CARE Indonesia International and P3SD
DfID cash grants for transitional shelter

Pariaman: Padang Earthquake Response, Indonesia

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Abbreviations and Terms

CI	CARE International
COs	CARE's Country Offices
CII	CARE International Indonesia (Indonesia's Country Office)
P3SD	CII's partner organisation in Pariaman
CIUK	CARE International UK: home to CI's shelter advisor
DFID	UK's Department for International Development
T-shelter	Transitional Shelters: shelters designed to bridge the gap between the emergency and full reconstruction
SC	Emergency Shelter Cluster: the humanitarian coordination structure for agencies to meet, share information, strategise and agree common standards
AAR	CARE International's After Action Review, evaluation by CI at intervals after emergencies
DRR	Disaster Risk Reduction
Korong	administrative zone at the level of a community of settlements
Toukong	Mason or builder

A The Sheltering Process: markets, livelihoods, materials and labour and cash for transitional shelter

A1 Livelihoods and markets: characteristics and interaction with shelter and housing

This brief analysis is based on a short field visit, interviews with CII staff and reference to documents produced by the Shelter Cluster in 2009-10. It is therefore only a superficial survey of markets and livelihoods: areas of life about which it is notoriously difficult to gather reliable data, pose reliable questions and get reliable answers. It should also be noted that there were no baseline surveys of livelihoods or markets in Pariaman, with the exception of an Emergency Market Mapping and Analysis of brick makers carried out in November 2009[1].

It was clear that the CII and P3SD field teams were familiar with the social and economic set up in the area and that this was a key element of the project's success. The teams were also aware that without a more detailed study – like the one that field staff referenced that was conducted by the government after the Yogyakarta earthquake – there were questions that they could not answer about the relative vulnerability of different families and communities both before and after the intervention. For example:

- who is "rich" and who is "poor" and how significant is the gap between these groups? What do these differences mean across a community in terms of cooperative mechanisms, exclusion and inclusion? What is the relationship between income sources, seasons and expenditure on goods, services (health and education), infrastructure (water, sanitation and transportation) and what was the impact of the intervention on these things?
- what is the scale and relative importance (vis a vis other sources of income and expenditure) of remittances? do they flow steadily or did this project provide a specific target for investment of remittances?
- were the benefits from the intervention (profits and incomes) spent in the local economy or on imported goods? How sustained will the impact on local livelihoods and markets be?

i) Housing, land and property:

Pariaman has a matrilineal system with women owning and inheriting land and housing;

- on marriage, the new husband will move on to the land of his wife's family;
- family homes are also a place to gather at key moments (7th month of pregnancy parties, birth parties, wedding parties, Eid celebrations etc.), these events are part of the fabric that oblige sharing and surely contribute to the appearance of homogeneity, egalitarianism, peaceful and cooperative community relations in these areas;
- symbolic and social importance of housing is also a key motivation for the investment in housing made by family members working elsewhere and this in turn probably influences gradual changes in housing types from local materials to imported, industrial materials seen used in other places and as symbol of status. Houses do not seem to be traded so are not purely a financial investment (buying a house, waiting for prices to rise, selling on),
- houses are also "non-tradable", in other words they cannot be traded across borders. This feature of housing in communities dependent on remittances is not well understood but may make investments in 'traditional' housing that uses local materials more sustainable for local growth in the long term because of the relative cost of other goods, services and wages i.e. spending on housing cannot generate foreign exchange so it does not allow you to buy imported goods: if you spend only on what is locally available you don't end up owing money outside your currency area. If you are spending remittances (foreign currency) on housing and buy imported materials, you also have no foreign currency debts but if there are other things you need that you **have** to import, housing may not be the best place to spend your precious foreign currency on imports;
- those living and working in "market areas" tend to also own land in local rural areas and new migration into the area from other provinces and islands does not seem to be important
- land prices in market areas seem to be high and rising (from conversation with field teams)

ii) Housing and livelihoods:

- housing and land in rural (remote areas) provides shelter and a basis for agricultural livelihoods such as:
  - rice paddies and other cereals crops;
  - coconut and other productive fruit trees;
  - trees for timber used locally and exported to other provinces;

[1] http://emma-toolkit.org/wp-content/uploads/EMMA-Indonesia-2009-Brick-Market.pdf

- urban land and housing provides shelter and a basis for the supply and demand generated by urban livelihoods including:
  - selling food and household goods;
  - offering services like sewing;
  - running small restaurants;
  - urban subsistence agriculture like rearing chickens (one shelter had incorporated a chicken coup underneath it);
  - roadside repair of vehicles;
  - letting of spaces for commerce, although we do not know the number of households getting income from letting and proportion of this income relative to other livelihoods or the resources and power that this gave owners of land in "market areas";
  - unskilled casual, construction labourers;
  - skilled builders – known as masons but working with timber, brick and concrete;
  - timber and brick processing (with brick production using waste from felling as an input);
- daily or monthly incomes are only one indicator and are not particularly useful because a) daily and monthly work for cash is not necessarily "full-time" with seasonal planting, harvesting and rain cycles, as well as other "non-cash" work becoming more or less important at different times of year; b) the value of incomes is always relative to household expenditure and priorities; c) remittances are likely to dwarf local incomes in their importance to the economy;
- important seasonal cycles seem to be: Eid celebrations as a period when people get married (and spend money in the local economy) because family members return and as a time when people are able to repay local debts; rainy season April – November when transportation, construction and brick production are slowed down.

iii) Housing processes:

- some people reported during focus group discussions (where funding for permanent housing was a preoccupation) that a house is started with a minimum of three rooms and further rooms are added to accommodate girl children;
- during individual interviews people reported more modest beginnings with one room, incrementally extended on the birth of female children;
- on marriage, the wife's room becomes the home of the new couple but when resources are available, new couples build an extension or preferably a new stand-alone house on the same family land, thus the priority in selecting a site for a new house is proximity to relatives and where land is owned (rather than vulnerability to physical hazards)

iv) Housing finance:

- clearly remittances - money sent back from family members working elsewhere – are a major source of housing finance;
- on birth, girls are sent jewels, money and livestock and some people reported trading these gifts to mobilise additional cash to top up the DfID cash grant – one woman reported selling 8 gold bracelets to top up her grant; these assets also seem to be used in "normal times" to expand housing on marriage;
- one rural family interviewed, reported that he had moved from a timber to a reinforced concrete house in 1999 and that this new investment was funded through a cooperative of 40 families who came together to build; the prevalence of these cooperative financing mechanisms and their relationship with remittances is not clear;
- access to formal credit for housing does not seem to be prevalent or necessary.

v) Housing costs:

- during individual interviews and focus groups people estimated the cost of housing from the floor area and were not particularly clear about the differences between brick versus timber in overall cost, this probably reflects the fact that housing expands slowly, that brick is the material of choice and that estimates are based on rough rules of thumb and quotes from masons that are not "tested" very often;

