

# **SHELTERING EMERGENCIES: Design development process of temporary housing in post-disaster settlement by community participation**

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## **Abstract**

The growing number of disasters have drawn attention to the need to provide housing for the displaced population. From the field study of flood-affected settlements in the Brahmaputra Valley in India, we realise that there is a need for emergency shelters which are comfortable, durable and affordable by the affected community. This paper discusses the design process of developing an emergency shelter for the displaced people in the post-flood settlements of the Brahmaputra Valley. The morphological records of the Brahmaputra River make it a unique geographical area that gets flooded annually. We carried out an exploratory investigation to analyse the various aspects of shelter development. The built culture of the affected community was documented by a selective study of flood-affected settlements to understand their lifestyle and the socio-cultural environment. Community consultation meeting and activity were planned and carried out to arrive at spatial design brief following the humanitarian standards. We considered an iterative approach to develop a Bamboo Kit Shelter, made with continuous consultation with the community. The full-scale prototype is then provided to a family to understand its ease of assembly and installation. The experience of using the shelter kit gives direction for further modification. We found that the shelter was appropriate for use in the post-flood situation. The community participation at each step of the design process has made it culturally appropriate and socially relevant. Further, explorations to make it transportable and material durability forms part of the findings of the study.

***Keywords: Brahmaputra-Valley, bamboo, disaster, emergency, flood, shelter***

# 1 Introduction

Humanitarian needs are growing at a rapid speed; each year, millions of people are displaced losing their homes during disasters. According to the World Disasters Report 2016, the number of refugees will continue to rise in the coming decade (World Disasters Report, 2016).

Humanitarian shelter aid plays an important role in supporting displaced communities. This paper intends to contribute to the application and development of a better relief and reconstruction process. The focus of this paper is a temporary shelter which is an intermediate shelter in the humanitarian shelter aid process. Multiple actors which include the affected people, community-based organisations, local and central government, NGOs and international agencies and, designers (who may be architects or engineers) and builders contribute to the successful implementation of emergency shelter. Two aspects of the shelter coordination among the several, are particularly crucial to achieving the desired results:

- Carrying out a systematic organisational design and
- Choosing an appropriate procurement strategy at the level of reconstruction.

This paper presents a community-based approach, including the participants in the program and the system of materials and products that were needed for effective recovery operations.

## 2 Organising for reconstruction- a design problem

Organising a reconstruction design project requires a systems approach to establish the mandate required for the project. Questions like who should be considered for participation and on what basis, also who decides the participation. The challenge is to identify the participants and also guide the relationships between the participants. The next thing that needs to be addressed is the type of reconstruction, whether it should be built and if so, where it should be built and how to initiate the project (UNHCR, 2008).

### *Temporary Shelter After Disaster – The type of reconstruction*

A construction project has many participants ranging from professionals to enterprises and artisans from a particular context of the building industry within a given national location. Thus the selected project participants are called a project team which gets together to design and execute the project (Davidson, 2010).

### *Temporary shelter for the Flood-affected people of the Brahmaputra Valley*

The annual flooding of the Brahmaputra Valley displaces over a million people destroying their houses either completely or partially. The displaced people seek shelter in government institutions like schools and other academic institutions. Since the annual flooding takes place during the hottest and humid period of the year, exploration for a design solution for comfortable housing was required over the accommodation provided around government institutions in the form of tarpaulin/plastic sheet tents. From the study of a settlement which got completely eroded during the 2019 Brahmaputra Valley flood in the Chirang District of Assam state in India, it was observed that displaced people were forced to reside in a dilapidated community hall where women would sleep inside the hall at night and men were forced to sleep outside in the open area. The sense of family and privacy were completely overlooked in such accommodation where the displaced people resided for over five months and more till they could build back their homes.



**Figure 1(A-G). Flood affected Area in Chirang District Assam (Source: Assam State Disaster Management Authority Hazard Maps and photographs by Author)**

to understand the built environment of the affected community. An initial shelter prototype was developed with community consultation. The prototype undergoes an iterative process where the user assembly and community involvement were analysed for further recommendations.

