

# **TOWARDS REBUILDING A NEW ANDAMAN & NICOBAR SHELTER & HABITAT REHABILITATION**

BY:-

**Dr. Anand S. Arya**

National Seismic Advisor, GoI-UNDP

**Ankush Agarwal**

Technical Officer, GoI\_UNDP

&

**Sh.Satya Narain Padhiari**

Shelter Team, UNDP - Orissa

Prepared Under

**GoI - UNDP Disaster Risk Management Programme**

**MINISTRY OF HOME AFFAIRS**

**G o v e r n m e n t o f I n d i a**

**N e w D e l h i**

**M a r c h 2 0 0 5**

# "Towards rebuilding a new Andaman & Nicobar"

## Shelter and Habitat Rehabilitation



**TOWARDS REBUILDING A NEW ANDAMAN & NICOBAR  
SHELTER & HABITAT REHABILITATION**

BY:-

**Dr. Anand S. Arya**

National Seismic Advisor, GoI-UNDP

**Ankush Agarwal**

Technical Officer, GoI\_UNDP

&

**Sh.Satya Narain Padhiari**

Shelter Team, UNDP - Orissa

Prepared Under

**GoI - UNDP Disaster Risk Management Programme**

**MINISTRY OF HOME AFFAIRS**

**Government of India**

**New Delhi**

**March 2005**

## **CONTENTS**

| <b>Chapters</b> | <b>Particulars</b>                                                                    |
|-----------------|---------------------------------------------------------------------------------------|
|                 | Introduction                                                                          |
| <b>1.0</b>      | Damage from Earthquake and Tsunami                                                    |
| <b>2.0</b>      | Damage Assessment to Settlements                                                      |
| <b>3.0</b>      | Situation Analysis                                                                    |
| <b>4.0</b>      | Action taken by Andaman & Nicobar Administration                                      |
| <b>5.0</b>      | Assistance required by Andaman & Nicobar Administration from Govt. of India           |
| <b>6.0</b>      | Formation of Technical Team by Govt. of India                                         |
| 6.1             | Reconnaissance Survey                                                                 |
| 6.2             | Strategy on Housing Reconstruction, Planning for Intermediate Shelters                |
| 6.2.1           | Materials used                                                                        |
| 6.2.2           | Design Adopted                                                                        |
| 6.3             | Evolving Model Designs for Intermediate Shelter construction                          |
| <b>7.0</b>      | Mobilization of Resources                                                             |
| 7.1             | Building materials                                                                    |
| 7.2             | Manpower for undertaking construction work                                            |
| <b>8.0</b>      | Preparation of Site/ Village Plans for Intermediate Shelter construction              |
| 8.1             | Technical Team from MHA facilitating the work                                         |
| 8.2             | Methodology adopted for formulating strategies on resettlement/ in-situ redevelopment |
| 8.3             | Study of existing Settlement Pattern                                                  |
| 8.4             | People's perception on Resettlement/ In-Situ Redevelopment                            |
| 8.5             | Identification of issues and problems                                                 |
| <b>9.0</b>      | Achievement vis-à-vis the target                                                      |
|                 | Annexure –1:- Design Guidelines for Tsunami affected areas                            |
|                 | Annexure – 2:- Technical Committee report                                             |
|                 | Annexure – 3:- Layouts prepared for different intermediate shelter sites.             |

## Introduction:

The beautiful archipelago of Andaman & Nicobar Islands consisting of 572 odd big & small islands lies like a necklace on the Bay of Bengal. Post independence these islands slowly but surely were becoming one of the ultimate tourist destinations because of its unique history and sheer natural beauty when tragedy struck.

A severe Earthquake measuring 9.3 on Richter scale was felt in Andaman & Nicobar Islands having an epicenter at 3.7 N and 95 E at a depth of 30 km off the Island of Sumatra in Indonesia between 06:30 to 06:35 Hrs on the 26<sup>th</sup> December 2004. The earthquake preceding the Tsunami was one of the largest inter-plate shallow thrust earthquakes that occurred at interface of the subducting Indian Lithosphere and the overriding Burma Plate. The fiercest Tsunami in the country's living memory of 3 – 6 m height which battered the coastline along the Bay of Bengal killing thousands of people and flatted a number of dwellings. More than 1900 human lives were lost and more that 5500 are still missing in the Islands.



### 1.0 Damage from Earthquake and Tsunami:

Extensive damage was reported from Car Nicobar, Katchal, Chowra, Nancowrie, Great Nicobar etc. in the Nicobar district and Netaji Nagar and Hut Bay in Andaman District. The earthquake and the resulting Tsunami had a severe impact on livelihood of the inhabitants. Fisherman living on the coasts lost their boats catamarans and fishing nets. Due to

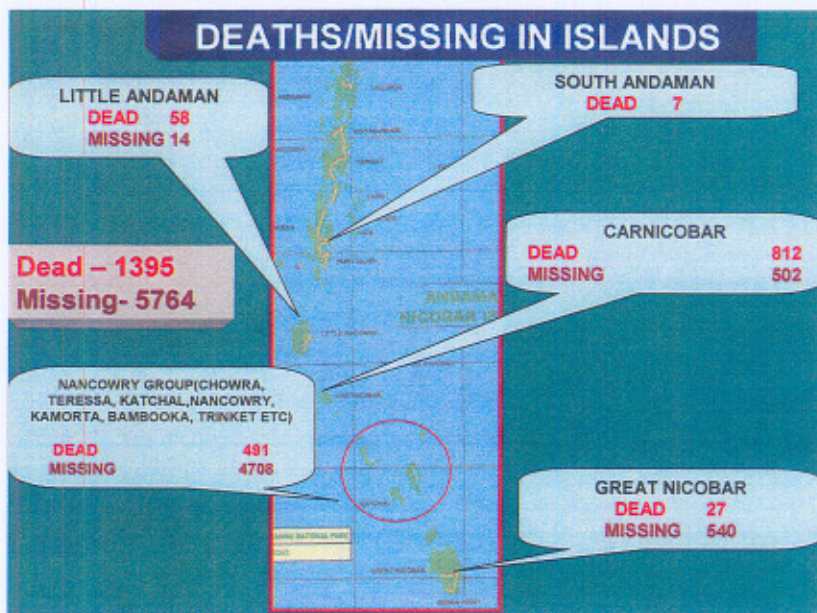


*Indra Point: Tip of Southern group of islands*

ingress of the seawater into the low-lying cultivated fields, the soil has become unfit for cultivation in large tracts of land. Many of the dug wells have been contaminated. Now the high tide is on an average about one meter higher than the pre earthquake situation and some areas are still getting flooded during high tide. The disaster caused an enormous environmental impact that will affect the region for many years to come.

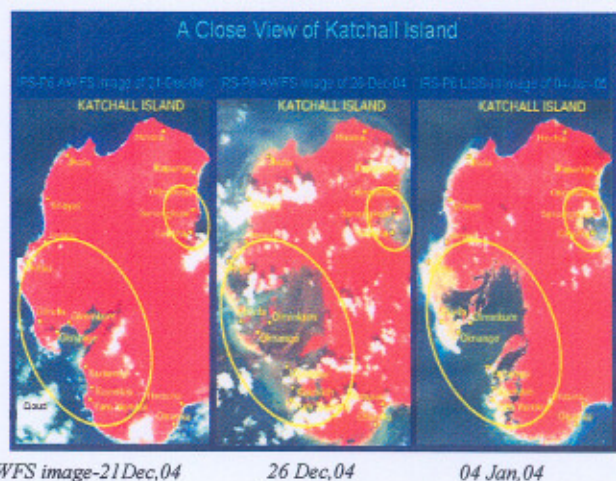
Fisherman living on the coasts lost their boats catamarans and fishing nets.

*Towards rebuilding a new Andaman & Nicobar  
...shelter and habitat rehabilitation*



Due to ingress of the seawater into the low-lying cultivated fields, the soil has become unfit for cultivation in large tracts of land. Many of the dug wells have been contaminated. Now the high tide is on an average about one meter higher than the pre earthquake situation and some areas are still getting flooded during high tide. The disaster caused an enormous environmental impact that will affect the region for many years to come.