Figure 1 Relative Construction Costs

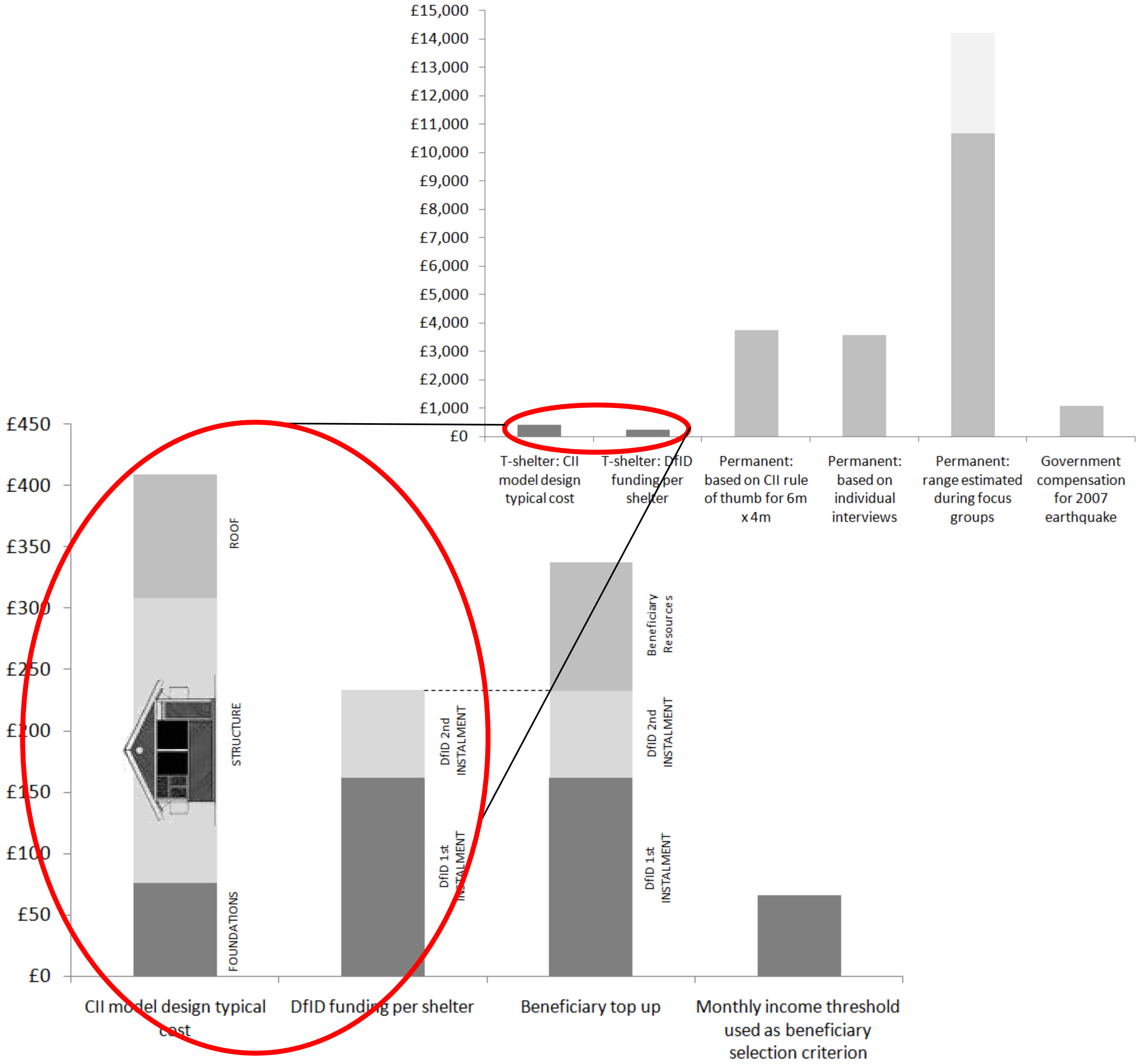


Figure 1 also shows that the estimated cost of the CII T-shelter models (6m rupiah) was about twice the cash grant of 3m rupiah. This meant that households had to match the DfID grant to complete their shelter according to the design: it was assumed that the grant would be topped up by salvaging material from damaged houses.

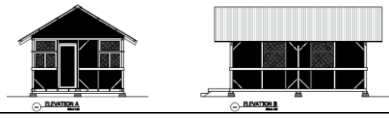
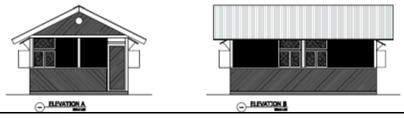
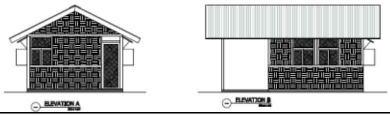
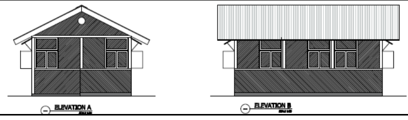
A1. b) Were beneficiaries able to access good quality, sustainable materials? And
A1. c) Were beneficiaries able to access good quality labour, where required?

Quantifying income against material prices is difficult and not always relevant in a context where incomes are seasonal, livelihoods are informal and not cash-based and where material costs relative to other household expenditure (i.e. food, school fees) are not known.

Instead, this evaluation looks at i) the original Bill of Quantities for the CII model designs; ii) relative prices of construction material and labour; iii) reported difficulties of householders; and iv) four generalised categories to illustrate how beneficiaries accessed labour and materials. These categories also try to describe some of the links between livelihoods, building and markets because location and livelihood appear to play a major part in the success of this cash-based intervention.

i) CII's model designs

Table 1 Comparison of CII model T-shelters broken down by component

	Prices in IDR (volume of timber, m^3)			Total (of which % from cash grant)	Total in GBP
	Foundations	Structure	Roof		
	1,064,000	3,551,921 (1.43m^3)	1,421,160 (0.43m^3)	6,037,081 (50%)	£430
	1,064,000	3,274,606 (0.91m^3)	1,414,500 (0.42m^3)	5,753,106 (52%)	£409
	1,064,000	3,274,606 (0.91m^3)	1,414,500 (0.42m^3)	5,753,106 (52%)	£409
	864,000	2,972,152 (0.97m^3)	1,712,220 (0.59m^3)	5,548,372 (54%)	£395

ii) construction materials and labour

Figure 2 below shows a comparison of different material prices looking at CARE International Indonesia's original estimates from the Bill of Quantities (BoQ), pre-earthquake prices "remembered estimates" by beneficiaries in September 2010 and post-earthquake prices paid during the T-shelter project.

Based on this limited sample, it seems that:

