Pōhaku

The Art & Architecture of Stonework in Hawai‘i

Foreword: Bob Krauss • Photography: Douglas Peebles

Cofounding Authors: David Cheever and Scott Cheever • Editors: Dr. Janine Shinoki Clifford, AIA and Frank S. Haimowitz
Mo'okini Heiau

Kohala, Big Island of Hawai‘i
Ancient

'O ka wahi o nā ˈokua, anamakua, me kāpuna kahiko

Located in the district of Kohala, standing like a silent sentinel on the wind-ravaged plain of Pu‘u‘eo, along the rocky coastline of Upolu, and constantly battered by the relentless sea, Mo‘okini Heiau majestically rises from the red-salt hardened earth. It stands, a voiceless testament to the architectural ingenuity of a once thriving people who paid homage to their many gods and chiefs.

Mo‘okini Heiau is said to be born of the religious order of Pe‘ao, the Kahuna Nui from Tahiti, who instituted a new religious order in Hawai‘i sometime around the 12th century. Mo‘okini, constructed by this religious order, would remain for centuries. It would become the conduit by which an Ali‘i Nui, great chief, perhaps Pi‘ilanihōkū, and his many descendants would worship his or her gods and ancestors. At this prominent heiau acts of purification would be performed, and at times a living person would be offered as a maka‘a, or sacred offering.

Ravaged by time and neglect since the arrival of Captain James Cook to our island shores, Mo‘okini Heiau has remained, like so many other native architectural features of this land, the physical, living representation of our cultural essence. It was a structure built by hands that extended for ten miles to pass water-worn stones from the rich, rain-drenched valley of Polohō‘ū to the plains of Pu‘u‘eo. Each stone was firmly placed one on the other until a great rectangular place of worship rose from the parched earth with a 30 degree vertical slope on the east side to a height of approximately 19 feet. Its thickness has been measured at six feet at the summit and 35 feet at its base with the elevation remaining consistent from the east to the western end. Mo‘okini was where religious pageantry honoring our “native sense of place” was performed.

Today, from the narrow entryway, we step into the area where the many ʻaii, or statues, resided and elaborate religious ceremonies occurred, not necessarily involving human sacrifice. No bones were found there during an early archaeological reconnaissance, as John F. G. Stokes reported. Rather, there is a sense of tranquility and continuation. Standing within the walls of Mo‘okini, silence is ominously present in every corner. The wind has no voice, the sea is calm, and the native is acutely aware that nā maka nā pāhaku kapu (the eyes of the sacred stones), placed strategically throughout the heiau, are observing every move, as if waiting for the utterance of native words. Words that will once again ask them to come forth and give life nā kanaka o ka ilua (to the people of the land). The people who climbed these rocky shores to honor the gods while surf pounded at their backs. We have crawled across the sacred ground of Mo‘okini as the maka‘a to honor our aina a pau, nā anamakua a me kāpuna (all the gods, guardians and ancestors). We ask that they give us the strength, knowledge, and vision to guide us through
times of trouble so that we may e ho'oponono (persevere, continuously grow).

Mo'okini Heiau, considered a luakini, a place for human sacrifice, because it is a "walled heiau" rather than a "platform heiau" is more than the Western archaeologist might imagine. As John Stokes was forced to concede, "it would be impossible to establish walled heiau and platform temples as individual and distinct types of heiau." He and others were unable to discern any spatial or temporal differences among Hawaiian architecture of this religious order. Stokes, though by his own admission limited in his understanding, saw Mo'okini as a symbol not of replacement, but a blending of the old and new styles of heiau architecture. Stokes was partly correct in his assumption. This new style was, in actuality, reflective of the new chief and his dedication to the religion.

From a native perspective and experience, Mo'okini is a physical symbol. The embodiment of the landscape in which it resides. Mo'okini was created to illustrate the mana, or spiritual power, that dwells within the land beyond its walls. Mo'okini is the image created in stone of the sea and the pali, or cliffs, that rise out of the sea, reaching to the place of the gods that reside within the clouds. It is the valleys, mountaintops, and multitudes of generations of native people who have made Kohala their home, for literally translated, Mo'okini is the living representation of "forty generations."

Pōhaku
(Thomas Keōlialii ʻIolani Stone, H.I.)
Puʻukoholā Heiau
Kawaihae, Big Island of Hawai'i
1790

On the approach to Chinaman's Hat (Mokolii Island) on Oahu, Hawai'i residents marveled over the thrilling vista as this island grows amazingly larger and suddenly advances toward you.

This is exactly the element of psychological warfare that Kamehameha the Great and his kahului paniolo, chief architect, Kapiolani created in Puʻukoholā Heiau, at Kawaihae Bay on the Kona side of the Big Island.

Prophetically specified, streamlined-rounded stones for the heiau came from Pololū Valley in Kohala. A hard-to-hand chain of over 20,000 men stretched for twenty miles, copying the Menehune, the indigenous pygmy of legend, by laboring through the stealth of the night. The ali'i faithfully invested their power in the mortared and unreinforced alaha hana pōhaku, or balancing stones, in directing this feat. Measuring 100 by 225 feet long and 16 to 20 feet high, Puʻukoholā's stepped and battered cavity walls have inward sloping stonework on three sides that enclose the ceremonial platform.

Puʻukoholā Heiau, Hill of the Whale, was specifically modeled as a three-story lava rock structure for the steeply sloping site 400 feet above sea level. The lifeless environment of speckled volcanic rock and eroded soil—more suitable perhaps for the moon or even Mars—vividly contrasted at the time with the solemn, white-robed kahuna seated on unique curvilinear terrace platforms that follow the natural contours of the land. From here the kahuna sat facing the ocean as they watched the planned events taking shape below.

