



Proposal for the Systematic Improvement of Cyclone, Earthquake and Tsunami Resistance of Housing and Village Infrastructure

Executive Summary

- Partner Housing Australasia (Building) Incorporated¹ offers pro-bono design services, project management and some funding to organisations involved in the construction of housing and village infrastructure. It is particularly suited to rebuilding in the wake of damage caused by cyclones, earthquakes and tsunamis.
- In particular, Partner Housing offers to implement a program of systematic improvements for housing and village infrastructure, by incorporating external roof anchors and tie ropes, cyclone washers, internal anchors and bracing and subfloor bracing.
- The proposed program would be integrated into the general building program funded by other NGOs and aid programs.
- The proposed program is modelled on the successful roof anchorage scheme currently being implemented in the Cook Islands by Partner Housing, Cook Islands Red Cross and Australian Red Cross.

Scope of Proposal

Partner Housing Australasia (Building) Incorporated specialises in providing pro-bono professional services to other NGOs and government instrumentalities of developing countries in south-east Asia and the South Pacific.

Our aim is to improve the safety and effectiveness of housing and village infrastructure, by offering and coordinating the pro-bono services of highly qualified and experienced professional consulting structural engineers and water and sanitation engineers

In particular, we offer pro-bono design services, documentation, project management, supervision and funding of some key materials, to other organisations involved in the construction of housing and village infrastructure.

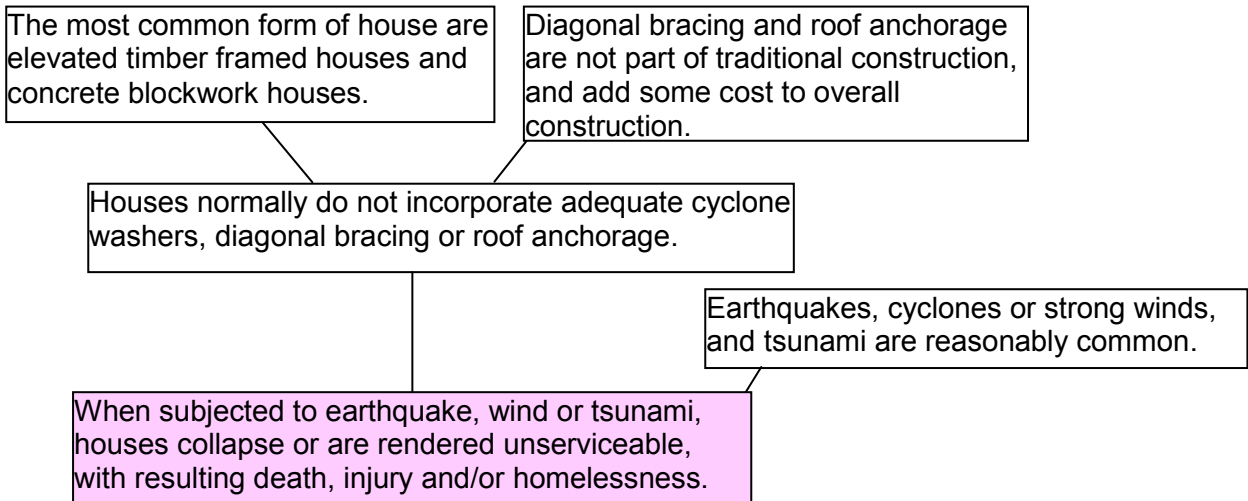
It is particularly suited to rebuilding in the wake of damage caused by cyclones, earthquakes and tsunamis.

¹ In this proposal, Partner Housing Australasia (Building) Incorporated is referred to as "Partner Housing". Refer to Appendix 3.

