



HOUSING RESILIENCE

INTRODUCTION



Deliverables	<ul style="list-style-type: none">• Resilient Housing• Automated Early Warning Systems
Beneficiaries	9,720
Budget	\$89,000
Location	All Communes

Problem statement

Poor and marginalised households tend to be less resilient and face greater difficulties in absorbing and recovering from the impacts of natural disasters. Recurrent disasters also compound losses for many households, forcing them to organize their livelihood such that overall risks can be reduced in the face of uncertainty, even if it means a reduction in their income and increased poverty (UNISDR 2009b).

Consultation with local communities and site investigations have corroborated that housing in the local communities are vulnerable to strong winds - in some communes up to 80% of housing is damaged by strong winds on an annual basis.

Resilience to natural hazards refers to the ability to protect lives, livelihood and infrastructure from destruction and damage, and to the capability of communities to rebuild following a natural disaster. This project seeks to improve the resilience of the affected communes and reduce their vulnerability to environmental hazards through the provision of education and training for local people to create local capacity to facilitate the construction of safe and resilient housing, provide new economic and livelihood options.

The poor are already resilient, by both nature as well as necessity. However, further funding, information, and support are needed to empower them to escape poverty traps and better cope with climate change-related disasters.

Location

Resilient Housing

The housing resilience program will be focused on communes identified to be susceptible to weather related disasters.

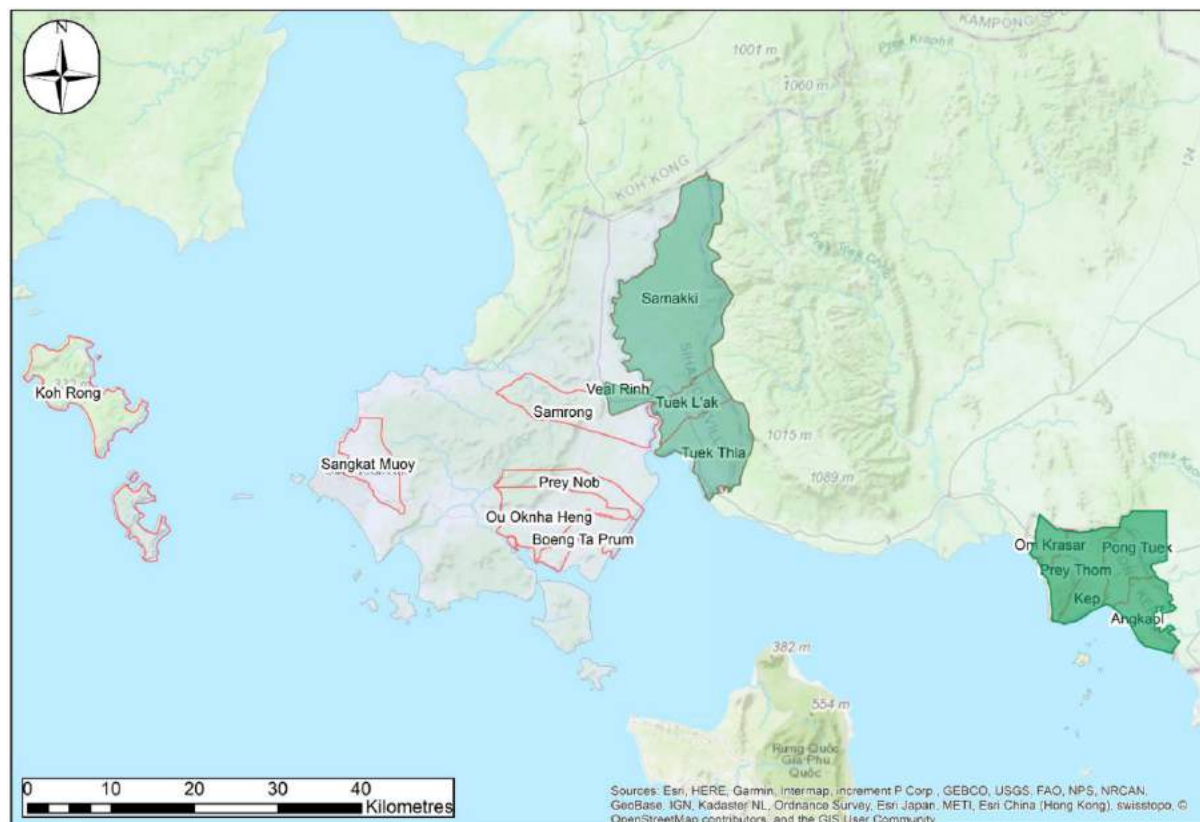


Figure 1 Location of Communes within Prey Nob and Kep Province. Housing resilience program to be targeted at communes shaded in green.

