



NEW ZEALAND JOURNAL OF ARCHAEOLOGY



This document is made available by The New Zealand Archaeological Association under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

To view a copy of this license, visit
<http://creativecommons.org/licenses/by-nc-sa/4.0/>.

A Kohika *Wharepuni*: House Construction Methods of the Late Pre-contact Māori

Rod Wallace and Geoffrey Irwin¹

ABSTRACT

The archaeological recovery and subsequent conservation of many wooden house parts from the waterlogged site of Kohika (V15/80) provides a rare opportunity to examine the superstructure of late pre-contact Māori houses. This paper describes the detail of various parts from small *wharepuni* and the derived architectural principles of construction. A general conclusion is that these included the application of Pacific canoe building technology to house construction in the New Zealand environmental context. Further implications arise from the convention of concealing the technical details of house construction.

Keywords: KOHIKA, MĀORI HOUSES, WHAREPUNI, HOUSE TIMBERS, ARCHITECTURE, HOUSE CONSTRUCTION.

Knowledge of the superstructure of 'traditional' Māori houses is still surprisingly limited, despite numerous ethnographic accounts and a growing body of archaeological information. Prickett (1982: 111–12) has proposed that the Māori house was a remarkably conservative cultural form throughout New Zealand prehistory, changing little until after European arrival. Scholars have classified Māori houses in various ways, the most basic distinction (Prickett 1982: 116) being between those made from pole and thatch and the "carefully fitted houses constructed of wrought timbers, with or without embellishment" (Best 1924: 559). The latter can be divided into 'meeting houses', i.e., larger communally owned structures often embellished with carved, painted and woven decoration, and smaller privately occupied sleeping houses. Unfortunately, no account of the structural details of such houses was ever written by someone who had actually built one. As a result, most ethnographic descriptions are quite superficial and often contain a lot of unstated guesswork where actual construction details are concerned. This paper uses house frame pieces recovered from Kohika (V15/80), a late pre-European archaeological site in the Bay of Plenty, to show how one particular small timber-framed house was constructed.

During the nineteenth century, displays of group solidarity and prestige became focused on meeting houses, which grew in size and degree of ornamentation (Neich 1994: 89–121). The adoption of European materials and construction techniques began quite early and was probably complete by the 1920s, when the last examples of houses built by traditional methods were described (Firth 1926). Knowledge of such construction methods became lost and by 1949 Sir Peter Buck (Te Rangi Hiroa) was forced to admit "No detailed description of the framework of the common Maori house is available to me and my memory cannot

¹ Department of Anthropology, University of Auckland, Private Bag 92019, Auckland, New Zealand

supply details which were never noted despite frequent contact with them ..." (Buck 1949: 117).

Archaeological evidence of pre-European houses consists mainly of patterns of post holes, hearths, and scatters of artefacts and other debris. Evidence of the superstructure is limited to house timbers found in waterlogged sites or dry caves. These have included some spectacular carvings found near Waitara in Taranaki (Duff 1961). Systematic archaeological excavations in wet sites have begun to yield large numbers of such timbers. In the 1970s, a small fortified settlement was excavated at Mangakaware near Te Awamutu (Bellwood 1978), which revealed post butts preserved in the wet ground around carefully made house floors. In the shallows of the lake bordering the site a collection of house parts was recovered. These were used in an hypothetical reconstruction of a prehistoric house frame.

The excavations at Kohika revealed a number of house floors and the scattered timbers from several structures. The reconstruction that is described here, therefore, should be regarded as a representation of one house *type*. Precise dimensions of the Kohika houses will be reported elsewhere. The house to be described here was based on a set of three complete *heke* (rafter type elements) of a single structure. Other frame elements were selected from the collection, as required, to complete the superstructure.

The forms of the Kohika timbers and the reconstructed house frame reveal many details of construction not noted by early European observers. It helps to illustrate and explain many of the rather cursory and, sometimes, inaccurate and contradictory descriptions of early Māori houses in the ethnographic literature. The architectural system illustrated in this paper is both fundamentally different from those of modern houses and, in a number of critical aspects, to that described as traditional in parts of tropical Polynesia.

THE KOHIKA SITE

The site is some 16 km west of Whakatane and 2 km inland from the existing mouth of the Tarawera River (Fig. 1). It was discovered in 1974 during agricultural drainage operations and reported to the Whakatane Museum. Museum staff and members of the Whakatane and District Historical Society visited the area and recovered wood and fibre artefacts from spoil heaps and the walls of the newly constructed drains, which were also found to contain palisading (Irwin 1975; Moore 1975). These artefacts had been preserved by water logging and it was realised that the drainage work posed an immediate threat to the contents of the rest of the site. The Department of Internal Affairs, Historic Places Trust, local *iwi* and the Department of Anthropology at the University of Auckland were consulted. It was decided that rescue excavations were needed to investigate the site and that conservation would be required for the threatened artefacts. The excavations were carried out in 1975, 1976 and 1977. Conservation and analysis has continued in a project directed by Irwin. A full report is in preparation.

At the time of occupation, the Rangitaiki and Tarawera rivers joined near Kohika and shared a common mouth to the sea at the northeastern corner of the then extensive Rangitaiki Swamp. Geomorphological information reveals that the site had been built on a partly natural and partly artificial island surrounded by swamp and shallow lakes within the fork of the two rivers. This placed the site in a strategic location in relation to communication routes both along the coast and inland up the river systems.

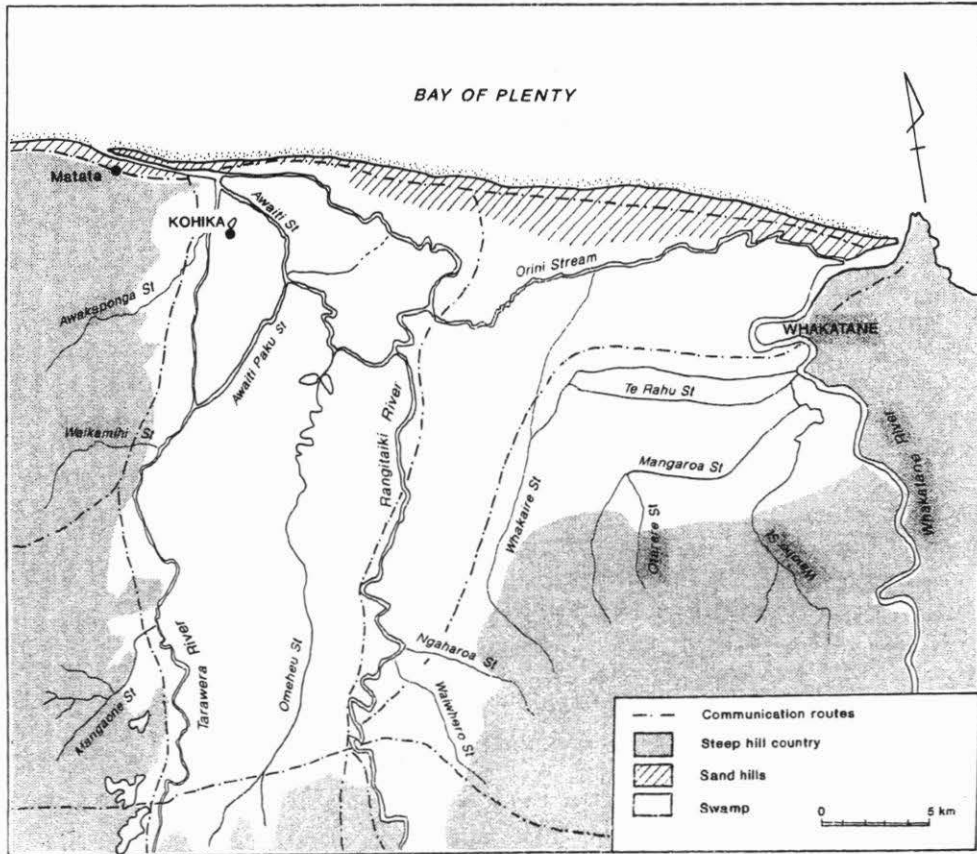


Figure 1: Map of the central Bay of Plenty, based on survey maps of the area before the drainage of the Rangitaiki Plains begun in the early 1900s.

