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TRADITIONAL HOUSING IN THE SOUTH PACIFIC - A new house loses its roof during a cyclone while an older house remains standing.

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THE DEVELOPMENT OF 'BASKET-WEAVE' CONSTRUCTION

Charles Boyle is an architect practising in Solomon Islands and author of "Disaster-Resistant Construction for Traditional Bush Houses". He is also the Director of 'Hybrid Technology', a charitable research trust which has been studying various elements of traditional housing construction in Solomon Islands and developing 'Basket-weave' construction, a method of building that is both based on those traditional techniques and responsive to the availability of materials and the finance required for them. This article comprises an interview with the editor during a recent visit to Solomon Islands.

You were in the Solomons during Cyclone Namu, what was it like?

I was in Honiara that weekend, living in a house at the top of a hill. The local news began to broadcast increasingly urgent messages about the development and path of the cyclone, but you couldn't tell how up-to-date it was; so we were all concerned just how far the information lagged behind actual events.

The rain became very heavy, the wind driving it through the windows and it became very dark. Every so often an electrical fuse on one of the poles outside would explode from a short-out, and finally we lost electricity and water. We did not know how much worse it might become.

You can imagine then what it must have been like living in the village without the re-assurance of police inspections, often without radio and the security of a solid home while the wind and rain howled around you. In the days after there was an initial spirit of co-operation, but later this gave way to despondency when the scale of the disaster, the number of lives lost, the extent of property damage and the disruption to food and water became clearer. Over 100 people were killed mainly from flooding and landslides, and we lost, either destroyed or severely damaged, about 40,000 houses and other buildings.

Is it possible to make a house cyclone-proof?

Well, you are dealing with the forces of nature which are somewhat unpredictable. All you can say is that you can make a house relatively stronger by employing techniques that strengthen it so it can better stand up to a cyclone.

Cyclones vary in their intensity and effects, for example, during three days in December 1988, more rain fell in Honiara than did during cyclone Namu, but no-one was killed. Likewise we had tremendous winds in March 1984 which threw up great seas and beached several ships. The winds were as strong and the seas certainly larger than during cyclone Namu, but again no-one was killed.

Why did so many houses fall down during Namu if it was not such a severe cyclone?

You have to look back on changes that had been taking place in the construction industry during the previous ten years or so. Solomon Islands Housing Authority had been developing and improving its low-cost timber-frame houses. At the same time, as a result of economic growth and population mobility, these ideas were being taken back to the more rural areas of the country.

There had not been a really significant cyclone in, for example, South Malaita, for at least ten years, and the importance of cyclone resistant construction was not paramount in house-building. Instead, the simpler 'Western style' and ostensibly permanent building technology of these timber framed houses was being used in conjunction with traditional building materials. The result was an unfortunate hybrid of a timber frame technology which requires strapping and bracing and which relies on nail fixings, and traditional pole frame materials which are for the most part unsuitable for nailed connections, and are also without the necessary long timbers from the ridge and eaves to the ground from which the traditional techniques derive most of their strength.

Population stabilisation had also placed greater demands on the availability of resources and proximity of building materials to the site; and it was understandable that the old labour and material intensive ways were superseded by easier and cheaper methods.

What caused them to fall down in the cyclone?

There were of course specific reasons why some buildings failed - I can only speak from general observation.

The form of many of these buildings was of stump foundations with a floor platform about 1.0m above the ground level over which was built the superstructure of the house - poles and leaf cladding. The weak point was

invariably the connection between the superstructure and the floor platform.

It was common to find the houses literally blown off the platforms because they were inadequately fixed at that point. You can see photographs of several older-style houses or their frames standing amidst these flattened houses.

Another source of building failure was the collapse of the walls at mid-span through inadequate girts and bracing. It was this that led us to look at traditional building construction more closely, and eventually put these thoughts together in a simple form in the Handbook.[1]

You mentioned that nails were unsuitable for use with traditional house-building materials. Can you explain what you mean a little more?

Nail fixings are increasingly being used for leaf house construction because they are cheap, easy to use and are an 'instant fix'. There are certain problems with this. Firstly, nails have only been economically available during the past 10 to 15 years for people building leaf houses and this is not long enough to determine the long-term effects of a nail on a pole. What we do know is that over a long period of time a pole will dry out and shrink away from the nail fixing rendering the connection progressively weaker. It is also difficult to knock a nail into a pole because of its shape - the nail will often skid across the surface, split the timber and is not really effective unless it penetrates vertically at the crown.

