RECOVERING COMMUNITY: An Approach to Transitional Housing for Post-Disaster Resiliency

Sadikshya Bastola

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RECOVERING COMMUNITY: AN APPROACH TO TRANSITIONAL HOUSING FOR POST-DISASTER RESILIENCY
by
Sadikshya Bastola

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Architecture
Major: Architecture

The University of Memphis
May 2021
DEDICATION

I would like to dedicate this thesis to my family. I express my gratitude to my parents, Shyam Jee Bastola and Saraswoti Bastola, for providing me with unconditional love, unfailing support, and continual encouragement throughout my life.

I am thankful for my two older sisters, Manisha and Soniya Bastola, for being the biggest cheerleaders and guides. I would not have been here without you. Thank you.
ACKNOWLEDGEMENTS

First, I would like to thank Professors Michael Hagge and Sherry Bruin for believing in me and providing me with this incredible opportunity to study here at the University of Memphis. This wonderful educational journey would not have been possible without your support.

I would like to thank Professor Jennifer Barker for your unending support and faith. Thank you for believing in me and helping me to push my boundaries to become a better architect.

My thesis work would not have shaped this way if it were not for Professor Marika Snider. Thank you for agreeing to serve as my thesis chair and for your direction and guidance throughout the thesis research process.

Special thanks to Professor William Randolph for providing great insight and helping me develop my critical skills. I am fortunate to have had the best learning experience here at the University of Memphis.

Last, I want to give strong thanks to my dear classmates with whom I share genuine friendships! Thank you for being kind and brilliant teammates. I will take this friendship with me. I hope our paths cross again in the future.
This thesis’s primary influence is my experience in a disaster, having experienced massive earthquakes myself. I am a survivor of the two earthquakes that happened in the space of three weeks in Nepal in April, 2015. It was a very traumatic and sad event that caused enormous loss of life and property. Even after the significant event, we were haunted by the tremors and aftershocks. The first week was the hardest, and very few of us slept as we were filled with a constant sense of panic. We had lost our dear ones; some were in grief and pain, but what most of us were trying to do was survive.

All the time, we were provided with blue tarpas for emergency shelter, which were constructed into a tent manually with available materials. Those temporary blue tarpas barely covered us, and we had to sleep on the bare ground with salvaged covers. It rained; it felt cold; and, without four walls surrounding us, it felt unsafe. Some people were even sleeping outside despite the hard and heavy rainfall. We lived in those tents for about two weeks, though they were meant to be used for only 3-4 days.

After a couple of weeks, we were shifted to a public school, a mass shelter. The quality of living was deficient there. We had to share the school halls with thirty or forty people. This left us without any comfort or privacy. After a month, the school members asked us to leave those shelters without any other housing alternatives. This was disheartening as we were displaced again, with nowhere to go, and we were back to the same state of physical and mental strain we were before. This affected our recovery process as we did not have a place to live until our houses were reconstructed or repaired. We finally settled in with our relatives and friends, adjusting here and there for almost a year. Not having our own space, privacy, or permanency affected us personally, mentally, emotionally, and financially.

I initially thought the first 24 hours after a disaster were the toughest. After being displaced twice, I realized the need for a proper housing phase that serves as temporary housing during the recovery process. After a disaster, there is a constant fight for survival and the search for a safe, secure place to feel normal amidst the surrounding chaos. When provided with proper temporary and permanent housing, quality of life can be improved.

One of the silver linings of this event was that we all came together as a community. We all cooked together, ate together, and shared our stories. We had our share of sorrows and sadness, but we were together laughing and cheering each other up. We were uplifting each other and, in a way, healing each other. This was a social therapy that we were receiving, making us feel cheerful and giving us a sense of belonging. This made me realize how powerful communal spaces are and how important they are to complete recovery after a disaster—to recover and rebuild faster and better.
ABSTRACT

The increasing recurrence of natural disasters raises a need for developing temporary and permanent housing solutions. As people rebuild their houses and the public environment, their human state is vulnerable. It is essential to understand a community’s needs to create shelters for displaced populations, keeping in mind the possible options. When people are provided a comfortable dwelling with safety, security, and privacy, a healing process can begin in their lives. This project focuses on designing a shelter that transforms into a permanent dwelling in order to heal individuals and establish community relationships. The research begins by studying current recovery strategies followed by a series of case studies to clarify the design proposal’s description. The research concludes with site-specific approaches that include transformable building systems and contextually responsive materials, allowing the design to nourish the site’s growth.
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The earth started rumbling and shaking
and I couldn’t think clearly.
Big crashing sounds were all I could hear.
Without pause I ran; I ran so fast.
A big thud!!!
What was that?

I knew the truth, but I hoped for it not to be true.
Life at that moment felt pale and blue.
As I looked back, the building collapsed before my eyes.
With that, I wished this bad dream to pass by.

I lost my place,
where I found my comfort zone,
where I was sane being alone,
where I spent all those wonderful times,
and it felt so safe to call it mine.
In a moment, it all fell into rubble.
I turned back one last time to see,
my happy place where I could no longer be.

There was chaos; there were screams;
I remember the dusty floors with bloodstains.
I understood how important ‘home’ had become.
And that one word still makes my heart cold and numb.

Help, help me; help me please.
What happened? Am I dreaming? I hope it is a dream.
I could not react and think with the constant screams.
Should I be worried about myself? My close ones.
Be worried about people trapped under the concrete,
unable to run.
Crying and waiting for HELP.

With a hungry stomach and nowhere to go,
I looked around to help people even so.
Blue plastic tents were our new home.
Many broken people living under, together, free to roam.
It rained; it felt cold.
It felt unsafe, without four walls to hold.

It felt scary, it felt dark.
But togetherness held us all near.
We cheered, laughed and sang, hiding pain and fear.
People had lost a house, a child, their partners.
Tears roll down again as that fear overpowers.

They didn’t have time to mourn their death, not even cry.
Not a proper way to say the final goodbye.
Some were not even found.
A big thud!!!
What was that?
Everything happened so suddenly.
Everything happened so fast.
Natural disasters have been drastically increasing in recent times. With changing climatic conditions, catastrophe will continue to happen, and with that, the demand for post-disaster housing will continue to exist. Disasters can severely disrupt the daily livelihood of people, along with the built environment. After a disaster, people struggle to rebuild their lives, thus, their state of mind is at its most vulnerable. During this time, people experience physical problems and have social, emotional, and psychological difficulties concerning their safety, health, and security. Given that, there is a necessity to evaluate the needs and options available to create safe and comfortable shelters as a sustainable process. This thesis presents the design of transformative, sustainable, temporary-to-permanent dwellings to provide inhabitants with a sense of dignity, ownership, and belongingness, to ultimately foster post-disaster community rebuilding.

There are two existing architectural solutions for post-disaster community rebuilding. There are two existing architectural solutions for post-disaster community rebuilding. The first is to design a temporary shelter and permanent housing. These shelters may decay quickly due to the lack of durable construction of more permanent ones. Temporary shelters may decay quickly due to the lack of durable construction of more permanent ones. Time-limited events can also affect the nature of natural disasters and impact housing losses. These differences include people's perception of disasters: unpredictable, outside our control, ill starred event, which gives an indication of how we perceive disaster unpredictability, outside our control, and overpowering. Natural disasters have immense power, killing people, displacing them, and destroying communities in a matter of hours. The loss of a community is the second most significant loss after the loss of life.

The emergency events database (EM-DAT) provides an updated database through the world information on the event and affect of over 20,000 natural and technological disasters from 1900 to the present day (figure 3). The first century of data captures floods and storms accounting for more than 50% of all disasters. Earthquakes are less frequent but have had a significant impact on housing loss and loss of economy compared to floods and storms (figure 4). The structure and characteristics of a building are essential during an earthquake, and thus usually, low-income populations are more vulnerable as they have few chances of having better materials and design. Where people are located (urban or rural areas) can also affect the nature and impact of the housing losses. These differences include people's preparedness to cope during these events, the building's structure, building materials, building codes, and settlement density within the area. Due to the significant impact on housing loss and loss of economy, there is a need for a proper recovery process for people struggling to rebuild their lives after a disaster. A study is done on the recovery process to understand the existing recovery process, organizations involved within the process, and the role in the recovery program to determine the interventions needed for successful disaster recovery.

This thesis's research is based on natural disasters (earthquakes, floods, and storms), and not on disasters related to human-made actions like war and technological incidents. As defined by the Oxford Dictionary, "a disaster is a sudden event of great calamity, great failure, ill-stared event, which gives an indication of how we perceive disaster unpredictability and overpowering." Natural disasters have immense power, killing people, displacing them, and destroying communities in a matter of hours. The loss of a community is the second most significant loss after the loss of life.

Climate change is giving rise to natural disasters on a global scale. Figure 1 illustrates the number of events happening worldwide. These events are killing and displacing millions of people annually. The United States is highly vulnerable to disasters. Figure 2 is a timeline showing major natural disasters in the US, which have caused a massive amount of destruction. There is increasing pressure to house these individuals through safer and more affordable housing. It is apparent that current mitigation methods are not sustainable and do not consider housing flexibility with time and a communal approach.4 Included in this research is the exploration of sustainable characteristics of buildings and building systems. Local resources and material availability play a role in determining structural components and building design. This is not a one-size-fits-all approach to community program that is adapted to each site. Instead, the objective is to establish a list of criteria for a building's needs with square footage minimums. This criterion also considers the availability of materials and a skilled labor force. Disaster response strategies in community rebuilding are an essential issue to this research. Approaching the design of community and housing at the same time allows for a community's intangible aspects to be considered. The first step is to understand the many complexities involved with a disaster, along with a study of the nature and effects of disasters.

**Natural Disaster and Vulnerability**

The research is based on natural disasters (earthquakes, floods, and storms), and not on disasters related to human-made actions like war and technological incidents. As defined by the Oxford Dictionary, "a disaster is a sudden event of great calamity, great failure, ill-stared event, which gives an indication of how we perceive disaster unpredictability, outside our control, and overpowering." Natural disasters have immense power, killing people, displacing them, and destroying communities in a matter of hours. The loss of a community is the second most significant loss after the loss of life.