Rounding Kealake Point in their war canoes, Chief Kūkū Kaunui'ula and his warriors fell instantaneously to their knees and buttocks; some even fell out of their canoes, as the heiau appeared before them where nothing of its size had been before.

Super-sized 'aunakea kiʻi, or ancestral tiki poles, and tall oblique-styled 'aunau, or places of offering, stood within the smoke from fires as the drums thundered relentlessly to a crescendo for the total psychological defeat of only twenty-six acknowledged enemies.
Here, Hawaiian legends chronicle the awesome impact and stupendous defeat of Chief Keōua. Kamehameha's cousin and rival, as he and his men were overcome and ceremoniously sacrificed on the stone altars to appease and glorify the warrior god Kū, to whom Puʻukoholā Heiau was dedicated.

King Kamehameha I was able to unify the Hawaiian Islands and to establish a kingdom to take its place among the sovereign nations of the world. On this broader scale, the fame of the imposing Puʻukoholā Heiau, Hill of the Whale, has served well. This was to be the last hukānai heiau, or temple, built in the Hawaiian Islands.

Andrew Charles Yanovich, AIA, APA, CSI
Environmental Systems Planning and Design Consultants
The legendary Naha Stone is possibly the most famous ancient stone in the state of Hawai‘i. Shrouded in mystery, it is believed that the first home of the Naha Stone was on the island of Kaua‘i. There it rested in the pristine waters of the Waipoo River until High Chief Makali‘iunukuaalawala loaded the 2,000-pound relic on a double canoe for a perilous journey to the island of Hawai‘i.

Placed in its new Hilo home at Pinao Temple, the sacred stone served as a platform to authenticate the Royal Naha lineage. If a male infant, positioned ceremoniously on the venerable stone, remained silent, it was proof of royalty, and he was destined to receive the title of prince, leader or king. If the infant cried, the status of commoner was immediately bestowed upon him.

Kamehameha, not of the Naha lineage, was born in Kohala of the Niu-pio royalty. His mother, Keku‘iapoiwa Elua, was a high princess, and his father, Keouanui, was the brother of King Kalani‘ōpu‘u. Kamehameha's youthful years were spent participating in sports, where he excelled in running, wrestling, casting spears, catching spears, swimming and the martial arts.

As an adult residing in Hilo, Kamehameha gained great warrior fame. It is said that it was his custom to respect the high chiefs as well as to care for the commoner. It is believed that this trait, together with his strength and tactical abilities, resulted in many victorious battles.

With the successes achieved in warfare, Kamehameha was summoned by King Kalani‘ōpu‘u to dwell within the royal household in Kohala. There, the high priests prophesied to the king that by moving mountains Kamehameha would win further battles and conquer all of the islands.

An excerpt from the legend as recorded in Hawaiian and translated by Reverend Stephen Desha, Sr. and adapted by J.W. De Vis-Norton speaks of Kamehameha: "If indeed the Naha Stone shall be this day moved by thee, then shall the whole group of islands from Hawai‘i to Kaua‘i be moved, but if indeed it shall be moved and turned from its resting place, then shall all dissensions be removed...and he put forth all his strength, and behold, the stone did move under his arms, and he raised it on its side and with supernatural strength did overturn it..."

The Naha Stone has rested in several places: in the Waipoo River, in the Pinao Temple, in the garden of J.A. Scott's Hilo residence, and behind the old Hilo Library. It is now in front of the new Hilo Public Library that was built in 1930 in a place of honor, for all to appreciate.

Russell Oda, AIA
Oda/McCarty Architects
Sensitive to every facet of nature and the universe, the early Hawaiians believed that everything, both living and nonliving, contained mana, a life force, or hā, breath. Water gave life to the land, and fruits of the land and sea sustained the people. With permission from the gods, pāhaka could be placed strategically to capture the water or to change its course. Water was wealth, and those who controlled it became the most powerful. Over the centuries, as stratified kingdoms evolved, the building and maintaining of loko kuapa, or fishponds, symbolized strength, and the number of ponds and the fish therein were testimony to the wealth of the chiefs. Through careful study of the geographic features on each island, kahikoikai, or trusted architects, advised their chiefs of the appropriate locations for the construction of these life-sustaining strings of pearls.

Pāhaka were critical to the construction of loko kaupā, or rock-walled fishponds, along the coastal shores and upon the reefs of the main islands in the Hawaiian Archipelago. Nowhere else in the world has this particular type of fishpond been found. Oral history attributes the use of rudimentary stone fishtraps to the time of Kane and Kanaloa (the pre-13th century), and by the 14th century, many loko kuapa were already said to dot the shorelines of Kane‘ohe Bay on the island of Oahu. Construction of various types of loko kuapa continued on other islands until the early 19th century. Various events in Hawaii’s history have led to the demise of the majority of the fishponds. It is unlikely that substantial recovery of fishpond production will take place in the future, for the economic climate in Hawaii has changed. Nevertheless, efforts are being made to restore and place in service several of these ancient structures as sustainable development demonstrations for education purposes, and as an opportunity to maintain ties to an element of cultural heritage that is on the verge of being lost forever. Current efforts to utilize Hawaii’s fishponds as resources/opportunities for providing students with hands-on learning activities indicate that this may be the lasting legacy of these ancient structures.

