Diachronic Design Changes in Heiau *Temple Architecture on the Island of Maui, Hawai'i*

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> The scientist only records what he has been able to establish as indisputable fact. In the same way, only what is unique to a person's experience is worth writing down as a guide and a warning to others.
>
> —Dag Hammarskjöld

FOR THE SCHOLAR INTERESTED in ancient Hawai'i, Dag Hammarskjöld's observation (1964) about literary commentary possesses a dual meaning. The first is that literary accounts, such as Hawaiian genealogies, land records, and ancient testimonies, as well as modern archaeological excavations and anthropological analyses, are important for the information they contain. Secondly, these same literary accounts are also important for the information they *do not* contain. In the case of Hawaiian *heiau*, or ceremonial temples, both literary and archaeological data on *heiau* architecture tend to be fragmentary and incomplete. Thus the modern scholar interested in *heiau* must gather and interpret the entire range of available sources to gain some valid understanding of their past.

The goal of this paper is to explore whether ancient Hawaiian *heiau* design varied systematically through time and space. Useful expectations about diachronic change of ceremonial architecture can be generated using historic and ethnographic sources; they can then be tested using archaeological data in order to obtain a basic understanding of *heiau* architecture and its relationship to the development of social complexity in Hawai'i.

Hawaiian temples (*heiau* is both the singular and plural form) ranged in size from small stone uprights placed by individuals or family households to large temple enclosures constructed under the direction of high-ranking chiefs. Monumental architecture, such as the larger *heiau* temples, represents one of the most manifest aspects of human labor in the archaeological record (Service 1975; Trigger 1990).

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Because centralized decision making and an organized labor force are often necessary for the construction of monuments, understanding how large *heiau* vary through time can tell us about the nature and development of social complexity in ancient Hawai'i.

Results of this study indicate that ancient Hawaiian architects employed a series of design systems to produce a wide array of temple morphological variation. Despite the vast amount of stylistic variation in temple architecture, they used repetitive design elements to create a sacred space that was both spatially circumscribed and architecturally imposing. A diachronic model, which states that simple structures such as terraces predate more complex structures such as platforms, can be developed based upon existing stratigraphic and chronological data recovered from *heiau* foundations. This model, presented here, is tested by examining the distribution of temple types on the island of Maui. Certain design elements, such as terraces and walls of stacked construction, cluster in windward regions—the initial areas of dense occupation according to the current model of island settlement (Cordy 1981; Hommon 1986; Kirch 1985, 1990). As Hawaiian society grew more complex, so did temple architectural design, with six-sided, notched shaping, platforms, and walls of core-filled construction. These elements have been found to cluster in leeward regions of Maui, areas thought to have been densely settled relatively late in the scope of Hawaiian history. *Heiau* size, however, does not significantly vary through space and may decrease after A.D. 1600.

BACKGROUND

Hawaiian accounts (HEN n.d.; 'Ī'ī 1963; Kamakau 1961, 1964, 1976; Malo 1951; Manu 1884) and ethnographies (Alexander 1891:45; Campbell 1967:131; Lisiansky 1814:109; Fornander 1969; Valeri 1985) represent important historic sources on *heiau*-building traditions. In contrast, archaeological research provides important information about the architecture of *heiau* temple foundations. Archaeological research on the *heiau* temple can be broken down into sequential periods (Dye 1989:4). The survey period of the first half of the twentieth century A.D. focused on describing and mapping *heiau* foundations throughout the archipelago (Bennett 1930, 1931; Emory 1924; McAllister 1933; Stokes 1917; Thrum 1907*a*, 1907*b*, 1908, 1909, 1910, 1938; Walker 1933). The excavation period of the second half of this century saw the excavation of a series of *heiau* foundations (Davis 1986; Green 1980:63–69; Kirch 1971; Ladd 1969, 1970, 1972, 1985, 1986, 1987; Masse et al. 1991).

Most literary sources link variability in *heiau* size to differing levels of worship in ancient Hawaiian society. Commoners built and used small shrines (Green 1980; HEN n.d. 1:374; 'Ī'ī 1963:160; Kirch and Kelly 1975:178; Restarick 1928; Weisler and Kirch 1985) in order to assure the productivity of nature (Valeri 1985:183–184). The labor necessary for small-scale construction projects most likely represents organization at the family level (Abrams 1984; Startin 1978). Family labor coordination lacks bureaucratic involvement and recruits laborers via membership within a kinship group. Chiefs built larger and more architecturally complex *heiau* for ceremonies used to integrate society and to guarantee success in chiefly endeavors ('Ī'ī 1963:137; Kamakau 1976:129; Malo 1951:189). The *luakini* temple, for example,

was constructed and used for polity-level ceremonies meant to assure a successful military conquest (Kamakau 1976:130–131; Malo 1951:159–187). Larger and more complex *heiau* were constructed using labor organized above the level of the family (Hastings and Moseley 1975; Moseley 1975; Peebles and Kus 1977; Pozorski 1980; Renfrew 1973), and they are believed to date from relatively late in Hawaiian history, when the level of chiefly organization became increasingly complex (Cordy 1981; Earle 1978; Goldman 1970; Hommon 1986; Kirch 1984, 1985, 1990). This type of effort, called custodial labor, was drawn from the general population and used exclusively for chiefly construction projects.

Abraham Fornander (1969, 2:59–60), in his ethnography of Hawaiian history (A.D. 1879), was the first to suggest that variability in the *style* of the *heiau* temple was linked to changes in religious practices through time. Fornander notes that in the earlier Nānāulu epoch of Hawaiian history truncated pyramidal temples existed for ceremonies focusing on worship of the god Kāne. These "open" temples permitted worship to be accessible to all celebrants. In the later epoch, walled temples came into prominence; these effectively shielded more complex rituals from public view. In his survey of the *heiau* on Hawai'i Island, J.F.G. Stokes (1917) grappled with the idea that enclosures supplanted platforms. The extreme variability in *heiau* design that he encountered, however, precluded success in his attempt to demonstrate the antiquity of platforms (Dye 1991). Although excavations of *heiau* foundations have also uncovered information that temples were constructed in a series of distinct architectural stages (Green 1980:663–669; Ladd 1969; Ladd 1970), no plausible evidence has been put forward concerning broad stylistic variation in *heiau* design.

To address these questions about *heiau* stylistic design, field work was undertaken on the island of Maui to collect architectural information on a large number of *heiau* temples, as well as to excavate selected *heiau* to examine their architecture and building chronology (Kolb 1991). *Heiau* architectural information was collected from an inventory of 108 temple foundations, those known *heiau* remaining on Maui. Each *heiau* was inventoried and mapped from existing descriptions and sketches (Walker 1933; SIHP 1973). Eighty-five of 108 *heiau* (79 percent) were then field checked for mapping accuracy.

Table 1 gives the distributions by district of these 108 remaining *heiau* on Maui. These foundations have a mean size of 924.5 m^2 and a median of 416 m^2. They range in size from 36 m^2 to 12,126 m^2. The size and architectural complexity of most of these *heiau* suggest that they were constructed using custodial labor, and that all served some sort of ritual function. The number of *heiau* present in each district varies considerably. This disproportionate distribution may be due to the fact that *heiau* in districts that possess large tracts of arable land are more likely to have been destroyed by commercial agriculture. The agriculturally rich Hāmākua Loa and Kā'anapali districts had many *heiau* in ancient times, but now have very few. Districts where commercial agriculture was not extensive (such as Kaupō and Kahikinui) still possess the majority of their original inventory of *heiau*. Kaupō, Hāna, and Wailuku–Kula districts—all politically important centers at the time of European contact—possess the largest number of *heiau*. Lahaina, another politically important district, has a disproportionately small number of *heiau*. Again, this may be due to accidents of preservation rather than to deliberate placement.

TABLE 1. *HEIAU* DISTRIBUTION BY DISTRICT ON MAUI

DISTRICT	NUMBER OF *HEIAU*	AVERAGE SITE AREA (m^2)	MEDIAN SITE AREA (m^2)	TOTAL SITE AREA (m^2)
Hāmākua Loa	5	916	1163	4579
Hāmākua Poko	0	0	0	0
Hāna	16	1184	307	18,942
Honua'ula	14	523	392	7327
Kā'anapali	4	1613	1819	6451
Kahikinui	15	307	260	4611
Kaupō	20	1223	517	24,458
Kīpahulu	2	4283	4283	8565
Ko'olau	6	407	351	2440
Kula	15	448	342	6720
Lahaina	3	1214	844	3641
Wailuku	8	1514	590	12,109
All *heiau*	108	924	416	99,843

Additional architectural information as well as chronological data were recovered from excavations undertaken at seven large and relatively complex *heiau* (Fig. 1). They include Haleki'i and Pihana *heiau* in Wailuku district; Pi'ilanihale in Hāna district; Lanikele *heiau* in Ko'olau district; Lo'alo'a and Pōpōiwi *heiau* in Kaupō district; and Molohai *heiau* in Kula district. Excavation methods focused on determining the relative age of architectural features via stratigraphic and absolute chronological evidence.

