



# **NATIONAL GUIDELINES ON TEMPORARY SHELTERS FOR DISASTER - AFFECTED FAMILIES**

**September 2019**



**NATIONAL DISASTER MANAGEMENT AUTHORITY  
MINISTRY OF HOME AFFAIRS  
GOVERNMENT OF INDIA**



# National Guidelines on Temporary Shelters for Disaster - Affected Families

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### **A publication of:**

National Disaster Management Authority  
Ministry of Home Affairs  
Government of India  
NDMA Bhawan  
A-1, Safdarjung Enclave  
New Delhi – 110 029

September, 2019

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Ministry of Home Affairs  
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सत्यमेव जयते

प्रधान मंत्री  
Prime Minister

**MESSAGE**

Natural disasters often leave behind damage and destruction of life and property. In the aftermath of such disasters, people seek refuge in temporary shelters for affected families.

It is satisfying to see that the National Disaster Management Authority (NDMA) is drawing up National Guidelines on temporary shelters for families affected, or displaced in the wake of natural disasters. These Guidelines have been prepared after consultations with various stakeholders including national and international organisations.

The National Guidelines will go a long way in providing succour to people and communities adversely affected by disasters.

Best wishes to NDMA for coming out with the National Guidelines on temporary shelters.

(Narendra Modi)

New Delhi

श्रावण 29, शक संवत् 1941

20<sup>th</sup> August, 2019





अमित शाह  
AMIT SHAH



गृह मंत्री  
भारत  
HOME MINISTER  
INDIA

## संदेश

वर्तमान समय में विश्व में प्रतिवर्ष आपदाओं की संख्या और उनकी क्षमता में लगातार वृद्धि हो रही है। इन आपदाओं से प्रभावित व्यक्तियों तथा क्षतिग्रस्त होने वाले भवनों की संख्या भी बढ़ रही है। आपदाओं के उपरान्त आपदा पीड़ितों को लम्बे समय तक अस्थायी आश्रय केन्द्रों में रहने के लिए मजबूर होना पड़ता है। इससे प्रभावित समुदायों तथा सरकार, दोनों के सामने जटिल समस्याएँ और चुनौतियाँ आती हैं।

मुझे यह जानकर हार्दिक प्रसन्नता हो रही है कि राष्ट्रीय आपदा प्रबंधन प्राधिकरण ने आपदा-प्रभावितों के लिए आवश्यक अस्थायी आश्रय केन्द्रों का निर्माण तथा आबंटन करते समय सामाजिक पहलुओं को सुनिश्चित करने हेतु दिशा-निर्देशों में तकनीकी और मानवीय पहलुओं पर बल दिया है।

मुझे विश्वास है कि सभी हितधारक व्यापक रूप से इन दिशानिर्देशों का संदर्भ लेंगे ताकि किसी आपदा के बाद शीघ्रतिशीघ्र आपदा पीड़ित लोगों की आजीविका की पुनर्बहाली की जा सके।

मैं, एन.डी.एम.ए. को इन दिशा-निर्देशों को तैयार करने तथा अन्य प्रभावी प्रयासों के लिए, अपनी शुभकामनाएँ देता हूँ।

शुभकामनाओं सहित !

(अमित शाह)





राष्ट्रीय आपदा प्रबंधन प्राधिकरण  
National Disaster Management Authority  
भारत सरकार  
Government of India

## Foreword

The frequency and intensity of disasters is increasing across the world. For a rapidly developing country like India, this translates into a significant impact on the built environment - many houses are either damaged or destroyed. This means that many of our people have to abandon their houses after a disaster. Giving the affected communities a place to stay with dignity until they can move back to permanent houses, is the most fundamental step to give them some sense of normalcy. Depending upon the level of disaster, their stay at temporary shelters may be long and uncertain. Therefore, their designs should be cost-effective, sturdy and take into account the needs of the people. Such temporary shelters ensure the safety of affected communities and also help prevent secondary events such as the spread of diseases. This has to be done both swiftly and efficiently.

To help States in doing so, National Disaster Management Authority, within its mandate of preparing guidelines to address different aspects of disaster risk management, has prepared these guidelines.

These guidelines not only focus on the immediate short-term needs but also on long-term housing and habitat recovery. It draws upon national and international experiences, lessons learnt from field engagements and feedback from relevant stakeholders to articulate guiding principles, implementation arrangements, and roles and responsibilities of all stakeholders. However, these guidelines can seamlessly be adapted to meet varied local needs, both rural and urban, across the country.

We are glad that these guidelines prioritise social inclusion with particular attention to gender and disability. It also proposes use of materials and technologies that promote self-help and empowers local communities by involving them in the process.

We hope that these guidelines will prove to be a milestone towards our efforts to strengthen the capacity of various stakeholders to incorporate planning and delivering adequate and efficient temporary shelters in their holistic disaster planning.

**Kamal Kishore**  
Member, NDMA

**Dr. D. N. Sharma**  
Member, NDMA

**Lt. Gen. N C Marwah (Retd)**  
Member, NDMA

**G V V Sarma, IAS**  
Member Secretary, NDMA



## ACKNOWLEDGEMENTS

One of the most important and immediate requirements after a disaster is to provide affected communities with temporary shelters so that they can live with dignity and work towards resuming their normal lives. These guidelines effectively address all relevant technical and social issues so that temporary shelters meet the needs of the disaster-affected households.

The preparation of these guidelines involved an extensive process of consultations, review and finalisation. Members of the Expert Committee, chaired by Shri Kamal Kishore, Member, NDMA, provided guidance and continuously reviewed the progress of the preparation of these guidelines. Shri G. V. V. Sarma, Member Secretary, NDMA; Lt. Gen. N. C. Marwah (Retd.) and Dr. D. N. Sharma, Members, NDMA, and Dr. Pradeep Kumar, the then Secretary in-charge, NDMA, provided valuable inputs and encouragement to ensure the timely completion of these guidelines. We gratefully acknowledge their contribution.

We would also like to place on record the significant contributions made by the Ministry of Home Affairs and Ministry of Housing and Urban Affairs.

Dr. V Thirupugazh, Head of Policy and Planning Division, NDMA, was instrumental in preparation of these guidelines. He conceptualised, provided critical inputs and guided the entire process that led to the finalisation of these guidelines. Shri Nawal Prakash (Senior Research Officer, NDMA) collaborated with various institutions and individuals, and coordinated all inputs. Shri Anuj Tiwari and Shri Mahendra Meena, Sr. Consultants, NDMA also provided technical support in preparing the Guidelines.

Dr. C. V. R. Murty (IIT Madras, Chennai) and Dr. Janki Andharia (TISS, Mumbai) used their vast experience in the field of post-disaster reconstruction and recovery to advice on the framework of these guidelines. We would also like to thank the drafting team, including Shri Vivek Rawal, Shri Rushank Mehta, Ms. Annie George, Ms. Shweta Sundar and Ms. Hiranya Kallakuri, which was coordinated by People in Centre Consulting, Ahmedabad.

State Disaster Management Authorities from Assam, Gujarat, Odisha, Tamil Nadu, and Uttarakhand shared timely feedback and inputs based on their experiences of post-disaster construction of temporary shelters.



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## LIST OF ABBREVIATIONS

|        |  |
|--------|--|
| ATI    | Administrative Training Institute                      |
| BCD    | Building Construction Department                       |
| CBRN   | Chemical, Biological, Radiological and Nuclear         |
| CGI    | Corrugated Galvanised Iron                             |
| CoR    | Commissioner of Relief                                 |
| CSO    | Civil Society Organisation                             |
| CSR    | Corporate Social Responsibility                        |
| DDMA   | District Disaster Management Authority                 |
| EcoSan | Ecological Sanitation                                  |
| ERC    | Emergency Response Centers                             |
| HRVCA  | Hazard, Risk, Vulnerability and Capacity Assessment    |
| IEC    | Information Education Communication                    |
| IIT    | Indian Institute of Technology                         |
| IRT    | Incident Response Team                                 |
| ISI    | Indian Standard Institute                              |
| MCR    | Micro Concrete Roofing                                 |
| MDF    | Medium-Density Fibreboard                              |
| MHA    | Ministry of Home Affairs                               |
| MNREGA | Mahatma Gandhi National Rural Employment Guarantee Act |
| MoEFCC | Ministry of Environment, Forest and Climate Change     |
| MoHFW  | Ministry of Health and Family Welfare                  |
| MoHUA  | Ministry of Housing and Urban Affairs                  |
| MoRD   | Ministry of Rural Development                          |
| MoU    | Memorandum of Understanding                            |
| NDMA   | National Disaster Management Authority                 |
| NDMP   | National Disaster Management Plan                      |
| NDRF   | National Disaster Response Fund                        |
| NIDM   | National Institute of Disaster Management              |
| NFI    | Non-Food Items   |
| NGO    | Non-Governmental Organisation                          |
| PDS    | Public Distribution System                             |
| PHED   | Public Health Engineering Department                   |
| PRI    | Panchayati Raj Institution                             |
| PSU    | Public Sector Undertakings                             |
| PWD    | Public Works Department                                |
| RC     | Reinforced Concrete                                    |
| RD     | Rural Development                                      |
| SC/ST  | Scheduled Castes and Scheduled Tribes                  |
| SDMA   | State Disaster Management Authority                    |

|      |  |
|------|--|
| SDRF | State Disaster Response Fund           |
| SECC | Socio Economic and Caste Census        |
| SIDM | State Institute of Disaster Management |
| SIRD | State institute of Rural Development   |
| TISS | Tata Institute of Social Sciences      |
| UDD  | Urban Development Department           |
| UT   | Union Territory                        |
| WASH | Water, Sanitation and Hygiene          |

## Section 1

# NATIONAL GUIDELINES FOR TEMPORARY SHELTERS FOR DISASTER AFFECTED FAMILIES

## INTRODUCTION

India is vulnerable, in varying degrees, to a large number of disasters. More than 58.6% of the landmass is prone to earthquakes of moderate to very high intensity; over 40 million hectares (12%) of its land is prone to floods and river erosion; close to 5,700 km, out of the 7,516 km long coastline is prone to cyclones and tsunamis; 68% of its cultivable area is vulnerable to droughts; and, its hilly areas are at risk from landslides and avalanches. Moreover, there are also risks due to Chemical, Biological, Radiological and Nuclear (CBRN) hazards and other man-made disasters. Disaster risks can be further compounded by vulnerabilities related to changing demographics, poor socio-economic conditions, unplanned urbanization, haphazard construction within high risk zones, environmental degradation and poor management of natural resources, climate change, epidemics and pandemics. The disaster situation many a time leads to wide scale loss of human habitat and shelters resulting in depriving the communities of privacy, dignity, safety and exposing to vagaries of elements like rain, temperature, wind, etc. Post disaster reconstruction and recovery is complex and entails many challenges for the affected communities as well the government.

## Objectives, Scope and Intended Audience

National Disaster Management Authority (NDMA) has put together this '**National Guidelines on Temporary Shelters for the Disaster-Affected Families**' that can assist states in managing post disaster shelter needs effectively. Drawing upon wide-ranging expertise from civil society organizations, government departments and international institutions, these guidelines attempt to bring together learning from field engagement over past many decades and aims to provide guidance on how to address the housing needs of the disaster affected households for short term and support them on the path of long-term housing and habitat recovery. The guidelines can be adapted and used in various contexts within India. Decisions-makers and stakeholders in all states can make use of the guidelines to design and implement intermediate shelters. The specific objectives of the document are to:

- Provide guidance to states to develop a systematic intermediate shelter response programme, in accordance with the needs after any disaster.
- Guide the planning and implementation of people centred response for the intermediate shelters by providing principles and standards for the design, construction and technology options.
- Define implementation arrangements with roles and responsibilities.
- Suggest ways to manage common challenges that may be encountered during this phase of housing recovery.

These guidelines are intended to help primarily:

- **Government Officials** from various disaster management authorities, other state and district officials from various relevant government departments,
- **Technical professionals**, including engineers, architects and planners working in housing related agencies.

- **Civil Society Organisations (CSOs), Non-Governmental Organisations (NGOs) and Private Sector** involved in humanitarian and shelter response after disasters.

The Guidelines are based on understanding that intermediate shelters are important not only for more effective planning of permanent housing but are critical for early recovery of daily livelihoods of the affected families and recovery of their socio-cultural life. When effectively facilitated, intermediate transitional shelters can set direction for long-term housing recovery. This document articulates guiding principles, implementation arrangements, roles and responsibilities, both rural and urban context. It looks into ways to ensure social inclusion with particular attention to gender and disability. Moreover, these guidelines provide standards and perspective on materials and technology, but not a design to copy or imitate. These guidelines focus more on the steps and strategies for intermediate transitional shelters within the early recovery framework.

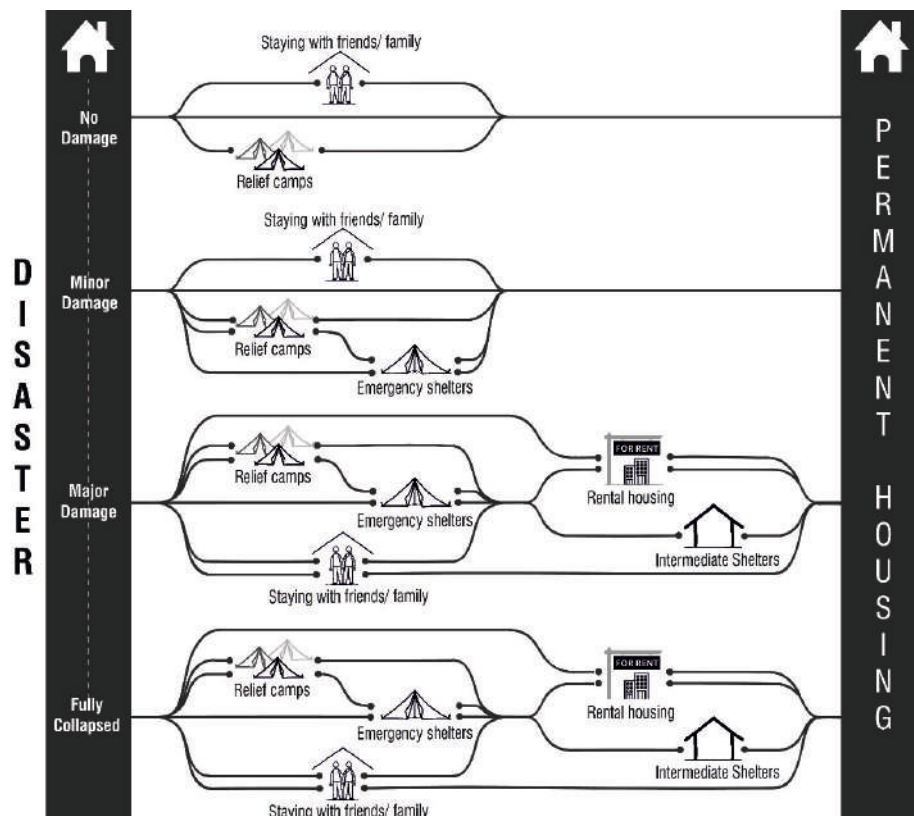
These Guidelines are for use in post-disaster situations. However, these also include preparedness necessary during normal times for successful post disaster implementation of intermediate shelters. Beginning within the humanitarian phase, response typically moves into early recovery phase. Early Recovery typically takes place within three to eighteen months after the disaster event. It includes activities such as clearing debris, restoration of basic community infrastructure, shift from emergency makeshift shelters or relief camps to intermediate shelters and early livelihood recovery. Therefore, the guidelines are also meant for use in the context of normal time pre-disaster contexts to anticipate the post disaster shelter needs, and guide on capacities required for facilitating intermediate shelters during early recovery phase.

## Section 2

### TEMPORARY SHELTERS IN EARLY RECOVERY PHASE

The term ‘**temporary shelters**’ is commonly used in a broad sense to denote shelters built immediately after a disaster to meet needs of shelter before permanent houses are rebuilt. As the concept of durability is associated with ‘permanent shelters’, temporary shelters are assumed to be the opposite i.e. which need not last long. ‘**Transitional shelters**’ is another terminology that is very common and again indicates the provisional nature of the shelters. This notion of being non-durable and provisional tends to be interpreted as shelters of lower specifications and poor quality. As a result these temporary shelters end up deteriorating to inhabitable conditions in a very short time, much before permanent shelters can be built. Therefore, it is absolutely necessary to tackle this perception upfront in these guidelines and ensure ‘temporary shelters’ are of adequate quality to provide for the needs of families till their permanent housing is restored or reconstructed.

Drawing upon past international and national experiences and lessons learnt, we can identify two incremental shelter types as an effective practice for temporary shelter response during early recovery phase prior to permanent shelter reconstruction. It starts with an immediate shelter response termed as ‘**emergency shelters**’ to address short-term urgent need of protection after a disaster. The next increment comes in the form of ‘**intermediate shelters**’, which involves addressing and fulfilling needs for the mid-term duration until permanent houses are rebuilt. We classify both these types of shelters as ‘**Temporary Shelters**’, explained further in this document. Qualifying with the above perspective, the term ‘Temporary Shelters’ is continued to be used in this document for reasons of consistency with the National Disaster Response Fund & State Disaster Response Fund (NDRF/SDRF) guidelines and the National Disaster Management Plan (NDMP).



*Different shelter options that people adopt in the process of rebuilding their homes*

After a disaster, people pass through different routes and stages towards rebuilding of their homes from the time disaster strikes depending on their situation, needs, capacities and support available. These may include moving to homes of friends and family, relief camps, building emergency makeshift shelters and intermediate shelters, or finding some accommodation on rent before permanent houses are reconstructed. The graphic on previous page presents all these myriad ways through which people may traverse during process of housing reconstruction and recovery. The above understanding indicates that housing recovery and reconstruction is essentially a socio-economic process. Choices on the path of recovery made by the house owners depend upon their socio-economic conditions and it is these that determine how effective the recovery would be. In other words, there is also a risk that many vulnerable households may get stuck in any of these intermediary stages and may not reach the stage of permanent housing. This risk needs to be mitigated through effective facilitation of temporary shelters.