Let us not allow the broken walls of the loko kuapa to separate us from that which was known and practiced in the past. The
foundations of the walls are still evident, as are the wisdom and knowledge of our kupuna. The reflections of the sun, moon, and stars upon our waters are as old as time. Let these be beacons of light to guide our children to these ponds of knowledge. Let us help them rebuild the walls of these living resources where they can gather, as did the pua'a'i, or fish, to grow and be nurtured. With education and inspiration, the legacy of our children's ancestors can be preserved and passed on to future generations, a man a man, forever and ever.

Clyde S. Tamaru, Ph.D.
Aquaculture Specialist, University of Hawai'i
Sea Grant Extension Service

Christine Tamaru
Hawai'i C's Aquaculture Consultants

Clockwise from top left: Kāne'ohe Bay, Oahu; Southwest shore of Molokai; He'eia, Oahu; Kāliko, Kona Coast, Big Island of Hawai'i.
One wonders why an architect would be fascinated with the stone formations of the Kaloko Fishpond and Fishtrap found on the Kona Coast of the Big Island. Certainly, the rocks are non-spatial in an architectural sense and present no spectacular form. The fishpond formation, however, is heroic in configuration and becomes even more intriguing as one understands the geographical, sociological and political context circa 1400. Further, in light of the available technology of the ancient Hawaiians, the design and engineering is in perfect balance with the understanding of the forces of nature, the ecology of seawater and the management of aquaculture.

To the uninitiated eye, the rocks amass between two seaward arms of lava flow look haphazard. Although the wall enclosing the shallow bay is straight in alignment, it is not crisp in the joinery between rocks. The grottoless bearing surfaces of the rocks are minimal, leaving large gaps or puka. When compared to the precise “bull bearing” masonry joints of the ancient Egyptian (e.g. pyramids of Giza), Minoan, Greek, the ruins of Machu Picchu or even Mayan temples, one might assume that the Hawaiians had no particular skill for stonework.

However, this would be an unfortunate observation as the ancient Hawaiians were purposeful in their masonry and layout of seawalls. The puka, or voids, which run from makai to manae within the wall, filter debris, oxygenating the seawater as it
passes from the ocean to the pond. The daily evidence of this action is the congregation of young pa‘ama‘a and mullet that point toward the wall during nalu surges. The fish enjoy the filtered water and small particles of food passing through the wall.

Peter Keka, a master mason in his 60s who was trained by his grandfather in ancient Hawaiian rock work, is currently restoring the Kaloko seawall under a grant by the National Historic Park. Kumu a‘o Keka believes that round rocks are spiritually more compatible with nature and the force of the sea. The puka between the round rocks also dissipate wave energy and create a backwash that helps to cleanse the wall.

There are at least three styles of a‘i masonry used in the construction of the Kaloko Fishpond and Fishtrap. However, there are no recorded names for the masonry styles. The teaching of the masonry methods is transferred by mouth and in ancient hula. Jay Keka, in his late 30s and nephew to Peter, is learning the craft along with Benson Chong, who is in his early 20s.

Intuitive engineering is evident in the placement of heavier three-man stones at the base of the wall. These stones are elongated and placed at a slight anchoring angle into the seabed, perpendicular to the force of waves. One and two-man stones are placed in random courses until the top course, which uses smaller and flatter cap stones with clinker infill. Additionally, a mokāi apron of one and two-man stones, approximately eight feet in width, absorbs the first rush of waves. Thus settlement, impact and structural balance are achieved. While most architects are interested in only the ‘static’ or gravity loads to attain equilibrium of structures, the Kaloko seawall must also deal with ‘dynamic’ nalu forces.

From this architect’s observation, the ancient Hawaiians were early practitioners of sustainable design (a current movement which seeks to design and build in concert with nature, conserving both materials and energy) and preservation of an entire ecological enclave. The ahupua‘a system devised by the ali‘i of which fishponds are an essential element, is an example of this thinking.

T. E. Garduque, FAIA
Garduque Architects
II. Pōhaku Quarries

There are several records telling of ancient Hawaiians strung out by the thousands in a human chain passing pōhaku one-by-one to each other until the stones reached a site where a heiau or a fishpond was under construction. Historians surmise that the stones were not quarried, but came from the surface of fields and valleys somewhat in proximity to the construction site.

That is not to say that early Hawaiians did not create quarries. The adze quarry atop 15,000-foot Mauna Kea is one of the astounding stories of early Hawai‘i. It has been recorded that a village of skilled craftsmen lived year-round in the high altitude cold cutting and shaping the finely ground basalt that formed the basic hand tools during pre-contact Hawai‘i.

An article in *Stone Implements and Stone Work of the Ancient Hawaiians* says: “It has always seemed strange that the adze-makers did not bring the raw material down to their homes and work at it up in comfort instead of freezing in their kapa garments at this great altitude. It may be that the mystery of the place and its very solitude kept the trade in few hands and so enhanced the value of the tool that so many must have” (Brigham 1902).

Remnants of adze quarries can also be found at Kilauea Volcano on the Big Island, near the summit of Haleakalā on Maui, at Mokomoni Beach on Moloka‘i, and above Waimea on Kaua‘i. According to Brigham, there were no known adze quarries on O‘ahu.

Much later, as the Hawaiians began unearthing stones in earnest and shaping the pieces of source material for structures, quarries large and small became relatively commonplace. Whereas the ancient Hawaiians often expended a tremendous amount of labor into moving available rocks, such as at Pu‘ukoholā Heiau on the Big Island, later builders often constructed their edifices at or near a quarry and spent most of their labor in shaping the unearthed pōhaku.

Besides gathering available stones, early Hawaiians also shaped them. Consider the artful shapes of poi pounders, some with holes cut out of the stone to make a handle. Weapons, too, were fashioned from pōhaku in many shapes and sizes. Recreation was enhanced with the many slum metal stone pieces used for games in early Hawai‘i.
At Punahou School, both Puaahi Hall and Cooke Hall are constituted of stone taken from just above the campus at Rocky Hill. Again, significant labor went into shaping the stone and not necessarily into hauling the stone long distances.

