

# TRANSLATION

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## Translation of Aid Houses in Tonga

This paper presents two house case studies from recent fieldwork in Tonga, which describes aid houses translated to Fangale'ounga village in Ha'apai group during the early 1980s. Following these case studies, the paper expands on the disaster and post events during funding and housing assistance identifying the key agents of each case study, namely international governments working with Tonga's Ministry of Works; and secondly the Ecumenical Centre in Tonga. The paper then analyses the resulting domestic architecture.

These architectural translations highlight the effects of natural disaster construction technology, imported building materials and reorganisation of living on Fangale'ounga's housing stock from the 1980s onwards. Whilst participants' ideas of planning and structural design have been affected by such aid translations, they have also been architectural lessons as participants now opt for more durable housing materials than what was used on the original aid house.

A demise of aid houses is the quick replacement of earlier technologies and local sustainable building materials rather than a negotiation with such local traditions. Arguably, aid houses have quickened the inevitable process of architectural change in a globalising Tonga. One of the case study houses, owned by Sioeli Vatu Kalu exemplifies this situation. It was assisted by international and local governments and explains common problems of additions to the original aid house. However another type of translation is an aid house owned by Kaho Taufu, which was built in the shape of the oval plan fale Tonga with round roof and utilises a combination of local coconut wood and imported materials and technology. Together they highlight the range of architectural and material translations of 1980s aid houses in Fangale'ounga, raising pertinent issues relevant to other parts of the Pacific, where such translations have propelled a change in building design, technology and materials.

## Introduction

This paper seeks to understand how cyclone aid houses have translated domestic fale architecture in Fangale'ounga village, Ha'apai.<sup>1</sup> Two house case studies from recent fieldwork are drawn upon; they identify houses of two families experienced prior to and after the 1982 Cyclone Isaac. The paper reveals the political and religious agents involved in designing such housing assistance including various foreign aid and organisations like Ecumenical Centre in Tonga. The paper then discusses the translation affects of these particular aid houses shown in resulting architecture.

Fangale'ounga represents a remote Tongan village that historically has endured many cyclones. The architectural affects of cyclone Isaac is especially critical because it resulted in a prefabricated house built as cyclone resistant housing for this island Kingdom. In light of recent Cyclone Ian events (6 January 2014), which again caused significant building damage across the Ha'apai Islands, this paper reflects on the architectural translations that have occurred over the last thirty years and considers how effective they were in equipping Tongans with an understanding of cyclone resistant technology and design.

## Case Study Site: Fangale'ounga

Fangale'ounga is located on Foa Island, one of the islands of the Ha'apai group, (fig. 1). Considered a remote village, Fangale'ounga has a population of 174 individuals, less than two percent of Tonga's total population<sup>2</sup>. Fangale'ounga today is an open almost un-bounded village with homes backing onto each other, compared to urban villages with tightly fenced property allotments. Positioned by the ocean, this village is divided in half by the main road that runs through Foa Island to the causeway that links Foa to Lifuka Island where the airport, main shopping area and government precinct are all located. Along this main road and inland behind the village are agricultural lots owned by the village people. Fangale'ounga has one operating general store, a township water tank, and four churches. PhD fieldwork has been conducted in Fangale'ounga since 2012, where participant and informant interviews with visual data have been collected. Out of 29 houses, 21 are aid houses and more than fifty percent of these have been modified to suit family demands.

## Cyclone Isaac in Fangale'ounga

Cyclone Isaac struck Tongan Islands on the 2 and 3 March 1982. Its highest wind gust recorded was 170 km/hour and the lowest pressure was 976.4mb, measured away from the eye of the cyclone.

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- 1 In the Tongan language 'fale' means an enclosed space intended for human purpose, which could be understood today as a building that is a house, church or meeting place. See other SAHANZ papers by author for further meanings.
  - 2 Tonga Government Statistics Department. *Tonga National Population and Housing Census 2011*, Nuku'alofa, 2011.

