

Mulivai's smart house

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Introduction

Housing in Samoa has undergone tremendous change in the last fifty years. While smaller and less permanent traditional Samoan houses, or fale, are still being widely used the big open round- or oval-shaped fale with thatched roofs have been largely replaced by open rectangular structures with corrugated iron roofs. Within the rural villages more and more families are building European-style dwellings with internal facilities such as kitchens and bathrooms.

In many ways the changes in local housing reflect the wider changes in Samoan society generally and individuals in particular. Greater mobility through international travel has exposed many Samoans to other ways of life while increased disposable incomes have allowed many to adopt non-traditional lifestyles. Amongst rural people there is a growing trend to relocate from the villages to live on private freehold properties in the urban area. Such a situation is likely to have a major impact on the future of the traditional Samoan way, or faa-Samoa, with more and more people moving away from the influence of their extended family, or alga, and the control of the family chief, or matai, as well as the authority of the village council, or fono. While family ties are still very strong there appears to be a general shift in focus from the extended to the nuclear family.

It is in this context that the Mulivai house was developed in the late 1970s. At the risk of sounding fashionable the 'smart' tag highlights a housing approach to building a family home that is appropriate for the local conditions, reflecting the following main considerations: i) selected aspects of the fale; ii) appropriate elements of tropical architecture; iii) relevant engineering design concepts; and vi) the scarcity of housing finance. This paper describes the main ideas behind the Mulivai house, as built by my wife and I on freehold land at Si'usega about five kilometres from the Apia town centre.

Background

My interest in low cost tropical houses went back to the early 1970s when I was studying civil engineering at the University of Canterbury, New Zealand. I read widely about the architectural and engineering aspects of tropical design and from then on developed a strong affinity with the subject.

In late 1976 I returned to Samoa from New Zealand with my wife and baby son. My parents were living in Lepa village about 70 kilometres from Apia but as a returning graduate working in the public service my family was able to rent a government flat in Apia. A friend sold us a half acre of freehold land in early 1978 for \$3000, paid with a loan from the Bank of Samoa. At the time our land seemed isolated with no water, electricity or telephone services and road access was just dirt track. A kilometre back towards town where services were available, one paid the same price we did for a quarter acre.

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Our first task was to identify the location of our house and then plant trees, lots of them. As well as various fruit trees we also planted some big trees closer to the proposed house site for shade. A number of the original trees are still standing including the big red flamboyant tree on the west side, but many were blown down by successive cyclones.

It was decided very early on that the house was to be two storeys. The initial loan of \$10,000 we received from the Public Trust Office in early 1980 was for building the top-storey. Later on when my wife's mother decided to stay with us, she paid for the construction of a self-contained flat downstairs. But with very low income in Samoa generally at the time, there was little chance for the average family to afford a \$10,000 housing mortgage.

My first job was as a building construction engineer for the Public Works Department where I was exposed to carpentry and house construction. Some of the valuable lessons I learned from the local tradesmen included effective ways of utilising available materials and practical techniques to solving problems. Construction was done incrementally with work done mostly during the weekends over a period of about eight years.

Aspects of the Samoan fale

A key feature of a Samoan fale is its openness. It is built on poles around the perimeter, with bigger internal poles for larger houses, which anchor the whole structure to the ground. The open sides permit full cross ventilation on all sides while the high oval or round roof provides plenty of space for internal air circulation.

The Mulivai house captures the openness of the fale while maintaining privacy. The floor space is 12 metres by 12 metres square, the maximum space that our budget allowed. About 40 per cent of external walls on all four sides are openings to provide cross ventilation. Built on a pole grid at 4 metres centres, the poles connect the whole structure from the roof to the ground. The roof is 3.5 metres high at the centre from the first floor, the maximum height allowed by the cost of timber and the lengths of available poles. At 8 metres by 8 metres square the lounge could be used for family meetings or other larger gatherings. It was considered that the combination of maximum floor space, maximum roof height and maximum external wall openings would help maximise the natural cooling effect of the whole building.

Elements of tropical architecture

Located between 13° 25' and 14° 05' south of the equator and between 171° 23' and 172° 48' west longitudes Samoa is right in the middle of the tropics. It is hot and humid averaging 28° Centigrade and 70 per cent humidity. While there is some relief from sea breeze during the day it is always hot in the sun. The design focus therefore is to ensure that the house is as pleasant and as liveable as possible by making it as naturally cool as possible particularly during the day.

To catch the sea breeze during the day and land breeze at night, the Mulivai house was oriented in a north-south direction. The sun setting in the west would heat up that side of the house in the afternoon. Bedrooms were therefore placed on the east side away from the afternoon sun to keep them cooler in the evening while the lounge and dining room were on the west side.



