the expansion of the Lunalilo Freeway and its incorporation into the H-1 Interstate Highway.

Also, by 1958 planning began on the Ewa terminus of the Lunalilo Freeway. Here, the firms of Belt Collins & Associates and Moffatt, Nichol & Taylor proposed a "three-level grade separation structure"; in other words, a double overpass with Middle Street as the upper most deck and an exit leading to Kamehameha Highway from the middle deck, both of which would bridge the Lunalilo Freeway as it continued straight ahead to merge with Moanalua Road. In addition, a ramp coming from Kamehameha Highway would tunnel under King Street to join the eastbound lanes of the freeway. In the following year, 1959, construction got underway on the interchange between the Lunalilo Freeway and the Pali Highway. Designed by Law & Wilson, this would become the first three level grade separation structure to be completed in Hawaii. The Middle Street separation was completed in 1964.

The section between Kalihi and Houghtailing streets, which commenced construction in December 1958, was completed in September 1960. The segment between Nuuanu Stream and Pele Street got underway in June 1959 and was finished in May 1962. In November 1960, ground was broken on the half mile between Middle Street and Pinkham Street, which was finished in April 1964. In late 1963, James W. Glover Ltd. was awarded the construction contract for the 1.3-mile section of the Lunalilo Freeway between Nuuanu Stream and Houghtailing Street, which when completed in 1966, allowed the opening of the highway between Kalihi Stream and the Pali Highway. This segment included six major bridges or overpasses: the Houghtailing Street underpass, Kapalama Canal Bridge, Palama Street underpass, Liliha Street overpass, Stillman Lane/Aala Street extension overpass, and Nuuanu Stream Bridge. Glover's low

[77] *Honolulu Advertiser*, April 1st, 1955, 1.

bid of $6,060,326.50, made his contract the largest single construction contract awarded by the State of Hawaii. The previous high contract was $5,136,916 for a unit of the Honolulu International Airport.

In addition to working on the segments of the highway from Middle Street to town, work also started on a newly conceived segment of the Lunalilo Freeway, which would run through Kaimuki and connect with Kalanianaole Highway. Underpasses were planned for 6th Avenue, 7th Avenue, Koko Head Avenue, and 16th Avenue, while 10th Avenue would run under the highway. Also, pedestrian bridges were proposed at 2nd, 4th, and 14th Avenues. In June 1963, the contract for the mile-long portion of the H-1 between First Avenue and Koko Head Avenue was awarded to Kaiser Company. Completed in June 1965, the one-mile highway deposited commuters to downtown at the Kapahulu-Kapiolani-King Street area, which remained a traffic bottleneck until the completion of Kapiolani Boulevard. Hawaiian Dredging and Construction commenced construction of this important bridge link in September 1965 and completed their work in May 1967. Also, in September 1965 Moses Akiona started work on the next increment of the H-1 from Koko Head Avenue to 17th Avenue, with an underpass at 16th Avenue.

In town, the highway segment between the Pali Highway and Pele Street was completed in October 1966, and included the Queen Emma Street overpass, as well as Structure Number 8 Grade Separation, which extended Punchbowl Street to run under the freeway as a westbound entry ramp to the Lunalilo Freeway. In September 1967, Gordon Hall Enterprises started work on the final segment of the Lunalilo Highway between Victoria and Keeaumoku streets. This section included a 30-foot high, fifth of a mile long Makiki viaduct between Ernest and Kewalo streets, which was designed in-house by Donald Ornellas, Melvin Tamashiro and Vernon Ching. It bridged both Piikoi and Pensacola streets, while the freeway went under both Ward Avenue and Keeaumoku Street. Originally, this segment of the freeway was to be at or below grade, but the HDOT decided to elevate it instead in order to avoid serious drainage problems, save time, and because it penciled out one million dollars less than the below grade alternative. With the opening of the Lunalilo Freeway, the journey from Kaimuki to Kalihi took ten minutes, while before the building of the highway such a cross-town trek normally required thirty minutes or more during peak traffic times.

Bids for completing the eastern end of the H-1 from 21st Avenue to Ainakoa Avenue were delayed until August 1967, when Hawaiian Dredging and Construction was awarded the contract for this segment, which included the raised, 2,160 feet long, six-lane Waialae viaduct that was not completed until November 1969. An even longer viaduct at Pearl City was over one mile long, and when completed in March 1970, the eight-lane wide and 6,000 feet long Pearl City viaduct was the longest viaduct ever built in Hawaii up to that time. The western side of the H-1 became fully functional in 1974 with the widening of Moanalua Road between Red Hill and Halawa, allowing drivers to travel from the Waialae viaduct at Kaimuki to the Palailai Interchange near Campbell Industrial Park without having to stop for any traffic lights, greatly expediting travel times. Such freeway driving was all made possible thanks to the use of bridges as overpasses, underpasses, and viaducts.

3.8: STANDARDIZATION, ADDITIONAL INTERSTATES, AND PRESERVATION (1968-1987)

Suburban Growth and Bridge Standardization

Following World War II, Oahu continued to be the archipelago's major population and economic center and experienced a boom in construction not seen on the neighbor islands. According to census records,

Oahu and Honolulu's population experienced the largest population growth between 1940 and 1960 while neighbor islands experienced population decline during the same time period. Between 1960 and 1980, Oahu's growth slowed but still lead all the islands while the other islands began to see modest growth rates return. Because of this, the majority of construction – road, urban, suburban, etc. – centered on Oahu.[78] Former plantation lands and agricultural landholdings became residential communities as landowners sold of properties to residential developers.[79] Between Pearl City and Diamond Head, Oahu saw much construction and densification of existing land.[80] The Bank of Hawaii observed in 1960 that Oahu contained over 80% of the State's population contained in less than 10% of its land, with nearly 60% in or near Honolulu. The postwar trend of suburbanization, automobile ownership, suburban shopping centers, and new roadways all played out in Oahu with new suburban centers in Kaneohe-Kailua-Lanikai on windward Oahu, Wahiawa near Schofield Barracks, as well as Waipahu and Ewa. Further plans for suburban development were at Barber's Point, Waianae, Waimanalo, Kahuku, and Wailua.[81]

Because of these trends, the majority of post-1945 bridges and the entirety of Interstate Highway bridges are to be found on Oahu. Information provided by HDOT and FHWA indicate that between 1968 and 1977, 106 bridges were built on Oahu as compared to 28 on Hawaii, 10 in Maui, and one on Kauai. In addition to Oahu experiencing the most bridge and road construction, bridge design became increasingly standardized. As a result, concrete and steel bridges and culverts built after 1945 fall under Program Comment, a 2012 decision made by the Advisory Council on Historic Preservation (ACHP) at the request of the FHWA that would eliminate individual historic review requirements under Section 106 of the National Historic Preservation Act. Bridges built after 1945 fall under Program Comment due to their standardized nature, inclusion into the Interstate Highway system, and different criteria used to evaluate their NRHP status. This program comment applies to the following types of bridges – reinforced concrete slabs bridges, reinforced concrete bream and girder bridges, multi-beam bridges, and culverts/reinforced concrete boxes.

A review of Program Comment requirements has led to a review of post-1945 bridges and culverts determined eligible by the 2013 SHBIE. This survey determined a substantial number of culverts constructed after 1945 to be eligible due to their use of lava rock construction for otherwise standard construction of the era. Historically, while lava rock construction in Hawaii is a notable use of local materials in building, in the context of roads, the territory and later state was an early adapter of

[78] Fung Associates, Inc., *Hawaii Modernism Context Study*, November 2011, 2-4; "An Introduction to Hawaii – the 50th State," *The Labor Market and Employment Security*, United States Department of Labor, May 1959, 4; Dore Minatodani, "Hawai'i - Censuses: Historical Censuses," University of Hawai'i at Mānoa Library, Hawaiian Collection, accessed April 5, 2023, https://guides.library.manoa.hawaii.edu/c.php?g=105181&p=684171; Bank of Hawaii, "Summary," *Review of Business and Economic Conditions* 5, no. 6 (June 1960): 2, retrieved from https://catalog.hathitrust.org/Record/009388905.

[79] Fung Associates, Inc., *Hawaii Modernism Context Study*, November 2011, 4-67, B-18.

[80] Architects Hawaii, Ltd., *Lemmon, Freeth, Haines, [and] Jones: Mid-Century Context Study (1948-1962)*, September 2018, 3.

[81] Bank of Hawaii, Department of Business Research, *Hawaii: The First Year of Statehood, 1960 Mid-Year Report on Business Conditions, Urban Development, Growth Patterns, Economic Potentials* (n.p., n.d.), 22, 37, 42, retrieved from https://catalog.hathitrust.org/Record/000552774.

reinforced concrete construction. The THD quickly abandoned CRM construction in the first decades of the twentieth century, though CRM made a reappearance during the Great Depression.[82] A notable CRM bridge example is the NRHP-listed Waiale Bridge where the massing and volume of CRM makes it a notable example as well as its steel-stringer structure. In contrast, steel pipe culverts on Volcano Road are of standard construction and the use of lava rock is decorative rather than integral.