In Prey Nob District, the investment will focus on the following communes (being those that were deemed particularly susceptible to strong winds following consultation with the local community and associated site visits):

- Teuk Thla
- Teuk L'ak
- Samaki
- Veal Rinh

In Kep Province, the investment will focus on the following communes (being those that were deemed susceptible to strong winds following consultation with the local community and associated site visits):

- Angkaol
- Pong Teuk
- Prey Thom
- Kep
- Ou Krasa

Beneficiaries

	BENEFICIARIES	QUANTITY	COST PER PRIMARY BENEFICIARY
Housing Resilience	Training workshop attendees	2000 Families (or 10,000 People Approx, with 50% representation of women.)	\$89,000/10,000 = \$8.9

BUDGET

Budget for Resilient Housing

DESCRIPTION	QUANTITY	UNIT PRICE	COST
Project Preparation Phases			
- Development of 'demo' building drawings	10 days	\$300 per day	\$3000
- Development of building manuals	20 days	\$300 per day	\$6,000
Construction of Demo Houses (In Kep and Prey Nob Provinces)			
- Construction of Traditional Style Demo Houses with Latrine and Storm-water Tanks (one in each province) (1)	2	\$15,000	\$30,000
- Construction of Masonry Style Demo Houses with Latrine and Storm-water Tanks (one in each province) (1)	2	\$15,000	\$30,000
- Engineering Input	10 days	\$300 per day	\$3000
Training Seminars			
- 2 highly skilled tradesmen to run educational programs (50 sessions in total at 3 hours per session) – Assume 20 attendees each class, with at least 5 women, and preferably 10.	100 x 4 hours sessions	\$20 per hour	\$8000
- Engineer to train tradesmen and women and run preliminary courses.	10 days	\$300 per day	\$3000
- Training Materials	-	-	\$1000
- Miscellaneous Costs	-	-	\$5000
TOTAL			\$89,000

Note:

(1) Housing construction costs are as reported by the commune leader for Pong Teuk on 19 October 2018 with allowance for necessary modifications.

DATA COLLECTION

Inputs

The following inputs were used for the development of this investment:

- Community Consultations (Refer to the proposal Part II, Section H)
- Site Records and Observations

Consultations

Consultation with communes were undertaken to understand the impact of strong winds and flooding on the specific communes. The relevant dates of consultation sessions wherein the vulnerability to strong winds and flooding hazards were identified are as follows:

- 16 October 2018 – Meeting with Kep Municipality
- 17 October 2018 – Meeting with Kep Province Department of Water Resources and Meteorology
- 18 October 2018 - Meeting with Angkaol Commune
- 19 October 2018 - Meeting with Pong Teuk Commune
- 20 October 2018 - Consultation with Preah Sihanouk Department of Meteorology and Water Resources
- 22 October 2018 - Consultation with the Eight Communes of Prey Nob District

Key takeaways from these consultation sessions are as follows:

- Teuk L'ak, Teuk Thla, Samakki and Veal Rinh communes are particularly affected by high winds;
- Prey Nob and Ou Okhna Heng are affected by localised flooding;
- Kep province is particularly susceptible to high winds;
- 175 houses were damaged in Pong Teuk Commune on the 18th of October 2018 by a storm, while the consultations were taking place. The team visited some of the damaged houses and assessed the damage. At least 150 houses are typically damaged on an annual basis;
- In some communes, up to 80% percent of houses are damaged by high winds on an annual basis;
- Both masonry and wooden houses are susceptible to wind damage;
- Irrespective of housing style, roof and wall construction quality typically with construction defects are at risk during high winds;
- All communes are affected by sanitation issues due to poorly constructed septic tanks and/or improper waste disposal methods;
- Solid waste causes drainage blockages and are compounding sanitation issues;

- Water quality is perceptibly worse during the dry season where fresh water availability is reduced.

Site Records

Coastal Cambodia Building Style Observations

In poor communities along the southern coast of Cambodia, traditional building styles are prevalent. Construction of housing stock is often mixed with both modern and traditional materials and building techniques.

Building Arrangement: The traditional Khmer house is typically a rectangular home with dimensions generally between 4x6m to 6x10m. Homes either sit directly on the ground, or more typically, on stilts (typically 3m above the ground). This is to avoid annual flooding, protect against petty theft, provide natural cooling and allow for the storage of animals and equipment under the house. Access provided by concrete or wooden stairs. Elevation above ground level facilitates the provision of shade for daily life activities at ground level during the day (Refer to Figure 8 & 28).