### **Emergency Shelters – Short-term Temporary Shelters**

Emergency shelters are made with an objective of immediate protection of life from the elements like sun, wind, rain or snow and to ensure a necessary degree of privacy. Many a times, the process of emergency shelters starts spontaneously as a self-protection measure by the affected households before any sort of help may arrive and are only a makeshift arrangement for dire need of shelter immediately after the disaster. This is usually done on their own or with support from within the community and their own social networks. The Government normally sets up relief camps during such emergency situations using existing community and public buildings and infrastructure and may also undertake distribution of cash or shelter materials like plastic sheeting, tarpaulins, etc. to support immediate sheltering.

### **Intermediate Shelters – Mid-term Temporary Shelters**

Once immediate exigencies of the hazard event are over, basic conditions of safety are somewhat restored and families, to an extent, have regained some control of their disturbed lives, emergency makeshift shelters are not found to be adequate. The affected community needs to move to durable intermediate shelters where a reasonable duration of time can be spent before permanent houses can be constructed. This indicates need of shelters which though not permanent but have greater extent of stability, robustness and comfort. Permanent housing reconstruction often takes 2-3 years so as to effectively address aspects of eligibility, habitat planning, land rights, resources and technical norms. While housing reconstruction policy and programme are being implemented, intermediate shelters play a significant role for affected people by offering space to reorganise their lives and revive livelihoods.

As intermediate shelters are for medium term duration till the affected community can settle in their permanent residences, they require significant support from government to facilitate essential services so that the affected community can return to normalcy at the earliest. Past disasters stand to show that this phase lasts normally from two to three years. Thus, it is important to recognise this distinction between the requirements and duration of use of short-term temporary emergency and mid-term temporary intermediate shelters and thus needing appropriate type of shelters.

## Section 3

### GUIDING PRINCIPLES FOR TEMPORARY SHELTERS

Following principles are the foundation for these guidelines on ‘temporary shelters – emergency and intermediate’:

1. **Support for recovery from a disaster is an entitlement of the affected people.** Affected people are entitled to non-discriminatory, equitable, inclusive and respectful access to support from the state and other public agencies for housing including temporary shelters. An entitlement perspective of recovery support automatically implies accountability and transparency by all the stakeholders including homeowners, communities, other agencies including NGOs and donors, and the Government.
2. **Affected people should not be treated as hapless passive recipients of relief but as resourceful agency.** Housing, particularly, is a people-led process. But after a disaster when people are in shock, they are generally seen as victims and control over the process of shelter construction is taken away by external agencies in name of quick delivery. Instead, we need a process to reassure, enable and strengthen peoples’ own capacities and initiatives. They are extremely resourceful with a lot of experience, knowledge, wisdom, skills and resources. Furthermore, engagement of the affected community in construction of their own shelters is therapeutic, with a timely facilitation helping in overcoming the trauma due to loss.
3. **The most vulnerable community members tend to be invisible or at the margins and unable to access support. Therefore, targeted attention should ensure their inclusion. No one should be left behind.** In the immediate aftermath of the disaster, the affected families may suffer many hardships and therefore, face issues of distress conditions, mental trauma, gender-based violence, caste conflicts, social discrimination, increased debt, etc. while trying to reconstruct their houses. Vulnerable people such as single women, old aged, physically challenged, terminally ill, illiterate, extremely poor, minorities and SC/STs, etc. may require additional support and facilitation to recover like others. The facilitation process must ensure shelter reconstruction to be inclusive with fairness, sensitivity and respect for social and cultural diversity, and be non-discriminatory in provision of assistance and support.
4. **Temporary shelters should be disaster resistant and not cause any further injury or loss of life.** During humanitarian and early recovery phase, it is likely that risk from natural hazards may not have fully subsided. It is, therefore, important that affected community is safe not only from the elements of nature but from any further impacts of subsequent or future hazards.
5. **Use of materials and technologies that involve self-help should be encouraged. This also includes building materials and components that can be retrieved, salvaged, recycled and reused from rubble or damaged houses.** Enabling and strengthening people centred process of recovery essentially requires including their own local materials and skills. This makes shelter construction not only quicker and cost-effective but also that can be supported by local artisans and possible to be maintained by the owners themselves.
6. **One design doesn’t fit all. A bouquet of design and technology options is necessary to ensure that people can have a shelter that’s appropriate for their needs.** People have different needs, preferences, constraints and conditions. If there is a particular design or technology imposed without any choices, not everyone may be able to build shelters with desired quality and safety features. It is important that many options of design materials and technology are available to people to choose from and they make their informed choice.

- 7. Temporary shelters should be durable at least until permanent house is reconstructed.** Depending on the scale of disaster, reconstruction of disaster resistant permanent housing may take time. Immediate needs are of short-term emergency shelters for safety and protection from the elements. In small scale disasters, it may be possible to repair and retrofit the damaged house. However, in case of large scale disasters, the shelter needs soon change from short-term emergency shelters to more durable mid-term intermediate shelters that can provide greater level of privacy, safety and setting for livelihood recovery until permanent houses are built.
- 8. Socio-technical facilitation of shelter process is not just a matter of certain tools and techniques but requires a mind-set and perspective of enabling the community.** Facilitators – social or technical – should work with attitude of serving entitlement of people and enabling them to make their own decisions on sound and rational basis, establish mechanisms to support their access to materials, skills, land, finance and knowledge. If process is facilitated well, it makes community to take up the responsibility and ownership of their disaster resistant intermediate shelters, making it stepping stone for permanent housing reconstruction.
- 9. If collective community efforts are facilitated well and in a timely manner, early recovery shelter process can become an active precursor to effective owner-driven housing reconstruction program later.** In the immediate aftermath of a disaster, collective synergy amongst the affected communities is high which, if not used positively for recovery, dissipates quickly. Therefore, it is necessary that the shelter process promotes and involves self-help and community support.



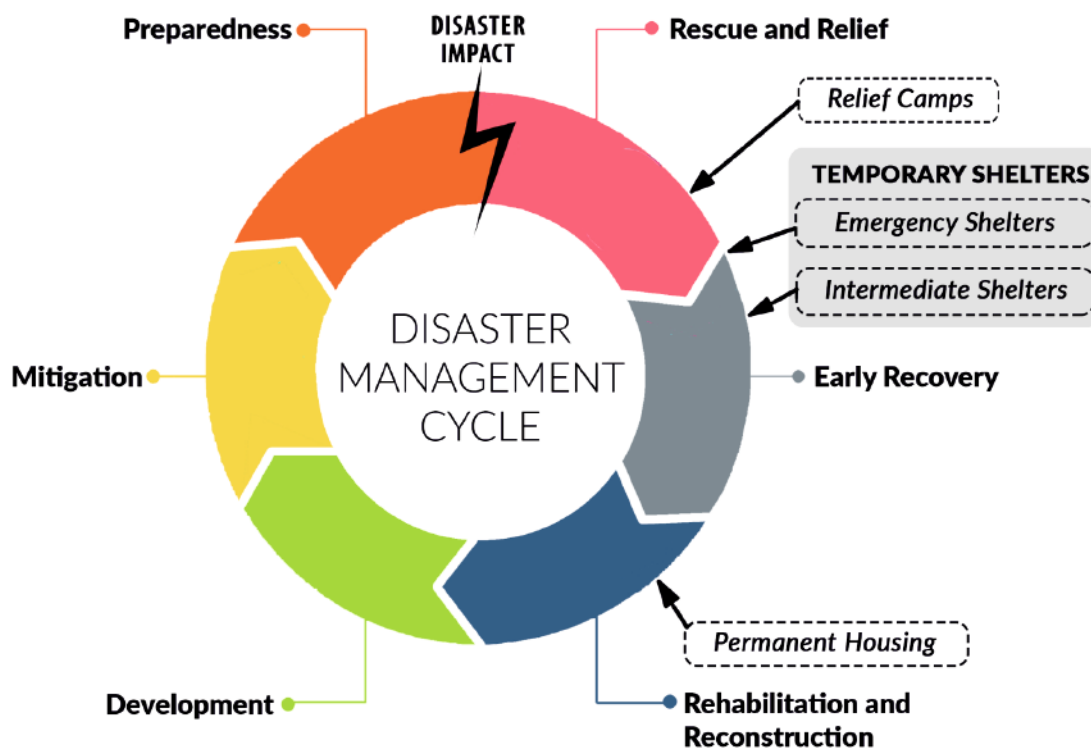
## Section 4

### APPROACH TO FACILITATING TEMPORARY SHELTERS

Foremost, the type and scale of a disaster - its extent of impact – should determine the approach to shelter recovery. For low-impact disasters, it may be possible to move back to their own permanent housing from relief camps without any need of temporary shelters. However, higher impact disasters need intensive planning to address socio-economic and technical complexities involved in reconstruction, mobilize adequate resources, include all the marginalised and vulnerable households for effective and adequate shelter recovery, and include a temporary shelter phase before permanent housing. In such scenarios, for effective facilitation of temporary shelters - emergency and intermediate, following considerations are important:

#### Continuously Evolving Shelter Needs

Shelter reconstruction and recovery needs to evolve continuously, beginning with emergency makeshift shelters to intermediate shelters in early recovery phase and finally permanent housing in rehabilitation and reconstruction phase.



In small disasters, affected community may quickly move from relief camps or temporary emergency shelters to permanent housing, requiring small repairs and retrofitting as per need. However, in case of major disasters, there is likely to be transition from relief camps and short-term emergency makeshift shelters to mid-term intermediate shelters. In such cases, the need for provision of basic services and civic infrastructure becomes more pronounced. The shelter response in most disasters may begin with relief camps for which NDMA has prepared separate detailed guidelines. Here it is important to note that it's essential to ensure that relief camps do not continue unduly long, as they fail to cater to continuously changing shelter needs. Long-time use of schools as relief camps may

affect education of children. Educational needs such as textbooks, stationery, etc. should be fulfilled to enable children start their school. Though, such needs are not focus of these guidelines. Important point to understand is that needs change with time after disaster as communities try to recover. Timely transition from relief camps to temporary emergency shelters and then to intermediate temporary shelters is much needed. The exact transition needs of rural and urban areas may differ due to different population densities, economic activities, socio-cultural networks, land constraints and environmental settings.

### **Enabling the Affected Community to Lead Their Own Shelter Recovery**

Intermediate shelters are an active precursor to long-term housing recovery and set forth the perspective, expectations and processes for permanent house reconstruction. After any disaster, it is understandable to have pressure to deliver shelters quickly. However, there are multiple issues that can arise with hasty construction of temporary shelters such as wrong identification of households, poor site selection, inappropriate choice of shelter designs, materials and construction technology, inflated costs, lack of community participation or ownership leading to dissatisfaction amongst families, and missing out on an opportunity to allow the families to recover through their own rebuilding process.

In past disasters, different states have adopted a variety of approaches towards providing shelters for mid-term needs. This provides us with a wide range of experiences, and hence the possibility to learn. In order to promote swift and effective post-disaster housing recovery, various approaches have been attempted worldwide as well as in India, including those that are contractor-driven, participatory agency-driven and community or owner-driven. These varied experiences of temporary shelters construction include relocation or in-situ construction, use of different designs and construction materials, and various methodologies of implementation. Over a period of time, our understanding of shelter reconstruction and recovery has made a paradigm shift from a donor-led relief approach to community-led entitlement approach with proactive facilitation by the State. Many experiences from past such as Marathwada earthquake (1991), Gujarat earthquake (2001), Kashmir earthquake (2005), Bihar Kosi floods (2008) and Uttarakhand flash floods (2013) emphasize the centrality of peoples' role. These experiences demonstrate that without a sense of ownership and participation, housing recovery programmes can face difficulties in ensuring acceptance and maintenance by the affected community. Framework that facilitated homeowners to be directly responsible for decision-making and enabled their leadership over their own house reconstruction have resulted in speedy and satisfactory recovery with strong sense of ownership. Effective livelihood restoration programs also contributed to quicker shelter recovery by strengthening peoples' ability to contribute and take ownership of construction.

Mechanisms such as technical guidance and support, material depots, access to safe land with secured tenure, local capacity building, monitoring systems, information dissemination, and grievance redressal systems are part of such a framework that can facilitate the process of intermediate shelter construction in the most dignified way for the survivors. Such an approach reduces unreasonable dependency on the government and external agencies, but instead establishes a people-centred process of reconstruction and recovery.

Multiple national and international experiences make case for the merits of adopting owner-driven reconstruction process in the aftermath of disasters. Both type of temporary shelters, emergency or intermediate shelters, are best managed by the community themselves; the process is most effective, efficient, fast and satisfactory if it is driven by the people. As the ability of the affected

persons to carry out this role can vary, capacity building efforts should be made. Empowerment of the owner as the primary decision maker is central to the ethos of this practice since she or he knows what is best for them. An external intervention by any agency could best be directed at strengthening peoples' initiatives and capacities to build their own temporary shelters through support for the gaps in material, finance, information, technical guidance and necessary tools.

**Owner Driven Framework enabled people to build temporary shelters effectively after Kashmir Earthquake 2005.**

The government policy on intermediate shelters facilitated an owner-driven approach by providing cash assistance along with other support mechanisms such as opening of bank accounts, setting up material depots, provision of technical guidance, regular supervision and grievance redressal system. This grassroots level engagement with the communities' problems and responding with contextually appropriate local solutions allowed for an efficient and transparent shelter process, resulting in high community satisfaction. To encourage timely completion of shelters, the government provided an additional incentive of Rs 5,000, which led to the completion of 90% of the shelters before the onset of winters. Understanding local requirements and issues, responsive policies and people centred facilitation were key aspects. Successful implementation of good quality shelters by the community in timely manner exemplifies the critical role policy framework and facilitation can play.



*Intermediate Shelters built after Kashmir Earthquake 2005*

*Credits: ODRC*

A common misunderstanding about owner-driven processes is that the each owner has to do physical labour for their own houses otherwise it's not owner driven. It should be understood that owner driven process places control and responsibility of shelter reconstruction with house owner and if needed, the owner could choose to hire contractors or labourers for construction of the shelters. Labour or contractors are accountable to the homeowner rather than to an external agency, leading to intensive supervision and quality control. Owner-led construction process utilises local resources such as community networks, locally available materials, knowledge, skills and human resources with greater potential for role of community based organizations and local self-government institutions like panchayats etc. Rapid community-based mapping and enumeration in a post-disaster setting should be used to enable faster decision-making in areas where there are gaps in information.

### Training of masons in innovative hazard resistant construction techniques for the temporary shelters contributed in disaster resistant permanent reconstruction: Case of Reconstruction after Uttarakhand flash floods, 2013.

Hazard-resistant prototypes of mid-term temporary shelters using locally available and salvaged stone were developed and demonstrated in the aftermath of 2013 flash floods. The shelters had low height stone masonry walls. Containment reinforcement GI wires and welded wire mesh bands were used as disaster resistant features. The roof was made with salvaged timber and CGI sheets easily available in the region. The construction was supported with the training of masons on random rubble masonry construction, which helped local artisans in strengthening their understanding and skills in masonry as well as hazard resistant construction. These skills and techniques were first utilised for construction of temporary shelters and later for disaster resistant permanent houses as well.



*On-site discussions with construction workers during the training sessions.*

*Credits: NCPDP*

### Timeliness of Temporary Shelters

Timely formulation and execution of the shelter policy is essential, since the first few weeks after the disaster is critical to shape the entire reconstruction programme. Intermediate transition shelters need to be built within the first three to four months after the occurrence of the disaster. Any further delays cause frustration and dissatisfaction amongst the survivors, while leading to construction of unsafe and unsuitable shelters. While the response has to be timely, it should not be hasty. There are multiple issues that arise with hasty erection of temporary shelters such as incomplete beneficiary selection, poor site selection, contextually inappropriate choice of shelter designs, materials and construction technology, inflated costs, lack of community consultation or participation leading to inappropriate shelter and dissatisfied families. Shelter response is most efficient when it is designed with foresight, to enable a smooth transition from early recovery shelters to the permanent housing.

## Identification of Affected Families Eligible for Temporary Shelters

Presently, National Disaster Response Fund (NDRF) and State Disaster Response Fund (SDRF) guidelines by the Government of India outline the terms of gratuitous relief to the affected families based on the extent of damage incurred. According to these guidelines, the owner shall receive due compensation only if his or her house was authorized by a competent authority. The list of beneficiaries is often drawn on the basis on already existing lists maintained in the village/ward level offices, which may not completely include the landless, Scheduled castes and Scheduled Tribes (SC/ST) communities, socially excluded families, women-headed households, squatters and tenant population, who are often the most vulnerable and in dire need of support. It is important to establish a system of identifying all genuinely affected families to ensure that aid and relief reaches the truly needy. Population lists such as Census and Socio Economic and Caste Census (SECC) data of the Government of India should also be referred to while drawing up beneficiary lists, along with identification with the help of the community to draw an inclusive list of all genuinely affected families. There should be necessary supervision to ensure inclusion of all vulnerable people.

Most assistance schemes in post-disaster situations in past have used the pre-disaster land and property ownership status of a family and approved buildings as a basis for eligibility of receiving housing assistance. This makes it easier for homeowners to receive adequate financial aid based on their property titles, as opposed to tenants and squatters who are unable to produce property titles or proof of tenancy. Taking a humanitarian view, the current situation of the affected person should be the criteria to access the temporary shelter assistance. The assistance scheme must ensure that all genuinely affected families are able to access the support provided by the government fairly, equally and easily. At the same time, it must be clear that temporary shelter support need not be the basis for permanent shelter assistance. Permanent Shelter assistance may be based on extent of damage as articulated in NDRF/ SDRF and as defined through the specific policy provisions by the Government.