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CURRENT RECOVERY PROCESS

Immediately after a disaster, government organizations and non-governmental organizations (NGOs) provide the basic infrastructure needed for daily survival. These typically include food, water supply, health, sanitation, shelter, and other essential items. These humanitarian response start immediately after a disaster and last for months and even years, depending upon the disaster’s scenario. NGOs also set up distribution centers to distribute items like blankets, toiletries, clothing, and school-related items. They set up an outreach team who talk to the affected individuals for counseling and gather information about their existing housing needs to address them. After a short-term recovery process like cleanup, setting up temporary shelters, and repair works, NGOs move out, and the recovery process is passed on to the community. Government organizations such as the Federal Emergency Management Agency (FEMA) support the displaced families for some time and provide temporary housing support through individual and household programs to qualifying disaster survivors. However, the FEMA trailers had some problems: formaldehyde levels were elevated resulting in an increased risk of health issues, which caused most of them to be decommissioned. The trailers placed on the owner’s property made them feel like their individual needs instead of communal ones. Similarly, the commercial sites parked many trailers together, causing less privacy and a congested settlement. FEMA’s Stafford Act states that temporary housing assistance should be temporary and should be provided no longer than 18 months after the disaster declaration, but some places need assistance to last longer than the 18 months timeframe.

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LIMITATIONS OF CURRENT PROCESS

Figure 6 shows the existing recovery process per the Global Facility reports for Disaster Reduction and Recovery (GFDRR). Disaster recovery interventions have been divided into phases to clarify the recovery process. The main problem in this process is the sequential implementation of the disaster response after a disaster to rescue people, to provide cash grants and emergency needs assessment up to 45 days after a disaster. However, the physical construction (i.e., temporary houses, infrastructures, or permanent houses) is started late in the process, so the response team begins to lose intensity with time and work slows down.

Role of FEMA

FEMA’s role is to support the citizens and first responders to build and improve the conditions after a disaster. FEMA relies on their housing units: the travel trailer, the park trailer, and the manufactured housing units (figure 5). Travel trailers have a small kitchen, bathroom, dining, sleeping area, and storage. Travel containers also have similar amenities, but can be larger, 120 wide by 36 feet long. Similarly, manufactured housing units have either one, two, or three bedrooms and range from 12-14 feet wide and 40-60 feet long. In 2011 and 2012, FEMA announced that the agency would no longer support the use of travel trailers and park trailers (parked in groups in parks with shared spaces), leasing the manufactured housing unit type the only supported temporary housing unit.

There are three different sites where the FEMA housing units are placed. If the owner has available space on their property, a housing unit can be placed there. If not, commercial sites are chosen (such as parks, campgrounds, or trailer parks that have necessary services to facilitate the temporary housing unit). The final site is one group site, similar to commercial sites, yet must be built from scratch, including services and utilities. However, the FEMA trailers had some problems: formaldehyde levels were elevated resulting in an increased risk of health issues, which caused most of them to be decommissioned. The trailers placed on the owner’s property made them feel like their individual needs instead of communal ones. Similarly, the commercial sites parked many trailers together, causing less privacy and a congested settlement. FEMA’s Stafford Act states that temporary housing assistance should be temporary and should be provided no longer than 18 months after the disaster declaration, but some places need assistance to last longer than the 18 month timeframe.

Role of NGOs

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Figure 5 shows the existing recovery process per the Global Facility reports for Disaster Reduction and Recovery (GFDRR). Disaster recovery interventions have been divided into phases to clarify the recovery process. The main problem in this process is the sequential implementation of the disaster response after a disaster to rescue people, to provide cash grants and emergency needs assessment up to 45 days after a disaster. However, the physical construction (i.e., temporary houses, infrastructures, or permanent houses) is started late in the process, so the response team begins to lose intensity with time and work slows down.
PHASES OF SHELTERING AND HOUSING

Housing should be started earlier in the recovery process to allow individuals and communities to return to normalcy and recover faster. For that, it is necessary to understand the existing phases of sheltering and housing—how it works and the processes involved. This is the first step in providing a residential reconstruction solution that is efficient and sustainable.

There are various phases of sheltering and housing processes introduced after a disaster (figure 7). One of the most used approaches has been presented by a pioneer in the sociology of disasters, Enrico Quarantelli. He organized the relief process into four phases: emergency shelter, temporary shelter, temporary housing, and permanent housing. Emergency shelters are quick, unplanned responses to protect people from the environment of disaster so they can have a secure place to sleep, such as family tents, schools, or sports centers, for a short time. Temporary shelters are comparatively more planned shelters providing food, sleep, and basic needs along with some privacy. Temporary housing provides the long-term needs where the affected families can reside from 6 months to 3 years with control of "private" and "public spaces" in their housing. This helps them to return to their normal daily activity. Finally, permanent housing considers the permanent need of the affected families followed by a resilient local construction technique to future disaster-proof the structure. These can be a newly built structure or renovated structure depending on the nature of the damage and financial resources available.

Some disaster victims are incapable of coping with the existing disaster and adopt temporary shelters as a permanent solution, which makes them more susceptible to danger in future disasters. This can be due to financial reasons and lack of resources to build a new structure. One of the examples is the recovery process of Haiti. Haiti has suffered from multiple natural disasters that impacted the safety, health, and housing of the country. The disaster victims expanded their relief shelters, which were designed to fulfill only their temporary needs and were incapable of handling the pressure of the long-term use. The temporary shelters have an assumed short stay and may decay quickly due to the lack of resilient and resistant construction. This resulted in increased vulnerability to future disasters due to the insufficient, structurally unstable homes.

The research is focused on the transitional phase due to the complexity of a lengthy process that is usually slow and has people living in inadequate conditions for a more extended period (figure 8). The temporary solutions are typically used longer than expected and eventually become part of the permanent housing. The permanent phase generally takes place some years after the disaster event due to several factors (lack of budget, lack of land rights, and lack of time for developing projects, among others). Therefore, temporary/transitional accommodation is needed to fill the gap. As it is challenging to get sustainable and durable solutions in the mid-term, transitional housing can be a possible solution in a reconstruction’s long-term process. This concept allows temporary shelters to serve as a basis for long-term solutions and encourages designers and manufacturers to explore incremental models that expand into permanent homes.

**Figure 7** Existing Housing Recovery Phases

**Figure 8** Transitional Housing to Close Gap

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11. Quarantelli, "Patterns of Sheltering."
13. Rosenfield, "Transitional Shelter Project."
The thesis follows the “Transitional Shelter Guidelines” by Shelter Center in May 2012, which define transitional accommodation as a more comprehensive shelter than a tent, designed to last more than a year and later transition into a permanent house. The relief and recovery are seen as a continuous entity in this process, and are an incremental process. During this timeline, the families go back to their normal daily activities and start recovering. This method of temporary housing can start from core housing, where the temporary housing transitions into a permanent house with the core as a constant entity that connects these transitional processes and acts as a serving space (figure 9).

Figure 10 shows the various processes involved in the construction of transitional housing. The first is the building systems. Although prefabricated systems are quick solutions, they have more construction costs and usually involve foreign materials that do not reflect local culture and techniques. Thus, this project uses local lumber and concrete masonry units, which are adequate for the site’s culture and are easier to collect, replace, and improve. This also ensures cultural continuity and communal acceptance of the structure. The second is the placement. This project is placed near the event area as it helps people maintain social networking, improve living conditions, and feel close to home. And finally, there are various processes of transitioning from temporary to permanent. This project uses housing as a core or starter house that can be expanded incrementally into a larger one. The accommodation has the core in the initial construction phase, which provides all the needed functions in a house. This is transitional housing that progressively becomes a permanent, resilient house through the core.

15. Martinez, “Transitional Shelter.”
16. “Shelter after Disaster.”
17. “Mississippi Hurricane Katrina.”
SUMMARY OF CHARACTERISTICS
1. FEMA Trailer: the units were quickly manufactured and transported provided temporarily for only 18 months; not sustainable; use low-quality materials
2. Paper Log House: quickly produced affordable housing with lightweight recycled paper tubes
3. Super Adobe System: fast and flexible system using earth architecture; can be built without any expensive pieces of equipment
5. Liina Transitional Shelter: dignified temporary shelter with control over privacy level

SUMMARY OF CHARACTERISTICS
1. Biloxi Model Home: families worked with local architects and designers to design a suitable home
2. EcoMod2: the house included vernacular architecture with covered porches and outdoor spaces as a passive approach; people were more involved and culturally aware; made sustainability a part of their daily lives
3. Make it Right: low-quality materials used; lack of vernacular architecture caused the houses to rot; lack of community spaces to allow communal interactions
4. Park One Model: engaged locals and community together; units were quickly and easily transported

SUMMARY OF CHARACTERISTICS
1. Shacks in San Francisco: used as a starter home; could be joined together to create a bigger house
2. The Domino House: mass-produced between 1940-1944
3. Dymaxion Development Units: low-cost, quick, and could be reassembled
4. Big Construction Kit House: flexible houses adaptable to change in family size
5. Transitional Shelter Project: incorporated culture and community together
6. Villa Verde: incremental building, half built and later completed by the families
7. Rapido: core building that expands to temporary and to permanent house over time
8. Back Home Rapid Recovery: designed with family engagement through design sessions; easy transportability
PROPOSAL

This thesis proposal focuses on a new disaster recovery process that includes building a temporary structure early in the reconstruction process to fill the existing shelter gap. The temporary dwellings are built to transition into permanent shelters as per the dwellers’ needs and desires (figure 23). This project follows immediately after the emergency housing phase so that people do not have to keep shifting from one housing to another. The main idea is to develop a method for transitioning a community that harmonizes with the community’s needs through various phases of recovery.

While the main focus is to address immediate housing and basic needs, the design also considers the importance of community spaces. The community space can be anything from a building (community center) to a communal green space (shared backyard, park, garden). One main idea is to have a shared green space (figure 56) rather than individual back yards. This allows families to come together through shared activity spaces and interact because community engagement is an essential part of the recovery process (figure 63).

A play area and park are designed later in the phase (figure 49). A new street layout is proposed to allow residents to be adjacent to the streets. This allows the housing units to be easily connected to the utilities and services where required. A business incubator blends the commercial and residential together and provides a threshold into the neighborhood. Overall, the transitional housing solution should be flexible to meet the needs of the community as it recovers.