Roofs: Whilst the roofs of traditional housing are typically of gable thatch roof construction it was noted that most of the existing housing stock in the region including new homes were typically constructed with corrugated steel gable roofs (Refer to Figure 9,10, 26 & 28).

Room Arrangements: The simplest houses consist of only one room on the upper floor (Refer to Figure 14), partitioned off to provide a storage place for rice, a bedroom for the parents, and further space for unmarried daughters.

Foundations: Foundations typically consist of timber or concrete load-bearing piles nested on concrete foundations (Refer to Figure 8, 19). For very loamy soils, wooden piles are driven up to 2m in depth to stabilize the foundation.

Wall cladding: Houses of the most marginalized are generally clad with palm leaf matting which is directly fixed to the structural framework (Refer to Figure 14). Fine bamboo struts are often used to anchor the matting. In more sophisticated houses wooden boards are used to clad the walls (Refer to Figure 8), aligned either horizontally or vertically. Walls for new homes are typically of masonry construction (Refer to Figure 26).

Ventilation: Housing stock is typically absent of electric or mechanical air conditioning. A draught-free environment is obtained through natural ventilation. In more modern masonry houses, natural ventilation is often provided through the inclusion of 'air bricks' along the façade of the building (Refer to Figure 13).

To maximise effectiveness and adoption from beneficiaries, proposed resilient housing designs are to consider the aforementioned local cultural sensibilities and borrow heavily from local building styles (Audefroy, 2010).

Issues with Existing Housing Construction

The following is a brief summary of issues identified within the existing housing stock during initial site visits to the local communes. Identified issues are typically associated with construction defects, poor workmanship, unsuitability of construction with local site context and/or poor local building techniques:

- Corrugated roof sheeting of inadequate thickness when subject to corrosion and absent of washers at fixing locations are highly susceptible to tears at fixings during high wind events (Refer to Figure 17, 23);
- Roofing projecting too far beyond the external wall edge and are therefore at higher risk of high uplift loads during wind events (Refer to Figure 21);
- Roof beam spacing too large and at risk of failure under loading (Refer to photo 24);
- Corrugated roof sheeting reliant on nails in lieu of more robust fixings such as screws for connection into roof beams (Refer to Figure 16, 17, 23, 25);
- Poorly constructed building joints with no steel straps or tie downs to mitigate high tension and compression forces at joints (Refer to Figure 21, 22);
- Poor material quality of insufficient thickness or strength (Refer to Figure 15);
- Foundations are sufficiently imbedded within the soil and subject to pull-out (Refer to Figure 19,20);
- Timber posts are not adequately attached to the concrete foundation (Refer to Figure 19,20);
- No use of diagonal bracing to stabilise the timber structure from lateral loads induced by wind and flood water (Refer to Figure 14);
- Housing stock insufficiently elevated from ground level in flood prone areas (Refer to Figure 1, 10, 27);
- Housing stock have larger exposure to wind forces due insufficient planting of protective vegetation to form a natural wind buffer against prevailing winds (Refer to Figure 26);

Increased Adoption of Masonry Construction

Cambodian people are finding it more difficult to acquire the raw timber materials needed and are resorting to more modern materials such as brick, cement and corrugated sheeting.

Distribution of masonry houses (Refer to Figures 9, 13 & 26) appeared to be more prevalent along main roads, with more traditional timber housing styles evident along rural roads (Refer to Figure 7, 8, 28). This is an indication that those with better means are opting for newer construction styles and materials. However, this doesn't necessarily make them less likely to be impacted by strong winds.

New housing stock and housing under construction typically appeared to be of a masonry style construction (Refer to Figure 26).

Whilst the primary residences appeared increasingly built from masonry and concrete elements, secondary residences, storage, animal pens, and sanitation structures were typically of timber construction and of substantially poorer quality (Refer to Figure 11).

Increased adoption of masonry and concrete elements for housing construction is consistent with information received during consultation sessions with the local communes. The Chief of Pong Teuk Commune informed the design team that homes built from masonry and concrete are favoured due to their greater resilience to extreme weather and competitive costing due to limited availability of timber materials. The Pong Teuk Commune leader also informed us that well-built traditional homes were, as of recent times, potentially costing more than concrete and masonry house construction.