BUILDING TRADITIONS

What is known today about *heiau*-building traditions comes primarily from Hawaiian sources on the construction process of the *luakini heiau*. Unfortunately, little has been recorded about the building and use of smaller *heiau*. It was usually a chief who presided over how and when a *heiau* was to be built. Chiefly residences and their temples were built or owned by high-level chiefs and their retainers (Lisiansky 1814:109; Thrum 1909:38), while smaller *heiau* were usually built by lesser chiefs or commoners (Campbell 1967:131; HEN n.d. 1:197, 374; Malo 1951:176; Kamakau 1976:129–130; Valeri 1985:185). Unlike a small community *heiau*, a *luakini* temple was commissioned when a ruler wanted to make war upon another chief or hoped to avert a calamity such as drought or famine. It was first decided whether an existing *luakini* temple should be refurbished or whether a new temple should be built. Malo notes that "The king, in the first place, inquired of his high priest in regard to building a *luakini*; whether he thought the old *luakini* would answer, provided the house and the fence were renewed; whether the old stone wall should be allowed to remain; and whether the old idols should still continue to be used" (1951:161).

If the remodeling of an existing temple was all that was required, the *heiau* was made *noa* (free), so that the workmen were able to enter the temple and refurbish it

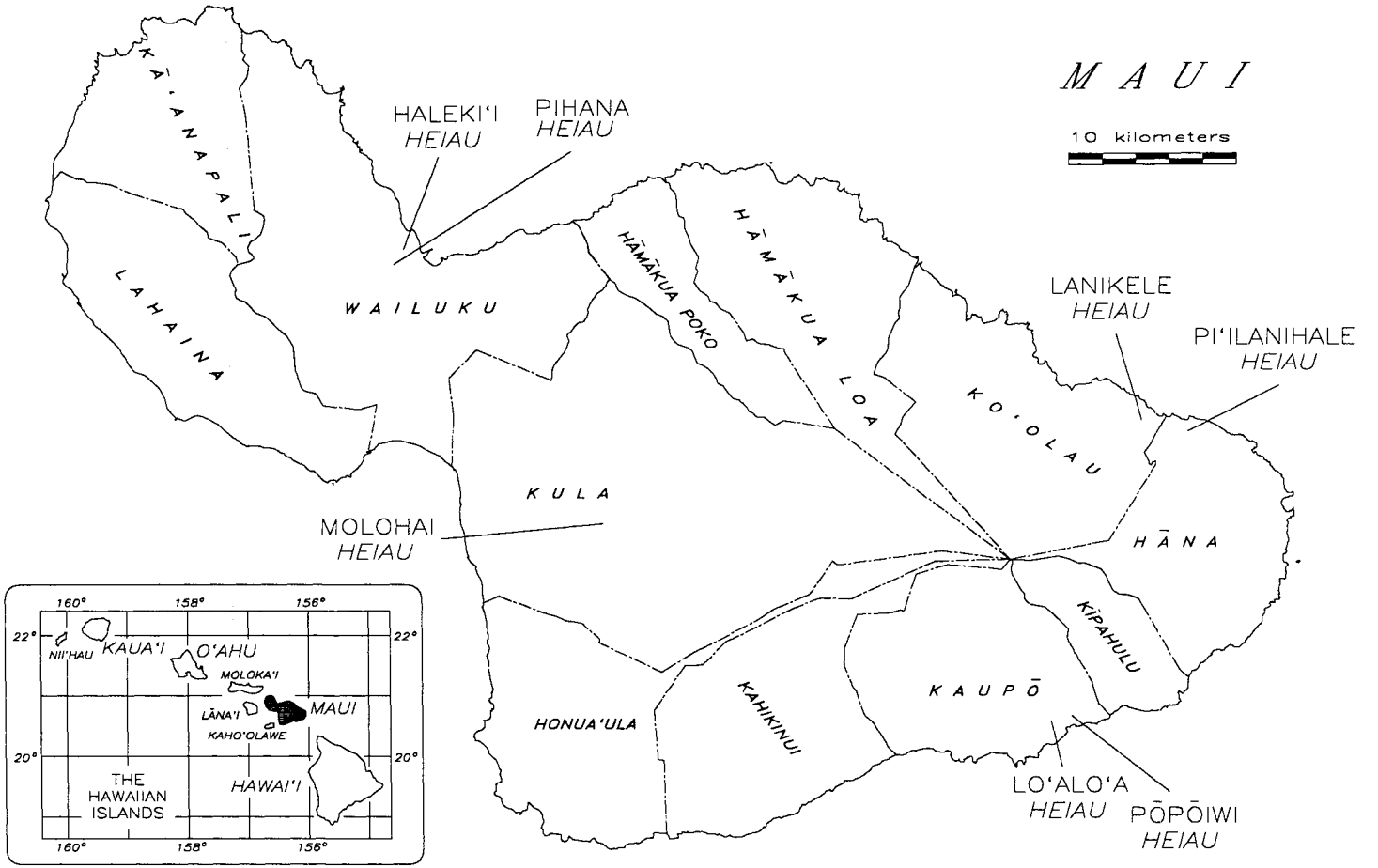

Fig. 1. Locations of seven excavated *heiau* on the island of Maui, Hawai'i.

(Malo 1951:163–172). Sometimes new walls or fences were added, sometimes whole buildings were erected. When the construction project was completed, the *heiau* was again made *kapu* (forbidden). The whole district was then ritually purified, and the temple was reconsecrated with a series of elaborate ceremonies during which hundreds of pigs were baked and consumed. This same process of purification was also undertaken after the completion of a new *heiau*.

It was an arduous task to build a new *luakini heiau*. The construction project required tons of stone for the foundation; special building materials, such as different types of *'ōhi'a* wood for furnishings (Thrum 1910:59); and elaborate rituals of purification. Before any of this could take place, however, the *kahuna kuikuhipu'uone* was summoned. This was the priest concerned with locating and building *heiau*, homes, fishponds, and the like (Malo 1951:163; Valeri 1985:137). This specialized priest was in effect a professional architect, familiar with the building plans and construction techniques of many *heiau*. According to Malo:

> It was his function to exhibit a plan of the *heiau* to the king; because this class of persons were thoroughly educated in what concerned a *heiau*. They were acquainted with the *heiau* which had been built from the most ancient times, from Hawaii to Kauai, some of which had gone into ruins. These *kahuna kuikuhipu'uone* knew all about these old temples, because they studied them on the ground, had seen their sites and knew the plans of them all.
>
> They knew all about the *heiau* which a certain ancient king had built, as a result of which he gained a victory over another king. That was the *heiau*, the plan of which the *kahuna kuikuhipu'uone* explained to the king; and if the king was pleased, he first made a sort of plan of the *heiau* on the ground and exhibited it to the king with an explanation of all its parts, so that he could see where the fence was to be run, where the houses were to stand, and where was the place for the *lananu'umamao* [oracle tower] with the idols. (Malo 1951:161)

The responsibilities of the *kahuna kuikuhipu'uone* suggest that the one goal when constructing a new temple was to imitate, or at least incorporate, architectural elements of *heiau* built by successful rulers. The knowledge of the *kahuna kuikuhipu'uone*, however, was used not to assure accurate duplication of an old plan of construction, but to create new architectural elements or incorporate combinations of older elements. Thus an architect's goal was to design something unique and unlike any previously built structure (Buck 1964:514) but which would immortalize and bring success to a chief by incorporating design features used in the temples of prosperous rulers. This goal is consistent with what is known of *heiau* design plans. Most *heiau* architecture conforms to broad design patterns, but each temple is unique in its stylistic detail or arrangement of internal features (Bennett 1930:21, 1931; McAllister 1933:9; Thrum 1907*b*:50). Variability in *heiau* form is also evident in the placement of the wooden furnishings atop a *heiau* foundation ('Ī'ī 1963:33–35; Malo 1951:162), and in the site plans of a number of *luakini heiau* (Ladd 1970:28–30, 1972, 1986).

Placement

An analysis of temple placement is important for understanding the decision-making process in the construction of a temple. Before construction began, the *kahuna kuikuhipu'uone* was responsible for determining the location and layout of a *heiau*. According to Kamakau (1976:132), a *luakini* temple was often constructed

upon "the site of a place of old." Kamakau's words corroborate the modern Hawaiian aphorism that it is not the *heiau* that makes a place sacred, but rather the place that makes a *heiau* sacred. The construction of a new *heiau* on a "site of old" could mean that a new structure was to be placed in the midst of the ruins of an older temple; that a new structure was to be built on a sacred place such as a hilltop (Manu 1884); or that an existing *heiau* was to be renovated. Historic accounts often use the word *construction* when they mean *renovation* (Fornander 1969, 2:102; Thrum 1908:60). Thus little distinction seems to have been made between the notions of temple "reconstruction" (Valeri 1985:235).

Excavations at 'Āle'ale'a *heiau* (Ladd 1969), Kāne'ākī *heiau* (Green 1980:63–69; Ladd 1970), Pahua *heiau* (Davis 1986), and seven of the eight temples excavated on Maui (Kolb 1991) confirm that some Hawaiian temples were constructed in a series of distinct building stages. Kāne'ākī is considered to have been first a community *heiau* constructed in the sixteenth century A.D., which then was expanded and took on the status of a *luakini heiau* in the seventeenth century A.D. Despite the periodic reconstruction of certain *luakini heiau*, traditional accounts repeatedly suggest that a major building episode of a *luakini* temple could be tied to a significant political event, such as a military conquest or the ascendancy of a ruler. This may or may not hold true for smaller building episodes, such as minor modifications of the features of a *heiau*.