The proposed design intends to have the following qualities:

- Dignified dwellings that focus on scale, safety, security, comfort, memory, and flexibility;
- Community engagement that focuses on activating connections between dwellings, activating connections between individual homes and the street, and activating the shared communal backyard space;
- A presence of nature that focuses on planting and healing through green spaces;
- Community infrastructure to foster growing community needs;
- And, sustainable interventions like rainwater harvesting, use of solar panels, and permeable paving to reduce the community’s energy needs and reduce the environmental impact of the newly developed structures.

SITE SELECTION

An appropriate place for this design proposal includes somewhere susceptible to natural disasters with relevant infrastructure, and a relatively dense population. Memphis has been selected as the primary testing ground for the design of a post-disaster resilient community because it experiences disasters like floods, hurricanes, and other extreme weather conditions throughout the year (figure 4). It has existing solid infrastructure, an availability of open space, and diverse demographics.

The reconstruction phasing needs to consider specific site conditions, site context, locally available materials, and cultural traditions to ensure a sustainable approach. The selection of the site is based on a study of different areas of Memphis for the availability of open space, proximity to major roads, availability of existing infrastructure, availability of a neighborhood that could support community support centers, and a healthy connection to the city (figure 20). As a downtown site, it has access to services needed during an emergency (figure 17).

The project site is located between Dr. M.L.K., Jr. Avenue and Robert R. Church Park (figures 14 and 15). As per FEMA guidelines, an appropriate site for temporary housing should have quick access to essential services like public transportation, parks, groceries, food stations, and entertainment areas, which are adjacent to the location. Figure 16 lists five parameters for site selection obtained from the precedent studies used for the site selection. Figure 18 shows the existing site conditions and neighboring context.

Based on the site analysis (figure 19) and five site selection parameters, the site zoning (figure 17) is organized so that the major commercial areas, business incubators, and community buildings are located along the main street for more connectivity and collective outreach. The housing units are buffered on the back of the commercial spaces to provide privacy.

15 "Temporary Housing Unit Program."
After a disaster, the relocation of people should be the priority. To “build back better,” the reconstruction process takes place earlier. After a disaster, three methods happen simultaneously: off-site construction, on-site construction, and the outreach team (Figure 21). In off-site construction, the lumber is brought in from the nearby lumber yard to be cut to the desired size and placed in the staging area. On-site, the debris clean-up is done, followed by a proper site evaluation. After that, the cores are constructed with the concrete masonry units (CMUs), which takes around a month’s time. Then, the lumber, which is being trimmed, is added to the core to build a temporary house. Simultaneously, the outreach team reaches out to the families to provide them with assistance and determine their housing needs. The temporary home later expands into a permanent one with the help of lumber panels, which are being custom-made immediately after a disaster event. It is a step-by-step process requiring various construction phases to provide both individual housing and community space, as indicated in the site development below.

**SITE DEVELOPMENT**

After a disaster, apart from the off-site construction and outreach team, major construction work happens on-site, where phases of construction take place from site analysis, to the core construction, to the temporary housing construction. The whole process takes place in seven phases and is outlined in Figure 22. Figure 23 shows the process of the transitional housing from the plotting (1 week), to the core (2-3 weeks), to the super roof (5 weeks), to a temporary house (7 weeks), and finally, to the expanded permanent home after one or three years of time.

**CONSTRUCTION PREPARATION**

Lumber is brought in from local lumber yards and warehouses. Concrete masonry units (CMUs) and other construction materials are also brought in.

**CONSTRUCTION RESPONSE**

After a disaster, lumber panels are immediately constructed in the local lumber yard. These panels are used to expand the temporary homes to permanent ones.

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<tr>
<th>Event</th>
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<td></td>
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<td>Site Assessment &amp; Construction</td>
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</tr>
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<td></td>
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<td>Home-owners fund the expansion. Landscape + parks maintained by the community.</td>
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**FAMILY EVALUATION**

The families are contacted to determine the home layout.

**SITE EVALUATION**

The number of families is determined from the outreach team, which helps to determine the number of homes to be built.

**CONCRETE SLAB**

The concrete slabs are constructed (Slab on Grade).

**CORE**

The core is constructed on-site with CMU walls and a flat roof.

**TEMPORARY HOUSING**

The lumber structure is attached to the core, providing living space until expansion happens and the entire roof is constructed.

**ADDITION**

The design team partners with builders and families to add home. Once the place is stabilized construction can begin at full scale.

**CONSTRUCTION TIMELINE**

1. COMMUNITY RESEARCH
2. OUTREACH + FAMILY INTAKE
3. SITE ASSESSMENT + CONSTRUCTION
4. DELIVER + ASSEMBLE
5. EXPAND

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**TEMPORARY HOUSING**

The lumber structure is attached to the core, providing living space until expansion happens and the entire roof is constructed.

**ADDITION**

The design team partners with builders and families to add home. Once the place is stabilized construction can begin at full scale.
PHASE 1
Site is cleared off and is surveyed for construction opportunities.

PHASE 2
A staging area is allocated at the center of the site, near the main road, to access construction materials for large load vehicles.

PHASE 3
Additional roads are proposed to add approachability to the site and open up the site to the four neighboring sides; this enhances connectivity.

PHASE 4
Green spaces and lots are allocated; parks and communal garden spaces allow increased communal connection.

PHASE 5
A concrete foundation slab is poured where the core will be constructed from CMUs. Ramps can be added to the dwellings for accessibility.

PHASE 6
Construction of the core is carried throughout the site, with a total of forty-four cores constructed. The core is built out to house a kitchen, bathroom, and mechanical spaces. It also serves as a storm shelter.

PHASE 7
As families begin to move into the site, light wood framing is added to the core to quickly build a temporary house. The temporary house is built with a super roof that minimizes the need to construct a roof later in the expansion phase, which can be expensive and intricate.
Figure 23: Transition of Housing

1. Slab + Low Walls
2. Core
3. Super Roof: (2 Designs)
4. Temporary Housing Units (2 Roof Designs)
5. Permanent Housing Units (2 Roof Designs), Ramp Version
DIGNIFIED DWELLING

Because housing can help re-establish normalcy in people’s lives and speed up the recovery process after a disaster, this thesis intends to provide clean, healthy, and dignified housing. The housing is flexible, allowing individuals to transform and adjust them, giving them a sense of ownership. The creation of dignified dwellings also includes providing shared spaces where people can gather and socialize with each other as a part of communal healing.

These dwellings have a vernacular typology: rectangular in plan, they are raised off the ground with three steps and feature an entrance opening directly to a porch. The porch is a vital aspect of the neighborhood and provides a place for social interaction. It is the intermediate zone between the public and the private areas. The housing front directly connects to the streets; however, the back is connected to a common shared space, providing both front and back porches. Also, the houses have a shared courtyard between them for more social interplay. (figure 48).

CORE

The dignified dwelling begins with an essential core structure (figure 27). Rapido’s housing model20 has highly influenced the design of the core. The core is made up of a fully equipped kitchen (refrigerator, sink, cooktop, storage space), a dining area, a bathroom, a mechanical room, and an additional room that can be converted into a second bedroom in the future (figures 24 and 25). The study of the FEMA trailer houses21 also provided the minimum requirements for a kitchen, bathroom, dining, sleeping area, and storage. The core model intends to provide all the spaces needed to meet long-term family needs and preferences. The core is built with concrete masonry units, which are locally available and is a local construction technique that is resilient and durable (figure 26). The core can be used as a storm shelter. Its flat roof allows stairs to be added later to create extra outdoor space above for gardening or relaxing.

19. Quarantelli, “Patterns of Sheltering.”
20. “Expanding Rapido.”
21. “Temporary Housing Unit Program.”

| 1. Kitchen + Dining | 11’-7” X 11’-3” |
| 2. Water closet | 8’-0” X 4’-6” |
| 3. Mechanical room | 5’-2” X 2’-9” |
| 4. Future water closet | 8’-0” X 4’-2” |
| 5. Closet (future washer and dryer) | 4’-2” X 3’-10” |
| 6. Storage (future replace) | 3’-0” X 2’-0” |

Figure 24  Core: Floor Plan

Figure 25  Core: Sections

Figure 26  Core: CMU Wall Section
SUPER ROOF

After the building plinth is completed and the core is added, the super roof is constructed. Building out the super roof towards the beginning of the process reduces cost while providing a covered outdoor room. The roofs are made with vernacular elements, i.e., gable roof and covered open space, and suitable exterior and interior finishes. The roofs are available in two designs. Roof 1 is a mix of a gable and lean-to roof, attached to the core, which has clerestory windows to allow light into the living space (figure 28). Similarly, roof 2 is a gable roof with a dormer window, allowing light into the living space (figure 29). People can choose to cover these roofs with more permanent claddings or add the salvaged roofing sheets recovered from their old, destroyed houses (figure 30). The construction time for these roofs is a week after the core construction.

Figure 28    Super Roof: Design 1
Figure 29    Super Roof: Design 2
Figure 30    Super Roof: Back Porch (Right)
TEMPORARY HOUSING

After constructing the super roof, the temporary house construction is started. Figure 31 shows the added lumber structure, which has flexible open space that can later be divided into a bedroom and a living room (figure 32). The plan is adaptable so that people can add or minimize their privacy level. The lumber framed houses are quick and inexpensive to build, versatile and cost-effective, and use widely available labor. Figures 34 and 35 show the temporary housing units with the two different super roofs. Various cladding can easily be added to the lumber frame structure (figure 33).

The large covered porch created from the super roof serves as an additional open space that allows people to store their salvaged items or have some social gathering at the back. People can choose to add stairs to have access above the core for additional open space. Similarly, the front low wall is constructed with landscaping elements to connect the residents to the street (figure 36) along with the back yard construction work (figure 37).

**Figure 31**  Temporary Housing: Floor Plan

1. Kitchen + Dining                                    11’-7” X 11’-3”
2. Water closet                                      8’-0” X 4’-6”
3. Mechanical room                                     5’-2” X 2’-9”
4. Future water closet                                     8’-0” X 4’-2”
5. Closet (future washer and dryer)                      4’-2” X 3’-10”
6. Storage (future replace)                                  3’-0” X 2’-0”
7. Gathering space                                                16’-0” X 10’-2”
8. Bedroom (temporary partition walls)                 16’-0” X 10’-5”

**Spare Bedroom + Dining Space**

The rolling bed can be pulled out from the bedroom into the gathering space to create a spare bedroom for a family member or guest. When not in use, the beds are pushed back under the beds in the bedroom.