Completing Interstate Route H-1 (1969-1986)

The H-1 was completed and opened on May 3, 1986.[83] The Honolulu portion of Interstate Route H-1 was also known as the Lunalilo Freeway and went from King and Middle Streets to the Waialae Viaduct over 8.2 miles, was constructed between 1952 and 1969 and described in section 2.8.[84] A second section Palailai and Aiea, was constructed between 1966 and 1970. This portion of Interstate Route H-1 shows the linkages between highway construction and suburbanization. H-1's alignment followed a more inland route than the Oahu Railway and Land Company (OR&L) and Kamehameha and Farrington Highways. The railroad and later roadways allowed for plantations and towns to be established along with a quick route into Honolulu and were the seeds of post-World War II suburbanization. By 1970, the Halawa to Palailai Interchange section had been completed and the Lunalilo Freeway, too, though they remained unconnected. The gap between Halawa to Middle Street would be complex as a a five-mile long, eight lane highway with complex interchanges at Pearl Harbor, Honolulu International Airport, and Keehi was anticipated.[85] Construction on this section began in April 1975 and was largely complete by 1984 with a short gap that would be filled in when H-1 was completed end to end in 1986.[86] The final portion of H-1 opened in May 1986 and the total cost of the entire highway was reported as over $506 million.[87]

[82] Alvarez, *Historic Bridge Inventory: Hawaii*, 72-73; Barbara Shideler and Ann Yoklavich, "Waiʻale Drive Bridge, National Register of Historic Places Registration Form," (U.S. National Park Service, U.S. Department of the Interior, 1996) 8-1, retrieved from https://catalog.archives.gov/id/63816026.
[83] State of Hawaii, Department of Transportation, *1987 Report to the Governor* (n.p., n.d.), 6, https://catalog.hathitrust.org/Record/010623628.
[84] State of Hawaii, Department of Transportation, *Year Ending June 30, 1970* (n.p., n.d.), 39, retrieved from https://catalog.hathitrust.org/Record/000548436.
[85] State of Hawaii, Department of Transportation, *Year Ending June 30, 1971* (n.p., n.d.), 45, retrieved from https://catalog.hathitrust.org/Record/000548436; State of Hawaii, Department of Transportation, Highways Division, *Interstate Route H-1, Palailai to Ainakoa*, May 1972, accessed April 26, 2023, https://evols.library.manoa.hawaii.edu/items/f9f64a18-3e8c-4c53-b85d-b73992744df1.
[86] State of Hawaii, Department of Transportation, *Nineteen Seventy Five Fiscal Year* (n.p., n.d.), 44, retrieved from; https://catalog.hathitrust.org/Record/000548436; State of Hawaii, Department of Transportation, Highways Division, Planning Branch, *Interstate Route H-1, Palailai to Ainakoa [and] Interstate Route H-2, Waiawa to Wahiawa*, October 1984, accessed April 26, 2023, https://evols.library.manoa.hawaii.edu/items/588d9876-1c87-4eeb-bf7a-f718d9490e70.
[87] "National Interstate Day," *The Honolulu Advertiser*, May 30, 1986, accessed December 12, 2024, https://www.newspapers.com/image/263174154/. The precise cost was reported as $506,118,659.

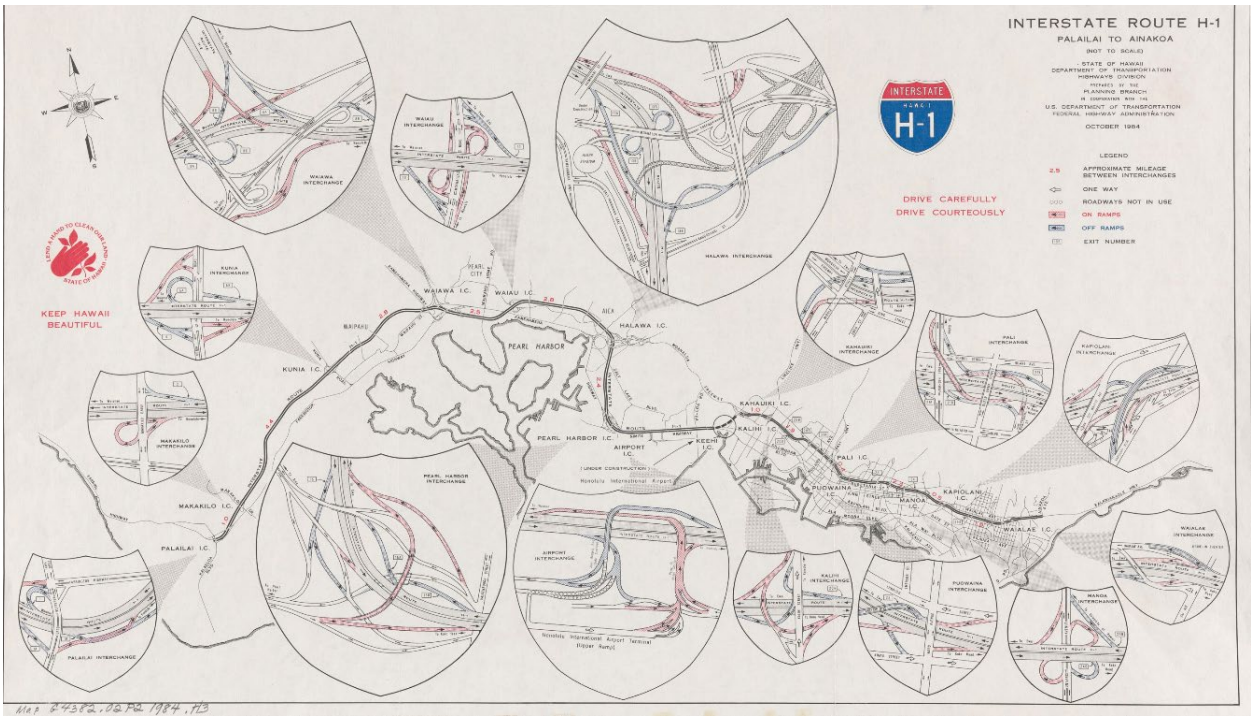


FIGURE 21 - INTERSTATE ROUTE H-1 IN 1984. SOURCE: STATE OF HAWAII, DEPARTMENT OF TRANSPORTATION, HIGHWAYS DIVISION, *INTERSTATE ROUTE H-1, PALAILAI TO AINAKOA*, OCTOBER 1984, HTTPS://EVOLS.LIBRARY.MANOA.HAWAII.EDU/ITEMS/588D9876-1C87-4EEB-BF7A-F718D9490E70.

Until the completion of this last section, the Moanalua Freeway (present-day H-201) acted as the primary connection between the finished portions of H-1 between Aiea to Kalihi and was widened and rebuilt to freeway standards between 1971 and 1974.[88]

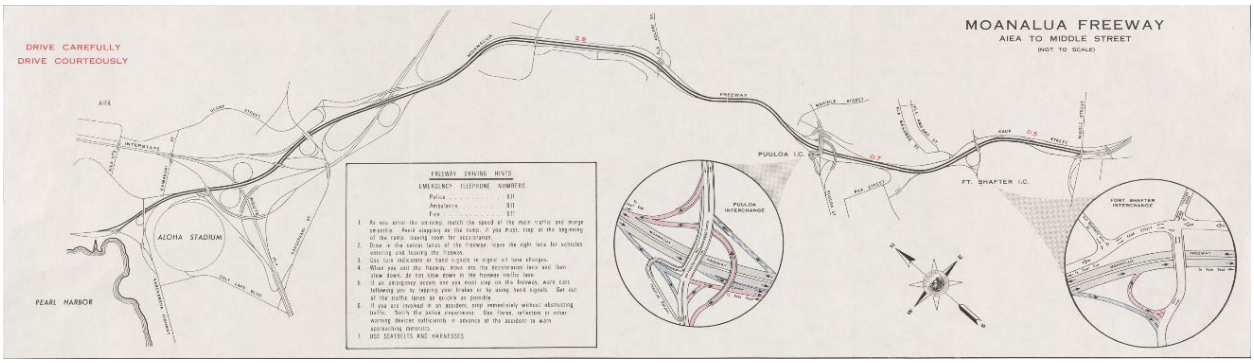


FIGURE 22 - MOANALUA FREEWAY (FUTURE INTERSTATE ROUTE H-201). SOURCE: STATE OF HAWAII, DEPARTMENT OF TRANSPORTATION, HIGHWAYS DIVISION, PLANNING BRANCH, *MOANALUA FREEWAY, AIEA TO MIDDLE STREET*, OCTOBER 1984, HTTPS://EVOLS.LIBRARY.MANOA.HAWAII.EDU/ITEMS/588D9876-1C87-4EEB-BF7A-F718D9490E70.

[88] JHK and Associates, *Evaluation of the Moanalua Freeway Carpool/Bus Bypass Lane*, Report no. FHWA-RD-77-99 (August 1977) 8, 14, 17, retrieved from https://catalog.hathitrust.org/Record/010631829.

"Forgotten Freeway": Interstate Route H-2 (1970-1977)

While initially excluded from the Interstate Highway System due to a limitation that restricted the network exclusively to the continental United States, Section 17 of the Hawaii Omnibus Act of 1960 (PL 86-624) allowed for three interstate routes to be planned for the island of Oahu.[89] A study undertaken by the Bureau of Public Roads and in cooperation with the State of Hawaii and the Department of Defense, recommended a 50-mile road network and three Interstate Highway Routes.[90] This series of freeways would connect Honolulu with Barber's Point, Schofield Barracks, and Kaneohe Marine Corps Air Station.[91] Interstate H-1, the longest highway at 27 miles, connected Barber's Point Access Road with Ainakoa Avenue via urban Honolulu. Interstate H-2, at eight miles in length, would connect Waiawa to Wahiawa [and the Shoefield Barracks], and Intestate H-3 would be a 15-mile route connecting Halawa to the Kaneohe Marine Corps Air Station.[92] The Highways Branch later recalculated these figures to a 51.9-mile network with H-1 at 27.5 miles, H-2 at 8.5, and H-3 at 15.9 miles for a total cost of an estimated $650 million and an anticipated completion date by 1976.[93]

In 1969, right-of-way acquisitions began for H-2 and construction of a 2.7-mile segment between Waiawa Interchange and Waiahole Ditch began by November 1970.[94] Construction of H-2 continued between Waikakalaua and Kipapa Gulches beginning in 1973.[95] The two-mile section between the Waiawa Interchange with H-1 and Mililani Memorial Park opened on October 3, 1974, commemorated with a ribbon-cutting ceremony by State Transportation Director E. Alvey Wright.[96] The 1974 *Annual Report* to the Governor boasted that H-2 was 94% complete or under construction since construction of the Interstate Highway System on Oahu began a decade prior in 1964.[97] H-2 opened in its entirety in