The Christian Science Church on Punahou Street is a hybrid of the examples mentioned previously. The architect designed the building to use the stones that were at hand in their original form. Looking carefully at this church you will see that it is built not of shaped or cut stone, but of field stones available on the property. An architect who is a church member relates how the builder almost ran short of readily available stones at the site to finish the church and accompanying hall. He resorted to scouting for sites with stones of similar size and color as a contingency. Luckily, as it turned out, there was enough material on the property to complete the project.

Besides Mōli‘ili Quarry, there were other known stone quarries, one of which is located at what is now Dole Park and one at Kāne‘ohe Point. The Dole Park Quarry
was quite small and there are no known records of which buildings might have been built of its stone. The Ka'ena Point Quarry was primarily a crushed stone source, used mainly for roadways.

Some would include the reefs around the Hawaiian Islands in a discussion about stone sources as coral was cut from the offshore reefs, especially around O'ahu. Coral material got quite a boost from Bingham's large church as others began to use it for many purposes. In his 1850 book Island World of the Pacific, Reverend Henry Cheever describes the uses of coral. "A very good building material consists of blocks cut from the coral reef, which is found on the leeward side of most islands. The palace of kings, and other government buildings, as well as many of the stores and dwellings of foreigners on O'ahu, are formed of this substance."

Apparently the kingdom was in the permit business early on because the minutes of the Privy Council in the spring of 1850 record three requests to cut coral. On March 6th, Mr. Hopkins "brought forward Mr. Paki's application for 1,000 reef stones." The request was granted.

On May 13, Mr. Young brought forward the proposition of Kapa'akea to obtain coral rock. The request was resolved as follows: "That Kapa'akea is authorized to cut and take from the reef 1,000 stones for building his own house." On a grander scale there was an application made on May 27, "from Keakaomahi to cut 6,000 coral stones for building her own house." It was approved.

Today, one would never consider mining coral for any use. It is protected by state and federal regulations. Pipiako, or stone, is not protected, but is now quarried in Hawai'i only as paving material for roads and highways.

David Cheever
Mōʻiliʻili Quarry
Honolulu, Oʻahu
1889

For more than 60 years, the Mōʻiliʻili Quarry was a primary source of the rock that built modern Honolulu. From about 1889 to 1949, it provided the stone that was used to build Honolulu's streets, sidewalks and curbstones, as well as some of its prominent buildings, including Central Union Church. Local craftsmen reportedly used Mōʻiliʻili Quarry stone for top-of-the-line gravestones, and a 1914 memorial to Kamehameha III, still seen in his birthplace of Keaulou on the Big Island, was made of polished Mōʻiliʻili rock.

The blue, basalt-lava rock from the quarry was considered among the best in the Islands and ran at least 55 feet deep. The origins of the quarry are not known, but by 1911 it was being run by the Honolulu Construction and Draying Company (now American HKCeD) under a $50 a month lease from the Bishop Estate. The company continued operating there until 1949.

The quarry was a noisy part of daily life in Mōʻiliʻili, so much so that a community newsletter was named the Quarry Dust. Residents reported they could set their schedules by the regular twice-daily blastings there. Workers would drill small holes into the rock wall, place dynamite in the holes, then blast away entire rock faces, shaking the nearby residents. The small stones were then removed with a power shovel and taken, first by a small railroad and later by dump trucks, to a crushing facility on the site. During World War II the blasting continued day and night to meet the demand for new military construction.

After the quarry was shut down in 1949 and the crushing facility was closed in 1951, the nearby University of Hawaiʻi acquired about 95 acres of quarry land and began developing it, mostly for athletic facilities. Today an impressive five-story stairway links the upper Mānoa campus to the lower facilities, which are still widely known by students and faculty as The Quarry.

Mike Leidemann
The Honolulu Advertiser

Aerial view of Mōʻiliʻili Quarry, from January 1949. Dole Street is at the top and a portion of Waikiki Avenue is at the bottom.
Quarrying Coral for Kawaiha'oe Church

Honohono, Oahu
1842

Before the Hawaiian men went into the water to quarry the coral, they followed a protocol for gathering, according to a telephone interview with Kamalei Danuser, as told to her by her grandfather.

When the tide was low, the men would pray as they entered the water, and they would pray again on exiting. They carried tools, ma'akalii with kon for long handles, and the wā, a metal rifle barrel pounded to a sharp point inserted over a wooden shaft. Tools were made by the men themselves to gouge out of the reef blocks of coral weighing more than 1,000 pounds. The blocks were hoisted onto canoes and paddled ashore, where they were shaped with special tools. They also practiced breathing and would take turns diving, going to depths of no more than fifteen to twenty feet, or it became too hard to hammer. When they did this at night it looked like torch fishing.

Some of the men carried adze from Mauna Kea, and among them were men whose only job was polishing the adze blades back onto their handles when they came loose.

Powder from the coral blocks mined from the reefs in Hawai'i is highly incandescent when burned. This phenomenon was readily observed by the mission children, who described the burning of coral for lime as "...an exciting time for us children...to be allowed to go and see the pit fired after nightfall" (Damon 1995). Kilns were set on the beach a short distance from where the church was being built, and the kilns would glow throughout the night.