**Movable Furniture**

The tables from the gathering space can be used for dining in the kitchen or moved in the gathering space to serve as a desk. This allows for multifunctional use of the pieces of furniture in the initial setup where the furnishings are temporary until a minimum.

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**Figure 32**  Adaptability of the Space

**Figure 33**  Temporary Housing: Wall Section

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**Pre-Finished Metal Drip Trim**

**Standing Seam Metal Roofing**

**Pre-Finished Metal Roofing**

**Rigid Insulation**

**Batt Insulation**

**Vented Soffit Trim + Soffit Board**

**Pre-Finished Metal Drip Trim**

**Batt Insulation**

**Roof Decking**

**Corrugated Box Rib Panel**

**Weather Barrier**

**2 x 6 Wood Framing**

**1/2" Gypsum Board Ceiling**

**1/2" Sheathing**

---

**Figure 34**

**Figure 35**

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**Wood Roof Truss**

---
Figure 37   Temporary Housing: Backyard Development
TEMPORARY HOUSING: INTERIOR DEVELOPMENT

The temporary housing plan is adaptable so people can add or minimize their privacy level. Figure 38 shows the initial settlement of two families in the same type of temporary housing units. These two renderings show how families can settle differently in the same open, flexible space as per their needs. Plywood is applied to the interior walls, which is an economical alternative wall finish that can be modified over time. The future fireplace, along with the washer/dryer closet, is used as storage space in the initial settlement phase.

Figure 39 shows interior development after one or more months, when people have settled down and returned to their everyday lives. Lumber partition walls divide the open space into a bedroom and living room so that people have control over their privacy. These walls are temporary and do not touch the roof. The bedroom space is private and secure, with two beds and a storage space to store clothes and valuable items. The living room can be used for sleeping or as a workspace when needed.
PERMANENT HOUSING

After some time, people can extend their temporary houses into permanent homes. There are four different housing layouts that people can choose from to extend their houses (figure 40). The residents can choose from two bedrooms, one bathroom; two bedrooms, two bathrooms; three bedrooms, two bathrooms, and four bedrooms, two bathrooms. Figures 41 and 42 show the permanent housing units constructed with the super roofs.

Villa Verde’s housing model highly influenced the expansion process of the house from temporary to permanent, allowing the owners to expand the homes themselves as per their need. Since the roof structure already exists, homeowners only have to buy prefabricated lumber panels to construct the desired interior layouts. The panels are designed per the house layout, making it cheaper and easier to buy. Since people are responsible for their permanent house expansions, this will minimize their overall expansion cost. The front yard (figure 45) and backyard (figures 43 and 44), along with landscaping items, are further developed in the permanent construction phase. This can take place in 3 to 5 years, after people have settled into the temporary housing units. Figure 48 shows the front elevation of the houses after people have settled. The temporary partition walls are removed to be used as a living room along with added furniture (figure 47). Figure 46 shows the kitchen after the owners have settled in permanently. The washer/dryer and small fire place (previously used as a storage space) are installed in the openings.

22 Fracalossi, “Villa Verde Housing.”
Figure 44  Permanent Housing: Shared Backyard Phase
Figure 45 Interactive Front Yard
Figure 48: Housing Units: Front Elevation
This thesis represents housing reconstruction as an activity of potential humanitarian concern that will touch the notions of basic human dignity, identity, and community rebuilding. Instead of providing ready-made solutions, the project focuses on working with individual families and their needs. The site includes employment opportunities, commercial units, and business incubators that have been designed to facilitate recovering the community’s growing economic needs. All the commercial areas are located along the main street to cater to the neighborhood and act as a public magnet. The housing units are further away from the main road to provide them with some privacy. The proposed road separates the housing units from the commercial strip and also separates the housing units on the basis to provide full access to the houses throughout the site. Communal spaces like the courtyard, shared communal backspaces, and parks have been designed to allow more communal interaction. A play area and a plaza are provided, which are accessible directly through the shared communal backyard (figures 50, 51 and 52). The community kitchen is also placed nearer to the church to support their efforts of food distribution. Food truck parking is provided, which can park around four trucks to engage the public through food (figure 49).

Various sustainable interventions have also been done on the site. The sidewalks are constructed with pervious paving. The shared courtyard between two houses supports rainwater harvesting (figure 65) through the larger area of the super roof. Solar collectors are proposed for each residence to make them efficient and sustainable. Business incubators provide job opportunities and various economic opportunities to allow the community to grow over time.

Program Legend
1. Plaza + Stage Area
2. Parking
3. Business Incubator
4. Community Center
5. Retail + Cafe
6. Bus Stop
7. Community Garden
8. Community Kitchen + Dining
9. Park
10. Play Area
11. Shared Communal Backyard
12. Food Truck Parking
COMMUNITY ENGAGEMENT

After a disaster, the loss of community is the greatest after the loss of life. This thesis incorporates community spaces to bring people together to have social therapy through social mixing. This is accomplished by providing shared courtyard space between two homes to connect them, the shared backyard space that connects all of the families, and the public gardens and parks that join the community as a whole (figure 54). This design also allows people to choose the level of interaction they want to have, thus providing them privacy and dignity (figure 58). A shared courtyard activates the connection between two dwellings. Front low walls and landscaping activates the relationship between the home and the street, and the shared communal backyard activates shared engagement throughout the community. Figure 53 shows the phases of creating community engagement in the houses, from the open space of the lots to the final shared collaborative space.

Figure 53    Phases of Creating Community (Top)

Figure 54    Socially Active Backyard Space (Bottom)
INTERACTIVE SPACES

The low walls in the front yard provide owners with some privacy level while still allowing social interaction (figure 55). The homes have planting and gravel strips that act as a rain garden (figure 56). The sidewalks are wide; the pavement and street are separated through another layer of vegetation. Furthermore, customizable house nameplates in the low wall give the feeling of ownership and a sense of belonging (figure 57).
Figure 58  Shared Backyard
Transition with Time

Over time, people begin to transform their homes as their needs increase. Figure 59 shows the initial courtyard space with the concrete masonry unit core structure. Similarly, figures 61 and 63 show the transition of the backyard space over time. Figures 60 and 62 show all the communal buildings built along with the housing units to support the growing community’s needs.
This thesis enhances the current disaster relief programs in the United States with something that adapts to an individual's needs with time, while considering the budget, environment, and sustainability. There is also a concentration of the significant role community plays in the recovery process. Recovering family and community together will help the recovery process be quicker and more successful. This is done through shared courtyard spaces, shared backyard spaces, and open spaces like a park, garden, and play areas.

One of the questions that led to the research was how to house individuals while allowing them to adapt as necessary. To allow for this flexibility, the design revolves around a core that houses essential functions: kitchen, bathrooms, and mechanical rooms. The concrete masonry unit construction makes the core rigid, cheaper, and locally responsive. The core units are made with an exterior finishing of brick masonry, which can be changed per people's location and need. This does not need to be done right away and could be done in months or years after a disaster.

The core is like a blank canvas where the housing units are added. These temporary units can be expanded into permanent ones later. There are two roof options available, and the exterior materials and claddings can be changed. The choice of roof design, floor plans, and the option to change the materials gives people flexibility to customize their homes, making the houses more desirable for them. By supporting the houses' expansion from temporary to permanent, people will start to feel the rush to the recovery phase and then disassemble and store them for reuse as they return to their permanent home after resettling. Typically, it is difficult to get sustainable and permanent solutions in the mid-term temporary shelter and permanent housing, but transitional housing can be seen as an achievable step in the long-term reconstruction process. The house initially serves as a temporary shelter and later can be expanded on or replaced to make it a permanent one, thus fulfilling the survivors' immediate and long-term needs. This concept is the result of gradually thinking of emergency shelters as a basis for a long-term solution and has also encouraged some architects and manufacturers to explore evolutionary or incremental prototypes that develop into permanent homes and can be the framework for future settlements.


The displaced population settles in the transitional shelter, starts home to be extended into a permanent one. However, the non-displaced communities can use them for temporary housing to recover and reuse them when they return to their homes. This solution does not stop massive disasters from occurring but might help minimize their damage and enable everyone to have some housing quality. One limitation of this thesis is that it does not look into the life beyond the occupancy of transitional shelters or possible ways shelters could be revamped or used other than for a residence. Further study should be done on how the houses transition with time and survive the next disaster and how they can recover from it.

CONCLUSION

The displaced population settles in the transitional shelter, starts home to be extended into a permanent one. However, the non-displaced communities can use them for temporary housing to recover and reuse them when they return to their homes. This solution does not stop massive disasters from occurring but might help minimize their damage and enable everyone to have some housing quality. One limitation of this thesis is that it does not look into the life beyond the occupancy of transitional shelters or possible ways shelters could be revamped or used other than for a residence. Further study should be done on how the houses transition with time and survive the next disaster and how they can recover from it.

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ARCHITECTURE FOR HUMANITY is a home-grown social business and nonprofit organization. Architecture for Humanity, in 1999, Deborah Aaronson edited the books. She works as a group publisher for Prada Press.

After a disaster, low-income populations face a more complex situation, magnifying their crisis before the event. Although post-disaster responses should help everyone in need, there should be an emphasis on giving solutions to the most disadvantaged people and the poorest countries. Displaced and non-displaced communities can use a transitional solution with different objectives. The non-displaced populations can use transitional shelters as a primary shelter or home that can be upgraded, expanded, or replaced. Simultaneously, displaced people can use them during the recovery phase and then disassemble and store them for reuse as they return to their permanent home after resettling. Typically, it is difficult to get sustainable and permanent solutions in the mid-term temporary shelter and permanent housing, but transitional housing can be seen as an achievable step in the long-term reconstruction process. The house initially serves as a temporary shelter and later can be expanded on or replaced to make it a permanent one, thus fulfilling the survivors' immediate and long-term needs. This concept is the result of gradually thinking of emergency shelters as a basis for a long-term solution and has also encouraged some architects and manufacturers to explore evolutionary or incremental prototypes that develop into permanent homes and can be the framework for future settlements.