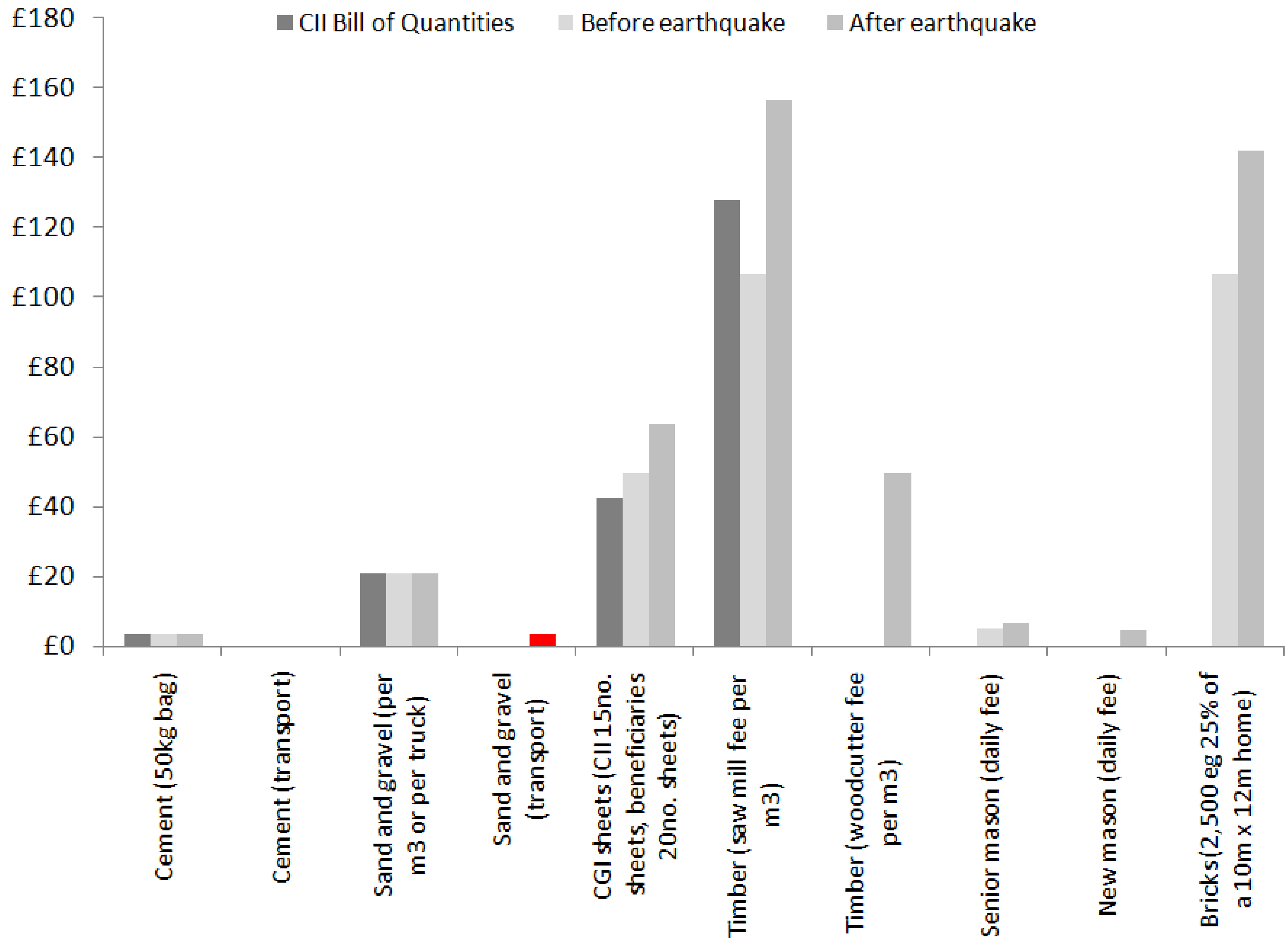
- CII did not include transport costs in the original BoQ. These were significant for beneficiaries in more remote areas, especially for cement, sand and gravel and CGI, although overall prices for these materials were stable and did not rise;
- Prices for timber and labour went up, probably because the markets were less elastic i.e. the market could not adjust to meet demand quickly enough – this is backed up by FGDs and interviews where beneficiaries and CII/P3SD staff explained that there were not enough construction masons and not enough "chainsaw masons"
- Sawmill prices were higher than the estimates for timber given in the BoQ and there was little salvaging of timber
- Brick prices went up slightly (as predicted by the EMMA survey) but there was anecdotal evidence that bricks were more willingly salvaged and reused
- Participants also reported that it was not the earthquake but the start of the project that brought price changes; others suggested that prices went up anyway, not because of the earthquake or the project
- Participants reported using various timbers: Miranti (purchased); Coconut, Durian and Sarooyan (from own sources); Gounoung, Bayou, Baneo
- Finally, beneficiaries also reported during this evaluation and the interim evaluation that certain purchases had been made collectively on behalf of the community by a nominated person who knew that market e.g. a senior mason would buy building supplies. This cooperative arrangement is a particular feature of this society which probably helped even those in remote areas to access materials without seeing price inflation or high transport costs and to benefit from bulk buying.

Box 1 Sustainable use of resources

During one interview with a sawmill owner and other corroborating evidence from the FGDs with P3SD staff, it emerged that immediately after the earthquake as people tried to begin reconstruction families would fell 10 trees: 5 to use for construction and 5 to sell to generate cash for other construction or household items. This sometimes meant felling productive trees.

With the arrival of the cash grants, it was no longer necessary to fell the 5 trees for cash. Productive trees were not cut down. This is likely to have a longer term impact on livelihoods since "productive environmental assets" have not been destroyed in the rush for shelter after the disaster.

Figure 2 Comparison of material prices



iii) problems and constraints reported by beneficiaries and some general beneficiary categories

The graphs below are based on extracts from the monitoring data provided by Indah Uzia. Figure 3 charts householders' reported problems. It appears that:

- initially householders had received the cash but could not get materials and labour;
- access to material was more of an obstacle at the start and then labour became the bottleneck;
- cash became a bottleneck later as people spent the grant.

Figure 4 looks at material availability by categorizing access as easy and close; easy and far; difficult and close; difficult and far. Predominantly, households reported that access was easy. Wood and roof sheeting seem to have been more difficult to access than other materials.

Figure 3 Problems reported by households

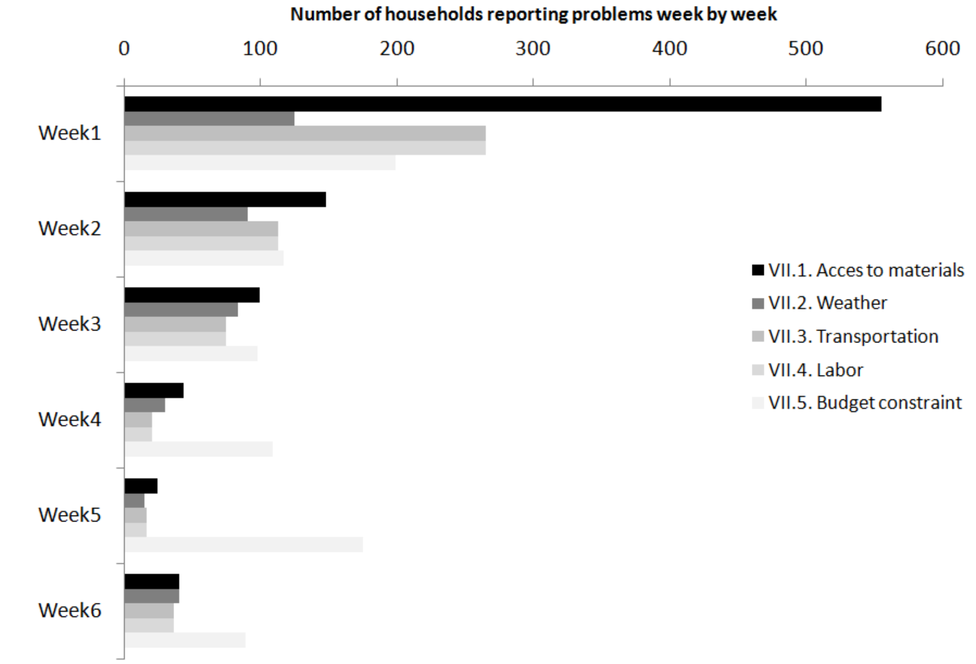
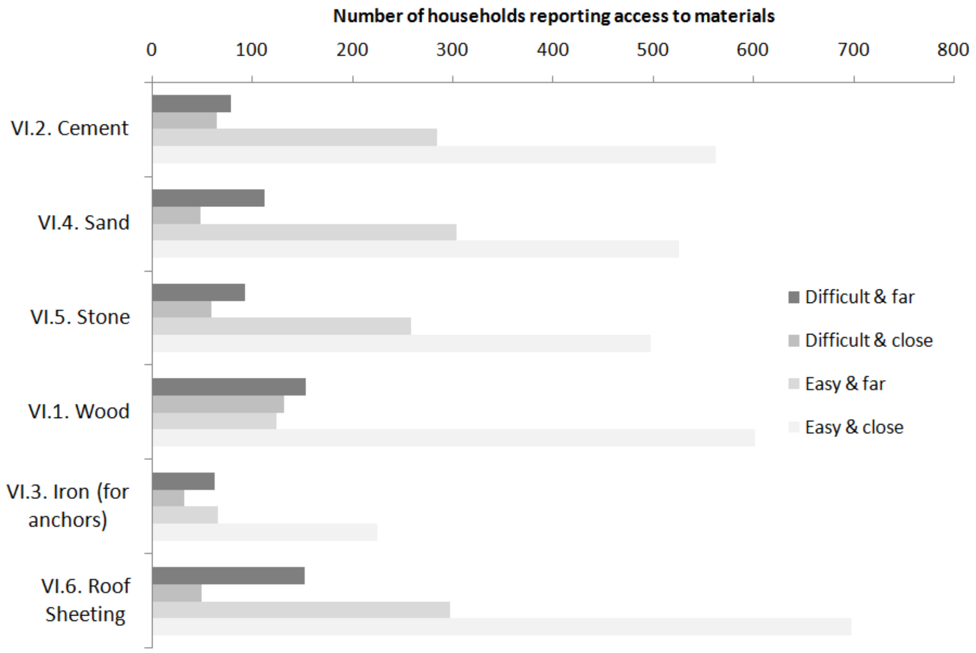


Figure 4 Access to materials



iv) Categories of households

The practical impacts of accessing labour and materials are perhaps more usefully seen in the context of community and household capacities and vulnerabilities.