The excavations revealed a lightly fortified village occupied probably by a small community. Remains of houses, storage pits, palisades and other structures were found, often with post butts still surviving. Organic items identified included parts of canoes, paddles, bird spears, agricultural tools, bowls, hair combs, woven fabrics, ropes and nets. Stone, bone, and shell artefacts were recovered as well. There was evidence for subsistence exploitation of the natural foods of the sea, rivers, swamps and hilly hinterlands.

Initially, waterlogged items were held in temporary storage tanks in Auckland while a purpose-built conservation laboratory was constructed. Specialised staff training took place and equipment needed for conservation was assembled. Mr Karel Peters was responsible for the bulk of the conservation of the items described in this paper. The work was completed, after his departure, by Dr Rod Wallace and the current Archaeological Conservator, Ms Dilys Johns. The items were then illustrated and analysed. In May 1998, some 350 wooden artefacts were returned to the Bay of Plenty, where they were greeted by representatives of regional *iwi*, the Regional Council and the Whakatane and District Historical Society. The

artefacts are currently in the care of the Whakatane Museum and Gallery as discussions about ownership continue.

Chronological evidence of radiocarbon and obsidian hydration dating (M. Jones, pers. comm. 1998), shows that the site was occupied at some period during the second half of the seventeenth century or early in the eighteenth century AD. It was abandoned before European contact. Kohika therefore provides a valuable example of Māori settlement and technology in the Bay of Plenty in late pre-European times.

THE KOHIKA HOUSES

House floors of varying sizes were uncovered during the excavations. These were built at ground level in dry areas, but artificially raised house floors were constructed at the low-lying and damp northern parts of the site. Only post butts and some planks still in their original positions were able to be associated with specific house floors. The recovered timbers originated from several different structures which stood during the lifetime of this particular village. The most common relate to small sleeping houses (*wharepuni*) but both floors and timbers of a larger house type were found. Some of the latter timbers display surface ornamentation and have been identified as *poupou* (wall posts) possibly from a *whare whakairo* or carved meeting house (Dr Paki Harrison, pers. comm. 1998).

Timbers were found both within the site and preserved in peat at its swampy margins. Some had been preserved by chance events. Fire had destroyed above surface structures in one part of the site, leaving charred butts protruding from the ground. Elsewhere, timbers set in the ground remained standing for longer periods until they rotted off near ground level. Several timbers have one side more weathered than the other, indicating they had lain on the ground for an extended period before being incorporated into waterlogged deposits and preserved.

In one area a number of house floors on similar alignments were superimposed in a manner suggesting that only brief time intervals separated each event. This may indicate the need for houses that could be dismantled and re-erected readily. The house frames described below could be considered of 'kitset' type designed to meet the requirements of a mobile population.

Examples of most different house parts were identified from the Kohika material. Carved mortise and tenon joints and lashing holes provided options as to how parts were assembled and excluded other possibilities. Such evidence, combined with information from written accounts of historic Māori houses, allows fairly secure identifications of the house timbers to be made. What follows is a description of examples of each different component of the house frames selected from the collection to match a set of three rafters described below. Each has its own identity number with the prefix KOH, e.g., KOH48. Each kind of house timber is named and its position in the house frame given in Figure 2.

HEKE (RAFTER TYPE ELEMENTS)

The three *heke* found (Fig. 3) are critical to the reconstruction of the house, as their length defines many of its dimensions. They are all made of totara (*Podocarpus totara*) and are 1420–1455 mm long, 70 mm wide and 40 mm thick. The lower ends have tenon joints designed to fit the tops of side wall posts (*poupou*) at an angle of approximately 125

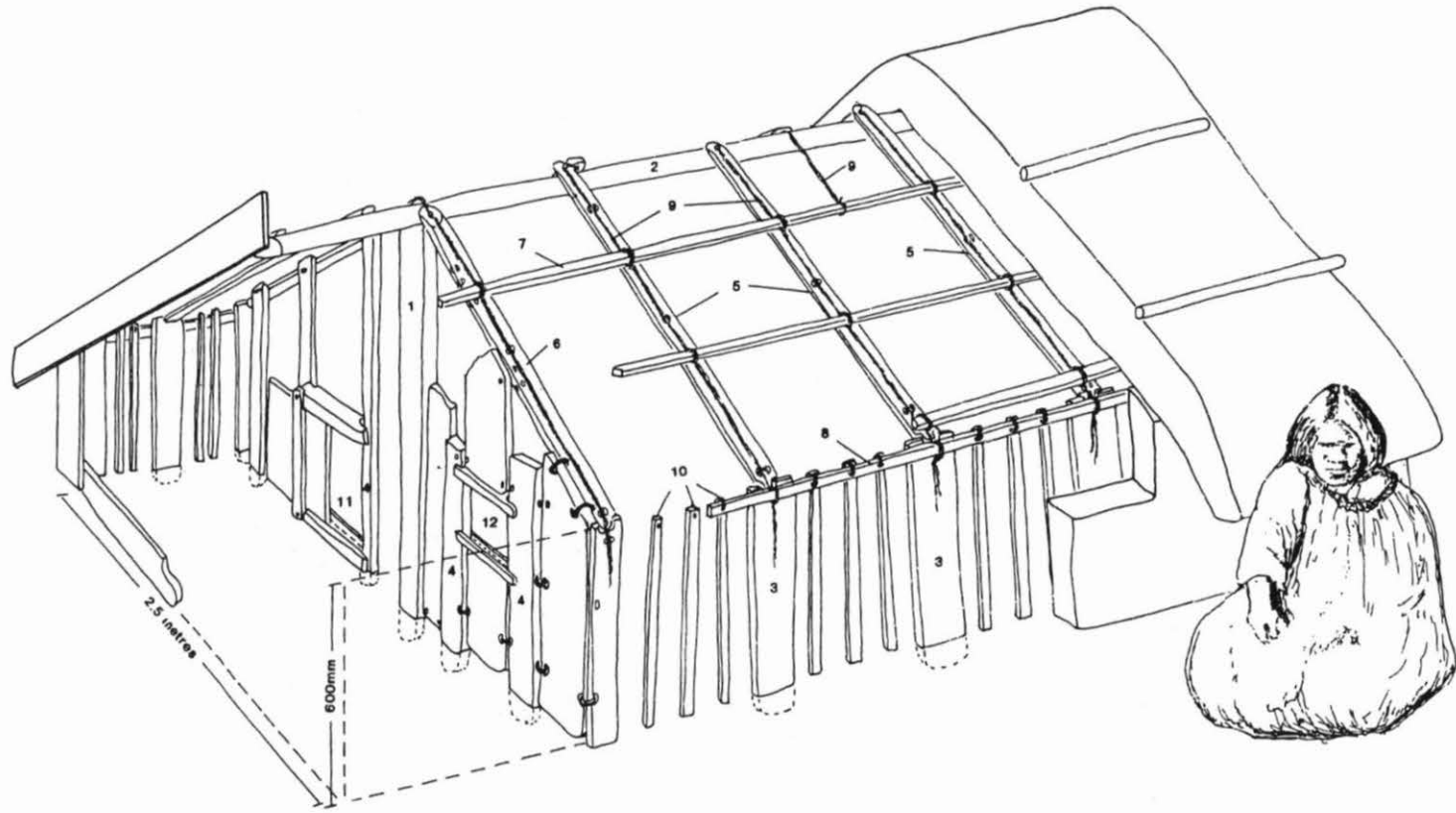


Figure 2: A reconstruction of the dressed timber frame elements of the Kohika wharepuni. This illustrates various options for the assembly of the different elements identified by the numerals. 1, poutāhuhu; 2, tāhuhu; 3, poupou; 4, epa; 5, heke; 6, heke ripi; 7, kaho; 8, kaho paetara; 9, tauwhenua; 10, tūmatahuki; 11, tatau; 12, pihanga.