Poles often contain natural acids which can erode nails and so weaken connections. Likewise, it is very difficult to pull apart a nail-fixed structure to repair or replace damaged members without splitting and weakening others.

Tied connections on the other hand do not damage the members and are easily repaired. Vines are often used when green, and they 'grow' and shrink onto the surface of the poles making a very strong joint. They are, however, heavy and difficult to gather, particularly if the host trees have fallen after a cyclone such as was the case in South Malaita. For a while we experimented with a polypropylene strapping material as a substitute for vine because of its weight and low cost and because it had similar tying characteristics to vine. We built a complete house using the material which was effectively protected

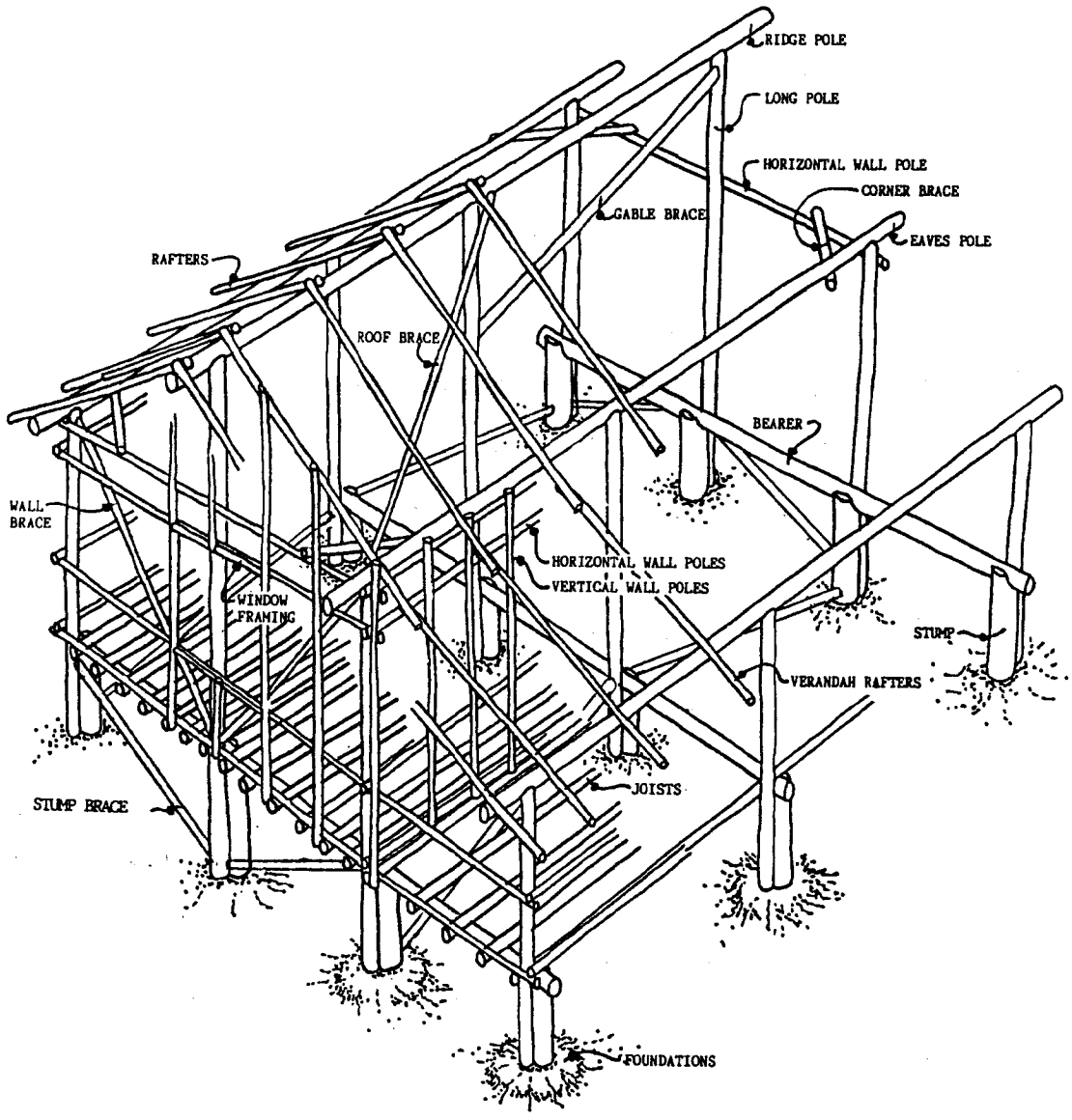
A complete house was blown off its platform during Cyclone Namu because of a lack of structural continuity between the walls and the floor.

from ultra-violet decay by the detailing of the leaf cladding, and would like to experiment more in this field.