[89] U.S. Department of Transportation, Federal Highway Administration, *America's Highways, 1776-1976: A History of the Federal-Aid Program* (Washington, D.C.: U.S. Government Printing Office, 1977), 477.
[90] U.S. Department of Commerce, Bureau of Public Roads, *Report on Extension of National System of Interstate and Defense Highways with Alaska and Hawaii required by Section 105 of the Federal-aid Highway Act of 1959,* January 1960*,* 29; *Report on the Status of the Federal-Aid Highway Program, Hearing Before the Subcommittee on Roads of the Committee on Public Works*, 91st Cong., 2d. sess., April 15, 1970 (Washington, D.C.: U.S. Government Printing Office, 1970), 82, retrieved from https://catalog.hathitrust.org/Record/008515050.
[91] State of Hawaii, Department of Transportation, Division of Highways, *Hawaii State Highways Annual Report, 1960* (n.p., n.d), cover letter n.p., retrieved from https://catalog.hathitrust.org/Record/002134890.
[92] State of Hawaii, Department of Transportation, *Year Ending June 30 [1967]* (Honolulu: n.d.), 32, retrieved from. https://babel.hathitrust.org/cgi/pt?id=mdp.39015023939500&view=1up&seq=250.
[93] State of Hawaii, Department of Transportation, *Year Ending June 30, 1971* (n.p., n.d.), 45, retrieved from https://catalog.hathitrust.org/Record/000548436.
[94] State of Hawaii, Department of Transportation, *Year Ending June 30, 1969* (n.p., n.d.), 42, retrieved from https://catalog.hathitrust.org/Record/000548436; State of Hawaii DOT, *Year Ending June 30, 1971*, 45, retrieved from https://catalog.hathitrust.org/Record/000548436.
[95] State of Hawaii, Department of Transportation, *Year Ending June 30, 1973* (n.p., n.d), 50, retrieved from https://catalog.hathitrust.org/Record/000548436.
[96] "Ribbon Cutting on H-2," *Honolulu Advertiser*, October 4, 1974.
[97] State of Hawaii, Department of Transportation, *Annual Report: Fiscal Year 1974* (n.p., n.d.), 1, retrieved from https://catalog.hathitrust.org/Record/000548436.

1977, making it the "first Interstate in Hawaii to fully become operational over its entire length."[98] The final cost of H-2 was reported at $43.9 million.[99]

While H-3 encountered much controversy in its planning, to be discussed in the next section, the *Honolulu Star-Bulletin & Advertiser* described H-2 as a "forgotten freeway" whose construction proceeded without comment or controversy. When taking a helicopter tour of H-2, Admiral E. Alvey Wright, State Transportation Director, confessed "I wish all our roads could be built like this," contrasting the ease of H-2's construction with the difficulties facing H-3.[100] H-2's unassuming nature and short length did not mean that it lacked notable features or innovations, however. For instance, the Design Branch tested methods of pavement skid resistance on H-2 by texturing concrete pavement with metal tines, which they reported was satisfactory in their annual report.[101] Another notable feature of H-2 included the 1,900-foot-long Kipapa Stream Bridge spanning Kipapa Stream. The annual report that proudly announced this highway's completion also highlighted how the Kipapa Stream Bridge was the first cantilevered, cast-in-place, segmental bridge in Hawaii. The HDOT annual report further described the bridge as one of "grace and beauty" with "clean lines" and announced its intention to enter the structure into the Prestressed Concrete Institute award program for 1977. The Prestressed Concrete Institute granted the award to the bride in November 1977, with bridge design engineer Clarence Yamamoto accepting the award. The Kipapa Gulch Bridge cost $13.5 million and the entire H-2 project cost $50 million.[102]

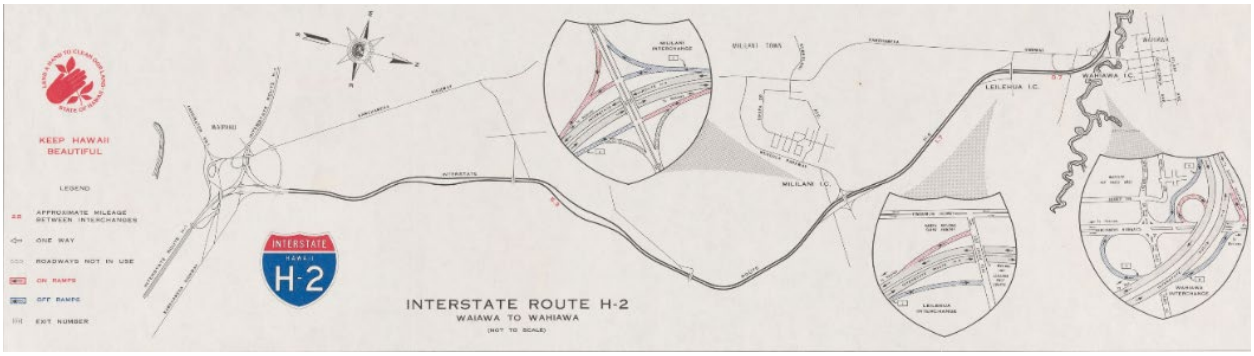


FIGURE 23 - INTERSTATE ROUTE H-2. SOURCE: STATE OF HAWAII, DEPARTMENT OF TRANSPORTATION, HIGHWAYS DIVISION, PLANNING BRANCH, *INTERSTATE ROUTE H-2, WAIAWA TO WAHIAWA*, OCTOBER 1984, HTTPS://EVOLS.LIBRARY.MANOA.HAWAII.EDU/ITEMS/588D9876-1C87-4EEB-BF7A-F718D9490E70.

[98] State of Hawaii, Department of Transportation, *[Annual Report] 1977 Fiscal Year* (n.p., n.d.), 44, retrieved from https://catalog.hathitrust.org/Record/010623627.
[99] "National Interstate Day." The precise cost was $43,960,341.
[100] David Smollar, "Through Heart of Oahu: 'Forgotten' Freeway Proceeds Smoothly," *Honolulu Star-Bulletin & Advertiser*, June 16, 1974, A-3.
[101] State of Hawaii, Department of Transportation, *Annual Report: Fiscal Year 1974* (n.p., n.d.), 53 retrieved from https://catalog.hathitrust.org/Record/000548436.
[102] Smollar, "'Forgotten' Freeway," A-3; State of Hawaii DOT, *1977 Fiscal Year*, 45; Bank of Hawaii, *Monthly Review: Business Developments in Hawaii and the Pacific Islands* (December 1977): 7, retrieved from https://catalog.hathitrust.org/Record/009388463; "Gets Award," *Honolulu Star-Bulletin*, November 14, 1977, D-4, https://www.newspapers.com/image/274444404/.

HIGHWAYS ON PAPER: INTERSTATE ROUTE H-3 AND INTERSTATE ROUTE H-4 (1968-1987)

Following the addition of Hawaii to the Interstate Highway Network, the designation H-1, H-2, and H-3 freeways were considered "committed" to the extent that other transportation plans and roadway developments assumed the completion of this network in relation to their own. Construction of H-1 and H-2 continued through the 1960s and 1970s while planning for two additional highways commenced, designated H-3 and H-4. Both highways would only exist on paper with H-3 being the source of controversy and repeated studies from the 1960s to the 1980s – Senator Inouye quipped at a 1985 Senate hearing that H-3 documentation amounted to 4-feet-high[103] – and H-4 only being briefly considered in 1968 in one study. These paper highways reflected changing attitudes towards roadbuilding, development, and motorization in Oahu's rural and urban areas as well as a resurgence in indigenous Hawaiian culture that reasserted pre-Contact society independent of haole interests.

The third highway, designated Interstate Route H-3, would become the most controversial segment of Oahu's interstate network due to its routing, litigation, and public outcry. Planned in the 1960s as a third trans-Koolau crossing after the Pali and Likelike Highways, HDOT envisioned a six-lane at-grade highway routed through the Moanalua Valley, Haiku Valley, Pali Golf Course, and Kaneohe Marine Corps Air Station, at an estimated cost of $250 million.[104] Pushed-back completion dates and increased costs for H-3 would be a main feature of the highway even before injunctions. The Bank of Hawaii published a map in 1965 anticipating H-3 – and all of Oahu's interstates – to be completed by 1971.[105] However, by 1967, HDOT anticipated all highway construction to be completed by 1974 for an estimated cost of

[103] Committee on Environment and Public Works, Subcommittee on Transportation, *Hawaii Interstate H-3 Project: Hearing Before the Subcommittee on Transportation of the Committee on Environment and Public Works, United States Senate, Ninety-Ninth Congress, First Session, November6, 1985* (Washington, D.C.: U.S. Government Printing Office, 1986) 63, retrieved from https://catalog.hathitrust.org/Record/010019618; U.S. Department of Transportation, Federal Highway Administration, State of Hawaii Department of Transportation, Highways Division, *Interstate Route H-3, Halawa Interchange to Halekou County of Honolulu Hawaii, Final Third Supplement Environmental Impact Statement*, October 1987, retrieved from https://catalog.hathitrust.org/Record/100932735. Between 1972 and 1982 the following documents were prepared for H-3, its impact, and its alternatives: 1) Final Environmental Statement: Administrative Action for Interstate Route H-3, Halawa Interchange to Halekou Interchange, six volumes (August 8, 1972) 2) Preface to Final Environmental Statement, Administrative Action for Interstate Route H-3, Halawa Interchange to Halekou Interchange, three volumes – Preface plus Appendices A and B (March 21, 1974) 3) Final Supplement to the Interstate Route H-3 Environmental Impact Statement, seven volumes (December 10, 1980) 4) Final Second Supplement to the Interstate Route H-3, Environmental Impact 4(f) Statement (1982)(September 28, 1982).

[104] *Hawaii's Interstate H-3 Freeway* (n.p., n.d), 3.

[105] Bank of Hawaii, "Transportation and Housing Needs of Oahu's Expanding Population: Urban versus Suburban Business Growth," *Review of Business and Economic Conditions* 10, no. 12 (December 1965): 16, retrieved from https://catalog.hathitrust.org/Record/009388905.