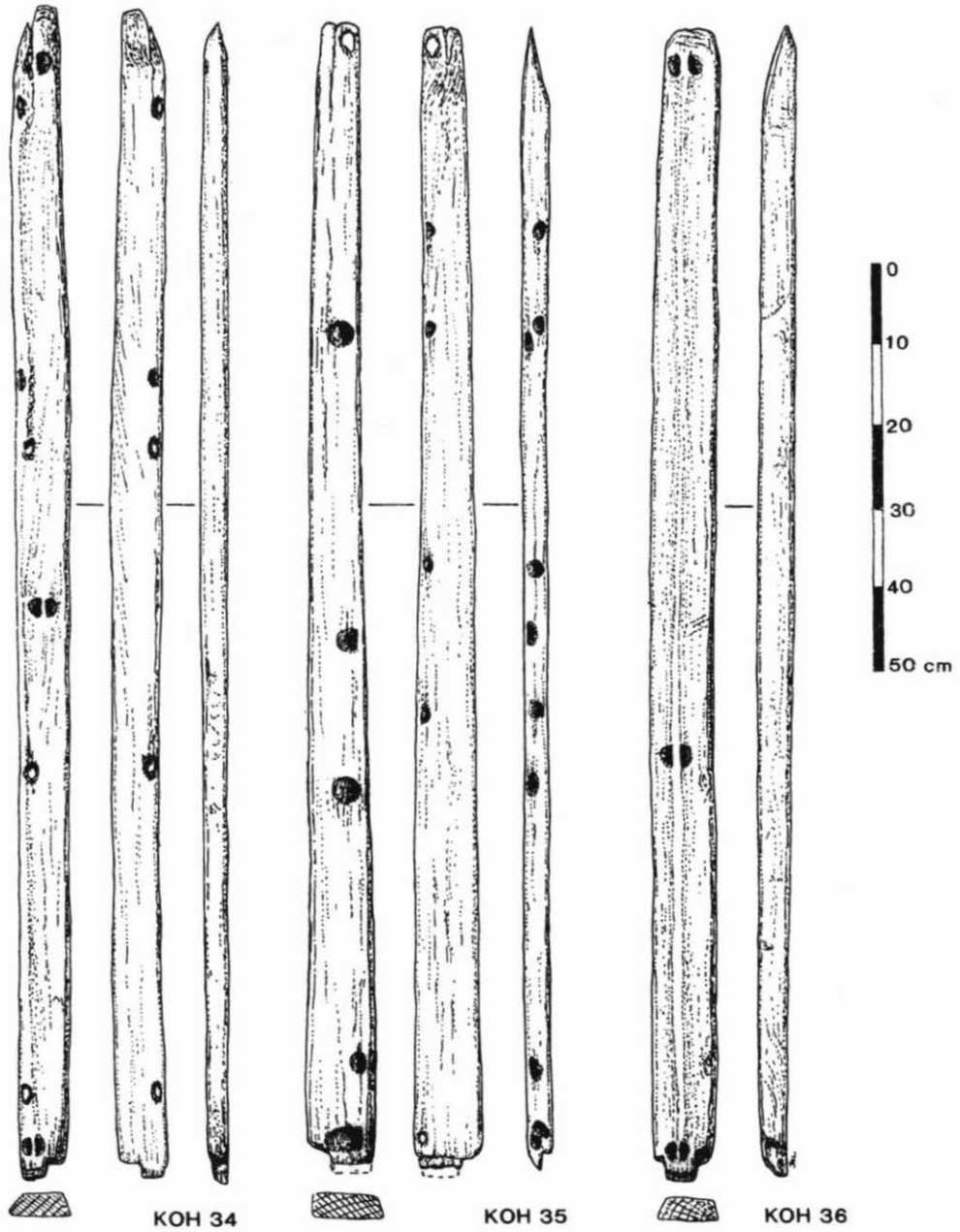


Figure 3: The three heke (rafters) found at Kohika.

degrees, while the upper ends are bevelled to allow joints to be formed flush with a ridge pole (see Fig. 4). The three rafters differ in detail but could all have come from the same house.

KOH36 has the simplest lashing holes with three face eyelets on its upper surface only. The tenon joint has been formed by cutting away both sides of the end of the rafter. The top end of the rafter has had its upper surface bevelled to form a smooth joint with the ridgepole (*tāhuhu*). A pale line runs down the centre of the upper surface where something in close contact with the wood prevented smoke staining. This was probably the *tauwhenua* or cable (which will be described below). If so, then the three face eyelets took lashings which held the cable in place along the centre line of the rafter.

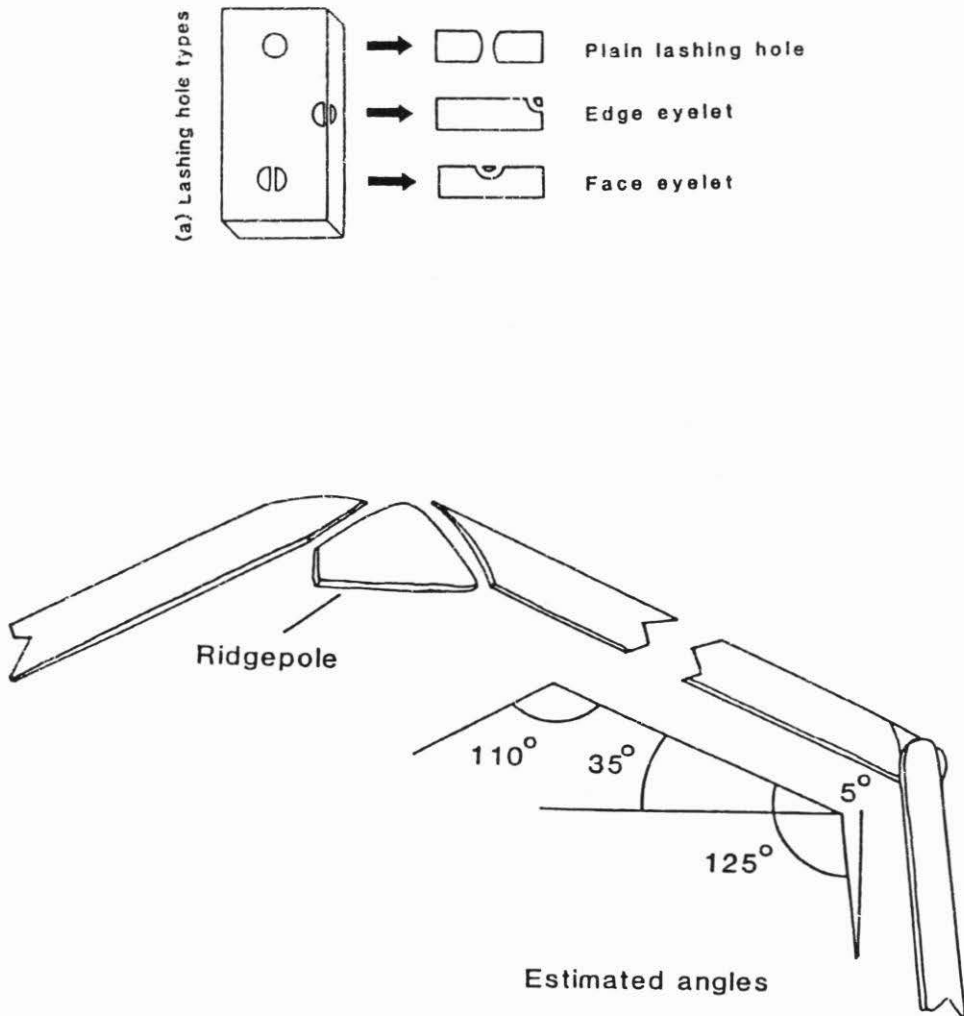


Figure 4: (a) A classification of lashing holes. (b) Illustration of the angles at which ridgepole, rafters and *poupou* join.

KOH34 has a tenon joint recessed only on one side. It has three face eyelets (like *KOH36*) plus a further five lashing holes along one edge. The upper end of the rafter has been bevelled on its underside where it would have met the ridgepole.