Scott Cheever
Kawaiahaʻo Church
Honolulu, Oahu
1842

In the middle of an otherwise dry and barren plain existed a sacred spring reserved for use only by high chiefs and their queens. The highest ranking who enjoyed the privilege of bathing in the large circular pool was the High Chiefess Hālo. The land near the spring came to bear her name: Ka Wai a Hālo – the Water of Hālo. It was adjacent to this site that Hiram Bingham, with the approval of Queen Kahanamoku, was allowed to establish his missionary post in Honolulu around 1821.

The stone church that we see today was preceded by a succession of four thatched grass buildings, which served as houses of worship.

By the mid-1850s, King Kamehameha III and the church congregation were evaluating the construction of a permanent stone church. A preliminary design, penned by Hiram Bingham, was discussed in 1856. The proposed church was to be 144 feet by 76 feet and contain a basement, an audience room, a gallery, a vestibule and tower.

The rulers of ʻOahu donated stone, lime, and timber. It is believed that Captain Don Francisco Martin’s son, Martin, was on the planning committee and he enlisted Ferreira, a master stonemason and armory specialist, to play a major role in the construction project. Coral was recommended because of its availability and economy.

A plaque on the church reads, “The building materials of the sanctuary were not easily accessible. The huge coral slabs had to be quarried underwater, and each weighed more than 1,000 pounds. Native Hawaiians dove 10 to 20 feet to hand-chisel these pieces from the reef. The physically and spiritually strong hauled some 14,000 of the slabs to this, their final destination. The Stone Church was dedicated on July 21, 1842.”

Visiting sea captains provided mahogany and other wood for its construction. Foreign workmen added Western features such as doors, a pulpit, a pulpit window, and astrolamps that gave the structure the “air of a house of worship.” Seating was on clean floor mats.

Historical records from the Governor's memoran-
dum in the Archives of Hawaii indicate the following sequence of work for this project: "On June 8th, 1839, cornerstone laid at manaka con corner at top of basement wall, of Waianae sandstone, gift of Chief Paki, floated to Honolulu on canoes or raft; dedication witnessed by a vast concourse of people who then went into old meeting house for prayer. Under this stone was a brass plate engraved by Kapeau, a Hawaiian Bible, and books on Mathematics and Anatomy, printed on the Mission press."

Details from Dr. Judd’s Diary reveal that a "...second pastor. Reverend R. Armstrong said that it was a greater work for the Hawaiian people than Solomon’s temple was for him."

In 1937, the restoration of the stone church led to the facing of the coral exterior with cement stucco sealing the church from the elements. Wood timbers supporting the roof superstructure were replaced with concrete beams that emulated a wood appearance.

Reverend Abraham Akaka became the eighth pastor in 1957. He championed a movement to restore the church to its original coral splendor. When the plaster was removed, beach sand remnants on the surface left the church with a certain ‘glow.’

In the ensuing years, the elements, insects, and ever-present residual salt imbedded in the coral caused certain reactions with adjacent building materials. Coral is defined as the “stony skeleton of a small sea creature.” Since sea creatures are revered in Hawaiian culture, it should come as no surprise that this linkage to the sea runs deep in the fabric of the church.

By the summer of 2001, the coral was sealed from the elements. The lower sections of the walls were treated for mildew stains. Golf ball sized tunnels were filled with a sand grout mixture, and a hydrolyzed lithium quartz penetrating sealer was applied, creating a water resistant membrane. At that time a 1,100-pound sample block was sent to Illinois for accelerated weather and porosity testing. When the block was cut into smaller pieces, large centipedes and plant material were found inhabiting it. The people working there had never seen insects such as these before, and it caused quite a commotion in the laboratory.

It is truly remarkable that this national treasure has been in service for over 160 years. Kawaiaha’o Church has expanded to meet its ever-changing requirements, responded to the technology of the times and yet maintained its own unique mana. It has hosted countless important functions of both the Hawaiian Kingdom and matters of state in the period after the 1898 annexation to the United States of America. Beyond this truly unique architectural statement, we must credit Queen Ka’ahumanu for her vision and her legacy, for without her we would not have a stone church called Kawaiaha’o.

Franklin L. Wong, AIA
Franklin Wong & Associates
Makawao Union Church

Makawao, Maui
1916

Makawao Union Church charms all who see it. C.W. Dickey displayed his versatility of design with this building, which could easily fit in the English countryside in a Masterpiece Theater episode. Perhaps this is what Dickey intended.

The church emulates an ancient stone building, but it is actually a state of the art reinforced concrete structure. The walls are approximately one foot thick cast-in-place concrete with steel reinforcing. The roof employs steel beams to support the heavy slate roof, while the windows are framed with glazed terracotta panels.

Lava rock veneer on the exterior was applied with great care. It is local rock, but the quarry is unknown. A cornerstone exactly dates the start of construction – 1916. (I wish we still did this on all buildings!)

Makawao Union Church is listed on the National Historic Register, and has been respectfully maintained by its parishioners. Its historical status is commemorated by a tasteful bronze plaque.

The interior is clad with rift-sawn, old-growth English oak. The rock work was well thought out and was selected to meet the aesthetics of the design. For example, the square cut of the rocks below the cornerstone is used to designate the foundation and floor line, with loose un-cut stones used for the upper wall infill.

Keystones and stone lintels have been employed to form window openings and doorways. Window and door frames and wall copings, that might traditionally have been made of stone, are made from glazed terracotta. Gladding McBean Co. of California was the most likely supplier, since they were a common supplier for C.W. Dickey at the time. Dickey used terracotta rather than cut stone for many of his buildings. Arguably, cut stone would have endured longer than terracotta, as chips in the glazing of the terracotta do not hide as well as they would have with solid stone used exclusively.