Out of the total area of Nancowrie group of islands, 15.64% of the area has gone under major changes. Nearly 6.8% of the area is submerged and 8.9% of are has been damaged. Maximum change (more then 42 %) has been observed in Trinket Island. More than 23 % of Katchal and 9% Kamorta & Nancowrie and Teressa group have gone in to major change. While analyzing the loss it was observed that 94.34% of the Mangroves in Katchal Island and 51.49% in Trinket Island, 42.88% in Kamorta & Nancowrie islands have been submerged in to deep water. In addition to Mangroves more than 62% of littoral forests in Katchal Island have been submerged in to deep water (27.11%) or converted in to sandy area (35.42%). It is also observed that 12.92% of evergreen forest in Trinket, 5.36% in Teressa / Chowra groups, 3 % in Tillangchong have suffered severe to moderate damage.



*Bengali Jetty damaged and submerged under sea water at Teressa*

#### Damage to Ports

Twenty-one out of the forty nine jetties in the islands were severely damaged. The passenger hall at Port Blair Haddo No. 3 jetty was completely damaged. The end portion of the Fisheries jetty sunk. In Hut Bay, the jetty was totally damaged and the approach to the breakwater and wharf was also damaged.

*Towards rebuilding a new Andaman & Nicobar  
...shelter and habitat rehabilitation*

In Car Nicobar the approach to the Mus wharf was partly damaged while the Malacca Jetty was totally damaged. In Campbell Bay the approach to the jetty collapsed completely. The jetties at Chowra, Teresa, and Katchal were severely damaged. Cracks developed in jetties at Kamorta and Nancowry.

The Port Management Board and Andaman & Lakshadweep Harbor Works have initiated steps on a war footing to repair and restore the jetties.

### **Damage to Power System**

The power supply system in A & N Islands was badly damaged. The 20 Mega Watt Powerhouse at Bamboo flat was shut down after it was submerged in seawater. Extensive damage was caused to the powerhouses, DG Sets, T & D systems, Transmission Towers, Power distribution transformers, buildings etc. in most of the islands.

### **Damage to Ships of A&N Administration**

Seven shipping vessels were damaged and two vessels sunk in the five sweeps of tidal waves. Propellers, Hulls, Shaft, Superstructure etc., were damaged in the above vessels. Both the dry docks were damaged and lock gates (caissons) were beyond repair. A forty ton diesel storage tank were uprooted and damaged with fuel partially leaking in the sea.



*Vessel brought inland by tsunami waves at Port Blair*

### **Damage to Roads & Bridges**

Road network in most of the affected islands was badly damaged. In some places the roads were washed out while in others cracks developed. The Andaman Trunk Road, which connects North Andaman to Port Blair, suffered damages at a number of places. The deck slabs in some of the spans in the main bridge connecting Mayabunder to Diglipur at Austin Creek were displaced both vertically and horizontally resulting in disruption of traffic. At other places bridges and culverts were totally damaged;

### **Damage to Water Supply**

There was extensive damage in the water supply network especially in the Southern Group of Islands. Wells in the flat lands were flooded with sea water. In Port Blair town itself the gravity mains were damaged in 37 places and pumping mains in 15 places.

A brief summary of the damage caused to major infrastructure facilities like roads, bridges, ports, water supply, ships etc, are given below:

|                                  |   |                   |
|----------------------------------|---|-------------------|
| Damage caused to ports           | - | Rs.275.07 crores  |
| Damage caused to power system    | - | Rs.150.00 crores  |
| Damage caused to buildings       | - | Rs.138.47 crores  |
| Damage caused to Roads & bridges | - | Rs.134.95 crores  |
| Damage caused to ships           | - | Rs. 64.90 crores. |
| Damage caused to Water Supply    | - | Rs. 35.02 crores  |

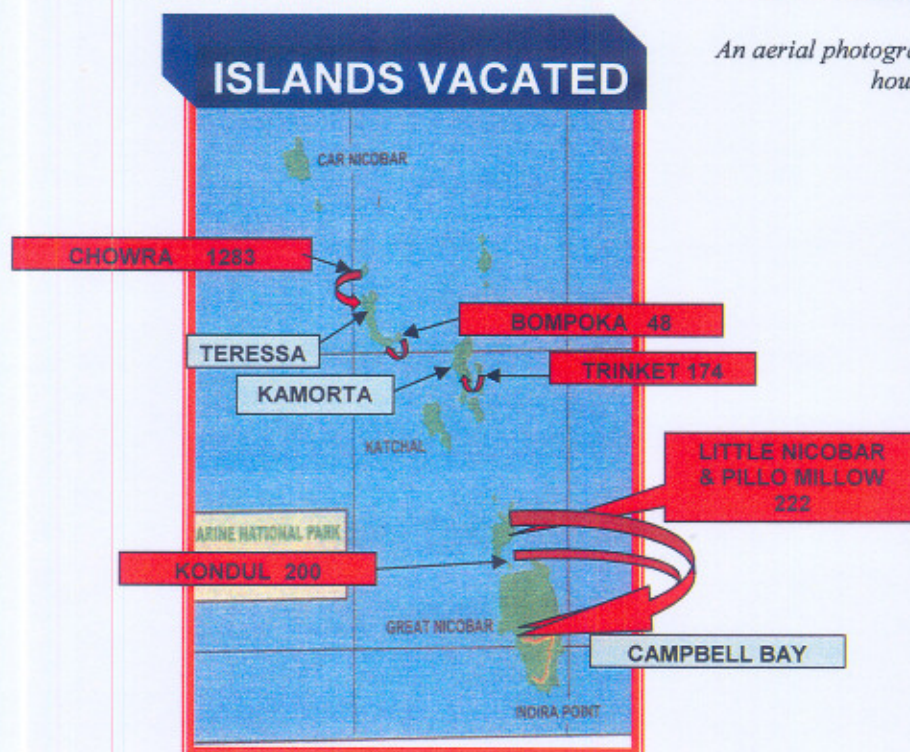
*Towards rebuilding a new Andaman & Nicobar  
...shelter and habitat rehabilitation*

## 2.0 Damage Assessment to Settlements:

The earthquake and the resulting Tsunami had a severe impact on housing and habitat affecting the livelihood of the inhabitants. More than 70% of the houses are damaged, as most of the settlements existed along coastlines, which was useful for interactions with sea mainly for livelihood activities. The southern Islands of the archipelago, mainly Chowra, Teresa, Bamboka, Katchal, Kamorta, Nancowrie and Trinket (Nancowrie group of islands),



*An aerial photograph of the damages caused to houses by tsunami*



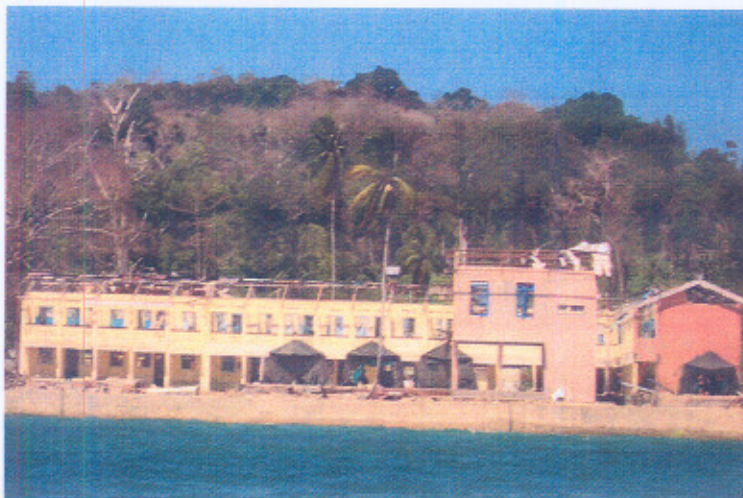
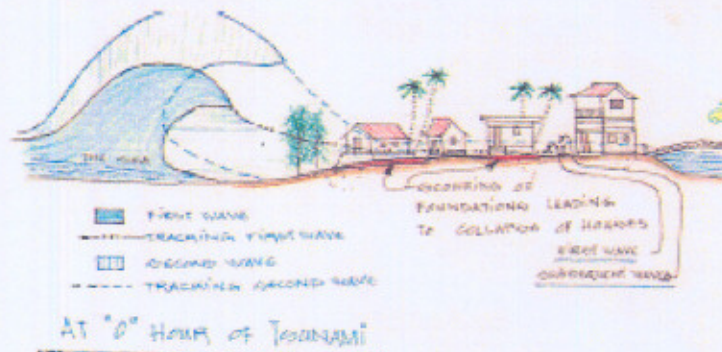
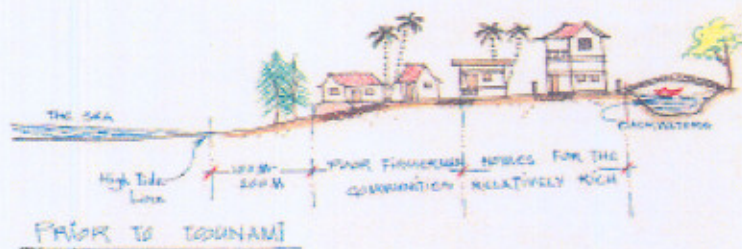
Campbell Bay are the worst affected. Three islands viz. Chowra, Bambooka and trinket have been abandoned; the west bay Katchal has been submerged in sea completely. This nature triggered geographical dislocations has made the life stand still. Relief camps are the homes for the inhabitants, mainly the tribals.