KOH35 is nearly the mirror image of *KOH34*. It has ten edge eyelet-type lashing holes along one edge, five cut from the upper surface and five from the lower.

The rafters are so similar they very probably came from the same house, with *KOH34* and *KOH35* being a matched pair of what Firth (1926) refers to as *heke ripi*. These rafters were placed along the top of the posts (*epa*) that formed the end walls. They have the lashing holes that would allow the attachment of each *epa*.

VERTICAL HOUSE ELEMENTS

Fourteen vertical elements of small houses found at Kohika are described below.

KOH9 is a nearly complete *poupou* (Fig. 5) made from kauri (*Agathis australis*). Kohika is outside the known geographical distribution of this species and this plank was probably imported from further up the coast. The bottom has rotted off near ground level but the top is intact and has a square notch cut in its upper end to interlock with the end of the rafter. A face type eyelet (Fig. 4) is placed just below this notch and would have been in line with those on the rafter, implying that its function was to hold in place the cable (*tauwhenua*) mentioned above.

KOH10 is a nearly complete totara *poupou* that has rotted off at its base (Fig. 5). It is more roughly made than *KOH9* but has a notch for the end of the rafter and three plain lashing holes distributed along its length. It has been split from the outside of a tree trunk with only the split surface and the sides adzed smooth. Many planks found at Kohika were made in this quite casual way, presumably since it was quick and the undressed surface could be ignored, being hidden by the insulation on the outside of the house frame.

KOH12 is probably part of an *epa* (end wall board). It is a totara slab 500 mm long with two edge eyelets opposite each other near its top (Fig. 5). Its top was burnt off square to a level where moisture from the soil would have risen while it was still standing. This pattern of fire damage to planks is common to many of the Kohika wall slabs in one area of the site and indicates an episode of fire while wall timbers were still standing.

KOH13 is a totara plank fragment very similar to *KOH12*. Its lower end has been rotted off in a somewhat ragged fashion but it is neatly burnt off at the top (Fig. 5). It has a single edge eyelet lashing hole. It may have been part of an *epa*.

KOH15 is a section of totara plank with the top burnt off (Fig. 5).

KOH11 (Fig. 6) is a plank that has rotted off at the base but is nearly complete above. The top has been cut off at approximately 35 degrees and thus it may have been an *epa* (wall end board). It has three simple lashing holes along one edge and two along the other.

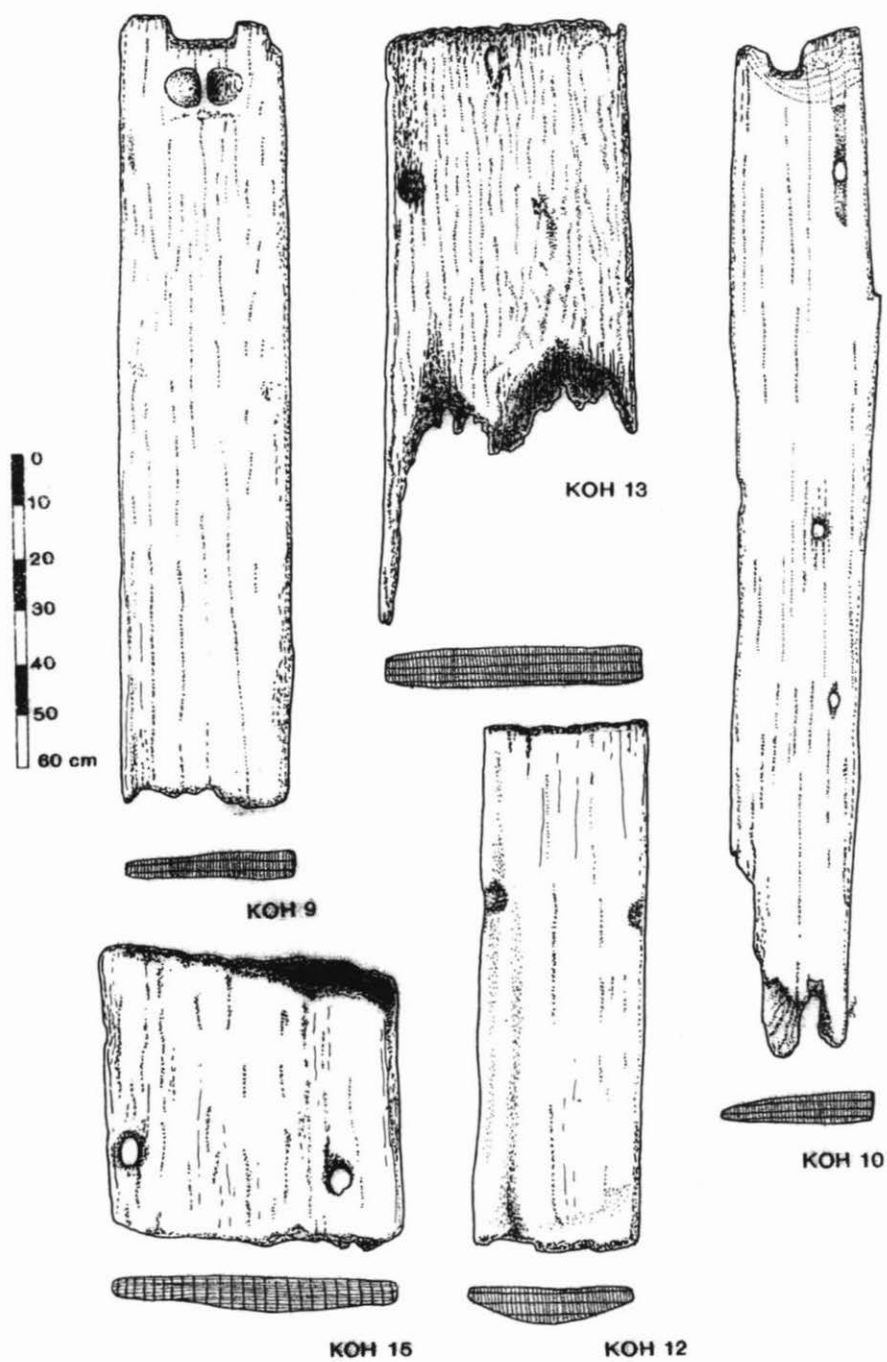


Figure 5: Five *poupou* and other vertical house frame elements found at Kohika.

KOH21 (Fig. 6) is a small plank of totara cut off at approximately 35 degrees and burnt off at the other end at the same angle. It has two simple lashing points along one edge. It is most probably from the top of an *epa*.

KOH32 (Fig. 6) is a small plank of pukatea (*Laurelia novae-zelandiae*) of triangular shape. It has seven large holes cut through it. It may have been the *epa* that abutted the side wall, as it was cut to accommodate such an inward slope. *Epa* of just this form are illustrated by French explorers in their descriptions of houses (Prickett 1974).