How wonderful it would be to interview the architect today to understand what forces shaped his decisions. Alas, we are left with the fascinating end product, some drawings, and bits of notes.

Anthony Riecke-Gonzales, AIA
Riecke Sundland Kano Architects, Ltd.
Russian Fort Elizabeth

Waima‘a, Kaua‘i
1816

The stone ruins of Russian Fort Elizabeth, a state historic park, sprawl over the bluff of the Waima‘a River, where the river empties into the bay that was Captain Cook’s first Hawaiian landing place in 1778. The ruins are evidence of that bizarre episode in Hawaii’s history from 1815 to 1817, when a Russian emissary plotted with Kaua‘i’s King Kaumualii to wrest Oahu, Lana‘i, Maui, and Moloka‘i from King Kamehameha the Great. In return, Russia would gain half of Oahu, all of Oahu and Kaua‘i’s sandalwood, and sites for establishing trading posts on the newly conquered islands.

Kaumualii was never defeated by Kamehameha, and according to Peter Mills, an associate professor of anthropology at the University of Hawai‘i–Hilo, and author of Hawaii’s Russian Adventure – A New Look at Old History (2002), recent archaeological fieldwork led by him supports Kaumualii as a rebellious as well as independent ruler.

Since 1810, the Kaua‘i king had recognized Kamehameha’s sovereignty, even as he continued to control Kaua‘i and Niihau and to claim that the other islands north of the Big Island of Hawai‘i were a part of his royal heritage. In 1815, he appears to have broken the sovereignty agreement with Kamehameha and was using foreign traders to help him maintain power even before the Russian episode.

In January 1815, the Russian-American Company ship Bring, out of Sitka, Alaska, wrecked off Waima‘a, and Kaumualii confiscated the ship and its cargo. The company sent an agent to negotiate the return of the cargo or payment for it and to seek the opening of an Hawaiian trading port.

When the agent, Dr. Georg Anton Schaeffer, a physician of German descent, did not get the help he needed from Kamehameha, he went to Kaua‘i and was welcomed by Kaumualii. Schaeffer went beyond his orders, and in return for Kaumualii’s agreeing to pay for the cargo, pledged to give the Kaua‘i ruler arms and ships.

In September 1816, Kaumualii began building the vast compound on the east bank of the mouth of the Waima‘a River to defend Kaua‘i during his planned invasion of Oahu. Schaeffer was its designer, using the layout of a traditional European fort, and it was named Fort Elizabeth for the wife of Czar Alexander I and flew the Russian-American Company flag. The builders were several hundred Hawaiians provided by Kaumualii, including his wives. The site was a sacred place: it had a heiau, homes of paramount chiefs, a pa‘ahe‘ahe‘a, or place of refuge, and had been the scene of battles between competing rulers of Kaua‘i.

The resulting compound was an amalgam of Hawaiian and European monumental architecture, according to Mills. It was an irregular octagon some 500 feet across. Its walls were built of rubble and earthen core – to withstand bombardment – but they were faced with outer walls of piled stone, laid without mortar in the Hawaiian heiau style of building. The walls were 12 feet high and 15 to 30 feet thick. Stairs were built into each of the star-like projections on the fort’s seaward side for access to cannons set on top of the wall. Inside the walls are the foundations of a flagstaff and other buildings erected during the fort’s life – most from its Hawaiian period, 1817 to 1844.

It was the American traders, fearful of losing their supplies of sandalwood if Schaeffer were to succeed in his plans, who convinced Kamehameha that the scheming doctor was a threat to his sovereignty. Kamehameha demanded that Kaumualii expel Schaeffer, and the Kaua‘i king, recognizing that Schaeffer was acting on his own and had no forces behind him, did Kamehameha’s bidding in 1817.

Kaumualii then threw out the Russians and finished the fort, naming it Fort Hipo. The fort continued to
have troops and was used as a jail and a burial ground. Hawaiian monarchs used symbols, elaborate rituals, and grand architecture which fort epitomized to establish supremacy over commoners and foreigners. Kaumualiʻi used Fort Hipo as a symbol of his sovereignty over Kauaʻi as he continued as an independent ruler, and it wasn't until after he died in 1824 that the Islands became truly unified and Kamehameha II (Liholiho) gained possession of the fort.

By the 1850s the buildings had fallen into disrepair. The fort was abandoned during that decade, and in 1864 the Hawaiian government ordered the fort be dismantled.

Nancy Bannick
Journalist, Historian, Preservationist

Aerial view of Russian Fort today. Note the star shape of the original stone fort is still visible.
It is surprising that Stephen Noboru Oyakawa is not better known among 1960s-era Hawai’i architects. This Honolulu-born son of immigrant Okinawan hog farmers walked through destiny’s door in 1944, when sculptor Isamu Noguchi introduced him to Frank Lloyd Wright in New York. Oyakawa spent the next dozen years or more as a Wright apprentice, one of the famed Taliesin Fellows, who not only studied at the master’s architectural elbow but also, according to a 1958 Honolulu Star-Bulletin interview, “learned to cook well, dance, play several musical instruments, sing, sculpt and do ceramics.”

Although Oyakawa was unsuccessful in his attempts to convince officials that Wright should design the Hawai’i capitol building, he himself became a popular architect for state-funded projects, including schools and the controversial round dorms at the University of Hawai’i. He completed the ‘Aīkea and Liliha branch libraries before designing Lihue Public Library in the late 1960s. Its slanted, lava rock faced walls underscore the importance of the building’s purpose by hinting at ancient, sacred, Hawaiian forms. The use of lava rock also lends a respectful nod to architect Hart Wood, whom Oyakawa admired and who employed lava rock for Lihue’s 1924 library, which this structure replaced.