Table 2 looks at four different cases that showed up during the project.

Table 2 Categories of households

Families in remote areas with a mason head of household and plenty of non-productive trees (and land!) **Reasons for successful access to labour** • the male head of household was a mason: this did not necessarily mean that the head of household worked as a priority on his own house but • he was more able to find and recruit other masons to assist him • he could choose to mobilise extra cash by working on other people's houses first **Reasons for successful access to materials** • family had enough non-productive coconut trees (i.e. sufficient land) so that they did not need to purchase additional timber • individuals were able to mobilise resources to buy additional tools (especially chainsaws) • brick producers and suppliers of cement and CGI sheet were willing to deliver to the door, rivers used for heavy and bulky materials like sand and gravel were close with a good road	**Families in "market areas" close to suppliers** **Reasons for successful access to labour** • casual, cash-based labour without the obligation to work in family agriculture may have been easier to find – it seems that labour supply in these areas was more likely to meet demand but evidence for this is anecdotal. **Reasons for successful access to materials** • materials suppliers charged lower delivery fees for households closer to markets and main roads • sawmills tended to be located close to market areas and main roads because they also sold to buyers from other provinces • brick producers relied on some inputs coming by road (eg wood fuel) and so were located by main roads, next to a pit for digging out mud and sand

Families in remote areas with no masons and limited timber (and land!)
 	
Problems with access to labour
• farming families without masons:
    ○ had trouble doing the work themselves
    ○ were not first in the queue to recruit masons from the community and
    ○ were more likely not to have a mason in the family if it was a female- or elder-headed households
• demand for masons was very high for the period after the first grant was given; supply could not keep up
• "earthquake masons" were unskilled labourers with some experience of construction who became new masons to fill the gap in supply: they were said to be cheaper but less competent than experienced master masons
• households where women had to supervise and monitor labour (particularly skilled labour) struggled to persuade masons to comply with CII/P3SD's minimum standards
• demand for woodcutters –workers with a chainsaw – surged and supply could not always meet demand. Since becoming a "chainsaw mason" required an investment in equipment, responding to demand may have been more inelastic (less flexible) than for general construction labourers
 	
Problems with access to sustainable materials
• families without enough non-productive trees, either had to fell productive trees or purchase timber (see Box 2)
• families far from markets and main roads had to pay higher delivery costs than those close to markets and main roads
• where damage to the original house was not perceived to be serious by householders, they were very reluctant to salvage or dismantle valuable materials from their houses.
• 2010 has experienced unusually heavy and frequent rainfall which slowed work
	Families in "market areas" with little damage to original house and no space to build
	
	Problems with access to labour
	• daily rates for labour may have been more expensive in market areas – certainly having wood sawn in urban markets was more expensive than hiring a man with a chainsaw in remote areas – this was difficult to quantify and not reported as a problem by people in these areas
	
	Problems with access to materials
	• a major constraint in urban areas was access to space/land for a transitional shelter. The space constraint also contributed to a powerful disincentive to build a transitional shelter because people were much more focused on their original house and plot and much more interested in repairing and rebuilding quickly than putting up a transitional shelter

A1. d) Did this project have a positive impact on local markets?

A reliable evaluation of these complex impacts without a baseline that can be triangulated using different sources of data from 2009, is not possible. However, it was possible to discuss with traders, community leaders, beneficiaries and project staff certain aspects of the markets and how they had been affected by the project. The methodology draws on indicators and analysis recommended by the EMMA methodology and the ICRC's guidance on market surveys[2,3] but is limited by being a snapshot on one day (a Sunday), in one location.

i) Job creation (casual, semi-skilled labour):

New jobs as "earthquake masons" and as "chainsaw masons" were undoubtedly created by the project because it involved an injection of cash and a short time frame in which to build – this put pressure on markets to supply materials and labour and briefly inflated the prices of some labour and some materials. The leader of one of the rural communities reported: "lots of people got jobs as masons; new masons were called "toukong gumpa" ("earthquake masons"); but they are unemployed again now!"

For the "chainsaw masons" who invested in chainsaws, providing this purchase did not indebt them, owning this asset may create livelihood opportunities over a more sustained period. Daily wages for construction labour did rise as a result of the project and many inexperienced masons had an opportunity to practice, learn and get some training during the T-shelter construction (Bill Flinn's report of young man planning to start a business). As an example and to show the scale of the cash grant relative to daily wages, these are rough prices:

- Skilled masons: 75,000/day before, 100,000 after
- Unskilled new masons (toukong gumpa): 70,000/day plus food and cigarettes
- Brick makers: 55,000/day when dry, 28,000/day in the rains (based on piece work)

ii) Enterprise creation, credit and competition (more than one employee):

There was evidence that this cash injection gave a push for some new businesses to open – one example being a hardware store that had started up using 10m rupiah (£700) of borrowed capital. This borrowed money was from relatives and it did not seem that it would have to be repaid in a rigid or conventional way. This may reflect the cooperative tendencies described in Section A.

At the same time, a rival hardware store in the same area that had been established for 20 years was still reporting a 50% rise in turnover since the project.

Box 2 Small businesses

One of the larger, family-run sawmills, employed family members first and then only a handful of people from the community – a workforce of 10 people. Orthodox assumptions about competition also did not seem to hold: this supplier was in a monopolistic situation without much competition (normal demand probably could not sustain 2 such sawmills with an investment required in 3 saws and a truck) but reported an approach to: a) price setting and prioritising customers that was based on whether customers were family, local second and from another province last. This informant's rationale was based on following the government's advice that people should try to help their neighbours first and a sense of social/religious obligation; b) giving credit which was based around emphatically not charging interest, again because of a sense of social/religious obligation.

Sawmill volumes: this was a 3 year old business set up by a former "chainsaw mason" who wanted to expand from 3 trees/day to 10 trees/day because of the high demand, now at 70m3/month but 60% less during the rains, a third is sold to a buyer who comes from Jakarta each month

iii) Integration (links between different markets)

This is an indicator of how well markets are able to adjust to new demand by transferring and reallocating goods over time and between different regions. It was not possible to survey prices in the nearest large market, Padang City, but from this tiny survey it seems that, for materials that were not available locally, the difference in price from Padang to Pariaman and then from Pariaman to smaller markets and the price paid by consumers was very small, especially for cement. Variation before and after the earthquake was also small with, for example, brick prices not

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[2] Lili Mohiddin and Mike Albu, "Emergency Market Mapping and Analysis (EMMA) tool," *Field Exchange*, no. 35 (2009): 3, http://fex.ennonline.net/35/emergency.aspx.