A storm surge of approximately 1.7 metres also resulted.<sup>3</sup> Unfortunately, Ha'apai suffered most damage more than any other group across Tonga's archipelago.<sup>4</sup>



Fig. 1. Map of Fangale'ounga, Foa Island, image courtesy of GIS department, Ministry of Lands and Survey, Tonga Government 2013

Certainly the aid organisation that greatly influenced the first case study in Fangale'ounga and indeed most of Tonga's aid housing was the British Building Research Establishment represented by Dr Keith Eaton, a structural engineer. A pool of funding assisted the tests and design process of Tonga's cyclone house including Australian and New Zealand Aid and British government.<sup>5</sup> The *Tonga Chronicle*, 26 March 1982, reports that Dr Eaton spent a month in Tonga to help design a "small cyclone-resistant house design" for "low-income Tongan families".<sup>6</sup> In this same issue, Eaton supplied the Tongan public a supplement outlining "How To Make Your Building Withstand Strong Winds".<sup>7</sup> This informative bulletin was translated into Tongan with diagrammatic pictures showing how positive and negative pressures of strong winds can affect a building. Eaton promoted 'better' (15 to 25 degree) and 'best' (30 to 40 degree) pitches and recommended a hip-angle roof over a gable roof. Furthermore how to tie down building members from foundations to wall and further to the roof, also where best to locate openings on a building. In effect this knowledge was transferred to the design of the fale a "fa", as locals call it, which means Tonga's hurricane or cyclone house.

According to a further newspaper article (dated 2 April 1982), over the following two years; they were designed for low-income Tongan families, toe)<sup>8</sup> These 7.2 metre by 4.8 metre houses were designed to be prefabricated, consisting of:

3 Gregory Frederick Reardon and John Oliver, *Report on Damage Caused by Cyclone Isaac in Tonga*, Townsville: James Cook University of North Queensland, 1982, np.

4 Reardon and Oliver, *Report on Damage Caused by Cyclone Isaac in Tonga*, 8.

5 Leveni 'Aho, Director of Ministry of Infrastructure, Transport and Works, personal communication, Nuku'alofa, 28 February 2013.

6 "Guide to Reconstruction" *The Tonga Chronicle*, 26 March 1982, Vol. XVIII, No. 43, 1.

7 "How to Make Your Building Withstand Strong Winds," *The Tonga Chronicle - Supplement*, 26 March 1982, Vol. XVIII, No. 43.

8 "Housing Scheme for Low-Income Families," *The Tonga Chronicle*, 2 April 1982, Vol. XVIII, No. 44, 1.

“20 assorted wall panels and seven roof trusses, plus rigid corner strips, cross-braces for walls, pre-cut corrugated iron roofing sheets, and special bolts, screw nails and strap fasteners to create an integral structure with maximum wind resistance.”<sup>9</sup>

Moreover the prefabricated parts encouraged assistance from the local community, under the supervision of Tongan Ministry of Works. This ‘self-help’ approach aimed to minimise costs of this two-bedroom dwelling to TOP \$2,200 with an additional TOP \$600 for transport and supervision costs.<sup>10</sup> By providing only a space to sleep and lounge, it was left to families to extend their houses at a later date such as bathroom and cooking facilities or more bedrooms. This scheme, as the article reported, could only be realised with overseas aid assistance of TOP \$4.5 million, primarily for importing building materials. A prototype of the house was built and tested at the James Cook Cyclone Structural Testing Station in Townsville, Australia.<sup>11</sup>

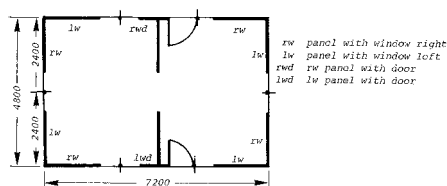


Fig. 2. Floor plan of the prototype built and tested at James Cook Cyclone Structural Testing Station built for case study 1, image courtesy of JCU CST 2014

The other agent important in the translation of Fangale'ounga's aid housing was the “Kosolio”, as Tongans call them, or the religious organization: Tongan Ecumenical Centre.

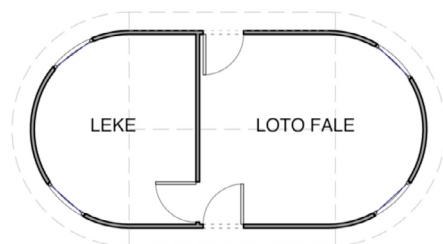


Fig. 3. Floor plan of second type of aid house built for case study 2. This plan shows addition of a stud wall dividing the leke—a private sleeping area—and loto fale: a multi-purpose space for resting, meeting, and working as seen during fieldwork (not to scale), author 2013

In the 1980s this organisation had an aid division that built houses for selected families of a village, who were considered more in need. Unfortunately records of this period are misplaced,<sup>12</sup> however

9 “Housing Scheme for Low-Income Families,” *The Tonga Chronicle*, Vol. XVIII, No. 44, 1.