This thesis also uses transitional housing as an achievable step in the long-term reconstruction process. Keeping low-income populations in mind, low-rise, high-density dwellings have been designed along with commercial areas that can be turned into offices. The government has created the super roofs built along with the temporary housing, thus, the homes do not have to spend a lot to expand the home to meet the house permanently for this project. It is proposed that the homeowners can easily buy the customized, prefabricated timber panels to develop the remaining structure.

In this book, Barakat discusses the importance of housing for the overall social and economic recovery of disaster-affected communities. Housing is a complex asset with links to education, health, security, and stability. The loss of a home constitutes not just a psychological blow, it can cause psychological trauma, challenges perception of cultural identity, disrupt social structure, and pose a threat to security. Sultan Barakat is the Founding Director of the Center for Conflict and Humanitarian Studies. He is also the Director of the University of York's Post-war Reconstruction and Development Unit (PRDU), renowned as the world's leading research center dedicated to studying the aftermath of war.

Housing reconstruction should be a more prominent part of programming after conflict and disaster because people are struggling to rebuild their homes. They do not have proper food, shelter, health, and security to return to normally. Along with that, community engagement should also be made a part of their recovery process allowing social mixing and interaction. This helps the community as a whole to come together and recover. The community must be involved in the project. By being directly involved in all aspects, the community would have a greater stake in the interdependence. They are not only rebuilding to a standard but are building responsibly as they are taking part in this process, including initial cleanup of the site, the planning of the project, and the construction process.
This thesis represents housing reconstruction as an activity that enables families to touch the notions of basic human dignity, identity, and community rebuilding. Instead of providing ready-made solutions, it seeks to engage families on working with individual needs and their needs. The ecoMOD project strives to address the notable environmental impact caused by buildings and to increase differences between high-income and low-income groups. This project intends to provide affordable housing to low-income people to give them a better space to live and invest in our communities. This thesis uses a series of local and creative solutions to make affordable housing. The house is located to merge exterior and interior, and commercial units, and4,000 square feet of living space. The neighboring context is brought into the house through a shared courtyard and interactive front and back porches that define outdoor/indoor spaces.


Actor Brad Pitt set up a foundation to rebuild 150 secure and affordable homes for families who lost their homes during Hurricane Katrina. To some, the idea was too inventive. Celebrated architects like Frank Gehry, David Adjaye, and Thom Mayne created designs for the foundation. A local architect, John C. Williams, looked into buildings using the most suitable sustainable materials. The problems started when a dozen of the green homes built started displaying severe signs of rotting. There were complaints of mold and decaying structures, electrical fires, and gas leaks. The foundation used fiberboard, a material said to be toxic free but it could not withstand the ample moisture of New Orleans. The homes were built hastily, with poor quality materials that did not consider New Orleans’s humid, rainy climate. Thus, the homes ended up threatening rather than protecting. Also, the design lacked community engagement affecting the recovery of the community. One lesson learned from this project is that a design should not only be aesthetically but also should be attainable. The design should consider the site context and local architecture. Thus, one of the leading solutions for designing disaster housing is to provide amenities to the community beyond just housing, which has been considered in this project.


The ecoMOD project aims to provide safe and secure, simple to construct, green homes for those displaced by natural disasters, power outages, or earthquakes. It was designed by eco-friendly, furniture designer, Frank Schooley. He used the same techniques and materials he originally developed for his eco-friendly furniture line, Tenappe, to design an emergency and disaster relief house. This project was the winner of the “Most Innovative Product Award,” for the 2013 AIA and International Development Forum (AIDF).

The main concept of this shelter is to be able to construct it, easily, within a day, without tools or electricity. During disasters, power outages happen stalling relief works and construction that mostly depend on electrical equipment. However, the shelter uses a new patented tool-free joint, similar to a carpenter style joint, making it easy to assemble with a locking peg, eliminating the need for electricity. They use eco-friendly materials, i.e. 100% recycled wood fiber material, which has been cut with component technology, and can be simply assembled and placed on an existing slab or on local materials like stone, rubber pavers, or even mud. They are already durable due to their unique design, making it easier to place them wherever they are needed without worrying about the perfect foundation. The shelters are safe and stable and come equipped with lockable doors and windows. Overall, these eco-friendly shelters provide quick, safe, and secure homes that are termite, water, and rust-resistant. They can last for more than 2 years and can be moved to different locations.

Concepts from this project are used as a precedent. This project follows a similar concept of constructing with local materials and tools to ensure that the new house is built using cheap, locally available lumber. The shelter is quick, safe, and secure.
The Dymaxion House or the Dymaxion Deployment unit (DDU) was designed in 1940 by Buckminster Fuller. He was a pioneer in producing mass housing. He developed these houses to be temporarily used by the United States military. The units were manufactured by the Butler Manufacturing Company and were deployed worldwide. They were simple and inexpensive, with ideal space for wartime production, and made from galvanized metal. The main idea was to have a low-cost, quick and demountable structure. The shape of the units was inspired by grain bins that had a curved roof and could be easily demounted. The ceiling is dome-like and has a hole in the top for a cover with ventilation. It consists of a 20-foot circular hut built of corrugated steel, looking much like a utop or the top of a metal silo. The interior was constructed with benches, openings, and a door. This thesis uses the idea of constructing a low-cost, quick structure that can easily house a family of four or more.


RAPIDO is a new approach to post-disaster housing with an understanding for, and designing of, the recovery housing process within months instead of years. The solution offered is a community-based approach that is centered on families. The design provided is architectural, social, and political, and so the entire community is rebuilding. The teams comprise the community corporation of Brownsville, ISS workshop, LA Union Del Pueblo Entero (LUPE), Texas A&M Hazard Reduction and Recovery Center, and Texas Low Income Housing Information Service, who seek to improve the lives of people through thoughtful design and making.

The first project was designed in Houston in July of 2018. The Rebuild Texas fund grant was provided to build around 15 RAPIDO house core units in the Gulf Coast communities along with research work to make-produce the cores to serve additional families affected by the storm. The main idea was to have a RAPIDO core hut where the family will reside in temporary housing. Later, as people return to normalcy and their housing needs increase, the dome’s permanent is built on the other side. Then the residents move over to the new extended side while the final modification is made to the cores they need in. Finally, the entire house is ready to be occupied.

RAPIDO project is the leading precedent for this thesis, as the project is based on a similar idea of centering the design on community rebuilding to recover the community as a whole. This thesis also uses a core, which has all the things needed in a house, from the kitchen to the bathroom to the mechanical room. The unique thing about the thesis is that during temporary housing construction, the design on community rebuilding is taking place. This category defines the highest impacting natural disasters causing homelessness, damage, and the highest impact along with their characteristics, which were found to be earthquakes, floods, and storms. These data were used to identify the number of people affected in each case. The project provides quick, reliable, and safe homes to help them recover fast.


The Federal Emergency Management Agency (FEMA) deployed 145,000 trailers down the ravaged gulf coast. These trailers were mostly provided as emergency or temporary housing after a disaster. But after some time in 2007, due to the suspicion of high formaldehyde levels, the manufacturer suspended sales of the trailer to the public and planned to move as many residents as possible out of them. The Centers for Disease Control and Prevention (CDC) did testing to determine the levels of formaldehyde inside travel trailers provided by FEMA. In most tested trailers, the amount of formaldehyde was elevated, causing health issues. One of the main reasons identified was poor construction and substantiated construction materials, so the trailer owners were instructed to spend most of their time outdoors. This incident highlighted the need for larger units and better-ventilated units to be used in emergency housing because, though its meant to be temporary, it should be healthy for people to live in. This thesis provides housing units that are bigger than the typical FEMA trailers. They are better ventilated and have controlled private and social spaces. The houses use locally sourced materials like lumber, bricks, and concrete masonry units (CMUs) that are not toxic in nature, readily available, and cheaper.


Villa Verde is a social housing project designed by an organization named Elemental. They came up with the half a house: “Model XV” architecture which is strengthened by the low-income group cannot afford a “large” house, and thus they are often left with smaller homes. Therefore, they are provided with half a “good” house instead of a tiny, complete house. For that, they build the building to allow for residents to increase the floor area of the house to 80 square meters. There is an equally sized area space next to each built section to expand their homes. The first floor of the finished half house is made up of unfinished concrete floors, and the second includes unfinished plywood. The floor is affordable, practical, and insulated with one in the kitchen and no other appliances. The houses are designed to expand the families the freedom to expand the homes as per their needs and budget. Eventually, there will be time to build alone – such as concrete foundations, plumbing, and electricity – has been finished for them.


This project was built by H-GAC, along with partners dignified houses, and Houston Innovative Research Labs. They held an open house in Harris and Galveston Counties in order to explore the community’s input on the home’s features. The H-GAC team designed and constructed a prototype home based on the needs and desires of the community. The Recovery Pilot Program explores an alternative post-disaster housing model, providing permanent housing that is long-lasting, efficient, meets local code, and fits into the neighborhood context. The home comes in two phases: the first one, consisting of a living area, kitchen, and bathroom, which is delivered as soon as debris is removed. The second unit can be modified so that additional living areas and bedrooms can be easily added as
This thesis also allows the residents to control culture and the expansion to fulfill family needs that grow the design to adapt to various climates, topography, and cultural needs. Concepts from this source are used to determine privacy levels and feel comfortable.

Sleeping spaces, a galley kitchen, and a multifunctional private and common spaces. There are two semi-private and night time activity, so there is a good separation of areas. There are various degrees of privacy provided inside for day and night time activity, so there is a good separation of spaces. These frameworks can be adopted anywhere in a new location. Thus, out of all possibilities, reusing the units is an advantageous strategy because the units are easily stored and transported, and are made of very little value; and, reusing the units, which might recover some costs but are still half of work, these programs suffer from problems like late delivery, which might be unfavorable due to social dysfunctions and other inherent problems. Cassidy Johnson is a Professor of Urbanism and Disaster Risk Reduction at the Bartlett Development Planning Unit, University College London (UCL). Her research and teaching field is post-disaster recovery, risk, and climate change adaptation.

This thesis uses the idea of reusing temporary housing units after disasters to address the need for strategic planning in temporary housing to solve its common issues. After a disaster, to address immediate housing needs, everything needs to be done quickly, from the site clearing to material bringing to construction work. Due to the unplanned nature of temporary housing, the units suffer from problems like the high cost of materials and late delivery, which further delays the project's limited budget constraints. Furthermore, design issues and improper unit design might affect the overall quality of housing being provided.