## Addressing Temporary Shelter Needs in Urban Context

The urban settings define a different context for temporary shelter due to the complex land use, lack of open spaces, existing shelter stock and damages incurred to it, different occupational and lifestyle patterns, and infrastructure. Often there are challenges regarding number of families that require immediate shelter support in urban post-disaster situation. People are likely to be living in variety of housing forms such as multi-occupancy dwellings, squatter settlements, tenancy etc. Special attention is needed for the affected squatters and rental population in city, as eligibility criteria are mostly based on property or land ownership which may lead to their exclusion.

In-situ rehabilitation could be difficult since, available open ground may be limited and covered with debris. Pre-disaster preparedness to identify accessible open land in time of disasters for temporary shelters can help meet some such exigencies. Less dense urban centres such as Tier 2 and 3 cities in India with considerable open space can consider setting up temporary shelters. Inclusion of neighbourhood-level resident associations and local civil society can be useful.

## Options for Use of Various Materials and Technologies

While minimum standards of shelters must be ensured for all the affected families with protection from local hazards and climate, use available skills and materials must be based on traditional building practices. A temporary shelter policy should provide either multiple design options or an

assortment of materials and technologies, allowing people to build shelters suited to their own requirement. The success of such an approach in terms of ease of implementation and adoption by the community was observed after the 2001 Gujarat earthquake. This consideration is based on understanding that one solution doesn't fit all. And, also the quantity of material are required in the aftermath of a disaster can put a monumental burden on environmental resources. This could lead to an imbalanced depletion of a singular resource in an already non-renewable pool of resources. Moreover, single material procurement and transportation can pose a major logistic issue for the government and market. While there should be different options, care must be taken to ensure parity in support provided to the affected communities by different humanitarian agencies.

Rapid needs assessment should be undertaken before deciding on type of shelter solution, to evaluate their usability and contextual relevance over other forms of shelter support. The assessment should involve people in the determining the choices, particularly including the shelter needs of the vulnerable population. Capacity assessment required to make available the preferred options on time and according to agreed specification should be done. Such needs assessment could also be undertaken as a pre-emptive preparedness measure before disaster strikes.

As with local materials, there is higher level of comfort and any repairs or additions over time can be easily carried out by the affected family. There is usually high preference of such shelters over tents or pre-fabricated shelters, which has been observed in multiple disasters in the past. Materials such as corrugated galvanised iron sheets and bitumen based corrugated sheets in past disaster responses were distributed to deliver shelters quickly due to their mass availability, but they were unfavourable for the climate. An initial investment into appropriate shelters can help avoid discomfort for the affected families and save additional resources needed to be spent on upgradation later on. Local materials are cost effective due to their easy availability, almost negligible transportation costs and are often best suited to the local climate. Most often they are already included in the construction vocabulary of the local community and therefore, people are familiar with them, ensuring their participation and ownership of shelter reconstruction. If planned well, mid-term intermediate temporary shelters can be adapted or recycled for construction of their permanent houses, as opposed to the common notion of temporary shelters being a wasteful usage of resources. This is important particularly in cases where shelters are at a location which is available only for short term and families have to be eventually moved. The temporary shelters should be constructed taking cognizance of the same, with a plan which guides the dismantling of temporary shelters while promoting maximum salvage and reuse of the materials.

One of the key technology facilitation required is for sanitation particularly flood affected areas where conventional toilets do not function. Conventional sanitation technology also has limitations where groundwater is high, or water availability is scarce. In such conditions, temporary EcoSan toilets may be used. Such technical options need to be identified and facilitated along with temporary shelters.

### Innovative eco-friendly sanitation technology provides functional and hygienic toilets in flood affected areas in Bihar 2013

Sanitation in flood-stricken regions such as Bihar (where inundation tends to stay for a time period ranging from a few weeks to 3-4 months), tends to be a major issue due to difficulties of disposal system.

The EcoSan toilets provided after the Kosi floods of 2013 in Bihar have been one of the few successful examples of solving sanitation issues areas with high ground water table in general and in flood-affected areas in particular.

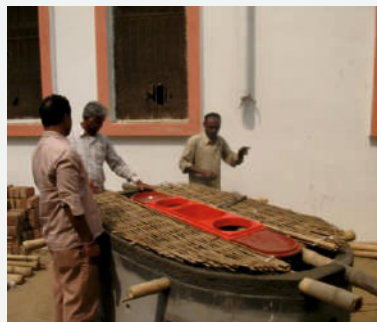
The principal feature of the EcoSan toilet is that it is above ground and works by separating urine and solid waste and hence making decomposition of waste easier. The entire disposal facility is raised above the ground as protection measure against flood and comprises of a special pan designed for collecting urine and faeces in two separate chambers.

Once the faecal chamber is filled, it is left for decomposing for 6-8 months. Ash and dried neem leaves are put into the excreta

chamber that help in killing any pathogens. The decomposed excreta is can be used as manure while the urine collected in the separate chamber is used directly after dilution as a substitute for urea.

The design of the toilet was appropriated to the materials and skills available in the Kosi region, local practices, people's lifestyle, geographical features and the economic constraints of the family. Stilted and non-stilted structure along with material choices of bamboo and bricks for super-structure provided different families options to select appropriate solution.

The involvement of the local community in construction facilitated easy repairs and maintenance, thereby making the system self-reliant. People found by-products useful for agriculture with easy solution for sewage treatment and disposal and hence named these toilets 'Phaydemand Shauchalay'



*EcoSan toilet constructed using bamboo for flood affected areas*

*Credits: Megh Pyne Abhiyan*





## Section 5

### TYPOLOGIES OF TEMPORARY SHELTERS

Temporary shelters can be understood in following three typologies.

1. **Assembly based shelters** such as shelter kits, tents, pre-fab units, shipping containers, etc.
2. **Construction based shelters** that are to be constructed in-situ or ex-situ with construction materials like bricks, stones, timber, bamboos, steel, cement, mud or other such materials.
3. **Rental accommodation** that the affected people can find in already existing undamaged houses that survive the disaster. This is not really a typology but an alternative way of accessing accommodation temporarily and fulfil needs for short-term and medium-term effectively, particularly in the urban context.

#### 1. **Assembly based Shelters:** *Shelter kits, tents, Pre-fab, shipping containers, etc.*

This category includes shelters that involve on-site assembly of individual elements/ parts that are pre-fabricated or manufactured elsewhere and transported to the site. In some situations in other countries, there has been use of shipping containers or trailer homes which are not appropriate housing options in our socio-cultural context. This is not a highly suitable option as people have to be completely dependent on external agencies for procurement, transportation and repurposing them for use as shelters. In these guidelines, mainly three following types of assembly-based shelters commonly used in our past disasters are discussed:

- i) **Shelter Kits:** A shelter kit is a defined collection of shelter components, fixings, and tools provided to meet the needs of the affected population for short-term emergency shelters. These kits could be designed based on needs, context and situation. Kits could include components with which one could build a shelter, or contain certain most essential material for the shelter. In some specific situations, these could only cater to specific needs such as erecting toilets, fences, water storage, etc. The design of the kit, also determines the additional support mechanisms that need to be provided with it.
- ii) **Tents:** Tents are one of the many available shelter options used particularly during the emergency phase. Tents used as intermediate shelters have been unsuccessful, since they only provide minimal protection from the elements, and are associated with a feeling of impermanence, leading to physical vulnerability of the residing family. They are available in varying sizes, either as family tents or as large tents used as warehouses and/or collective centres. As commonly used tents have limitations in terms of their functions, other essential services such as water, sanitation, cooking spaces etc. are usually provided outside the living quarters. Tents can be erected in-situ on individual plots of the homeowners or as part of a camp-type ex-situ settlement. The process of erecting tents is much faster, often accomplished in a couple of hours and thus, making them most viable for the emergency phase till a more durable settlement strategy is devised. However, people are often able to create their own makeshift constructions with salvaged and locally available materials before tents can be distributed. Also tents are quite expensive and not available in required quantities when in need.
- iii) **Prefabricated Shelters:** Prefabricated shelters are built by assembling standardized, mostly non-modifiable, prefabricated components manufactured in factories and transported to the construction sites. These prefabricated shelters can be made of a variety of industrial materials; a common design being structures built using steel frames with composite material panels such as plastics or cement based fibre reinforced boards. These prefabricated

shelters usually come with standardized specifications and in-built disaster resistant features. However, past experiences have shown that procurement and delivery of prefabricated shelters is a complex process leading to delayed and costly response. In past, negligible participation of the local community in the construction process has resulted in poor acceptability of these shelters. Adoption of pre-fabricated shelters requires careful and detailed need assessment so as to consider issues like suitability of standardized design for different families, climatic performance, durability of materials, ability of local community to repair and maintain, need of external aids such as cranes, disposal of degraded shelter material in environmentally safe manner and viability comparison with other construction based shelters or rental options. One advantage of such shelters if made with durable materials is that it is possible to dismantle and reuse these shelters.

## 2. Construction based Shelters: *Using salvaged or other locally available materials*

This category includes shelters that are constructed (in-situ or ex-situ) using materials and resources available locally, or from other non-local external sources and/or materials salvaged and reused from the collapsed houses, and supplemented by the use of local technology and traditional building knowledge. Shelters includes a wide range, from quickly erected structures of wooden posts and thatch to more durable shelters using materials like bricks, earth, cement, etc., which may then be upgraded with time as a step towards permanent reconstruction. Construction can either be undertaken by homeowners themselves or with various support mechanisms discussed in the next section. The construction-based shelters have flexibility of

### Locally available materials used to build aesthetically good quality disaster resistant temporary shelters after Cyclone Phailin 2013

With the help of local artisans, mid-term temporary shelters were designed incorporating cyclone resistant features for the vulnerable families in Ganjam district after Cyclone Phailin by an NGO. 300 such shelters were built using locally available resources such as bamboo, local red soil, dung and stones. This shelter design offered a quick, aesthetically pleasing, disaster-resistant, and economically viable solution while also allowing owners to engage in the construction process. Most of the materials needed for construction could be salvaged from old houses, or procured locally at minimal costs. This demonstrated that local materials and skills could be easily used to improve disaster resistance of the shelters making them aesthetically appealing. These shelters not only fulfilled needs of the affected families but could also very well be part of local socio-cultural milieu.



Temporary shelters in Ganjam district

Credits: SEEDS

additions/modifications, offering a wide array of possible housing typologies to the homeowner, based on their resource capacities.

The use of local materials allows local skills to be used, as these materials are a part of their construction vocabulary, and hence facilitate owners' involvement and participation in the construction of their houses. These factors also enable them to undertake repairs, maintenance and/or modifications on their own as and when necessary. Such direct involvement of owners in the recovery process, also contributes to their overall mental and emotional recovery from trauma after a disaster. Local materials are normally cheaper due to their availability, pose negligible transportation costs and are often best suited to the local climate. In cases where resources available locally are not durable, of poor quality, not available in required quantities; or likely to have a significantly adverse impact on the local ecology and environment, alternative materials may have to be considered. A good source of material resources that can be utilized in the intermediate shelter construction phase is the debris from collapsed or damaged houses. It is very important for local authorities or other government agencies to understand that these are only temporary shelters and they must ensure that these shelters are not allowed to become default permanent housing.

### 3. **Rental Accommodation:** *Making use of existing and surviving housing stock*

This alternative option is based on tapping into existing shelter stock which may be safe as a resource to rehabilitate disaster-affected families. Unlike shelter typologies discussed earlier, provision of rental accommodation does not require material or construction support and is most suitable for places where availability of land is scarce, and adequate housing stock is unaffected. This may be the case in many urban areas after disaster. Existing shelter stock usually consists of private apartments or public housing. In some cases, shelter types discussed in the previous categories, such as prefabricated shelters may also be assembled and then made available for rent, but it is a resource intensive process. Such a process may be of some utility in situation where the risk of land encroachment by the displaced people is deemed high. To facilitate rental accommodation, the government may provide cash assistance for certain specified period until permanent housing is restored through repairs or reconstruction.

#### **Facilitative measures such as Information outreach and financial assistance support affected communities to find rental accommodation. - The 2011 Japan Earthquake and Tsunami**

Centre for Information on Public Houses for the Affected Families was set up by the Japanese government to provide Information on an existing database of disaster-safe housing units available for renting. Additionally, government-owned housing was also made available to the affected people as rental accommodation. A rental subsidy was paid directly to the disaster-affected tenant household for up to 2 years, which was then further extended by 12 months.



## Section 6

### TECHNICAL GUIDELINES AND STANDARDS

These technical guidelines and standards for construction of temporary shelters are prepared, drawing upon lessons learnt from past experiences and feedback from relevant government and non-government stakeholders. They are developed, keeping in mind the implementation framework guidelines mentioned earlier to ensure people-centred reconstruction. These guidelines and standards include aspects of site selection and planning, shelter design, materials, and technology, with considerations for inclusion of gender, vulnerability and disability, wherever necessary. The technical guidelines are organised as follows:

1. Identification and Selection of Sites for Temporary Shelters
2. Site Planning and Services
3. Design of Temporary Shelters
4. Materials and Construction Technology (Assembly-based Shelters and Construction based Shelters)
5. Rental Assistance for Temporary Shelters

#### 1. Identification and Selection of Sites for Temporary Shelters

In post disaster situations, the safety of the inhabitants from future or recurring disasters and other threats is of paramount importance. Considerations regarding the site location, its surroundings, geographic features, soil condition, access and availability of services and other necessary resources are critical, not only for the safety of the house owner and inhabitants, but also for their basic comfort, appropriate living standards and continuation of livelihood activities. At times, it may be possible to modify some of the site features to make the site suitable for habitation. The guidelines stated below will help to identify safer sites for temporary shelters:

- i) Site for temporary shelters should be evaluated for various site and soil conditions and its vulnerability to future disasters. If the site shows any of the characteristics listed below, relocation may be considered:
  - a) Land is damaged or lost after the disaster,
  - b) Site is highly prone to future disasters, like flood, liquefaction, tsunami, landslide or cyclone, or
  - c) Site is close to hazardous conditions, like potential polluting sources and landfill sites, which are unfit or unsafe for living.
- ii) As far as possible, affected house owners should be encouraged to build the temporary shelter on their own existing site, provided the site is deemed safe for habitation and construction. However, receiving assistance for temporary shelter is not an evidence of land ownership or basis for permanent housing assistance.
- iii) In case the suitable site option seems difficult, subject experts should be consulted and further technical solutions should be explored to improve the site conditions to make it fit for construction of temporary shelters.
- iv) Temporary shelters should be built at a safe distance from damaged or vulnerable structures, so that any collapse of the old structure does not damage the new shelter or otherwise compromise the safety of occupants.
- v) The location of the in-situ temporary shelter should not obstruct siting of permanent house.

- vi) Considering the temporary shelter phase to last for 2-3 years, the site should be evaluated for probable disasters as well as seasonal variations based on reliable meteorological data, and its consequences on the site/ shelters till the permanent shelters are provided. The temporary shelters should be designed accordingly.

In case relocation is the only viable option, the following should be considered for selecting the site:

- i) Relocation may be done only with people's consent and agreement.
- ii) Site should be selected as close to the original location as possible, so that people's livelihood and routines are least impacted. The location should be conducive to supporting the livelihood activities and opportunities of the affected communities.
- iii) Site should have continuous and sufficient access to basic services, such as water supply, hygienic sanitation, toilets, electricity and transportation. The site's proximity to other services, such as health facilities, education facilities, communication services, banking services, markets and towns should also be assessed, in addition to the basic infrastructure.
- iv) Sites with the following characteristics should preferably be avoided:
  - a) Prone to erosion or scouring, low-lying areas, steep slopes, narrow valleys or ravines;
  - b) Close to pollution sources, landfill sites, etc;
  - c) Ecologically sensitive areas, like forests, wetlands or coastal lands and natural water paths; or
  - d) Areas likely to become marshy or waterlogged during the rainy season.
- v) To avoid flooding, the temporary shelters should not be built in the low-lying areas. Suitable land with elevation higher than the usual flood level should be identified. If such land is not available, the shelter should be raised to a higher elevation.
- vi) On hilly terrain, construction on unstable slopes should be avoided. If unavoidable, sufficient distance should be left between the slope edges and the shelter.
- vii) Natural features such as trees or earthen mounds should be identified around the site, which provide protection from natural elements. Building shelters on their leeward side would protect the shelter from excessive and forceful winds.
- viii) Ownership and land titles, permitted land-use according to master plan of the region, and existing use by host or neighbouring communities of the chosen relocation site should be considered.
- ix) Preferably, the water table should be substantially below the foundation, to avoid damage to the shelter.
- x) Relatively level sites are preferable for better mobility. Land with a general slope of 2-4% permits natural drainage of surface runoff, thereby not requiring provision of a storm water drainage system.
- xi) Impact of temporary settlement on the immediate environment, such as ground water table, soil quality and vegetation, if any, should be minimised and existing natural features should be preserved.
- xii) Land requirement for total number of households needing temporary shelters including private space – closed and open, internal access roads, community open space, and space for basic services should be considered.

- xiii) Safety and privacy of all members of the affected community should be ensured while planning and layout of intermediate shelter camps. Dark, deserted spaces and blind spots, which are prone to dangerous incidents should be avoided. The selected site should be safe for women, elderly and children as well as safe and accessible to people with disabilities.
- xiv) Such a site should be chosen, which can later be vacated after the purpose of temporary shelters is fulfilled, and permanent housing is constructed. In order to see that the affected family vacates the temporary shelter voluntarily, it is necessary to involve them right from the beginning in the reconstruction programme.