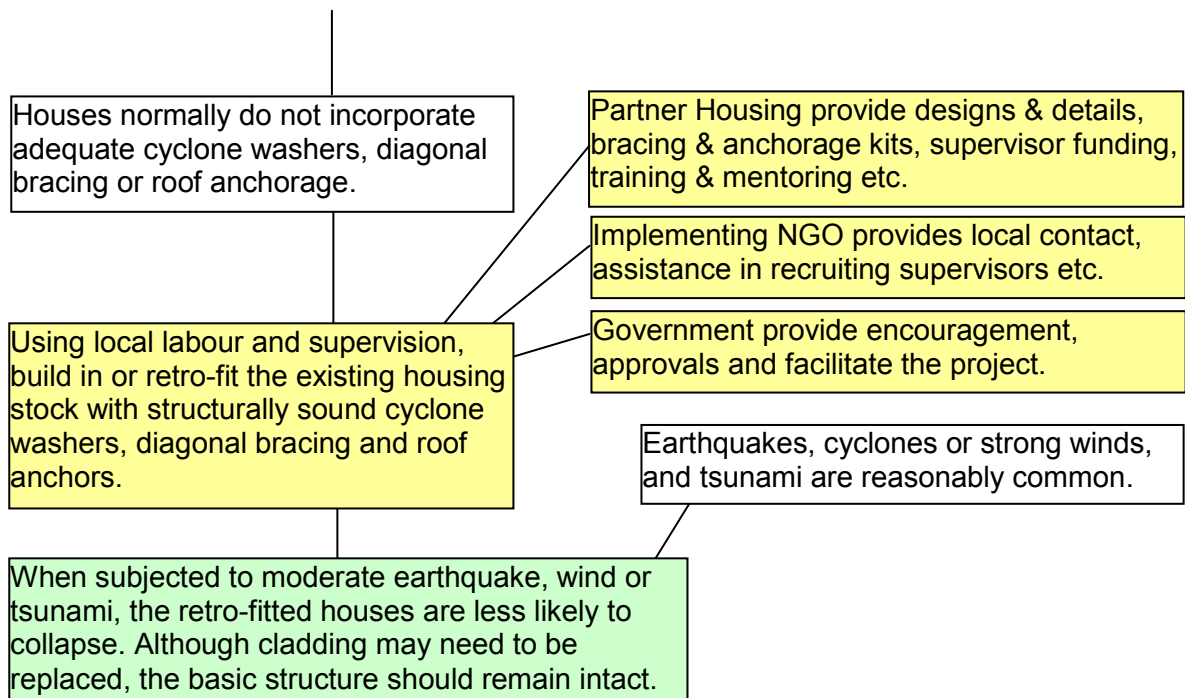
Technical Considerations

Partner Housing offers to implement a program of systematic improvement of the resilience of housing and village infrastructure subject to cyclonic wind, earthquake and tsunami, by incorporating external roof anchors and tie ropes, cyclone washers, internal anchors and bracing and subfloor bracing.

Problem Tree



Solution Tree



Appendix 1 sets out the interim recommendations for determining the cyclonic wind, earthquake and potential tsunami loads on houses and small buildings in the region covered by this proposal. These interim recommendations are offered to, and are subject to confirmation by, the authority charged with regulating construction in the region. Construction should not be undertaken until such approval is granted by the relevant consent authority.

Integration into the General Building Program

The Partner Housing program involves the provision of features, which are essential for the safety of the building in extreme weather, but are commonly omitted from low-cost construction. These include:

- External roof anchors and tie ropes for enhanced cyclone resistance;
- Cyclone washers to minimise the risk of sheet steel roofing blowing off;
- Internal anchors used to tie roof and wall structures into a single structural unit; and
- Roof bracing, wall bracing and subfloor bracing, used to resist collapse under wind, earthquake and tsunami load.

The Partner Housing program makes provision for these features to be installed at the time of construction (or at the time of refurbishment in the case of post-construction enhancement).

A series of design details and construction checklists are available, covering both enhancements and basic construction. There are in the form of Building Skills Training Resource material and can be used for both formal structures training and informal on-the-job instruction.

The Partner Housing program provides a “budget specifically for the funding of:

- Close on-site supervision during all phases of the construction (or refurbishment); and
- Materials for the particular structural enhancements.

This ensures that, provided the cost of basic construction is met by others, the extra details and effort for structural reliability in cyclonic wind, earthquake and tsunami can be achieved.

Model

The proposed program is modelled on the successful roof anchorage scheme, currently being implemented in the Cook Islands by Partner Housing, Cook Islands Red Cross and Australian Red Cross. This is described in detail in Appendix 2.