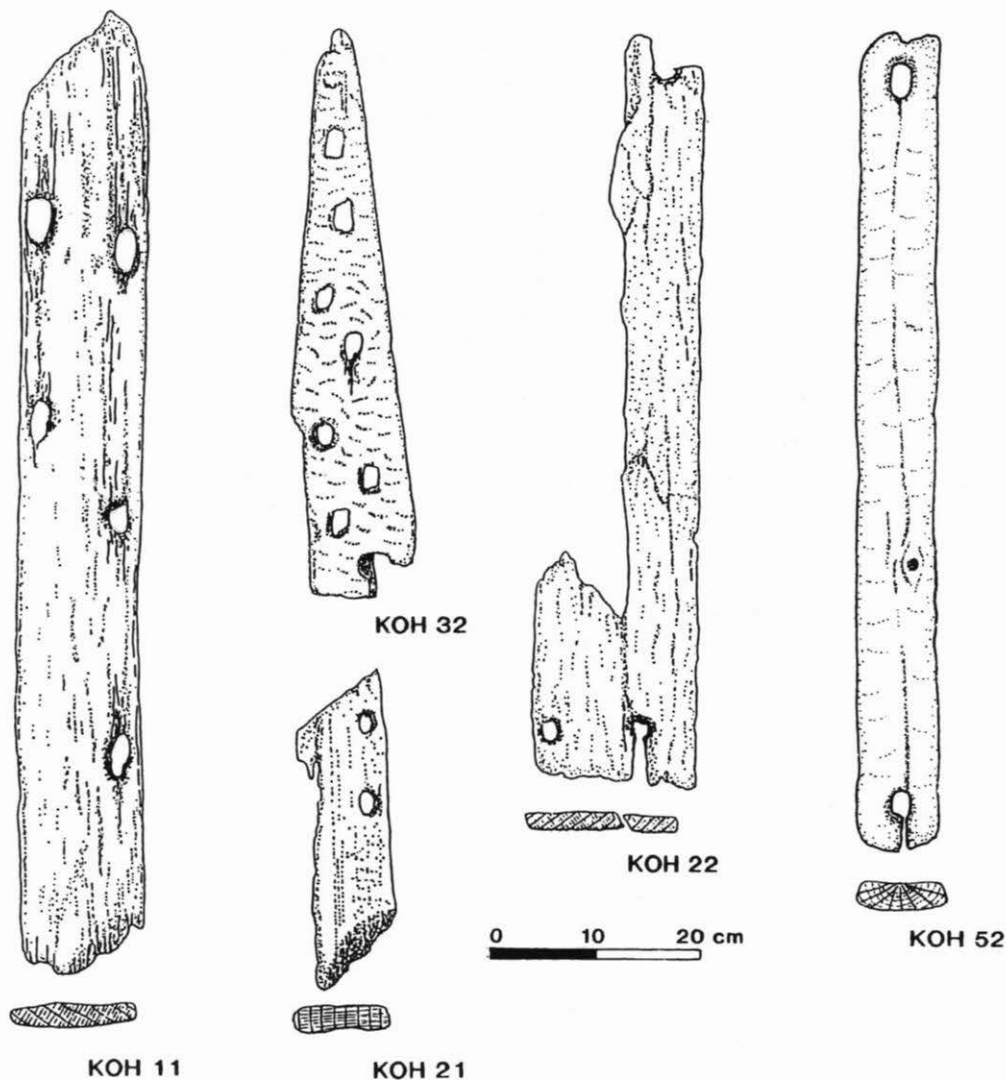


Figure 6: Five *epa* and other vertical house frame elements found at Kohika.

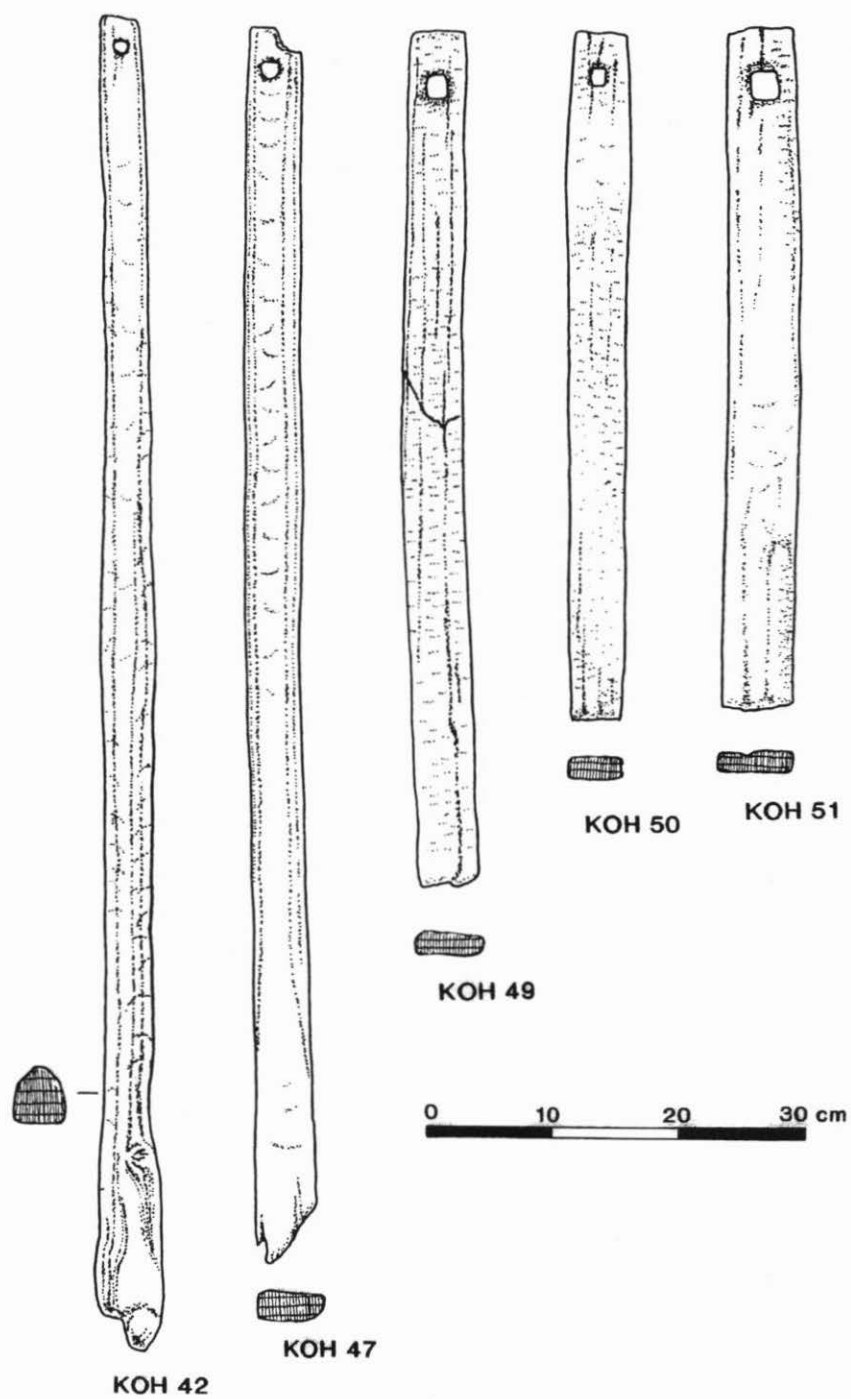


Figure 7: Five vertical battens (*tāmatahuki*) found at Kohika.

KOH22 (Fig. 6) is a plank of pukatea that was originally 720 mm by 155 mm. There are simple lashing holes at each surviving corner. This plank may have been an *epa* from below a window.

Nine artefacts from Kohika meet Firth's (1926) definition of *tūmatahuki* or vertical wall battens set between the side wall posts. These battens are all in an excellent state of preservation with neither rot at their bases nor fire damage above. Unlike the *poupou*, which were posts fixed in the ground that stood till they rotted off, battens rapidly detached from the house when it decayed and entered the water which preserved them.