$523,728,000 for all three interstates.[106] By 1971, the targeted completion date for all three interstates was 1976 and at a cost of $650 million.[107] Ultimately, H-3 was completed in 1997 at a cost of $1.3 billion.

The first significant delay occurred in 1972, when a suit against H-3 resulted in the Federal District Court imposing an injunction against the design and construction of H-3's Moanalua Valley routing, though it did permit work to continue on windward Oahu between Kaneohe Marine Corps Air Station, Pali Golf Course, and the Halawa Interchange. In 1973, the Moanalua Gardens Foundation submitted an application for the valley to be declared a national landmark while HDOT continued to plan H-3 between 1973 and 1975. Ultimately in 1976, the 9th Circuit Court reinstated the injunction ruling that 4(f) requirements stipulated "feasible and prudent" alternatives to be considered for projects that encroached on historic sites or recreation facilities.[108] The Moanalua Valley alignment, was ultimately abandoned in 1977 for a North Halawa Valley alignment that was approved in 1980. The next controversial segment arose with the Haiku Valley alignment, planned in conjunction with the future Hoomaluhia Botanical Garden in 1978. Another supplemental EIS had to be prepared for this stretch of H-3 in 1982 and construction began on the Halekou Interchange in 1983. The following year, in 1984, the U.S. Ninth Circuit Court of Appeals reinstated the injunction against H-3. Senator Daniel Inouye then sought an exception for H-3 from 4(f) requirements in 1985 at Subcommittee on Transportation hearing in the Senate. The Senate voted in favor of 4(f) exemption for H-3 in 1986 which President Reagan signed into law in 1986. A Court order lifted all injunctions in 1987, and construction recommenced. When completed in December 1997, H-3 was a four-lane highway with significant stretches of elevated roadway, 26 bridges, and mile-long tunnels; it was the most expensive road built in Oahu at $1.3 billion.[109]

Two pieces of Federal legislation underpinned H-3's rerouting, litigation, and pace of construction – Section 4(f) of the US Department of Transportation Act of 1966 and the National Environmental Protection Act (NEPA) of 1969. NEPA required an Environmental Impact Statement (EIS) to determine the effects a given project would have on the environment as well as archaeological and historic resources. 4(f) legislation forced the FHWA to determine whether feasible and prudent alternatives existed for the project at hand. H-3 would be the first project in Hawaii where an EIS would be required, though it had reached advanced stages of planning before the passage of NEPA.

HDOT's Annual Report noted that H-3's alignment had been the source of controversy as early as 1964, when it tentatively set a public hearing for the fall of that year, though it did not specify what made H-3's alignment controversial.[110] In the Draft EIS for H-3, the document provided a brief history of the

[106] State of Hawaii, Department of Transportation, *Year Ending June 30, 1968* (n.p., n.d.) 35-36, retrieved from https://catalog.hathitrust.org/Record/000548436.
[107] State of Hawaii, Department of Transportation, *Year Ending June 30, 1971* (n.p., n.d.) 45-46, retrieved from https://catalog.hathitrust.org/Record/000548436.
[108] *Hawaii's Interstate H-3 Freeway* (n.p., n.d), 4.
[109] Kevin Allen, "How the Interstate H-3 Came to Be," *Hawaii Magazine*, September 20, 2021, https://www.hawaiimagazine.com/how-the-interstate-h-3-came-to-be/; *Hawaii's Interstate H-3 Freeway* (n.p., n.d), 5-6.
[110] State of Hawaii, Department of Transportation, *Year Ending June 30, 1964* (n.p., n.d.) 49, retrieved from https://catalog.hathitrust.org/Record/000548436.

project between 1965 and 1971, when planning first began for the highway. When the first public hearing for H-3 met on January 11, 1965, HDOT proposed five H-3 corridors (text lightly edited):

1) North Halawa Corridor – from an interchange with Interstate Route H-1 in the vicinity of Makalapa Crater, it traversed northeasterly through North Halawa Valley and tunneled through the Koolau range, emerging in Haiku Valley. It next proceeded southeasterly and then easterly to an interchange at Halekou on the Kamehameha Highway.
2) Moanalua Corridor – originated in the vicinity of Honolulu Airport, traversed the Salt Lake complex to Moanalua Highway and then proceeded up Moanalua Valley through the golf course subdivision to a tunnel at the head of the right branch of the valley. Emerging from the Windward Pali, it included an interchange with the Likelike Highway on the windward side, and then proceeded to the interchange at Halekou.
3) Kalihi Corridor – superimposed Route H-3 upon the existing Likelike Highway. In effect, it would have widened the four-lane Likelike Highway to six lanes, terminating at the Halekou Interchange.
4) Nuuanu Corridor – started in the vicinity of the Kapalama Drainage Canal and the Lunalilo Freeway, proceeded northeast, roughly paralleling the existing Pali Highay, and then penetrated the Koolau range through a long horseshoe tunnel. It then arced in a reverse curve to the interchange at Halekou.
5) Manoa Valley Corridor – started near the University of Hawaii, proceeding along the ewa slopes of St. Louis Heights, emerging through the Koolaus at Maunawili Valley and proceeding to the Halekou Interchange.[111]

[111] State of Hawaii, Department of Transportation, State Highways Division, *Environmental Impact Statement for Interstate Route H-3: Halawa Interchange to Halekou Interchange, Oahu, Hawaii* (Draft, June 1971), 1-2, retrieved from https://catalog.hathitrust.org/Record/100932735. Block-quote text lightly edited.

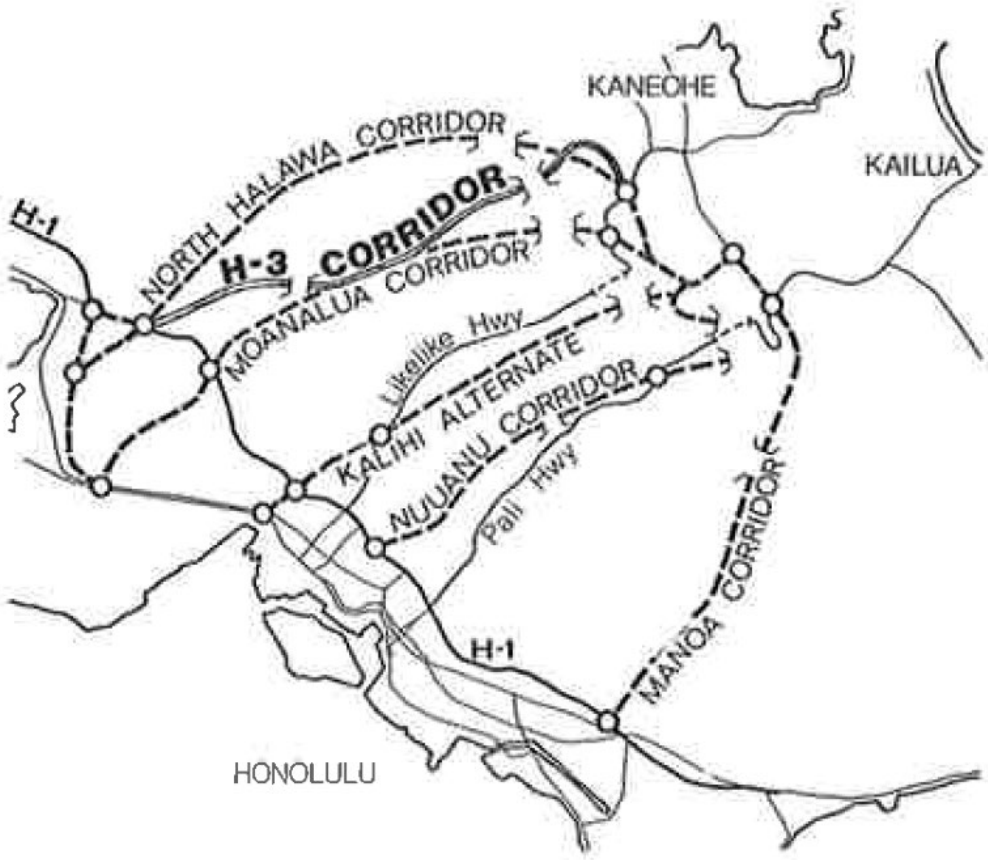


FIGURE 24 - PROPOSED INTERSTATE H-3 CORRIDORS. SOURCE: RICHARD D. BAUMAN AND DOAK C. COX, "THE MOANALUA CORRIDOR: ENVIRONMENTAL PROBLEMS ALONG THE PROPOSED ROUTE OF HAWAII INTERSTATE H-3," *HIGHWAY RESEARCH BOARD SPECIAL REPORT* 138 (1973): 73.

The draft EIS explained that the State of Hawaii preferred the Kalihi Corridor, but the public meeting shifted the routing to the Moanalua Corridor. Housing development in the southern portion of the Moanalua Corridor changed the H-3 routing to what the draft EIS referred to as the Halawa Corridor. This alignment would interchange with H-1 at Halawa near Aiea, enter the South Halawa Valley and parallel the Moanalua Valley until the Red Hill Naval Reservation, tunnel through the Red Hill, then enter the Moanalua Valley, and follow the original Moanalua corridor alignment. Plans for routing H-3 through the Haiku Valley and minimizing possible interference with the U.S. Navy radio installation were worked out through 1967 and by August 1970 the Federal Highway Administration approved the design.[112] The FHWA approved a 9.4-mile long, 6-lane divided highway, primarily at grade with a 0.4-mile-long Red-Hill Tunnel, 0.9-mile-long Trans-Koolau Tunnel, and a one-mile-long viaduct on the Pali cliff side of the alignment.[113]

[112] State of Hawaii, Department of Transportation, State Highways Division, *Environmental Impact Statement for Interstate Route H-3: Halawa Interchange to Halekou Interchange, Oahu, Hawaii* (Draft, June 1971), 4-5.
[113] Bauman and Cox, "The Moanalua Corridor," 73.