This model has a proven track record, and has been reviewed favourably by the RMIT University. Refer to the detailed study:

A Scoping Study: Shelter and Disaster Risk Reduction in the Asia-Pacific Region

November 2012

Dr Esther Charlesworth and Dr Iftekhar Ahmed

Humanitarian Architecture Research Bureau (HARB)

School of Architecture & Design

RMIT University, Melbourne, VIC 3000

Commissioned by the Shelter Reference Group (SRG) Australia

Appendix 1

Interim Recommendations for Determining Loads on Houses

Overview

Set out below are interim recommendations for determining the cyclonic wind, earthquake and potential tsunami loads on houses and small buildings in the region covered by this proposal.

Approval by Consent Authority

These interim recommendations are offered to, and are subject to confirmation by, the authority charged with regulating construction in the region. Construction should not be undertaken until such approval is granted by the relevant consent authority.

Loads on Village Housing in the Asia-Pacific Region

All loads are subject to amendment to suit the building regulations of the country.

Location: Fiji

Building: Small detached village building; Presenting a low degree of hazard to life and other property in case of failure; Single storey; Cladding on elevated braced timber frame OR Reinforced concrete masonry on concrete slab-on-ground; Maximum dimensions: 12.5 x 8.0 m, 2.7 m storey, Maximum eaves height 6.0 m, Maximum ridge height 8.5 m, Maximum pitch 35°

Design: Design life 25 years; Annual probability of exceedance 1 in 250; Probability of exceedance during life: 0.10

Soil: Shallow clay-sand, Characteristic internal friction angle 30°; Site classification "M"; Ultimate bearing capacity 500 kPa.

Permanent Loads: Elevated timber building, $w = 2.5 \text{ kN/m}^2$ (floor area), Reinforced masonry building $w = 3.5 \text{ kN/m}^2$ (floor area)

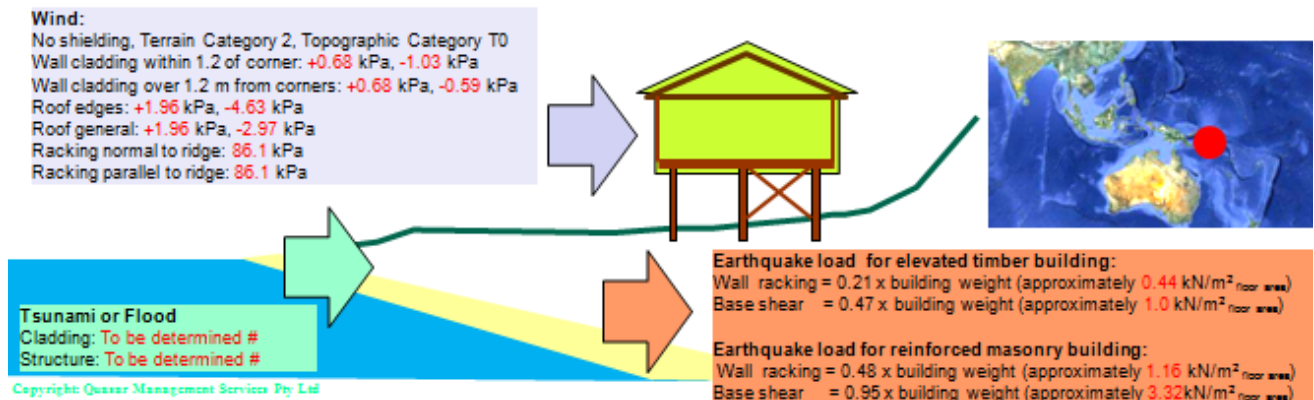
Imposed Loads: Floor load 1.5 kPa; Roof load 0.25 kPa

Wind: Strong cyclones, Wind Class IV(C), $V_{250(3,10)} = 62 \text{ m/s}$, $V_u = 58.6 \text{ m/s}$; $q_{zu} = 2.06 \text{ kPa}$

Earthquake: Probability $k = 1.0$; Hazard $Z = 0.40$; Subsoil = C; Ordinate $C_{a(T1)} = 3.68$; Ductility, $\mu = 2.00$; Performance, $S_p = 0.77$

Tsunami: Elevation > "To be determined" m (or Distance from high-water mark "To be determined"; Tsunami risk factor $(1 \text{ to } 10) \#$

Flood: Building is not in or close to a watercourse, Flood risk factor $(1 \text{ to } 10) 0$



Appendix 2 Case Study – Cook Islands Cyclone Preparation

Overview

Partner Housing*, in partnership Cook Islands Cross and Australian Red Cross, is improving the cyclone resistance of housing throughout the Cook Islands.