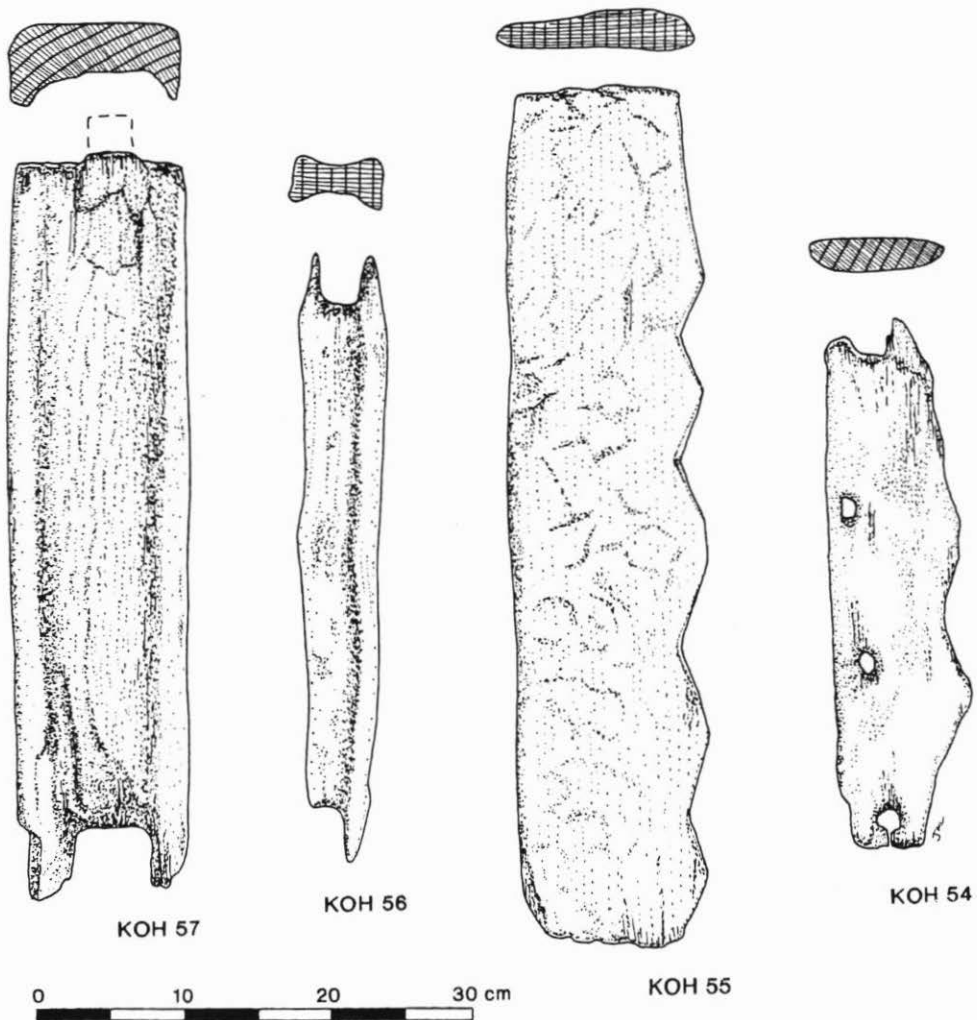


Figure 8: Four door and window elements found at Kohika.

Five of these battens are illustrated (Fig. 7). Their lengths indicate a range of different wall heights, i.e., different sized houses. The two larger ones illustrated are from a group of five sufficiently similar to suggest they were part of the same house, one with a side wall height of just over a metre. The three shorter battens are just over half that height. All were split from heart totara, quite casually dressed by adze and a lashing hole chiselled in one (the top) end.

DOORS AND WINDOWS

Several possible door or window parts were found at Kohika. One was a fragment of *pare* (flashing above window) decorated with incised carving, clearly from a very much more elaborate house than is described here. It will not be discussed further in this context. Four simpler pieces are illustrated in Figure 8 and described below.

KOH54 appears to be a window facing board or *kōrupe*. It is a slab of pukatea with one edge cut in a zigzag pattern, the other having two lashing holes. Each end also has simple lashing. Its simple form suggests it came from a house of relatively modest status.

KOH55 is identified here as a *pare*. It is a slab of totara 575 mm long with a zigzag upper margin. It is very similar to a *pare* illustrated by George Angas from a meeting house at Raroera near the Waipa River (Reed 1979: Plate 9), and to *KOH54* above. Though the wood was adzed relatively smooth, the lack of lashing holes suggests it may have been unfinished.

KOH56 is identified here as a window sill. It is a piece of totara 398 mm long with a 'U-shaped' cross-section and deep recesses cut in each end. These recesses may have fitted around the edges of *epa* or window jambs. The window would have been closed by a slab that fitted in the groove along its length.

KOH57 matches the description of a door sill given by Williams (1896). It is a slab of totara 488 mm long with a deep U-shaped hollow along its length. One end has a deep square notch and the other has the remains of a square tongue. The socketed end could have fitted around a solid door jamb, perhaps formed by an *epa*, with the tongue at the other end being inserted between the parts of a two-piece 'jamb'. This latter arrangement would have allowed the door slab to slide along the groove and through the split 'jamb' into a cavity in the wall insulation.

KOH52 is a batten 202 mm long with a simple perforation in each end (Fig. 6). This item would make a satisfactory door jamb element, as the inner part of a two-piece jamb, with the door sliding in front of it. This is illustrated in Figure 2.

THE RECONSTRUCTION

The three complete rafters supply much of the information needed to reconstruct the front elevation of this *wharepuni*. Illustrations of historic Māori houses (Prickett 1982; Reed 1979) show an average roof pitch of approximately 35 degrees from the horizontal and side walls sloping inwards at approximately five degrees from vertical. These angles conform

very well to those obtained by fitting Kohika *poupou* and *heke* together. This is illustrated in Figure 4.

The wall posts found at Kohika indicate that house walls ranged from 500 to 1000 mm high. Figure 9 illustrates two possible reconstructions of the front elevation of the Kohika *wharepuni* using each end of this size range. Doors, windows and front wall elements, etc., were incorporated in the reconstruction as appropriate. Of the two results, the one with the shorter side walls yielded proportions closest to ethnographic illustrations. The resulting *wharepuni* has an external width of 2.7 m (8 ft 10 in.) and a maximum external height of 1.5 m (4 ft 10 in.). This would make it narrower than all but one of the 12 'Chiefs' houses' recorded by early European visitors to New Zealand, but about average for the 19 'other' houses (Prickett 1982: 123–25). Dimensions assembled by Prickett indicate that houses were between 1.5 and 2 times as long as they were wide. This would give the Kohika *wharepuni* an external length of 4–5.5 m. This appears to be a typical size for a superior sleeping house but far too small for a house used for communal purposes.

MĀORI HOUSE CONSTRUCTION TECHNIQUES

The following account is based on the interplay between the actual timbers described above and descriptions of historical Māori houses. The main sources used here are Prickett (1974, 1979, 1982) for contact period houses, Williams (1896), Phillips (1952), Makereti (1986) and Firth (1926) for nineteenth century and early twentieth century houses and Anon. (1988) for the modern carved house. Additional information is from Bellwood (1978), Best (1924), Buck (1949) and Prickett (1982).

The following discussion describes each step in the construction of a house in order to define the mechanical or architectural system employed. This information is condensed on Figure 2 and shows various ways in which each timber could have been incorporated into the frame. It clearly could have been erected and dismantled many times either at the same spot or elsewhere over a period of time. This feature would have been important for a people who experienced mobility of settlement. It could also account for why so much time and craftsmanship was expended on the manufacture of each timber.

The Māori timber-framed house differed from its modern New Zealand equivalent quite systematically. Construction began by setting up a line of centre posts spanned by a heavy ridgepole (*tāhuhu* or *tāuhu*) that projected at the front over the porch. In the case of the small Kohika house only two posts, the *poutuarongo* at the back and the *poutāhuhu* at the front, would have been necessary though more would have been needed in larger houses. As this formed the primary structural support, the house could be seen as being built from the top down.

Construction of the side and end walls began by setting vertical posts or boards (*poupou* for the sides and *epa* for the ends) into prepared holes in the ground. Slots were cut into the top of each *poupou* to take the tongue (*teremū*) of the *heke* (rafters), i.e., a mortise and tenon joint. How rafters joined at the ridgepole is not entirely clear and three different options are illustrated on Figure 2. *Heke ripi* (rafters at the tops of end walls) must have met end on. If this pattern was followed for the other rafters (as is the case in historic and modern meeting houses), it would result in post holes in matched pairs on either side of the house. If rafters were crossed at the ridge line, *poupou* would still be in pairs, but the post holes would have to be systematically offset on either side of the house. It appears this is

precisely the case for the floor plan of the Makotukutuku house (Leach *et al.* 2000). A third option illustrated is of rafters not paired at all.