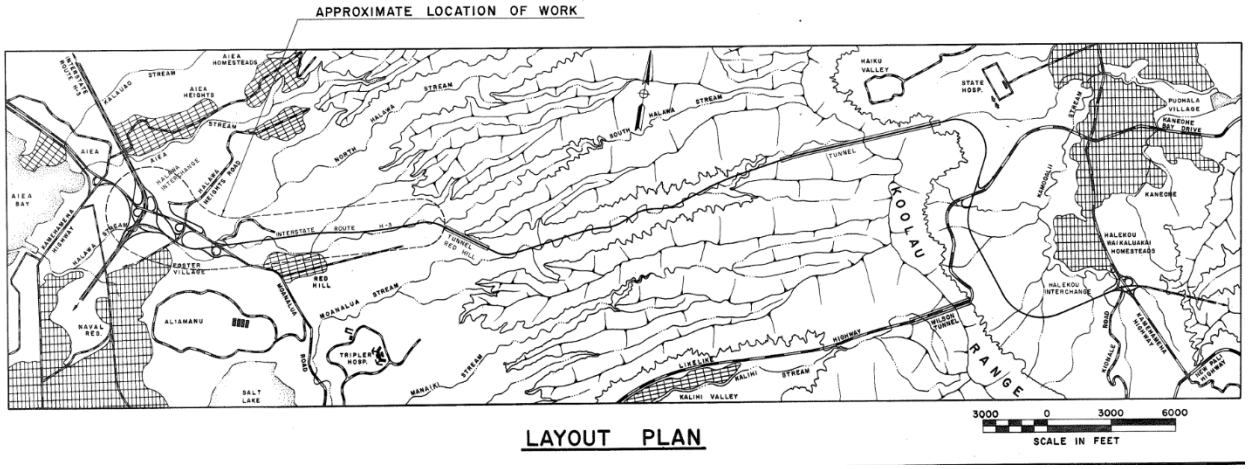


FIGURE 25 - INTERSTATE ROUTE H-3 ORIGINAL ALIGNMENT THROUGH RED HILLS AND MOANALUA VALLEY (1967). STATE OF HAWAII, DEPARTMENT OF TRANSPORTATION, HIGHWAYS DIVISION, HONOLULU, HAWAII, *SUB-STRATA INVESTIGATION PLANS FOR A PORTION OF INTERSTATE ROUTE H-1, HALAWA INTERCHANGE, FEDERAL AID INTERSTATE PROJECT NO. I-H1(38) AND INTERSTATE ROUTE H-3, HALAWA INTERCHANGE TO THE RED HILL TUNNELS, FEDERAL AID INTERSTATE PROJECT NO. I-H3-1(3), DISTRICTS OF HONOLULU & EWA, ISLAND OF OAHU*, PREPARED BY PARSONS BRINCKERHOFF-HIROTA ASSOCIATES, NOVEMBER 16, 1967, SHEET 1, RETRIEVED FROM HTTP://162.221.244.142:8080/AS-BUILT/RES/OAHU/ROUTE%20H-1/00H1-041A/TITLE%20SHEET.PDF.

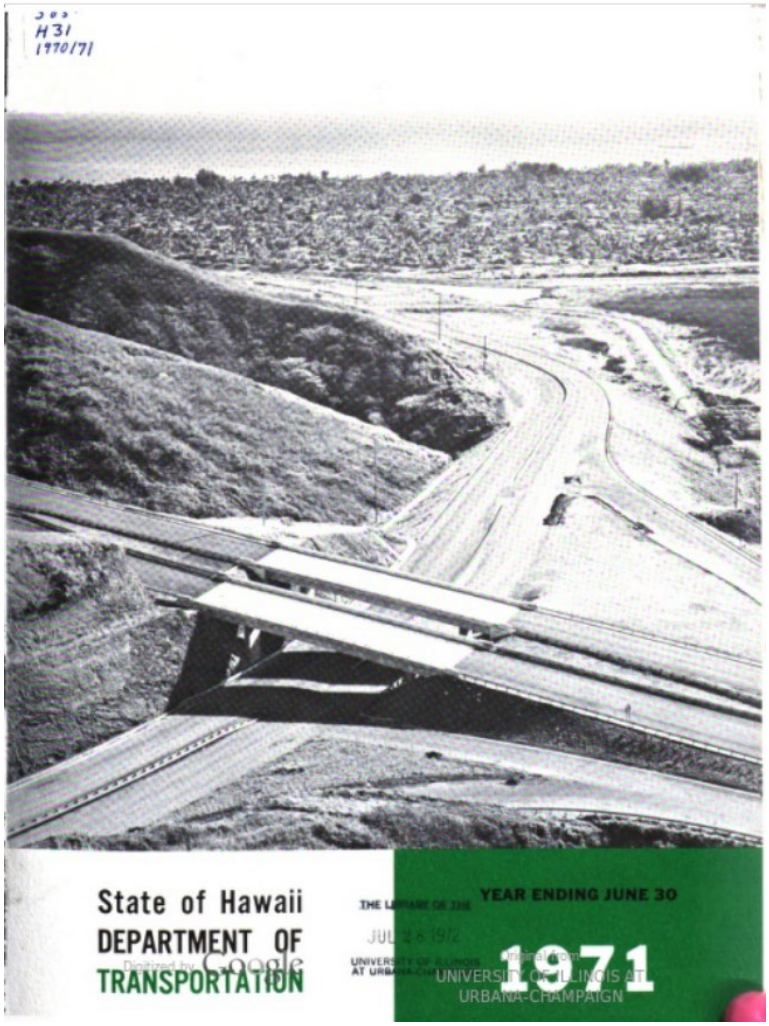
Construction first began on windward Oahu. By 1969, right-of-way acquisitions began for H-3 and construction began in 1970 at the Kailua Interchange at Mokapu Saddle Road as a four-lane highway.[114] Contracts for H-3 had been awarded to construction on windward Oahu, though the lowest trans-Koolau tunnel pilot project bidder miscalculated the construction cost on this portion of the highway and had to withdraw. At the end of 1971, HDOT readvertised the pilot tunnel as it awaited the results of the first environmental impact study to be published for H-3.[115] The Design Branch also began to use consulting firms for project management and administration.[116] H-3 contracts awarded in 1970 were for sections between Kailua Interchange to Kaneohe Marine Corps Air Station, and between Halekou and Kailua

[114] State of Hawaii, Department of Transportation, *Year Ending June 30, 1969* (n.p., n.d.) 42, retrieved from https://catalog.hathitrust.org/Record/000548436; State of Hawaii, Department of Transportation, *Year Ending June 30, 1970* (n.p., n.d.) 39-40, retrieved from https://catalog.hathitrust.org/Record/000548436. Listed in *Annual Report* as "Kailua Interchange – Mokapu Saddle Road (Kailua Interchange) to Mokapu Road. Extension and Interstate Route H-3, Kailua Interchange. 0.782 mile and 0.256 mile. S-0630(7), S-0630(10), I-H3-1(7):13 and I-H3-1(2):8. Dillingham Corporation. Contract Awarded August 18, 1969."

[115] State of Hawaii, Department of Transportation, *Year Ending June 30, 1971* (n.p., n.d.) 45-46, retrieved from https://catalog.hathitrust.org/Record/000548436.

[116] State of Hawaii, Department of Transportation, *Year Ending June 30, 1971* (n.p., n.d.) 51, retrieved from https://catalog.hathitrust.org/Record/000548436.

Interchanges.[117] Another contract was drawn up for the Kailua Interchange and Mokapu Saddle Road.[118]



Construction of H-3 merited its inclusion on the cover of HDOT's annual report for 1971.[119]

However, in 1972, the court injunction and EIS's preparation and approval delayed the readvertisement for the H-3 trans-Koolau pilot project tunnel, though construction on the complex Halawa Interchange (future junction of H-1, H-3, and H-201) began in leeward Oahu while construction continued on H-3 on windward Oahu between Kaneohe Marine Corps Air Station and Halekou Interchange, which, in the words of the annual report, "remained unaffected by the controversy involving the tunnels and their leeward approach."[120] This section of H-3 at the base included culverts and flashboards underneath the highway

FIGURE 26 - COVER OF 1971 HDOT ANNUAL REPORT SHOWING FIRST COMPLETE SECTION OF H-3. SOURCE: STATE OF HAWAII, DEPARTMENT OF TRANSPORTATION, *YEAR ENDING JUNE 30, 1971* (N.P., N.D.), COVER PAGE.

[117] State of Hawaii, Department of Transportation, *Year Ending June 30, 1971* (n.p., n.d.) 54, retrieved from https://catalog.hathitrust.org/Record/000548436. Contract numbers I-H3-1(8):14 and I-H3-1(2):8. J.A. Thompson & Son, Inc. Contract Awarded July 9, 1970. Halekou Interchange to Kailua Interchange. Contract numbers I-H3-1(23):11 and I-H3-1(2):11.

[118] State of Hawaii, Department of Transportation, Year Ending June 30, 1971 (n.p., n.d.) 63, retrieved from https://catalog.hathitrust.org/Record/000548436. Kailua Interchange and Mokapu Saddle Road numbers I-H3-1(7):13 and I-H3-1(2):8, S-630(7), S-630(11).

[119] State of Hawaii, Department of Transportation, *Year Ending June 30, 1971* (n.p., n.d.) 85, retrieved from https://catalog.hathitrust.org/Record/010623627. Cover image described on page 85 as "The first unit of the long-awaited Mokapu Saddle Road on windward Oahu received final inspection on June 25, 1971. This view looks toward Kailua and shows the H-3 interchange in the foreground. The two-tenths-mile portion of the freeway built under the contract for Mokapu Saddle Road represented the start of construction on the Interstate tunnel route which is to link Halawa with Kaneohe Marine Corps Air Station. The entire highway will be extensively landscaped."