## 2. Site Planning and Services

This sub-section discusses the site planning and services in detail, to enable the site for safe and secure rehabilitation. Specific attention to basic services is essential for overall well-being of the community. Site and infrastructural planning is discussed below with specific focus on including water, sanitation and hygiene (WASH) services:

### Site and Infrastructure Planning:

In case the community is being settled on their original place, the site planning is easier and essential services may already exist, though those may have been damaged. These services may require restoration, repair or reinstallation sometimes. On relocation sites, though many new services will have to be installed, existing services may be integrated and utilised. While developing the site plan for temporary shelters on existing or relocation sites, the following guidelines should to be considered:

- i) In case of relocation, the affected community should be relocated in such a way that its internal social structure and support system is not disrupted. Maintaining existing neighbourhood networks is preferable.
- ii) Facilities to be provided within the site should arise from the requirements of the community, which might differ on the basis of livelihood, lifestyle and social structure of the community. While planning for ancillary functions in temporary settlements, attention should be paid to spaces required by young children, women and the elderly.
- iii) Space/s needed for speedy resumption or restoration of livelihood activities such as farming, handicrafts, other local economic activities and markets should be identified and provided through community consultations.
- iv) Safe access to common services should be ensured, while planning the site layout. Inclusion of multiple community spaces –places to meet, walk, play, eat, exercise, etc., for diverse user groups (children, women, elderly, etc.) will add to a safer environment.
- v) Access to social, health and educational infrastructure such as crèche/ aanganwadi, health centre (with special facilities for women), school, PDS, semi-open community and social spaces should be provided after community consultations.
- vi) Safe and adequate access to water, sanitation facilities, electricity, transport and communication connectivity, and waste management system should be ensured. Consider infrastructure for water and sanitation at the initial planning stages of a settlement, and not as an add-on.

- vii) Existing service infrastructure should be used and strengthened as much as possible. If the required site infrastructure is not in place or is damaged, it should be restored on priority basis or additional arrangements should be made until such time.
- viii) Ideally, there should be at least one disability-friendly route within the site boundary, connecting public transportation stops, all public facilities and residential units to the maximum extent feasible, while coinciding with the route of the general public.
- ix) Access to site should be cleared of rubble and debris.
- x) For relocation sites, transportation systems should be planned to ensure good connectivity to the nearby towns, the original settlement locations and existing livelihood locations.
- xi) Adequate road widths should be provided to facilitate easy vehicular and pedestrian movement according to the density of the settlement and its location with respect to nearby facilities and settlements. The road widths should allow emergency vehicles to pass through without obstruction.
- xii) To mitigate fire risk, at least a minimum of two metres should be provided between shelter blocks/ units. When flammable materials are used for the shelters, the space between shelter units should be increased.
- xiii) Layout of the shelters on new sites should be such that they reduce tunnelling effect of the wind. Cluster type layouts not only help avoid wind tunnels but also provide interactive and safer neighbourhoods.
- xiv) Street-lighting infrastructure should be installed along access routes and priority locations, such as toilets, wash areas and public service areas. Criteria for street lighting should be based on illumination and safety requirements for night lighting at public areas.

#### **WASH Facilities:**

Based on many past experiences, it is felt necessary to emphasize on adequate WASH facilities for temporary shelters. This was observed more in relocated settlements and in flood situations. In many shelter sites, limited availability of water for household use may impact personal sanitation and hygiene as well. This can increase health risks, particularly for women and adolescent girls, causing urinary tract infections or pelvic inflammatory diseases. In the past, installation of community toilets with poor maintenance system has been a failure. The following guidelines pertaining to water and sanitation facilities for good hygienic conditions should be implemented for temporary shelter sites:

- i) People should be provided with the necessary information, knowledge and understanding to prevent water and sanitation-related diseases. The know-how required to use and maintain the facilities is important for community. This should cover all aspects of safe water chain, including collection, transport, storage, treatment, and use at community as well as household level.
- ii) Local and sustainable sources of water supply should be prioritised and the existing infrastructure should be strengthened, where required.
- iii) Appropriate technology should be chosen in consultation with hydrologists, geologists and the local communities. Natural water sources such as hand-dug wells, bore-wells, gravity-fed supply systems, rain-water harvesting systems etc., or existing water supply schemes should be preferred over transporting water through vehicles. The later should be seen only as a temporary and short term solution.



- iv) A mix of options should be considered for water source to avoid over-exploitation and pollution.
- v) Decentralised systems, such as rain water harvesting in appropriate locations should be encouraged, especially in locations with frequent rains, low ground water tables or contaminated water bodies.
- vi) Women's participation in water supply and sanitation programmes should be encouraged, while ensuring their safe and regular access to water and sanitation facilities.
- vii) Adequate supply of water to meet the requirements of the affected population should be prioritised and ensured. Average use of water is at least 3 litres per person per day for drinking and 15 litres for toilet and bathing. Additional water requirement for infants, senior citizen and those with medical condition should also be provided.
- viii) Adequate distance as per public health norms should be maintained between water points/ storage and sanitation facilities.
- ix) Design, type and location of toilets and disposal system should be based on an understanding of people's cultural habits and preferences – especially women, children, older people and people with disabilities. Its maintenance system, cleanliness and ownership must be discussed with the community prior to construction.
- x) Separate closed structures for toilets and bathrooms made of durable materials should be provided. These structures should be constructed such that they enable women and transgender people to use them with adequate privacy.
- xi) Usually, individual toilets and bathrooms at household level work better than community facilities. They should be preferred over community toilets or bathrooms.
- xii) Requirements for cleanliness and maintenance of toilet facilities should be considered when planning the toilets. In case of community facilities, its upkeep and maintenance mechanism and responsibilities should be thought through, discussed with the community and put in place immediately, since it has direct impact on hygiene.
- xiii) In case of community facilities, female bathing cubicles should be well separated from male bathing cubicles. The toilets should be provided separately, keeping the similar principle of privacy and safety.
- xiv) Adequate space and provision for female menstrual needs e.g. cleaning, drying or disposal of sanitary napkins should be ensured.
- xv) The distance from any household to the nearest water point should ideally be less than 500 metres, and the waiting time at a water source should preferably be no more than 30 minutes.
- xvi) In case of community facilities, ideally 1 in every 20 toilets should be disabled friendly. However, in the temporary shelter settlements, where it may not be possible to meet the above standards immediately, the ratio of 1 for 50 can be adopted in the beginning, and should preferably be brought up to 1 for 20 as soon as possible.
- xvii) Although emergency measures should be adopted to provide quick basic services such as water, electricity and waste-disposal, it is important to find sustainable and durable options which are maintained by the local communities with minimal external support. It is not advisable or viable to handover complex and unaffordable systems requiring complex maintenance to communities.
- xviii) Waste disposal arrangement should be made for sanitary disposal of solid waste, keeping in mind local conditions of availability of water. Preference should be given to integrating the

waste disposal system with the existing system on the location. If none exists, the disposal sites should be located at a safe distance from the settlements to prevent health hazards, while allowing daily movement of garbage through practical means. Solid waste disposal sites should be located away from water sources. They may be located either at central areas or at the periphery. As a practice, waste segregation should be encouraged, along with organic waste disposal systems such as composting, which reduces the overall quantum of waste to be handled.

- xix) Garbage containers of 100 litres, 1 per 50 persons or 1 per 10 families are recommended. Ideally one bin of capacity 50–100 litres should be provided for every 3-5 households.

### 3. Design of Temporary Shelters

Design of temporary shelters should be based on considerations mentioned earlier in the document, e.g. hazard resistance, functionality, durability and owner driven reconstruction. The community and people should be enabled and empowered in every aspect of decision making regarding shelter design. This includes deciding spatial requirements, selection of materials, construction technology, and execution of shelter construction. The following points should be considered in the design of temporary shelters:

- i) Hazard resistant construction principles should be followed in temporary shelters.
- ii) Climatic considerations are important to ensure desirable comfort level in the temporary shelters. Climatically-sensitive design parameters, such as building orientation, material selection, roof designs, thickness of walls and natural lighting, should be considered for shelters. In this regard, the following guidelines should be followed in design of temporary shelters:
  - a) *Considerations in cold climate:*
    - 1) In cold climates, the air flow around door and window openings should be minimised to ensure personal comfort, while also providing adequate ventilation for traditional heaters or cooking stoves.
    - 2) A lower height should be preferable in cold climates to minimise the internal volume that requires heating. The internal floor-to-ceiling height should preferably be a minimum of 2 metres.
    - 3) Sufficient insulation should be ensured in the floor, walls and roof, through non-conductive materials.
    - 4) In areas prone to snowfall, suitable roof slope should be provided to ensure minimum accumulation of snow on the roof.
  - b) *Considerations in warm and humid climate:*
    - 1) Shelters should be designed to maximise ventilation and minimise entry of direct sunlight into the shelter.
    - 2) The ceiling should be designed to facilitate good air circulation and ventilation.
    - 3) The roof should have overhangs and an adequate slope for rainwater drainage. Large overhangs should be avoided in locations vulnerable to high winds, unless roof comes close to ground.
  - c) *Considerations in hot and dry climate:*

- 1) Door and window openings should be positioned away from the direction of the prevailing wind to minimise heating by hot winds and heat radiation from the surrounding ground.
  - 2) The ceiling should be designed to facilitate good air circulation and ventilation.
  - 3) Heavyweight construction material (such as earth or stone) ensures thermal comfort, despite changes in night and day temperatures. However, the likely effect of seismic action should be considered when heavy materials are used. Alternatively, lightweight material may be used with adequate insulation.
  - 4) Double-skinned roof with ventilation should be provided between the layers to trap heat, particularly when Corrugated Galvanised Iron (CGI) sheets or tents are used.
- iii) Design of temporary shelters, particularly intermediate shelters, should be based on existing local practices, lifestyles and cultures of the affected families, making maximum possible use of local resources to enable owner-driven process.
  - iv) Women, elderly and physically challenged should be involved in the design of temporary shelters for their needs and priorities. Shelters should ensure safety, security, comfort and privacy for all.
  - v) Shelters should be designed with sensitivity to the specific needs of pregnant women, breastfeeding women, women with young children and single women. Spaces such as kitchens, bath, washing areas and drinking water facilities, which are used more often by women or where women need specific consideration, must be designed in consultation with women.
  - vi) In-situ temporary shelters on the owners' own land should be designed in such a manner that they can be upgraded to comply with the technical norms of safe permanent housing, wherever possible.
  - vii) Spaces for cooking should be adequately ventilated and materials used near such spaces should be fire resistant. Fire risks should be assessed and mitigated for the shelters with heaters and for cooking facilities.
  - viii) The need for storage should be recognized and adequately provided for in the temporary shelters.
  - ix) When families own livestock, spatial requirements for the cattle should be catered to at the site and household levels as appropriate.
  - x) Design of temporary shelters should accommodate for home-based works such as weaving, handicrafts, broom making, block printing, or any other such activities. In certain cases, it could be designed through support for livelihood recovery support.

#### 4. Materials and Construction Technology

Along with design and planning considerations, materials and construction technology have a huge bearing on the safety, sustainability and cost. It is important to consider peoples' own ability and ease to execute construction and maintenance while opting for certain technology and materials. Temporary intermediate shelters, estimated to last for 2 to 3 years, should be constructed in a manner that they are safe in case of any potential risks due to hazards during this period. Durable design, materials and construction technology should be chosen accordingly to ensure a safe and

dignified shelter. For hazard resistant construction of temporary shelters, the basic ABCD principle must be followed.

- i) A for Anchorage: The shelter should be anchored well to the ground.
- ii) B for Bracing: The walls and roof of the shelter should be diagonally braced.
- iii) C for Connections: All connections and joineries of various building components must be tied well with each other, and be strong enough to resist natural forces.
- iv) D for Diaphragm: Roof should act as a single plane diaphragm, and not as separately moving elements.

### ***Assembly-based Temporary Shelters***

#### **Shelter Kits:**

- i) The decision to provide shelter kits should be informed by rapid assessment to determine their need and advantage of use in terms of context, usability and workability, over other emergency shelter response options such as tents and cash assistance.
- ii) Capacity assessment should be carried out before procurement to deliver the shelter kits on time and according to agreed specification.
- iii) A select number of shelter kits should be pre-positioned and stockpiled regionally, to facilitate immediate distribution at the time of disaster. Preferably, this activity should be carried out as pre-disaster preparedness.
- iv) The kits should be physically and economically feasible to transport over long distances, by the homeowners and vulnerable individuals carrying the kits from the distribution sites to their own sites.
- v) The process of distribution of kits also provides an opportunity to disseminate information through training materials, manual, repair, retrofitting etc.
- vi) Shelter kits to be used in temporary shelters should be subjected to periodic review and monitoring and adapted accordingly.
- vii) The materials provided in the kit should be suitable in the local context, and respond to varied degrees of damage, e.g. if the shelter kit only provides tools and sheeting material such as tarpaulin then, for fully damaged houses, ease of access to other additional materials that may be required to make a shelter (e.g. the frame) should be considered.
- viii) Basic training should be held for the disaster affected communities, on when and how to use the shelter kits, storage of components, site preparation before assembling the shelter, laying of foundations and anchors, various types of shelters that can be built using the same kit and repair/maintenance of the shelter over time, etc.
- ix) Vulnerable people may need to be additionally supported, by way of providing cash for hiring labour to assemble the shelter, providing the necessary labour, working with partner organisations who will then provide support, establishing reconstruction committees to mobilise community support for these vulnerable committees, etc.
- x) Community tool kits should be provided where the social structure allows, permitting for shared resources and thereby reducing unnecessarily excessive distribution.

#### **Tents:**

- i) Tents as a shelter solution are viable only for the emergency phase of the recovery process. The tents should be durable enough to withstand wind, rain and other climatic conditions.

Double layered tents that provide better protection from heat and cold are preferable, as compared to the single layered.

- ii) Regional storage and stockpiling of tents should be done in a dry and ventilated environment, to ensure protection from sun, rain and vermin, which may lead to rotting of the canvas.
- iii) Transport over long distances should be feasible and economical, and with consideration for the homeowners and vulnerable individuals to carry them from the distribution sites to their own sites.
- iv) For non-displaced people, tents are useful in allowing people to remain on their own land, when their houses have been destroyed. However, efforts by the people towards building makeshift emergency shelters using salvaged and locally available materials should be aided with other appropriate support mechanisms.
- v) For displaced people, tents provided by way of planning an ex-situ camp-type settlement, would need additional provision of other essential services within the settlement premises.
- vi) Experts should be involved for the site planning and preparation for tented camps, to reduce specific risks such as fire, in addition to any other hazards the site may be prone to.
- vii) In camp-type settlements, tents should be pitched in clusters as opposed to long rows.
- viii) Support mechanisms for the disaster affected communities should be provided such as tools, training and/or skilled labour on where and how to erect the tents and site preparation before erecting the tents.

#### **Prefabricated shelters:**

Use of prefabricated shelters should be left to the choice of the house owners and market outreach of manufacturers. With all the considerations mentioned earlier in section 5, If prefabricated shelters are built, the guidelines are as follows:

- i) The manufacturers and suppliers of prefabricated shelters should be pre-identified so as to ensure adequate supply in required time duration at specified places at short notice on pre-agreed rates.
- ii) Design options with common specifications and costs should be used to allow modifications by people as per their need.
- iii) Adequate measures should be incorporated to improve climatic performance of the prefabricated shelters particularly arising due to its thin walls and roof.
- iv) Prefabricated shelters preferably be based on locally sourced materials over materials that are sourced from long distances, as these could be assembled more quickly and provide comparative benefit to local economy.
- v) When using prefabricated shelters, adequate training to enhance capacity of local community to repair and maintain must be included otherwise there will be likelihood of degradation of shelters due to extensive usage in very short time. There may also be need to make provision of appropriate tools with the community.
- vi) Prefabricated shelters may also need external aids such as cranes and skilled operators for the same which should be arranged.
- vii) Most of the prefabricated shelters are not likely to be made of easily recyclable or biodegradable material. Degraded, broken and damaged materials from such shelter will require safe disposal and adequate arrangements for the same must be planned.

- viii) These shelters may also be assembled on relocation site and then if needed, could be made available through rental assistance to avoid risk of land encroachment. In such cases the dismantling of shelters may be planned easily.

### ***Construction-based Temporary Shelters***

Various materials from the viewpoint of availability, ease of construction and maintenance, management of resources and environmental impact are discussed in the following general guidelines regarding the material selection for temporary shelters:

#### **Material Selection:**

- i) Most often local materials such as stone, mud, bamboo, wood and thatch, owing to their prevalent widespread usage, are already included in the construction vocabulary of the community, and thus, conducive to the owner-driven model of shelter construction. The familiarity with the materials facilitates deeper involvement, such that people's participation is highest in the decision-making process and its execution. Thus enabling house owners to have maximum control and ownership of the shelter-building process. With local materials, any repairs or addition over time can be easily carried out by the family. It has been observed in the past that use of local materials has enabled quicker access and hence, construction, as compared to using options such as tents and prefabricated shelters, which need to be procured from elsewhere.
- ii) The choice of materials should be determined by what is available on or near site. Priority should be placed on sourcing materials locally, as local materials are cheaper and quicker to access due to their availability, with almost negligible transportation costs, and are often best suited to the local climate.
- iii) Materials such as mud, wood and bamboo are prone to requiring frequent repairs, due to their susceptibility to damages such as, erosion, decay and insect infestation. Hence, they may need extra protection and should comply with the technical norms developed for their use.
- iv) Good quality disaster resilient construction with any material should be ensured, which requires provision of significant technical skill support.
- v) Sometimes large-scale local sourcing of materials is not possible, and is likely to have a significant adverse impact on the local environment. This necessitates sourcing materials from far. While introducing new materials and construction technologies, its conduciveness with the local practices should be considered.
- vi) As opposed to local materials, the industrial materials are highly resource intensive in their production, procurement and transport, having a great impact on the environment. The impact of using these materials on different aspects of shelter occupation should also be critically assessed before implementation.
- vii) Materials, such as CGI sheets, tarpaulins, being light-weight and cheap have become part of local construction vocabulary and are easily available. They may be fast and easy to install and can be transported to remote or hard-to-reach regions as well. However, they are not climate responsive, and need additional measures to ensure comfort inside the shelter. Though they allow easy repairs by the house-owners, they require frequent repairs or replacements.