Based on the team's post-strong wind event site investigation on the 18th of October 2018, damage to residences were typically to roofing elements. On that date, over 175 residences were reportedly damaged according to the Chief of Pong Teuk Commune. Damage also extended to properties of masonry construction where (following a site inspection) it was evident that roof construction was not adequate. Specifically:

- Masonry to beam connections (Refer to Figure 25);
- Roof beam to roof beam connections (Refer to Figure 24); and
- Corrugated sheet to roof beam connections (Refer to Figure 17, 23).

Based on the increased adoption of concrete and masonry house construction and evidence that masonry houses are affected by environmental factors, it is proposed that any training on building practices provided to communes (in addition to the repair and construction of traditional timber houses) include training on construction methodology for masonry houses to address key construction shortcomings.

Quality of Building Materials

One of the key issues of housing construction within these provinces is the availability of suitable materials. Refer to Figures 7, 11, 14, 15, 16, 20, 21,22, where the use of poor-quality building materials (i.e. insufficient material strength and thickness and poor fixings) is evident.

With the reduced availability of quality timber due to historic deforestation, and the consequential use of inferior timber material in housing construction, for the poor there is an increased susceptibility to environmental impacts due to poor housing infrastructure.

The proposed training and workshops to be provided as part of this investment is to emphasize the importance of quality building materials, and to provide guidance on which materials/techniques allow for quality, low cost construction. Locally-available precast construction elements for incorporation into housing construction in lieu of other materials is to be evaluated as part of these workshops.

Assessment of Environmental Impacts to Housing

Based on consultation sessions with the communes, susceptibility of housing to wind events is a recurrent issue for the community, with hundreds of houses being damaged on an annual basis. There is a clear need to improve housing resilience in the region for wind-based events, particularly with respect to wall bracing and roof construction.

Despite identifying water marks clear above floor level for many housing structures, flooding was perceived as lesser of an issue for the community. It was noted that most traditional houses were built elevated from the ground and therefore protected from low level flood waters. Masonry houses on the other hand, were observed to be of sufficient strength to weather minor flood events.

With rising sea levels and houses being increasingly built of masonry construction flush with the ground level, there is an increasing risk of housing infrastructure susceptibility to larger flood events. To reduce the risk, communes should carry out hazard mapping to identify areas at higher flood risk. Furthermore, flood protection requirements for 1 in 100-year flood events should be articulated in educational programmes associated with housing resilience.

Protective Vegetation

Housing, where protected by a shelterbelt of vegetation, were reported by local residents as more resilient against strong winds. It is recommended that housing resilience educational programmes include information on the introduction of vegetation shelterbelts as cost effective wind protection.

Stormwater Retention

With water of increasingly greater scarcity in the area, safe drinking water harder to access, existing housing stock and new housing stock should incorporate storm water storage from roof runoff. Poor access to quality drinking water is reiterated by the local residents who reportedly at relative high cost and effort purchase water from distant reservoirs.

Rainwater is considered to be of very high quality by both recipients and non-recipients and was thus used extensively where available. The annual rainfall in the regions, which is in excess of 1400mm per year, can facilitate rain water harvesting efforts in the region. Costs for domestic rainwater tank reportedly range from US\$160 for a jumbo jar to US\$250 a concrete ringed tank (Refer to Figure 12).

Sanitation

Poor sanitation facilities have been identified as an issue during by both community consultations and on-site visits. Sanitation and hygiene awareness workshops should be carried out which emphasise the importance of latrines uses with activities and visual representations to connect open defecation to river water, which people might drink. Poor

sanitation is a particular concern for women. Participants should understand the importance of latrines and be motivated to build one in their home (Refer to Figure 11).

Research by the World Bank's Water and Sanitation Programme published in 2012 argued that more than half of the Cambodian households that lack a latrine could, in fact, afford one.

Sustainability Issues

Long-term use of demo housing infrastructure:

Following completion of all learning programs, community infrastructure used to accommodate the housing resiliency seminars is to be repurposed:

- Demo housing (4 houses total) is to be augmented to a fit for purpose state for permanent settlement.
- Learning centre (1 learning centre total) to be augmented for use as a community centre. Ongoing management of the community centre to be under the purview of the commune.

Sustainable use of local materials

With respect to the types and quantities of local materials used in housing construction, the programme is expected to have a net benefit outcome:

- Successful implementation of housing resiliency principals within local construction would have a net benefit and result in reduced requirement for reconstruction and therefore requirements for new materials following wind and flooding events.
- Program to identify newer construction styles that incorporate the use of materials that mitigate risks of deforestation.