[3] ICRC, "Guidance Sheet 1: Carrying Out A Market Assessment," in *Microeconomic Initiatives Handbook* (ICRC, n.d.), 120-125, http://www.icrc.org/Web/Eng/siteeng0.nsf/htmlall/p0968/$File/ICRC_002_0968.PDF.

exceeding the peak price recorded after the 2007 earthquake reported in the EMMA survey. One reason for this is the quality of infrastructure: the road network – at least during the dry season – is excellent.

Given the reliance on migration, another potential explanation is the fact that even in remote areas, families have experience of travelling and working elsewhere and have good information about prices in other cities.

Conclusions

Access to materials and labour were not the main reason for non-completion but they did contribute to delays, especially where the local labour market could not expand quickly enough. Customary collective action and the ability to mobilise additional funds quickly by selling assets and receiving money from overseas were key factors leading to success. Early on, this project may have limited the felling of productive trees. A longer lasting impact on markets is impossible to quantify.

Recommendation

- **access to local materials and labour markets is a critical risk factor in shelter programmes and should be analysed for comparison before and after the disaster and before and after the intervention**
- **higher prices paid by remote or otherwise marginalized communities for transport or labour to deliver materials should be considered a risk factor in cash programmes, especially for the vulnerable in these communities**
- **CI should always evaluate the risks of transitional shelter programmes using assessments of pre-disaster housing processes; seasonal livelihoods, capacities and vulnerabilities that place additional demands on people's time and resources; the security of housing and land ownership structures; tendencies towards collective labour and buying or monopolistic tendencies in markets.**

A2 Technical quality, technical support and risk reduction

A2. a) Was this technical guidance applied? And

A2. b) Are beneficiaries now living in safe transitional shelters?

This analysis of the design borrows from the World Health Organisation's approach to the evaluation of risks to water quality: rather than massive, expensive, "after-the-fact" sampling of water, WHO looks at risks of contamination in a whole water system[4]. This evaluation does not rely on sampling of shelters (just a visual inspection of a 10% sample would mean 340 shelters, at 10 per day, we would be looking at a month's work with a team of at least 2 or 3 people). **Instead, we look at risks in the system of design and implementation that contribute to disaster risk reduction in final construction.**

The framework in Table 3 has been developed specifically for this evaluation but it has implications for all of CARE's shelter programmes and the way that CARE's engineers and non-engineers use technical advice in design and building. The idea of this framework is to break down the different assumptions and decisions that are made during design and to identify how the design is translated into construction. The red circles show what was done during this project.

- **Acceptable risks:** in the UK, this is a negotiated process involving politicians, large insurers, scientists and engineers. It is a cost benefit analysis which depends on a) how risky the rest of your life is (is it worth society investing in better insulation or better healthcare?); b) how long things are supposed to last (is it worth building a temporary exhibition space to resist a very unusual storm?) and c) how valuable, vulnerable or important certain people or buildings (is it worth making a house as resilient as a nuclear plant?). Engineers do not make these decisions – a collection of people with different interests and competences make these decisions over a long time.
- **Design assumptions:** what sort of earthquake? what wind speed? Once the acceptable risks have been established, a design code can be developed to guide engineers on what these risks mean in terms of loads on a building.
- **Design:** given an earthquake and high wind, will the design resist? Design calculations are used to test whether the design will work given the assumptions about what it will have to go through.

[4] Hunter, P.R., Fewtrell, L., 2001. 10. Acceptable risk, in: Water Quality: Guidelines, Standards and Health Assessment of Risk and Risk Management for Water-Related Infectious Disease. IWA Publishing on behalf of WHO.

- **Spectrum of options for quality control:** now that we have a design, how do we make sure people build it? Table 1 breaks down different aspects of the design that need to be controlled or understood: ground conditions, material properties, structure and connections. In other contexts, CARE can take more control of construction by having a single, fixed design and delivering shelters with some pieces pre-fabricated or by employing its own carpenters, technicians and engineers to supervise construction very strictly. For a cash programme, the monitoring is an important way to make sure people build something safe. Monitoring does not have to be done by engineers but it needs good technical knowledge to develop the paperwork and training for monitoring teams. For example, if beneficiaries are given a lot of flexibility in the size of the shelter they build, monitoring teams should not be checking for the total number of vertical supports but for the number of vertical supports per metre of wall. Why? Because all other things being equal, the vertical supports will be taking a greater share of the weight if there are 4 along an 8m wall than if there are 4 along a 4m wall.

A2. c) Design Process

Table 4 summarises the steps that were taken in developing a wind and earthquake resistant design.

i) CII Internal Processes

In March 2010, CII issued designs and Bills of Quantity for 4 model timber shelters. The designs were checked by Arie Infanto and approved by Adjie Fachrurrazzi. During this evaluation it was possible to establish the following – other steps may have been taken but documentation was not provided:

- Design advice was given informally and only verbally on the telephone by Institut Teknologi Bandung (ITB), CII design partner.
- The original design assumptions (what sort of earthquake? what wind speed?) were not recorded
- The design calculations (given an earthquake and wind, will the design resist?) were not available
- The Bill of Quantities (BoQ) or estimates of the material needed to build had been calculated and were provided but these are not load calculations for signing off the design
- Verbal reassurance was given that the design had been tested using SAP modelling software, although the inputs and outputs from this modelling were not available
- The recommendations from the external structural engineer were incorporated into CII designs and monitoring, although this was not evident in the monitoring tool and trainings for staff and beneficiaries had already been conducted and were not repeated so the mechanisms for transmitting these changes are not clear

ii) CIUK External Advice

In May 2010, CIUK requested a structural review by Regan Potangaroa. The recommendations from this review

- Design assumptions are stated and design calculations were carried out
- Design recommendations were given, some of which were practical but none of which appear to have been followed

iii) CIUK External Monitoring and Evaluation

In June 2010, Bill Flinn conducted a technical evaluation5 of the shelters under construction and gave detailed and practical advice on improving quality on site and worked closely with the field teams. This advice came 2 months after the first cash distribution and coincided with the second cash distribution. P3SD teams reported that it was more difficult to influence households and masons once the second and final instalment of cash had been paid.

A3 Technical support

A3. a) How effective were technical training sessions? (Were they appropriate and accessible?)

A3. b) How effective were technical guidance materials (designs and posters)?

A3. c) How effective was ongoing technical guidance (through field staff and housing clinics not that relevant to this project)?

Quality Control Process

Quality control was based on training and information for P3SD staff and householders to enable a self-build approach where householders could do the work themselves or pay others.

(i) P3SD field staff:

[5] Flinn, "Indonesia Post-Earthquake Shelter Response. Pariaman, Padang, West Sumatra: Progress Evaluation 16 to 24 June 2010."

- Training by CII: this included classroom training for 13 hours and then an opportunity for all monitoring staff to participate in construction of a model shelter built as per the design. 2 groups built 2 shelters e.g. 30 people in each group and were in the field from 12pm until 2am;
- Training material: the only documented training materials were a reinforced concrete construction handbook from Aceh and slide show on general timber construction
- Equipment and monitoring paperwork: teams carried tape measures and cameras and were given a T-shelter monitoring form initially developed by the M&E Manager (Indah Uzia) before the first cash distribution. An analysis of this tool and what it could and could not do for quality control is shown in Table 5. To reinforce the field staff's understanding of monitoring beyond the designed T-shelter (i.e. to check the enormous variety of T-shelters built by beneficiaries) several other tools were developed:
    - An annotated version was developed by Adjie and Sanjay (awaiting translation) but this was only available to staff 6 weeks after the first cash disbursement
    - A version with images was developed by Sanjay but never shared with the to field team

(ii) Beneficiaries:

- **Training by CII:** 25+ people in training sessions, trained everyone "because design was important", included structural design principles but no practical, hands-on training; the FGDs suggest that women from beneficiary households often went to trainings because men were out working;
- **Training material:** CII used the same material used to train masons for the Disaster Risk Reduction project: a package developed for reinforced concrete houses and targeted at masons. The **designs that CII gave out were very important** as householders repeatedly said in FGDs that they used "CARE's picture" to give their masons instructions.
- **Technical monitoring:** each household received 1 visit per week from the P3SD team and this was cited as a key part of their motivation to continue