- viii) The impact of sourcing non-local material for construction on natural environmental resources should be assessed, keeping in mind its users, the extraction and regeneration rates of the materials and the ownership of these resources. Use of materials with a significantly high carbon footprint should ideally be avoided.
- ix) Several building materials like stone, mud, bamboo, bricks and wood can be salvaged from debris and re-used to build shelters appropriate for the intermediate phase. Technical support should be provided to the families to inform about quality of material salvaged and its usability in temporary shelters. This can reduce the burden of fresh acquirement of materials.
- x) A comprehensive debris management plan should promote salvaging of debris for reuse or safe disposal, involving the local communities in the process. Mechanised rubble clearance at sites of damaged or destroyed houses using bulldozing should preferably be undertaken only after collection of salvageable materials, which could be recycled into temporary shelters or new homes.
- xi) Where materials for a complete shelter cannot be provided, roofing materials for the minimum covered area should be prioritised. The rest of the needs should be met with as soon as possible.

Potential, limitations and recommendations for use of various different building materials for construction of temporary shelters is discussed in detail in Annexure-1. They should be studied for more detailed understanding.

#### **Construction Technology:**

The following guidelines for construction of temporary shelter ensure adherence to principles of hazard resistant construction. There may be some variations in the construction techniques and methods based on local conditions, however, the principles remain same:

- i) Tents or similar shelters may not require foundation but need to be anchored well in a manner that it is not uprooted in high winds.
- ii) For shelter types that require foundation, it should preferably be at least 300 mm deep. Any variations should depend upon soil type and other geographic conditions of the site.
- iii) In locations where the bearing capacity of the soil is low, light weight structures should be built.
- iv) The plinth should preferably be at least 150 mm higher than the highest expected flood level.
- v) Adequate surface water drainage should be ensured around the shelter, with consideration of the raised plinth.
- vi) Temporary shelter should be well anchored to the ground with foundation, be diagonally braced if bamboo or wooden posts are used, have strong connections between various building components and be provided with in-plane bracing in the under-structure of the sloping roof, following the earlier mentioned principle of ABCD.
- vii) The temporary shelter should be designed such that if any structural member fails, the load can be transmitted by other structural members and it does not collapse immediately.
- viii) When constructing using masonry blocks, height of the walls should be kept low ( ideally 900 to 1200 mm) to reduce casualties in case of recurring tremors or until the technical norms for permanent construction are finalized and implemented under supervision.

- ix) Depending upon the wall materials, the masonry walls should not be more than 350-450 mm thick. The walls above 1200 mm of height should preferably be made of light weight material.
- x) Basic principles of laying the masonry units such as use of water level and plumb, and staggering of joints should be followed.
- xi) Through stones and corner stones should be placed as per standard specifications to bind the stone masonry wall.
- xii) Ideally, a single continuous wall should not be longer than 5m.
- xiii) Asymmetric, large or too many openings on the same wall should be avoided.
- xiv) The distance between the corner edge of the wall and inner edge of the opening should be at least 1/6th the wall height.
- xv) The lintel level of all openings should be the same.
- xvi) A band should be provided on top of masonry walls. This band could be made of bamboo, timber or welded wire mesh with mortar.
- xvii) Diagonal bracing should be provided as per the technical requirement between the vertical and horizontal members of the structural system of the building.
- xviii) All the main elements of a house and their joineries should be strong and enable the house to sway back and forth together as one unit during an earthquake, withstanding the stresses and other effects. This may induce some damage, but total collapse can be avoided.
- xix) The joinery should be well made and strong between foundation and wall, between various wall units (bricks/ blocks/ stones), between structural frame and wall panels, between different walls, between walls and roof, and between roof and its under-structure. Weak joineries increase risk of damage.
- xx) In any hazard prone areas, preferably no heavy weight roofs should be allowed in temporary shelters.
- xxi) Light weight roofs should be anchored very well. It is particularly important in cyclone prone regions. When constructed, walls should be kept low and roofs must hang closer to the ground.
- xxii) To protect the shelter from snow, wind and water, the joints of the roof should be strong, secure and leak proof.
- xxiii) Technical facilitation support should be made available to the house owners during construction of temporary shelters for supervision and quality assurance.

## 5. Rental Assistance for Temporary Shelters

Rental assistance for temporary shelters is very appropriate in many circumstances particularly in urban areas where there may be sufficient housing units be available for use in case of disaster. This option provides flexibility to the owners to choose accommodation as per the preference of location, size, cost, services, etc.



Section 7

**ROLES AND RESPONSIBILITIES OF STAKEHOLDERS**

| Themes                      | Centre | State   | District/Block/Local Bodies(District Administration and DDMA) | Non-Governmental Organizations/ Private Sector | House-owners |
|-----------------------------|--------|---|---|--|--------------|
| Developing policy framework |        | State specific guidelines, based on NDMA Guidelines for temporary (emergency and intermediate) shelters covering eligibility criteria, entitlements, disbursal mechanism, delivery and facilitation mechanisms, involvement of non-state actors like NGOs and Private sector, coordination, monitoring, certification, feedback mechanism, grievance redressal, etc.<br><br>(State Govt., SDMA, Revenue Dept., CoR) |   |  |              |

**Notes:**

1. Disaster Management in different States is looked after by different Departments. CoR has been mentioned as an indicative authority, but depending upon the State work allocation the concerned Department should discharge the duties as per this Matrix.
2. Ensure provisions and facilities for Persons with Disabilities in emergency and intermediate shelters.

| Themes  | Centre   | State  | District/Block/Local Bodies(District Administration and DDMA)   | Non-Governmental Organizations/ Private Sector   | House-owners  |
|---|--|--|---|--|---|
| <p><b>Need assessment and identification of house owners</b></p>          | <p>Set norms and methodology to assist the respective state governments in the damage and needs assessment.<br/><br/>(MHA)</p>           | <p>Conduct a preliminary and detailed damage and needs assessment.<br/><br/>(State Govt., CoR, Dept. of Revenue, SDMA)</p>             | <p>Carry out damage and needs assessment as per the state directives.</p>   | <p>Identify needs of the most vulnerable and assist the State and District to ensure their inclusion.</p>  | <p>Participate in the damage and needs assessment, providing appropriate and correct information.</p>                                     |
| <p><b>Delivery of temporary (emergency and intermediate) shelters</b></p> | <p>Set norms and facilitate temporary (emergency and intermediate) shelters by providing tents etc., in case of need.<br/><br/>(MHA)</p> | <p>Set norms for identification of disaster-affected households eligible for shelter assistance.<br/><br/>(State Govt., CoR, SDMA)</p> | <p>As per norms, identify the disaster affected households eligible for shelter assistance.</p>   | <p>Facilitate the process. Assist the District Administration in identification of eligible households for shelter assistance, under government supervision.</p>       | <p>Respond as per request of State Government.</p>  |
|   |  |  | <p>Quality check for temporary (emergency and intermediate) shelters and implementation &amp; technical support in case of intermediate shelters.</p> | <p>Assist the affected households in construction of their shelters, particularly the most vulnerable, who may lack capacities to build on their own, by providing</p> | <p>Erect temporary (emergency and intermediate) shelters following specifications, norms and details as per the technical guidelines.</p> |

| Themes | Centre  | State  | District/Block/Local Bodies(District Administration and DDMA)  | Non-Governmental Organizations/ Private Sector   | House-owners |
|--------|---|--|--|--|--------------|
|        |   | <p>undertake construction of shelters as per their own needs, preferences and resources.</p> <p>(State Govt., CoR, Revenue Dept.)</p>  |  | <p>financial, material, technical, managerial, human resource support as necessary, in compliance with the government policy and norms.</p>  |              |
|        | <p>Guidelines on Minimum Standards of Relief as per Section 12 of DM Act 2005. (NDMA)</p>                               | <p>Ensure compliance with minimum standards of relief as per Section 19 of DM Act 2005, based on NDMA Guidelines on Minimum Standards of Relief, issued by NDMA.</p> <p>(State Govt., CoR, SDMA)</p> | <p>Provide shelter support to the affected households in compliance with the minimum standards of relief, set by State Government.</p> | <p>As per the directions of the State Govt. and District Administration, coordinate with Government in providing shelter support to the affected households in compliance with the minimum standards of relief, set by State Government.</p> |              |
|        | <p>Assist the respective state governments in the task of providing safe, hygienic and secure temporary (emergency)</p> | <p>Provide safe, hygienic and secure temporary (emergency and intermediate) shelters to meet</p>   | <p>Provide safe, hygienic and secure temporary (emergency and intermediate) shelters</p>   | <p>Provide or assist the district administration in providing safe, hygienic and secure temporary shelters to</p>  |              |

| Themes   | Centre   | State   | District/Block/Local Bodies(District Administration and DDMA)                     | Non-Governmental Organizations/ Private Sector   | House-owners |
|--|--|---|---|--|--------------|
|  | <p>and intermediate) shelters to meet the needs of people in disaster-affected areas. (MHA)</p>  | <p>the needs of people in disaster-affected areas. (State Govt., CoR/SDMA)</p>  | <p>to meet the needs of people in disaster-affected areas.</p>                    | <p>meet the needs of people in disaster-affected areas.</p>                                |              |
| <p><b>Facilitating access to materials</b></p> | <p>Prior and long-time tie-up with manufacturers and suppliers to provide tents/shelter kits/prefabricated shelters and materials such as tarpaulins, CGI sheets, bamboo, etc. starting within 24 hours of placement of order and help in transporting them. (Min. of Steel, Min. of Industry, Min. of Railway, MHA, MoEFCC)</p> | <p>Pre-identify material depots and suppliers for tents/shelter kits/prefabricated shelters and materials such as tarpaulins, CGI sheets, bamboo, etc. up to the village level and enter into a MoU for supply at short notice, starting within 24 hours, as per requirement. (State Govt., SDMA, Industry Dept., CoR, Revenue Dept.)</p> | <p>Develop material banks/depots for distribution and identify local vendors.</p> | <p>On the request of district administration, assist in distribution to the community.</p> |              |

| Themes | Centre  | State  | District/Block/Local Bodies(District Administration and DDMA)   | Non-Governmental Organizations/ Private Sector   | House-owners  |
|--------|---|--|---|--|---|
|        | <p>Procure and provide tents, shelter kits prefabricated shelters, tarpaulins, bamboo, CGI sheets and other temporary shelter</p> | <p>Stockpile tents, shelter kits, tarpaulins, bamboo and temporary shelter material in regional warehouses/ stores/ ERCs and have tie-ups with forest depots for bamboo, timber, etc.<br/><br/>(State Govt., CoR, Revenue Dept.)</p> | <p>Develop material banks/depots and tie-ups with local vendors.</p>                                      | <p>Based on the request of the District Administration, assist the District /Block/ /Gram Panchayat in distribution of tents, shelter kits, prefabricated shelters, tarpaulins, bamboo, CGI sheets and other temporary shelter materials. Identify and fulfil gaps in coordination with District/Block/Gram Panchayat as per their directives.</p> | <p>Salvage and re-use materials from damaged houses as far as possible, in accordance with technical guidelines.</p>      |
|        | <p>Procure and provide tents, shelter kits prefabricated shelters, tarpaulins, bamboo, CGI sheets and other temporary shelter</p> | <p>Procure and provide tents, shelter kits, prefabricated shelters, tarpaulins, bamboo, CGI sheets and other temporary shelter materials catering to the needs of the responders.</p>  | <p>Procure and distribute tents, shelter kits, prefabricated shelters, tarpaulins, bamboo, CGI sheets</p> | <p>If needed, provide additional tents, shelter kits, prefabricated shelters, tarpaulins, bamboo, CGI sheets and other</p>   | <p>Understand the constraints of relief distribution and cooperate with district administration and State Government.</p> |

| Themes | Centre  | State  | District/Block/Local Bodies(District Administration and DDMA)                           | Non-Governmental Organizations/ Private Sector  | House-owners |
|--------|---|--|---|---|--------------|
|        | materials, on the request of stakeholders.<br>(Min. of Steel, Min. of Industry, Min. of Railway, MHA, National Disaster Response Force)   | (State Govt., CoR, Revenue Dept.)  | and other temporary shelter materials, based on the directives of the State Government. | temporary shelter materials in coordination with District/Block/Gram Panchayat as per their directives and avoid duplication. |              |
|        | Establish regional logistics facilities, coordinated with National Disaster Response Force teams to keep stocks of temporary shelters, tents and other non-food items.<br>(MHA, National Disaster Response Force) | Deploy a dedicated local team to receive the temporary shelter supplies.<br>(State Govt., CoR, SDMA)       | Deploy a dedicated local team to receive the temporary shelter supplies.                | On request, facilitate the district administration in logistics / supplies.   |              |
|        |   | Depending upon the requirement, coordinate with the relevant Central Ministry to make sure that the tents/ | Communicate the requirements and coordinate with the relevant state                     | On request, facilitate the district administration.   |              |

| Themes | Centre | State   | District/Block/Local Bodies(District Administration and DDMA)                              | Non-Governmental Organizations/ Private Sector | House-owners |
|--------|--------|---|--|--|--------------|
|        |        | shelters reach the site on time.<br>(State Govt., CoR, SDMA)  | authorities, to make sure that tents/shelters reach the site on time.                      |  |              |
|        |        | To coordinate with railways, airlines and other means of transport to provide effective services to the field level.<br>(State Govt., CoR, Revenue Dept.) | Receipt and storage of supplies.   |  |              |
|        |        | Maintain logs of all material movements and details of distribution to required locations.<br>(State Govt., CoR, Revenue Dept., Supply Dept.)             | Maintain logs of all material movements and details of distribution to required locations. |  |              |
|        |        | Monitor any undue increase in the prices of essential items or hoarding of the same that may subsequently have  | Monitor any undue increase in the prices of essential items or hoarding of the same        |  |              |

| Themes   | Centre   | State  | District/Block/Local Bodies(District Administration and DDMA)  | Non-Governmental Organizations/ Private Sector   | House-owners |
|--|--|--|--|--|--------------|
|  |  | <p>an adverse impact on people's shelter recovery.<br/>(State Govt., CoR, Revenue Dept., Supply Dept.)</p>   | <p>that may subsequently have an adverse impact on people's shelter recovery.</p>  |  |              |
|  |  | <p>Set up material depots.<br/>(State Govt., CoR, Revenue Dept., Supply Dept.)</p>   | <p>Set up material depots.</p>   | <p>On request, participate / facilitate in setting up and operations of material depots.</p> |              |
| <b>Facilitating access to required skills)</b> | <p>Compile and maintain a consolidated database of trained construction artisans such as masons, plumbers, electricians, etc. from government/private vocational training institutes, NGOs and CSR organisations.<br/>(State Govt., Dept. of RD, Dept. of Social Welfare, SDMA, Skill Development Dept.)</p> | <p>Compile and maintain a database of trained construction artisans such as masons, plumbers, electricians, etc. from government/private vocational training institutes, NGOs and CSR organisations.</p> | <p>Compile and maintain a database of trained construction artisans such as masons, plumbers, electricians, etc. and provide additional resources as per need. Share this information with house owners.</p> | <p>Hire trained artisans.</p>  |              |



| Themes   | Centre   | State   | District/Block/Local Bodies(District Administration and DDMA)   | Non-Governmental Organizations/ Private Sector   | House-owners  |
|--|--|---|---|--|---|
|  |  | <p>Compile and maintain a consolidated database of trained building professionals such as engineers and architects from professional associations.<br/>(State Govt., PWD/BCD)</p> | <p>Compile and maintain a database of trained building professionals such as engineers and architects from professional associations.</p> | <p>Provide trained building professionals such as engineers and architects to house owners for undertaking construction of their shelters.</p>                     | <p>Seek professional advice wherever necessary.</p>   |
|  |  | <p>Compile and maintain a database of building contractors from professional associations.<br/>(State Govt., PWD/BCD)</p>   | <p>Compile and maintain a database of building contractors from professional associations.</p>  | <p>Provide trained building contractors to house owners for undertaking construction of their shelters.</p>  | <p>Hire trained contractors.</p>  |
| <b>Facilitating access to technology/ know-how</b> | <p>Facilitate preparation of technical guidelines.<br/>(Respective Ministries)</p> | <p>Based on guidelines issued by centre, preparation, adoption and implementation of technical guidelines.<br/>(State Govt., CoR, SDMA, respective departments)</p>               | <p>Adopt and implement the technical guidelines.</p>  | <p>Demonstrate and disseminate appropriate design and technologies, in accordance with the technical guidelines set by the State, to the affected communities.</p> | <p>Decide upon appropriate design and technology from available options for shelter construction, as per their needs, preference and resources.</p> |