Long-term sustainability of the training programme:

To maximise the continuance key learnings of the program within the targeted communities:

- Best practises to be documented in paper and digital formats and distributed to public facilities including local government offices and schools. Discussion sessions will also be held to support less literate people in the community who may not be able to benefit from written information:
- Best practises to be documented in both written and video format in Khmer, using accessible language
- Videos to be uploaded online to Youtube and also shared to people who have access to smartphones (increasingly common in the target area)
- Prior to completion of the training programme, local municipality to be offered the opportunity to fund extensions to the programme.
- Otherwise, it is expected that the housing resiliency learnings will be informally conveyed through the broader community and their families

Papers

Some of the most relevant literature reviewed include:

Shelter and disaster risk reduction:

- ADRC (2012) Natural Disaster Data Book 2010: An Analytical Overview. Kobe, Asian Disaster Reduction Center (ADRC).
- Lyons, M. et al (eds) (2010) Building Back Better: Delivering People-Centered Housing Reconstruction at Scale. Rugby (UK), Practical Action Publishing.
- Tran Tuan Anh (2017). Developing Design Options for Housing in Disaster-prone Areas of Central Vietnam. RMIT University.
- Tran Tuan Anh, Tran Van Giai Ph (2013). Community consultation for long-term climate-resilient housing in Vietnamese cities: a comparative case study between Hue and Da Nang. Asian Cities Climate Resilience.
- Dr Esther Charlesworth, Dr Ifterkhar Ahmen (2012). Scoping Study: Shelter and Disaster Risk Reduction in the Asia-Pacific Region. Humanitarian Architecture Research Bureau (HARB), RMIT University.

Lessons from past projects:

- Aquilino, M.J. (2011) Beyond Shelter: Architecture and Human Dignity. New York, Metropolis Books.
- UN-Habitat and IFRC (2009, 2010 and 2012) Shelter Projects. Fukuoka and Geneva, UN-Habitat and the International Federation of Red Cross & Red Crescent Societies (IFRC). Evaluation frameworks:
- AusAID (2005) AusAID (2005) AusGuideline: The Logical Framework Approach. Canberra, AusAID.
- Twigg, J. (2007) “Evaluating Disaster Risk Reduction Initiatives” in Benson, C. and Twigg, J. (2007) Tools for Mainstreaming Disaster Risk Reduction: Guidance Notes for Development Organisations. Geneva, International Federation of Red Cross and Crescent Societies and ProVention Consortium.
- Lizarralde, G. (2002) “Organizational Design, Performance and Evaluation of PostDisaster Reconstruction Projects”. Conference proceedings, Improving Post-Disaster Reconstruction in Developing Countries. Montreal, Université de Montréal.
- J.F. Audefroy, B.N.C. Sánchez, Integrating Local Knowledge for Climate Change Adaptation in Yucatan, Mexico, International Journal of Sustainable Built Environment (2017), doi: [http:// dx.doi.org/10.1016/j.ijbsbe.2017.03.007](http://dx.doi.org/10.1016/j.ijbsbe.2017.03.007)

*Housing Resilience Design**Stage 1 - Project Preparation Works*

Project preparation works are to take consideration of the following key consideration to ensure that the housing resilience works are adequately implement with appropriate consideration of the local context:

- Housing Resilience Literature: Mobilised project team to undertake a literature review on disaster resilient shelter construction and leading practices.
- Local Construction Practices: Undertake an assessment of local building practices and architectural styles, based on previous work conducted by UN-Habitat in Cambodia. The programme will be tailored to suit the local context and local culture. The assessment will analyse cultural requirements regarding functional spaces, housing styles, typology, materials and local construction techniques. Local availability of housing precast construction elements to be evaluated. Note that the assessment will take place under Output 1.2 of the project, and its findings implemented here.

Note: Design without adequate local representation and cultural sensibility are very likely to create conflict or even rejection from beneficiaries (Audefroy, 2010) and subsequently result in the ineffectiveness and unsuitability of rebuilt houses for future disasters.

- Hazard Mapping: Undertake housing and community multiple hazard assessment and ranking to produce community-based climate and disaster mapping and planning. Hazard mapping to take into account sea level rise, projected flood levels for 1 in100 year flood, local accounts of flood and wind prone areas.

Note: Evaluation tool detailed within Section 4.1 of paper Scoping Study: Shelter and Disaster Risk Reduction in the Asia-Pacific Region by Humanitarian Architecture Research Bureau (HARB) wherein an evaluation framework when undertaking this exercise with local communities is provided.

