
**DESIGNING DISASTER RELIEF SHELTERS FOR A COMMUNITY FOCUSED
RELIEF SYSTEM**

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Abstract

Disasters are adverse events that arise due to geological or climatic changes, or actions of human beings. Disasters are known to cause serious impacts on the livelihoods of people, bringing about losses and damage to people and property in its wake. With the loss of lives, belongings and safety, victims are displaced and their sense of dignity and personal space are lost.

Countries from all around the world recognize these hazards and vulnerabilities. Effective steps are taken for prevention, mitigation, response and recovery - all essential processes in disaster management.

While developed countries have systems and up-to-date equipment that help prepare them for such events, developing countries and under-developed countries lack the preparedness and mitigation efforts to avoid or minimize the damages inflicted.

Unfortunately, India faces multiple natural disasters that caused havoc to life and property. With the lack of the required infrastructure and a proper disaster management plan, India witnesses more casualties and losses compared to other developing countries. As such, a disaster relief shelter can contribute to reducing the loss of lives, properties and damages.

When disaster strikes, the need for shelter is of utmost importance. Disaster relief shelters provide the necessary support to victims of traumatic disasters while also acting as an immediate reaction to the calamity. They provide refuge temporarily until the situation is brought back under control or until they can be relocated to a safer, more permanent location.

In addition to providing the basic requirements of drinking water, food, sanitary facilities and other commodities to victims of calamities, disaster relief shelters must keep in mind the emotional and mental state of the affected communities/persons. Disaster relief shelters are the first step of a community towards resilience and self-sustenance on a long term basis.

The essay sets out to highlight the disaster management plans in India and other countries, the criteria that shelters need to cover, and the design proposal that responds to different disasters.

Keywords: Disaster relief shelters, vulnerability, community focused relief system, disaster management, disaster prevention and mitigation, resilience and self-sustenance.

Part 1: Disasters (Introduction and impacts)

Introduction

A disaster is an adverse event that results in great damage, loss of property and lives, harm, and destruction. The severity of a disaster depends on the affected's resilience and preparedness, and the available resources that mitigate the disaster. Disasters are broadly classified into two categories: natural and man-made.

Natural disasters arise from changes in the earth's climatic and geological structure, causing a large scale impact on life forms and the built environment. The various types of natural disasters are brought about by an imbalance of one or more natural elements. For instance:

- Earthquakes
- Landslides
- Sandstorms
- Floods
- Tsunamis/Hurricanes/Cyclones
- Tornadoes
- Wildfires
- Volcanic Eruptions

On the other hand, man-made disasters occur due to malicious human intent, error or negligence of systems. Such examples are:

- Terrorism and social unrest
- Hazardous material incidents (oil spills, gas leaks, radiation, etc.)
- Cybercrimes and attacks
- Explosions and bomb blasts

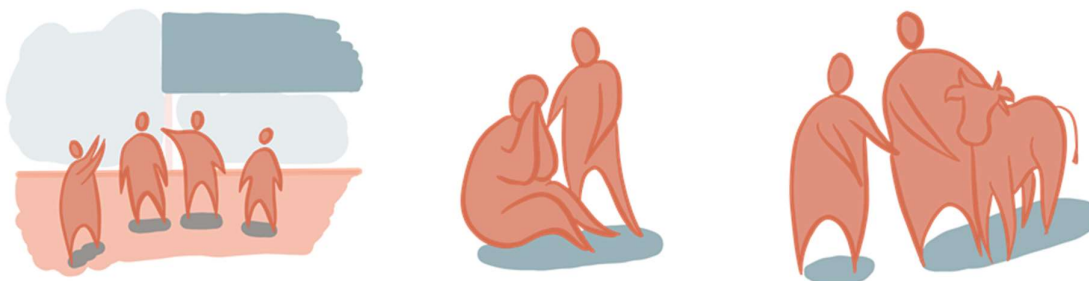
- War
- Crime and arson
- Biological and chemical threats
- Maritime, aviation, rail and road accidents

Disasters cause a serious disruption of the functioning of a community or a society and lead to human, material, economic and environmental losses and impacts. In such events, there is a need for attention to secure and provide food and drinking water for those affected. Medical and pathological fields require more attention, especially in cases of epidemics/pandemics.