| Themes                                    | Centre  | State   | District/Block/Local Bodies(District Administration and DDMA)  | Non-Governmental Organizations/ Private Sector  | House-owners   |
|---|---|---|--|---|--|
| <p><b>Facilitating access to land</b></p> | <p>Facilitate preparation of guidelines to assist the respective state governments in facilitating access to land, and other stakeholders to develop a policy framework for temporary (emergency and intermediate) shelters and support them with relevant guidelines and standards.<br/><br/>(NDMA, MoRD, MoHUA)</p> | <p>Pre-identify suitable land to be used for temporary (emergency and intermediate) shelters, if relocation is needed after the disaster (where in-situ construction not possible), workout arrangement for its use, in coordination with district and local bodies.<br/><br/>(State Govt., CoR, Revenue Dept., PRI dept., UDD)</p> | <p>Pre-identify suitable land to be used for temporary (emergency and intermediate) shelters, if relocation is needed after the disaster (where in-situ construction not possible), workout arrangement for its use.</p> | <p>Incorporate their feedback and inputs.<br/><br/>Assist the government authorities conduct consultations with the affected communities in case of relocation.</p> | <p>Community should not make any construction on unauthorized lands.</p> |

| Themes | Centre | State   | District/Block/Local Bodies(District Administration and DDMA)  | Non-Governmental Organizations/ Private Sector  | House-owners  |
|--------|--------|---|--|---|---|
|        |        | intermediate) shelter by any agency.<br>(State Govt., CoR, Revenue Dept.)   | temporary (emergency and intermediate) shelters.   | public and private land being used for temporary (emergency and intermediate) shelters.   |   |
|        |        | Conduct HRVCA and inform the households building shelters regarding potential risks at their land and mitigation measures.<br>(State Govt., CoR, SDMA)                      | Inform the households building shelters regarding potential risks at their land and mitigation measures.                               | Help district administration to inform the households building shelters, regarding potential risks at their land and mitigation measures.   | Decide upon whether to relocate or not, considering safety of their homestead land. |
|        |        | Identify households requiring land for intermediate shelter such as landless, tenants, etc. and enabling short term provision of land.<br>(State Govt., CoR, Revenue Dept.) | Identify households requiring land for intermediate shelter such as landless, tenants, etc. and enabling short term provision of land. | Facilitate district administration in identification of households requiring land for intermediate shelter such as landless, tenants, etc. and enabling short term provision of land. |   |

| Themes                                | Centre  | State   | District/Block/Local Bodies(District Administration and DDMA)                      | Non-Governmental Organizations/ Private Sector   | House-owners   |
|---------------------------------------|---|---|--|--|--|
|                                       |   | Dismantle temporary shelter and move to permanent shelter, within stipulated time. (State Govt., CoR, Revenue Dept.)  | Dismantle temporary shelter and move to permanent shelter, within stipulated time. | Facilitate district administration in dismantling emergency and intermediate shelters when constructed on public land after permanent reconstruction is completed. | Dismantle temporary shelter and move to permanent shelter. |
| <b>Facilitating access to finance</b> | Provide financial assistance in accordance with the Manual on Administration of State Disaster Response Fund (SDRF) and National Disaster Response Fund (NDRF) and subsequent notifications/revisions. (MHA, Min. of Finance) | Provide financial assistance in accordance with the Manual on Administration of State Disaster Response Fund (SDRF) and National Disaster Response Fund (NDRF) and subsequent notifications/revisions. (State Govt., CoR, SDMA) | Distribute assistance in quickest possible manner.                                 |  |  |

| Themes | Centre   | State  | District/Block/Local Bodies(District Administration and DDMA)                                      | Non-Governmental Organizations/ Private Sector            | House-owners   |
|--------|--|--|--|---|--|
|        | Support convergence of MNREGA, Swachh Bharat Abhiyan and other such relevant schemes through relevant guidelines.<br><br>(MHA, NDMA, MoRD, MoHUA, other relevant Ministries) | Implement/ Ensure convergence of MNREGA, Swachh Bharat Abhiyan and other such relevant schemes.<br><br>(State Govt., CoR, RD Dept., PHED)    | Implement/ Ensure convergence of MNREGA, Swachh Bharat Abhiyan and other such relevant schemes.    | Facilitate district administration in convergence.        |  |
|        |  | Set up banking mechanisms including opening of bank accounts of the affected households, if needed.<br><br>(State Govt., CoR, Finance Dept.) | Open bank accounts, if required, of affected households who are eligible for the state assistance. | Assist the house owners in accessing their bank accounts. | Use government assistance for constructing shelters. |
|        |  | Ensure timely cash transfer through a transparent and accountable mechanism.<br><br>(State Govt., CoR, Finance Dept.)                        | Ensure timely cash transfer through a transparent and accountable mechanism.                       |   |  |

| Themes  | Centre  | State   | District/Block/Local Bodies(District Administration and DDMA)  | Non-Governmental Organizations/ Private Sector  | House-owners   |
|---|---|---|--|---|--|
|   | Guidelines on use of CSR funds for temporary (emergency and intermediate) shelters. (MHA, Min. of Corporate Affairs,)   | Make provisions for and enter in to agreement with corporate and PSUs for utilizing CSR funds in temporary (emergency and intermediate) shelters and related areas. (State Govt., CoR, SDMA, Industries Dept.)  | Use of CSR funds as per Centre and State guidelines and schemes.   | Assist the State district administration, as per need.                                |  |
| <b>Ensuring access to basic services and infrastructure</b> | Assist the state to address the public health needs (preventive as well as curative) in temporary (emergency and intermediate) shelters. (Min. of Jal Shakti, Min. of Health) | Respond to the public health needs so as to prevent and mitigate a sudden outbreak of epidemic, water and food contamination as well as other public health-related problems in the aftermath of a disaster. (State Govt., CoR, SDMA, PHED, Health Dept.) | Respond to the public health needs so as to prevent and mitigate a sudden outbreak of epidemic, water and food contamination as well as other public health-related problems in the aftermath of a disaster. | Assist the district administration, as per need for providing public health services. | Participate in management of community level management and maintenance of basic services. |

| Themes | Centre | State   | District/Block/Local Bodies(District Administration and DDMA)  | Non-Governmental Organizations/ Private Sector   | House-owners   |
|--------|--------|---|--|--|--|
|        |        | <p>Provide water / Sanitation / Electricity / Communication / Transport / cooking fuel etc. for those in temporary (emergency and intermediate) shelter sites.</p> <p>(If temporary (emergency or intermediate) shelters are on relocation sites, make temporary arrangements for basic services.</p> <p>(State Govt., CoR, Health, Power, Transport Departments)</p> | <p>If existing services (drinking water, sanitation, electricity, communication, access, transportation, etc.) are disrupted or critically deficient, provide alternate arrangements and simultaneously repair existing infrastructure to restore the services.</p> <p>(If temporary (emergency or intermediate) shelters are on relocation sites, make temporary arrangements for basic services.</p> | <p>Assist district administration for safe water and sanitation for the affected households.</p> | <p>Participate in management of community level management and maintenance of basic services and infrastructure.</p> |

| Themes                                       | Centre  | State   | District/Block/Local Bodies(District Administration and DDMA)                                       | Non-Governmental Organizations/ Private Sector  | House-owners   |
|--|---|---|---|---|--|
| Water  | Assist the respective state government in providing disaster-affected areas with clean drinking water and to prevent the spread of water borne diseases.<br><br>(Min. of Jal Shakti, MoHFW) | Provide disaster-affected areas with clean drinking water and prevent the spread of water borne diseases.<br><br>(State Govt., Health and Sanitation Dept., CoR, Water Supply Department) | Implementation of measures by the district administration, as per government directions.            | Assist the district administration, as per need.  | Manage and maintain basic services and community infrastructure. Follow government instructions. |
| Sanitation (toilets, waste disposal, sewage) | As per request from State/UT, assist in organizing emergency water supplies when there is a scarcity of potable water.<br><br>(Min. of Jal Shakti)  | Provide emergency water supplies when there is a scarcity of potable water.<br><br>(State Govt., Health and Sanitation Department, Water Supply Department, CoR)                          | Provide water tanks, storage facilities, install hand pumps, clean and recharge wells.              | Provide water tanks, storage facilities, install hand pumps, clean and recharge wells.              | Follow government advisories.  |
|  | Assist State Government, if required, by providing guidelines and technical assistance on sanitation and hygiene.   | Ensure sanitation and hygiene measures including safe disposal of human excreta, waste water and solid waste including  | Construct and/or manage toilets, soak pits, and waste disposal systems in the affected communities. | Construct and/or manage toilets, soak pits, and waste disposal systems in the affected communities. | Follow government advisories.  |



| Themes                 | Centre   | State  | District/Block/Local Bodies(District Administration and DDMA)                 | Non-Governmental Organizations/ Private Sector | House-owners |
|------------------------|--|--|---|--|--------------|
|                        | (Min. of Jal Shakti, Min. of Health)   | availability of appropriate tools and equipment.<br><br>(State Govt., CoR, SDMA, Health & Sanitation Department)   |   |  |              |
|                        | Ensure quick availability of hygienic portable toilets, for emergency shelters, through pre-disaster agreements/ contracts with suppliers.<br><br>(Min. of Jal Shakti, Min. of Health) | Ensure availability of hygienic portable toilets and bleaching powder for emergency shelters through pre-disaster agreements/ contracts with suppliers.<br><br>(State Govt., SDMA, Health & Sanitation Department) | Implementation arrangements hygienic portable toilets for emergency shelters. | Support district administration.               |              |
| <i>Street lighting</i> |  | Make adequate arrangements for street lighting in public spaces, so as to ensure safety of women and children.<br><br>(State Govt., Power Department)  | Make arrangements as per requirement.   |  |              |

| Themes  | Centre | State   | District/Block/Local Bodies(District Administration and DDMA)   | Non-Governmental Organizations/ Private Sector  | House-owners |
|---|--------|---|---|---|--------------|
| <p><i>Safety &amp; Protection</i></p>                 |        | <p>Effectively coordinate between various state agencies for safety of the affected community particularly women, children, dalits and other marginalised community groups and protection from any discrimination.<br/><br/>(Home Department, Police and other relevant state agencies)</p> | <p>Ensure adequate and timely preventive and punitive action as required in case of any disruption of peace, or any discrimination. Address any grievances in this regard sensitively and as per the law.</p> | <p>Mobilize community groups to work with the authorities to maintain peace and harmony and sensitize them for safety and protection of the vulnerable.</p> |              |
| <p><i>Other basic services and infrastructure</i></p> |        | <p>Make adequate arrangements to provide access to schools, child care, health facilities, markets and livelihood needs, recreational spaces.<br/><br/>(State Govt., CoR, Education, PHED, Health, Women and Child Welfare etc.)</p>  | <p>Necessary set up for implementation arrangements.</p>  | <p>Assist the district administration in setting up and run schools, child care, health facilities.</p>   |              |

| Themes                   | Centre   | State   | District/Block/Local Bodies(District Administration and DDMA)   | Non-Governmental Organizations/ Private Sector  | House-owners |
|--------------------------|--|---|---|---|--------------|
| <b>Capacity building</b> | <p>Assist respective states in preparing and implementing a capacity building plan for the government personnel, engineers, contractors and masons.</p> <p>(NIDM, MHA, NDMA, MoRD, MoHUA, Min. of Skill Dev.)</p>  | <p>Prepare and implement a capacity building plan for the government personnel, engineers, contractors and masons.</p> <p>(State Govt., CoR, RD Dept., ATI, SIDM, SDMA)</p>   | <p>Facilitate orientation and training of government personnel on facilitation of temporary (emergency and intermediate) shelters.</p>  | <p>Organise capacity building programmes for beneficiaries and assist the district administration in orientation and training of government and other stakeholders.</p>   |              |
|                          | <p>Assist the respective states in developing appropriate IEC strategy and material to inform and educate engineers, contractors, masons and house owners on appropriate standards and norms for disaster-resistant temporary (emergency and intermediate) shelters.</p> | <p>Develop appropriate IEC strategy and material to inform and educate engineers, masons and house owners on appropriate standards and norms for disaster-resistant temporary (emergency and intermediate) shelters.</p> <p>(State Govt., CoR, RD Dept., ATI, SIDM, SDMA)</p> | <p>Implement appropriate IEC strategy and material to inform and educate engineers, contractors, masons and house owners on appropriate standards and norms for disaster-resistant temporary (emergency and intermediate) shelters.</p> | <p>Develop appropriate IEC strategy and material to inform and educate engineers, contractors, masons and house owners on appropriate standards and norms for disaster-resistant temporary (emergency and intermediate) shelters.</p> |              |

| Themes | Centre  | State  | District/Block/Local Bodies(District Administration and DDMA)                       | Non-Governmental Organizations/ Private Sector  | House-owners  |
|--------|---|--|---|---|---|
|        | (NIDM, MHA, NDMA, MoRD, MoHUA, Min. of Skill Dev.)  |  |   |   |   |
|        | Assist in developing and providing skill trainings for constructing shelters.<br>(Min. of Skill Development & Entrepreneurship, MoRD) | Conduct training programmes for masons and other required skilled resource persons.<br>(State Govt., Skill Development Institutes, SIRD, ATIs, SIDM, SDMA, and other concerned state government departments) | Conduct training programmes for masons and other required skilled resource persons. | Provide trained masons and facilitate/assist in skill development training to house owners for undertaking construction of their temporary (emergency and intermediate) shelters. | Hire trained masons or encourage their masons to undergo training on disaster resistant construction. |
|        |   | Ensure that affected community is trained (as part of post recovery measure).  | Provide WASH training for the affected households, in coordination with NGOs.       | Provide WASH training for the affected households in collaboration with the stakeholders.   | Participation and follow instructions / advisories of Government.                                     |
|        |   | Ensure that affected community is trained (as part of post recovery measure).  | Facilitate training of the affected communities on the maintenance and              | Facilitate training of the affected communities on the maintenance and  | Participation in various training and awareness programs.   |

| Themes | Centre | State   | District/Block/Local Bodies(District Administration and DDMA)  | Non-Governmental Organizations/ Private Sector  | House-owners  |
|--------|--------|---|--|---|---|
|        |        | Ensure that affected community is trained (as part of post recovery measure). | upkeep of shelters, basic services and community infrastructure, in coordination with NGOs.  | upkeep of shelters, basic services and community infrastructure.  |   |
|        |        |   | Undertake awareness and training on gender-based violence, social inclusion, inclusion of physically and mentally challenged, elderly and children, in coordination with NGOs. | Undertake awareness and training on gender-based violence, social inclusion, inclusion of physically and mentally challenged, elderly and children. | Participation in various training and awareness programs. |

## Annexure 1

### Potential, Limitations and Recommendations for Use of Building Materials in Temporary Shelters

A study and evaluation of all commonly used materials was made on various parameters to understand their potential and limitations for use in temporary shelters. These parameters include the ease of accessibility, procurement and delivery of these elements; their intrinsic physical, mechanical and thermal properties; and their ease of usage in the construction process, and structural requirements for hazard resistant construction. The following table presents the summary.

| S.N.                        | Materials  | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations  |
|-----------------------------|--|---|--|--|
| 1                           | <b>Stone</b><br>(Primary Usage:<br>Foundation,<br>Plinth, Low height<br>walls) | <p><i>Accessibility, Procurement and Delivery:</i></p> <ul style="list-style-type: none"> <li>i) Can be locally sourced.</li> <li>ii) Can be salvaged and reused from disaster debris.</li> </ul>             | <ul style="list-style-type: none"> <li>i) Not easy to transport.</li> <li>ii) Needs basic processing (shaping and sizing before usage in construction).</li> </ul> | <ul style="list-style-type: none"> <li>i) Extraction should be monitored, with respect to environmental impact to avoid depletion/degradation including hydro-geological impacts, such as landslides and changes to existing water channels.</li> <li>ii) As far as possible, salvage and reuse material from debris; avoid extraction for fresh stone.</li> </ul> |
| <i>Material Properties:</i> |  |   |  |  |
|                             |  | <ul style="list-style-type: none"> <li>i) High compressive strength, compact composition, highly durable, resistant to weathering and degradation.</li> <li>ii) High durability ensures longevity.</li> </ul> | <ul style="list-style-type: none"> <li>i) Can cause severe damage, if not used properly, because it is a heavy material.</li> </ul>                                | <ul style="list-style-type: none"> <li>i) Walls built for intermediate shelters should be of low height, to minimize damage in recurring disasters.</li> </ul>   |

| S.N.                          | Materials | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations  |
|-------------------------------|-----------|---|--|--|
|                               |           | <ul style="list-style-type: none"> <li>iii) High thermal conductivity and high thermal mass (slow to warm and slow to cool), makes it suitable for extreme climates.</li> <li>iv) Non-combustible.</li> </ul>   |  |  |
| <i>Usage in Construction:</i> |           |   |  |  |
|                               |           | <ul style="list-style-type: none"> <li>i) Being a traditionally used building material, people are aware of its nature, characteristics, and usage in construction.</li> <li>ii) Repairs and maintenance can be undertaken by homeowners themselves with minimal or no facilitation, and with commonly used tools.</li> <li>iii) Can be reused to build permanent housing with suitable modifications/additions by homeowners with time.</li> <li>iv) Versatile material and can be used in various construction techniques in combination with different materials.</li> </ul> | <ul style="list-style-type: none"> <li>i) Lack of skilled labour could result in poor construction quality.</li> <li>ii) Time consuming, resource intensive process; may be more suited for permanent shelters.</li> </ul> | <ul style="list-style-type: none"> <li>i) Safer use of material and good construction quality can be assured by providing technical skill support and/or capacity building.</li> </ul> |