10 TOP \$2,200 is AUD \$1,277, TOP \$600 is AUD \$348, TOP \$4.5 million is AUD \$2.6 million according to www.oanda.com 21 May 2014.

11 Geoffrey Neville Boughton and Gregory Frederick Reardon, *Simulated Wind Load Tests on the Tongan Hurricane House*, Townsville: James Cook University of North Queensland, year unknown.

12 Current director of Tongan Ecumenical Centre, personal communication, 20 September 2013.

oral history from fieldwork identified a local Ha'apai man named Fatongia Lotui,<sup>13</sup> who designed this aid house with a round roof and oval floor plan, clearly mimicking the fale Tonga style (fig. 3).

### Case Study: Fale 'o Kalu

Sioeli Vatu Kalu, an elderly farmer from Fangale'ounga, owns the first case study house.<sup>14</sup> Although Sioeli has lived in a number of types of houses in Fangale'ounga from the mid twentieth century through to the present day, the paper focusses on more recent history from the late 1970s: when building material and architectural styles in Fangale'ounga were already moving away from early fale Tonga styles and the use of only local plant materials.

The late 1970s were a time of prosperity for many families in Fangale'ounga and according to Sioeli there were many agricultural export opportunities available to Tongans. For this reason, people were renovating and 'updating' their houses, especially as their families were growing in number. Sioeli's earlier house was a corrugated metal house that measured 6.7 metres long by 4.9 metres wide. This house had a gable roof and clad in corrugated metal roofing on all its walls with roof cladding fixed to local wood framing. The floor was constructed from a concrete block perimeter wall filled in with pata pata (crushed coral), then the customary fale Tonga floor: hulu (dry coconut fronds) and topped off with takapau (young coconut leaves woven into a mat), papa (a broad pandanus mat) and fine pandanus mats. The layout of this house was relatively simple, with a fabric partition down the middle of the house creating a loto fale and a private bedroom on the other side, reminiscent of the simple spaces of an early fale Tonga with its amenities as separate stalls outside.

It was during this time, in 1976, that Sioeli saved up TOP \$5,000 to build his new family house. He negotiated with a lay builder named Sione Kali to build a timber-framed house. It measured 8.5 metres long by 5.5 metres wide. Sione sourced the building materials from the capital city Nuku'alofa and shipped it back to Ha'apai and eventually transported to Fangale'ounga village by vehicle. Sioeli explains he would have liked to internalize the bathroom and kitchen within this house. Unfortunately when the house neared completion, with only glass louvre windows and doors to be installed, Cyclone Isaac struck and destroyed the unfinished house. No building materials were salvageable.

Immediately in the aftermath of the cyclone, while families waited for government assistance, Sioeli and his family built a fale Tonga clad in pola, or coconut thatching, with the typical fibrous floor on pata pata. As Sioeli remembers, this fale Tonga was too small for his large family.

It was in 1983 that the family finally received a cyclone aid house after paying a TOP \$700 bond to the Tongan government's cyclone committee. When government labourers worked on Sioeli's house, they were daily fed with cooked pigs on a spit, which highlights Sioeli's immense appreciation for

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13 'Ofa ki Manono Taufa, personal communication, Fangale'ounga, 11 and 13 September 2013.

14 Sioeli Vatu Kalu, personal communication, Fangale'ounga, February 2013 to May 2014, aged 71 at time of first interview.

their assistance. Sioeli fortunately had helpers from the village to cook food and also assist the construction.

Sioeli's cyclone aid house follows the typical prototype set out by Tonga's reconstruction project. However with an extra stud wall that divides the bedroom space into two bedroom spaces. The light framed house stands on timber stumps and clad in plywood with external battens. The openings are filled in with timber framed glass louvre windows and hollow core doors. According to Sioeli, bathroom facilities were not included and the government workers did not consult him regarding how many rooms to construct.