The primary load-bearing structure of the house was, in essence, a series of arches supported along the centre line by a ridgepole. This structure was then reinforced by light horizontal and vertical elements, stringers and battens, held together by cables and lashings. Several *kaho* (purlins or stringers) were run parallel to the ridgepole across the rafters as

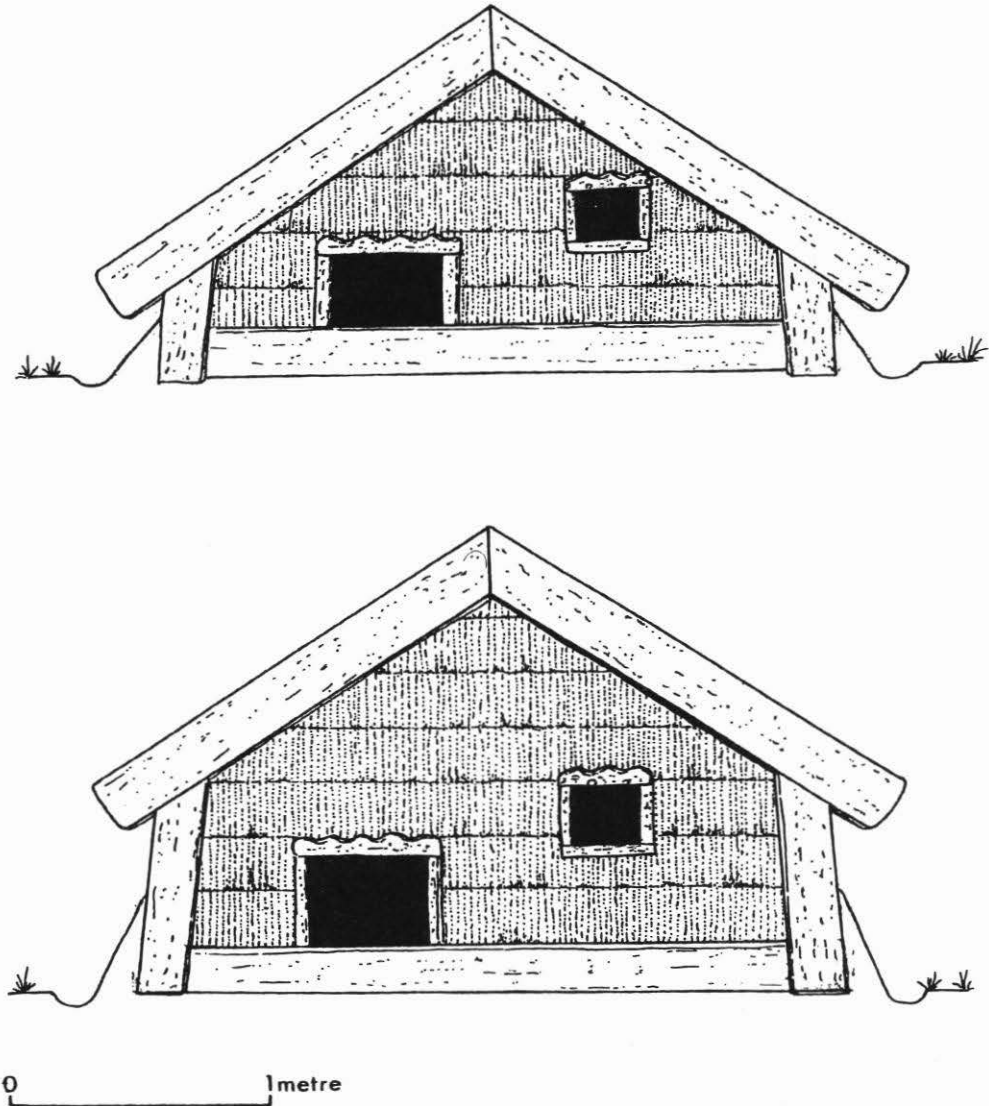


Figure 9: Two options for the front elevation of the house, using different wall heights.

well as a single one (the *kaho-paetara* or *kaho-matapū*) near the top of each side wall. Cables (*tauwhenua*) ran across the house to hold the frame together. These ran up the *poupou* and along the top of the rafters down to the opposite side, holding the *kaho* in place by looping around them (Best 1924: 565; Makereti 1986: 299). The cables are said to attach to buttresses (*pou mātua*) set up outside each *poupou*. These accounts described nineteenth century meeting houses built by traditional methods (Neich 1994). Photos of such houses do sometimes show a line of light posts outside the walls of houses (Neich 1994: Figs 69, 106 and 131). It is clear, however, that their main function was to support the eaves, a necessity in such large houses in the absence of projecting rafters. They disappeared as soon as corrugated iron roofing and galvanised steel gutters were adopted. Lines of post holes outside and parallel to house walls were not found at Kohika and are rare in other sites. This leaves unresolved the question of what the ends of the *tauwhenua* were anchored to at Kohika.

The spaces between the *poupou* were filled by light vertical battens (*tāmatahuki*). Their bases were set in shallow grooves in the ground and lashed at the top to the *kaho-paetara*. The end walls consisted of vertical *epa* connected along the top to special end rafters, the *heke ripi*. At Kohika many planks were found with lashing holes indicating they had been joined edge to edge. These might have filled spaces between *epa* though these would, like the *tāmatahuki*, not be set in the ground. The options for front wall construction are illustrated in Figure 2.

There was a single door (*tatau*, *kāaha* or *whatitoka*) and window (*pihanga*, *mataaho* or *matapihi*) in the front wall. Doorways were small, to European eyes, with entry being on hands and knees. They were closed by solid slabs of wood that sat in grooves in sills and lintels, sliding sideways into cavities in the wall insulation. Accounts of how lintel and sill plates were fitted are either vague (Williams 1896 and Firth 1926) or relate to large late nineteenth century houses (Makereti 1986: 307–8). In the case of the Kohika house, we have many of the actual pieces and can propose the system illustrated in Figure 2.

The Māori house had its load-bearing structure as the internal surface with the insulation on the outside. Spaces in the frame were first filled with panels of reed matting (*tukutuku*) supported by the *tāmatahuki*. Rushes, tree fern trunk slabs or other insulation were then packed against the outside of the frame. The front walls were carefully finished with neatly packed insulation held in place by lashings or perhaps battens. The houses were thickly thatched and finished off with facing boards placed above the door (*pare*), window (*kōrupe*), the front ends of the side walls (*amo*) and roof (*maihi*), and along the front of the porch (*paepae*) (Fig. 9).

DISCUSSION

In most European type timber-framed houses the walls have a base plate and a top plate with vertical studs in between. The top plate carries the rafters which often abut and support the ridgepole. The Kohika house has a fundamentally different system with walls constructed in the same manner as a post and batten fence and the only horizontal load-bearing element being the ridgepole. This architectural system appears significantly different from that employed in tropical Polynesia (e.g., Buck 1927) but essentially identical to that found in meeting houses of the nineteenth century, which had been built in a traditional manner.

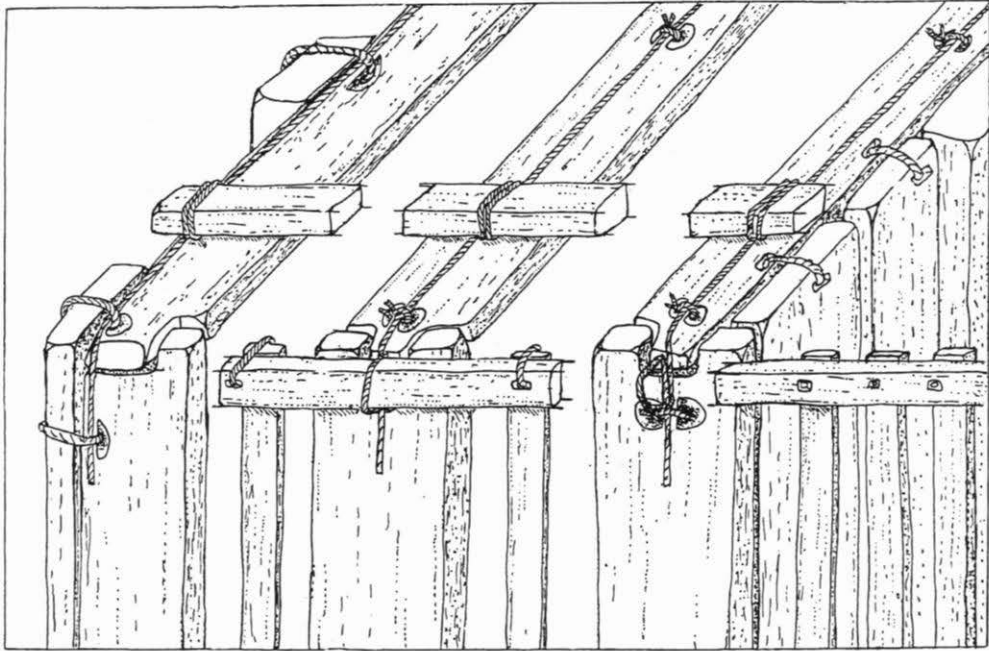


Figure 10: External view of the Kohika house frame, illustrating in detail the various ways timbers could have been assembled.