The pilot program involved over 150 homes in three villages on the remote island of Mangaia.

Steel anchors are set in concrete blocks or rock outcrops, and tie ropes provided to secure roofs from the intense suctions induced by tropical cyclones.

The ropes may be installed at the start of the cyclone season, or during the period when a cyclone is known to be approaching.

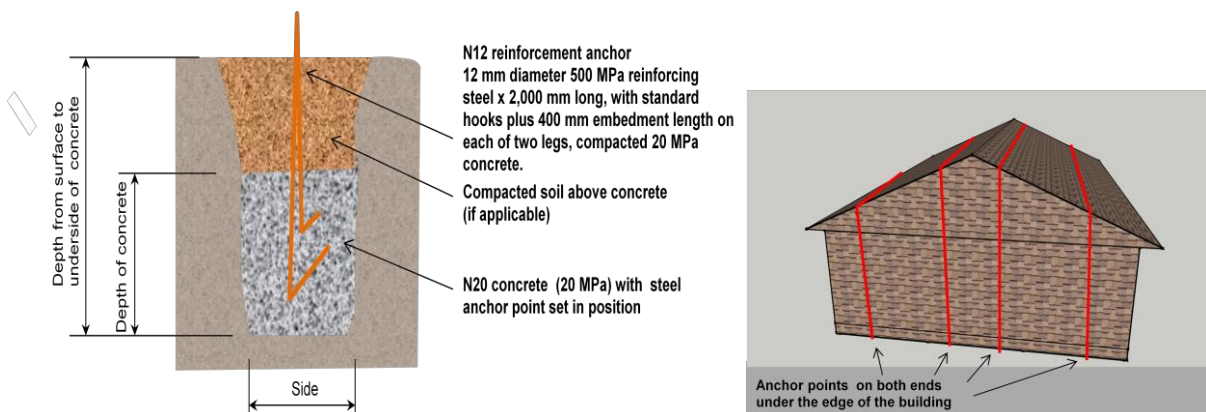


Roles and Responsibilities

- Partner Housing initiated the program and was responsible for identifying the overall need, designing the system, providing the funding, monitoring the initial construction and providing on-going advice.
- Cook Islands Red Cross identified the local need, planned the program, coordinated the local consultation, organised and supervised the local construction, and monitored the outcomes.
- Australian Red Cross facilitated the partnership.






Design

Partner Housing provided load assessment and detailed design of the anchorages.



Local Innovation

Partner Housing has encouraged local adaptation of the basic system by the builders who are installing the anchor systems. Local innovation has resulted in significant improvements in the construction.

1. Excavate 450 x 450 x 1,000 deep hole. 
2. Bend N12 reinforcement anchor.
3. Prepare a mold out of a 100 dia x 700 mm pipe, split down one side and hold together by two rings.
4. Place the anchor and install N20 concrete. Install the mold around the anchor. 
5. Remove the mold. 
6. Expose the anchor. 
7. Backfill and compact soil leaving anchor point exposed. 

Red Cross Branch Capacity Building Workshop
"Together becoming Resilience" 26th Nov - 3 Dec 2012




The workshop brought executive Branch members from the outer islands to Mangaia. A visit to Project site was included in the program and also conduct a proper roping exercise. The CIRC president Nga Jessie who is also the Chief of Fire Service in Rarotonga ran the rope exercise with assistant from other rope experts from the uniform organisation volunteering with RC.




Care and plaiting end of Rope - RC Branch member observed by community volunteer and District council member

Stakeholder Engagement

From the outset, Partner Housing has worked closely with Cook Islands Red Cross to ensure that the program met local needs. This included visiting the remote island of Mangaia and attending discussions with the local Red Cross chapter on local requirements and policies for tie rope installation.

Quality Control

During an early site visit, Partner Housing developed a practical method of site testing the installed capacity of anchorages, and this has been employed by the builders for on-going quality control purposes.