In cases of natural or man-made disasters, victims, refugees fleeing from violence and poverty, and displaced people require shelter facilities. Post-disaster recovery is complex, and it imposes numerous challenges for the affected communities and the government.

Temporary shelters are set to house the affected communities and prevent secondary events which further add to the severity of the disaster that occurred. In the case of man-made disasters such as wars, persecution or violence, refugee camps are set up as temporary facilities for immediate protection.

In cases of long-term displacement and forced migrations, services are expanded to include educational and livelihood opportunities. Additionally, refugees are provided with materials to build more permanent homes and rebuild their lives.



Part 2: Countries tackling the disasters (Comparative Study)

Disaster Management

The International Federation of Red Cross and Red Crescent Societies, a humanitarian aid organisation that has its reach across 192 countries has defined what the phrase Disaster Management entails. According to the body, this includes organisation and management of the resources as well as the responsibility of tackling the humanitarian facet of emergencies, natural and man-made alike, concerning preparedness, response and recovery conducive to ensuring the least possible impact of said disasters.

To take on disasters as well as urge responses and recovery post-disaster, disaster management involves organising, planning, coordinating and implementing means and measures to guarantee the prevention, preparedness and mitigation of disasters.

Disaster management consists of preparedness and mitigation. The two phases are essential, to save lives, restore livelihoods and reduce risks faced by communities.

Disaster Preparedness

Disaster preparedness is essentially ensuring measures and resources in such a way that individuals, households, businesses, communities and societies can respond effectively and recover more quickly in case of a disaster. Through disaster preparedness, those who face such situations are aware of the methods and the techniques of utilising resources for their safety.

Disaster preparedness consists of formulating plans that ensure readiness, procuring and storing the required resources, and training and developing skills to effectively perform tasks during a disaster.

Essentially, disaster preparedness planning consists of two phases - the response phase and the recovery phase. The recovery phase depends on the actions taken during the response phase, and a good response phase ensures a quick and efficient recovery phase. This means that with adequate planning, resources and communications, the requirements of affected people are met in a shorter period.

However, since the resources for disaster response are limited, there is a challenge for governments and civil societies to utilize them effectively and efficiently to attend to all the phases of disaster management.

Disaster Prevention and Mitigation

Disaster prevention and mitigation is the elimination or reduction of the impacts and risks of disasters. This is possible through active measures done before the occurrence of disasters.

Disaster mitigation involves either structural or non-structural measures. Necessary tools and equipment provide data on past events to focus efforts and funds at the right places. Typically, prevention and mitigation can be adopted at three different levels: municipal, provincial and individual.

Minimizing the severe effects of disasters such as floods, cyclones and earthquakes, in susceptible areas, can be achieved by proper planning and mitigation measures. The following key areas should be addressed to achieve this objective:

- **Risk Assessment and Vulnerability Mapping:** This analysis in a structure susceptible to damage should be conducted making use of Geographic Information System (GIS) based databases such as the National Spatial Data Infrastructure (NSDI) and National Database for Emergency Management (NDEM).
- **Increasing Trend of Disasters in Urban Areas:** Measures must be taken to put a stop to unplanned urbanization. A system and set of actions must be devised and must be

given the highest priority. State Governments and Union Territories must take charge and direct their focus towards Urban Drainage systems while paying special consideration to natural drainage systems.

- **Critical Infrastructure:** Infrastructure that is essential like roads, dams, bridges, irrigation canals, power stations, railway lines, bridges, water distribution networks, ports, river and coastal embankments should be checked regularly for standards of safety to see if it is as per the worldwide safety standards. If the current measures are deemed to be inadequate, immediate action must be taken to achieve maximum safety.
- **Environmentally Sustainable Development:** Efforts on development along with environmental consideration should be handled in a way that ensures sustainability.
- **Climate Change Adaptation:** Along with a sustained and effective approach taken to tackle the challenges of the rise in the frequency and intensity of disasters, the promotion of a plan of action for climate change adaptation and reduction of disaster risk is a must.

Other areas to be looked into are - **Hazard mapping, Adoption and enforcement of land use and zoning practices, Implementing and enforcing building codes, Flood plain mapping, Burying of electrical cables to prevent ice build-up, Disaster mitigation public awareness programs, Insurance programs.**

Disaster Response globally

Japan

The Government of Japan (GOJ) and the Japanese civil society play vital roles in disaster relief. The GOJ dispatches Japan Disaster Relief Teams, provisions for emergencies and financial aid as disaster responses. The Japanese Red Cross Society, NGOs and private companies also contribute through physical support, supplies and aids.