There is also evidence that other criteria were used for the placement of a *heiau*. *Heiau* were often located relative to the domain of a particular god. For instance, fishing shrines are usually found near the sea, under the domain of Kū, Kū'ula, and Hinahele. As a rule, however, most *luakini* temples were located near the communities where the *ali'i nui* resided in each political district (Cordy 1978; Green 1980; 'Ī'ī 1963:160; Kolb 1991). The concept of "sanctity" seems to have been important in locating a *heiau*, and the sanctity of a place could be sufficiently inadequate to cause a priest to request the *ali'i nui* to move a *heiau* because it was built upon "a place where to excrete" (Valeri 1985:254).

The local topography of a temple was intimately tied to the concept of "sanctity." Large *heiau* were generally situated upon prominent locations such as hilltops, bluffs, or knolls (Kolb 1991; Shimizu 1980). High ground affirms the divine and inaccessible nature of high-ranking *ali'i*, while affording an excellent view of the surrounding countryside and coast. Smaller *heiau* were usually placed within villages, upon mountain slopes, in upland valleys, along the coast, or in any other location that would best serve the people (Bennett 1931:35). Shimizu's (1980) analysis of *heiau* topography found that *heiau* on O'ahu were consistently located on the physiographic divisions between the fertile plains and upland areas.

Placing *heiau* upon hilltops or knolls had a strong influence on their design. Local topographical features were often natural outcrops of rock or promontories steeply sloped and incorporated into the overall *heiau* design. Any attempt to examine *heiau* architecture must take into account this Hawaiian practice of incorporating local topography.

Orientation

Temple orientation is important because it can be used to identify variation in temple design. A *mauka-makai* (mountain-sea) alignment in *heiau* orientation seems

to have played a more important role in *heiau* design than an east-west orientation (see Malo 1951:9), as demonstrated by Shimizu (1980) in his comparison of 23 *heiau* foundations from O'ahu. He notes that the basic rectangular shape of most *heiau* foundations is either oriented perpendicular to the coastal-mountain axis or parallel to it. This is also confirmed by the 108 remaining *heiau* found on Maui (Kolb 1991). Ninety-nine of these *heiau* (92 percent) are documented as having their longitudinal axis oriented either perpendicular or parallel to the coast-mountain axis, while the orientation of only nine (8 percent) *heiau* is unrelated to the *mauka-makai* axis. Despite the fact that most island ridges and cliffs are usually oriented along a *mauka-makai* axis, they played little part in the orientation of temples. Temple *mauka-makai* orientation was not usually dependent upon the orientation of a ridge but rather was a purposefully chosen architectural design.

Materials

Practically any available material was utilized in *heiau* construction. Rough field rock and smooth water-worn rock of different varieties and sizes were collected for use. Rocks were dry laid, that is, stacked in such a way as to hold together without the aid of mortar. Lava rock was generally not worked or modified in any way; the natural geometry of lava and basalt slabs was adequate for providing the necessary amount of angularity needed for the dry-laid stacking of rock. However, Fornander writes, "In making his tours around the island, Umi erected several heiaus, distinguished from the generality of heiaus by the employment of hewn stones" (1969, 2:101).

The use of hewn rocks in *heiau* building projects is rare. Hawaiian *heiau* that incorporate hewn rock are all on the island of Hawaii and include Kukuipahu *heiau* (Kohala district), Pōhaku Hanalei *heiau* (Ka'ū district), Hi'iaka *heiau* (Kona district), the stones of which were used for building the first Christian church at Kailua; and Kūki'i *heiau* (Puna district), which incorporated a number of hewn blocks in its construction (see also Stokes 1917:558).

The majority of rocks used in *heiau* construction were extrusive rocks resulting from erupting lava; such rocks were usually collected from the surface rather than quarried. Although most rock used to construct *heiau* came from local sources, some oral traditions suggest that the rock sources for some *heiau* were located far from the building site (Fornander 1969, 2:36)

All lava rock can be classified into two forms that are intergradational in structure but visually distinct, *'a'ā* or *pāhoehoe* (Wentworth and Macdonald 1953). Water-worn rocks (*'alā*) were frequently used as well, particularly water-worn pebbles called *'ili'ili* stones, which were used as pavement.

TEMPLE ARCHITECTURE

What is known about *heiau* architecture comes primarily from archaeological research on the construction sequence of temple foundations. Each temple foundation comprises a series of basic architectural elements. These elements form the basic building blocks of dry-laid rock foundation. Such basic architectural elements are then repeatedly combined in variations to create distinct structural features like the terrace, platform, and enclosure.

By and large, the most striking characteristic of larger *heiau* foundations is how they create a bounded space stylistically more complex than domestic architecture. Larger *heiau* strongly establish this bipolar system of interior space versus outside environment by using certain architectural features, such as enclosure walls or a raised platform, to isolate a ritual space from the surrounding environment. In addition, almost every *heiau* commands a panoramic view of the surrounding area. They are located either upon promontories or directly upon the shoreline, allowing them to be visible from a distance.

Architectural Elements

An architectural element is the basic unit of construction of a *heiau*. The method used to build architectural elements was typical of the early Hawaiian style of building both large and small stone structures. It consisted of stacking rocks into uniform patterns to form a veneer facing, sometimes with an inward slope from the base to the top of the stack for stability. Only compression held these stacked rocks together; neither mortar nor dressing was used.

For the purposes of this study, I define three types of architectural elements: the face, rubble fill, and the floor.

The Face

The most common architectural element found in *heiau* architecture is the face. A face consists of stacked rock, used as a retaining barrier and veneered on one side. A face consists of rocks stacked more than a single course high. These rocks are stacked irregularly (like bricks), forming an interlocking lattice. An important technique that was often used in constructing a face is to wedge small, stone-sized rocks between the larger rocks making up a face (Ladd 1986:10), a process called chinking. These small rocks help to distribute weight evenly and thus to minimize slipping or movement of larger rocks.

Faces vary in the materials used in construction, in height and thickness, and in angle of slope. In the construction of faces, Hawaiian builders most likely used only the eye for accuracy, since opposing faces of a rectangular platform are not always parallel, nor are they always of the same length.

Rubble Fill

Rubble fill constitutes most of the volume of a rock foundation; it consists of a lattice of stacked rock placed behind the veneer of a face. Fill rocks were tightly interlocked in order to minimize the pressure on the exterior portion of the veneer. If fill rocks were stacked improperly, they tended to shift downward and outward, placing extra pressure upon the veneer face. This extra pressure tends to crush the small wedging stones of a face, resulting in the dislodging of the facing rocks and the eventual collapse of the facing. If constructed properly, rubble fill lends support to veneer faces. Facing rocks, which usually protrude behind the veneer into the rock fill, are anchored by the weight of this fill.

Rubble fill is composed of all sizes of rock. Boulders were usually placed at the base of a platform to anchor the construction. Cobble-sized rocks were then placed on top of these boulders, tightly interlocked to stabilize the fill and to distribute their weight evenly onto the underlying boulders. Small cobble-sized and large pebble-

sized fill rocks were then placed on top of these cobbles in the same manner. Many times gravel and pebble-sized rocks were used as wedges to stabilize and support larger rocks. Smaller rocks were also used as rubble fill placed inside walls.

The Floor

A floor, sometimes called a surface, is a horizontal area of construction. A floor can either be natural, such as an outcrop of smooth lava, or manmade, like the stone paving found on a platform. A floor was laid down to level and smooth an activity area. A floor was uniformly covered with smooth cobbles, carefully laid to form a lattice. Sometimes dirt was also used. A pebble-sized rock pavement can be composed of rough lava, smooth water-worn stones, or a combination of both. The average floor is about 0.2 m deep, but it can be as thick as 1 m. A floor can be described in terms of its rock composition, such as a pavement of water-worn stones or one of *'a'a* rock.

Structural Features

Architectural elements were combined and recombined in variations to create structural features. Because these elements can form many different combinations, the structural features defined here represent ideal forms, that is, they are combinations of contiguous architectural elements that are repeatedly used. Three primary types of structural elements are prevalent; terraces, platforms, and walls.