The article influenced the study of the existing recovery framework and design units to create a design framework. These frameworks can be adopted anywhere immediately after a disaster to allow for quick construction and modification to fit the specific post-disaster situation. This will enable the project to be completed within the timeframe with proper design standards.

The units are an elegant and dignified solution to the current global problem of refugees and displaced populations due to disasters, natural or human-made. It serves as a warm, temporary shelter to be provided to people in crisis in cold climates. It is designed to accommodate families of various sizes for around four months during the post-reconstruction phase, where the design is adaptable to various topographical, climatic, and cultural needs. The shelter is made with sustainable materials like Finnish wood and other wood-based materials, easily assembled in 6 hours by two adults following a simple diagram and using common tools. One of the interesting concepts is that it is easy to add or subtract frames to increase or decrease the shelter's size. Also, there are various degrees of privacy provided inside for day and night time activity, so there is a good separation of private and common spaces. There are two semi-private sleeping spaces, a kitchen, and a multifunctional living space that allow the residents to control their privacy levels and feel comfortable.

Concepts from this source are used to determine privacy levels and feel comfortable. The author carried out six case studies of temporary housing programs after disasters to address the need for strategic planning in temporary housing to solve its common issues. After a disaster, to address immediate housing needs, everything needs to be done quickly, from the site clearing to material bringing to construction work. Due to the unplanned nature of temporary housing, the units suffer from problems like the high cost of materials and late delivery, which further delays the project's limited budget constraints. Furthermore, design issues and improper unit design might affect the overall quality of housing being provided.

As per this research, there are five possible solutions to address the layer of use temporary units after they have served their purpose: long-term use of the units that might be unfavorable due to social dysfunctions and crime rates; dismantling units and storing them, which may cost as much as a new unit due to dismantling, transporting, storing, and reassembling costs; selling the units, which might recover some costs but are still half of the initial investment; demolishing the unit, which is of very little value; and, reusing the units, which will add additional cost to transport, dismantle, and reassemble in a new location. Thus, out of all possibilities, reusing the units is an advantageous strategy because the units are easily stored and transported, and are made of very little value; and, reusing the units, which might recover some costs but are still half of work, these programs suffer from problems like late delivery, which might be unfavorable due to social dysfunctions and other inherent problems. Cassidy Johnson is a Professor of Urbanism and Disaster Risk Reduction at the Bartlett Development Planning Unit, University College London (UCL). Her research and teaching field is post-disaster recovery, risk, and climate change adaptation.

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Transitional shelters are designed to facilitate the transition of affected populations to more durable shelters. Since the affected families will take part in constructing post-disaster shelters themselves, they must be provided with self-management skills and easily available resources. Context is different everywhere, so should the shelter designs be able to adapt to each site response and project. Transitional shelter designs and orientations are different in each place; thus, the layout should be adapted to the site's cultural context. Therefore, the design brief should always encourage design flexibility to allow the occupants to design or change their space as they start living inside it. Planning is crucial, including detailed analyses of local materials, transportation strategy, storage and procurement processes, and the import of materials if needed; to make sure the project is completed on time. The design of a transitional shelter because the more complex the design is, the more training and resources it requires to be built, which will slow down the reconstruction process. Thus, the specifications of shelter should include data on the quality of the materials needed to achieve the intended design and easy maintenance after it has been built.

This thesis follows a particular design timeline where three processes happen simultaneously after a disaster: infrastructural construction, site construction, and families’ reaching out. This allows the materials to be prepared offsite while designing the site and making it ready for the construction work, while also reaching out to the families to know about their housing needs and design preferences. This will allow the construction to be quicker, maintaining the quality of work. Also, the permanent house planning is ample and flexible where the inhabitants have designs they can choose from as per their needs.


Natural disasters and environmental disasters are causing an increase in catastrophic incidents that are affecting populations all around the world. The author gives a broad overview of various kinds of disasters and how they impact structures. The research covers a wide range of natural disasters, including earthquakes, floods, storms, hurricanes, extreme heat, landslides, and mudflows, with the most deadly being listed first. Roxanna McDonald was born in Romania, where she did restoration work, before moving to Britain and completing post-graduate studies in Building Conservation. McDonald is a member of the Royal Institute of British Architects.

According to a study conducted by Landau Forte School case studies, floods, storms, and earthquakes have a higher death toll and damage level than other disasters. Storms are linked to global atmospheric levels such as ocean temperature and are highly unpredictable. Their direction, speed, and growth dynamics are all unknown, making accurate predictions difficult. Most floods, on the other hand, behave predictably. As a result, they are “established threats.” Although particular floods, such as those in Houston, Texas, and India. The houses were built near the damaged site to ensure a healthy connection to the city.

Shigeru Ban is a Japanese architect known for designing quick and efficient houses for disaster victims using recycled cardboard tubes. He is primarily known for his innovative use of material and his dedication to humanitarian efforts worldwide. After tragedies, his paper log houses have been designed for temporary living and have similar characteristics. His designs are based on 10,233 feet by 33 feet, and are not regulated by the HUD. Finally, manufactured housing units have either one, two, or three bedrooms, bathrooms, a kitchen, oven, and refrigerator. Some units also have a raised platform to make people feel safe in terms of flooding and other extreme weather conditions. The site is also chosen to have access to necessary services like public transportation, parks, groceries, food stations, and entertainment areas to support the community and ensure a healthy connection to the city.

This thesis keeps in mind that the construction and characterization of the house, and the housing needs and design preferences. This will allow the construction to be quicker, maintaining the quality of work. Also, the permanent house planning is ample and flexible where the inhabitants have designs they can choose from as per their needs.

The Federal Emergency Management Agency (FEMA) assigns temporary housing to natural disaster victims to fulfill their immediate housing needs. They are a better solution than tents as they function longer, but are meant to be temporary and cannot be used as permanent housing. They are mass-produced, so nearly all trailers have the same general layout and can be easily transported. A typical FEMA trailer can measure 14’ by 22’, or 8’ by 32’, consisting of a master bedroom, a kitchen area with a refrigerator, and a bathroom with a shower. Pieces of furniture are also available, which are attached to the trailer. Parking on the outside and inside walls are not allowed, and it is also illegal to sleep in the trailer. If there are electricity, air conditioning, indoor heating, running water, and a refrigerator, they are more difficult to predict. It is still understood, and oven, and a large refrigerator. They are regulated by the United States Department of Housing and Urban Development (HUD). They are also poorly insulated and away in high winds as they are manufactured from plastics, aluminum, and particle board. Because of that, they need high maintenance and care.

There are three types of trailers. Travel trailers typically have a small kitchen, bathroom, dining, sleeping area, and storage. They are intended for recreational purposes and are not regulated by the HUD. Park models have been designed for temporary living and have similar characteristics. Park models have been built on 33 feet by 33 feet, and are not regulated by the HUD. Finally, manufactured housing units have either one, two, or three bedrooms, bathrooms, a kitchen, oven, and refrigerator. Some units also have a raised platform to make people feel safe in terms of flooding and other extreme weather conditions. They are mass-produced, so nearly all trailers have the same general layout and can be easily transported.

The thesis designs the house to feel less like travel trailers because people disliked the trailer houses. They were composed using aluminum and synthetic substances that later caused health problems, had a unpleasant ventilation system, and had a cutting framework that limited the modification of the house as specified by the family’s need. Likewise, since those homes were temporary and also movable, it did not allow people feel comfortable due to the constant change in their area.


The house was small with 180 square feet of interior space; it was later improved to have larger interiors with a more living area per person. The houses were built near the damaged site to ensure a healthy connection to the city.
Eventually, the criteria for the transitional housing given by Papper and Ali involve the transitional housing being straightforward development strategies, sound insulation, and aesthetically pleasing. The thesis also allows the researchers to couple temporary and permanent solutions as per their need, with locally sourced materials.


Natural disasters have been drastically increasing in recent times. The cities are growing, and the population is rising, and so are the consequences of natural disasters increasing proportionately. Due to the severity of natural disasters, countries cannot provide sufficient infrastructure to accommodate the number of displaced people in need of shelter and housing. This study was supported through grants by the Department of Civil and Environmental Engineering, the University of New Haven, to discuss the existing problems with temporary housing and focus on the need for additional research into the development of housing solutions for long-term housing to needs of the population. Daniel V. Perrucci is a Ph.D. candidate at the University of New Haven, civil engineering, with an expertise in sustainable engineering, green infrastructure, and technologies. Can B. Aktas is a professor of civil engineering at the University of New Haven. Can B. Aktas, Ph.D., is an assistant professor and the program coordinator for the civil engineering studies program, with expertise in sustainable engineering, green infrastructure, and life cycle assessment.

Their study aims to prepare for disasters in terms of adaptation and infrastructure resilience through the development of affordable and durable housing solutions. A long-term disaster-affected temporary housing is a crucial component of disaster response and recovery. A long-term disaster-affected temporary housing is an issue that usually starts up as a shelter for a short time but may be used for many years, making design and infrastructure resilience a necessity for future disasters. The shelter is based on their research in Turkey, after the 1999 earthquake, where they built a fast construction system with a roof made in two days, and the building skins were handmade locally to help with the transition period relief. The shelter is called the “residents” who use the materials to fashion building skins. This project is an excellent example of incorporating culture and community together in a project.


The article’s main point is to review and specify language associated with disaster relief housing. The terms “sheltering” and “housing” are two separate terms in the disaster literature. Emergency sheltering, temporary sheltering, temporary housing, and permanent housing all differ from each other. They are paid differential attention in planning and have diverse roles in rebuilding a community after a catastrophic event. Enrico L. (Enny) Quarrelli was an American sociologist widely known as one of the founding scholars of disaster social science. He was the founder and first editor of the International Journal of Mass Emergencies and Disasters, 1963-1987, and was awarded the Charles E. Fritz Career Achievement Award in 1995. He worked with his colleagues to establish the International Research Committee on Disasters, and the International Journal of Mass Emergencies and Disasters. The research included a study of Brazilian shelters in Hiroshima, which had been constructed in response to the earthquake that devastated the area back in January of 2010. The goal was to localize as much of the shelter’s productive capacity, keeping in mind safety and welfare but allowing the shelter itself to become a part of the culture. The study’s impact on the outcome of the transitional shelter was debatable. They drew on lessons learned from that post-disaster condition, recognizing that disaster relief had already been delivered. This resulted in a more straightforward and temporary housing system. They built a fast construction system with a roof made in two days, and the building skins were handmade locally to help with the transition period relief. The shelter is called the “residents” who use the materials to fashion building skins. This project is an excellent example of incorporating culture and community together in a project.