- Demo Housing Locations: In coordination with local commune leaders identify sites within Kep province and the affected Prey Nob communes wherein construction of demonstration houses are ideal. Location to be located near to transportation routes and suitable for training workshops to be held.
- Implementation Documentation: Produce implementation documentation including detailed construction documentation (taking into consideration local context, commune specific hazards and commune consultation), a training curriculum and an implementation plan.
- Development of Monitoring Procedures: To ensure effective coordination and management of housing resilience projects, monitoring procedures and checklists to be developed for the respective stages of the project to facilitate tracking of project progress against the success criteria and compliance with the established standards. Plan to include report project success vis-à-vis success criteria and reporting on lessons learned from both successes and failures.

Stage 2 - Approvals

Submit Housing Resilience Documentation and attain formal approval from the Provincial Department of Land Management, Urban Planning and Construction, and Provincial Hall of Preah Sihanouk and Kep Provinces.

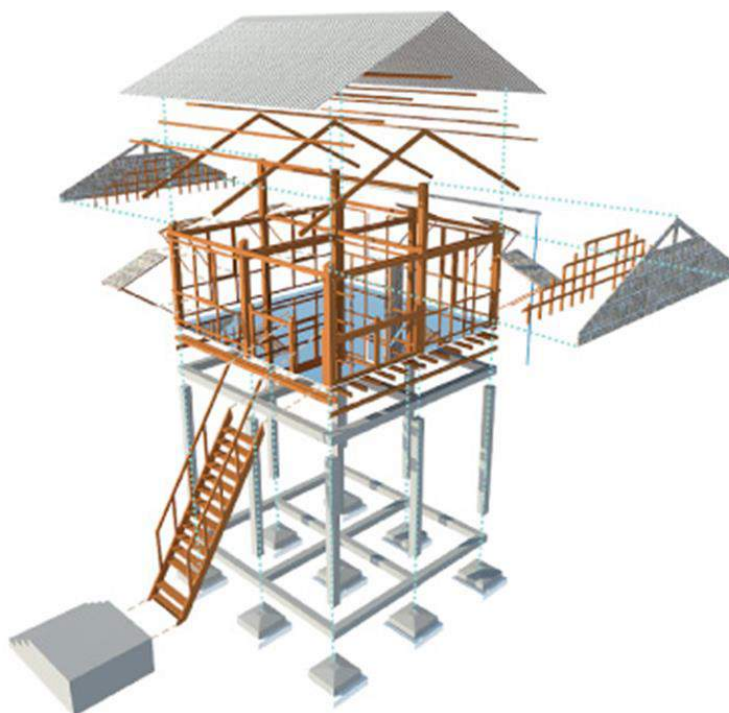
Stage 3 – Program Implementation

The investment will be implemented as per the implementation documentation plan and documentation produced within the Stage 1 works. Works within this phase includes, but not exclusive to:

- Construction of Demo Houses (Refer to Figure 5) and associated latrines / storm water tanks;
- Identification of beneficiaries within local community i.e. members suitable to attend the capacity building workshops (“Local Capacity Building Workshops”);
- Training and Local Capacity Building Workshops:
 - Workshop on identifying and understanding commune specific hazards inclusive of hazard mapping
 - Workshop on construction materials and technical detailing
 - Workshops on house layouts and associated construction budgeting
 - Sanitation and hygiene awareness workshops promoting healthy behaviors and latrine use
- Development and distribution of design manuals for workshop attendees; and
- Ongoing program monitoring and evaluation to assess effectiveness of the workshops.



Figure 2 “Example of Demonstration Houses Constructed in Central Cambodia”



Community Engagement

Figure 3 *“3D Isotropic deconstructed view of sample demonstration house. Demo house arrangements and construction details to be adjusted following completion of the stage 1 works.”*

Key to the success of the investment is ensuring community involvement in the development of housing styles with construction techniques suitable for the local context. Community involvement in the development of hazard maps is also critical.

Construction Requirements

A structural engineer trained in housing resilience will be involved in the development of the implementation plan and associated documentation. The structural engineer will also be required to train staff involved in the investment as well as supervise its initial implementation.

Key Risks & Safeguarding Issues

There are no significant risks or safeguarding issues. Refer to the safeguards section **XXXX** of this report for details.