| S.N.                        | Materials   | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters   | Recommendations  |
|-----------------------------|---|--|--|--|
| 2                           | <p><b>Adobe, Rammed earth, Cob</b><br/>(Primary Usage: Foundation, Plinth, Walls)</p> | <p><i>Accessibility, Procurement and Delivery:</i></p> <ul style="list-style-type: none"> <li>i) Can be locally sourced.</li> <li>ii) If used as blocks, only the transportation of pressing machines needs to be facilitated.</li> </ul>  | <ul style="list-style-type: none"> <li>i) Depleting natural resources effects availability of the quality of soil needed for earth-based construction.</li> <li>ii) Soil salinity, if present, can make it unusable.</li> <li>iii) Weak water resistance</li> <li>iv) Not conducive for transportation, over long distance, and hence, not appropriate for use where locally unavailable.</li> </ul>   | <ul style="list-style-type: none"> <li>i) To ensure good quality construction, soil needs to be tested to identify its properties, such as its composition and salinity levels, among other qualitative analysis tests.</li> <li>ii) The manufacturing of earth blocks and the construction process may be undertaken simultaneously, to accommodate the drying period.</li> </ul> |
| <i>Material Properties:</i> |   |  |  |  |
|                             |   | <ul style="list-style-type: none"> <li>i) High compressive strength in dry conditions for well-formed compressed earth units. Cement stabilization increases strength further.</li> <li>ii) Low thermal conductivity and high thermal mass ensures significant and stable temperature differences between indoor and outdoor temperatures.</li> <li>iii) Non-combustible.</li> </ul> | <ul style="list-style-type: none"> <li>i) Low shear and tensile strength.</li> <li>ii) Direct contact with water (rainfall, splash back or moisture) causes erosion, the impact of which would be felt more in unstabilized earth constructions, than in stabilized earth construction.</li> <li>iii) Prone to moisture based degradation; in wet conditions, strength can deteriorate rapidly.</li> <li>iv) Prone to termite infestations.</li> </ul> | <ul style="list-style-type: none"> <li>i) To be used for low height wall construction in temporary shelters.</li> <li>ii) Cement stabilization or framed construction, significantly adds to the strength of the wall.</li> </ul>  |



| S.N. | Materials | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters   | Recommendations  |
|------|-----------|--|--|--|
|      |           | <p><i>Usage in Construction:</i></p> <ul style="list-style-type: none"> <li>i) Can be used in various ways:<br/>Sun dried cobs (On-site or local manufacturing process),<br/>Adobe bricks (On-site or local manufacturing process),<br/>Rammed earth construction (on-site process), and<br/>Framed earth construction, such as Wattle and daub.</li> <li>ii) Versatile material and can be used in various construction techniques in combination with different materials.</li> <li>iii) Being a traditionally used building material, people are aware of its nature, characteristics, and usage in construction; hence, reduces dependency on external aid.</li> <li>iv) Can be reused to build permanent housing with suitable modifications/ additions by homeowners with time.</li> </ul> | <ul style="list-style-type: none"> <li>i) Lack of skilled labour, could result in poor construction quality.</li> <li>ii) Needs frequent maintenance and repairs, lack of which significantly reduces the structure's lifespan.</li> </ul> | <ul style="list-style-type: none"> <li>i) Additional technical support, training and skilled labour may be needed, to ensure good quality construction.</li> </ul> |

| S.N.     | Materials                                     | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters   | Recommendations   |
|----------|---|--|--|---|
|          |   | v) Areas where good soil is available, earth construction is a low cost option.  |  |   |
| <b>3</b> | <b>Bamboo</b><br>(Primary Usage: Walls, Roof) | <p><i>Accessibility, Procurement and Delivery:</i></p> <ul style="list-style-type: none"> <li>i) Can be locally sourced.</li> <li>ii) Can be transported from other regions.</li> <li>iii) Can be reused, if salvaged bamboo shows no considerable wear, tear and/or rot.</li> </ul> | <p><i>Material Properties:</i></p> <ul style="list-style-type: none"> <li>i) Needs to be chemically treated before use.</li> <li>ii) Only 3-5 year old bamboo is suitable for construction.</li> <li>iii) Shaped by nature, hence size and shape options are limited.</li> </ul> | <ul style="list-style-type: none"> <li>i) Bamboo extraction should be monitored, with respect to environmental impact, to avoid depletion/degradation.</li> <li>ii) Structural members require thicker, mature bamboo.</li> </ul> |
|          |   | <p><i>Usage in Construction:</i></p> <ul style="list-style-type: none"> <li>i) Being a traditionally used building material, people are aware of its nature, characteristics and usage in construction; and hence,</li> </ul>  | <ul style="list-style-type: none"> <li>i) Moisture can lead to decay and eventual damage to structure.</li> <li>ii) Combustible.</li> <li>iii) Prone to fungi and termite infestations.</li> </ul>   | <ul style="list-style-type: none"> <li>i) High tensile strength and elasticity makes it a suitable for use in earthquake prone regions.</li> </ul>  |
|          |   | <ul style="list-style-type: none"> <li>i) Lack of technical support, could result in poor construction quality.</li> <li>ii) Can decay fast, if not treated well.</li> </ul>   |  | <ul style="list-style-type: none"> <li>i) Capacity building measures such as training and prototype construction by implementing agency is required for</li> </ul>  |

| S.N. | Materials   | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations   |
|------|---|---|--|---|
|      |   | <p>reduces dependency on external aid.</p> <p>ii) Repairs and maintenance can be undertaken by homeowners themselves with minimal or no facilitation and with commonly used tools.</p> <p>iii) Versatile material and can be used in various construction techniques in combination with different materials.</p> <p>iv) Easy installation and disassembly makes it suitable for use in temporary shelters.</p> <p>v) Simple tools required for constructing with bamboo.</p> |  | <p>the community to ensure good quality disaster resistant construction.</p> <p>ii) Only treated bamboo should be used for construction.</p> <p>iii) Direct contact with ground should be avoided to protect from termite attack.</p> <p>iv) Should be protected from water or moisture as far as possible for longevity.</p> |
| 4    | <p><b>Wood</b><br/>(Primary Usage:<br/>Wall panels<br/>(wooden planks),<br/>Structural<br/>sections (wooden posts), internal fixtures and Roof)</p> | <p><i>Accessibility, Procurement and Delivery:</i></p> <p>i) Can be locally sourced.</p> <p>ii) Can be salvaged from damaged structures and reused.</p>   | <p>i) Could have serious environmental impact, if large quantities are harvested from forests in unsustainable manner.</p> <p>ii) Needs to be seasoned before usage in construction.</p> | <p>i) Felling of trees to extract wood should be monitored with respect to environmental impact, to avoid depletion/degradation of available resources.</p>   |

| S.N. | Materials | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters  | Recommendations  |
|------|-----------|---|---|--|
|      |           | <p><i>Material Properties:</i></p> <ul style="list-style-type: none"> <li>i) High resistance to vertical loads and horizontal forces.</li> <li>ii) Good thermal and acoustic insulation properties.</li> <li>iii) Flexibility and versatility ensures suitability for a wide range of applications in the shelter process.</li> </ul>   | <ul style="list-style-type: none"> <li>i) Highly Combustible.</li> <li>ii) Exposure to extreme temperatures makes it prone to weathering and degradation.</li> <li>iii) Moisture build up can lead to decay and rot adversely affecting its durability and life.</li> <li>iv) Prone to termite/insect infestation.</li> </ul> | <ul style="list-style-type: none"> <li>i) Seasoning, chemical treatment or painting of wood protects it from decay.</li> <li>ii) In regions with high rainfall and humidity, wooden members of the shelter need to be protected from rot and decay.</li> </ul> |
|      |           | <p><i>Usage in Construction:</i></p> <ul style="list-style-type: none"> <li>i) Being a traditionally used building material, people are aware of its nature, characteristics, and usage in construction.</li> <li>ii) Repairs and maintenance can be undertaken by homeowners themselves with minimal or no facilitation and with commonly used tools.</li> <li>iii) Can be reused to build permanent housing with suitable modifications/additions by homeowners.</li> </ul> | <ul style="list-style-type: none"> <li>i) May need frequent maintenance and repair, wherein certain sections may need to be replaced over time.</li> <li>ii) Lack of skilled labour could result in poor construction.</li> </ul>   |  |

| S.N.     | Materials   | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters   | Recommendations   |
|----------|---|--|--|---|
|          |   | iv) Versatile material and can be used in various construction techniques in combination with different materials.   |  |   |
| <b>5</b> | <b>Thatch</b><br>(Primary Usage: Roof, wall panels) | <p><i>Accessibility, Procurement and Delivery:</i></p> <ul style="list-style-type: none"> <li>i) Can be locally sourced, as variant specie of grass, palm reeds, straw bales, bamboo reeds etc.</li> <li>ii) Can be procured by homeowners themselves.</li> <li>iii) Can be reused.</li> </ul> <p><i>Material Properties:</i></p> <ul style="list-style-type: none"> <li>i) Lightweight, renewable and natural material.</li> <li>ii) Offers good climatic performance in hot or cold weather conditions.</li> </ul> | <ul style="list-style-type: none"> <li>i) Needs roof under-structure and tying and fixing mechanisms for shelter construction.</li> </ul>  | <ul style="list-style-type: none"> <li>i) Transportation not needed, as it is more viable to find and use local variants.</li> <li>ii) Local knowledge may be required to identify appropriate kind of grass, straw, reed etc, suitable for construction.</li> </ul>  |
|          |   |  | <ul style="list-style-type: none"> <li>i) Water can leak, if adequate slope is not maintained.</li> <li>ii) Extremely flammable.</li> <li>iii) Prone to insect infestation.</li> </ul> | <ul style="list-style-type: none"> <li>i) To avoid seepage of rainwater, under structure should be sealed thoroughly, and the roof angle should be steep enough to enable surface run-off.</li> <li>ii) Ample allowance for the projection of eaves and gables.</li> <li>iii) Needs to be tied well and secured with the under structure to resist cyclonic high-intensity winds.</li> <li>iv) Avoid cooking in thatch shelters.</li> </ul> |

| S.N. | Materials  | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters   | Recommendations   |
|------|--|--|--|---|
|      |  | <p><i>Usage in Construction:</i></p> <ul style="list-style-type: none"> <li>i) Being a traditionally used building material, people are aware of its nature, characteristics, and usage in construction.</li> <li>ii) Repairs and maintenance required overtime can be undertaken by homeowners themselves with minimal or no facilitation and with commonly used tools.</li> </ul>  | <ul style="list-style-type: none"> <li>i) May need frequent maintenance and repair; wherein certain sections may need to be replaced frequently.</li> <li>ii) Lack of skilled labour, could result in poor construction techniques and hence, compromising life of the shelter.</li> </ul> | <ul style="list-style-type: none"> <li>i) Poor construction techniques can be avoided by providing technical skill support.</li> </ul>  |
| 6    | <p><b>Bricks/Cement concrete blocks/stabilised earth blocks</b><br/>(Primary Usage: Walls, foundations, plinths)</p> | <p><i>Accessibility, Procurement and Delivery:</i></p> <ul style="list-style-type: none"> <li>i) Bricks and concrete masonry blocks (solid and hollow) are industry manufactured products, and hence can be procured according to requirements on any scale and design.</li> <li>ii) Bulk production ensures cost-effectiveness.</li> <li>iii) Can be salvaged from debris and reused, even if some units are broken.</li> </ul> | <ul style="list-style-type: none"> <li>i) Produced off-site, they need to be transported to the construction site.</li> <li>ii) Quality of available bricks/ blocks many a time is sub-standard.</li> </ul>  | <ul style="list-style-type: none"> <li>i) Should be sourced from local manufacturers/suppliers, to minimize transportation from source to site.</li> <li>ii) Quality of bricks or blocks found in a region should be evaluated before procuring.</li> <li>iii) Quality control measures during manufacturing need to be adopted to ensure good quality bricks or blocks.</li> </ul> |

| S.N. | Materials | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations  |
|------|-----------|---|--|--|
|      |           | <p><i>Material Properties:</i></p> <ul style="list-style-type: none"> <li>i) High compressive strength, compact composition makes it highly resistant to natural forces, weathering and degradation.</li> <li>ii) High thermal conductivity and high thermal mass (slow to warm and slow to cool), makes it suitable for extreme climates.</li> <li>iii) Fire resistant.</li> </ul> | <ul style="list-style-type: none"> <li>i) Un-reinforced masonry buildings are prone to damage, in recurring disasters.</li> </ul>  | <ul style="list-style-type: none"> <li>i) Good quality bricks or blocks to be used to build at least 200 mm thick walls.</li> </ul>  |
|      |           | <p><i>Usage in Construction:</i></p> <ul style="list-style-type: none"> <li>i) Already prevalent widespread usage ensures people's familiarity with the material and it's usage in construction and hence, also conducive to further repairs and maintenance if needed.</li> </ul>  | <ul style="list-style-type: none"> <li>i) Time consuming and resource intensive process.</li> <li>ii) Additional curing time required for masonry construction, if cement mortar is used.</li> </ul> | <ul style="list-style-type: none"> <li>i) Walls built for temporary shelters should not be taller than sill level (1200 mm) to minimize damage in the event of recurring disasters.</li> <li>ii) 125 mm thick walls should be avoided.</li> <li>iii) Good masonry skills should be used.</li> <li>iv) Additional technical support needed for support regarding incorporation of DRR features such as earthquake bands.</li> </ul> |

| S.N.                        | Materials   | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations  |
|-----------------------------|---|---|--|--|
| 7                           | <p><b>Tiles (Burnt clay tiles, Micro-concrete roofing (MCR) tiles etc.)</b><br/>(Primary Usage: Roof)</p> | <p><i>Accessibility, Procurement and Delivery:</i></p> <ul style="list-style-type: none"> <li>i) Being factory manufactured products, tiles can be procured on a large scale as well, based on requirements; also relatively small orders can be purchased locally, depending on supply and demand.</li> <li>ii) Bulk production ensures cost-effectiveness.</li> <li>iii) Can be salvaged from debris and reused, if units are not considerably broken.</li> </ul> | <ul style="list-style-type: none"> <li>i) Produced off-site, they need to be transported to the construction site.</li> <li>ii) Improper burning of clay tiles causes poor quality of construction as their strength is compromised.</li> </ul>                                      | <ul style="list-style-type: none"> <li>i) Should be sourced from local manufacturers/suppliers, to minimize transportation from source to site; to avoid the added risk of breakage of tiles during transit.</li> <li>ii) Facilitating procurement from local industries promotes local economy and livelihoods.</li> <li>iii) Quality of tiles found in a region should be evaluated before procuring.</li> <li>iv) Quality control measures during manufacturing need to be adopted to ensure good quality tiles.</li> </ul> |
| <i>Material Properties:</i> |   |   |  |  |
|                             |   | <ul style="list-style-type: none"> <li>i) Tile roofs have sufficient strength to take normal handling stresses and occasional foot traffic for maintenance access purposes; but, are incapable of carrying loads.</li> <li>ii) MCR tiles are stronger due to the presence of concrete and hence, are more durable than clay tiles.</li> </ul>   | <ul style="list-style-type: none"> <li>i) Clay tiles are permeable to water and may be prone to leakage due to excessive water absorption.</li> <li>ii) Low thermal resistance; hence requires insulating mechanisms underneath the roof.</li> <li>iii) Brittle in nature</li> </ul> | <ul style="list-style-type: none"> <li>i) Clay tiles may need treatment before use, to make them water repellent.</li> </ul>   |



| S.N.                          | Materials   | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations  |
|-------------------------------|---|---|--|--|
|                               |   | <ul style="list-style-type: none"> <li>iii) Resistant to corrosive environments.</li> <li>iv) Non-combustible.</li> <li>v) Good acoustic properties, due to density and thickness.</li> <li>vi) Unlike clay tiles, water absorbed by MCR tiles does not cause any degradation in its properties.</li> </ul> |  |  |
| <i>Usage in Construction:</i> |   |   |  |  |
|                               |   | <ul style="list-style-type: none"> <li>i) Where locally available and traditionally used, prevalent widespread usage of these sheets ensures people's familiarity with the material and it's usage in construction.</li> </ul>  | <ul style="list-style-type: none"> <li>i) Tiles require frequent repair and maintenance.</li> <li>ii) For good protection in regions with heavy rainfall, steep sloping roofs are required to ensure water does not percolate through the tiles inside; which is a resource intensive process.</li> <li>iii) In regions with high velocity winds, some percentage of tiles may need periodic replacement.</li> </ul> | <ul style="list-style-type: none"> <li>i) Tiles need to be anchored well to the roof under-structure.</li> <li>ii) Tile roofs are heavier than sheet roofing; hence, structure underneath needs to be made accordingly.</li> <li>iii) Use skilled labour for installation of tiled roof to ensure adequate slope.</li> </ul> |
| <b>8</b>                      | <b>Steel sections</b><br>(Primary Usage: prefabricated shelter) | <p><i>Accessibility, Procurement and Delivery:</i></p> <ul style="list-style-type: none"> <li>i) An industry manufactured product, it can be procured on a large scale through</li> </ul>   | <ul style="list-style-type: none"> <li>i) Large quantities of steel can be logistically difficult to transport.</li> </ul>   | <ul style="list-style-type: none"> <li>i) When transporting to difficult location, it should be ensured that steel members are not deformed.</li> </ul>  |

| S.N.                        | Materials  | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations |
|-----------------------------|--|---|--|-----------------|
|                             | <p>components,<br/>Structural sections, rebars, sheet products, internal fixtures, and connectors)</p>   | <p>manufacturing industries and on a smaller scale also through local suppliers and fabricators.</p> <p>ii) It can be procured in various shapes and sizes, depending on what component of the shelter design it is used for.</p> <p>iii) Production happens off-site and then assembled on-site.</p> <p>iv) Steel components salvaged from debris, can be reused for temporary shelter construction or can be sold as scrap metal.</p> | <p>ii) Transportation may have cost implications for the users.</p>                                      |                 |
| <i>Material Properties:</i> |  |   |  |                 |
|                             | <p>i) High compressive and tensile strength; making it highly resistant to deformation and breakages, hence, highly durable.</p> <p>ii) Can be bent and moulded and welded into desired shape and form without resulting in deformation.</p> <p>iii) High melting point and hence, does not melt/disintegrate in the event of small fires.</p> | <p>i) High thermal conductivity, hence, negligible resistance to outdoor temperature.</p> <p>ii) Steel is susceptible to corrosion and damage in the presence of excessive moisture content and rainfall prone areas.</p>   | <p>i) Corroded steel should be avoided and protection through paints or coatings should be provided.</p> |                 |