The Office of the United Nations Disaster Risk Reduction analyzed the shelter from the survivor’s perspective, rather than the assisting groups and traditional perspective of the donors. Disasters are an opportunity to introduce wholesome improvements in housing, building, and community planning. UNDRR has been assisting nations of the world in their struggle against natural disasters, which have been devastating nations, especially in recent years. This report on ReliefWeb is the first comprehensive study to be published on disaster relief housing. It specifically focuses on the foundation for emergency shelter and post-disaster housing, reflecting the current mistakes of shelter, the problems with sheltering, and the survivors’ need to reduce disaster and homelessness.

The relief system should be introduced through local community structures rather than through local governments. It is also about using building construction because most people are unaware of these laws and do not have enough funds to achieve the standard of materials and construction specified. Housing reconstruction reforms depend on some pre-conditions that include the values and housing forms, using cheaper and abundantly available materials, and having the construction process significantly easier. This resulted in creating many jobs for professional designers. The survey’s impact on the outcome of the transitional shelter was debatable. They drew on lessons learned from that post-disaster condition, recognizing that disaster relief had already been delivered. This resulted in a more straightforward and temporary housing system. They built a fast construction system with a roof made in two days, and the building skins were handmade locally to help with the transition period relief. The shelter is called the “residents” who use the materials to fashion building skins. This project is an excellent example of incorporating culture and community together in a project.
The thesis focuses on constructing low-rise, high-density, post-disaster housing through the traditional mass housing process, i.e., lumber construction and local concrete masonry units, utilizes locally available lumber and technology. The construction process is cost-effective and requires less labor. The prefabrication of building elements is crucial for mass housing projects, as it reduces the need for skilled labor and enhances productivity.


FEMA is the United States Federal Emergency Management Agency. They are a federally-funded agency with a mandate to support citizens before and after disaster. This thesis follows the similar concept of flexibility, allowing the inhabitants to expand the houses over time. There were two construction kit systems: the “honeycomb system” and the “Domino house.” Walter Gropius developed a housing solution, also called big building blocks, that had the ability of individual building elements to form a larger unity, i.e., the flexible composition and configuration of parts into a whole. They were inspired by children’s building blocks, which could be moved around, added, or subtracted. The concept was later used and implemented by other architects, such as Konrad Wachsmann and Fritz Haller, for mass housing. Alpine Magnus Seelow is an architect and architectural historian. His work focuses on the conceptual and idealized principles used in the house design.

This article influences this thesis to locate a site near the original housing so the disaster survivors feel safe and comfortable. This temporary housing scenario urges the community to return to their home while they continue to rebuild or repair it. This trailer-at-residence allows the homeowner to live adjacent to their home during the recovery phase, and it can be problematic. The near original housing, which can be problematic. The boat-at-residence is not located near the original housing, which can be problematic. The trailer-at-residence is transformable as per the inhabitants’ needs. Similarly, Big Construction Kit featured the qualities of precision and interchangeability in housing. Walter Gropius developed a construction kit that could be moved around, added, or subtracted. The kit was later used and implemented by other architects, such as Konrad Wachsmann and Fritz Haller, for mass housing.

This thesis focuses on constructing low-rise, high-density, post-disaster housing through the traditional mass housing process, which is affordable and technically more straightforward. Salvaged roofing material is used in the kit design to facilitate a more affordable alternative to the initial housing phase’s roofing material. As developed by Walter Gropius and Adolf Meyer, the concept was later used and implemented by other architects, such as Konrad Wachsmann and Fritz Haller, for mass housing. Alpine Magnus Seelow is an architect and architectural historian. His work focuses on the conceptual and idealized principles used in the house design.


The Office of Inspector General (OIG) of the Department of Homeland Security (DHS) has prepared a series of reports and special investigations related to the temporary housing needs of disaster survivors. The OIG has examined the effectiveness of the Temporary Housing Unit Program and Storage Site Management. This thesis focuses on the need for mass housing and prefabrication to fulfill immediate housing needs. The inhabitants are allowed to plan them as per their needs. As a result, each house is different from one another.


SuperAdobe is an earth architecture developed by CalEarth founder Nader Khalili. Nader Khalili is an Iranian American architect who designed the superadobe system for NASA’s challenge to create housing for 100,000 human settlements on the moon. The similar method and technologies he developed were then applied to build an emergency shelter project to provide a safer haven for Iraqi refugees seeking shelter in Kirkuk, Iraq, and inspired by the earth architecture in the deserts.

Le Corbusier developed the Domino house in 1914, a housing prototype consisting of horizontal slabs and pilotis to reduce the building to its minimum. This project was designed in response to the housing crisis generated by the first and second world wars that prompted architects to develop new housing ideas. The building had open floor plans with concrete slabs supported by reinforced concrete columns. This allowed the occupants to have flexibility in planning their day-to-day activities. The building project also included mass housing and prefabrication parks, which were later adopted in most post-disaster solutions. The same house was never replicated or mass-produced. However, the concept of standardization and prefabrication were later adopted by other architects. This thesis focuses on the need for mass housing and prefabrication to fulfill immediate housing needs. The inhabitants are allowed to plan them as per their needs.


Unless otherwise noted, figures are by author.
APPENDICES

APPENDIX 1: PRESENTATION MATERIALS

Figures 65-68 are the final presentation boards used at the time of the thesis defense. Figure 69 is the final setup for the presentation.

Figures 70 and 71 contain photographs of the overall site model and detail model of the transitional housing. Figure 72 features the research summary presentation slides.
THESIS STATEMENT:
This thesis presents the design of transformative, customizable temporary-to-permanent dwellings to provide inhabitants with a sense of my happy place where I could no longer be.

I turned back one last time to see, where I spent all those wonderful times, where I found my comfort zone,

Life at that moment felt pale and blue. I knew the truth, but I hoped for it not to be true.

A big thud!!!
Without pause I ran; I ran so fast.

And tears rolled down again as that fear overpowers.

People had lost a house, a child, their partners; and someone to

Many broken people living under, together, free to roam.

Blue plastic tents were our new home,
I looked around to help people even so.

With a hungry stomach and nowhere to go,

What happened?

An Approach to Transitional Housing for Post-Disaster Resiliency
Figure 67: Presentation Boards: Backyard Construction

Figure 68: Presentation Boards: Dwelling on Memories

LUMBER PANEL DETAILS: EXPANSION AND FLEXIBILITY

COMMUNITY ENGAGEMENT

• SHARED COLLECTIVE BACKYARD SPACE
• ACTIVATE CONNECTIONS BETWEEN TWO DWELLINGS

GROUND FLOOR PLAN

= 1/16' = 1' 0"

PROPOSED STREET SECTION AND PLAN

THE CORE

TREES

30" WIDE PLANTING STRIPS WITH LOW SCREEN WALL

SHRUBS AND FULL HEIGHT PLANTING

24" GRAVEL STRIPS

SHARED COURTYARD

SHARED COMMUNAL BACKYARD SPACE

8' WIDE SIDEWALK

2

1/16' = 1' 0"

STRETCH SITE SECTION

COMMUNITY KITCHEN + DINING

COMMUNITY GARDEN

BUS STAND

RETAIL + CAFE

COMMUNITY CENTER

BUSINESS INCUBATOR

SOLAR COLLECTORS

RAIN WATER HARVESTING SYSTEM

PERVIOUS PAVING ON THE SIDEWALK

SUSTAINABLE INTERVENTIONS

12. Food truck parking
11. Shared communal backyard
10. Play Area
9. Park
8. Community kitchen + Dining
7. Community Garden
6. Bus Stand
5. Retail + Cafe
4. Community Center
3. Business Incubator
2. Parking
1. Plaza + Stage Area

Program legend
Figure 69  Final Defense Layout

Figure 70  Transitional Housing Model
This thesis presents the design of transformative, customizable temporary-to-permanent dwellings to provide inhabitants with a sense of recovery and community engagement.

There was chaos; there were screams. In a moment, it all fell into rubble. Life at that moment felt pale and blue. Without pause I ran; I ran so fast.

What was that? Some were not even found. They didn't have time to mourn their death, not even cry. Many broken people living under, together, free to roam. Should I be worried about myself? My close one? Am I dreaming? I hope it is a dream.

An Approach to Transitional Housing for Post-Disaster Resiliency

It takes approximately two large trucks 8' by 25' by 8 to deliver all of the components to the site.

### Roof Unit
- Aluminium Roofing 7"

### Floor Unit
- FROM LOCAL LUMBER YARD

### Parameters for Site Selection
- Social Mixing
- Open Spaces
- Activity + Entertainment Zone
- Retail
- Food Distribution
- Transitional Space + Services
- Comfortable
- Spiritual Therapy
- Place of Worship
- Clothes
- BEALE STREET BAPTIST CHURCH
- I AM A MAN PLAZA
- E PONTOTOC AVE

### Site Planning
- Connectivity: opening up the site through the proposed road
- Zoning: green spaces and housing lots
- Foundation slab + core is constructed throughout the site
- 30" wide planting strips with 8' wide sidewalk
- 24" gravel strips
- PROGRESSIVE TURLEY S
- T

### Diagrams
- Ground Floor Plan
- Lot Units
- Permanent Housing Needs
- Temporary Housing Needs
- Transient Housing as a Solution
- Biloxi Model
- Park One Model
- Rapido
- Villa Verde
- After the Disaster
- Rebuild or Repair
- Future Disaster Proof
- Resettle in New Houses
- Use of Local Vernacular Architecture

### Appendix 2: Process Piece
The continuous structure of the drawings and diagrams (Figure 73) depicts the constant process of work that happens immediately after a disaster. The drawings are organized by three essential topics: the purpose of the project, location and factors that influence the project, and design of the project.
APPENDIX 3: PRECEDENT STUDIES

The following precedents show the architectural concepts and design requirements considered in the design of this post-disaster housing project.

TEMPORARY HOUSING
Temporary housing projects play an essential role in allowing families to return to normalcy after a disaster event. These housing are intended to be used for a short period, from 6 months to 2 years.