The Terrace

A terrace is a level area composed of a series of retaining faces, but which always has at least one side that is not modified with a face (Fig. 2). A terrace was built by erecting a face at the base of a slope and then placing rock fill or sediment behind in order to raise it level with the top of the face and create a surface. Many times a slope was cut away at the base of the facing, and then the removed rock was used as rubble

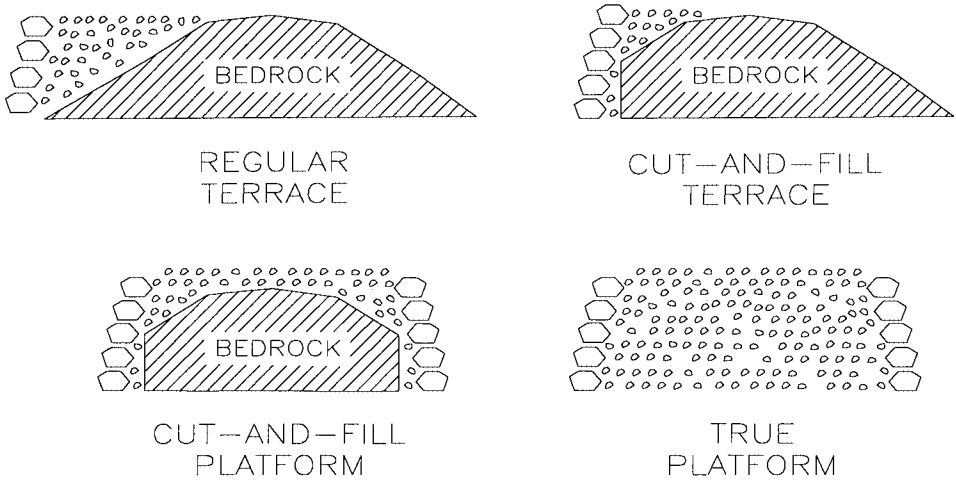

Fig. 2. Schematic views of terrace and platform construction techniques (side views).

fill. This is called a cut-and-fill terrace. A cut-and-fill terrace appears higher than it really is because the natural slope of the rock beneath the face appears to be integral with the face itself.

The Platform

A platform is a level area formed by retaining faces on all sides (Fig. 2). A platform is stylistically more complex than a terrace since it consists of more faces. A platform that incorporated a natural feature such as a hilltop required less labor for its construction than a true platform. Four faces were erected along the boundary of the hill, sometimes using the cut-and-fill method. Kamakau gives a good description of the construction of *heiau* platforms: "The hardest work in making heiaus of the ancient days was in laying the stones (*'oka nini i ka pohaku*). If the heiau was on a cliff or hillside, stones had to be laid and interlocked (*hahau me ka ho'oniho i ka pohaku*) until they reached the highest level." (1976:135).

A true platform, rather than a veneered outcrop, involved considerably more labor and material to construct. A true platform required erecting four separate faces layer by layer while rubble fill was placed behind the growing face.

The Wall

A wall is a double-faced, free-standing rock structure, with rubble fill placed between the two faces (see Bennett 1931:36–37). On Maui, walls were found to be of two varieties (Fig. 3). A wall of stacked construction is regularly faced with cobbles and filled with rocks similar in size to those used in its faces. A wall of core-filled construction is also regularly faced, but the rubble fill between the faces consists of smaller pebble-sized rock.

Temple Form

Using combinations of structural features, *heiau* architects designed and constructed a vast array of temple design types. Most *heiau* foundations, however, are a single structural feature around or upon which additional faces or walls were con-

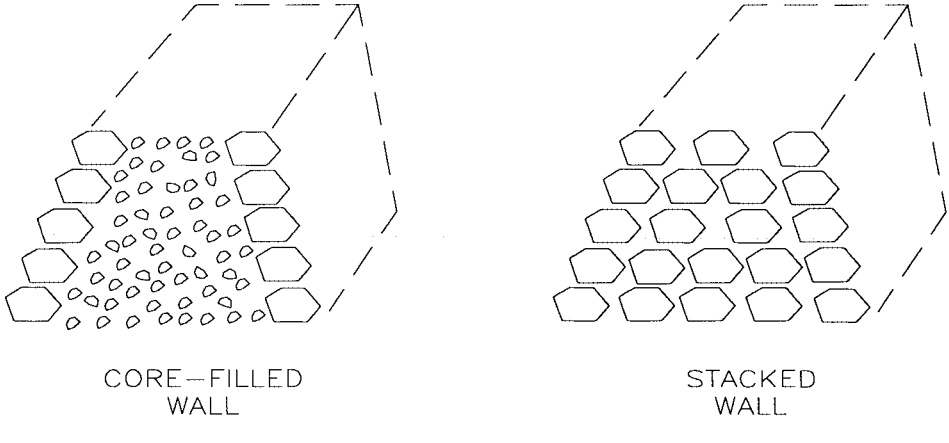

Fig. 3. Schematic views of *heiau* wall types (side views).

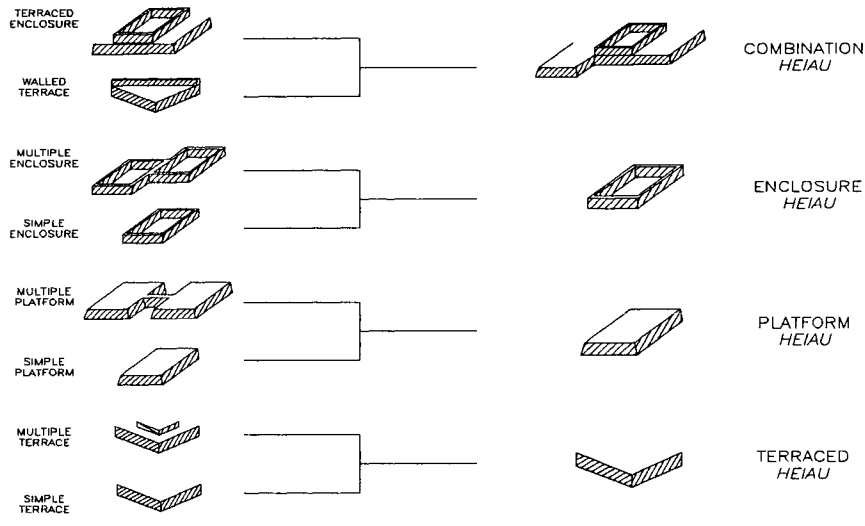

Fig. 4. *Heiau* architectural types and subtypes, from least (bottom) to most (top) complex.

structed. On Maui, four general architectural styles of *heiau* foundations seem to be present: (1) terraced *heiau*; (2) platform *heiau*; (3) enclosure *heiau*; and (4) combination *heiau*. These four discrete categories encompass the entire range of *heiau* design found on Maui, although a series of subtypes exist. These subtypes provide a heuristic means to describe *heiau* variability within the context of temple construction.

Figure 4 illustrates the various *heiau* architectural types found on Maui. Twenty-nine of 108 *heiau* (27 percent) are terraced *heiau*. Terraced subtypes include simple terraces, multiple terraces, and walled terraces (also see Bennett 1930:19). The walled-terrace *heiau*, 16 of which are found on Maui, is a terrace with walls located on its up-slope or nonterraced side. The walled-terrace *heiau* is not an enclosure built upon retaining terraces, but rather a simple terrace with one or two walls built upon it. The walled-terrace is also not as complex as a combination *heiau*. Unlike combination *heiau*, most of the walled-terrace *heiau* on Maui appear to have been constructed in a single building episode. This placement of a wall on the nonterraced side of a terraced *heiau* corroborates traditional information that suggests the architect opted to use a combination of walls and faces to create an enclosed ritual space.

Twenty-one of 108 *heiau* (19 percent) are platforms, possessing retaining faces on all sides. Of these 21 platform foundations, two comprise multiple platforms. Of the temples excavated on Maui, Haleki'i *heiau* (Wailuku district) is an example of a simple platform, while neighboring Pihana *heiau* is an example of a multiple platform.

The most numerous type of Maui *heiau* is the walled-enclosure *heiau*, of which there are 46 (43 percent). Forty of these are simple in design, that is, they consist of a temple made up of a single confined space. Six of these enclosures possess multiple confined spaces. The remaining nine enclosures are terraced, that is, some of their enclosure walls are buttressed by retaining terraces. The terraced-enclosure is similar in design to the walled-terrace *heiau* but is slightly more complex because it pos-

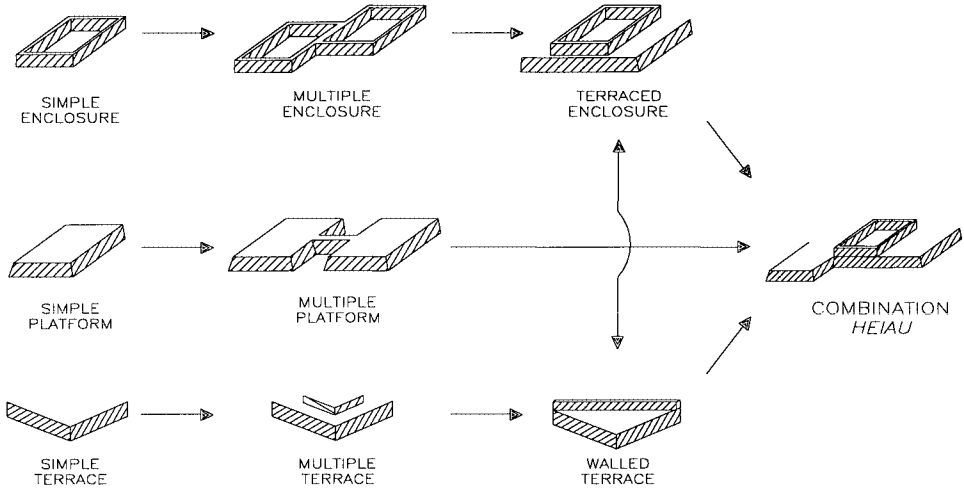

Fig. 5. Hierarchy of *heiau* designs.

sesses a complete set of walls. Molohai *heiau* (Kula district) is an example of a simple enclosure, while Lanikele *heiau* (Ko'olau district), is an example of a terraced enclosure. On Maui, of the 87 *heiau* that possess walls (enclosures, walled terraces, and combination *heiau*), 38 foundations have stacked walls while 39 have core-filled walls. Ten *heiau* have a combination of both stacked and core-filled walls.