### 3 Design Brief Development

From the perspective of humanitarian temporary shelter aid, the design criteria are divided into three main areas:

- Basic human necessities like the essential qualities of home and its spaces, the social environment and functions.
- Settlement requirements set by the aid organisation precisely drainage, arrangement, security, water and sanitation
- Technical requirements regarding standard physical and mechanical properties of the shelter and settlement.

#### 3.1 Sense of Place

The process of housing is the basic aspect of dwelling in traditional cultures. Primitive cultures endowed individuals and households with the knowledge and materials required to coexist with the ecology of the area. The household led to the formation of the “place” of the individual and household in society (Rapoport, 1969). The study of Maslow’s hierarchy of human needs introduces a brief reflection about human needs as a source of motivation in life. A careful shelter design addressed to the creation of a welcoming and familiar environment could facilitate the recovery process of the users through its inhabitation. We find that when individuals are in control of the space, they live in, and have privacy needs met, feelings of comfort and freedom are possible. This freedom permits relaxation and the individual development of the self (Smith, 1994). In this respect, Nobel Laurette Amartya Sen’s capability approach suggests a theoretical method to assess the quality of life and social wellbeing in humanitarian design. Capability approach focuses on people and their capabilities. Since people live in groups, families, neighbourhoods and communities, it is essential to understand the collective capabilities of vulnerable communities (Tonon, 2018). It is necessary while

working with communities to be acquainted with the culture of the settlement. The Co-Design Approach was considered to explore the design of emergency housing in flood-prone areas of the Brahmaputra Valley, India.

**Table1. List of Design Criteria based on the essential qualities of human necessities**

SI No	Design Criteria	Objectives	Source
1	Security	<ul style="list-style-type: none"> <li>• feeling of safety and security</li> <li>• ensuring protection for the inhabitants and their belongings.</li> <li>• Protection from nature and other external anti-social factors.</li> </ul>	(IFRC, 2011)
2	Permanence	<ul style="list-style-type: none"> <li>• experience of continuity that characterises the home environment.</li> <li>• sense of belonging and connection with the place</li> </ul>	(Hayward, 1977)
3	Personalisation	<ul style="list-style-type: none"> <li>• exclusive control and use of the environment</li> <li>• self-expression and scope for customisation</li> </ul>	(Sebba & Churchman, 1986; Pennartz, 1986)
4	Privacy	<ul style="list-style-type: none"> <li>• control of space in dense and crowded environments</li> <li>• sound insulation</li> <li>• internal partitions</li> </ul>	(IFRC, 2011)
5	Social Relationships	<ul style="list-style-type: none"> <li>• relationships with family</li> <li>• community meeting places</li> <li>• shared spaces for cooking, washing, cleaning etc.</li> </ul>	(Smith, 1994)
6	Complexity	<ul style="list-style-type: none"> <li>• visual perception</li> <li>• scope for customised assembly to avoid confusion due to repetition</li> </ul>	(Stamps, 2005)
7	Identity (Form,Color,Light)	<ul style="list-style-type: none"> <li>• perception of physiological, environmental and cultural factors</li> </ul>	(UNHCR, 2011)

### 3.2 Spatial requirements and functions

Space is a major constraint in post-disaster shelter and settlements. A single unit is mostly used to perform multiple activities. Table 2 lists the design criteria which we considered while making the spatial arrangements.

**Table 2. List of Design Criteria based on the spatial requirements and functions**

SI No	Design Criteria	Objectives
1	Sleeping Areas	<ul style="list-style-type: none"> <li>• indoor area with the optimum size for sleeping</li> </ul>
2	Health and Hygiene	<ul style="list-style-type: none"> <li>• one latrine per 20 individuals to be considered</li> </ul>
3	Culinary activities	<ul style="list-style-type: none"> <li>• covered space preferably shared clean and dry</li> </ul>
4	Storage	<ul style="list-style-type: none"> <li>• storage of belongings and other relief materials</li> </ul>
5	Washing and cleaning	<ul style="list-style-type: none"> <li>• externally provided facilities of WASH to be considered</li> </ul>
6	Studying	<ul style="list-style-type: none"> <li>• Community space among shelters one in 100 shelters</li> </ul>
7	Outdoor playing/playing/working/meeting	<ul style="list-style-type: none"> <li>• Semi covered spaces</li> </ul>

### 3.3 Humanitarian standards

The aid agencies have set up some general requirements concluded in several instruction documents during the last ten years. Among the most recognised are *The Sphere Handbook* (SPHERE PROJECT, 2018) first published in 2000 communally by IFRC and several humanitarian NGOs. It includes a specific part on Minimum standards for shelters, settlements and non-food items. Table 3 lists the criteria given by the aid agencies.

