

A Comparison of the Proposed “Steel House” with Constructed Block Wall Houses in the Jaffna Peninsula: Preliminary Findings

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A. Introduction

This report covers the preliminary findings of a two day visit to the Jaffna Peninsula (10-11 April 2016) undertaken by the authors to compare the proposed “steel house” with constructed block wall houses. Two model houses of the former were inspected (Note: 65,000 are proposed for construction over the next 4 years); as were several of the latter (of which over 50,000 have been constructed over the past 4 years). The inspection focused on technical aspects, although other aspects are also commented on. The model houses are commented on in the light of the block wall ones. Both are essentially rectangular and cover 550 square feet. A full research report is under preparation. The motivation for the comparison is the public interest that will be served; especially in the light of the relatively novel and untested nature of steel houses in Sri Lanka.

B. Structural Aspects

- B.1. The steel houses are founded on a 150 mm thick reinforced concrete slab which is placed on ground, in one case raised above existing ground level by around 450 mm. This will be unsuitable for flood conditions or even heavy rains that could erode the soil under the foundations. In comparison, the block wall houses are founded on random rubble masonry around 450 mm deep with a 300 mm plinth; this foundation depth and plinth height will be much more stable, especially under flood conditions.
- B.2. The wall panels of the steel house are made of a sandwich of two corrugated steel sheets enclosing polyurethane foam insulation. There are reportedly vertical galvanized steel channels at intervals along the perimeter, although these cannot be seen since covered by the sheets. This arrangement would generally be satisfactory for in plane and out of plane lateral loads and for vertical loads. The block wall house, with 100 mm (min) cement: sand block masonry would however be much sturdier for all types of loading.
- B.3. The roof panels are also made of sandwich panels such as the above, but probably somewhat thinner and without the stiffening channels – once again it was not possible to observe this. The span from roof ridge to wall supports is around 3.1 m. There are no intermediate purlin supports. This appears somewhat inadequate, because the maximum span recommended for corrugated sheets is generally 1.2 m (less than half the span utilized). In this panel of course there are 2 sheets separated by insulation, but they are unlikely to act compositely. The block wall houses have timber framed clay tiled roofs, which have been tried and found to be satisfactory over a long period; provided the timber is either properly chosen and/or treated.
- B.4. The steel house has a roof slope of 14°, which is reasonably satisfactory for sheet type roofing; it should be noted however that the greatest wind uplift, which would be a concern in the north and east of the country, will occur for roof slopes of around 10°. The slope of the

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tiled roof in the block wall house is however around 25°, which would relieve uplift significantly; in addition the relatively loose fitting tiles will tend to provide wind gaps that will reduce uplift pressures.

- B.5. The corrugated steel sheets are prone to corrosion, especially in environments close to the sea, if the coating is compromised by cutting, drilling, punching/riveting or even scratching. The electrochemical compatibility between bolts/rivets and the sheet must also be ensured. Such corrosion can take place in under 10 years. The block wall houses have very few materials than are subject to corrosion.

C. Non Structural Aspects

- C.1. The fixing of the door frames to the panels in the steel houses appear to be quite flimsy. Parts of it have been fixed to wall panels with double sided tape. In one case the jointing to the panels had not been carried out properly. Electrical fittings (plug sockets and external conduits) were found to have been dislodged already in one of the houses. The door hinges are also very small and appear quite fragile. The block wall houses do not suffer from such defects because the walls and fixtures are quite sturdy.
- C.2. There are no openings such as grills between the tops of doors and windows and roof in the steel house. This is poor design for hot climates because it does not allow hot air to rise and escape; such a design is better for cold climates or for air conditioned spaces in hot climates. Grills are routinely provided in the block wall houses. In addition, there is always a gap between wall plate and roof covering, allowing hot air to escape and making these houses much more comfortable thermally.
- C.3. The windows in the steel houses are small in size and may not satisfy standard ventilation requirements; also only half the window can be opened because of the sliding action. They have also not been provided bars, thus posing security issues (especially for vulnerable recipients), since windows would need to be opened for better ventilation. Such bars are provided in many of the block houses, where in any case the need to have windows opened is not as great because of the better ventilation at roof level.
- C.4. The steel houses have not been provided with a hearth and chimney, required because most recipients would be using firewood for cooking (and unable to afford cooking by gas). The steel house concept does not appear able to accommodate such an arrangement, because in one of the houses, a separate kitchen was being envisaged outside the house. Block wall houses have long been constructed with hearths and chimneys that appear to be working well.
- C.5. The use of the prefabricated panels appears to make future extensions in plan area infeasible for the steel houses, because of the specialist jointing techniques required. On the other hand, there were a number of examples where block wall houses (including the roof) had been extended in plan.
- C.6. The unfamiliar technology of the steel houses would also make repairs difficult if not infeasible. Where block wall houses are concerned, materials and operatives are readily available for repairs.
- C.7. The stated guarantee period of a steel house is 30 years, whereas a block wall house would probably have a life of 50-60 years. Also steel panel fabrication is primarily used for

temporary structures or office/storage ones. The block wall houses are capable of being handed down for at least one generation.

- C.8. The erection time of a steel house would be much less than for a block wall house; although the proposed 4 years for constructing 65,000 steel houses is not very different to the 50,000 block wall ones constructed also over 4 years.

D. Other Aspects

- D.1. The steel houses would require much less sand and hardly any timber for construction, thus helping to reduce the demand for natural resources. The block wall houses would require both; although such requirements appear to have been met without too much difficulty in the construction of the 50,000 houses over the past 4 years.
- D.2. Most of the recipients of owner driven block wall houses displayed a positive sense of ownership, allowing them to plan and even extend what has already been constructed with their involvement. (Note that the following of 'Vasthu' principles seemed to be of great importance to them). The steel houses would require an essentially contractor driven approach, which would not create this sense of ownership.
- D.3. The construction of the above 50,000 block wall houses has reportedly created employment and also promoted the local economy (e.g. retail shops for materials). The proposed contractor driven steel houses will not deliver this advantage.
- D.4. Despite furniture and other features being incorporated in the steel houses, they are still around at least double the cost of a block wall house of the same area. The steel houses are supposed to have a financing arrangement however, that has not been matched by any proponent of block wall houses.

E. Conclusions

- E.1. The steel houses suffer from the following key drawbacks compared to the block wall houses:
- (i) inadequate foundations;
 - (ii) insufficient roof support;
 - (iii) risk of steel corrosion despite the coatings provided;
 - (iv) poor ventilation;
 - (v) absence of hearth and chimney;
 - (vi) poor or non-existent capacity for extension or repair;
 - (vii) much shorter lifespan;
 - (viii) unlikely to create a sense of ownership;
 - (ix) very unlikely to foster the local economy and generate employment;
 - (x) at least double the cost.
- E.2. The steel houses have the following advantages over the block wall houses:
- (i) reduced consumption of natural resources, primarily sand and timber;
 - (ii) reduced erection time;
 - (iii) a reported financing arrangement for their construction.
- E.3. In the above context it is clear that the way forward is to construct block wall houses, while finding ways to overcome any disadvantages they may have (e.g. finding new sources of natural resources; alternative technologies to reduce natural resource usage; arranging financing).