The remaining 12 temples (11 percent) are combination *heiau*. The largest and most architecturally complex are Pi'ilanihale *heiau* (Hāna district) which is a terrace *heiau* with platforms flanking its east and west sides; Pōpōiwi *heiau* (Kaupō district), a multiple-terraced foundation with a large enclosure on its top; and neighboring Lo'alo'a *heiau*, a platform with an abutting terrace.

In terms of architectural types, terraced *heiau* represent the least complex style because they always incorporate natural topographic features, such as bedrock outcrops. Platforms and enclosures are more architecturally complex designs because they incorporate few, if any, topographic features. Combination *heiau*, the most complex type, are temple foundations that combine a series of structural features, such as a platform with an enclosure, a series of enclosures, or several small structures. Combination *heiau* are usually quite large.

Heiau subtypes can also be ranked according to their relative complexity (Fig. 5). The first level of complexity includes simple terraces, simple platforms, and simple enclosures. At the next level are the multiple structures. The walled-terrace and the terraced-enclosure structures represent the third level of complexity among *heiau* subtypes. They are more complex because they represent a blending of the terraced style and the enclosure style. There is no platform counterpart at this level of complexity, since all platforms on Maui seem to be devoid of major walls or large enclosures. Some platforms, however, do possess additional terraces, which are used to buttress the platform faces, forming a sort of stepped platform. Platforms that require buttressing terraces are usually so large and complex that they can be classified as combination *heiau*.

Fig. 6. Hierarchy of *heiau* shapes.

Temple Shape

Another way to categorize *heiau* design is according to temple shape formed by terraces, platforms, and enclosures. *Heiau* foundations tend to form rectilinear polygons, that is, closed-plane areas bounded by a series of straight sides. These polygons can be aligned along a continuum from simple to complex. Simple shapes possess fewer sides, while complex shapes possess many sides. Figure 6 depicts the various *heiau* shapes from simple to complex.

On Maui, the most common *heiau* shapes are rectangular and notched. Rectangular *heiau* are convex four-sided polygons where the sides are roughly at right angles. A notched *heiau* is similar to a rectangular temple with a corner removed, so that it resembles a thick L shape (Walker 1933). Thus notched shapes are concave rectilinear polygons that possess six sides.

Four of the 108 Maui *heiau* (4 percent) have three sides. These represent the simplest designs. They include three terraced temples made up of two faces, and a single triangular platform temple. Fifty-five of 108 *heiau* (51 percent) have four sides and are rectangular in shape. These include platforms, enclosures, and walled terraces. Thirty-nine (36 percent) *heiau* have six sides and so are notched. Notched *heiau* can be of any form—terraces, platforms, enclosures, or combination. Interestingly, the notched or concave end is always on the *mauka* or up-slope side of these six-sided structures. This notching may have provided additional support for a wooden superstructure. Ten *heiau* (9 percent) have more than six sides. These include multiple terraces, multiple platforms, multiple enclosures, and combination *heiau*. *Heiau* with more than six sides tend to be larger and more complex than most temples, such as the combination *heiau*.

Although six-sided structures are believed to be a specialized shape common to

TABLE 2. *HEIAU* STYLES BY MODAL AREA ON MAUI

TEMPLE STYLE	NUMBER OF *HEIAU*	MEAN SITE AREA (m^2)	MEDIAN SITE AREA (m^2)
Simple terrace	7	251.1	247.0
Multiple terrace	6	1538.3	343.5
Walled terrace	16	543.3	477.5
All terraced	29	678.7	364.0
Simple platform	19	846.9	498.0
Multiple platform	2	2148.5	2148.5
All platform	21	970.9	498.0
Simple enclosure	31	427.4	297.0
Multiple enclosure	6	729.7	683.5
Terraced enclosure	9	776.9	699.0
All enclosure	46	535.2	355.5
Combination	12	2929.4	1324.5
All *heiau*	108	924.0	416.0

Maui (Bennett 1930:18), *heiau* of the notched variety can be found on neighboring islands. Examples can be found on Hawai'i and Kaua'i (Bennett 1930:app. A), Lāna'i (Emory 1924:61, 63), as well as O'ahu (author, personal observation). Kāne'ākī *heiau* is also notched, a shape believed to have been added late in the structure's construction sequence (Ladd 1970). The presence of the six-sided shape on neighboring islands suggests possible ceremonial or chiefly influence from Maui, influence that may have occurred within the context of the Maui chiefly ascendancy in the eighteenth century A.D. (Cordy 1981).

Temple Size

Survey data from the *heiau* on Maui also prove useful for examining patterns of *heiau* size. Table 2 is a breakdown of *heiau* sizes for the 108 *heiau* on Maui. These temple foundations have a mean size of 924.5 m^2 and a median of 416 m^2. They range in size from 36 m^2 to 12,126 m^2. The frequency distribution of Maui *heiau* size reveals a skewed unimodal distribution with 88 (82 percent) less than 1000 m^2 (Fig. 7). Of these 88 *heiau*, 64 (57 percent) are under 500 m^2. The 20 *heiau* over 1000 m^2 are quite large, suggesting they served as important temples. The recorded functions of ten of these *heiau* confirm this; five are *luakini* temples, three are important chiefly residential structures, and one is a *pu'uhonua* (place of refuge).

Not surprisingly, the largest temple foundation type is the combination *heiau*, which has a mean size of 2929.4 m^2 ($n = 12$). The large size of combination *heiau* is probably due to the temples being intermittently expanded through time. Platform

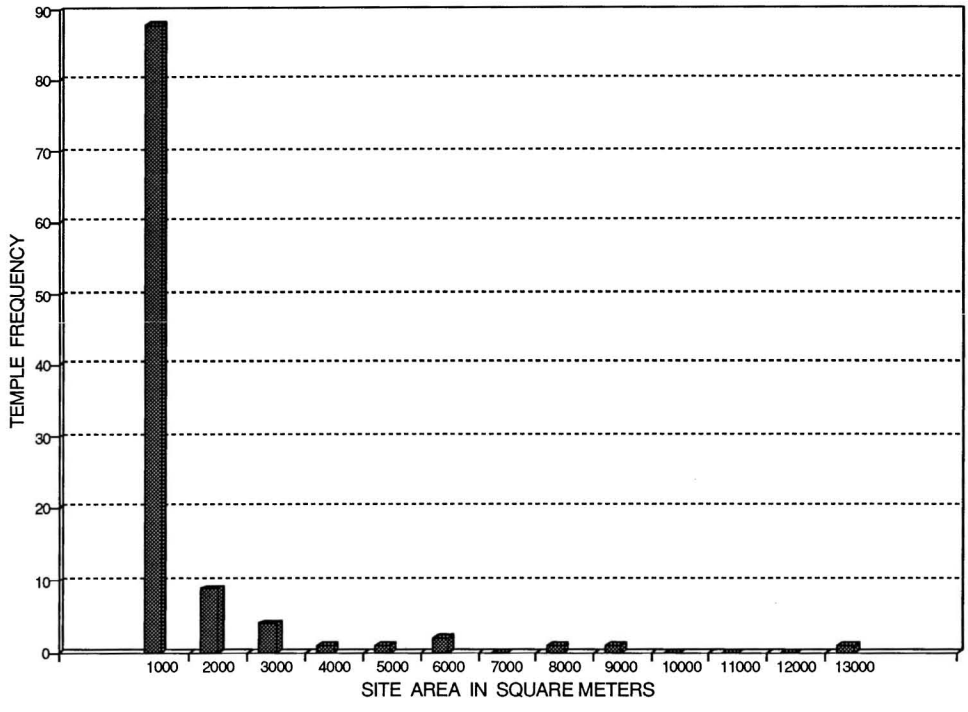

Fig. 7. Frequency histogram of *heiau* size on Maui.

heiau represent the second largest design, also because they were intermittently expanded through time. Platforms have a mean site size of 970.9 m^2 ($n = 23$). The mean size of a terraced *heiau* is 678.7 m^2. Multiple terraces (mean of 1538.3 m^2) are larger than walled terraces (mean of 543.3 m^2), and both are larger than simple terraces (mean of 251.1 m^2). Enclosures represent the smallest type, having a mean site size of 535.2 m^2. Multiple enclosures (mean of 729.7 m^2) are larger than simple enclosures (mean of 427.4 m^2), as well as most simple and walled terraces.

DIACHRONIC VARIATION IN TEMPLE DESIGN

As noted above, previous research has posited a model with which to explain variability of *heiau* design. This model holds that temples became larger and more elaborate as ancient Hawaiian society grew increasingly complex. Thus systematic variability in temple design reflects change in the nature of Hawaiian society, including the development of a distinct elite class who commissioned larger *heiau* for their use.

Although only a few *heiau* have been dated, it is clear that testing this model requires a detailed examination of diachronic temple design. Excavations undertaken at seven *heiau* on Maui (Fig. 1) provide a preliminary means by which to develop a relative chronology of temple design. This information on temple chronology is then used to examine the distribution of temple types on the island of Maui.

