The Study of Refurbished Shipping Container in Disaster Prone Area: Focus on Earthquake & Flood

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Abstract: Refurbished shipping containers as housing buildings in disaster-prone areas. These containers are considered sustainable construction modules, providing quick and efficient temporary housing solutions. They also serve as safety and shelter during crises, fulfilling basic human needs during earthquakes and floods. Disposable and recycled containers contribute to a sustainable construction system. These containers can act as valuable housing modules for people stuck in vulnerable areas and provide a quick and efficient solution for temporary housing needs. providing safety and shelter in times of crisis. by fulfilling the basic human need in times of earthquake and flood In the face of natural disasters like earthquakes and floods, where homes are destroyed and communities displaced, these containers stand as resilient shelters, providing safety and refuge to those in need. Their sturdy construction and adaptable design make them ideal candidates for emergency housing, swiftly assembled to accommodate displaced populations.

Keywords: Refurbished shipping containers, vulnerable areas , Emergency housing,

1.INTRODUCTION.

In response to the pressing need for sustainable and affordable housing solutions, architects and researchers are increasingly turning to innovative approaches that encompass the entire lifecycle of residential units. This paper endeavors to reshape future architecture by examining design, construction, and operational strategies that leverage prefabricated shipping containers. By focusing on space design, building materials, thermal comfort, and self-sufficiency, the aim is to elevate architectural standards while addressing societal and environmental challenges. The widespread availability of shipping containers stands in stark contrast to their underutilization in the realm of housing construction. This paper seeks to explore the underlying reasons for this disparity and to identify opportunities for maximizing the benefits of container-based architecture. By reviewing past implementations and current practices, the goal is to uncover strategies that enhance safety and resilience, particularly in light of emerging health concerns

Through an interdisciplinary approach that integrates architectural design, engineering principles, and sustainable development goals, this research aims to unlock the full potential of prefabricated shipping containers as a catalyst for transformative architecture. By examining the entire lifecycle of residential units – from conceptualization to occupancy – this paper seeks to chart a course towards more resilient, adaptable, and environmentally conscious built environments. As India grapples with the increasing frequency and intensity of natural disasters, the adoption of refurbished shipping containers as emergency shelters represents a forward-thinking response to the challenges of rapid urbanization, climate change, and humanitarian crises. By leveraging these containers' versatility and adaptability, communities can not only meet the immediate needs of disaster refugees but also lay the foundation for a more resilient and inclusive built environment in the future.

2. Authority Responsible for Providing Disaster Management in India

The NDMA, National Disaster Management Authority act as the apex body for disaster management, is headed by the Prime Minister and has the responsibility for laying down policies, plans and guidelines for DM (and coordinating their enforcement and implementation for ensuring timely and effective response to disasters) . will approve the National Disaster Management and DM plans of the Central Ministries/Departments. It will take such other measures as it may consider necessary, for the prevention of disasters, or mitigation, or preparedness and capacity building, for dealing with a threatening disaster situation or disaster. Central ministries/

departments and State Governments will extend necessary cooperation and assistance to NDMA for carrying out its mandate.It will oversee the provision and application of funds for mitigation and preparedness measures.

The National Disaster Management Authority (NDMA) allocates funds for the National Disaster Response and Mitigation Fund (NDRMF) to address disasters like earthquakes and floods, which often cause significant infrastructure damage and losses. This fund serves as a financial resource to support relief and mitigation efforts in response to such calamities. By proactively investing in disaster preparedness and response, NDMA aims to minimize the adverse impacts of disasters on infrastructure and communities. The NDRMF plays a crucial role in facilitating swift and effective responses to mitigate the consequences of earthquakes and floods, ensuring a more resilient and safer environment for all

Figure 1DISASTER MANAGEMENT CYCLE

3. AREAS IN INDIA vulnerable to earthquake and flood

3.1. Earthquake

India's vulnerability to earthquakes is due to its geological location and tectonic activity. The country's proximity to major fault lines, such as the Himalayan belt and northeastern India, makes it particularly susceptible to seismic events. Historical earthquakes like the 2001 Gujarat and 2011 Sikkim earthquakes highlight the country's vulnerability. India's growing population and urbanization further heighten the risk, with dense urban centers facing increased exposure to earthquake impacts. To mitigate potential devastation, comprehensive earthquake safety measures, including robust building codes, disaster preparedness, and public awareness campaigns, are crucial.