(iii) Masons:

- **Training by CII:** 1,000 masons were trained as part of CII's DRR programme between December 2009-January 2010. Although these masons were apparently from areas where CARE was working, it was not possible to verify whether the masons that had been trained were among the beneficiaries and masons building the T-shelters;
- **Payment:** participants were not paid but did get lunch to go to training
- **Public outreach material:** Posters and pictures from the DRR project were up on the sides of houses and throughout the communities where the evaluation was carried out: the content of posters had to be approved by the Government of Indonesia which wanted one poster to be used by everyone (JAICA's version is available on the Padang Shelter Cluster website)

(iv) Gender, technical competence, money and decision-making power

Regan Potangaroa's structural review made the point that quality would depend on "socializing the standards"[6]. One element of this process involves understanding how householders and house builders interact and make decisions. In different cultures and contexts, there are different relationships between householders and house builders: sometimes the house builder is paid to advise the householder and sometimes the builder is seen as a labourer who follows the householder's instructions. The success of monitoring also depends on the relationships between monitoring teams, house builders and householders.

Figure 5 illustrates the relative influence of different groups and how they were targeted by CII's training and is based on findings suggesting that during this project:

- women were often at home next to the T-shelter site on a daily basis but were not in a position either socially or as a result of CII's training to supervise confidently an experienced mason
- experienced masons were skilled at working with the materials but were sometimes reluctant to take advice from people they perceived as "non-technical" including male and female householders who were not masons and occasionally the P3SD monitors
- inexperienced masons were more likely to follow advice but faced limitations in their workmanship
- the P3SD monitors felt confident to motivate and give instructions but were not always present at key moments (e.g. mixing concrete) and were not equipped with monitoring paperwork that would formally help them monitor shelters that diverged from the designed model

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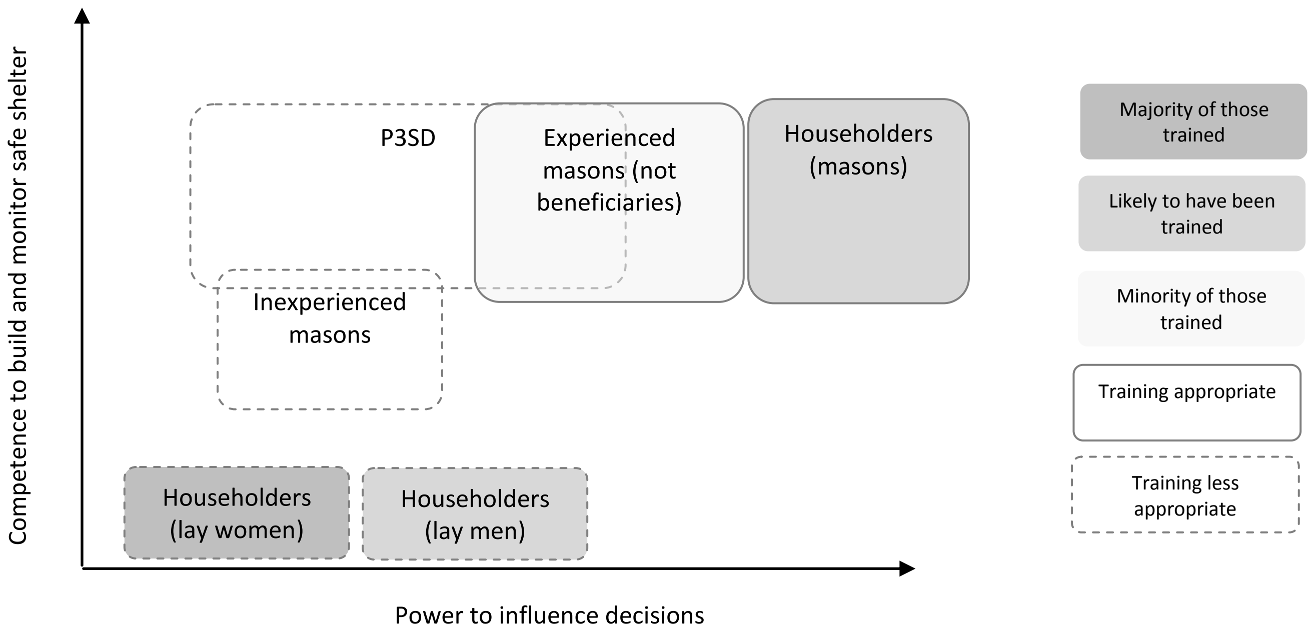
[6] Regan Potangaroa, "Structural Engineering Review of Transitional Shelter Designs" (Dr Regan Potangaroa Associate Professor Dept of Architecture Unitec Auckland NZ, May 2010).

- once the final funds had been disbursed or a family had been refused the second instalment, it was much more difficult for P3SD monitoring staff to influence quality and motivate householders to progress

Figure 5 Relative influence of different participants



Conclusions

- **Design and construction process:** the sequence of design advice meant that the model T-shelters did not have formal structural sign off soon enough. The monitoring process meant that the gap between the unchecked design and the final construction was even wider. This puts CII in an interesting position: CII is liable for the design component but this built design has not been shown to be code compliant (in CII's documentation); construction by beneficiaries (who are now technically liable but to whom we are accountable) is not compliant with design so beneficiaries are theoretically at risk from two steps in the process: design and construction. The combination of flexibility for beneficiaries and the CII/P3SDmonitoring tool created a possibility that the final structures would be very different from original design. Design assumptions and the risks associated with variable ground conditions are hard to quantify and, though less important for timber structures, could have presented an opportunity for checking ground conditions for future masonry construction;
- **Technical monitoring:** the tool developed by CII was useful for monitoring progress but not quality. In a programme with flexibility in design, the technical monitoring tools need to reflect compliance with the main principles and minimum standards of the original design but when this tool was field tested with P3SD staff it was clear that beneficiaries could have their shelter checked off without the design complying with key principles.
- **Safer shelter:** it is not possible to judge the structural safety of every built shelter – this makes the design and construction process all the more important! However, as Bill Flinn points out timber is inherently safer than unconfined masonry in an earthquake.
- **Training for P3SD:** a 60-strong monitoring team was built from scratch. The team had varying levels of experience and technical competence but the CII theoretical and practical training successfully built the team into a motivated and confident monitoring group. The more technical team members helped others.
- **Training quality:** the quality of the training model is difficult to evaluate because results were not monitored; a training needs assessments was not done; participants (whether men, women or masons) were not clearly defined or addressed by the training; trainings were crowded with 100+ participants and pre and post tests were not analysed. Despite matrilineal ownership of housing and land, masons were more influential than non-technical householders in deciding on construction and should have been more systematically targeted.
- **Training materials:** the handbooks were developed for reinforced concrete construction rather than T-shelter. Clear and detailed slide shows on selecting timber and visual inspections of salvaged material were available.
- **Outreach posters:** these also dealt with DRR and reinforced concrete construction rather than timber T-shelters.

Recommendations of the Evaluation Team

- Training needs assessments should be a routine component of shelter programmes to identify who has the most influence over building practices and what skills and knowledge they will need to influence safer buildings
- Pre- and post tests for staff and beneficiary training should be conducted, analysed and acted upon to adapt training to need as early as possible
- Technical monitoring tools should be designed by M&E and engineers to control quality as wells as progress
- CI construction projects should include an analysis of the steps in the design and construction process to identify where the risks in design and construction quality can be minimised to reduce risk for beneficiaries and to understand CI's liability. The trade-offs must be weighed up between allowing beneficiaries to adapt shelters (thus motivating greater participation) and controlling design.