| Sl.No. | Islands         | Houses Damaged |                  |                    |
|--------|-----------------|----------------|------------------|--------------------|
|        |                 | Fully Damaged  | Severely Damaged | Marginally Damaged |
| 1      | Car Nicobar     | 2876           | 74               | 11                 |
| 2      | Nancowrie       | 1878           | 18               | 0                  |
| 3      | Great Nicobar   | 1131           | 44               | 13                 |
| 4      | Little Andaman  | 1689           | 116              | 0                  |
| 5      | Rest of Andaman | 572            | 2614             | 6414               |
| Total  |                 | 8146           | 2866             | 6438               |

### 3.0 Situation Analysis:

The Tsunami of December 2004 has affected more than 17000 houses and rendered the families homeless, devastating several habitats and bringing about changes in ecomorphology.

The primary cause for the high damage is related to the location of the settlements on the coastlines of the Islands. The Government had formulated and passed the Coastal Regulation Zones (CRZ), 1992, prohibiting permanent settlement within 500 meters of the coast. However this has not been enforced in these areas where the settlements have existed for more than 25-30 years. In the aftermath of this Tsunami and devastation to these entire coastal habitats, the Government is now considering relocation that is resettlement of some of these communities along with reconstruction of their habitats.



*Katchal: A school building on sea coast completely damaged*

The houses too close to the sea have been washed away and there have been heavy casualties in the first line of houses. Close to the shore, the waters were of enormous height of about 20'-25'. However, with distance away from the sea within the settlement, the height of these waters dropped appreciably, they were of height about 10'-15' within the settlement. It is interesting to note that the tsunami has completely changed the topography of the area. The ground level has been elevated

with sands deposits and in some cases there has also been appreciable drop in the ground level with sands having been washed away.

Substantial resources have become available for reconstruction from variety of sources. Gaps still exist however in technical expertise for designing effective habitats that are culturally sensitive, that respect the pattern of the past settlements evolved over time and at the same time integrate technically sound disaster mitigation measures. There is also need for an effective coordination mechanism linking all stakeholders and all levels of Government concerned habitat reconstruction, which ensures a participatory approach, building from the concerns of the dwellers themselves.

#### **4.0 Action taken by Andaman & Nicobar Administration:**

As soon as the Tsunami waves hit the Islands, the entire Administration machinery swung into action. The search, rescue and relief operations were started. The officials of Revenue Department coordinated the relief and rescue operations with police force, medical and health services and all other associated departments. Despite the shock and suddenness of the event the task was started with utmost commitment and dedication. The Army, Navy, Air Force and the Coast Guard fully supported the operations of the Administration. A total of 13482 people have been evacuated to Port Blair from Southern group of Islands. More than 5589 people have been evacuated to the main land.

These efforts enabled relocating the affected families to safer places. Relief camps have been opened in safer places. In 205 relief camps, 45811 people are being provided ration and other essential services. Essential items were mobilized from Govt. of India and from local markets with the help of Deputy Resident Commissioners of Andaman & Nicobar Administration. The items were moved with the help of ships of A & N Administration, Naval ships also extended valuable assistance in transporting the relief supplies to the affected Islands.

Because of severe damage to the ports, the relief supplies had to be handled at many locations for transportation first by bigger ships and then by smaller ships and then by smaller boats, making the logistics very difficult. However the officials of the Administration were posted at key locations to facilitate the supply of the relief items. A brief relief measures taken up is as follows:

1. 205 relief camps has been setup, where about 45811 people are staying
2. Medical teams were dispatched in sufficient numbers
3. Special Relief Officers have been posted in all the Island to coordinate the relief work
4. Immediate steps were taken up to restore the essential services by various departments
5. Urgent steps have been taken up to make the infrastructure functional.
6. Road and sea route are established to reach the most interior and inaccessible areas.
7. Tools and equipments whatever were available provided to the inhabitants for construction/ repair of damaged houses.

## **5.0 Assistance required by Andaman & Nicobar Administration from Govt. of India:**

Massive assistance is required from the Government of India for short-term relief measures and long-term rehabilitation. The fishermen community and the Nicobari tribals were particularly affected by the disaster. The assistance required from the Government of India is detailed in the following categories:

- Gratuitous Relief
- Re-imbursement of losses
- Temporary Relief
- **Temporary Housing**
- Relief and Rehabilitation
- Repairs and Reconstruction
- Financial Assistance to Autonomous Institutions
- Social Security

More than 10000 families have become homeless due to permanent/ severe damage to their houses as well as temporary displacement and loss of livelihood. For immediate relief and rehabilitation of the affected people, construction of temporary and semi-permanent houses is required so that they can get shelter before the onset of monsoon.

The total fund requirement for the temporary and semi permanent structures comes to Rs. 261.55 crores.

## **6.0 Formation of Technical Team by Govt. of India**

In the context of providing safe shelters to the Tsunami affected people a team of housing experts was deputed by the Ministry of Home Affairs headed by Prof. Anand S. Arya who had discussions with the OSD Housing, MHA and officials of PWD Andaman & Nicobar Administration on the issues of immediate construction of temporary dwelling units and to develop strategies for reconstruction and planning for temporary shelters.

Prior to discussions of the expert group with the Andaman & Nicobar Administration a small workshop was organized at National Institute of Disaster Management (NIDM) to finalize the design criteria to be adopted for construction in Tsunami affected areas in India. This workshop was attended by a number of experts from different institutions all over India

### **6.1 Reconnaissance Survey:**

After the workshop, technical team along with Prof. Arya visited Andaman & Nicobar Islands for reconnaissance survey of the available resources and to assess the nature and extent of damage. Based on the field assessment and discussions with the govt. officials of PWD and the A & N Administration the observations were,

1. No building material can be produced in these Islands. The building materials have to be transported from the main land, therefore the materials should be lighter to transport and easy to construct.
2. There is a scarcity of skilled people who will construct the houses, therefore the designs and the material of houses should be people friendly and easy to construct by the beneficiaries themselves.
3. The most important observation is that, in these Islands the onset of monsoon is on 24<sup>th</sup> of April, therefore the dwelling units has to be constructed before the onset of monsoon.

Based on these inputs and discussion with the affected tribal- and non tribal communities the materials to be used & the layouts were specified. Several 'alternatives using wood column, bamboo bracing, bamboo purlins, pipe columns, CGI sheets, bison panels, Calcium Silicate board covering etc. were considered from the point of view of cost, easy availability and time of supply. Further it was proposed to build these shelters at elevated land & away from the sea shore

## **6.2 Strategy for Reconstruction, Planning for Intermediate Shelters:**

The Government had already drawn a strategy for intermediate settlement on the identified sites. The intermediate shelters were to be built by the administration in South Andaman, Little Andaman and Campbell Bay for non-Tribal population. The plinth area of these shelters will be 23 sq mts including 3 sq mts toilet. The total cost assessed by the PWD for 3850 temporary shelter units is Rs 4850 lacs.

For Tribal Areas, semi- permanent dwelling units, the layout and the specification was finalized in consultation with the Tribal Captains. A single unit of 23 sq mtr for single family and another design of 89.2 sq mtr for joint family consisting of 4 families has been finalized for the Car Nicobar Islands. For Nancowry group of Islands the units having area of 35.8 sq mtr has been finalized.