[120] State of Hawaii, Department of Transportation, *Year Ending June 30, 1972* (n.p., n.d.) 47-48, retrieved from https://catalog.hathitrust.org/Record/000548436.

to link ponds with Kaneohe Bay and regulate water levels for nesting birds.[121] Ultimately H-3's windward Oahu routing would be changed several times as a result of a flood control project as well as the changing boundaries of Hoomaluhia Park.[122] While the section between the Marine Base and Mokapu Saddle Road opened in 1972, sections of H-3 also saw extensive landscaping with the planting of thousands of trees.[123] The 3.5-mile section between Halekou and Kaneohe Marine Corps Air Station was completed at the end of 1974, though connections with the Kamehameha Highway still had to be made before this section of H-3 became operational.[124] The section between Kaneohe Marine Corps Air Station and Kailua Interchange was not under court injunction and was almost ready to be opened by June 1977.[125] The section between Kaneohe Marine Corps Air Station and Kailua Interchange was scheduled to open for August 1977.[126]

FIGURE 27 - INTERSTATE ROUTE H-3 ON WINDWARD OAHU (1987). SOURCE: JAMES ALLEN BIER, *O'AHU REFERENCE MAPS 2 WINDWARD COAST, NORTH SHORE, LEEWARD COAST, REVISED EDITION*, 1987, HTTPS://EVOLS.LIBRARY.MANOA.HAWAII.EDU/ITEMS/821586A3-30C0-4B5E-9B45-81C3FF0FCA90.

[121] State of Hawaii, Department of Transportation, *Year Ending June 30, 1972* (n.p., n.d.) 48, retrieved from https://catalog.hathitrust.org/Record/000548436.
[122] *Hawaii's Interstate H-3 Freeway*, 2.
[123] State of Hawaii, Department of Transportation, *Year Ending June 30, 1973* (n.p., n.d) 47-48, retrieved from https://catalog.hathitrust.org/Record/000548436.
[124] State of Hawaii. Department of Transportation. *Annual Report, Fiscal Year 1974* (n.p., n.d.) 48, retrieved from https://catalog.hathitrust.org/Record/000548436.
[125] Department of Transportation, *1977 Fiscal Year* (n.p., n.d.) ii, retrieved from https://catalog.hathitrust.org/Record/010623627.
[126] Department of Transportation, *1977 Fiscal Year* (n.p., n.d.) 55, retrieved from https://catalog.hathitrust.org/Record/010623627.

While construction continued on windward Oahu, the Moanalua Valley routing of H-3 was called into question by environmentalists, native Hawaiians, and cultural preservationists. The passage of the National Environmental Policy Act (NEPA) in 1970 did not exclude H-3 from having an Environmental Impact Statement (EIS) prepared because other projects at a similar stage in the planning and design process before the passage of NEPA had not been grandfathered in either. The first EIS statement for H-3, a 22-page document, was completed and circulated to state and municipal bodies as well as community organizations in 1971. At this point, opposition to the planned freeway crystallized around its routing, environmental impact, and damage to pre-Contact archaeological sites. In particular, the DOT partially funded a Bishop Museum study of Moanalua Valley that identified 20 archaeological sites within the right-of-way, four of which would be affected. The document's short length and cursory addressing of the highway's various impacts drew criticism of the document as more of a justification for the highway rather than an assessment of its effects. Given the negative response to the 22-page EIS, the DOT began preparing a 5-volume "prefinal draft" EIS in December 1971.[127] By 1972, the Design Branch awaited the five-volume EIS to be published before Federal Approval to continue the H-3 project.[128] Ultimately, a stop work order issued in 1972 halted the pilot tunnel project. The Department of the Interior's Advisory Board recommended further assessment of H-3's routing through the Moanalua Valley, Red Hills, and Halawa Valley in light of the Moanalua Valley's natural, historic, and cultural resources.[129] Through 1974 the Design Branch continued to conduct compliance work in preparing environmental documents and public outreach for H-3.[130] The Halawa Valley routing and the stop work order clearly demonstrates the ways highways, motorization, developmentalism, and environmentalism evolved between the mid-1960s and 1980s.

When framing the need for H-3, proponents argued for its importance connecting military bases, commuter relief to Honolulu, and as a scenic highway. Public comments solicited by HDOT in the 1960s reflected the interlocking of elite business, economic, and tourism interests with roadbuilding, as well as the long history of road projects in Hawaii that, as historian Dawn Deunsing observed, linked scenic roads with tourism, commerce, westernization, and economic growth.[131] When soliciting public response to H-3 in 1965, HDOT observed a largely positive response. Reflecting the business and economic interests of Oahu, the Chamber of Commerce of Honolulu and the Oahu Development Conference saw H-3 as an opportunity to expand, not replace, roadways and open new scenic areas to drivers. The Army and Central Labor Council of Hawaii both supported the Moanalua Valley route. Interestingly, while the Outdoor Circle did not support any particular alignment, they expressed that "…[we stand] for the preservation of natural beauty and [feel] strongly that great care should be given to the design of this highway and to the contours of the land" and viewed H-3 as "[a] great scenic highway through a practically virgin area."[132] Outdoor Circle's history of Honolulu's elite society women

[127] Bauman and Cox, "The Moanalua Corridor," 73-78.
[128] State of Hawaii, Department of Transportation, *Year Ending June 30, 1972* (n.p., n.d.) 53, retrieved from https://catalog.hathitrust.org/Record/000548436.
[129] State of Hawaii, Department of Transportation, *Year Ending June 30, 1973* (n.p., n.d) 50-51, retrieved from https://catalog.hathitrust.org/Record/000548436; *Hawaii's Interstate H-3 Freeway*, 3.
[130] State of Hawaii. Department of Transportation. *Annual Report, Fiscal Year 1974* (n.p., n.d.) 44, retrieved from https://catalog.hathitrust.org/Record/00054 8436.
[131] Deunsing, *Hawai'i's Scenic Roads*, 4.
[132] *Environmental Impact Statement for Interstate Route H-3* (Draft, June 1971), 2-3.

and anti-billboard campaigns from the 1920s and 1930s linked road construction with tourism and automobilism as a means to experience Hawaii's natural beauty in a balance between preservation and access.[133] As its court injunctions and work stoppages delayed construction, Senator Inouye cited worsening and lengthening commute times across the Koolau and raised the specter of expiring Federal Funding deadlines that would leave the State of Hawaii unable to complete the partially-built highway on its own funds.[134]

Opposition and protests to H-3, crystallized into the "Stop H-3" Association, would reflect changing views of the environment – that roadways and automobiles damaged nature. The first site where this dynamic played out for H-3 was in the Moanalua Valley. Originally owned by Princess Bernice Pauahi Bishop, her widower Charles Reed Bishop of the "Big Five" willed the property to his business partner Samuel Mills Damon in 1884.[135] In 1970, two heirs of the Damon Estate formed the Moanalua Gardens Foundation and made available to the public 3,000 acres of land. Initial plans for H-3 saw the park and highway to be developed together, though unpublished records of Gertrude MacKinnon Damon came to light in 1970 detailing the valley's rich archeological and native-Hawaiian cultural sites. These materials prompted the foundation to commission the Bishop Museum to conduct an archaeological study of the valley that demonstrated that the valley "embodie[d] physically the entire course of Hawaii's history…[the] very names of the valley's ridges, pools and mountains bear in sequence the names of the traditional ancestors of the Moanalua mountain chiefs."[136] In particular, the highway would pass within 100 feet of the Pohaku ka Luahine ancient Hawaiian petroglyphs, and would became part of the Moanalua Valley's justification of eligibility to the National Register of Historic Places.[137] In addition to the valley's rich historical value, the proposed at-grade highway would force a channelization of the valley stream, harm wildlife, and damage rare flora and fauna. The Moanalua Valley also featured five distinct forest types and acted as a major habitat for the endangered 'elepaio bird, the last place where the rare Oahu creeper bird and the endangered Hawaiian hoary bat were sighted.[138] These discoveries prompted a change in public opinion, notably the Outdoor Circle who then opposed the project. By the 1970s, the reemergence of Native Hawaiian activism foregrounded alternative forms of sovereignty and land use that opposed roadbuilding and ecological damage and became another critical voice against H-3. These efforts saved the Monalua Valley, though H-3 would be rerouted to the North Halawa Valley

[133] *Environmental Impact Statement for Interstate Route H-3* (Draft, June 1971), 2-3; Deunsing, *Hawai'i's Scenic Roads*, 4, 163-164, 251.
[134] Committee on Environment and Public Works, Subcommittee on Transportation, *Hawaii Interstate H-3 Project: Hearing Before the Subcommittee on Transportation of the Committee on Environment and Public Works, United States Senate, Ninety-Ninth Congress, First Session, November6, 1985* (Washington, D.C.: U.S. Government Printing Office, 1986) 63-64, retrieved from https://catalog.hathitrust.org/Record/010019618.
[135] Lynda Arakawa, "Moanalua Valley's Future Stays Forested," *Honolulu Advertiser*, April 22, 2007, http://the.honoluluadvertiser.com/article/2007/Apr/22/ln/FP704220335.html.
[136] State of Hawaii, Department of Transportation, State Highways Division, *Final Environmental Station Administrative Action for Interstate Route H-3, Halawa Interchange to Halekou Interchange, Oahu, Hawaii*, volume II, [May 21, 1973], 37, retrieved from https://catalog.hathitrust.org/Record/010019618.
[137] Arakawa, "Moanalua Valley's Future Stays Forested"; Advisory Council on Historic Preservation, *A Report to the President and the Congress of the United States, 1973-1974* (Washington, D.C., June 30, 1975), 28, retrieved from https://catalog.hathitrust.org/Record/000523595.
[138] Arakawa, "Moanalua Valley's Future Stays Forested."

after 1977, although this routing also passed through native Hawaiian sites of archaeological and cultural significance.