**Table 3. List of Design Criteria based on the Humanitarian Standards**

Dimensions	Transport	Cost	Appropriateness	Assembly	Durability and Afterlife
Shelter for 5	Local availability of material	Per family 150 dollars (considered as per the context of Rural Assam)	Culturally and Socially relevant	Preferably made by the user community	Contribute to reconstruction

### 3.4 Structural and Technical requirements

The aid organisations usually set the structural and technical requirements of shelter design, and we considered the following parameters. The engineering calculations are outside the scope of this study. However, we approached to verify with relevant references.

- Load Bearing
- Thermal Comfort
- Water Resistance
- Vector control
- Fire Resistance
- Environmental impact

## 4 Context of domestic architecture of the displaced settlement

The context of this paper is Assam a state in the northeastern part of India. According to Census 2011, Assam has a population of 3, 11, 69,272 and area of 78,433 sq. Km making it the largest state in the northeast. It is prone to natural disasters namely floods, landslide and earthquake being in seismic zone 5 ( a vulnerability index for extremely earthquake-prone Areas in India). The River Brahmaputra is one of the largest rivers in the world which flows through the state. Every year the river Brahmaputra and its tributaries create major destruction of resources by flood and soil erosion. Flood in the region occurs due to a variety of causes such as.

- Heavy Rainfall in short space of time
- Storm
- Aggravation of Riverbed
- Encroachment in the flood plains
- Degradation of the catchment area in the form of deforestation
- Lack of Proper Control of Land use

- Illegal development on wetlands

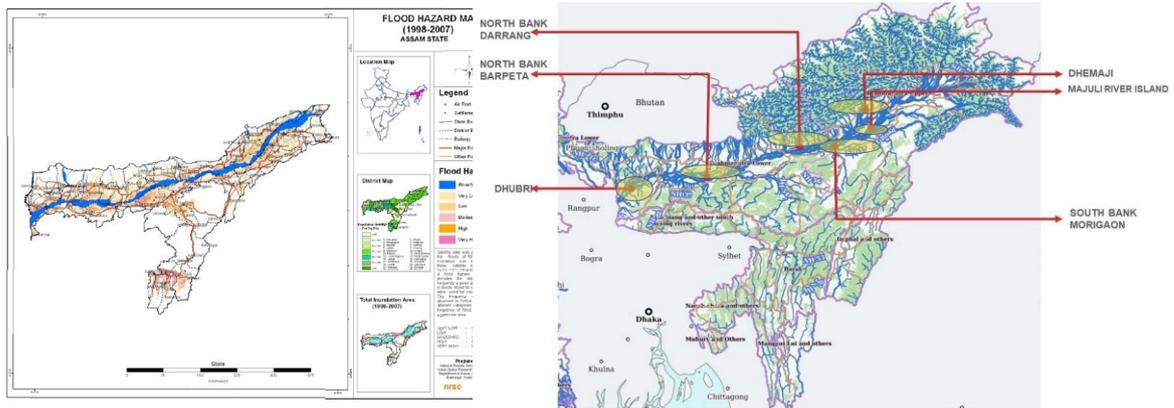


Figure 2 A Flood Hazard Map of Assam (Source: Assam State Disaster Management Authority)

Figure 2B Map showing most vulnerable areas across the State of Assam (Source: Author)

The state of Assam faces serious challenges to settlements, particularly the housing, both urban and rural. According to the flood damage data published by the Assam State Disaster Management Authority, the effects of the flood on damage to people and infrastructure is an annual feature which brings great economic loss to the state. Six hundred villages have got submerged and over 3 lakh people affected in the year 2017 and similar accounts are occurring subsequently. The annual flooding of the River Brahmaputra also provides the fertile siltation at the riverbanks, which supports the mostly agrarian society in the rural areas.