The beneficiaries themselves with assistance from the Administration will do the construction. Building construction materials shall be provided by the Administration along with the direct payment of Rs. 10,000 (ten thousand) per family for their labour. The total cost assessed by PWD for 6250 semi- permanent tribal dwelling units for Car Nicobar and Nancowrie Islands comes to Rs 9375 lacs. The cost of materials has been calculated based on the DSR- 2002 without adding cost index for A & N Islands. Cost of material has been taken as Rs 1,40,000/- per unit for Tribal family.

| Name of the Island | Nature of Dwelling unit | Area of the dwelling unit | Executing Agency | Total units  |
|--------------------|-------------------------|---------------------------|------------------|--------------|
| South Andaman      | Non tribals             | 23 sqm                    | Department       | 850          |
| Little Andaman     | Non-tribals             | 23 sqm                    | Department       | 2000         |
|                    | Tribals                 | 50 sqm. for 2 families    | Beneficiary      | 50           |
| Car Nicobar        | Tribals                 | 85 sqm. for 4 families    | Beneficiary      | 4000         |
| Kamorta            | Tribals                 | 50 sqm. for 2 families    | Beneficiary      | 650          |
| Nancowry           | Tribals                 | 50 sqm. for 2 families    | Beneficiary      | 200          |
| Terresa            | Tribals                 | 50 sqm. for 2 families    | Beneficiary      | 650          |
| Katchal            | Tribals                 | 50 sqm. for 2 families    | Beneficiary      | 500          |
| Campbell Bay       | Non-tribals             | 23 sqm                    | Department       | 1000         |
|                    | Tribals                 | 50 sqm. for 2 families    | Beneficiary      | 200          |
| <b>Total</b>       |                         |                           |                  | <b>10100</b> |

- It is proposed to construct 10100 temporary / semi-permanent dwelling units to shift the people living in camps/ tented accommodation.
- Out of 10,100 units, 3850 are for non-tribals and 6250 for tribals.
- The designs of the units have been finalized in consultation with NIDM/ MHA.
- The units have been designed to withstand earthquake & cyclonic winds.
- The locations for the shelters in tribal areas (i.e. covered in Protection of Aboriginal Tribes Regulation, 1956) have been selected by the tribal councils and village councils.

#### **The Size and specifications of the units:**

- The average covered area of a dwelling unit shall be 21-25 sq mtr per family (including kitchen and toilet)
- The brief specifications are as below:
  - Roofing with CGI sheets
  - Walling with CGI sheets
  - Frame of steel or wooden posts
  - Raised compacted earthen flooring
  - Common kitchen, bath and toilet for families (vary for each design)
  - Provision of doors and windows.

### **Material Requirement and trans-shipment**

- The total material requirement has been worked out to be 4500 MT of CGI sheets and 8000 MT of structural steel and non-structural items.
- CGI sheets were procured by MHA from Steel Authority of India Limited.
- Government of Kerela is providing 1,00,000 pieces of bamboos of the length 6-8 m for the construction purposes.
- Government of West Bengal is providing 10,000 Sal poles. The first lot of 3,000 has already arrived at Port Blair.
- Plastic ropes are being provided by Government of Maharashtra.
- House making tool kits are being provided by Government of Punjab.
- Site cutting, bending & fabrication tool from Government of Andhra Pradesh.

### **Construction**

- For non-tribal families the units will be constructed by APWD and for the tribal families, beneficiaries shall themselves construct their houses. Approximately 40 man-days employment shall be created in each family.
- A list of materials to be procured by MHA was submitted based upon the estimates prepared by APWD
- A&N PWD will set up mini fabrication workshops in different islands for fabrication of steel structures so as to expedite the whole process of construction. It is targeted to complete the construction by 15<sup>th</sup> April.

## **6.2 Evolving Model Designs for Intermediate Shelter construction:**

After the first reconnaissance survey the housing expert's team worked out various designs for immediate construction of the Intermediate Shelters based on the requirements of different communities. As the monsoon is approaching and construction of more than 10,000 houses within such a short span is not an easy task.

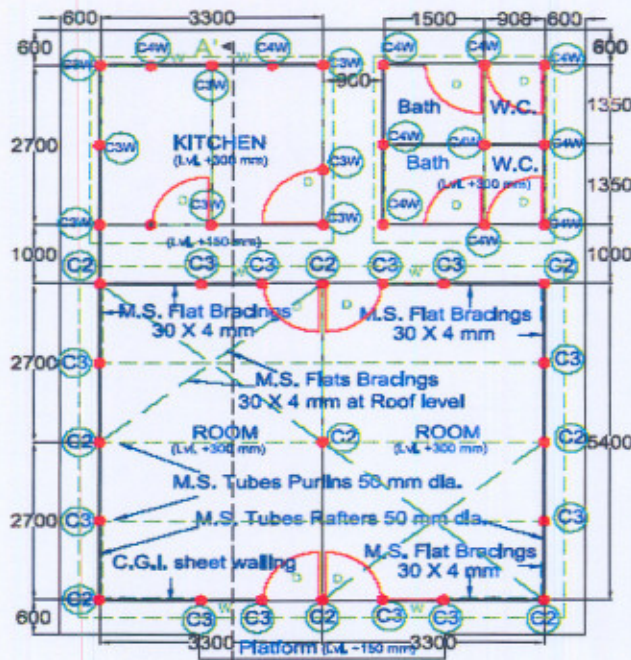
### **6.2.1 Materials Used:**

Use of steel and CGI sheets was emphasised as the availability of wooden post and other local materials was not certain. Secondly, the sheets & steel could be easily removed & used at any other place, if required. Thirdly, as form work is not required therefore erection of dwelling units using steel & CGI sheets is very fast. Fourthly, they can resist earthquake & cyclonic wind forces.

### **6.2.2 Design Adopted:**

The house designs are made very simple and easy to built by the beneficiaries themselves, without much external help. The units were designed for non-tribals & different tribal groups after discussing the requirements with their captains and village heads. The design was prepared based on the further usage of the units once the permanent houses are constructed and if required the units can be dismantled and installed at other place. Bracings were provided in walls and roofs looking into the seismicity & winds speeds in Andaman & Nicobar islands thus making it earthquake and cyclone resistant.

**Design 1: Two Unit Structures** with separate Kitchen and Toilet facilities for each unit  
To be constructed at Teressa, Katchal, Kamorta, Nancowry & Campbell Bay



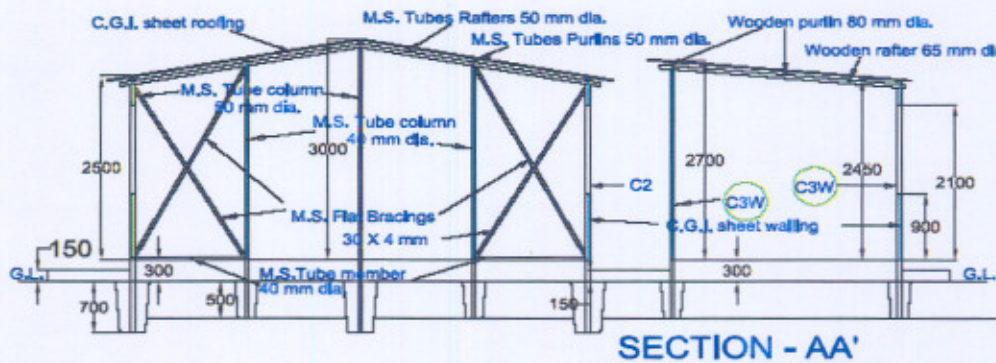
**Material & Column details**

**ELEMENT, MATERIAL & SIZES IN MAIN HALL**

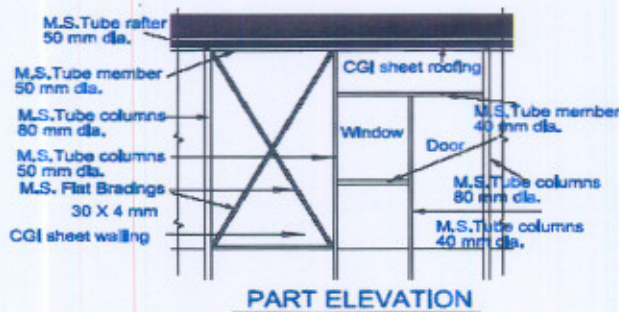
Column C1:- Steel Tube NB 80 (M)  
Column C2:- Steel Tube NB 50 (M)  
Column C3:- Steel Tube NB 40 (M)  
Rafters & Purlins:- Steel Tube NB 50 (M)  
M.S. Flat 30 mm X 4 mm (use in all alternatives)