Mansel G. Blackford's work on Kaho'olawe reveals two strands of environmentalism in Hawaii, the first being representative of the white middle class who viewed a pristine environment as separate from the human-made world and to be consumed in leisure time. In contrast, native Hawaiian activism framed the landscape as spiritual and cultural in which humans stewarded the environment.[139] Opposition to H-3 generally spoke more to the first form.

The timing of the H-3 injunction also coincided with the Federal-Aid Highway Act of 1973 that permitted substitution of interstate highway construction with mass transit options, and HDOT reexamined and prepared new studies for H-3 and TH-3 if the highway were to be built to accommodate transit as well.[140] Through the 1970s, HDOT reexamined the five trans-Koolau alignments (North Halawa, Moanalua, Kalihi, Nuuanu, and Manoa), three variant alignments (Moanalua Puuloa, Moanalua Makalapa, Kalihi Alternate), as well TH-3 alternative with two mass transit lanes and four mixed-traffic lanes, a four-lane mixed traffic H-3 alternative, and a no-build alternative. Ultimately in 1977, HDOT proposed a four-lane mixed traffic H-3 routed through the North Halawa Valley and FHWA approved this alignment in December 1980. In April 1982, the United States District Court required a supplemental EIS for the Hoomaluhia Park alignment which the FHWA approved in September 1982, though in 1984 the Ninth Circuit Court determined that 4(f) requirements had not been satisfied. Senator Inouye held a Senate Hearing in 1985 that sought to exempt H-3 from 4(f) requirements, which Congress passed in 1986 and President Reagan signed into law. All court ordered injunctions were lifted by 1987 and H-3 construction recommenced.[141]

[139] Mansel G. Blackford, *Pathways to the Present: U.S. Development and its Consequences in the Pacific* (Honolulu, University of Hawai'I Press, 2007), 60-61, https://doi.org/10.2307/j.ctt6wr309.
[140] Advisory Council on Historic Preservation, *A Report to the President and the Congress of the United States, 1973-1974*, 30.
[141] U.S. Department of Transportation, Federal Highway Administration and State of Hawaii, Department of Transportation, *Report Number: FHWA – HI-EIS-87-01-F(S), Interstate Route H-3 Halawa to Halekou Interchange, Final Third Supplement to the Interstate Route H-3 Environmental Impact Statement*, 1987, I-1-2, https://babel.hathitrust.org/cgi/pt?id=ien.35556030122501&view=1up&seq=13; Allen, "How the Interstate H-3 Came to Be."

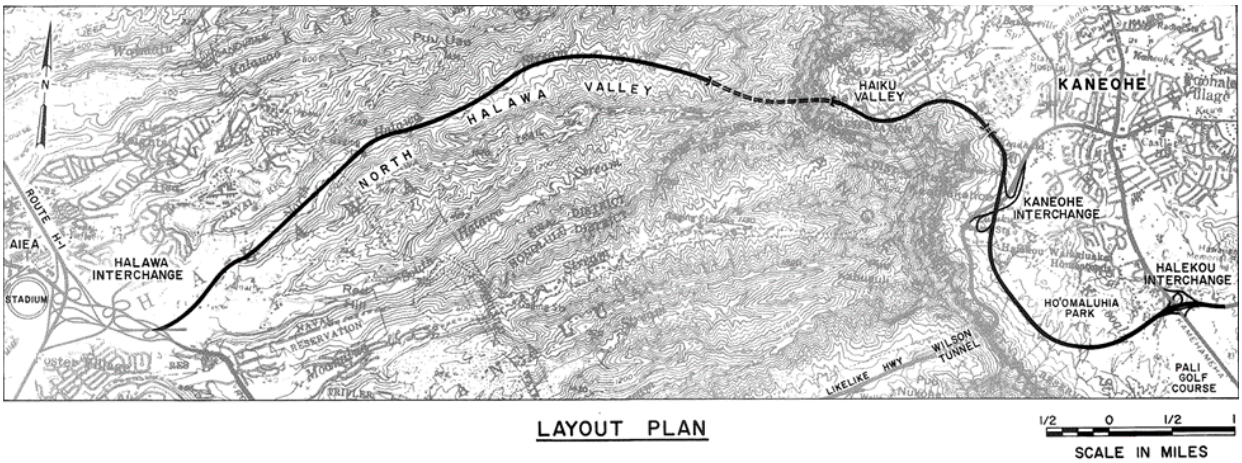


FIGURE 28 - INTERSTATE ROUTE H-3 NORTH HALAWA VALLEY ALIGNMENT (1983). SOURCE: STATE OF HAWAII, DEPARTMENT OF TRANSPORTATION, HIGHWAYS DIVISION, HONOLULU, HAWAII, PLANS FOR SUBSTRATA INVESTIGATION, INTERSTATE ROUTE H-3, HALAWA INTERCHANGE TO HALEKOU INTERCHANGE, HALAWA VIADUCT SECTION, FEDERAL AID INTERSTATE PROJECT NO. I-H3-1(31), UNIT 2, DISTRICT OF EWA, ISLAND OF OAHU, APRIL 1983, RETRIEVED FROM HTTP://162.221.244.142:8080/AS-BUILT/RES/OAHU/ROUTE%20H-3/00H3-029/TITLE%20SHEET.PDF.

In contrast with the delays, sustained protests, and injunctions facing H-3, a short-lived interstate proposal surfaced for Honolulu's waterfront. With the three interstates considered to be committed projects after 1960, an additional interstate was planned for Honolulu's makai corridor and briefly designated H-4. If H-3 indicated changing values of highway building in rural areas, H-4 became embroiled in nascent protests against urban freeways. In the early 1960s, highway planners sought to construct H-1 independently of the Lunalilo Freeway. To this end they proposed a double-deck, elevated highway of seven possible routings through urban Honolulu, with a preferred waterfront routing. The Oahu Development Conference, Downtown Improvement Association, and the Outdoor Circle opposed this routing on the grounds that a highway would damage Honolulu's scenic waterfront for tourists and harm land value in some of the most valuable sections in the city. The *Honolulu Star-Bulletin* further editorialized that opponents feared a waterfront highway would replicate the same mistake as San Francisco's Embarcadero Freeway.[142] Ultimately, H-1 adapted the Lunalilo Freeway alignment through Honolulu in 1965.[143] In 1967, the State of Hawaii's Department of Planning and Economic Development identified an "urgent need for freeway service in the makai corridor between Middle Street and Kapahulu Avenue" and proposed a grade-level facility traversing Rainbow (Sand) Island and in two tunnels under Honolulu Harbor's entrances. The Department assessed that such a facility would not obstruct waterfront views from Honolulu's Civic Center or Central Business District, offer a fast route between the airport and Waikiki for tourists, and an additional detour route.[144] A cross-Sand Island road

[142] Tom Knaefler, "Highway Controversy Boils Along Toward Decision," *Honolulu Star-Bulletin*, March 23, 1963, page 2, accessed February 20, 2024, https://www.newspapers.com/image/270511974.
[143] "U.S. Names Lunalilo H-1, State To Recoup $23 Million," *The Honolulu Advertiser*, February 12, 1965, page A-1, accessed February 20, 2024, https://www.newspapers.com/image/259065078/.
[144] State of Hawaii, Department of Planning and Economic Development, *State of Hawaii General Plan Revision Program*, Part 5, *Land Use, Transportation and Public Facilities* (Honolulu: n.p., 1967), 131, retrieved from https://catalog.hathitrust.org/Record/007115409.

never made it past this proposal stage, likely due to the expense and difficulty of constructing two underwater tunnels underneath the busy Honolulu Harbor.

Makai corridor proposals continued when HDOT proposed a fourth highway for Oahu, designated Interstate H-4, in 1968. This 6.5-mile-long, potentially elevated freeway, would have run along Honolulu's waterfront and connected with H-1 at the Keehi Interchange to the west and the Kapiolani Interchange to the east, offering a complement to the Lunalilo Freeway/Mauka Arterial segment of H-1 and a reconstruction of the Makai Arterial. Plans for the Kapiolani Boulevard exit ramp from H-1's eastbound lanes even included a ghost ramp for a connection to the inbound lanes of the Makai Arterial. Opposition to this project stopped it from advancing past the planning stage.[145] While an FHWA report from 1970 lists a 6.5-mile "Honolulu, south loop" interstate additional request to the highway network, additional research has not shown any more reference to this highway during the period under review for this study.[146] The short planning life of Interstate H-4 signaled a change in Highway planning as public opinion and objections, in addition to available funding, shaped road construction from the 1970s onwards. A makai corridor still continues to be studied in conjunction with creating a Sand Island road route with tunnels underneath the Kalihi and Main Entrance Channels.[147]

[145] Joseph F.C. DiMento and Cliff Ellis, *Changing Lanes: Visions and Histories of Urban Freeways* (Cambridge, Massachusetts: MIT Press, 2013) 265, note 96; State of Hawaii, Department of Transportation, Highways Division, *Proposed Route H-4, Interstate and Defense Highway System Extension Pursuant to the 1968 Highway Act, prepared by the Highway Planning Branch in cooperation with the U.S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads*, October 1968, 2, 17; State of Hawaii, Department of Transportation, *Year Ending June 30, 1969* (n.p., n.d.), 42, "Interstate Highway (Lunalilo Freeway), Kapiolani Interchange, Ramp Connection to Kapiolani Boulevard," http://162.221.244.142:8080/As-Built/res/Oahu/Route%20H-1/00H1-040/00H1-040.htm.
[146] U.S. Department of Transportation, Federal Highway Administration, *Stewardship Report: On Administration of the Federal-Aid Highway Program, 1956-1970*, April 1970, 58.
[147] State of Hawaii, Department of Transportation, Harbors Division, *Honolulu Harbor 2050 Master Plan* (November 2022), 8-3, 8-4, accessed April 26, 2023, https://hidot.hawaii.gov/harbors/files/2023/01/VOL-I_HHMP-2050.pdf.

