



ISLAND AID ADVANCED HYBRID SHELTER DESIGN CONCEPT

Rationale for moving from a t-shelter unit constructed completely from Bamboo to a technologically advanced permanent hybrid unit constructed from Interlocking Compressed Earth Blocks (ICEB) and Bamboo.

Permanent Shelter Priority

Four full months after the earthquake of September 30th 2009, there are still tens of thousands of individuals living without safe reliable shelter. These individuals desperately need to move on with their lives and sustainable shelter is the first major step in beginning to reestablish any sense of normalcy. Although our 100% bamboo shelters have been very well received by beneficiaries and are a good long life shelter solution, when reevaluating our program and priorities Island Aid has decided that it is critical for our beneficiaries to have an immediate and permanent shelter solution. The government of Indonesia shares the same perspective on the immediate need for permanent shelter. On January 29th 2010 the Technical Supporting Team (TPT) of the National Agency for Disaster Management (BNPB) requested that organizations focusing on shelter activities immediately move away from distributing shelter units that are designed to be temporary in nature and refocus efforts and resources on permanent shelters.



Hybrid System

As an organization committed to finding sustainable solutions to complex problems, Island Aid has designed a highly earthquake resistant permanent shelter system, using a hybrid combination of Interlocking Compressed Earth Blocks (ICEB's) and bamboo. The unit is built on a stone and mortar foundation and ICEBs (reinforced with steel for earthquake resistance) are used to construct the lower half of the perimeter wall. The upper half is built from bamboo post with flattened bamboo cladding panels, similar to our previous all bamboo design. Upon presumed receipt of government reconstruction grants, beneficiaries can choose to completely extend the walls with ICEBs. The anticipated 15 million IDR grant to owners of severely damaged homes will be sufficient to complete the structure. The treated bamboo roofing structure will remain as part of the permanent house. The hybrid home is expandable using the ICEB system on independent footings and beneficiaries can add on in the future as their resources permit. The cost of a hybrid unit vs. a strictly bamboo unit is somewhat higher however the added value created by this system and passed on to beneficiaries greatly outweighs the increased cost.



Reduced Transportation and Logistics Cost

The Interlocking Compressed Earth Blocks are produced on or near the building site using a high proportion of natural materials from the area. Concrete and steel reinforcement is all that needs to be purchased from building supply stores and these are widespread throughout the Province. The new design uses 60% less bamboo than our earlier design. This greatly reduces the amount of transportation logistics and cost necessary to move material to beneficiary build sites.



Advanced Affordable Technology

The production system Island Aid is using for the ICEB segment of our hybrid homes is designed by engineers from the Centre for Vocational Building Technology (CVBT), which is a Thailand based NGO with more than 18 years of experience in creating employment for villagers through modern small scale technology and training in building material production. With input from very experienced designers and architects, our hybrid houses are quite technically advanced, have an extremely high level of earthquake resistance yet can be produced using mostly locally sourced materials and with a modest level of production training. There is currently no other organization operating in the West Sumatra Earthquake response shelter sector currently utilizing this building method nor are there any other organizations providing shelters of this superior quality.



Interlocking Compressed Earth Blocks (ICEB) are made from laterite soil blended with Portland Cement and then compressed using a Cinva-Ram type manual press. They are a popular building material in Southeast Asia due to their low cost, accessibility, and pleasing appearance. These blocks are used to make load-bearing walls, eliminating the necessity for a reinforced concrete post and beam frame for support.

The interlocking blocks have a male and female component, allowing them to be laid by unskilled workers quickly and without mortar. A visiting UN engineer described them as being very much like Lego blocks. Mortar is used to fill the hollow sections of the blocks in stages where steel ring reinforcing is designed into the structure. The blocks are strong and durable, supporting buildings of two to three stories and with an unlimited lifespan when built on a proper foundation and with appropriate roof overhangs. Buildings constructed with the blocks are aesthetically pleasing, and the blocks are thick enough to provide excellent thermal and sound insulation. These blocks are a more sustainable technology than other construction materials of similar purpose. They are made of locally sourced clay soil, an easily accessible material, and their use cuts down on the amount of concrete and steel necessary for building construction. Furthermore, they're an alternative to wood as a building material or fired bricks, which require log burning in their creation. For self build homes, CVBT have seen savings of 20-30% compared with the ubiquitous concrete block and reinforced concrete frame solution much favored in West Sumatra. In India, Thailand and Vietnam, these blocks are especially appealing to low-income households in constructing a home and countless small village enterprises are busy producing the blocks.