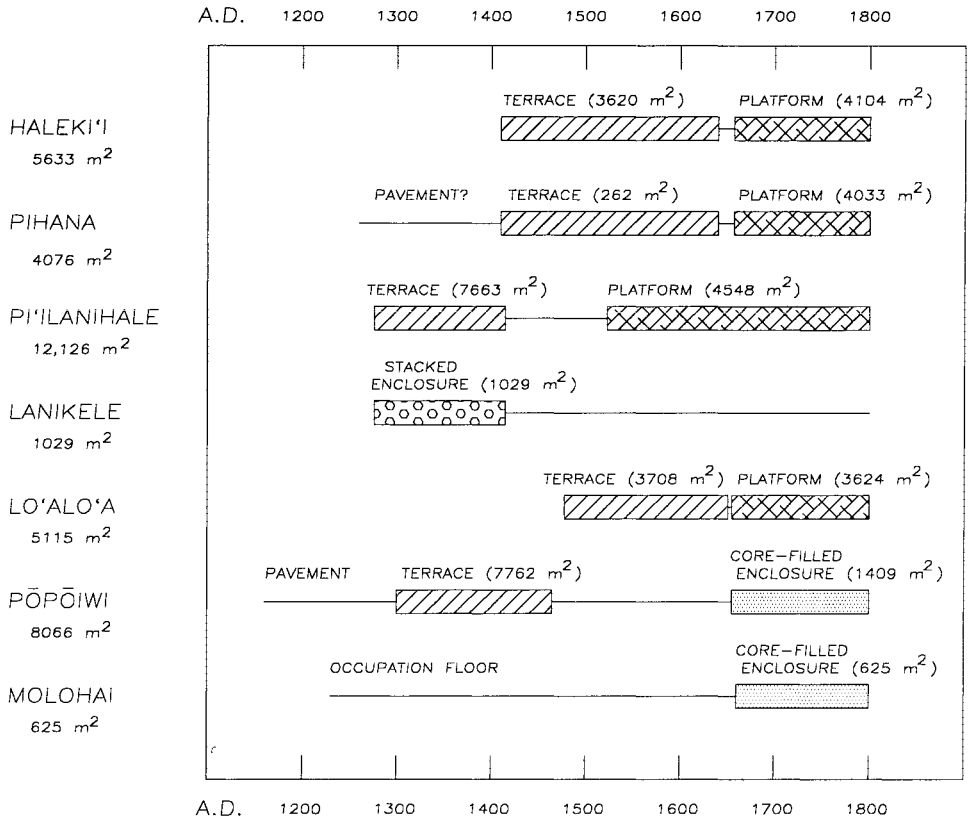

Fig. 8. Construction episodes for seven Maui *heiau*.

A Chronology of Temple Style

Chronological evidence from seven *heiau* on Maui indicates that none of them was constructed in the early period of Hawaiian history (Kolb 1991:196–260). The earliest building episodes from four different *heiau* date to A.D. 1235–1374, a time when Hawaiian society was growing increasingly complex. Terraces represent one of the earliest stylistic designs, used between A.D. 1200 and A.D. 1600. Enclosures and full platforms, on the other hand, were styles extensively used after A.D. 1600.

Figure 8 depicts the relative architectural growth of the seven excavated Maui *heiau*. At least four and possibly five of the seven were originally constructed as terraces. The best evidence for the antiquity of terraces comes from Pi'ilanihale *heiau* at Honomā'ele (Hāna district). Pi'ilanihale is a combination *heiau* consisting of two platforms linked by a large central terrace. Stratigraphic evidence suggests that this central terrace was originally constructed to fill in the shallow ravine that once bisected the *'a'ā* hill upon which Pi'ilanihale was placed. Radiocarbon dating of the various structural features at Pi'ilanihale confirms that the central terrace was in use c. A.D. 1276–1415.

The multiple terraces at Pōpōiwi *heiau* at Kahua'i (Kaupō district), a combination structure that served as a *pu'uhonua*, were built c. A.D. 1300–1465. Excavations at

neighboring Lo'alo'a *heiau* at Kepio (Kaupō district), a combination *heiau* that served as a *luakini* temple, reveal that it was originally a terraced *heiau* constructed c. A.D. 1478–1651.

The early construction sequence of Pihana *heiau* at Wailuku (Wailuku district), a multiple platform that served as a *luakini* temple for the high chiefs of West Maui, also reveals the presence of terraces. Although the construction style of the earliest building sequence at Pihana is somewhat unclear due to the repeated renovation of the structure, a terrace was added to the south end c. A.D. 1410–1640. The initial building episode of neighboring Haleki'i *heiau*, a chiefly residential complex, was also a terrace built during the same time period.

Platforms represent a stylistic type that is more recent than terraces. Evidence supporting the notion that platforms are a relatively recent stylistic development comes from four of the Maui *heiau*. For example, both Haleki'i and Pihana *heiau* at Wailuku were converted to platforms after A.D. 1657. Similarly, the two platforms flanking the central terrace at Pi'ilanihale were added at a later date, sometime after A.D. 1523, and the east terrace at Lo'alo'a *heiau* was converted to a platform sometime after A.D. 1655.

Evidence from Lanikele *heiau* located at 'Ula'ino (Ko'olau district), an enclosure that served as a navigational *heiau*, indicates that it was constructed as early as many terraced structures. Charcoal samples recovered from the base of the walls of the structure indicate that Lanikele was constructed c. A.D. 1276–1415. Evidence from Molohai *heiau* at Kēōkea (Kula district), on the other hand, suggests that enclosures were also used late in the course of Hawaiian history. Molohai is a simple enclosure of the notched variety constructed in a single building episode sometime after A.D. 1660. Although no charcoal was recovered from the base of the enclosure walls at Pōpōiwi or the large wall at Pi'ilanihale, these walls are associated with building episodes dated to sometime after A.D. 1655 at Pōpōiwi and sometime after A.D. 1657 at Pi'ilanihale.

One trait that might clarify the continued use of the enclosure is the variation present in wall types. Stratigraphic evidence and comparative dating from four *heiau* demonstrate that walls of stacked construction are older than walls of core-filled construction. Lanikele *heiau*, for example, was constructed with stacked walls, while Molohai *heiau* was constructed mostly with core-filled walls. Furthermore, stratigraphic evidence from Pi'ilanihale and Pōpōiwi *heiau* indicates that walls of stacked construction were modified at a later date with core-filled extensions.

Another trait that may account for the antiquity of Lanikele is its shape. Lanikele, unlike Molohai *heiau*, is a square rather than a notched enclosure. Notched *heiau*, which represent a stylistic type from Maui, may be a relatively late design feature that developed from rectangular *heiau*. Evidence supporting this idea comes from ^{14}C dating of two other notched enclosures at Waiohuli (Kula district): Kaumehe'iwa *heiau* and SIHP #50-50-10-2042 (Brown et al. 1989:21). Radiocarbon dating of domestic occupation levels that predate the construction of both these structures indicates that these *heiau* must have been constructed after A.D. 1650. Domestic occupation before A.D. 1650 was also present at Molohai *heiau*.

Construction evidence from other islands, although somewhat sparse, corroborates the Maui sequence. A ^{14}C sample collected from the base of Kāne'ākī *heiau* at Mākaha (Wai'anae district, O'ahu), a multiterraced *heiau*, yielded a date of 405 ± 95

B.P. (Ladd 1970:30). This date produces a bidecadal calibrated range of A.D. 1319–1660 at 95 percent confidence (Stuiver and Reimer 1987), a range consistent with terraced *heiau* constructed on Maui.

In contrast to the Maui *heiau*, however, evidence from the island of Hawai'i suggests that platforms there may represent an early stylistic design. Radiocarbon samples recovered from the base of 'Āle'ale'a *heiau* at Hōnaunau (Kona district, Hawai'i), a platform *heiau*, produced dates of 790 ± 200 B.P. and 800 ± 200 B.P. (Ladd 1969:130). The bidecadal calibrated date ranges at 95 percent confidence for these dates are A.D. 860–1470 and A.D. 812–1460 respectively (Stuiver and Reimer 1987). A volcanic glass sample from Site A-27, a possible platform from Hōnaunau, resulted in a date of 610 ± 50 B.P., or a date range of A.D. 1270–1470 (Ladd 1987:77).

Unfortunately, dates from 'Āle'ale'a are somewhat tenuous (see Ladd 1969:app. B), as is hydration-rim dating of volcanic glass (Olson 1983). The discrepancy between the antiquity of platform temples from Maui and Hawai'i islands could suggest that regional stylistic preferences varied between islands. However, the two platform *heiau* at Hōnaunau are not as large as the three combination *heiau* on Maui.

The date from the enclosure walls at Molohai correlates with the only other date recovered from an enclosure *heiau*: Structure A at Waha'ula *heiau* (Puna district, Hawai'i). The date from Structure A is 185 ± 50 B.P. (Carter and Somers 1990:Table 8; Ladd 1987:76), which yields a calibrated range of A.D. 1430–1955 at 95 percent confidence (Stuiver and Reimer 1987).