FEMA TRAILER HOUSES
FEMA’s trailers accommodate survivors’ immediate housing needs after a disaster (figure 74). The trailers could be connected to existing services (i.e., electrical power, sewage, and water) at the resident’s home. The second method was to deploy multiple trailers to a single location or a group site. Generally, the sites did not have existing services immediately available, so the services had to be installed for each trailer, which was expensive. The overall process was not sustainable because after the trailer served its needs, it was deconstructed, and all the infrastructure connected (sewer, power, water) needed to be removed. This was costly and inefficient.1

PAPER LOG HOUSES
Architect(s)/Organization: Shigeru Ban
Location: India, Japan, and Turkey
Size: 180 sq. ft. interior, 64 sq. ft. semi-open space
Type of Construction: On-site construction

Key Takeaways: Quickly produced housing with lightweight recycled materials.

SUPER ADOBE SYSTEM
Architect(s)/Organization: Nader Khalili
Location: Khuzestan, Iran
Size: 150 sq. ft.
Type of Construction: On-site construction

Key Takeaways: Inspired by traditional earth architecture in the deserts of Iran and can be built together.

Cortex Shelter
Architect(s)/Organization: Cutwork Studio
Location: Worldwide
Size: 150 sq. ft.
Type of Construction: Manufactured

Key Takeaways: Quick, sustainable, comfortable, affordable.

This shelter’s mission is to create a safe place for people to call home (figure 77). It is inexpensive and easy to build, easy and fast to assemble, and maintained throughout any weather conditions as it has a protective shell outside.

1 “Temporary Housing Unit Program.”
2 “Paper Log House/Kobe.”
3 “What is SuperAdobe.”

Shigeru Ban is a Japanese architect known for designing quick and efficient houses for disaster victims using mainly recycled cardboard tubes (figure 75). After the tragedies, his paper log houses solved the urgent housing needs of families displaced in Turkey, Japan, and India. The paper tubes are light in weight and easy to transport so that anyone can get involved in the assembly process, which takes about 8 hours for six houses to be assembled. The main idea was to build a shelter quickly with increased participation from community members.2

1. “Temporary Housing Unit Program.”
2. “Paper Log House/Kobe.”
3. “What is SuperAdobe.”
Handbendable metallic tubes form the framework where waterproof and washable insulation sheets are snapped and locked.  

LIINA TRANSITIONAL SHELTER
Architect(s)/Organization: Aalto University Wood Program
Location: Espoo, Finland
Size: 194 sq. ft.
Type of Construction: Manufactured
Key Takeaways: Flexible framework, control over privacy level for day time and night time activities, dignified shelter.

Liina has been designed to shelter refugees worldwide (figure 78). The primary building materials are the prefabricated sandwich panels: Finnish wood and wood-based materials are used to make it dignified and sustainable. It can house a family of five or six people for up to five years and then can be recycled, resold, upgraded, or relocated.  

PERMANENT HOUSING
A depth of study was done on the existing permanent housing projects and the major take aways from them.

BILOXI MODEL HOME
Architect(s)/Organization:
Location: Biloxi, Mississippi
Type of Construction: On-site construction
Key Takeaways: Allow for many design solutions through design consultations.

This program provided design and financial solutions to construct houses for families impacted by Hurricane Katrina (figure 79). This program’s main motive was to approach reconstruction in a mode that facilitates a good design solution by standardizing processes and parts. They provided a “one-stop-shop” where the families could get architectural, construction, and financial services along with some legal assistance.  

ECOMOD2
Architect(s)/Organization: John Quale and UVA students
Location: Gautier, Mississippi
Size: 1,807 sq. ft.
Type of Construction: Prefabricated house
Key Takeaways: Assembled together by community, affordable, cost effective, vernacular coastal design.

EcoMod2 is a research project at the University of Virginia, dedicated to creating sustainable and renovated modular housing units for affordability (figure 80). The prefabricated house was flat-pack panelized home providing a total area of 1,087 sq. ft., including bedrooms. The house allowed for natural ventilation and included energy efficiency measures. The house was shipped to the site and assembled by the families or the community as a whole. The ability to be part of the construction of the home helped the community come together.  

MAKE IT RIGHT
Architect(s)/Organization: Multiple Architects
Location: 9th ward, New Orleans
Size: 1,900 sq. ft.
Type of Construction: Manufactured
Key Takeaways: Flexible framework, control over privacy level for day time and night time activities, dignified shelter.

Make It Right was a project whose goal was to build 150 homes to sustain natural disasters for former residents.
residents (figure 81). Actor Brad Pitt led this program to rebuild affordable, safer-storm and flood-resistant, and sustainable (LEED platinum) houses. This project had many issues, one of which was that most of the houses were not contextual and not vernacular. Also, low-quality materials were used, which caused problems like rotting of the house, leakage of the roof, and mold, making the houses unfit for settlement. The design also lacked community engagement.8

**KATRINA COTTAGES**

Architect(s)/Organization: FEMA funded research
Location: Mississippi
Size: 480 sq. ft.
Type of Construction: Prefabricated house
Key Takeaways: Designed with focus on community engagement and making people feel at home.

FEMA trailers received backlash due to the quality of materials used and the mobile homes not giving a feeling of being at home. Thus, the Park Model, also called the Katrina Cottage was funded by FEMA to produce a better housing typology (figure 82). These homes took into account what the community wanted for their homes, and were made site-specific by including vernacular elements from the region. They are a prefabricated home that meets the HUD-code standards and International Residential Code. However, they still looked like a mobile home, which people rejected. Also, the Park Model did not meet permanent housing requirements, so it was used for temporary purposes only.9

**TRANSITIONAL HOUSING**

A study was done on the history of transitional housing, including how it has developed and improved over time.

8. Dickinson, “Make It Right.”
9. “Katrina Cottages.”

**SHACKS IN SAN FRANCISCO**

The San Francisco earthquake of 1906 is known as one of the most significant earthquakes ever recorded. The Army Corps of Engineers provided temporary housing to a large group of displaced families. They designed small wooden cottages, which were temporary and could be transported to the site (figure 83). The cottages ranged from 13 square feet to 27 square feet of interior area. With time, people could rebuild or expand them into a new house. Thus, most people used these cottages as a starter home, and even some people joined one or more houses to create a bigger house.10

**THE DOMINO HOUSE**

The housing crisis generated by the first and second world wars prompted architects to design and test housing ideas. Le Corbusier designed the “Domino House” in 1914 (figure 84). The main idea was to give users complete autonomy to divide the interior by creating two open floor plans, with concrete slabs supported by reinforced concrete columns. This was technically transitional, but it introduced a core house that could be modified in the future with time. With this house, Le Corbusier introduced the concept of mass housing and prefabrication, which was later adopted in post-disaster solutions for the San Francisco earthquake of 1906.11

**Dymaxion Development Unit**

The Dymaxion House, was designed in 1940 by Buckminster Fuller, a pioneer in producing mass housing (figure 85). He designed these houses to be temporarily used by the United States military for domestic purposes. These structures were mass-produced between 1940 and 1944. Their main idea was to have a shelter that was low-cost, quick, and demountable. The shape of the units was based on a grain bin that had a higher curved roof and could be easily demounted. Following this concept, he later developed his geodesic domes to build rapidly deployable shelters.12

11. “The City as a Project.”
12. “Dymaxion Deployment Units.”
Walter Gropius and Adolf Meyer developed these housing solutions, which are also called big building blocks (figure 85). They are inspired by the children’s building blocks that could be moved around, added, or subtracted. The housing was expandable and includes a core of 25 square meters. Their main aim was to provide a flexible house, adaptable to the constant change in family size and economic conditions.13

**BAUKASTEN IN GROBEN**

**TRANSITIONAL SHELTER PROJECT**

This shelter was designed in response to the earthquake that devastated Haiti in January 2010. The Design/Build studio carried these out at the Maryland Institute College of Art. Their main goal was to design a shelter that could adapt to a specific environment, culture, and climatic conditions (figure 87). They localized the shelter production, which allowed the shelter itself to become a part of the culture. The structure is made up of a simple metal frame with plywood sheathing on the frame’s interior. The double walls provided a naturally formed ventilated air cavity to reduce heat. The interesting thing they did was they offered locals the responsibility of designing the outer building skin, which they could do with locally-found materials like bamboo, rubber tires, and plastic bottles, among other items.14

**VILLA VERDE**

Architect(s)/Organization: Elemental (Alejandro Aravena)
Location: Constitucion, Chile
Size: 10’ by 22’ (each section)
Type of Construction: On-Site construction
Key Takeaways: Incremental building that can adapt with time.

Villa Verde is a social housing project designed by Alejandro Aravena. The main idea was to have the home half-built instead of creating a tiny house (figure 88). This idea is similar to designing a core unit. The ground floor is half-built, including two-bedroom spaces. As families move in, they can extend the other half of the house as per their needs with time and with their choice of materials.15

**RAPIDO**

Architect(s)/Organization: Lower Rio Grande recovery Location: Rio Grande Valley, Texas
Size: Core units are 12 by 40’
Type of Construction: On-Site construction with pre-manufactured elements
Key Takeaways: Incremental building that can adapt with time.

The main goal of this project was to allow the community to grow along with the families, with months instead of a year after a disaster event. Rapido uses a manufactured panel system that is shipped to a site after a disaster and assembled into a core at first (figure 89). The assembly process is more accessible so the whole community can take part. Once the community and families stabilize, the core unit is expanded into a complete home.16

**BACK HOME RAPIDO RECOVERY**

Architect(s)/Organization: BC Workshop with Tegrity Homes Location: Harris County and Galveston County, Texas
Size: Core units are 27 by 44’
Type of Construction: Prefabricated houses
Key Takeaways: Focus on client needs with design sessions.

This project is a FEMA-funded research project in Texas. They engaged with community members and architects to design the home, thus making the project desirable and acceptable. The houses are made with vernacular elements (double gable roofs, covered open space, and suitable finishes) (figure 90). They manufactured the core unit in half to be transported easily and fastened together on the site later. This allowed them to be prefabricated; they were joined together on-site by the community, which allowed community engagement as well.17

15. Fracalossi, “Villa Verde Housing.”
16. “Expanding RAPIDO.”
17. Glaesmann, “Alternative for Disaster Relief Housing.”