- Kolkata, West Bengal
- Guwahati, Assam
- Bhuj, Gujarat
- Imphal, Manipur
- Amritsar, Punjab
- Srinagar, Jammu & Kashmir
- Port Blair, Andaman and Niccobar Islands
- Chandigarh, Punjab and Haryana
- Dehradun, Uttarakhand
- Darbhanga, Bihar
- Delhi
- Mandi, Himachal Pradesh
- Sadiya, Assam
- Tezpur, Assam
- Jorhat, Assam

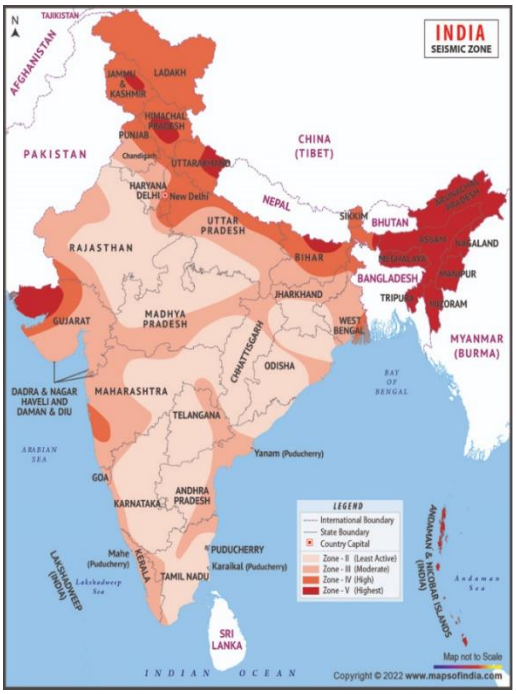


Figure 2 EARTHQUAKE ZONE IN INDIA

3.2. Flood:

India is a major flood-prone country, causing significant loss of life and infrastructure. Each year, millions of people are affected, affecting around 40 million hectares of land. The frequency of floods has increased due to climate change, and India's vast coastline, spanning 7,517 kilometres, is prone to these disasters. Factors like atmospheric rivers, intense rainfall, and land use changes contribute to these disasters. In recent years, floods have damaged infrastructure, including homes, leading to

displacement and loss of shelter. To mitigate these impacts, India needs comprehensive flood management strategies, including improved infrastructure, early warning systems, and better land use planning.

Here are notable past flood crises in India:

1987 Bihar Flood
1998 Gujarat Flood
2000 North-East India Flood
2005 Mumbai Flood
2019 Floods in Gujarat, Kerala, Karnataka, Maharashtra, Uttarakhand, and Himachal Pradesh
2023 Sikkim Flood - Heavy rain caused a glacial lake to overflow, resulting in casualties and missing individuals.

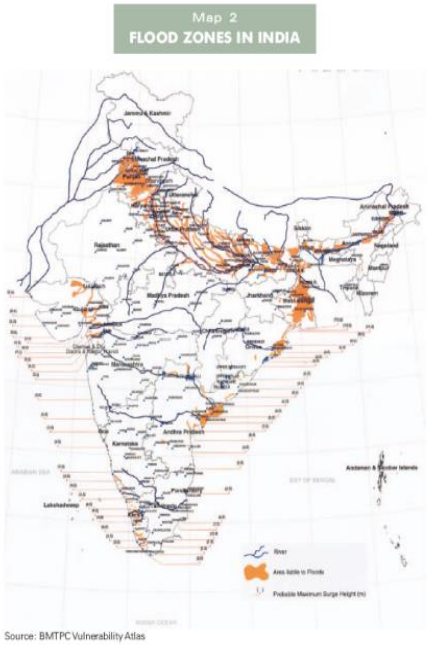


Figure 3 FLOOD PRONE AREAS IN INDIA

4.0. Overview of disaster and temporary housing in disaster prone areas

Container housing offers several advantages for providing temporary and immediate response to people affected by disasters and aiding in their recovery:

Rapid Deployment: Shipping containers can be quickly transported to disaster-stricken areas and repurposed into habitable shelters, providing immediate relief to displaced individuals and families .

Cost-Effectiveness: Container housing is often more cost-effective compared to traditional temporary housing solutions, such as tents or prefabricated structures. Containers offer long-term use and durability, minimizing the need for frequent replacements or repairs .

Durability and Safety: Shipping containers are inherently strong and resilient, making them suitable for disaster-prone areas. They offer protection against the elements and potential hazards, ensuring the safety and security of occupants .

Scalability and Flexibility: Container housing can easily adapt to the size and needs of the affected population. Modular designs allow for flexibility in layout and configuration, accommodating varying household sizes and preferences .

Basic Amenities Integration: Containers can be retrofitted with basic amenities such as electricity, plumbing, heating, and sanitation facilities. By providing essential comforts, container housing improves the quality of life for residents during their temporary stay .

Community Integration: Container housing projects can be designed to promote community cohesion and social support networks among affected individuals. By fostering a sense of belonging and resilience, container housing aids in the recovery process .

Sustainable Reuse: Repurposing shipping containers for housing reduces waste and promotes sustainable practices. Giving a second life to these durable structures aligns with principles of environmental conservation and resource efficiency .

4.1. Major ports in India

India's ports serve as a bustling hub for trade, with countless shipping containers arriving and departing from these locations daily. These ports present a potential epicenter from which used containers can be sourced and repurposed for further modification and sale.

India's vast coastline and strategic location make it an ideal place to extract and procure used shipping containers from its bustling ports.