Livelihood Support

Island Aid intends to train and employ beneficiaries and local labor to produce all of the ICEB. With a single ICEB press four individuals can produce more than 300 bricks per day. A single hybrid home requires approximately 1,200 blocks. Initial supervision of the critical mixing process will be provided jointly by Island Aid and one of our program partners. Due to the simplicity of the Lego like dry stack design, we hope it will be possible to involve women and other vulnerable individuals in the final building process. It is our hope that ICEB production can become a microenterprise for groups in the areas we support and will do whatever possible to facilitate this in the future as small scale ICEB production has proven extremely successful in creating new employment for villagers in other countries in the region.



DESIGN SPECIFICATIONS AND CONSTRUCTION SEQUENCE

Footings:

Stone or salvaged rubble footings to be constructed by owner using PU recommended dimensions (60 cm deep x 30cm wide at the top) Mortar mix to PU standard. 8mm deformed steel bar risers to be placed as shown on construction drawings. (not included in this addendum) Island Aid will supply cement and steel and timber riser bar template to ensure risers link to wall reinforcing.

Floor slab:

All vegetation and humus rich soil to be removed from the interior and replaced with demolished building rubble or sand. This layer to be compacted manually. The slab can be poured either before block work or after. If the slab is to be poured after block work (most likely) a 7cm thick x 20cm wide concrete plinth should be laid on top of the rock footings and leveled with care to ensure that block work above will bond correctly. At corners and piers the plinth will be extended and thickened to 10cm with a banana pith plug cast in to receive the bamboo poles later. Island Aid to provide cement. Owner to provide aggregate, sand and labor.

ICEB Block Wall:

ICEB hand presses will be deployed to strategic locations as close as possible to the recipients home sites. Island Aid will train local workers to produce blocks using local soils. A three week cure is required for ICEB blocks giving home owners ample time to complete footings and screed or slabs.

8mm deformed steel vertical reinforcing bars are wired to starter bars and blocks threaded dry from above. The first course of ICEB blocks have a molded channel for steel reinforcing. 8mm smooth bar is laid and the channel is filled with cement mortar. All vertical hollows are filled. Plain ICEB blocks are then threaded down the vertical steel and laid dry. The top course of ICEB blocks is also a channel block with 8mm steel reinforcing. Before filling this channel all vertical hollows are filled with cement mortar. The vertical steel will protrude approximately 25cm from the top of the block wall for use in the future construction of full height walls. Block walls will be allowed to cure for 2 weeks before the bamboo frame is erected. Island Aid to provide block presses, cement & steel. Owner to provide labor.

Bamboo Frames:

Treated bamboo frames incorporating poles and trusses will be assembled at site to standard designs. Bamboo to be pre-cut before trucking to site. Bamboo to be connected by 10mm steel bolts but these will not be tightened. Frames will be stood with poles located in the corners of the block walls or piers seated in the recess cast into the floor plinth or slab. Steel wire will be used to lash the poles into position at the top of the block wall using the protruding 8mm steel starter bars to tie to. After the frame is standing and ring beam attached, bamboo nodes adjacent bolts will be filled with mortar to prevent cracking. (bolts be tightened after 2 weeks cure time). Island Aid to provide bamboo, bolts and cement for mortar. Labor by owner.

Bamboo Ring & Sill Beams:

Bamboo to be drilled to accommodate steel starter bars and located along the top of the block wall. Ring beam to be bolted to poles (see above). Island Aid to provide bamboo, bolts and cement for mortar. Labor by owner.

Cladding:

Bamboo panels using crushed treated bamboo to be attached to the ring beam and sill beam by nails or screws. Labor, Doors and windows to be provided by owner.

Roof:

Bamboo roof fanning and bracing to be bolted in place. Island Aid to provide two plastic tarps for use by owner on the understanding that owners will re-use salvaged PGI material from damaged houses. Alternatively, owners may elect to use thatch roof material or other roof solutions such as pressed metal tiles or compressed bitument fibre corrugated roofing. Labor and roofing material by owner.