The house was constructed within one week. As Sioeli remembers, he and his large family squeezed themselves into their cyclone house. However, they eventually had to drag over another cyclone aid house - owned by a relative who migrated overseas - for Sioeli's growing sons while Sioeli, his wife and daughters remained in their aid house.



Fig. 4. Junction between Sioeli's cyclone house's timber stumps and concrete block addition's perimeter wall, author September 2013

In 1995, Sioeli's eldest daughter, who was now working, was able to secure a bank loan of TOP \$6,000 to extend their family's cyclone house. Sioeli negotiated with an acquaintance from his church, a builder named Temsi Hoko to extend his house towards the front with a lean-to structure. The extension as it stands today is made from concrete block walls on a concrete slab that is enclosed by a concrete block perimeter wall (fig. 4). This addition provides a generous family room. Temsi closed in what was the living room of the earlier cyclone house with a stud wall, creating a new hall way and a generous third bedroom with entry two doors. Along this hallway the timber stud walls and ceilings are now lined with Masonite hardboard (fig. 5).

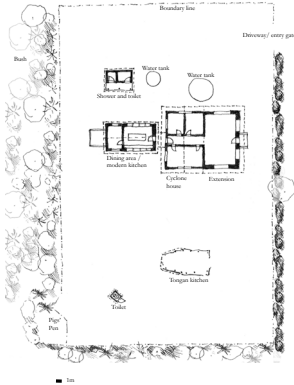


Fig. 5. Site and floor plan sketch of Siieli's property, author May 2014

In 1996, Siieli asked a local village builder Kaho Taufa - the next case study participant - to construct a building made from concrete block work to accommodate a new kitchen, dining and food storage area. This building is linked to the main house by a covered threshold, (fig. 6). Beside the kitchen stands a smaller concrete block building with corrugated metal roofing that covers the new toilet and bathroom stalls.



Fig. 6. Siieli's id house to the right with new kitchen built behind, the bathroom and toilet beyond, author September 2013

During the interview in September 2013, Siieli complained he had water leaking through the junction between the original cyclone house's roof and more recent lean-to roof. He explained the drop from the cyclone house to the lean-to roof was too deep that he had to place timber packers underneath the lean-to roof to create a closer transition and tighter roof junction. There are similar weather-proofing issues experienced by others from the village who have cyclone houses with lean-to additions.

Siieli explains if given the chance, he will replace the timber frame of the cyclone house with concrete block work so both structures last the same length of time. Furthermore, he would change the planning of the house and extend out on either side of the current cyclone house's footprint to form a 'T' shaped layout with the existing concrete block work addition to the front. Siieli would like



to internalise the bathroom and toilet so these spaces are more accessible for him and his wife as they grow older.

## Case Study: Fale 'o Taufa

Kaho Taufa, a farmer and village lay builder, owns the second case study house.<sup>15</sup> This case study also begins with the more recent housing history that identifies the house type Kaho lived in prior to Cyclone Isaac and then immediately after.

Kaho met his wife 'Ofa in Fangale'ounga, when he attended his sister's wedding.<sup>16</sup> They soon married in 1980 and decided to remain in Fangale'ounga and build a house there. 'Ofa's family gave the newly married couple land at the back of the village, behind her grandfather's property, where Kaho and 'Ofa built their first house. This was a fale Tonga in the fa'ahiua style, or gable roof form and rectangular floor plan. The simple interior had a fabric curtain dividing a private sleeping area and larger living room. The house had three door openings into this living room providing the light and ventilation necessary for the interior with no window openings around the house, this was common for such early fale Tonga<sup>17</sup>. The house was clad in pola on walls and roof with a floor consisting of hulu, takapau, papa and pandanus fine mats. The house's structure was made from locally sourced wood from the Siale mohe tree, or *Leucaena Leucocephala*. Twine was used to tie these members together. Kaho built a bathing stall in the early 1980s, and like the family's toilet stall, built earlier by 'Ofa's father, the stall applied Siale mohe for the rectangular structure and lined again with pola.

According to 'Ofa just before 1982 it was common to see more timber houses with weatherboards around the village. The kitchens of these timber houses were usually clad in corrugated metal. At that time a small number of fale Tonga thatched in coconut pola remained, including Kaho and 'Ofa's property. When Cyclone Isaac struck, many houses collapsed including their fale Tonga. For some houses just their roofs were torn off, and particularly the outdoor kitchens' corrugated sheets were torn off leaving only the structure.