However, while Japan plays an excellent role as an aid provider, their unwillingness to play a role as an aid recipient proves to be a fatal move. In the event of the Tohoku Earthquake (March 11, 2011), the GOJ accepted international aid (response teams, financial aids and relief supplies) from 95 nations and international organizations. Before the acceptance of help, about 20,000 people were killed, and many more were missing.

The GOJ and Japanese civil society realized that in addition to being an effective aid provider, it is essential to be an effective aid recipient. This led to “Double Use Capability”, one of the solutions. This means a country needs to play the role of both a provider and a recipient. The basis of this is employing legal arrangements/partner agreements, human resources and equipment.

For all disaster risk management activities in Japan, the Basic Disaster Management Plan plays a vital role. It is the master plan prepared by the Central Disaster Management Council in Japan, under the guidelines of the Disaster Countermeasures Basic Act. The Basic Disaster

Management Plan explains the duties of the central and local governments and the public corporations in implementing measures. The plan also lists down disaster countermeasures - preparation, emergency response, recovery, and reconstruction - for various types of disasters.

Post-Tohoku Earthquake, the capacity of existing disaster risk management planning systems have been assessed and revised. The GOJ revised the Basic Disaster Management Plan on December 27, 2011, based on reports from the Expert Committee on Earthquake and Tsunami Disaster Management. The revisions included improvements such as:

- Disaster management for tsunamis and earthquakes
- Raising public awareness on evacuation, disaster risk management and hazard maps
- Additional investments and resources for reinforcement and retrofitting of buildings
- Improve communication tools such as tsunami early warning systems

Dominica

The Caribbean Island nation of Dominica is exposed to a multitude of natural disasters including tsunamis, volcanic eruptions, hurricanes, earthquakes, landslides, floods, and droughts. As part of disaster mitigation and relief shelter management, the entire island is equipped with close to 150 emergency shelters, providing refuge to those displaced. Emergency shelters across all districts of Dominica have been successful in encouraging refugees to actively participate in community-building activities. However, these disaster relief shelters also face challenges of providing access to the disabled, inadequacy of Water, Sanitation, and Health facilities (WASH) at a larger level in addition to lack of privacy of individuals of a community, and insufficient lighting and communication facilities.

United States of America (USA)

In the United States, Federal Emergency Management Agency (FEMA) is part of the Department of Homeland Security. FEMA's role is to help people before, during and after disasters, and develop strategic plans for disaster preparedness and mitigation. FEMA coordinates with the federal government to prepare and respond to disasters.

Typically, in the United States, when a disaster strikes, the state identifies the disaster. A disaster assessment is made and the government officials review the damage and determine the extent of the disaster and its impact.

Based on the findings, the governor decides if the state has adequate resources to respond to the disaster. Should there be a lack of resources, then the governor determines the type and the amount of assistance needed from the federal government. The state, tribe or territory affected submits a major disaster declaration request.

Then, the president reviews the request and determines whether the state and the local governments need federal assistance to recover from the disaster. Upon approval, a disaster is

declared and FEMA contributes to the disaster response through fundings, supplies and personnel. Thus, along with the local authorities, FEMA works to help communities respond, recover and rebuild from disasters.

Disaster Management in India

Developed countries have systems and effective programmes that reduce the impact of the disasters on them, while the developing and the under-developed nations suffer more from these disasters. In India, the concept of disaster preparedness is uncommon and as such India suffers from human and economic losses more than other developing countries.

India often witnesses droughts, floods, cyclones, avalanches, earthquakes and landslides. Landslides are common in the regions of the lower Himalayas and the Western Ghats, while floods are a common natural disaster, especially along the banks of the Brahmaputra river and other rivers, and the coastal regions. With the increase in temperature over the past few years, rains have become more severe, thereby facing higher risks of floods.

Disaster Management Act of 2005, India

The Disaster Management Act of 2005 (DMA 2005) is an act passed by the government of India for the 'efficient management of disasters and other matters connected to it.'