A Chronology of Temple Size

As noted above, it has been postulated that variability in *heiau* size may be linked to changes in Hawaiian worship through time. As ancient Hawaiian religion grew increasingly complex, it would be expected that larger and more complex *heiau* were constructed. Chronological evidence from five of the seven Maui *heiau* that were examined (Pihana, Haleki'i, Pi'ilanihale, Lo'alo'a, and Pōpōiwi) suggests that these structures increased in size through time (Fig. 8). The building sequence at Pihana *heiau*, in particular, reveals the most dramatic change in size through time. Pihana was a multiterraced structure of less than 1000 m^2 before A.D. 1640, and then was eventually refurbished by adding multiple platforms of 4548 m^2. Only Lanikele and Molohai *heiau*, the two enclosures that were constructed in relatively short periods of time, did not increase in size through time.

Although the overall size of combination *heiau* increased through time, the relative size of the building episodes from three *heiau* decreased through time. The most pronounced decrease was at Pōpōiwi *heiau*, a terrace of 8066 m^2 that was converted to a combination *heiau*. The enclosure placed atop the structure after A.D. 1655 (1409 m^2) was considerably smaller than Pōpōiwi's original terraces (7762 m^2). Similarly, the two platforms added to the terrace at Pi'ilanihale *heiau* (4548 m^2) were also considerably smaller than the original terrace to which they were added (7663 m^2). Lo'alo'a *heiau* also saw a reduction in the size of building episodes through time. Only Haleki'i and Pihana *heiau* showed a relative increase in the size of their building episodes through time.

SPATIAL VARIATION IN TEMPLE DESIGN

It is possible to elucidate variation in temple design by examining *heiau* spatial distribution according to the various geographic and ecological zones of Maui. The chi-square technique, a statistical method for analyzing categorical data, can be employed to test regional distributions of *heiau* design features. The purpose of the chi-square and its resultant test statistic, χ^2, is to test whether or not observed frequencies within a data set conform to a model of expected frequencies for that data set (Kuebler and Smith 1976:236). A probability of less than 5 percent ($p < 0.05$) will be judged statistically significant.

Four chi-square comparisons were performed with the Maui *heiau* architectural data (Tables 3–6). Each comparison examines the distribution of an architectural trait over the four geographic and ecological zones of Maui (Fig. 9):

- Zone 1 comprises windward areas where wetland agriculture was utilized. It is characterized by perennial streams and high amounts of annual rainfall. The amount of arable land in Zone 1 is relatively small given the steepness of the stream valleys. Zone 1 districts include Hāmākua Loa, Hāmākua Poko, Kīpahulu, and Ko'olau.
- Zone 2 comprises windward areas where dryland agriculture was primarily practiced. It is characterized by a lack of perennial streams but ample annual rainfall. Zone 2 districts include Hāna and Kaupō.

TABLE 3. COMPARISON OF *HEIAU* STYLES BY ECOLOGICAL ZONE ON MAUI

TYPE	ZONE *1*	ZONE *2*	ZONE *3*	ZONE *4*	ALL
Terrace	6 (2)	16 (6)	2 (−2)	5 (−7)	29
Platform	2 (−1)	6 (−1)	5 (2)	8 (−1)	21
Enclosure	5 (−1)	6 (−9)	7 (1)	28 (11)	46
Combination	0 (−1)	8 (4)	1 (−1)	3 (−5)	12
All	13	36	15	44	108

$\chi^2 = 27.90$, $df = 9$, $p < 0.0010$

Note: Numbers in parentheses represent the residuals (observed minus expected frequencies).

TABLE 4. COMPARISON OF *HEIAU* WALL TYPES BY ECOLOGICAL ZONE ON MAUI

WALL TYPE	ZONE *1*	ZONE *2*	ZONE *3*	ZONE *4*	ALL
None	4 (1)	7 (−1)	3 (0)	8 (2)	22
Core-filled	2 (−3)	12 (−5)	5 (−2)	29 (9)	48
Stacked	7 (2)	22 (5)	9 (2)	10 (−10)	48
All	13	41	17	47	118

$\chi^2 = 20.14$, $df = 6$, $p < 0.0026$

Note: Numbers in parentheses represent the residuals (observed minus expected frequencies).

TABLE 5. COMPARISON OF *HEIAU* SHAPES BY ECOLOGICAL ZONE ON MAUI

SHAPE	ZONE *1*	ZONE *2*	ZONE *3*	ZONE *4*	ALL
2- or 3-sided	2 (1)	2 (2)	1 (0)	1 (−1)	6
4-sided	9 (3)	22 (5)	5 (−2)	16 (−5)	52
6-sided	2 (−3)	5 (−8)	8 (2)	25 (9)	40
8- or 10-sided	0 (−1)	7 (4)	1 (0)	2 (−2)	10
All	13	36	15	44	108

$\chi^2 = 26.02$, $df = 9$, $p < 0.0020$

Note: Numbers in parentheses represent the residuals (observed minus expected frequencies).

TABLE 6. COMPARISON OF *HEIAU* SIZE BY ECOLOGICAL ZONE ON MAUI

SIZE	ZONE *1*	ZONE *2*	ZONE *3*	ZONE *4*	ALL
500 m² or less	7 (−1)	20 (−1)	5 (−2)	30 (5)	62
500–1000 m²	2 (−1)	9 (0)	4 (0)	11 (0)	26
1000 m² or more	4 (2)	7 (0)	6 (3)	3 (−5)	20
All	13	36	15	44	108

$\chi^2 = 10.20$, $df = 6$, $p > 0.1164$

Note: Numbers in parentheses represent the residuals (observed minus expected frequencies).

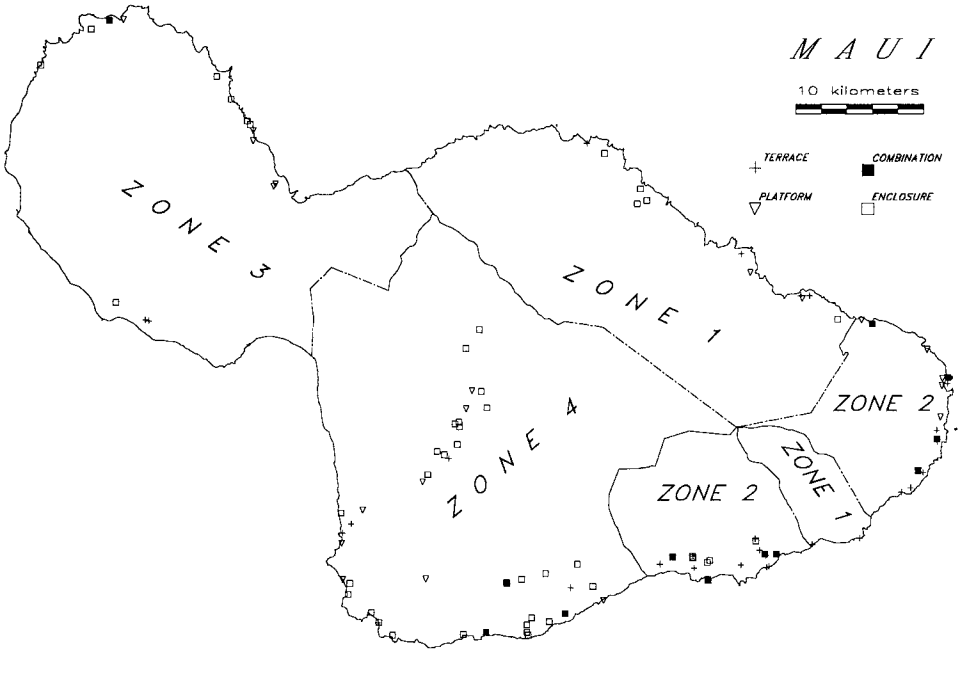

Fig. 9. Geographic and ecological zones of Maui, with distribution of 108 *heiau* by style.

- Zone 3 comprises drier areas where wetland agriculture was utilized. It is characterized by perennial streams, but receives smaller amounts of annual rainfall than Zone 1 or 2. Zone 3 districts include Kā'anapali, Lahaina, and Wailuku.
- Zone 4 comprises the very arid leeward areas where dryland agriculture was practiced. It is extremely arid and lacks perennial streams and even moderate amounts of rainfall. Zone 4 districts include Honua'ula, Kahikinui, and Kula.

The first chi-square test examines the distribution of terrace, platform, enclosure, and combination *heiau* within the four ecological zones of Maui. Visual perusal of *heiau* types (Fig. 9) suggests terraced and combination *heiau* appear to be concentrated in Zone 2 districts, such as Hāna and Kaupō. Platform *heiau* appear to be evenly distributed across Maui. In contrast, enclosures appear to be concentrated in Zone 4, the arid leeward districts, such as Honua'ula, Kahikinui, and Kula. A chi-square test is useful for statistically confirming this visual pattern. The null hypothesis for this chi-square test states that the distribution of stylistic types is the same for all four ecological zones. The resultant χ^2 of 27.70 ($df = 9$) is statistically significant ($p < 0.001$). Upon examination of the residuals (observed minus expected frequencies) in Table 3, one can see that terraced and combination *heiau* are indeed concentrated in Zone 2, enclosures are concentrated in Zone 4, and platforms are evenly distributed.