In the aftermath of Cyclone Isaac, 'Ofa complains that they waited a long time before they were given a house to live in. While they waited, they lived in a tent provided by the Tongan government's cyclone committee. Kaho and 'Ofa was the only family selected from Fangale'ounga by the Ecumenical Centre of Tonga for housing assistance because their property had missed the inspection for a government assisted aid house. Other similar aid houses can be seen in neighbouring villages.

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15 Kaho Taufa, Fangale'ounga, personal communication, Fangale'ounga, February 2013 to May 2014, aged 59 at time of first interview.

16 'Ofa ki Manono Taufa, personal communication, Fangale'ounga, 11 and 13 September 2013.

17 Early fale Tonga did not have permanent window openings since whole wall section of thatching would have to be rolled up or pulled up like a venetian blind for such an opening. Wall openings were more common of Samoan fale and Tongan kitchens.

Their aid house is designed as a fale Tonga with round roof style and two external doors centred along its two long ends (figs. 3 and 7). Kaho added a stud wall down the middle of the oval floor plan creating a modest bedroom to one side and a larger living room on the other end. Currently a double bed fits in here with mostly storage. The only expense Kaho and 'Ofa incurred were costs of cutting down coconut trees from their bush lot and having them sawn into timbers at a government mill in the main town of Ha'apai, Paangai. 'Ofa recalls that it cost them TOP \$50, to process ten coconut logs.

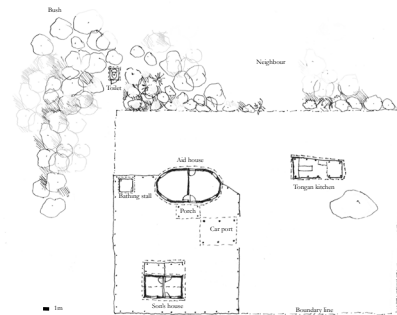


Fig. 7. Site and floor plan sketch of Kaho's property, author May 2014



Fig. 8. Kaho's fale Tonga style aid house with roof tiles and coconut wood cladding with porch and car port area, author September 2013

The Ecumenical Centre of Tonga organization provided all other materials to complete the build, including roof tiles, corrugated metal roofing, timber framing for the roof, nails and bolts, a plywood plate, cement, sand and aggregates for the concrete slab floor, (fig. 8). The couple boasts that their aid house has very good air circulation because there are no soffit linings, thus allowing the cool air to flow in and circulate in the high roof space, which also has no ceiling linings, (fig. 9). Thus, drawing in cool air. Furthermore the roof tiles sit on top of corrugated metal roofing, which appears to delay the sun's heat transfer through the metal.



Fig. 9. Interior of Kaho's aid house showing no ceiling and soffit linings, author September 2013



Fig. 10. Elevation of Kaho's Tongan kitchen now clad in corrugated metal, author September 2013.

The house is largely unchanged, apart from minor renovations carried out in more recent years. This includes replacing the coconut timber framed and panel awning windows that eventually deteriorated in 1994 with pine timber boards. In the late 1980s, the previous toilet and bathroom stalls clad in pola were replaced by corrugated metal sheeting. The kitchen, once clad along the lower part of its walls with pola, is now replaced by corrugated metal (fig. 10). The kitchen roof remains as pola and only the part over the open fire has corrugated metal roofing. The fale tolo, or covered porch area, was also added in 1990, now useful for family functions that extend outside the aid house.

If they have the chance, 'Ofa explains, they would like to change the aid house's structural materials and cladding to concrete block so it does not deteriorate as fast as the coconut wood, which is already rotting externally. They would like the new additions to extend out from the aid house to the front where the current porch is located. They hope to complete this extension in concrete block work. In doing so, they prefer to retain the circular floor plan and in its original size especially since only the couple and their grandchild reside at this house. The extension to the front provides them extra space for visitors to stay and store 'Ofa's many belongings, which she explains are currently stored at another house their family owns.