North view



East view



South view



West view

Engineering design concepts

Samoa is affected by cyclones, earthquakes and because it is near the sea it is also prone to tsunamis. Cyclone forces are particular critical on small buildings as witness after previous tropical cyclones that struck Samoa when many buildings were destroyed. As discussed above, a pole structure was used in the Mulivai house, considered ideal to resist lateral wind forces. The 16 poles were local hardwood and extended from the roof to the ground, linking together the whole structure.

To achieve maximum structural integrity, all structural elements were tied together - poles concreted to the ground, floor bearers bolted to poles, floor joists tied to bearers, bottom plate tied to joists, external walls tied to bottom plate, top plate tied to the wall and poles, roof rafter tied to top plate, purlins tied to rafters and roofing iron fixed to purlins.

The square hip roof meeting at the centre provided a smooth shape that helped minimise the uplift pressure on the roof during high winds. This pressure could pull away the roof lining and framing. As well the 300 millimetre openings at the top of the walls eased the inverse pressure at the eaves that could lift the roof structure off the top plate. With a longer than normal roof overhang of 1.5 metres, the roof rafters were braced back to the wall to help hold the roof down.

Limited housing finance

In 1980 when our housing loan was approved, my salary was only about \$2,500 per annum which meant that I had very limited disposable income for mortgage repayments. Innovative ideas were therefore required in order to add value to available funds, it was a matter of balancing functions against costs. The external walls, for instance, were 2.4 meters high as those timber lengths were considerably cheaper. Ideally it could be 2.7 metres to give extra wall height and openings as well as more internal roof space. However that would mean using the next size up of 3 meter lengths resulting in more waste.

External walls were single-lined with 20 millimetre timber fixed from inside. As the framing and lining were all exposed to the weather and light outside, it was latter found that this arrangement helped preserved the timber as termites and ants did not like to live in open space. Internal walls and ceiling were also single-lined with 6 millimetre hardboard, the most practical and cheapest liner boards available although not the most existing. Ceiling rafters were set at 800 millimetres centre and purlins at 600 millimetres so that the 1200 by 2400 millimetre hardboard sheets could be cut into threes and fixed as 1200 by 600 millimetre boards. The smaller size was more convenient to handle and could be fixed by one person as well as being cheaper and easier to replace.

Initially no windows were installed at the external wall openings except for security and insect screens as the extended roof overhangs generally kept the rain out. The screens were fixed from the inside for ease of maintenance. However during tropical cyclone Val in 1991 the driving rain went right through the house both upstairs and downstairs. Louver windows were then installed in 1992 although the openings at the eaves remained.

The floor plan was fairly open to improve internal air movement. Apart from the lounge all other rooms were of minimum size and governed by the pole grid. The polished timber floor used all 2.4 meter lengths of 20 millimetre tongue and grove cut to size. There were no covered kitchen cupboards, shelves or drawers as these provided good hiding places for

cockroaches and other pests. Walk-in pantries were built so all kitchen wares and groceries were kept in one place for easier cleaning and protection.

Overall every task was carefully planned to minimise either material or labour costs. For instance, electrical services were streamlined to reduce wiring and fittings, plumbing services were concentrated in one area to ease the connection of inflows and outflows and the whole house was painted in three colours - mission brown stain for the outside, stain/varnish for floor, outer inside wall and roof rafters and white for all other internal walls and ceiling - to simplify procurement and use of material.

Conclusion

When we planned the Mulivai house, we wanted something that was affordable in the local context, incorporated appropriate aspects of Samoan and tropical architecture and could withstand the strong tropical cyclones that frequented Samoa. We also wished to build a structure that was uniquely us, reflected our ideas and characters and did not stand out from the surrounding neighbourhood. Through patience and the innovative application of common concepts it was possible to provide an affordable and, we think, interesting house.

We have since perused other measures to improve our home's sustainability. All our water needs are met from rainwater collected off the roof and stored in concrete tanks behind the house. A solar hot water system was installed which works adequately without being connected to the power supply. All our green waste is cooked and used as dog food - our five dogs provide efficient home security. My wife's mother moved back to Christchurch and her downstairs flat is now the master bedroom. An art studio for my wife was added downstairs next to our bedroom so she can work from home. Other tasks that are considered include the treatment of grey water and use it to irrigate the garden around the house which is well-shaded by the eaves, and to develop alternative forms of energy to compliment or replace electricity from the national grid. Our house project that started in 1980 looks like it will go on indefinitely.

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