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**Second Expert Consultation on Habitat and Shelter in  
Tsunami Rehabilitation**

**Venue: Ezilham, Chennai on the 11<sup>th</sup> April, 2005**

**Summary Report and Recommendations**

**Background**

The NGO Coordination Centre at the District Collectorate in Nagapattinam organised an expert consultation on shelter and habitat in March 2005 wherein a select groups of engineers, architects and planner participated along with a few leading NGOs intending to take up permanent shelter. The consultation provided rich insights into causes for damages to structures by the tsunami and came up with ideas for improved settlement planning that can resist various natural disasters including tsunamis, cyclones and earthquakes. The technical guidelines of the Tamil Nadu Government on tsunami rehabilitation were also discussed in detail. While there was a consensus on many issues, there were also disagreements on some. It was felt that a follow up consultation was required, preferably in Madras, where more senior engineers, architects and planners could participate.

**Second Consultation**

The second consultation was therefore organised on the 11<sup>th</sup> April 2005 at Chennai to enable participation of experts from other places who were attending a workshop on shelter and habitat being organised by UNDP on the 12<sup>th</sup> at Chennai. This is the summary report on the consultation. The following were set as focus of this consultation.

- Clarification and interpretation of technical guidelines by the experts, who were involved in developing these guidelines
- Recommendations to the Govt. of Tamil Nadu on further additions required to the technical guidelines to take care of retrofitting of tsunami damaged buildings (permitted by the new Govt. shelter policy), the use of alternative materials (mud blocks, hollow cement blocks, etc.) and alternative designs (sloping roofs, etc.)
- Suggest to the government if some of the safety features in the guidelines are excessive as they are comparable to those recommended in Seismic Zone V in the Gujarat guidelines while Tamil Nadu falls only under Zones II and III
- Suggestions for quality control measures and systems, given that construction is to be undertaken in Tamil Nadu on an unprecedented scale (130,000 houses)

The representatives of the NGOs had internal discussions in the morning session and subsequently Mr. Shankar, officer on special duty- relief, participated in the deliberations and explained the stand of the Government on the reconstruction policy. In the post lunch session Dr. Lakshmanan and Dr. Shantha Kumar, members of the technical committee that drafted the guidelines, answered queries raised by representatives of NGOs.

***Main issues discussed and clarifications on guidelines:***

The expert committee members Dr. Lakshmanan and Dr. Shantha Kumar gave the technical ground on which the guidelines were formed, for specific issues on which the NGOs raised concerns/ doubts.

1. Cyclone related considerations are behind use of safety features meant for seismic zone V in coastal Tamil Nadu.

The criticism that the technical guidelines had gone for safety features that are essential for Zone V in the seismic atlas of India when the Tamil Nadu coast fell only under Zone II or Zone III was discussed. The Committee Members clarified that the main consideration on the Tamil Nadu coast was cyclone safety rather than seismic safety of structures. The use of design considerations meant for seismic safety in Zone V automatically takes care of the loads that come due to cyclone winds. The Committee members said that they had taken into account recommendations made by experts on cyclone safety. Indian Standards meant for Cyclone resistant structures are ready and are likely to be published soon.

2. Shelters to be situated at 5m elevation and 500m distance from the shore

As per the flood hazard map of the BMTPC vulnerability atlas of India, Tamil Nadu coast has experienced storm surge in the range of 3m to 11m above Mean Sea Level (MSL). Taking the minimum storm surge of 3m and adding 0.8m considerations for tidal variations and 1m consideration for wave rise on obstructing structures, the elevation has been arrived as 5m from the MSL.

500 m is the normal runoff length for tides of 3m height<sup>1</sup>. The guidelines given are +5m elevation from the MSL and 500 m from the shore, in which +5m elevation is more important.

3. Reinforcement bars in brick masonry.

Reinforcement bars are recommended as per earthquake resistant buildings to take lateral load. According to explanations by the technical committee members, lateral loads because of cyclone will be larger than the lateral load due to earthquake. Reinforcement bars should be of 16mm diameter for the ground floor and 12mm diameter for the first floor in case of double storey building; and 10 mm diameter for

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<sup>1</sup> Even though the 500m distance was assumed to be coming from the CRZ regulations by the NGOs, the committee members did not say so and justified the 500m distance on this ground.

single storey building. If construction of first floor is contemplated at a later time, the ground floor now planned should have 16mm diameter bars. 16 mm bars have been suggested taking the corrosive environmental conditions into account.

The corner reinforcement for cyclone resistant buildings is not required in earth quake resistant buildings since the purpose of reinforcement is to keep the foundation intact. The foundation will not collapse even if there is “scouring” action and the soil is taken away by flooding due to storm surges.