| S.N. | Materials   | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters  | Recommendations   |
|------|---|--|---|---|
|      |   | <p><i>Usage in Construction:</i></p> <ul style="list-style-type: none"> <li>i) Facilitates rapid building of temporary shelters.</li> <li>ii) Shapes and sizes of the modules can be adapted to desired architectural plans.</li> <li>iii) Physical properties of steel make it a very versatile material for construction.</li> </ul>                     | <ul style="list-style-type: none"> <li>i) Using pre-manufactured steel components, may need to be supplemented with technical skill support for assembly and completion of the shelter, increasing dependency of the homeowners on external aid.</li> </ul>   | <ul style="list-style-type: none"> <li>i) Fixing details and connections need to be accurately fabricated and installed to ensure the adequate strength of the structural elements.</li> </ul>                              |
| 9    | <p><b>Prefabricated panels (Fibre reinforced plastic/ gypsum/ cement boards, engineered wood/ plywood)</b><br/>(Primary Usage: Wall panels, Structural sections, internal fixtures, fittings)</p> | <p><i>Accessibility, Procurement and Delivery:</i></p> <ul style="list-style-type: none"> <li>i) Being an industry manufactured product, it can be procured on a large scale as well, based on requirements.</li> <li>ii) Saves construction time on-site.</li> <li>iii) Bulk production and procurement may result in cost-effective products.</li> </ul> | <ul style="list-style-type: none"> <li>i) Risk of damage while transit over long distances and it's cost implications.</li> <li>ii) Sourcing from local manufacturers/suppliers may only be possible in large cities, due to usage of specialised technologies and may not be serviced in small towns and villages.</li> <li>iii) Reuse and recycling for the permanent shelters may not be viable due to short lifespan of these materials.</li> </ul> | <ul style="list-style-type: none"> <li>i) Quality control measures during manufacturing and procurement need to be adopted to ensure all prefabricated elements are of good quality and accurate specifications.</li> </ul> |

| S.N. | Materials | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters  | Recommendations  |
|------|-----------|--|---|--|
|      |           | <p><i>Material Properties:</i></p> <p><i>Plywood/Engineered wood:</i></p> <ul style="list-style-type: none"> <li>i) Lightweight.</li> <li>ii) Uniform structural properties make them better load carriers, as compared to solid wood of the same dimension.</li> <li>iii) Relatively high resistance to temperature changes compared to wood, resulting in increased durability.</li> <li>iv) Engineered wood manufactured using wax and resin binders, such as MDF, are waterproof.</li> </ul> <p><i>Plastic/polymer based panels:</i></p> <ul style="list-style-type: none"> <li>i) Good electric and acoustic insulators.</li> <li>ii) Waterproof.</li> <li>iii) Lightweight.</li> </ul> | <p><i>Plywood/Engineered wood:</i></p> <ul style="list-style-type: none"> <li>i) Combustible material.</li> </ul> <p><i>Plastic/polymer based panels:</i></p> <ul style="list-style-type: none"> <li>i) Low melting point and heat resistance, and hence are highly inflammable and susceptible to deformation/melting in extremely hot climates.</li> <li>ii) Low ductility and malleability, hence may fail without prior indication under compressive/tensile forces.</li> </ul> | <ul style="list-style-type: none"> <li>i) Prefabricated plastic/polymer based/ cement based/ wood panels may require additional insulating layers for climatic comfort.</li> </ul> |

| S.N. | Materials | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters  | Recommendations |
|------|-----------|--|---|-----------------|
|      |           | <p><i>Cement based panels:</i></p> <ul style="list-style-type: none"> <li>i) High compressive strength and dense compact composition makes it highly resistant to natural forces, weathering and degradation.</li> <li>ii) Fire resistant.</li> <li>iii) Sturdier and more durable compared to timber, plastic and fibre based sheets and hence ensures longevity and high resistance to wear and tear.</li> </ul> | <ul style="list-style-type: none"> <li>iii) Expensive and difficult to maintain, they often degrade the structural skeleton underneath due to lack of upkeep.</li> </ul> <p><i>Cement based panels:</i></p> <ul style="list-style-type: none"> <li>i) Exposed cement panels could lead to possible weathering and degradation due to natural reasons or poor maintenance.</li> <li>ii) High thermal conductivity makes it unsuitable for extreme climates.</li> </ul> |                 |
|      |           | <p><i>Usage in Construction:</i></p> <ul style="list-style-type: none"> <li>i) Speedy and easy installation process.</li> </ul>  | <ul style="list-style-type: none"> <li>i) Inefficient assembling can lead to poor joineries, leakages or void spaces in the shelter.</li> <li>ii) Being engineered materials and relatively new innovations, homeowners lack knowledge in building with them.</li> </ul>  |                 |

| S.N.                        | Materials   | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters   | Recommendations  |
|-----------------------------|---|--|--|--|
|                             |   |  | iii) Homeowners may have to depend on external aid to conduct repairs and retrofitting in the future.  |  |
| 10                          | <b>Precast RC poles</b><br>(Primary Usage: Structural sections) | Accessibility, Procurement and Delivery:<br>i) Being an industry manufactured product, it can be procured on a large scale as well, based on requirements.<br>ii) Saves construction time on-site.<br>iii) Bulk production ensures cost-effective products.<br>iv) Reduces burden on naturally occurring resources.<br>v) Easy manufacturing process enables the involvement of local manufacturers and suppliers.<br>vi) Speedy installation process. | i) Manufacturing RC poles is not conducive in areas with water scarcity. If not cured well, strength of the pole will be compromised.<br>ii) It is difficult to monitor small manufacturers for the quality and adequacy of reinforcement used.<br>iii) Transit over long distances may lead to damage and hence, monetary losses. | i) Quality control monitoring measures during manufacturing need to be adopted to ensure all units are of good quality and accurate specifications.<br>ii) Curing of all units should be done for minimum 14 days. |
| <b>Material Properties:</b> |   |  |  |  |
|                             |   | i) High compressive strength and dense compact composition makes it highly   | i) Fluctuations in temperature, especially in regions with extreme climates, may result in   |  |

| S.N. | Materials  | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters  | Recommendations   |
|------|--|--|---|---|
|      |  | resistant to natural forces, weathering and degradation.<br><br>ii) Sturdy and highly durable, and hence, ensures longevity and high resistance to wear and tear.<br><br>iii) Fire resistant.                                | expansion and contraction of the units.   |   |
|      |  | <i>Usage in Construction:</i><br><br>i) Can be reused for building permanent shelters.<br><br>ii) Easy and speedy installation.  | i) RC poles are heavy and need careful transportation.<br><br>ii) Usually weak anchoring and connections in practice when used in shelters. | i) Need careful and adequate anchoring and connections with foundation, beams and roof members.   |
| 11   | <b>Tarpaulin (including plastic/polyester based sheeting materials)</b><br><br>(Primary Usage: Roofing, Wall panels, waterproofing and insulation) | i) Can be procured on a large scale based on requirements. It can be purchased from local vendors.<br><br>ii) Bulk procurement may be cost-effective.<br><br>iii) Being a lightweight portable material, it is conducive for | i) Not an environment friendly material and disposal may cause ecological concerns.   | i) Should be procured and used only for the emergency shelter phase, owing to its lack of longevity.<br><br>ii) Procurement should be from sources that are follow health and environmental protection regulations by the government.<br><br>iii) Storage of tarpaulin sheets procured, should be in a dry, moisture free, rodent free place to prevent |

| S.N.                          | Materials  | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations  |
|-------------------------------|--|---|--|--|
|                               |  | transportation across long distances.<br><br>iv) Can be reused and recycled.  |  | degradation, preferably under roof cover.<br><br>iv) Distribution of sheets should be done in continuous rolls instead of individual sheets, to allow for customized context-specific usage. |
| <i>Material Properties:</i>   |  |   |  |  |
|                               |  | i) Lasts approximately 0.5-1 year.<br>ii) Extremely flexible owing to its fabric-like profile.<br>iii) Plastic based composition, hence, water-proof. | i) Anticipated short life span of tarpaulin sheets, with respect to temporary shelters.<br>ii) Can be easily punctured by sharp points or worn away by rough surfaces.<br>iii) Exposure to sunlight and high winds can reduce its lifespan.<br>iv) Poor climatic comfort in extreme heat and cold weather. | i) Tarpaulin should be used only for short-term emergency shelters, as it does not provide adequate protection against extreme weather.  |
| <i>Usage in Construction:</i> |  |   |  |  |
|                               | i) Already prevalent widespread usage of tarpaulin sheets ensures people's familiarity with the material and it's usage in construction. |   |  | i) Usage should ensure it is taut and fixed well, to avoid sagging across the sheet, as it may then form water puddles and compromise on the strength of the roof cover.                     |



| S.N. | Materials  | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters   | Recommendations   |
|------|--|--|--|---|
|      |  | ii) Repair and maintenance can be undertaken by the homeowners themselves, using simple resources, such as stitching and adhesives or by appropriate tying mechanisms.<br><br>iii) Easy availability, installation and versatility, allow it to be appropriated to various functions and in combination with various materials.  |  | ii) Fixings and connections should be made strong enough so as to resist wind loads.<br><br>iii) Adequate slope must be provided when used as roof cover so as to drain rain water effectively.<br><br>iv) Not to be used in conditions where there may be snow.<br><br>v) Using it beneath bedding/ mattresses, can help prevent dampness from rising.   |
| 12   | <b>CGI sheets</b><br>(Primary Usage: Roofing, Wall panels) | <i>Accessibility, Procurement and Delivery:</i><br><br>i) Can be procured on a large scale as well, based on requirements; relatively small orders can be purchased locally, depending on supply and demand.<br><br>ii) Depending on the condition after damage, it can be salvaged from damaged structures and reused.<br><br>iii) Being a lightweight portable material, it is conducive for | i) Production of CGI sheets is energy intensive, resulting in carbon emissions that contribute to air and water pollution. | i) Use only ISI certified products.<br><br>ii) Care should be taken to make sure there is no deformation/damage to corrugations while transporting.<br><br>iii) Procurement should be from sources that are follow health and environmental protection regulations by the government.<br><br>iv) Storage of CGI sheets procured, should be in a dry, moisture free place to prevent degradation, preferably under roof cover. |

| S.N. | Materials | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters  | Recommendations   |
|------|-----------|---|---|---|
|      |           | transportation across long distances.   |   |   |
|      |           | <p><i>Material Properties:</i></p> <ul style="list-style-type: none"> <li>i) Corrugations provide strength and resistance against disfiguration/resistance, galvanization further increases durability.</li> <li>ii) Light weight enhances durability and flexibility of the sheet and lightens the load on underlying built structure.</li> <li>iii) The lightweight nature of CGI sheet roofs, ensures minimal destruction in the event of recurring earthquakes.</li> <li>iv) Corrugations ensure effective drainage of water and protection against seepage of water inside the shelter.</li> <li>v) Non-combustible material.</li> </ul> | <ul style="list-style-type: none"> <li>i) Despite the protective zinc coating against corrosion, excessive atmospheric moisture content or contact with water, can result in the corrosion of this coating, further exposing the base plate. Hence, Low durability in corrosive environments.</li> <li>ii) High thermal conductivity and hence, low resistance to outdoor temperatures.</li> <li>iii) In high rainfall regions, CGI roofs produce significant noise, in addition to susceptibility to corrosion.</li> </ul> | <ul style="list-style-type: none"> <li>i) Zinc coating thickness specifications can be decided to achieve context-appropriate resistance to corrosion. Pre-coated sheets are preferable.</li> <li>ii) Use as wall panels, suitable only in temporary shelters. If used as wall panels, care should be taken to avoid contact with the ground or high levels of moisture.</li> <li>iii) Insulation mechanism is recommended in extreme climates, to counter heat transfer.</li> <li>iv) Sound insulation is necessary to counter noise during rainfall.</li> </ul> |

| S.N. | Materials  | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations   |
|------|--|---|--|---|
|      |  | <p><i>Usage in Construction:</i></p> <ul style="list-style-type: none"> <li>i) Compared to traditional roofing materials, such as bamboo, thatch and tiles, CGI sheet roofing is more durable and needs lesser maintenance expenses.</li> <li>ii) Fast and easy installation</li> <li>iii) Already prevalent widespread usage of CGI sheets ensures people's familiarity with the material and it's usage in construction and hence, conducive to further repairs and maintenance if needed.</li> </ul> | <ul style="list-style-type: none"> <li>i) Poor connections/tying with the under-structure and walls, can lead to poor performance against wind in cyclone prone areas and damage.</li> </ul> | <ul style="list-style-type: none"> <li>i) Needs to be anchored well with the roof under-structure with J or U bolts. Strong connections ensure protection from wind loads, particularly in cyclone prone regions.</li> <li>ii) Adequate slope should be provided in snowfall areas.</li> </ul>  |
| 13   | <p><b>Other corrugated sheets (Bitumen/cement/ plastic-based sheets)</b><br/>(Primary usage: Roofing, Walls, waterproofing and insulation)</p> | <p><i>Accessibility, Procurement and Delivery:</i></p> <ul style="list-style-type: none"> <li>i) These can be procured on a large scale based on requirements.</li> <li>ii) Depending on the condition after damage, it can be salvaged from damaged structures and reused.</li> <li>iii) Being a lightweight portable material, it is conducive for</li> </ul>   | <ul style="list-style-type: none"> <li>i) Production process is energy intensive, resulting in carbon emissions that contribute to air and water pollution.</li> </ul>                       | <ul style="list-style-type: none"> <li>i) Use only ISI certified products.</li> <li>ii) Procurement should be from sources that are follow health and environmental protection regulations by the government.</li> <li>iii) Care should be taken to make sure there is no deformation/damage to corrugations while transporting.</li> </ul> |

| S.N. | Materials | Potential with respect to temporary shelters  | Limitations with respect to temporary shelters   | Recommendations   |
|------|-----------|---|--|---|
|      |           | transportation across long distances.   |  |   |
|      |           | <p><i>Material Properties:</i></p> <p><i>Bitumen based sheets:</i></p> <ul style="list-style-type: none"> <li>i) Waterproof.</li> <li>ii) Lightweight.</li> <li>iii) Flexible.</li> </ul> <p><i>Plastic based sheets:</i></p> <ul style="list-style-type: none"> <li>i) Good electric and acoustic insulators.</li> <li>ii) Waterproof.</li> <li>iii) Lightweight.</li> </ul> | <p><i>Bitumen based sheets:</i></p> <ul style="list-style-type: none"> <li>i) Dark colour leads to heat absorption, resulting in extremely uncomfortable heated indoor spaces.</li> <li>ii) Exposure to extreme heat hence, drastically reduces lifespan.</li> <li>iii) Combustible material</li> </ul> <p><i>Plastic based sheets:</i></p> <ul style="list-style-type: none"> <li>i) Low melting point and low heat resistance; mean they are highly inflammable and susceptible to deformation/melting in extremely hot climates.</li> <li>ii) Exposure to extreme heat hence, drastically reduces lifespan.</li> <li>iii) Faster susceptibility to degradation due to wear and tear.</li> </ul> | <ul style="list-style-type: none"> <li>i) Require additional layer of insulation for climatic comfort in extreme weather conditions.</li> <li>ii) Sound insulation is necessary to counter noise particularly during rainfall.</li> </ul> |

| S.N.                          | Materials   | Potential with respect to temporary shelters   | Limitations with respect to temporary shelters  | Recommendations |
|-------------------------------|---|--|---|-----------------|
|                               |   | <p><i>Cement based sheets:</i></p> <ul style="list-style-type: none"> <li>i) Highly resistant weathering and degradation.</li> <li>ii) High thermal conductivity and high thermal mass (slow to warm and slow to cool), makes it suitable for extreme climates.</li> <li>iii) Fire resistant.</li> <li>iv) Waterproof.</li> <li>v) Sturdier and more durable than plastic and bitumen based sheets.</li> </ul> |   |                 |
| <i>Usage in Construction:</i> |   |  |   |                 |
|                               | <ul style="list-style-type: none"> <li>i) Fast and easy installation.</li> <li>ii) Already prevalent widespread usage of these sheets ensures people's familiarity with the material and it's usage in construction.</li> </ul> | <ul style="list-style-type: none"> <li>i) Poor connections/tying with the under structure and walls, can lead to poor performance against wind in cyclone prone areas and damage.</li> <li>ii) May require frequent repair and maintenance.</li> </ul>   | <ul style="list-style-type: none"> <li>i) Needs to be anchored well with the roof under-structure with J or U bolts. Strong connections ensure protection from wind loads, particularly in cyclone prone regions.</li> <li>ii) Adequate slope should be provided in snowfall areas.</li> <li>iii) Use as wall panels, suitable only in temporary shelters.</li> </ul> |                 |

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## Contact Us

For more information on  
*National Guidelines on Temporary Shelters for Disaster - Affected Families*

Please contact:

**National Disaster Management Authority**

NDMA Bhawan, A-1 Safdarjung Enclave,  
New Delhi-110 029

Tel: +91-11-26701700

Web: [www.ndma.gov.in](http://www.ndma.gov.in)