Are you suggesting that we only use tied fixings for traditional construction?

Not exactly. Traditional materials are best fixed by traditional means - vine ties, long poles and the like, and modern materials are best fixed by modern means such as nail fixings, strapping and metal bracing, but what is really needed is more experimentation and study. Simply mixing the two can have unfortunate results.

For example, one part of the reconstruction programme following cyclone Namu was the provision of galvanised iron roof sheeting to provide permanent roofing. Although adequate means in the form of galvanised wire tie-throughs and the use of sawn timber purlins may have been used for the roof sub-structure, the connection of these to the round pole roof structure below may not have been properly considered. As a result, it is possible to imagine during the next cyclone, entire roofs being torn away and cart-wheeling through the village. In this case mixing the technologies may not allow for the essential structural continuity from roof to ground.



3-D representation of a well-designed traditional house-frame.

In many instances the roof sheeting provided was stored awaiting the time when the owner would use it on a permanent house - either sawn timber frame or block-work - rather than on a traditional pole structure. It would seem therefore more important to provide a strong building underneath so that you can make proper use of 'permanent' building materials on the roof and walls. It was consideration of these problems that led us to develop 'Basket-weave' construction.

Can you tell us a little more about 'Basket-weave' construction?

'Basket-weave' construction is a way to make a building that relies on a strong timber frame provide all the necessary resistance to cyclones and earthquakes, which then provides a strong base over which the cladding, leaf or galvanised steel, or timber can be fixed.

The method of detailing - projecting the frame members and the various purlins and girts which allow for jointing in all directions - gives rise to its name, in the sense that the walls and roof are 'woven' over the frame a little like an up-turned basket. Because the entire cladding is then acting together, it is much stronger, and because it relies on a frame for its strength rather than the cladding, this also allows for repair and improvement to the cladding without jeopardising the essential strength of the building.

It is not a new technology - for example in America this is sometimes called pole-barn construction - just that it has not been applied in this part of the world. I suspect people concerned with housing development have tended to concentrate on the more 'permanent' timber frame techniques at the higher end of the cost range and in the urban areas. You have to have a certain personal motivation to want to spend time in the village talking with people about their needs and discussing their crafts and most professionals in the field, unless highly paid to do so, will not take the time out to do this. You also need time to build trust and to communicate with people without pushing ideas and to allow for response rather than demand.

What are the characteristics of the technique?

The frame design evolved out of the traditional frame techniques in the country and the principles involved apply equally when using sawn timber frames or traditional round poles. Although we have evolved some construction details so you can use sawn timber purlins and girts over a round pole structure, it is preferable to see leaf cladding over a leaf pole structure, but either leaf or sawn timber cladding may be used over a sawn timber frame.

The process of erection - generally of fixing the elements together and trimming them to suit afterwards - makes it suitable for builders with limited skills. The detail of the cladding provides for a three-way connection wherever possible so that three elements are tied together with resistance being provided in all three axes and this stiffens the joints greatly.

What applications do you see for the technique?

The frame can be fabricated on site using a portable saw-mill, or remotely cut and supplied (hence its application for rural housing reconstruction programmes), and could even form the basis for a small industry producing the frame kits for sale.

It would likely be welcomed by funding agencies because the frame components are easily quantifiable. The technique is particularly responsive to joint development projects between, for example, a central funding or development agency who could provide the frames, and a local group or village who could provide the cladding according to their own economic ability.

What future do you see for your work?

Well, we see our work constantly in flux, responding to both needs and adapting traditional techniques as we become aware of them. This allows for cultural continuity. Being a construction technique rather than a building design, it can be adapted for use in many types of building. So far we have designed houses, a resource centre, rural community centres and a school. We would like to see the technique being adapted for many other types of rural and peri-urban buildings where low cost simple construction techniques are appropriate. We would also like to continue our research into traditional housing technology which has given us the groundwork of established examples on which much of our work is based.

The nineties is the United Nations Decade of Natural Disaster Reduction, and also a decade of war on homelessness, so we have at least ten years of work to focus on.

References:

1. **Disaster-Resistant Construction for Traditional Bush Houses - a handbook of guidelines.** Sydney: AODRO,1988

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