That Oyakawa understood light is abundantly clear. The transition from outdoors into the library is gentle, and the combination of high, tinted glass panels and rows of florescent lighting provides consistent brightness without glare.

The late sixties buzzwords “modern” and “technology” were amply exemplified in the building. Library-to-Wilcox School TV conduits, an audio “listening room” and carrels, and state-of-the-art equipment monopolized news about the building when it opened.

Soaring above the structure and its contents, the dominant, swelling wave of a roof still proclaims the Information Age’s optimistic future to all in Lihue and beyond.

Pat I. Griffin
Kapaa, Kaua’i
Dry Masonry Walls

Ancient to Present

The intimate knowledge of handling stones is a skill that most wall builders say begins to develop after about two years of dry masonry work. Most wallers feel that this is the most important attribute of a good wall builder. One stone wall builder said, “After fifty years of wall building, I can look at a large pile of stones and know exactly where each one goes.” Pu‘ahonua, at left and below, is a beautiful example of dry wall construction, standing nearly 20 feet high.

A typical free standing wall called hakahaka, or hollow, stands about four to five feet high. The base is usually four feet wide and the width tapers to three feet on the top. The kikulu, or two exterior skins of the wall, are built far enough apart to leave a hollow space between them. This open hollow is filled with unusable rubbish stones called hakahaka. This hakahaka style of construction is the most popular in use today.

Stone walls were still very much in demand well into the first half of the 20th century. These walls were used to control wandering livestock that for many years had run free in the uplands. On the Big Island of Hawai‘i during the early 1800s, Governor Kuakini built a massive wall to exclude newly introduced Western livestock from the populated coastal region. Major parts of Kuakini’s Wall still stand in Kona.
Facing page: Two views of the stonework at Pa'ahonua, the Great Wall, built to protect the sacred City of Refuge at Hōnōnua on the Kona Coast of the Big Island.

King Kamehameha I built the thousand-foot-long wall using pa'oa style masonry in 1790 A.D. Pa'oa wall building is a column and lintel technique used to save materials, according to anthropologist Patrick Kirch.

Left: Part of Kalakini's five-mile-long wall in Kona.

Below: The basic styles of dry Hawaiian pānaha wall building, from information provided by Nathan Napola. 
With the full scale establishment of ranching in the last half of the 19th century, Hawaiian wall builders were needed to build paipī, or livestock enclosures to contain cattle. Paniolo, or Hawaiian cowboys, considered wall building and wall repair necessary skills.

During this time, the more elaborate masonry structures of early Hawai‘i were adapted to a cruder and simplified wall. The new walls needed to be built quickly and had to extend over large tracts of land. A waller would boast of his wall building prowess by saying how many feet of wall he could complete in a day’s work. This was often anywhere from 20 to 30 feet a day.

People in Hawai‘i are slowly realizing that these dry masonry walls have an important aesthetic value beyond mere usefulness. Over time, the old dry walls have become an integral part of the rural landscape contributing to the environment and visually enhancing the lives of residents and tourists alike.

Nathan Napake
State Historic Preservation Division
Department of Land and Natural Resources
Facing page, left: Kalo (Coro) terraces, Honokalani, Maui, 1940. Multi-tiered kipapa style masonry.
Right: Dry masonry wall at Ulupalakua Ranch in Upcountry Maui.

This page, above: Stone cattle wall and cattle barn in Upcountry Maui.
Left: Stone cattle corrals at Pahoa, near Kona, Big Island of Hawaii.
Menelune Ditch

Waimoa, Kauai
Pre-contact

The plaque at Kauai’s famous Menelune Ditch indicates that this cliffsidence watercourse in Waimoa Valley is part of an ancient aqueduct that legend attributes to the Menelune, the legendary race of little people who accomplished difficult construction feats overnight. Legend has it that they were working for King Ola of Waimoa thus the original name of the Menelune Ditch, Kii-a-Ola who paid them with shrimp.

The site is about one and one-half miles up Menelune Road from Kauaihi Highway in Waimoa. It is at the base of the cliff that forms the west wall of the Waimoa River Valley. Most of what is seen today, however, is part of the irrigation system built from 1901 to 1903 by the former Waimoa Sugar Mill Company and a tunnel excavated through the cliff when the county road was built in 1920 up against the ditch wall.

The earlier ditch was either destroyed or lies beneath the road. It carried drinking and irrigation water from an intake above to taro fields above the level of the river in lower Waimoa Valley.

The aqueduct was indeed an outstanding work, but it may not have truly been ancient. It was first described by Captain George Vancouver during his visit to Waimoa Valley in 1792; later observers detailed the ditch’s unique engineering and construction. The causeway was 24 feet above the base of the steep cliff and was supported by a wall of stones and clay. It also provided the residents of Waimoa with a pathway around the precipice, which at the time was at the river’s edge, to inland areas.

The construction of the ditch was unique in the use of dressed and jointed stones. They were squared off on all sides except the inside — some even all around — and were fitted together to present a smooth flat surface on the river side. The blocks were of various sizes — some five feet long and more than three feet in depth and width. There was some coursed but more impressive was the use of three types of joints — double, square, and notched — seemingly aimed at keeping the wall top level and fitting the stones together in the easiest way. The stones were probably cut by pecking and grinding.

The ditch ran for 2,000 feet and its water could irrigate 75 acres of farm land below the tunnel and about 40 acres above. The roadbed construction left only the upper two feet of ditch wall exposed — just three courses of stone — and only a 200-foot length of this wall is visible just above the tunnel.

Further archaeological research is needed to determine the derivation of the ditch work that is visible, how much remains of the original causeway, and its actual age.