## Summary: Translation of Aid Houses in Fangale'ounga

Clearly, these aid house case studies of Fangale'ounga have clear architectural distinctions but also similar relief housing intentions. The political agency of the government's cyclone house translated an architectural idea of 'resisting' the elements and in affect imparting a sense of control and similarly creating a desire in many for a permanent durable architecture. The religious agency of the Ecumenical Centre of Tonga imparted an architectural evocation of Tongan cultural identity. Both aid house approaches have instilled a belief in self-help. All participants have experienced living and building an early fale Tonga. Such experience and skill informed Sioeli and Kaho's families, making them more capable of being resilient and self-reliant in the immediate days after the cyclone before aid arrived. Arguably, although this earlier domestic fale could efficiently and cost-effectively be erected, it also reminded these participants why they wanted a more durable and larger dwelling, thus heightening the anticipation of the aid house.

The first case study reveals that Sioeli like others in his community were already changing or as he states was part of the "fakalalakaka", which in Tongan translates as 'developed and advanced' lifestyle. Sioeli's earlier planned house was built as a timber framed structure and applied imported building materials. Consequently, such changes were progressive steps in this direction. Cyclone Isaac may have delayed the fulfilment of this anticipation but the aid house presented a second chance to live again in a modern house, although more modest in size. Thus, the aid house for many families in this disaster stricken village afforded the perception of architectural advancement. Conversely, the affordance of an aid house allowed many to give up or surrender their previous housing practices and receive new building fabrics, technologies, and for some new structural forms.

The aid houses were presented as building shells, thus inviting architectural additions. Interior walls were left unlined and bathroom and kitchen amenities excluded to reduce construction costs.<sup>18</sup> Ironically then, the aid house perpetuated the semi-outdoor living Tongan lifestyle with externalised kitchen and bathroom/toilet stall. Such exclusions would have disappointed families especially during the post-occupancy phase. Conversely, this may have encouraged families to add to the given space thus creating a sense of ownership: certainly a 'hands-on', not 'hands-off' approach. Although the government intentionally provided the aid house as temporary solutions, my fieldwork shows the aid houses have become permanent fixtures of one's home, and only slightly modified or extended from its original footprint to suit family needs.<sup>19</sup> The first case study added a lean-to to the gable house and, like most additions in Fangale'ounga, has created weather-proofing and head height issues. The weather-proofing over this junction is usually insufficient, and eventually ponds and leaks causing damage to the internal linings and finally creating mould issues. Achieving a desirable head height under the lean-to with an already low eave line can be challenging. The less

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18 Leveni 'Aho, Director of Ministry of Infrastructure, Transport and Works, personal communication, Nuku'alofa, 28 February 2013.

19 Leveni 'Aho, Director of Ministry of Infrastructure, Transport and Works, personal communication, Nuku'alofa, 28 February 2013.

than minimum pitch of the flat roof thus results in more ponding around this junction. Thus, what began as a spatial problem of the aid house has led to weather-proofing issues and potentially a health hazard internally. The aid house, finally, has been a source of inspiration for other buildings of the home, such as replacing the natural materials of outdoor amenities with imported materials to match the main house's modern fabrics.

The second case study reveals that there were a few families in Fangale'ounga, like the Kaho and 'Ofa, who in recent history were living in a coconut thatched fale Tonga. The quick replacement of such fale with aid houses reveals how Cyclone Isaac not only demolished the remaining fale Tonga but relief efforts replaced them with aid houses. However, this second aid house was not entirely a foreign set of ideas or building materials, but presented a blend of the local and international ideas of architecture. Certainly, a brave idea during a time when architectural ideas and materials from overseas were increasingly considered more advanced than the local. As an architectural agent, this second aid house also promoted self-reliance and self-reflection as a source of fakalalakala by portraying a familiar form and applying coconut wood. Such re-education appears to have succeeded when Kaho and Ofa boast that their fale style aid house reflects their heritage and for this reason has differentiated them from other families in Fangale'ounga. The efficacy of this aid house to translate such cultural belief is further proven when the couple hope to expand out from their aid house by maintaining its current form.

Perhaps the most important agency of the aid house was its ability to shift Tongans from building houses to tolerate environmental conditions to now resisting the environment's elements. The fale Tonga would have flexed with strong winds, allowed air through its thatching, and the roof structure was easily dismantled from its supporting posts for residents to bunker down during a cyclone. Moreover, Tongans expected to salvage belongings and repair thatching after natural disasters. But the aid house, perhaps more than any other modern construction, instilled a belief in Tongans that houses can resist cyclones. Thus, in doing so, avoiding the stress, heartache, and financial woes of repairing a home after another cyclone. This effective shift in belief in a house's construction and maintenance has trickled down to what materials one now prefers.