**ELEMENT, MATERIAL & SIZES IN KITCHEN & TOILET**

Column C3W:- 80 mm dia. at base Wood Ball or Bamboo  
Column C4W:- 65 mm dia. at base Wood Ball or Bamboo  
Rafters:- 65 mm dia. at middle point Wood Ball or bamboo  
Purlin (kitchen):- 80 mm dia. at middle point Wood Ball  
Purlin (toilet):- 65 mm dia. at middle point Wood Ball



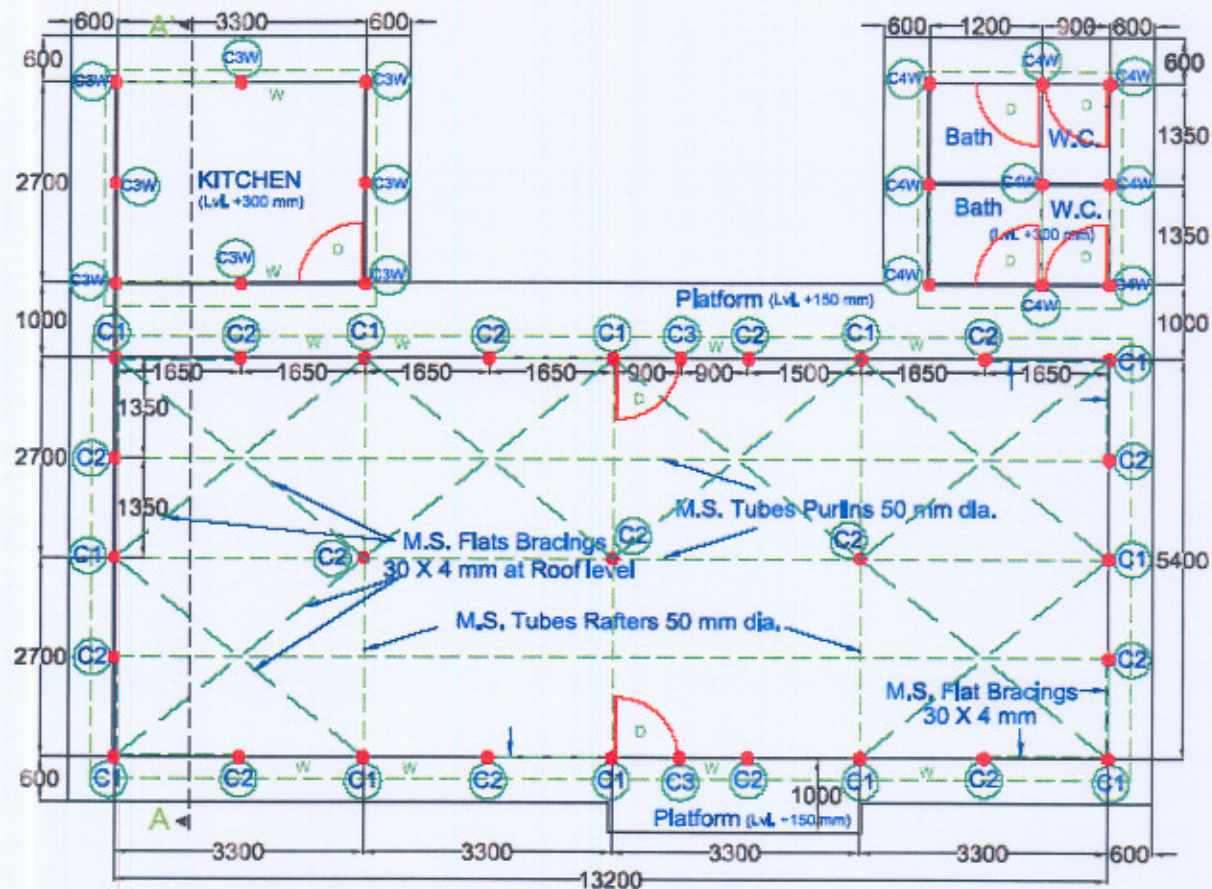
**SECTION - AA'**



**PART ELEVATION**

**Section and Part Elevation of Two Unit Structures**

**Option 2: Four Unit Structures** with separate Kitchen and Toilet facilities  
To be constructed at Car Nicobar

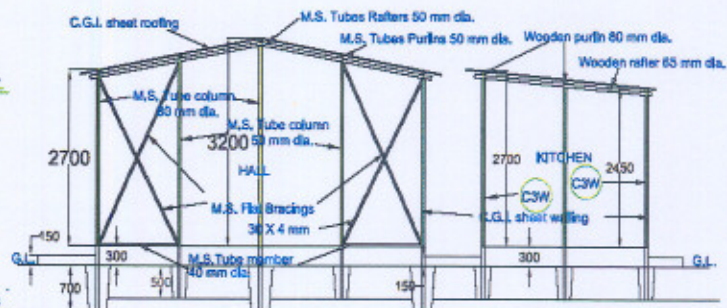


**ELEMENT, MATERIAL & SIZES IN MAIN HALL**

Column C1:- Steel Tube NB 80 (M)  
Column C2:- Steel Tube NB 50 (M)  
Column C3:- Steel Tube NB 40 (M)  
Rafters & Purlin:- Steel Tube NB 50 (M)  
M.S. Flat 30 mm X 4 mm

**ELEMENT, MATERIAL & SIZES IN KITCHEN &**

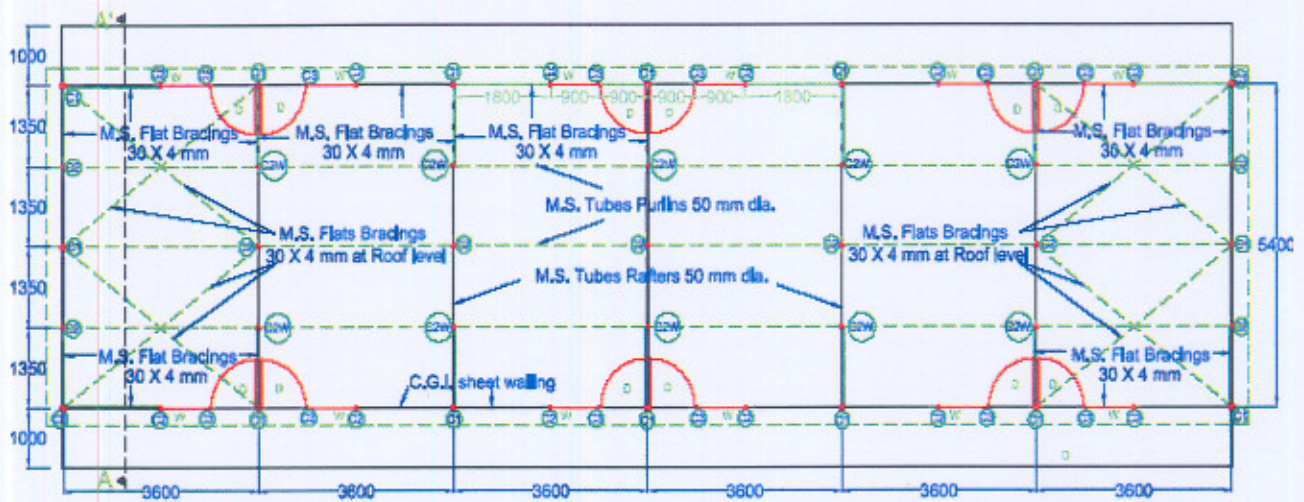
Column C3W:- 80 mm dia. at base Wood Ball or Bamboo  
Column C4W:- 65 mm dia. at base Wood Ball or Bamboo  
Wooden post  
Rafters:-65 mm dia. at middle point Wood Ball or bamboo  
Purlin (kitchen):-80 mm dia. at middle point Wood Ball  
Purlin (toilet):-65 mm dia. at middle point Wood Ball