Before the Act, the focus was on disaster relief and recovery. However, with numerous consecutive events such as the tsunami of 2004, floods and the earthquake in Jammu and Kashmir, it became necessary for India to address disaster management. Thus, the Disaster Management Act, 2005 was made effective from December 23, 2005, to provide for the effective management of disasters and matters connected therewith or incidental thereto.

The role of the National Disaster Management Authority (NDMA) is:

- Laying down policies for disaster management
- Approving the plans prepared by the different concerned Departments
- Draw a National and State Plan

The Disaster Management Act of 2005 defines Disaster Management as an integrated process of planning, organizing, coordinating and implementing measures that are necessary for:

1. Prevention of threat of any disaster
2. Reduction of risk of any disaster or its consequences
3. Readiness to deal with any disaster
4. Promptness in dealing with a disaster
5. Assessing the severity of the effects of any disaster
6. Rescue and relief
7. Rehabilitation and Reconstruction

Drawbacks of the DMA, 2005:

- 1) The act fails to categorise the country into various disaster-prone zones which would lead to issues in mitigating the damages caused.
- 2) The act also states disasters to be sudden events, ignoring the possibility of epidemics and other disasters that progress over a long period.

However, after a decade, the first-ever National Disaster Management Plan was formulated in 2016. The Plan is aligned with the Sendai Framework of Disaster Risk Reduction 2015-2030, a major agreement of the post-2015 development agenda in UNDRR (United Nations Office for Disaster Risk Reduction). NDMP lists out the roles and responsibilities of all levels of Government, from the Panchayat to the Central Government, while covering all phases of disaster management.

However, there are numerous problems with NDMP. Identification of the activities to be taken by the Government are too generic and there is no time frame for these activities. Furthermore, with the lack of fund requirements, the plan is ineffective, thus India would require more efforts and planning for it to be disaster resilient.

Unfortunately, with the drawbacks of DMA and the lack of goals of NDMP, India is still vulnerable to disasters. For India to build up resilience, its infrastructure needs to be in order. Hence, a disaster relief shelter is essential as it plays a vital role in disaster management.

Part 3: Disaster relief shelters

To prepare for cases of disaster, India needs to have its infrastructure in place. As such, a disaster relief shelter is essential for any disaster management.

A disaster relief shelter is a temporary shelter that houses victims and displaced people. These shelters provide private and secure spaces for those who have lost or left their accommodations in the aftermath of a disaster. They also allow refugees to recover from the trauma of disaster and provide a base for rehabilitation.

Ideally, disaster relief shelters are designed to support communities and require little maintenance. A universal prototype can be deployed in any disaster-stricken area lacking basic facilities. These prototypes are modular and can be easily stockpiled. Additionally, they should be assembled in a short period, without any need for power tools.

Although disaster relief shelters are an integral part of the response and recovery, one universal prototype for the design of these shelters would not be appropriate due to their response to varying factors like the topography, climatic conditions, the number of users and the type of disaster that has occurred.

For example, in cases of most disasters, disaster relief shelters make use of lightweight materials that are found in abundance in and around the temporary site, but in cases where

disasters are mainly due to an imbalance of wind forces, propping up a lightweight disaster relief shelter would cause additional damage.

Thus, the climate, along with the cause of the disaster must be carefully studied and taken into consideration while designing a disaster relief shelter.

Why a shelter for disaster relief must be built:

- To provide shelter from harsh climatic conditions
- To ensure that the dignity and privacy of victims are respected and maintained
- To provide security and personal safety, while allowing survivors to recuperate and recover
- To give survivors the time and the mental space to decide upon the next step (retrieval/salvage of properties and belongings, rebuilding from broken foundations)

While designing and constructing a relief shelter for victims of disasters, a few important aspects must be taken into consideration. These include:

1. the scale and type of a disaster - whether the disaster is manmade or artificial; How many people has it affected and displaced? What is the severity of the disaster?

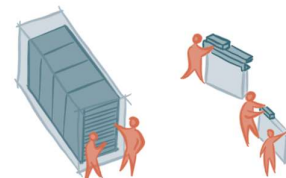
2. Context - location of the disaster; availability of resources close to efficiently manage natural environmental resources.

• Further, issues related to water, hygiene, sanitation, electricity (at a community level) among others would be easily understood and resolved.