Learning the physical and emotional character of materials is a key theme that both these histories implicate. In particular, participants felt that living in an aid houses made from lightweight structural timber is not as secure as concrete block work, which appears stronger and more robust. Some even explained that the timber house moves and sways during strong winds and heightens the uncertainty of the structure that is supposedly cyclone resistant. Effectively, the shift in thinking towards the possibility of an environmentally resistant house has superseded the aid house's original lightweight framing. Participants now want the 'next best thing' according to construction trends, which, according to my participants, is concrete block work. Apart from their presumptions of material strength, the concrete block is more affordable because it is manufactured locally. A report on damage caused by Cyclone Isaac in Tonga explained that "generally concrete block houses

performed better than timber framed houses.”<sup>20</sup> In analysing the remains of the damaged concrete blockhouses the report explains that correct reinforcement and use of bolts were missing in such buildings.<sup>21</sup> However, due to the mix of inexperienced lay builders and small building budgets less attention is given to this essential technology. Builders and house owners usually accept such shortcuts in order to quickly erect a roof over their families. However such shoddy work proves costly after future disasters.

Avoidance behaviours in Tongan society are defined by behaviours that remove an individual from a situation that is deemed disrespectful to another individual according to custom. In Tongan domesticity, this is played out between a brother and sister relationship because a sister holds a higher ranking in their Tongan kinship relations, particularly an older sister. Her brothers are lifetime protectors and providers. Mutually, the sister and brother perform respect for this relationship by behaving modestly and appropriately when in each other’s presence. For this reason it is common to have brothers and sisters sleep furthest away from each other to reduce any misgivings, especially when either one has reached the age of puberty. As adults, brothers may never enter a house where his sister lives until invited inside by her. Therefore it is interesting that this customary avoidance behaviour between brother and sister was still upheld even within a cyclone house. As Sioeli explains their family used another aid house for their young men to reside, whilst the young women remained in the main house.

A similar persistence of culture was highlighted with the second case study when ‘Ofa explained the bedroom space is primarily a storage area, sometimes a place to sleep with her husband, but she prefers sleeping in the living room where it is more open and much cooler. Thus, the aid house’s plan did not dictate how they lived.

Cyclone resistant technologies that are exemplified in the structure of these aid houses have not explicitly affected the way Tongans now build in Fangale’ounga today. But these participants and some others from Fangale’ounga do imply they have an understanding of how best to orientate their houses towards the prevailing wind. They explained the importance of facing the length of their roofs to the wind rather than the shorter ends. It is not clear if they learnt this from Eaton’s bulletin, but it is apparent that the cyclone aid houses have heightened their awareness of natural disasters and how buildings can supposedly resist it with careful design and material choice.

The town officer of Fangale’ounga, a participant living permanently in a cyclone house with a lean-to extension, expressed in interviews that only time could tell whether their houses are indeed cyclone resistant.<sup>22</sup> With recent Cyclone Ian events more than 70% of buildings in Ha’apai’s islands of Lifuka

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20 Reardon and Oliver, *Report on Damage Caused by Cyclone Isaac in Tonga*, np.

21 Boughton and Reardon, *Simulated Wind Load Tests on the Tongan Hurricane House*, 8.

22 ‘Ulu Tamale, personal communication, Fangale’ounga, February 2013, aged 49 at time of interview.

and Foa Island were damaged.<sup>23</sup> A Fangale'ounga participant immediately after the cyclone described only two buildings<sup>24</sup> in their village as having remained intact: their concrete block house with hipped roof, designed by an architect and built by one of Tonga's most experienced builders and a Latter day Saints Mormon church, also built in concrete block. This begs the question whether the cyclone resistant housing was ever truly translated?

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23 Reporter unknown, "Cyclone Ian: Communications cut after storm lashes Tonga's Ha'apai island group," *Australian Network News*, 11 January 2014, <http://www.abc.net.au/news/2014-01-12/cyclone-ian-moves-away-from-tonga/5195954>.

24 Fieldwork in May 2014 revealed most damage to lean-to extensions, roofing and internal linings, total demolition of some timber framed houses, collapse of outdoor kitchens, and collapse of early concrete block church buildings (Catholic and Church of Tonga).