SAFEGUARDS

ENVIRONMENTAL AND SOCIAL SAFEGUARD PRINCIPLE	RISK MITIGATION ACTIONS INCORPORATED IN THE DESIGN
<p><i>Compliance with the law</i></p> <p>projects/programmes supported by the Fund shall be in compliance with all applicable domestic and international laws.</p>	<p>There are no anticipated legal issues. The demo houses will all be constructed on state public land. Compliance with the law has been fully checked and is described in Part II, Section E of the proposal.</p>
<p><i>Access and Equity</i></p> <p>Projects/programmes supported by the Fund shall provide fair and equitable access to benefits in a manner that is inclusive and does not impede access to basic health services, clean water and sanitation, energy, education, housing, safe and decent working conditions, and land rights. Projects/programmes should not exacerbate existing inequities, particularly with respect to marginalised or vulnerable groups.</p>	<p>This investment will provide educational benefits</p> <p>There is a small risk that improperly planned capacity building activities associated with the investment could favour some groups or people over others. However, as described in this project sheet, women and men will be targeted equally, and the project will work with local elected commune officials to identify householders with the greatest need.</p>
<p><i>Marginalised and Vulnerable Groups</i></p> <p>Projects/programmes supported by the Fund shall avoid imposing any disproportionate adverse impacts on marginalised and vulnerable groups (including children, women and girls, the elderly, indigenous people, tribal groups, displaced people, refugees, people living with disabilities, and people living with HIV/AIDS). In screening any proposed project/programme, the implementing entities shall assess and consider the impact on marginalised and vulnerable groups.</p>	<p>There are no anticipated issues regarding marginalised groups and vulnerable groups.</p> <p>This project will:</p> <ul style="list-style-type: none"> • Provide new economic and livelihood options to the marginalised; • Improve housing resilience for the marginalised and vulnerable. <p>Otherwise, please see above under 'Access and Equity'</p>
<p><i>Human Rights</i></p> <p>Projects/programmes supported by the Fund shall respect, and where applicable, promote international human rights.</p>	<p>There is no evidence to suggest that human rights will be violated. Rights issues concerning land, women, labour and indigenous people are addressed separately in this sheet.</p>

Gender Equity and Women's Empowerment

Projects/programmes supported by the Fund shall be designed and implemented in such a way that both women and men 1) have equal opportunities to participate as per the Fund gender policy; 2) receive comparable social and economic benefits; and 3) do not suffer disproportionate adverse effects during the development process.

Men and women will be given equal opportunity to provide their labour to the training and housing construction process, under the [People's Process](#) approach. Whenever women provide their labour, the project will ensure that they have access to separate bathrooms and hygienic products.

All labourers (male and female) employed under the project will be given a mandatory briefing on the prevention of sexual harassment and exploitation prior to commencing their work.

Core Labour Rights

Projects/programmes supported by the Fund shall meet the core labour standards as identified by the International Labour Organization.

There are no specific risks to core labour rights resulting from this investment. However, the following safeguard provisions will be made.

Safety equipment will be required for workers on the site and provided for them.

This activity will draw upon labour from the community. All workers in the project will be informed of their rights to organise, including joining formal labour unions, in accordance with the law.

All workers employed by the project (including under agreement of cooperation) will be aged 18 or over).

Indigenous People

The Fund shall not support projects/programmes that are inconsistent with the rights and responsibilities set forth in the UN Declaration on the Rights of Indigenous Peoples and other applicable international instruments relating to indigenous peoples.

There is no evidence of indigenous people or undocumented migrants in the target area, and consequently there is no risk that the activities will affect indigenous people.

Involuntary Resettlement

Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids or minimizes the need for involuntary resettlement. When limited involuntary resettlement is unavoidable, due process should be observed so that displaced persons shall be informed of their rights, consulted on their options, and offered technically, economically, and socially feasible resettlement alternatives or fair and adequate compensation.

There is no resettlement required as a result of this sub-project.

The provision of improved housing resilience and construction techniques does not imply resettlement for any of the beneficiaries. Rather, it is designed to empower them improve their own dwellings in a manner suited to their own context.

Protection of Natural Habitat

The Fund shall not support projects/programmes that would involve unjustified conversion or degradation of critical natural habitats, including those that are (a) legally protected; (b) officially proposed for protection; (c) recognized by authoritative sources for their high conservation value, including as critical habitat; or (d) recognized as protected by traditional or indigenous local communities.

There is a risk that the investment would source wood unsustainably, causing deforestation. Wherever wood is used in the construction. The project will seek a supplier of FSC compliant (or similar) timber

The housing resilience investment seeks to improve the quality of new and existing housing stock. With this program, there should be a reduction in housing repairs and therefore, a reduction in the consumption of building materials, which are often sourced from unsustainable forestry sources. An overall reduction in materials used for construction should be beneficial with respect to the preservation of natural habitats and associated biological diversity.