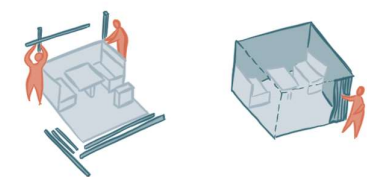
• Disposal of waste, sewage, facilities for potable water, minimising heating and lighting through the use of electricity, building a society that can sustain itself while ensuring utmost comfort and space for every individual to recuperate are among other issues that can be tackled when building relief shelters for disaster-struck areas.

Additionally, communal facilities such as play areas and healthcare facilities, schools, spaces of congregation and interaction, have to be available to those affected by the disaster.

With India being a country of varying topography and climate, the disaster relief shelter must be adaptable to be deployable anywhere. Health and hygiene are compromised during disasters. Hence, the disaster relief shelter must be equipped with services and be self-sufficient in cases where relief supplies are inadequate.



The most important criterion is the cost of these shelters. With materials that are easy to procure and ease of assembly, the price of the shelters can be low enough for a common man to purchase one of them. It must be also kept in mind how parts of the shelters must be stored after dismantling them and how the materials can



be salvaged and recycled after passing the lifespan of these shelters.

Part 4: The design proposal

As a response to the issue posed in the previous section, we designed a disaster relief shelter.

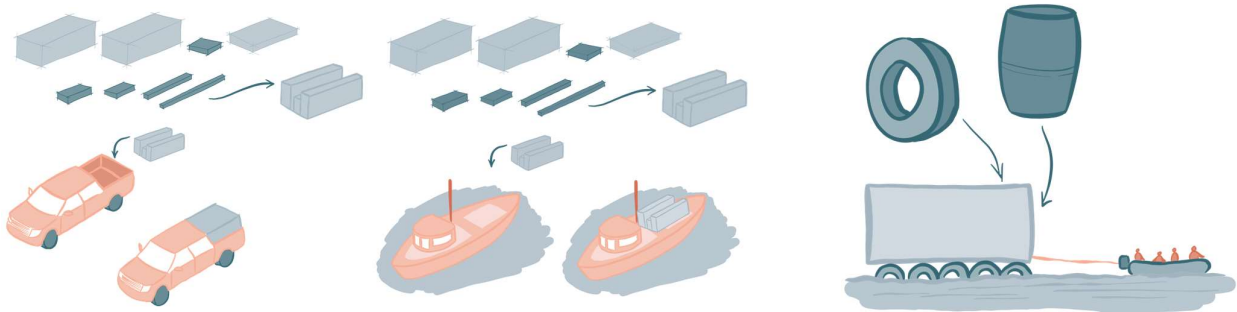
Individual unit

Our design is a rapid build modular housing prototype that can be easily assembled and disassembled using low skilled human labour within six hours. These individual units are designed with the intent of providing immediate refuge for those displaced in the wake of a disaster.

The prototype can be deployed across the country on various topographical conditions - on sloped surfaces, flat land, and flooded areas. Two prototypes have been designed

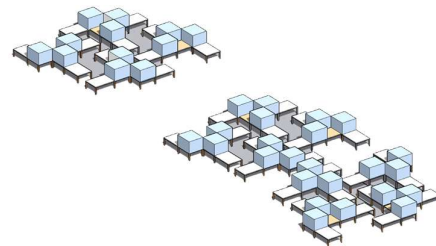
- **Prototype 1:** deployable on land with adjustable stilts that support the entire structure
- **Prototype 2:** a water prototype where the structure is supported on a buoyant raft made of materials such as plastic barrels, water bottles, tyres.

Both the prototypes are made of materials that can be easily procured and transported via boats and trucks.



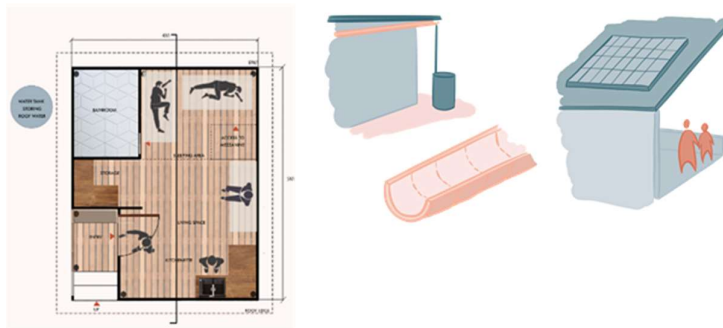
Cluster - arrangement and purpose

These units are grouped in clusters to imbibe a sense of community living, encourage interaction among victims, and provide the users with a haven to begin the process of rehabilitation.