A4 Disaster Risk Reduction and long-term impact

A4. a) To what extent have we reduced beneficiaries' vulnerability to future risks, including earthquakes?

A4. b) What have been the wider impacts of this project for beneficiaries, particularly in terms of livelihoods? (See Section 0, A1. c) and A1. d))

It is important to recognise that Disaster Risk Reduction (DRR) is a comprehensive approach involving a range of activities[7]:

- community-led risk and vulnerability assessment
- capacity building to address key vulnerabilities e.g. education, training and information
- early warning and preparedness
- policy and institutional change
- partnerships and networks for development around environmental, land-use and infrastructure planning

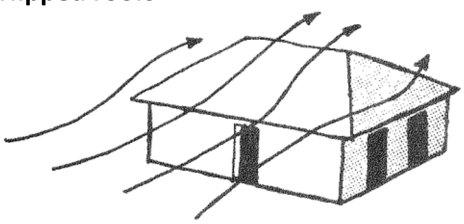
The activities in CII's programming – both for T-shelter and permanent housing – are concerned with safer buildings. This makes an important contribution to Disaster Risk Reduction but is unlikely to be sufficient over the longer term to reduce social and economic losses associated with disasters.

Spreading practices for safer building start from the perception that they are achievable, affordable and desirable. It is also important that model designs incorporate features that are safe and replicable in more permanent structures. In this project, the following observations were made at different stages of evaluation:

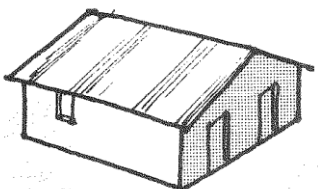
- location of doors should be moved away from corners: openings next to columns weaken structures. This is less important for timber structures but could easily be avoided in t-shelter because it is risky "aesthetic" for masonry, which is potentially the preferred construction type over the longer time;
- t-shelter gable roofs (Figure 6) move away from what seem to be traditional, 'normal' hipped roofs in rural areas. Hipped roofs are better in strong winds and also reduce the risks associated with gable ends caving in observed in masonry, urban housing. The impact of this over the long term cannot be evaluated and will depend on what people prefer and can afford.

Figure 6 Hipped and Gable Roofs and photo showing collapse of a masonry gable wall

Hipped roofs[8]



Gable roofs



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[7] Inter-Agency Secretariat of the International Strategy for Disaster Reduction (UN/ISDR), "Living with Risk: A global review of disaster reduction initiatives" (United Nations, 2004), http://www.unisdr.org/eng/about_isdr/bd-lwr-2004-eng.htm.

[8] Frederick C. Cuny, "Improvement of Rural Housing in Haiti to WIthstand Hurricanes" (Intertect, 1982), http://www.josephashmore.org/extdocs/CUNY-1982-HAITI.pdf.

- Some replication of the tying techniques promoted in the t-shelter project were observed in extensions of houses. Replication is an indicator that practices and building culture may have been changed by the project. The scale and sustainability of these changes cannot be evaluated.

Conclusions
Activities centred on safer building are not sufficient over the longer term to reduce risks, vulnerability and social and economic losses associated with disasters.

Recommendations of the Evaluation Team

- **COs should ensure that T-shelter projects target training e.g. trainings for local builders (technical content on construction); trainings for male and female non-builders (on monitoring, DRR and budget planning)**
- **COs should ensure that training manuals use general on construction principles adapted to local materials and techniques e.g. a specific timber training manual on construction principles and details.**
- **COs monitoring tools should focus on both construction progress and construction quality**
- **Where beneficiaries have lots of flexibility in shelter size, COs should ensure that monitoring tools reflect compliance with design principles: monitoring should not rely on counting structural members but must also look at minimum spans and cross sections; monitoring scores should avoid criteria that rely on percentages of completed connections.**
- **CI should emphasise in shelter programmes that comprehensive Disaster Risk Reduction cannot be achieved through safer buildings alone: future shelter programming should consider other activities that contribute to community resilience**

Table 3 Steps in Design to Construction Processes

Design test
What? confirmation that design resists assumed loads
Who decides? Seismic structural and geotechnical engineers
How? Load calculations (provided by structural engineer with design); Computer simulation (e.g. finite element modelling); Physical simulation (e.g. scale models and shake table)

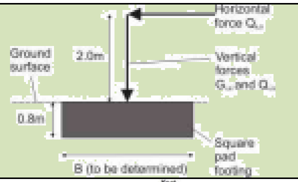
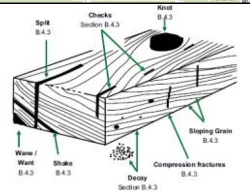
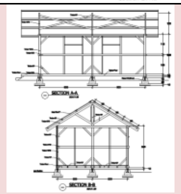
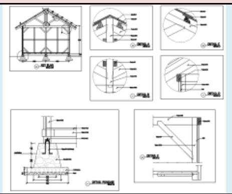
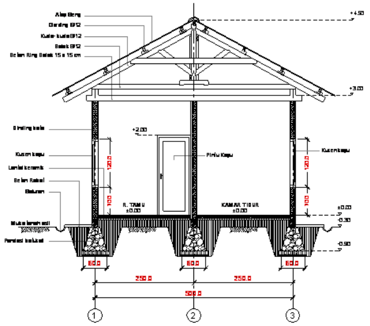
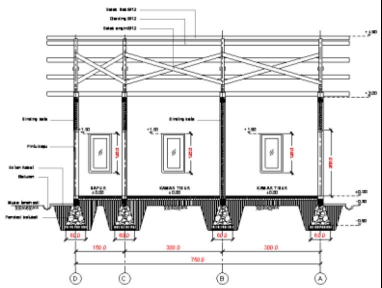
Acceptable risks	**Design assumptions**	**Design**		**Spectrum of options for quality control**			
What? negotiated political, financial and social/moral consensus	**What?** parameters for level of seismic risk	**What?** structure that resists assumed loads (4 key components of design where risks can arise in quality control during construction)		**What?** Options for controlling the risk that the real building will behave exactly like the designed building			
Who decides? Politicians, lawyers, civil servants, global insurers (actuaries/risk analysts), engineering contractors, seismologists, meteorologists	**Who decides?** Seismologists, geotechnical and structural engineers	**Who decides?** Seismic structural and geotechnical engineers		**Who decides?** Contractors, engineers and technicians, skilled construction labour, unskilled labour **or** beneficiary families.			
				CONTROLLED		**UNCONTROLLED**	
How is it decided? Probability and magnitude of a hazard; vulnerability, damage and loss estimates; cost/benefit analysis of mitigation	**How is it decided?** Design code based on simulation of forces produced by "magnitude of probable hazard" and used to derive assumed wind and seismic loads. Not always legally enforced or enforceable.	Ground conditions		Geotechnical survey, soil maps, lab soil tests & sampling	Field tests	Visual inspection	None
		Material quality		Product labelling (factory tested to international standards/specs)	Field tests	Visual inspection	None
		Macro structure: the **system** for bearing loads		Fixed standard design	Choice of several fixed standard designs	Minimum standards for cross-sections spans	Principles with flexibility in: cross-sections spans (non-engineered)
		Micro structure: the **details**, joints and connections		Fixed standard details (engineered)	Choice of several fixed standard designs	Minimum standards (e.g. connections and guidance on fixing)	Principles with flexibility in construction (non-engineered)