The well-connected logistics infrastructure of India's ports enables the efficient transportation and shipment of refurbished containers to different locations vulnerable to earthquakes and floods. These modified containers, specifically designed to serve as resilient shelters during calamitous events, can be strategically deployed in areas prone to such disasters. This, in turn,

Figure 4 MAJOR PORTS OF INDIA

supports disaster management efforts by providing timely and robust temporary housing solutions to affected communities.

5.Modification In Shipping Container

5.1.Dimensions:

•Shipping containers (SCs) come in various dimensions, typically 6.0, 9.0, and 12.0 meters in length, with heights ranging from 2.4 to 2.7 meters and a standard width of 2.4 meters.
•High cube (HC) containers, with a height of 2.7 meters, are commonly used for architectural purposes due to their increased internal height. Examples include the 20′HC (6.0 meters long) and 40′HC (12.0 meters long) containers.

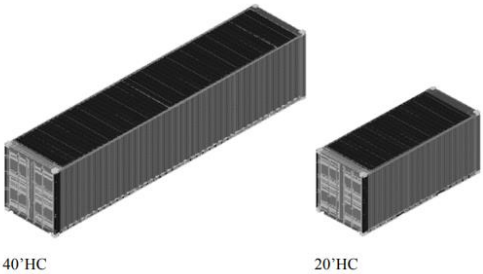


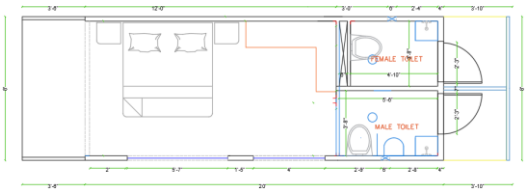
Figure 5. Containers 20'HC and 40'HC.

5.2. Stacking:

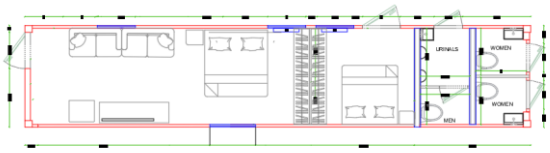
•The stacking capacity of SCs varies based on factors like load and structural design. Literature suggests a range from six when fully loaded to 12 when empty, but some sources claim there's no vertical stacking limit, contingent upon structural calculations and reinforcement.

5.3. Structure and Apertures:

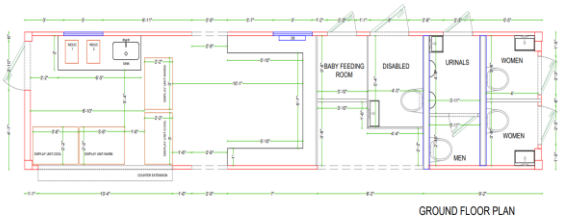
•SCs are typically made of weathering steel or corten steel for high corrosion resistance. Construction involves trapezoid metal sheets for walls, ceiling, and edges, with a grid supporting the wooden floor. Standard wall and ceiling thickness is 2 mm, with corrugated steel sheets ranging from 25 to 50 mm. Deep corrugation enhances inertia and rigidity.
•Preparation for construction includes disinfection, cleaning, cutting of openings, surface treatment, and painting in a controlled factory environment. SCs are then transported to the site for assembly. The average lifespan of an SC is approximately fifteen years.



FLOOR PLAN OF 20' HC

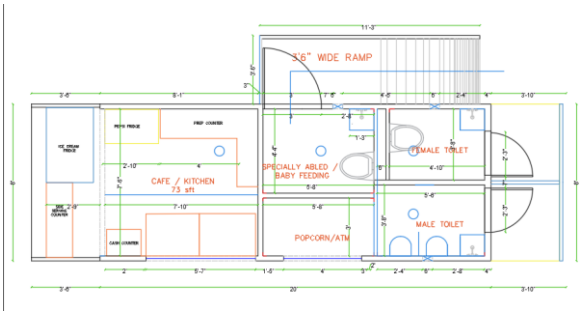


GROUND FLOOR PLAN OF 40' HC



GROUND FLOOR PLAN

Floor Plan of Container kitchen 40' for disaster resilient



Floor Plan of Container kitchen 20' for disaster resilient

6.CONCLUSION

The innovative utilization of refurbished shipping containers as resilient shelters presents a progressive solution to the pressing challenges posed by natural disasters in India. By leveraging the well-connected logistics infrastructure of the country's ports, these modified containers can be efficiently transported to disaster-prone areas, offering timely relief to affected communities. Through interdisciplinary collaboration and a focus on sustainable development, this approach not only addresses immediate housing needs but also fosters resilient and environmentally conscious built environments. By embracing prefabricated container architecture, India can navigate the complexities of rapid urbanization, climate change, and humanitarian crises more effectively. This research underscores the transformative potential of container-based housing, emphasizing the importance of holistic lifecycle management to ensure long-term sustainability and adaptability. Ultimately, the adoption of shipping containers as emergency shelters represents a forward-thinking response that paves the way for a more resilient, inclusive, and future-ready built environment in India

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