The second chi-square test was applied to these data to examine the distribution of wall types. The null hypothesis for this test states that the distribution of core-filled and stacked walls should be the same for all four ecological zones. A third category of those *heiau* lacking walls was also added. Note that 10 *heiau* possess both types of walls. A χ^2 statistic of 20.14 ($df = 6$) is statistically significant ($p < 0.0026$), forcing the rejection of the null hypothesis. An examination of the residuals in Table 4 reveals that core-filled walls are concentrated in Zone 4 (leeward/dryland) but sparse in all other zones. Stacked walls, on the other hand, are prevalent in Zones 1, 2, and 3, but not concentrated in Zone 4.

A third chi-square test was applied to these data to examine the distribution of *heiau* shape. Shapes include four-sided or rectangular *heiau*, six-sided or "notched" *heiau*, *heiau* with less than four sides, and *heiau* with more than six sides. The null hypothesis states that the distribution of rectangular and notched *heiau* should be the same for all four ecological zones. A χ^2 of 26.02 ($df = 9$) is statistically significant ($p < 0.002$), forcing a rejection of the null hypothesis. Upon examination of the residuals in Table 5, one can see that rectangular *heiau* are concentrated on the windward side of Maui (Zones 1 and 2), while notched *heiau* are concentrated on the leeward side of the island (Zones 3 and 4).

The final chi-square test examines the distribution of *heiau* less than 500 m^2, *heiau* between 500 and 1000 m^2, and *heiau* larger than 1000 m^2. Certain districts that have been commercially developed, as noted above, could also have disproportionately fewer *heiau*. The null hypothesis for this test states that the distribution of temple size is the same for all four ecological zones. The resultant χ^2 of 10.20 ($df = 6$) is not statistically significant ($p < 0.1164$). An examination of the residuals in Table 6 however, reveals that Zone 4 (leeward/dryland) does possess a slightly smaller proportion of larger *heiau* than the other zones. It also has a larger proportion of smaller *heiau*.

Regional Variability

Spatial variation in *heiau* design may reflect regional stylistic preferences between competing polities. *Heiau* style may reflect the amount of social interaction that occurred between social units (Deetz 1965; Hill 1977; Longacre 1970; Plog 1976; Whallon 1968), or it may have been used to encode social information, convey group identity, and enforce boundary maintenance (Conkey 1978, 1980; Wilmsen 1973; Wobst 1977).

The dichotomy between windward and leeward styles would therefore represent stylistic preferences of *heiau* designs between East Maui (Zones 1 and 2) and West Maui (Zones 3 and 4). Both East and West Maui were powerful polities whose relationship was one of rivalry and conflict (Cordy 1981; Hommon 1976, 1986; Kolb 1991). Terraces, combination *heiau*, stacked walls, and rectangular shapes may represent the stylistic preferences of the East Maui chiefs. Enclosures, core-filled walls, and notched shapes may represent West Maui styles. The fact that East Maui was eventually annexed by the West Maui chiefs might explain why West Maui styles such as core-filled enclosures came into prominence after A.D. 1650.

Diachronic Variability

Spatial variation in *heiau* design may also reflect diachronic change. In the Hawaii islands, the growth and stability of human society was strongly related to environmental variability (Cordy 1974; Green 1980:71; Hommon 1976; Kirch 1985, 1990). Windward areas with their relatively wet and stable environment would have been preferred by early Polynesian settlers because such areas could support populations with a combination of wetland and dryland crops. Thus areas with more rainfall would have contained dense populations earlier than leeward areas with their lack of fertile soils and their infrequent rainfall.

We would expect that the oldest *heiau* types, like the terrace, would be prevalent in Zones 1 and 2 (regions with early dense population), while newer, *heiau* types, like the notched enclosure, would be prevalent in Zone 4 (a region that became densely populated late in the course of Hawaiian history). Zone 3, which is a somewhat arid region possessing perennial streams, should have a mix of older and new designs. We would also expect that stacked walls would be more prevalent in Zones 1 and 2, while core-filled walls would be prevalent in all zones.

Comparative dating of *heiau*-building episodes confirms that *heiau* found in Zones 1 and 2 were constructed first (Fig. 8). These include the terraces built at Pi'ilanihale and Pōpōiwi *heiau*, and the stacked enclosure of Lanikele *heiau*, all constructed c. A.D. 1250–1450. Early occupation was also present at Pihana and Molohai *heiau*, but activity at these *heiau* predates the construction of the rock structures. Haleki'i and Pihana *heiau* were the next structures to be built. These Zone 3 *heiau* were constructed c. A.D. 1400–1650. The last region of *heiau* construction was Zone 4, where core-filled enclosures were constructed sometime after A.D. 1650.

We would also expect that the complexity and size of *heiau* types would increase through time. Platform and combination *heiau*, which represent more complex temple designs, should be more prevalent in Zones 1 and 2, since they represent older structures that were periodically reconstructed. Larger, single-building-episode *heiau*

would be more prevalent in Zone 4, since drier areas were densely occupied late in the course of Hawaiian history when temples were increasing in size.

The presence of more combination *heiau* in Zone 2 confirms that they represent older and thus refurbished temples. This suggests that chiefs in Zone 2 took advantage of existing structures rather than relying on the construction of new temples. The relatively even distribution of platforms suggests they are neither the oldest nor the newest temple design.

Although *heiau* size does not appear to vary spatially, there does seem to be a slightly disproportionate number of small/large *heiau* in Zone 4 only. The larger number of smaller *heiau* in Zone 4, as well as the building episodes from three combination *heiau*, raises the possibility that the overall labor invested into temple construction decreased through time. Chiefs in Zones 1 and 2 may have been taking advantage of existing structures rather than constructing new temples, while fewer people (or less powerful chiefs) were involved in the construction of *new* temples in Zone 4. Such a decrease in overall labor may also reflect a change in the scale of community organization (see Hommon 1986), or it may suggest that the ritual function of a temple became more important as chiefs became less concerned with the size of their temples.

SUMMARY

This study analyzes *heiau* architecture by generating expectations about diachronic change using historic and ethnographic sources and then testing these generalizations using archaeological data from Maui. Historic accounts on *heiau*-building traditions suggests that ancient Hawaiian architects employed a series of design systems to produce a wide array of temple morphological variation and that *heiau* were systematically modified or expanded through time. One rule of *heiau* design, however, was to create a sacred space that was both architecturally unique and physically imposing.

Archaeological evidence suggests that *heiau* foundations are generally polygonal and convex in shape, and less than 500 m^2 in size. Similarities in *heiau* design are due in part to the repeated usage of similar architectural features, such as faces and walls, as well as of topographical features, such as hilltops or ridge lines. Terraced *heiau* represent the least complex architectural design because they make use of natural topographic features. More complex architectural designs include notched shapes, and platform and combination *heiau*. These designs are more complex because they are completely free-standing structures that do not incorporate or rely upon the natural topography.

Although stratigraphic and contextual data from seven excavated *heiau* as well as survey data from 108 temples from Maui represent only a preliminary analysis of the antiquity of *heiau*, they now form a working model that can be tested with supplementary diachronic data on *heiau* construction sequences. This model states that terraces and stacked enclosures were an early stylistic design utilized between A.D. 1200 and A.D. 1650, and that platforms and core-filled enclosures were styles utilized after A.D. 1650. Combination *heiau* represent temples that were refurbished, and therefore older temples.

Terraced *heiau*, rectangular shapes, and stacked walls are all design features more

commonly found in Zone 2 (windward/dryland agriculture) of Maui, and they appear to be early *heiau* design features. Enclosure *heiau*, notched shapes, and core-filled walls, on the other hand, are more common in Zone 4 (leeward/dryland agriculture), particularly in those arid regions where dryland agriculture was practiced. Temporal variation in stylistic design of the *heiau* temple may also be linked to regional stylistic preferences between East and West Maui.

Heiau size, however, does not appear to increase from A.D. 1200–1650. A general decrease in overall *heiau* size may be linked to changes in social organization and/or to the ritual function of a temple. To clarify how *heiau* size varied through time, a more detailed examination of the labor expended in *heiau* construction is necessary.

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ABSTRACT

The archaeological and historical record of ceremonial architecture in the Hawaiian Islands is examined. The purpose is to describe and explain diachronic change in the design of *heiau* temples using historic documents, ethnographic and archaeological research, and in particular, analysis of 108 *heiau* temples built between A.D. 1200 and A.D. 1800 on the island of Maui. Results indicate that ancient Hawaiian architects employed a series of design systems to produce a wide array of temple morphological variation. A diachronic model of *heiau* architecture, which states that simple structures such as terraces predate more complex structures such as platforms, is developed based upon existing stratigraphic and chronological data recovered from *heiau* foundations. This model is tested by examining the distribution of temple types on the island of Maui. Certain design elements, such as terraces and walls of stacked construction, cluster in windward regions—the initial areas of dense occupation according to the current model of island settlement. As Hawaiian society grew more complex, so did temple architectural design, with six-sided, notched shaping, platforms, and walls of core-filled construction. These elements were found to cluster in leeward regions of Maui, areas thought to have been densely settled relatively late in Hawaiian history. *Heiau* size, however, was found not to vary through space and may even decrease after A.D. 1600. KEYWORDS: Chiefdoms, Heiau, Hawai'i, Maui, Monumental Architecture, Style.