Anchors installed as part of the program are sampled and site-tested as part to the on-going quality control program, and provide excellent resistance to wind uplift. Cement bags are loaded onto a 10 : 1 lever system.



Some of the anchors previously installed by others were also tested and found to offer very little resistance to wind uplift, and pulled out of the ground with no additional load applied to the lever arm.

Internal Reviews

Regular monitoring and reporting by Cook Islands Red Cross has facilitated close control and meant that future planning has been possible.

| Sites | 1st Stage install anchor | 2nd Stage Rope Down | Remarks |
|---------------------|-----------------------------|------------------------|--|
| Tamarua 30 homes | Complete | 25% | Roping on going after exercise by RC Branch Capacity Building workshop til end of December |
| Ivirua 64 homes | 98% | 20% | Roping on going after exercise by RC Branch Capacity Building workshop til end of December |
| Oneroa 102 homes | 50% | | |

| QUICK NOTES | |
|---------------------|---|
| Issues | Remarks |
| Budget | Balance from last instalment Enough to Support of Project Supervisor to end of Dec |
| | No other support funds for Focal Point visits and contingencies. |
| Supervisor | Must have to maintain standard of project on ground |
| Addition assistance | Island government added 4 labours to project Supervisor |
| Community | Taking part in tie down of homes after rope exercise |
| Roll Out | Islands earmarked for roll out of project witnessed the benefit of the project; including all branch executives from other islands during Capacity workshop. President of House of Chiefs were also impressed by the Project. |

Extracts from Progress Report by Cook Islands Red Cross

RMIT Review

A recent study of a number of Shelter Risk Reduction projects by the RMIT University reviewed the Cook Islands project and drew the following conclusions:

- The system of roof anchoring introduced in the project provided better resilience to cyclones, addressing a key vulnerable part of the house.
- Although the whole structure was not strengthened and only a part of the roof was made secure, it still improved the resilience of houses to some extent
- Reliance on imported materials might affect sustainability and long-term resilience.

Partner Housing Australasia (Building) Incorporated

Appendix 3

Partner Housing Australasia (Building) Incorporated

Mission

Partner Housing Australasia (Building) Incorporated is a christian ministry working with families, volunteers and donors to provide building services, financial assistance and nurture for the provision of affordable housing to those in need throughout Australia and beyond.

Operations

Partner Housing Australasia (Building) Incorporated is an entirely volunteer organisation, providing pro-bono professional engineering, architectural and building services and funding to other organisations for housing , water supply and sanitation. Partner Housing offers three basic services:

1. Pro-bono design assistance to other NGOs carrying out construction in Australia.
2. Pro-bono “Design and Help-Desk” engineering services to other NGOs and the governments of smaller developing Asia-Pacific countries.
3. Finance, Design, Materials-Supply and Supervision for village construction projects.

The first overseas assignment, in 2005, was the technical auditing of tsunami reconstruction in Thailand, Indonesia, India and Sri Lanka. Since then, Partner Housing has provided extensive pro-bono professional assistance for building projects in Solomon Islands, Kiribati (for the government of the Republic of Kiribati), and smaller projects in other Asian countries, including Cook Islands, Papua New Guinea, Mongolia, Timor Leste, Pakistan and India. Partner Housing is providing “funding, mentoring and technical assistance” programs for village projects in three Asia-Pacific countries:

- Solomon Islands: Sanitation and water supply (Partners- Two community associations)
- Papua New Guinea: Village house construction (Partner - Vision for Homes PNG)
- Cook Islands: Improve cyclone resistance of houses (Partners - Cook Islands Red Cross and Australian Red Cross)

Name: Partner Housing Australasia (Building) Incorporated
ABN: 88 722 057 429 **Charitable File No:** 15429
Business Address: 80A The Scenic Road, Killcare Heights NSW 2257, AUSTRALIA
Postal Address: PO Box 702, Pennant Hills NSW 1715, AUSTRALIA
Phone: +61 4 0721 8926 Fax: +61 2 4360 2257
Email: PartnerHousing@electronicblueprint.com.au
Web: www.partnerhousing.net
President: Rod Johnston (Public Officer)
Secretary: Arthur Gray