Nancy Bannick
Journalist, Historic Preservationist
Two-legged creatures in Hawai‘i have always needed stepped pathways to get up slopes and over hilly obstructions. The black and white photo at left, from the Bishop Museum, shows a pre-contact trail that goes from Mānāki Bay on the southeast side of Lāna‘i up to a heʻau at Kaumolā. A similar ancient foot path on the eastern shore of Lāna‘i goes from Naha to the Pālama‘a Basin in the central plain of the island.

A foot path on O‘ahu, top left, probably built around the turn of the century of curb stones, climbs steeply up from Madeiros Street to Spencer Street on Punchbowl.

In Mānoa, a wide cut stone pathway, top center, climbs up from O‘ahu Avenue to Hillside Avenue. A narrower portion of the same foot path, top right, goes from Hillside up to Terrace Avenue saving walkers considerable time. It looks to be built from smaller curb stones.

David Cheevers
Ballast Block Sidewalk Stones
Downtown Honolulu, Oahu
1800s

Next time you're walking downtown, look closely at the sidewalks; you may be treading on history at least 100 if not 150 years old or more. In the 1000 block of Nu'uanu Avenue in front of the old Lai Fong store or at the corner of Nu'uanu and Merchant Street, bordering Murphy's Bar and Grill, you will see granite block paving in place of the usual plain concrete.

What you are standing on are called "ballast blocks" or "ballast stones." These rough cut stones, made of granite about 15 inches square and two and a half inches thick, illustrate an interesting story.

It may not have been the most praiseworthy event in the history of the Hawaiian Kingdom when the hills and mountains of Oahu, and the other islands, too, were cleared of 'ilihi or sandalwood. This aromatic wood, discovered in about 1810, was highly prized, especially in China. The Hawaiian monarchs, beginning with Kamehameha I, required many of the conditioners to spend much of their time cutting sandalwood and carrying it to the port in Honolulu, where it was loaded on ships for transport overseas. The king claimed two-thirds of the proceeds and chiefs the rest. In the heyday of the sandalwood trade, about 1820, the cargo sent to China was worth as much as $200,000 in 1820 dollars.

What is the tie between the Hawaiian sandalwood story and the granite underfoot? It is reported that the relatively empty sailing vessels returning from Canton or other Chinese ports, needed equally heavy cargo to stabilize the ship to avoid capsizing in bad weather on the return trip to Honolulu. Granite, one of the hardest and most durable rocks available, was plentiful in China, and the sidewalk blocks you see are those "ballast stones," so appropriately laid down to provide a comfortable walking surface on what was once dirt and mud.

In about 1850, after most of the island's sandalwood had been cut and sold, the kingdom apparently continued to import the wear-proven granite blocks from China. The Honolulu Advertiser on July 11, 1859 reported that, "A substantial pavement of Chinese granite blocks has been laid in the front of Messrs. Allen and Robinson's office buildings, Queen Street. This is a pattern that might well be imitated on portions of Fort Street and other business thoroughfares of the city, where in many places the sidewalks are relics of a bygone barbarism and unworthy of the progress attained in other directions." Unfortunately, this ballast paved area has been replaced with other materials.

But, all is not lost! Very recently the city has replaced the corners of King Street and Nu'uanu Avenue with a comparatively good imitation of the ancient stones, about the same scale and texture, but of different colors than the originals.

Frank S. Haines, FAIA
Architects Hawaii Ltd.
Miyamato Bowl

Honolulu, Oahu

1898

This early stone reservoir was built in the crater of Kaimuki Hill, the top of an ancient shield volcano, by Theodore Lansing and A.V. Gear, who formed a real estate partnership in 1898. They developed Kaimuki, one of Hawaii’s first major subdivisions. They bought 260 acres of Paul Isenberg’s ranch – the area bounded by Kapahulu and Wai‘alae avenues, Ocean View Drive and the back of Diamond Head – and later an additional 260 acres extending to Kailua and Kailua avenues. Before they could subdivide the barren, rocky, red-dirt land with little vegetation other than kahili, cactus, and lanai, they had to develop a water supply.

In 1898, they hired the McCandless brothers to dig two wells. Then, with the help of E.E. Richardson and Co., they brought in pumps and pipe from San Francisco and built the original Kaimuki Pumping Station (one of Honolulu’s first artesian well stations), the reservoir, and a main along Kaimuki Avenue with small pipes branching to the new blocks in their subdivision. This circular reservoir, whose walls are brick, lined with concrete and faced with mortared lava fieldstone, served the pumping station until 1911.

The reservoir has been the meeting place of Boy Scout Troop 10 since 1910, a year after it was formed by Scoutmaster Charles S. Crane, who was mayor of Honolulu from 1926 to 1940. The bowl served the scouts very well despite its one major flaw; it had no entrance or exit and Scouts had to climb the 14-foot high walls, in some places six feet thick, to get in and out. “In later years,” according to Eagle Scout and Assistant Scoutmaster Gordon Wong, “Mr. Crane organized a group of parent volunteers who, equipped with jackhammers, chisels, crowbars, and an unlimited supply of devotion, punched an access hole through the solid stone wall of the reservoir.”

Many Honolulu leaders were members of this troop during their youth, including Masao Miyamoto, a retired University of Hawaii photographer, who joined the troop as a boy of 12 in 1925. In 1952 Mr. Miyamoto had become the second scoutmaster of Troop 10 and by 1945 had taken over from Crane. He served as scoutmaster for 46 years, and in 1999 the bowl was renamed Miyamoto Bowl, in his honor.

Nancy Bannick
Journalist/Historic Preservationist