#### 4.1 Rural built typology in the state of Assam

From the Hazard Profile of the State, we realise that the state is highly vulnerable to natural disasters, mostly floods and earthquake. The effects of floods and earthquake especially affect the human dwellings be it residential or of public use. Traditional Rural Housing Typology

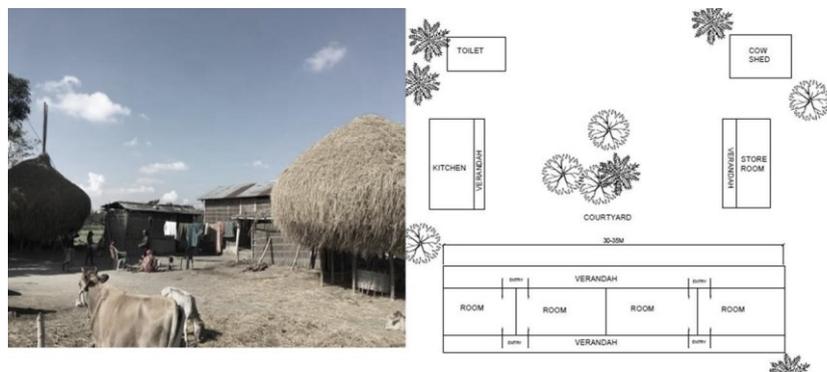


Figure 3 A typical Homestead and a single Line Plan of a Rural Flood Prone Homestead (Source: Author)

As shown in Figure 3 generally consists of a homestead with a cluster of rooms arranged around an open courtyard and surrounded by betel-nut trees, plain tall trees, bamboos and vegetable gardens. A Bamboo fencing surrounds the homestead. The several spaces in the homestead consist of a front yard, the living room as a block with no shared wall, the bedroom, the kitchen block and the shed. A prayer room and a granary and most of the time a tower of hay for the cow shed consists of the spatial features of the homestead. The built elements are mostly constructed using Bamboo or *ikra* a variety of weed wattle and daub technique. Most of the dwellings do not have windows but *jalis* instead as openings. The flooring is often mud and

sometimes plastered with cement. The structural columns in the new houses are made of concrete pillars with bamboo infill walls. Profile corrugated galvanised iron sheets are used for the roofing. We observed from the field study that the flood-prone areas did consider houses on stilts as flood resilient features in some of the rural areas. However, due to the difference in the effect of flood and cultural adaptation houses on stilts are limited to a few tribal areas only.

## 5 Co-Design Process

The co-design process, a form of community participation was carried out to address the post-disaster reconstruction requirement. We carried out a community participation design exercise with representatives from the displaced population. The community shared a need for assistance in designing through a cumulative effort. A process of architectural facilitation was made through an intense method of drawing discussions, prototype and modelling to engage the participants in the design process. We documented the process to develop a methodology for co-design. The act of enabling all members addressing the displaced population: young people and adult, man and women, authority and contractors to enter into the design dialogue is the key that reduces relief situation alienation.