Section of Four Unit Structures

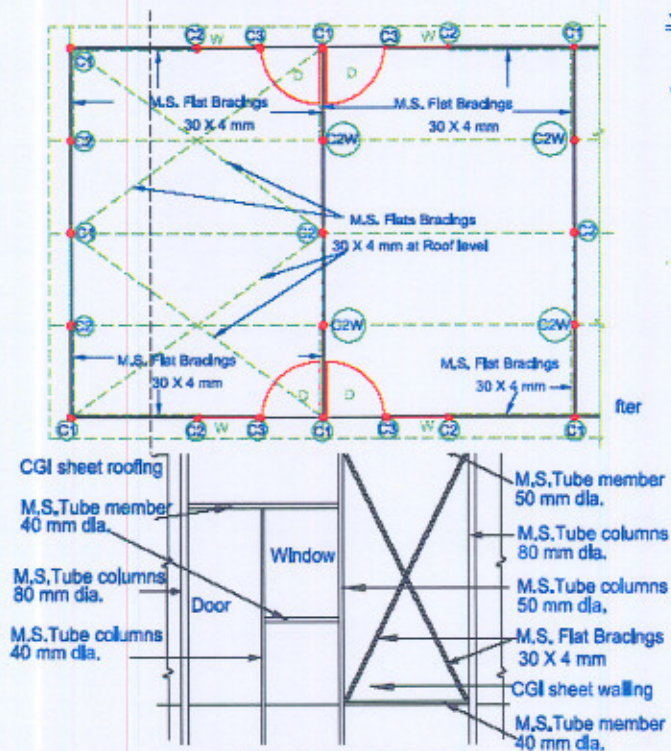
**Option 3: Six Unit Structures** (for non-tribals) with inbuilt kitchen and common toilet facilities

To be constructed at Port Blair, Hut Bay, Campbell Bay

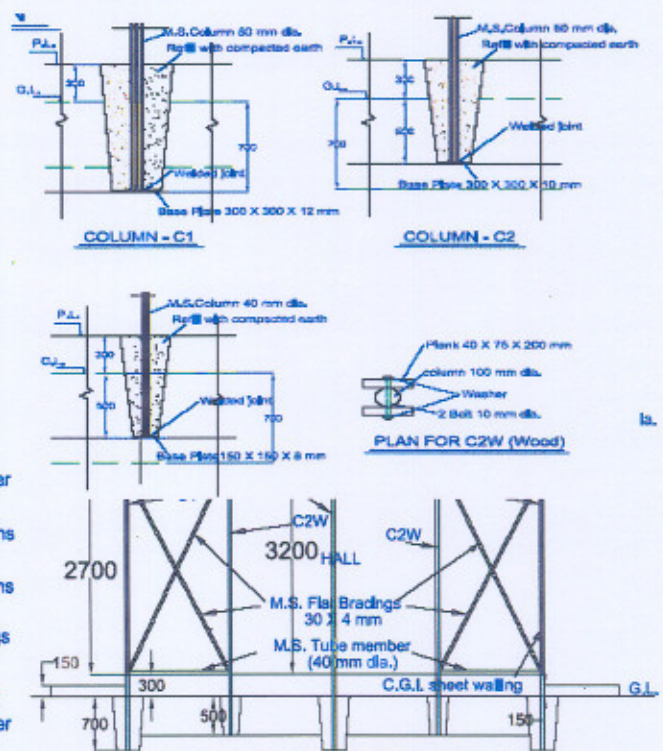


**Enlarged part Plan**

**Column details**

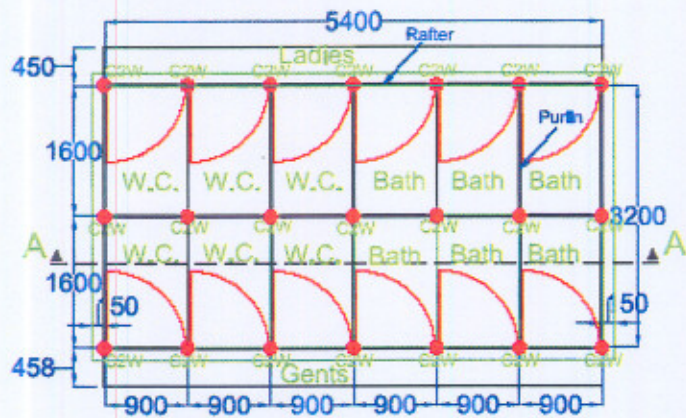


**Part Elevation**



**Section for Six unit Block**

*Towards rebuilding a new Andaman & Nicobar  
...shelter and habitat rehabilitation*



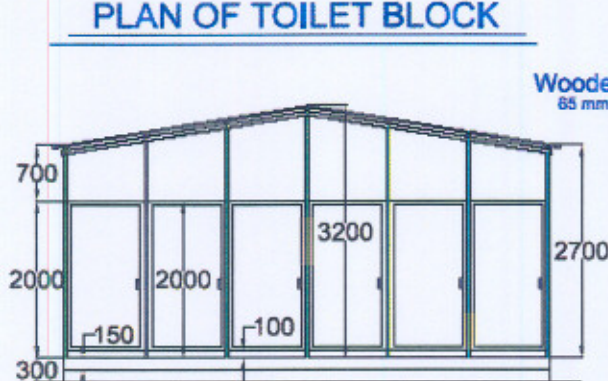
**PLAN OF TOILET BLOCK**

## Elements, Materials & sizes

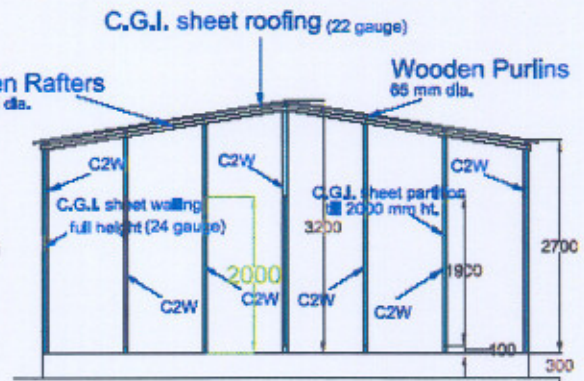
Column C2W:- 80 mm dia. at base wood balli or bamboo wooden post

Rafter & Purlin:- 65 mm dia. at middle point Wood Balli/Bamboo

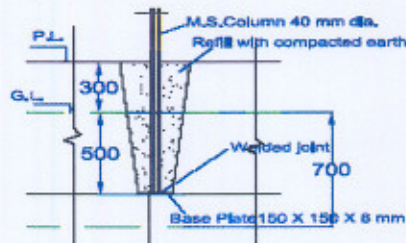
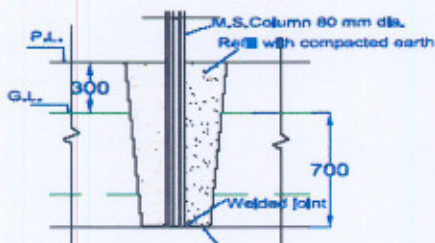
Toilet Blocks for Six Unit Houses



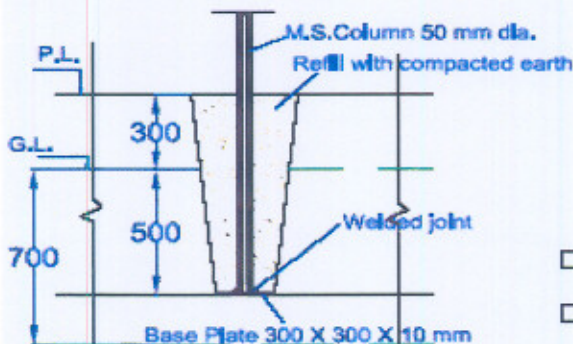
**ELEVATION**



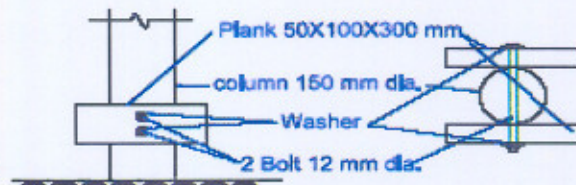
**SECTION AA'**



Construction Details of Columns and Joints

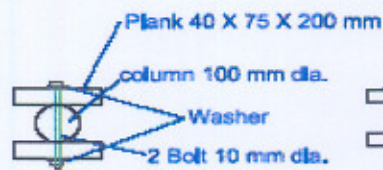


**COLUMN - C2**

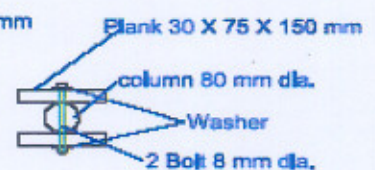


**ELEVATION**

**PLAN FOR C1W**



**PLAN FOR C2W**



**PLAN FOR C3W & C4W**

## Alternate wooden column detail

Towards rebuilding a new Andaman & Nicobar  
...shelter and habitat rehabilitation

## **7.0 Mobilization of Resources:**

In order to expedite construction of intermediate shelters, MHA initiated advance procurement action, so that the material reaches Port Blair & other islands at the earliest possible. The Ministry procured most of the building materials from primary producers and, to the extent possible, the Administration's ships is being used for transporting materials from mainland and inter islands.