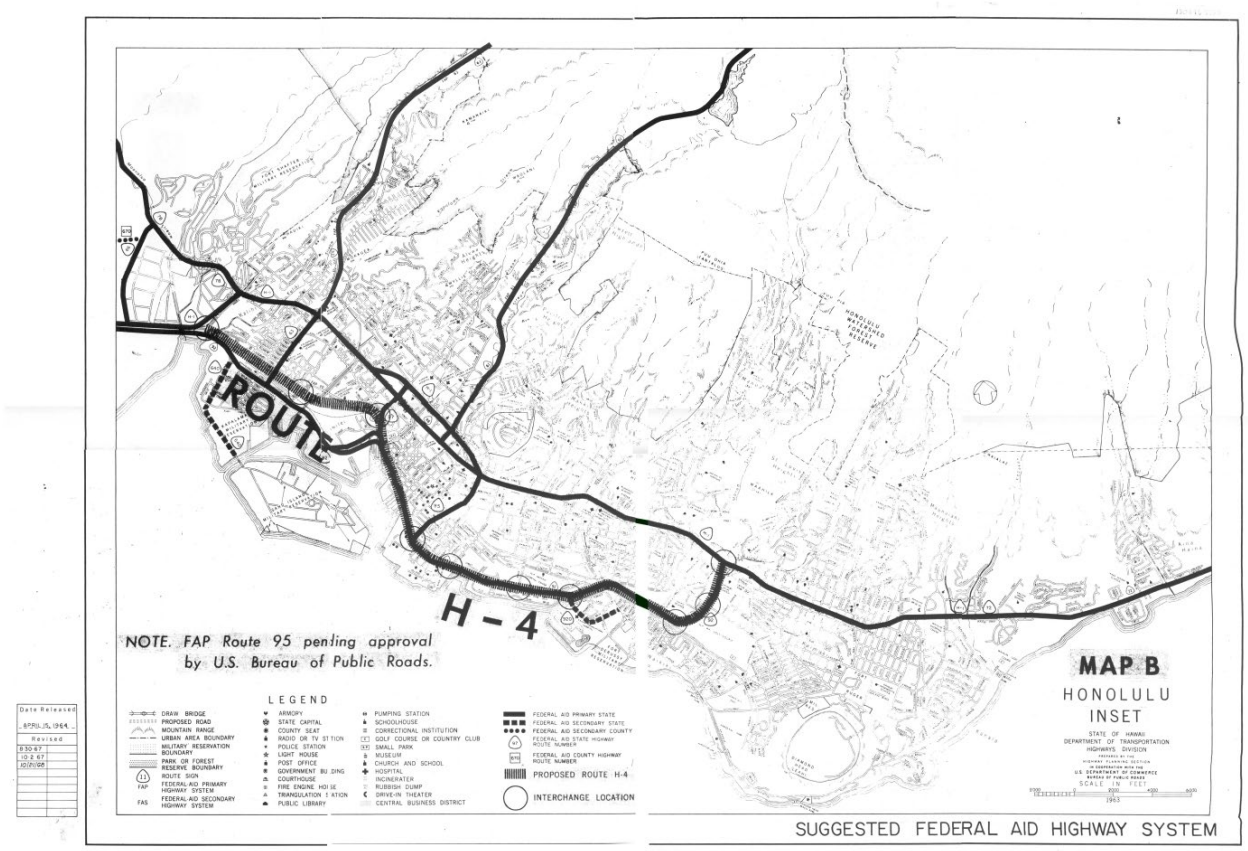


FIGURE 29 - PROPOSED INTERSTATE ROUTE H-4. SOURCE: HIGHWAYS DIVISION, *PROPOSED ROUTE H-4,* MAP B .

HISTORIC PRESERVATION CONSIDERATIONS (1969-1987)

Hawaii's spectacular postwar growth, especially after it gained statehood, was rooted in real estate, tourism, and a developmental ethos that equated progress with growth. The introduction of jet plane service and development of Waikiki as a tourist destination resulted in a dramatic increase of leisure travel to Hawaii. Across the archipelago, the economy began its transition away from plantation crops to tourism, single-family suburban housing, urbanization, and mass motorization, all of which affected Hawaii's roads. While new construction meant new, more standardized bridges, the road network of the Territorial era started to fall into disrepair, showed a need for increased maintenance, or outright replacement.

Spurring the need for new construction, during the late 1960s and early 1970s, a series of disastrous vehicular bridge collapses occurred, causing loss of life throughout the United States. The nation began to focus attention on the decaying state of the civil infrastructure in general, and on the nation's bridges in particular. In 1970 Congress established a special Federal Aid program to provide up to three-fourths of the funds needed to help meet state bridge renewal needs. The initial funds from the Special Bridge Replacement Program became available in late 1972. The Surface Transportation Act of 1978 extended and expanded the Special Bridge Replacement Program to what is now known as the Highway Bridge Replacement and Rehabilitation Program. At the time, $4.2 billion was appropriated from 1979 through to 1982 for bridge replacement and rehabilitation.

Replacing old infrastructure began to run against a nascent localized historic preservation movement with Kauai's North Shore being one of the first sites. In addition, the process of roadbuilding began to change from an elite-level process guided by commercial or military priorities to one in which government and state agencies sought out public feedback and local groups.[148] As recounted in the National Register of Historic Places Nomination Form for the Kauai Belt Road additional documentation, in the mid-1970s, HDOT proposed a two-lane replacement of the Hanalei Bridge at a location 500 feet from the original bridge. Public hearings held in 1974 and 1975 as part of the environmental review process for the National Environmental Policy Act (NEPA) allowed residents of nearby communities an opportunity to share thoughts and concerns with HDOT's proposal. A pressing concern frequently shared was future growth and development on the North Shore spurred by a new and widened Hanalei Bridge that could result in a further influx of tourists and tour buses. These concerns and challenges to HDOT's environmental process resulted in the agency studying wider project impacts for the entire North Shore and proposed replacements for the Kaua'i Belt Road's single-lane bridges. Once again, public outcry against substantial alterations to the Kaua'i Belt Road and its bridges came from the community amid an effort to preserve the rural nature of the road. Concurrently, the Kaua'i Historical Society prepared NRHP nomination forms for all of the North Shore bridges including the Hanalei Bridge. FHWA requested a formal eligibility determination from the Keeper of the National Register, who determined that the Hanalei, Wai'oli, and Waipā Bridges were eligible for listing in the NRHP in 1978. As a result, FHWA and DOT proceeded to only repair the single-lane bridges and instead widen the Kūhiō Highway from Princeville to Kalihiwai.[149]

An important voice in these early preservation advocacy efforts was the North Shore Belt Road Citizens Advisory Committee. Formed in the mid-1970s with 86 Kaua'i residents and originally chaired by founding member Carol Wilcox, the group formed to oppose tour buses on the North Shore and protest plans to demolish the Hanalei Bridge. After learning more about the Kaua'i Belt Road, the group's emphasis shifted to the roadway and efforts to maintain its look and feel.[150] Consequently, the advocacy group renamed itself the Hanalei Roads Committee.[151] According to one scholar, the Hanalei Roads Committee was the first such group in Hawai'i that advocated for preservation of historic roadway corridors and scenic byways.[152] The Hanalei Roads Committee, and communities along the North Shore, viewed the Hanalei Bridge as a "gateway to the North Shore, a cultural resource that helped define their district and distinguish it from other places in Hawai'i." The organization is committed to maintaining the roadway's rural characteristics, its single-lane bridges, historic features, and "perpetuate Hanalei's 'slow pace of life and friendliness.'"[153] Roadbuilding no longer meant transforming space or submitting nature to commerce, but its preservation helped maintain a "sense of place" whether as rural or Hawaiian.[154]

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[148] Duensing, *Hawai'i's Scenic Roads*, 257.
[149] Wilson Okamoto & Associates, Inc., *Final Environmental Assessment, Kūhiō Highway, Remove/Repair/Replace Metal Members, Hanalei District, Kaua'i, Hawai'i*, January 2020.
[150] Anthony Sommer, "North Shore Highway on Kaua'i Gains Protection," *Honolulu Star-Bulletin*, April 23, 2004.
[151] Meeting Minutes, Kaua'i Planning Commission, November 12, 2019.
[152] Duensing, *Hawai'i's Scenic Roads*, 256.
[153] Ibid., 256.
[154] Ibid., 257.

4.0: SUMMARY

The 2013 SHBIE built upon previous efforts to formally document Hawaii's historic bridges. Like that report, this 2024 SHBIE update continues and expands HDOT's efforts to identify and evaluate historic bridges throughout the state. The SHBIE, and its bridge inventory forms and bridge lists, should be viewed as living document continuously updated to benefit current and future project planning. To that extent, future efforts should continue to utilize the updated Bridge Inventory Form developed for this update and seek ways to further standardize the SHBIE by tying updates to individual bridge inspection cycles and information provided in the NBI and AASHTO HDOT Bridge Management (BrM) databases.

In total, the 2024 SHBIE includes:

- Identifying 196 bridges built between 1968 and 1977 and adding them to the 707 bridges inventoried in the 2013 SHBIE, creating an inventory of 902 bridges constructed between 1894 and 1977. These 902 bridges have been sorted into matrices by island and by ownership (state- and county-owned) in the relevant Appendix.
- Updating the historic context through the 1980s. Areas of focus included bridge standardization, construction of interstate highways, and historic preservation considerations.
- Reevaluating bridges identified as HDOT's 100 Priority Bridges. Priority bridges received an updated form. Additional research was conducted to determine whether the 2013 NRHP eligibility status would change. Of the 100 Priority Bridges, 11 bridges that were evaluated as eligible in 2013 have been determined to be not eligible.
- Identifying changes since the 2013 SHBIE including bridge replacements or major alterations. Thirteen bridges have been replaced. Two bridges have undergone substantial alterations, which led to a reevaluation of their NRHP eligibility status.
- Providing clear evaluations using the NRHP Criteria for Evaluation and aspects of integrity. Bridge matrices and updated bridges have removed the use of "high preservation value" from bridge evaluation and updated forms include evaluation of all aspects of integrity.

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