Moreover, the capacity building emphasis the benefits that natural buffers (primarily in the form of trees) can provide. This is complementary to the protection of natural habitats.

Conservation of Biological Diversity

Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids any significant or unjustified reduction or loss of biological diversity or the introduction of known invasive species.

The constructions will all take place in villages and/or urbanised areas. As such there are no immediate risks to biodiversity in the locality.

See also 'Protection of Natural Habitats', above.

Climate Change

Projects/programmes supported by the Fund shall not result in any significant or unjustified increase in greenhouse gas emissions or other drivers of climate change.

There will be no or negligible emissions resulting from the project.

The housing designs consider making use of natural lighting and cooling.

Pollution Prevention and Resource Efficiency

Projects/programmes supported by the Fund shall be designed and implemented in a way that meets applicable international standards for maximizing energy efficiency and minimizing material resource use, the production of wastes, and the release of pollutants.

There is no risk of pollution arising from the project. The construction will not involve any hazardous materials.

Community members will be trained on proper disposal of old housing materials.

For sustainable use of timber, please see protection of natural habitats.

Public Health

Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids potentially significant negative impacts on public health.

Construction of houses requires physical labour, including climbing ladders and using tools. All labourers from the community will be given health and safety briefings, and protective clothing and equipment, where necessary.

Aside from this, there are no risks arising from the investment.

<p><i>Physical and Cultural Heritage</i></p> <p>Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids the alteration, damage, or removal of any physical cultural resources, cultural sites, and sites with unique natural values recognized as such at the community, national or international level. Projects/programmes should also not permanently interfere with existing access and use of such physical and cultural resources.</p>	<p>There are no sites of cultural, physical or intangible heritage in the areas earmarked for house construction.</p> <p>Most houses in Cambodia have spirit houses on the property (often at the front of the house). Construction will not affect spirit houses.</p>
<p><i>Land and Soil Conservation</i></p> <p>Projects/programmes supported by the Fund shall be designed and implemented in a way that promotes soil conservation and avoids degradation or conversion of productive lands or land that provides valuable ecosystem services.</p>	<p>There are no risks relating to land and soil conservation arising from the investment</p>

PHOTOS



Figure 4 *“Typical example of poorly constructed traditional house. This house is located in the Prey Thom commune.”*



Figure 5 *“Typical traditional house with traditional construction methods. This house is located in the Pong Teuk Commune”*



Figure 6 *“Typical Masonry Style House. This house is in the Prey Thom Commune.”*



Figure 7 *“Typical housing construction for informal settlements along coastline. This house is located in Kep Commune.”*



Figure 8 *“Typical external latrine construction/ arrangement. According to census data, in many communes, up to 70% of houses did not have their own latrine.”*

Figure 9 *“Typical construction for external storm water tanks collecting water from rooftops. Few houses were equipped with these tanks.”*



Figure 10 *“Example of higher quality corrugated sheeting construction. Use of screws with washers evident. Higher quality corrugated steel noted as composed of thicker material.”*

Figure 11 *“Example of local internal construction styles. No bracing visible.”*



Figure 12 *“Example of use of poor materials in local construction. Recurrent failure of critical elements reported as problematic by local populace.”*



Figure 13 *“Example of the use of nails to secure roof members together. Nails are known to perform poorly under tension loading.”*



Figure 14 *“Damaged corrugated roof sheeting that has been removed from masonry houses due to strong winds.”*



Figure 15 *“Example of localised flood in areas sensitive to rainfall (frequently experienced where drainage is inadequate).”*



Figure 16 *“Closeup of foundation failure identified in Figure 10. Foundation not secured into ground with evidence of previous failure.”*



Figure 17 *“Timber identified has not been secured into concrete foundation.”*



Figure 18 *“Example of poor joint construction with inadequate materials and construction quality. Example of poor joint construction.”*



Figure 19 *“Use of nails inadequate under high loading.”*



Figure 20 *“Closeup of foundation failure identified in Figure 10. Foundation not secured into ground with evidence of previous failure.”*

Figure 21 *“Timber identified has not been secured into concrete foundation.”*



Figure 22 *“Example of poor joint construction with inadequate materials and construction quality.”*

Figure 23 *“Example of poor joint construction. Use of nails inadequate under high loading.”*



Figure 24 “Typical example of house construction style in flood prone areas.”



Figure 25 “Additional example of traditional construction styles.”