### **7.1 Building Materials:**

Based on the drawings & estimates prepared for intermediate shelters, APWD made a request to MHA for procurement of following materials

|                                            |                   |
|--------------------------------------------|-------------------|
| CGI Sheets                                 | - 4500 MT         |
| Bamboo Poles                               | - 900 MT          |
| Salwood Poles                              | - 400 MT          |
| Mild Steel Tubes/Columns                   | - 3437 MT         |
| Non-structural & other miscellaneous items | - 1295 MT         |
| Portland Cement                            | - 1223 MT         |
| Plastic rope for house making tool kits    | - 6000X1000 meter |

### **7.2 Manpower for undertaking construction work**

The construction of intermediate shelters is executed by A & N PWD. Appropriate number of technical teams from CPWD has also been deputed to assist A & N PWD. Apart from this Central Para Military Forces were also made available to the administration for early completion of work.

#### *Plan & Layout preparation:*

Intermediate shelter designs & layouts of each site are jointly prepared by Architects from MHA & APWD.

#### *Fabrication of Steel structures:*

Fabrication contractors were hired and they were asked to setup a fabrication workshop on each island, so as to expedite the availability of fabricated materials to the beneficiaries.

#### *Erection & completion:*

For tribal houses the beneficiaries will construct their own houses for which they will be paid a lump sum amount as per A & N administration's decision. And in non-tribal areas APWD is constructing the houses and wherever NGO's are coming forward for constructing the intermediate shelters they are being provided with land & material.

## **8.0 Preparation of Site/ Village Plans for Intermediate Shelter construction:**

It is understood that before the construction there is an imperative need for developing site/ village plans so that all physical & social infrastructure facilities could be provided in a better manner to the inhabitants and to build a safer habitat.

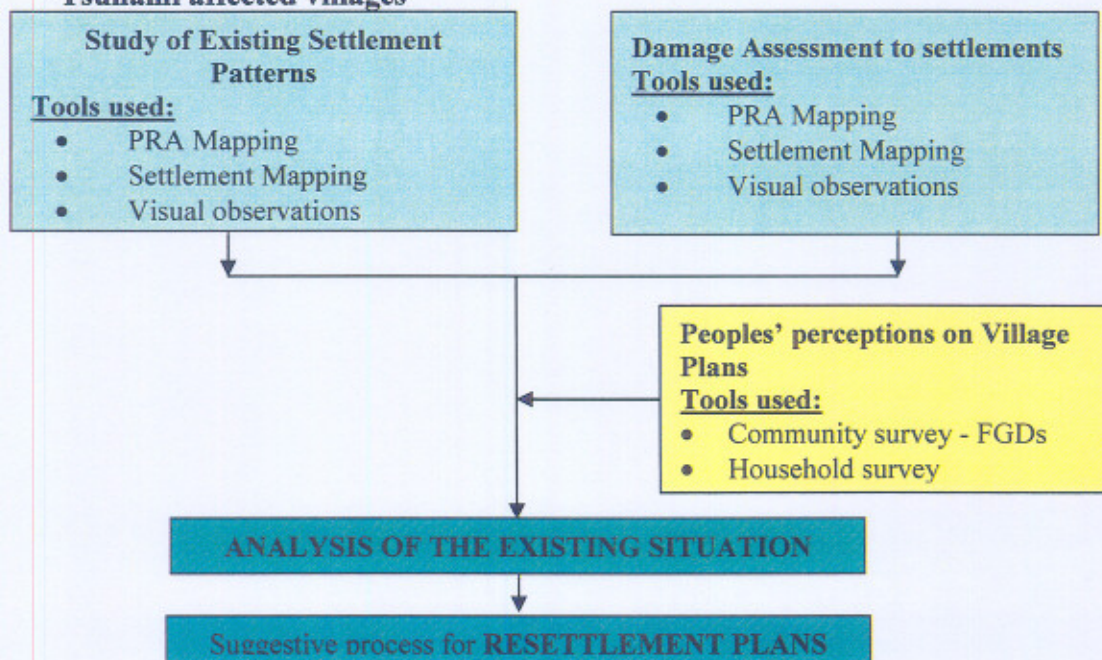
### 8.1 Technical Team from MHA facilitating the work

To expedite the whole process of reconstruction a request was made to MHA for deploying architects/planners to assist APWD for preparation of layout plans of each site in Andaman & Nicobar. Soon after a team of 5 architect/planners was sent to Andaman & Nicobar under the technical guidance of Prof.A.S.Arya, National Seismic Advisor. Prof.Arya was also advised to visit A & N Islands in alternate weeks to assist A & N administration in the task of construction of Intermediate Shelters. After discussion of architects/planners with Mr. Naresh Kumar, Secretary APWD the following tasks were identified;

- To develop integrated Site/ village plans in a participatory manner that are culturally sensitive, respect the way of living of fisher and tribal communities and protect the entire habitats against future natural disasters. The Site plans designed will also integrate water and sanitation measures. Based on the extent of damage to housing and the willingness of some of the communities to resettle, there are two situations arising:
  1. Complete relocation of the entire village and resettlement of the entire community, while ensuring continued access to the coastal areas for fishing and fish processing.
  2. Partial resettlement of the communities whose houses have been washed away or totally collapsed or who are willing to resettle, while things are restored in their old habitats.
- Ensure that the relocated communities have adequate right to economically productive land/ forest. In the case of fishers that they retain right to the land where they have been living on the shore, as workspace for their boats fish processing equipment and nets.

The ultimate goal is that all these vulnerable communities are to be settled in habitats that are designed to be safe and culturally acceptable as well as their livelihood relation with Forests (coconut trees) and sea should be maintained.

### 8.2 Methodology adopted for formulating Site/ Village plans for resettlement of the Tsunami affected villages



### 8.3 Study of existing settlement pattern

#### Location:

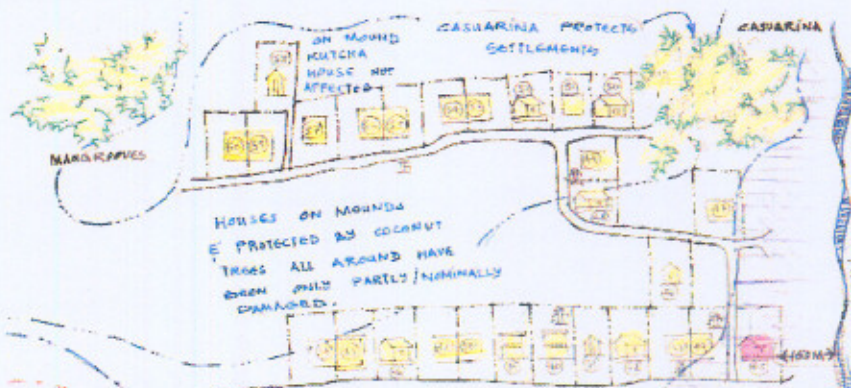
Generally all the rural settlements were located along the coast within 100-200 meters from the shoreline below 10 meters contour and were well connected by sea routes as well as kutcha & pucca roads (wherever constructed by APWD). These areas are mostly covered by thick tropical evergreen rain forest with intermittent coconut & beetle nut groves owned by different villages. The coconut and beetle nut cultivation is the primary occupation of the villagers.