**Figure 4 Community participation in Design development at Chirang (Source: Author)**

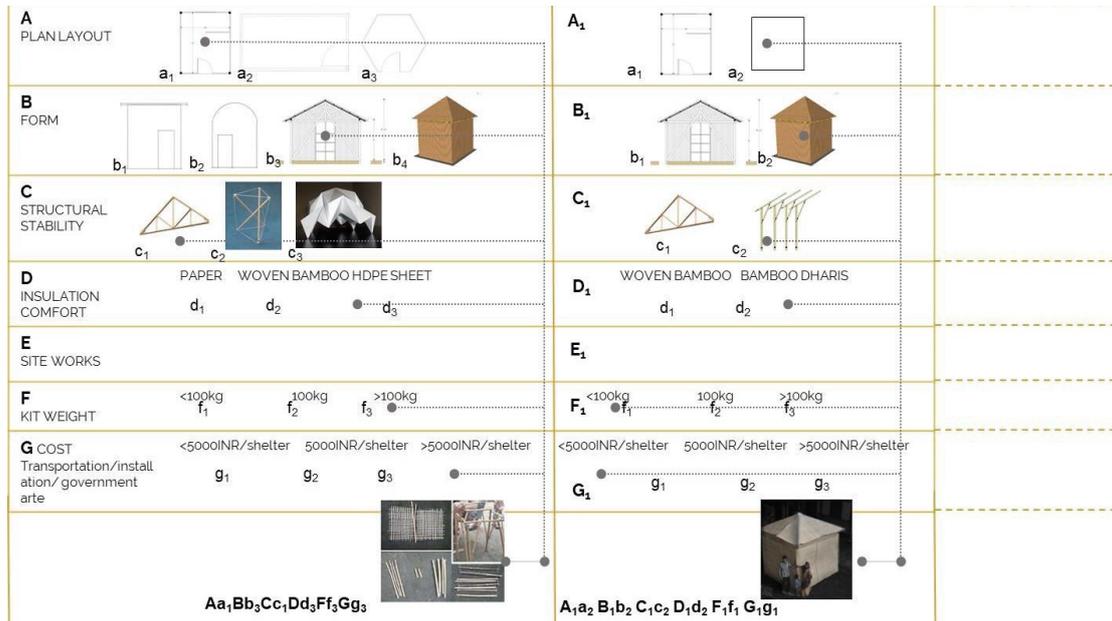
Considering the SPHERE Humanitarian standards, Shelters were designed along with selective members of the affected community which could meet the needs of the community and which could be delivered with the availability of land and other resources.

### Assessment of relocation and resettlement issues

A preliminary assessment of displacement pattern and rehabilitation of a displaced community was made in community consultation. User interview was conducted to understand the effect on the daily lifestyle due to the displacement. A range of possible relocation options was explored in consultation with the community Figure 4 shows the community consultation activity of developing early housing model. The displaced community was homogenous in terms of their cultural and religious belief. Completely agrarian the community was dependant on the fertile soil in the banks of the River Brahmaputra. As an emergency shelter, the entire community of 75 families resided in a community hall of size 180m<sup>2</sup>. The makeshift camp in the community hall lacked the basic human shelter need with the improper spatial distribution. Ventilation, sanitation and lighting were not adequate for the activities of reading and stitching. Women and children occupied the hall space, which impacted the family comfort and mutual support. The community lacked information on shelter rights and humanitarian assistance. From the assessment exercise development of unit shelter in a cluster was explored in consultation over community shelter.

## Developing layout plans

The contemporary DIY, “do it yourself” culture, ethic, process and tips, and its creative incorporation in academic experiences of architectural self-construction seemed to be appropriate in the said context. CASA Collaborative strategies for Adaptable Architecture and AIDA Analysis of Interconnected design area, way of design method was explored to develop several options. Figure 5 shows the process of layout development and suitable design alternatives. One of the layout plans was processed further for prototype development of the temporary shelter kit by user assembly.



**Figure 5** CASA Collaborative strategies for Adaptable Architecture and AIDA Analysis of Interconnected Design Area (Source: Author)