One of the most striking features of this building method is the way in which the makers went to so much trouble to ensure the lashings were not visible from the inside of the structure. This was achieved by mortise and tenon joints and the extensive use of 'face' and 'edge eyelets' in preference to simple holes passing directly through the planks. This left internal surfaces relatively clean with lashings exposed mainly on the outside of the frame, visible or accessible only during house construction. This aspect is illustrated in Figures 10 and 11. This deliberate masking of construction details goes a long way to explaining deficiencies in the ethnographic literature on houses. Despite having had repeated contact with such houses, Sir Peter Buck may have had no memory of the details simply because they were almost completely hidden from his sight.

This principle was continued by the use of facing boards, which further masked construction details. Only where masking was impossible, e.g., in the *tukutuku* panelling, were lashings turned into an artistic aspect of architecture. In contrast, the systems described by Buck (1938: 277) from parts of tropical Polynesia have open girder-like frames secured by highly visible and ornamental sennit lashings.

The question arises as to why the New Zealand Māori developed this new approach. The answer may be partly environmental and partly technological. In the case of superior Māori house types, the need to adapt to a colder climate by constructing thick, well insulated walls was met by using squared timbers and planks obtained from the abundant, large diameter trees available in New Zealand. Assembling such timbers into structures requires different

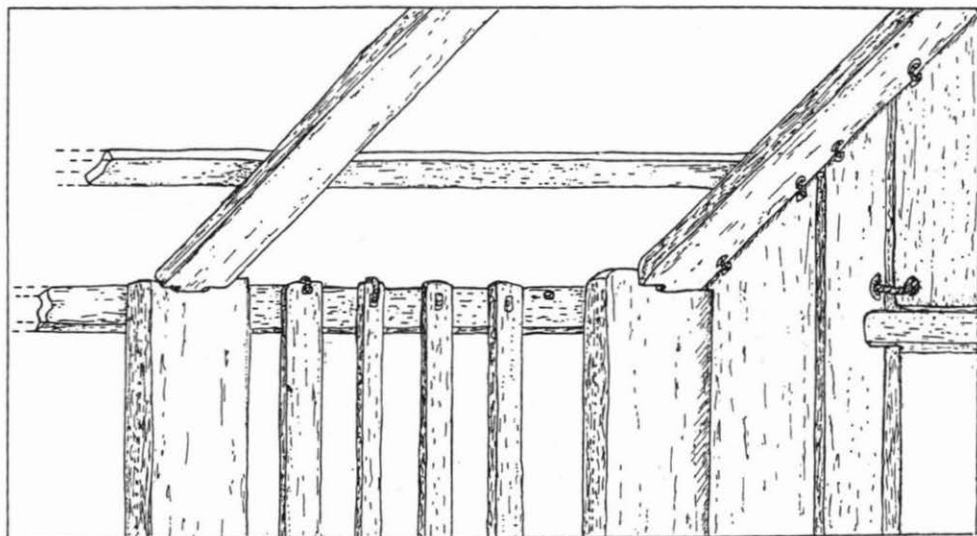


Figure 11: Internal view of the Kohika house frame, illustrating in detail the various ways timbers could have been assembled.

techniques from the ones employed on tropical Polynesian houses constructed of poles. The solutions that the New Zealand Māori adopted, as illustrated in Figures 10 and 11, bear a striking resemblance to those used in the building of plank canoes all across the Pacific. These canoes are made from planks which are fitted together with watertight joints to form hull surfaces with no exposed lashings to be abraded. It is suggested that there was a transfer of technology from canoe building traditions to house construction methods in response to the radically different environmental constraints and opportunities met during the settlement of New Zealand by the early Māori.

The principle of deliberately concealing the technical details of building methods within the walls may have contributed to another feature of Māori architecture, i.e., the persistence of the meeting house form into modern times. In tropical Polynesian architecture, the form of the house is strongly influenced by the highly visible building techniques. The adoption of European building methods inevitably altered the appearance of the house in a radical way. The Māori house hides its construction methods so that the inward and outward appearance of the meeting house was retained in a highly recognisable way despite the adoption of European materials and construction methods. After all, if an observer of the calibre of Buck could spend half a lifetime visiting traditional Māori houses yet could not recall the precise details of their construction, would it not have been easy to adopt completely different construction methods without disturbing the essential effect?

REFERENCES

- Anon. 1988. *Tane-Nui-A-Rangi*. Auckland University Press, Auckland.
- Bellwood, P. 1978. *Archaeological Research at Lake Mangakaware, Waikato, 1968–70*. New Zealand Archaeological Association Monograph 9. Dunedin.
- Best, E. 1924. *The Maori*. Vol. II. Tombs, Wellington.
- Buck, P.H. 1927. *The Material Culture of the Cook Islands (Aitutaki)*. Board of Maori Ethnological Research Memoir 1. Avery, New Plymouth.
- Buck, P.H. 1938. *Vikings of the Sunrise*. Lippicott, Philadelphia.
- Buck, P.H. 1949. *The Coming of the Maori*. The Maori Purposes Fund Board, Wellington.
- Duff, R.S. 1961. Waitara Swamp search. *Records of the Canterbury Museum* 7 (4): 303–26.
- Firth, R.W. 1926. Wharepuni: A few remaining Maori dwellings of the old style. *Man* 26: 54–59.
- Irwin, G.J. 1975. The Kohika Site, Bay of Plenty. *Historical Review* 23 (2): 101–104.
- Leach, B.F., Davidson, J.M. and Wallace, R.T. 2000. The form and construction of the Makotukutuku house, a 16th century dwelling in Palliser Bay, New Zealand. *New Zealand Journal of Archaeology* 21 (1999): 87–117.
- Makereti 1986. *The Old-Time Maori*. New Zealand Women's Press, Auckland.
- Moore, K.W. 1975. Kohika site N68/104 Bay of Plenty: A preliminary report. *Historical Review* 23 (1): 60–61.
- Neich, R. 1994. *Painted Histories — Early Maori Figurative Paintings*. Auckland University Press, Auckland.
- Phillips, W.J. 1952. *Maori Houses and Food Stores*. Dominion Museum Bulletin 8. Government Printer, Wellington.
- Prickett N.J. 1974. Houses and House Life in Prehistoric New Zealand. Unpublished MA thesis, Department of Anthropology, University of Otago.
- Prickett, N.J. 1979. Prehistoric occupation in the Moikau Valley, Palliser Bay. In B.F. Leach and H.M. Leach (eds), *Prehistoric Man in Palliser Bay*, pp. 29–47. National Museum Bulletin 21.
- Prickett, N.J. 1982. An archaeologists' guide to the Maori dwelling. *New Zealand Journal of Archaeology* 4: 111–47.

Reed, A.W. (ed.) 1979. *Early Paintings of the Maori. Illustrated by George French Angas.* Reed, Wellington.

Williams, H.W. 1896. The Maori *whare*: Notes on the construction of a Maori house. *Journal of the Polynesian Society* 5: 145–54.

Received 4 November 1998

Accepted 27 January 1999