The emotional and psychological states of the users is an important aspect influencing the design of clusters. The abundance of large open spaces between units functions as a courtyard where people can congregate, interact and engage with each other. Open to sky decks placed adjacent to every unit behave as spillover spaces as well as provide scope for further expansion of units.

The community as a whole is designed to be self-sufficient with solar-powered lighting and heating and rainwater harvesting systems.



Each individual unit is designed to be modular and is organised in a pattern which would account for future expansion. Three typologies of units have been designed- the smallest of 20 square metre houses upto 5 persons at a time, a 30 square metre unit that houses 8 people, and the largest being a 50 square metre area unit housing 10 people at once.

Design of an individual unit:

Each unit is furnished with:

- An entrance foyer with the aim of encouraging community dialogue
- A kitchenette with basic provisions for cooking and washing
- A living area
- A sleeping area- accommodated on a mezzanine as well as demarcated from the living space by a temporary partition
- A bathroom
- A storage space for belongings, food rations, vessels

In addition, units are provided with a sloped roof that aids in collecting and thereby harvesting rainwater, as well as a solar panel attached to the roof that aids in achieving energy efficiency by powering electrical lighting systems within individual units.

Further, a retractable chajja has been incorporated by opening out the top portion of the unit's rear wall. This helps in the creation of a clerestory window that would aid ventilation and natural lighting during the day while also serving the purpose of a chajja- to shade the adjacent community pathways. A water tank has also been provided to each unit to aid in self-sufficiency.

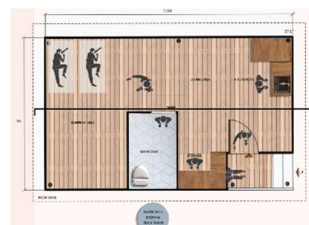


Figure 2: Floor Plan 30 Sq.m Unit

Figure1: Floor Plan 20 Sq.m Unit



Figure3: Section for 20 Sq.m Unit



Figure 4: Section for 30 Sq.m Unit

Materiality:

Translucent Polycarbonate sheets have been made use of for walls- to maximise daylight penetration while maintaining privacy of users within. Two walls of every unit are diagonally braced to provide additional stability and resistance against lateral forces arising due to high wind speeds as well as earthquake tremors of lower magnitudes. Further, lightweight Wood Plastic Composite (WPC) panels have been used due to its low life cycle cost and easy maintenance in addition to being an environmentally friendly material by making use of recycled plastic scraps and discarded wood.

Conclusion

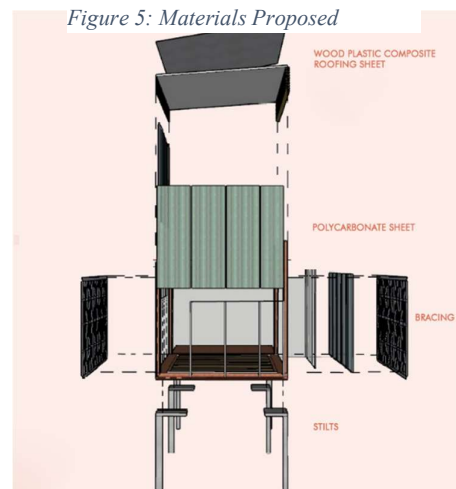
Disasters occur not by chance but as the result of the environment's vulnerability to hazardous conditions. While advancing technologies have helped us predict disasters, the complexity and the variations in natural disasters doesn't allow us to accurately pinpoint the occurrences or the extent of damage inflicted. The best hope is observation and data from previous instances, and taking steps to minimize the damage and losses.

As a result, it is of utmost importance to prepare for upcoming disasters by developing the required infrastructure. One solution is disaster relief shelters that are affordable for common men, to provide privacy and secure places during arduous times. Through well-prepared disaster management plans, awareness and adequate facilities, the affected country, state or community can move onto the post-disaster life with ease and little time.

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Figure 5: Materials Proposed



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