All the villages were located very close to the sea & on relatively flat lands, which have led to complete destruction of all villages due to tsunami preceded by an earthquake measuring 8.9 on Richter scale. It has been observed that in many places the soil along the coast is soft due to coral formation. Most of the buildings, whether made of RCC, load bearing structure and traditional kutcha houses on stilts have been severely damaged. The destruction was caused to villages located between 5m to 10m above mean sea level and up to a distance of 500m to 1000m from the sea.

#### Pattern of the settlement:

The tribal community in the island is well organised and has their own system of governance evolved over the years. Each village has a **village captain** elected through secret ballots. Apart from captain there are 2<sup>nd</sup> & 3<sup>rd</sup> village captains to assist the first captain. All the villagers are also the members of **Tribal Council** headed by a chairman elected from

amongst the village captains who is assisted by an office bearer secretary for 4 years. Each village is like an extended joint family. The village is further divided into **tuhets** located as close as possible. Tuhet is a cluster of houses mainly in a circular fashion, belonging to a nucleus family and the extended (offshoot) families. A girl or boy is provided separate home in Tuhet on marriage. Such married couple live with their children independently with separate kitchen etc., maintaining allegiance with the nucleus family, thus making additional housing unit instead of expanding the house to accommodate the growing family. Grown up children move to stay with head of the tuhet until marriage.



**Kakana village of Car Nicobar, before Tsunami**

#### Community spaces & social infrastructure:

As per the existing social system prevalent among the Nicobari people, each tuhet has one Choukamy (birth house) a rectangular hall of size 7.5m X 10.5m, one Paritkupa (death house) smaller than the birth house of 8.0m X 5.0m. The house of head of tuhet is in the

centre and is the biggest amongst all the houses of the tuhet. Other houses including the birth house & the death house are constructed around the tuhet head's house in a circular fashion.

As a whole, the village generally has one **Elpanam** (community hall), one **worship place** (church) and one **recreation club**. These social infrastructure facilities are generally constructed as per the availability of suitable land. In some interior old settlements it has been observed that the Elpanam & Church are constructed at the center of the settlements.

While planning for the village, existing social system as prevalent among Nicobari people needs to be taken into consideration.

#### **Land and Housing characteristics:**

The traditional way of Nicobari people living in "**Machan Houses**" (houses on stilts upto a height of 1.2m). These houses are generally constructed with bamboo/wooden paneling as per one's liking and affordability. Roofs are thatched (local grass/cane leaf) or with CGI/AC sheets. In typical Nicobari house, floors are made of bamboo, beetle nut strips and country wood frames. The flooring provides good ventilation from bottom thus adding to the comfort.

These dwelling units generally have separate living & sleeping room. The space below the house on stilt, complement the lifestyle of the Nicobari tribal and is very useful area for daily chores during rains. The Nicobaris use the stilt space to keep their domestic animals and birds (pigs & hens). The location of kitchen, bath & toilet (wet areas) are preferred at ground level (one of the reason could be to do away with the need to lift the water to upper level).

The dwelling unit meant for head of Tuhet, it is generally a large house of approximately 90-95 sqm. plinth area as the grown up children are also accommodated in it.

In some villages, one could see a conventional Golghar, a round dome shaped house on stilts containing one big hall only. This structure on stilts is generally at a height of about 1.8m – 2.0m.

#### **Physical Infrastructure:**

In terms of basic facilities, the villages were quite well off in spite of being remote areas. There were primary schools, high schools, senior secondary schools and anganwadi centres. Similarly there were sub centres & primary health centres at each island constructed by Government of India. But 90% of these infrastructure facilities are destroyed in this tsunami as they were constructed close to the sea coast.

#### **8.4 Site/Village Layout Planning & People's perception.**

Village survey & community meetings were conducted to study the morphology and genesis of the Nicobari settlements. The cultural, social, living pattern and livelihood of these people including the relationship with the local environment and its impact on it was also studied and observed.

The villagers were insisting on having their traditional settlement pattern on higher grounds. Because of the topographical conditions (hilly terrain) and the forests as well as the land issues of the tribal people on these islands, there are very few ideal places/land available

for the construction of intermediate shelters. Most of the identified sites have absolutely no connectivity because they are on mountain slopes and in.

Through participatory approach/techniques the villagers were involved in planning and designing of their new intermediate settlements to come up. Based on the community requirements, the site plans are being in consultation with APWD architects & engineers.

## **8.5 Identification of issues and problems**

Present issues arising in the construction of Intermediate Shelters:

The first question for the affected people is, where these people will settle now? The tribals are rendered homeless nothing is left, the villages where they had their beautiful Nicobari huts (square, rectangular and round) have vanished. The survivors have selected new sites away from sea on the higher regions. However it will be not an easy task, because of land ownership issues.

*Issues that are coming up in the construction of Intermediate Shelter;*

1. The surviving families are reluctant on making their houses on other's land. Some or other tribal family owns each square meter of land and nobody is willing to transfer the complete ownership in favor of new entrants. This reality has to be understood while taking a decision for habitation as well as in planning for new settlements as it has a chain of inter-relationship of their living pattern, culture, food habits, livelihood (land based economy) etc. The basic civic facilities like drainage, water supply, sanitation and power/ electricity etc has to be provided in a planned manner.
2. The villagers are insisting for having their traditional settlement pattern on higher altitudes (more inland areas). Because of the topographical conditions (hilly terrain) and the forests as well as the land issues of the tribal people in these Islands, there are very few ideal places/ land available for the construction of intermediate shelters. People are not ready to clear more land for the new settlements because in most places the land from 30 to 50 meters of sea coast is used for coconut and beetle nut plantation and other forest trees, which are the prime source of livelihood for these people. The people want to construct the houses within the forests, without cutting the trees and that to on higher altitudes. In this case it would be very difficult to create planned settlements with all basic physical and social infrastructure facilities.
3. Most of the identified sites have absolutely no connectivity because they are on mountain slopes and in dense forests. Transporting building materials to these places (sites) will be very difficult, the only way is through head-load, which shall require a lot of time and human resource. The inhabitants will also not allow constructing new roads, as it would require cutting down a lot of trees including their coconut and beetle nut plantations.
4. The villagers are insisting for constructing the houses in their traditional style - "Machan houses" (houses on stilts). As most of the sites selected here are mountainous and on slopes, the construction of these Machan Houses would be very difficult as it would require varied sizes of MS steel tubes to be used as posts/ columns.

5. The Tribal villagers use to live in joint families (in one joint family there are 18 to 25 members) and each joint family use to live in a cluster of houses. Here the typical tribal settlement pattern is - segregated cluster of houses and between two clusters normally there is a gap of 20-30 meters. The sites selected for construction of intermediate shelters by the villagers are small patch of lands on mountain slopes where all required dwelling unit construction could not be constructed.
  6. The administration is facing problems in transporting all these heavy building materials mainly because of insufficient out-boats and other required logistics and more over after the Tsunami the sea coast lines have been changed drastically and has become very shallow. Therefore large boats or ships can not be used, the only way of functioning is that, large boats carry the materials and anchor atleast 1.0 - 1.5 km away from the coast and from there smaller boats or local boats "dungis" (smaller boats sufficient only to carry 15 CGI sheets at one time) are being used, which is consuming a lot of time as well as cost. From the coast again these materials has to be transported by head loads to the uphill sites, as there is no vehicular roads.
- > *For these reasons there are ample opportunities of using local materials like coconut trunks those have fallen down in Tsunami and wooden ballis available in the local jungles/ forest. Now for using these local materials the villagers need tools and equipments like axes, woodcutting saw (small and big electric or battery operated so that the work could be done faster).*
- Special attention could be given on locally suitable material and technology (Indigenous Technology).

#### *Constraints:*

1. The locals have expressed strong reservations against bringing construction manpower from the mainland. The construction of permanent dwelling units and other facilities will involve items of work requiring skilled manpower. To depend upon the tribal, who are not proficient in construction activities, may lead to delay in completion.
2. The land in Car Nicobar and near by Islands belong to tribal. There may be resistance from the tribal for making available land on temporary basis to the large construction agencies for setting up their stores and labor huts.
3. The loading & unloading facilities at all these islands need to be upgraded to facilitate berthing of large ships carrying construction materials directly from mainland.