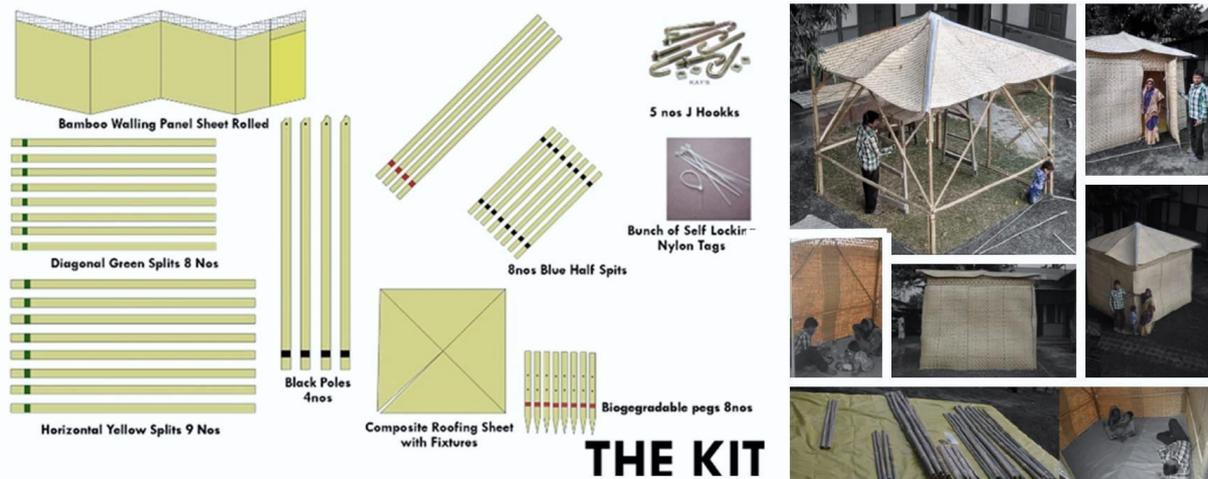
## Design of the Bamboo shelter kit

Bamboo is the traditional building material of Assam. It is used commonly as a construction material due to its rigidity, strength and availability. In a post-disaster specifically to the region affected by the annual floods, the needs of families are not made by tents and tarpaulin. The hot and humid weather following the floods makes it uncomfortable and prone to vector-borne diseases. The cultural and comfort levels of tents and tarpaulin cannot meet the comfort of a bamboo structure. Thus, we decided to develop the structure using bamboo with wall cladding of woven bamboo mats of size 120cmX250cm. Bamboo matting has a porous surface that keeps the structure cool in the hot and humid climate of Assam.

### *The spatial, functional, humanitarian and technical aspect of the shelter kit*

- 9m<sup>2</sup> per unit shelter.
- Maintaining the privacy of the family unit by perforated walling over openings.
- Opening of the shelter into the access pathway.
- Community cooking corner with cleaning facility is considered in the commonplace.
- A shared toilet & washing facilities per every eight units.
- The lowest position of the roof inside the shelter unit considered to be a minimum of 1.8m.

- A compressed roofing layer develops a sandwiched roof with HDPE Sheet and woven bamboo mats for the roofing.
- A 15cm perforated lattice bamboo between the roof & the top of the wall cladding act as ventilation to enable the release of hot air.



**Figure 6 The Bamboo Shelter Kit and its assembly (Source: Author):**

- All residents were involved in setting up the shelter kit.
- User assembly thus giving scope for customisation and sense of ownership.
- The affected community were involved in the process of designing. They had the skills and experience of utilising the local resources and which makes the process fast.

## 6 Discussions and Conclusion

From the findings of the community-led design exercise, we found that the design discussions should be made open to all of those who might be affected in post-disaster displacement. The aspirations that originate within the community are architecturally developed into visions of accord so that they are applicable in post-disaster situations. Further, we iterated the shelter making exercise to develop a Shelter Kit which can be made available for the recurring flood disaster every year across the region.

From the user experience of the said shelter, we realise that the:

- Shelter meets the structural stability as desired by the user.
- Users responded positively to comfort in the shelter.
- We were able to meet the financial cost requirement.
- The minimum humanitarian standards have been met.
- Users feel secure, and there is a sense of home due to the use of bamboo as a material.
- Assembly time of the Kit is 1 HR. 15 MNTS by four people
- Weight of each shelter Kit is an average of 75 to 80 kg.
- 10 shelters per 3 Wheeler Van can be delivered
- There is an abundance of local resources precisely bamboo to deliver the required quantities

The field of post-disaster housing is very multi-disciplinary uniting the principles of social, environmental and technological sustainability together with economics, logistics and politics. From the study, we realise that working with the community is an effective approach in the affected areas where victims are often seen to long for assistance externally. In a developing

country with limited resources at our end, we must try to work with the existing resource and address its shortcomings. In the developed shelter kit, the use of bamboo was encouraged for it being a low carbon footprint product, socially relevant and economical to the context. However, the concern of termite infestation due to non-treatment of bamboo, ecological harvesting of bamboo followed by the waterproofing of the walls gives scope for further research of exploring the material and learning the traditional treatment practices which can not only contribute to the longevity of the shelter kit but also give an aesthetic visual character due to the stains of the use of plant-based insecticides.

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