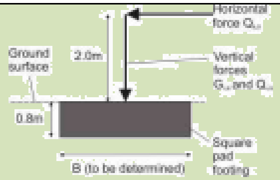
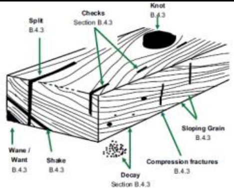
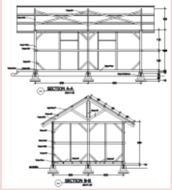
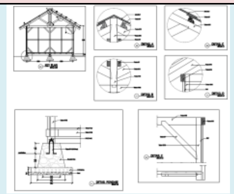
Table 4 CII P3SD Approach to Acceptable Risks, Design Assumption and Design Testing and the use of seismic design expertise

<table>
<tr><th>Key Dates</th><th>Acceptable risks</th><th>Design assumptions</th><th>Design</th></tr>
<tr><td>March 2010: designs issued</td><td>DfID Proposal: “build back better and safer (earthquake resistance) housing”</td><td>Design assumptions, load calculations and outputs from SAP[9] not seem</td><td>Designs: 4 models checked by Arie Infanto and approved by Adjie Fachrurrazzi
Design advice: informally by telephone and undocumented from Institut Teknologi Bandung (ITB), CII design partner.</td></tr>
<tr><td>May 2010: structural review by Regan Potangaroa</td><td>Seismic loads based on the Indonesia code SNI 1726:2002 for zone 6.</td><td>Wind loads based on a design wind speed (3 second gust) of 43metres/sec.
Timber flexural (bending) strength of 6MPa
Soils bearing capacity of 60kPa for dead and live loads and 70kPa for seismic loads</td><td>Foundations: allowable soils bearing capacity of 60kPa for dead and live loads and 70kPa for seismic loads
Floors: concrete mix 1:3:4 mix and compaction of the back fill material
Trusses: 30˚ pitch, 3KN tie detail be used at the ridge collar tie and as a tie to the top plate of the walls
Lateral Load Capacity (wind and Seismic): connections between the knee braces and the frames are critical: “3kN tie” detail between those joints otherwise bracing insufficient
On-site checking: soils bearing capacity (scala penetrometer to 1200mm); timber flexural strength greater than 6MPa tested by loading a span; concrete with a rebound hammer; building strap connections</td></tr>
<tr><td>June 2010: Bill Flinn</td><td></td><td></td><td>Timber frame is an inherently safer method of construction but mix of carpentry details; timbers are often undersized; structural principles are frequently hybrids and this is particularly clear in roof structures; foundations are inadequate; simple design principles are often ignored.
Incomplete houses:
Incorporate steel strapping on all diagonal knee bracing
Avoid scarf jointing critical members
Diagonal boarding particularly in internal partitions.
Beams used with their longest cross-sectional dimension vertical
Diagonal bracing in the ceiling plane
Avoid openings close to corners
Outward opening doors and simple bolts on the inside so that people can exit quickly.
Check asbestos board
Completed houses:
Add steel strapping to bracing and scarf joints.
Add bracing in the plane of the ceiling as in 5 above.
Take more severe action if there are causes for concern. Add in extra knee bracing, particularly if the corner posts are 10cm x 5cm (frequently).</td></tr>
<tr><td>July 2010: design criteria for RC and confined masonry “permanent house” model (Institut Teknologi Bandung)</td><td>SNI 03–1726-2002 “Indonesian Earthquake Code” Zone 5[10]
peak base rock acceleration 0.25g
peak ground acceleration for soft soil 0.36g.
475 years earthquake return period (probability of exceedance 10% in 50 years service life).</td><td><table><tr><th></th><th>Dead load (kg/m²)</th><th>Live load (kg)</th></tr><tr><td>Brick Wall</td><td>250</td><td></td></tr><tr><td>Ceiling + Frame</td><td>10</td><td></td></tr><tr><td>Metal Roof</td><td>10</td><td></td></tr><tr><td>Roof (concentrated load)</td><td></td><td>100</td></tr></table>No Indonesian code for masonry type structure so International Building Code(IBC) and Eurocode is used</td><td> </td></tr>
</table>

[9] http://nisee.berkeley.edu/elibrary/getpkg?id=SAP4

[10] SKBI-1.3.53.1987, “Indonesian Guidelines to the loading design for house and Building”;SNI 03–1726-2002, “Indonesian Earthquake Loading Code”;SNI 03–2847-2002, “Indonesian Concrete Code”;NI-5 PKKI 1961: “Indonesian Timber Building Code”;International Conference of Building Officials, “International Building Code” (IBC), 2003 Edition; American Concrete Institute (ACI); ACI 318/318R “Building Code Requirements for Structural Concrete (ACI 318) and commentary.” (ACI 318R); ACI 530 “Building Code Requirements for Concrete Masonry Structures and Commentary (ASCE 5) (TMS 402)”

Table 5 CII P3SD Approach to Quality Control: monitoring (tangible, measurable paper trail)

Design		**CII/P3SD Monitoring Tool**	**Comments on CII/P3SD approach to monitoring**
Ground conditions		DATEXXX: field monitoring teams received this monitoring tool and equipment (LIST REF) Beneficiaries had to have all stages completed with a "1" filled for "Done" It was possible for beneficiaries to have completed a stage below minimum standards and achieve a "1" but receive an additional indicator of "Quality" – a "poor" mark would be used by field monitors to try to motivate improvements Motivating changes or improvement after the first and second tranches of cash had been disbursed became increasingly difficult for monitors	**Bearing capacity:** no monitoring; no testing **Foundation depth:** monitored: presence or absence of foundation; not monitored: depth, width, length, concrete mix **Structural Review (May):** suggested testing of soil bearing capacity and for (non-structural) floors monitoring compaction of the back fill material
Material quality		(see monitoring tool below)	**Timber:** not monitored; not tested **Concrete mix:** Not monitored: specified in design (March): 1:2:3 and in Structural Review (May): max 1:3:4
Macro structure: the **system** for bearing loads			**Structural members:** monitored: presence or absence of main and intermediate supports (based on 4x6 plan) **Cross sections:** monitored: minimum standards for dimensions (e.g. 5/5 is 5cm x 5cm); not monitored: orientation of beams (e.g. **I** not __) **Spans:** flexibility in expanding shelter dimensions from 4x6 minimum; not monitored: spans between vertical supports, rafters and purloins not monitored: span of trusses and (new) cross-sections required not monitored roof pitch 30˚ not less than 20˚
Micro structure: the **details**, joints and connections			**Anchors:** Monitored: presence or absence (after pouring concrete) **Wood joints and Ridge detail:** Monitored: presence or absence **J-hooks:** Monitored: presence or absence but not used (too expensive)

No	PARAMETER	1 = Done 0 = Not done	Quality/*Kualitas* Good	Poor
II	**DURING CONSTRUCTION/SELAMA PELAKSANAAN**			
	For ± 75 %			
A	**Fondation / *Pondasi***			
1	Anstamping / *Anstampang*			
2	Stone Fondation / *Pondasi Batu*			
3	Anchor / *Angker*			
B	**Structure / *Struktur***			
B1	Main post 10/10 / *Tiang utama 10/10*			
B2	Joist 5/10 / gelagar anak 5/10			
B3	Plint tiess 5/10 / Gelagra induk 5/10			
B4	Bracing/Sokong			
B5	Wood joint/Sambungan kayu			
B6	Vertical intermediate support 5/5 / Tiang praktis 5/7			
B7	Vertical intermediate support 5/5 / Tiang praktis 5/5			
B8	Horizontal intermediate support 5/7 / Penyangga pingganng5/7			
B9	J hock/Ankur (pengikat) dari taing ke kuda-kuda			
B10	Floor / *Lantai*			
C	**Roofing / *Atap***			
C1	Truss / *Kuda-kuda*			
C2	Wind Bracing / *Ikatan Angin*			
C3	Purlin / *Gording*			
C4	Ridge/Bubungan			
C5	Facia board 2/20 / Liasplank 2/20			
C6	Roof / *Atap*			