Vertical reinforcements and horizontal bands enable building to resist lateral loads due to cyclone and earthquake. It also helps in making different components of the building (roof and walls) behave as one by binding the whole structure together.

#### 4. Maximum length to thickness of the wall:

Technical committee members clarified that the length of the wall could be a maximum of 16 times the thickness of the wall as against 8 times given in the guidelines. This correction is to be made in the guidelines.

#### 5. Alternate materials for construction

Hollow cement blocks can be used instead of bricks but the spacing of vertical reinforcement bars will have to be redesigned as per building codes. The bars should be covered by 4”x4” concrete.

The guidelines given are meant for brick wall masonry and RCC roof. However, this does not mean that other materials cannot be used. It only means that designs made of other materials will need whetting by institutions like SERC, IIT or Anna University.

However, other types of roofs will have to be tied well with the walls to ensure seismic and cyclone safety. Therefore, if ferro-cement channels are used, the roof needs to be anchored properly. Tie beams may have to be designed on the walls for this purpose.

#### 6. Use of indigenous technology and materials.

To a specific question on guidelines for use of indigenous technology and materials, the experts expressed that any material and technology that conforms to IS codes will be acceptable. This guideline does not rule out other engineering options.

#### 7. Depth of foundation

The depth of foundation has been kept at 1.6 m to ensure safety from scouring of sand at the time of storm surges or flooding. The depth of foundation is recommended to be uniform for all the walls and all along the length.

In case of raising the ground level by creating a mound, the foundation of the building should go below the original level of the soil. The mound should be supported by retaining wall. Masonry wall up to say about 45 cm and pitching the soil will also be of help. However, in practice this option is likely to turn out more expensive.

#### 8. Alternatives to deeper foundation

- Wall aprons could act as alternatives to deep foundations
- Technical committee members were of the view that foundation depth of 1.6m would provide safety from scouring and hence not allow damage of floor inside the rooms. Therefore, even if column beam type of construction is undertaken, reduction in foundation depth will not be advisable.
- The use of compound wall foundations to counter scouring was not considered effective by the Committee members based on experiences in the current tsunami.

#### 9. Roof

Flat RCC roof is recommended from the point of view of wind. Light roofs will be lifted off. Gable or roof bands will be required to tie the roofs to the walls in case of tiled roof and AC sheets since they don't have sufficient self load to keep roof intact. Also cyclone safety measures will be required to ensure that uplift pressures as defined in codes are resisted.

#### 10. Ground beams

Fig 15 in the guidelines gives details of the ground beams. Ground beams and grade beams are the same.

The tie beam at 1 m below ground level holds the super structure together in the event of any scouring of sand below the foundations. The plinth band provided at plinth level also takes lateral pressure of soil. Providing band at sill level is not recommended as the band cannot be continuous and hence useless. *The ground beam absolutely essential but the plinth beam is only recommended and can be omitted.*

#### 11. Openings in the direction of sea.

NGO representatives expressed that door and window openings in the direction of sea will facilitate sea breeze getting into the building, otherwise it will be very uncomfortable because of higher humidity near sea. *The experts clarified that openings could be in the direction of the sea.* The only limiting factor as far as openings is that the openings should not exceed 50% of the wall area.

The Committee members explained that the guidelines are not intended for RCC framed structures but for brick wall masonry structures for small house buildings in the range of

300 sq. ft area. In general, the guidelines were to provide help to ordinary persons putting up small houses on the coast. Basically, the guidelines were intended to cover “non engineered” structures. The larger buildings for common use like balwadis, schools, etc need to be properly “engineered structures” requiring design inputs by structural engineers.

The technical committee members were clear that the guidelines were limited in their scope and options and alternatives not covered by the guidelines could be taken up provided they are designed or whetted by qualified structural engineers. However, the NGOs expressed their fear that the scope of the guidelines would be misunderstood by the District Administration which may not allow any deviation from the guidelines. The possibility of coming up with additional guidelines to cover alternative materials and designs (as was done in Gujarat after the earthquake) was discussed. The committee members were of the view that this will have to be commissioned by the Government of Tamil Nadu. Alternatively, any new design could be whetted by IIT, Anna University or SERC, rather than prepare additional guidelines.

Participants were of the view that the Tamil Nadu guidelines erred in not making the scope of the guidelines clear in the introduction itself. It was felt that the addition of a few paragraphs explaining the scope of the guidelines and the design criteria used (e.g. use of Zone V seismic design requirements to take care of cyclone wind loads) will go a long way in helping the engineers and architects using the guidelines to understand the various provisions of the guidelines.

The discussions on recommendations to government, suggestions on quality control mechanisms, etc. could not take place due to limited time availability. It was agreed that these could be discussed in the subsequent day’s meeting (on 12<sup>th</sup> April) and sent to the Government.