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

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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.
First, I would like to thank Professors Michael Heggie and Sherry Bryan for believing in me and providing me with the 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.
PREFACE

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.

At the time, we were provided with blue tarps for emergency shelter, which were constructed into a tent manually with available materials. Those temporary blue tarps 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.
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.
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 survival 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.
INTRODUCTION

Natural disasters have been drastically increasing in recent times. With the changing climatic conditions, catastrophic events will continue to happen, and with that, the demand for post-disaster housing will continue to exist. Disasters can seriously disrupt the normal daily life 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 transitional housing for a natural disaster as fundamental for individual, household, and community-level recovery. Additionally, a prominent idea in the specific approach is to foster community organizational development to support rebuilding efforts that are not just limited to developing infrastructures, but in strengthening communities in a matter of hours. The loss of a community is the second most significant loss after the loss of life.

There are two existing architectural solutions for post-disaster housing. The first is to design a temporary structure, which is later reused or reconstructed after people return in a permanent place. The second is to create a transitional solution. Currently, there is a disconnect between temporary shelters and the construction of permanent ones. Temporary shelters may decay quickly due to the lack of durable and resistant construction and assumed short stay. In contrast to deteriorating rapidly in terms of material, permanent solutions take too long. Thus, it is necessary to develop a structure that can bridge the temporary shelter and permanent structure gap for long-term use after a disaster. In response to that, transitional housing provides an essential transition from immediate relief to permanent housing needs. Enrico Quarantelli, a pioneer in disaster sociology, recognizes four phases of disaster relief: emergency shelter, temporary shelter, permanent housing, and permanent housing. He finds that transitional housing plays a significant role in the reconstruction process to shelter affected communities and help them recover. This thesis utilizes several case studies to illuminate the nature of disaster in terms of the devastation level for the built environment. Deep investigation into these case studies not only yields needed standards and resolves (resolved and unresolved) for addressing materials and services, but also helps to conceptualize the need to sustain human capacity, shaping transitional housing for a natural disaster as fundamental for individual, household, and community-level recovery. Additionally, a prominent idea in the specific approach is to foster community organizational development to support rebuilding efforts that are not just limited to developing infrastructures, but in strengthening relationships for community reforming. 3

This project is located in Memphis, Tennessee. The city experiences severe weather events such as hurricanes, flooding, and even an occasional tornado. The project site location provides access to most of the services and infrastructures needed. The reconstruction of considering specific site conditions, site context, locally available materials, and cultural traditions to ensure a sustainable approach. Thus, this outlines strategies for resilient and adaptive housing in an area where catastrophes can potentially happen, addressing the need for a paradigmatic vision of solutions to account for immediate and long-term housing needs after a disaster. 4

2. Shelter after disaster.
4. Quarantelli, Patterns of Sheltering.
5. Johnson, Strategic Planning.
7. Quarantelli, Patterns of Sheltering.
10. Ibid.

DESIGN SOLUTION

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 not immune to disasters. Figure 2 is a timeline showing major natural disasters in the US, which have caused considerable death and economic losses. 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. 5 Included in this research is the exploration of sustainable characteristics of buildings and building systems. Local resources and material availability play a determining structural components and building details.

This is not a “one size fits most” community program that is shipped 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 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

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 and great misfortune, calamity, great failure, ill-timed event, which gives an indication of how we perceive disaster unpredictable, 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 (Fig. 3). The 20th century was most affected by natural disasters, for more than 50% of all disasters. Earthquakes are less frequent but have a significant impact on housing loss and loss of economy compared to floods and storms (Fig. 4). The structure and characterization of a building are essential during an earthquake, and thus usually, low-income populations are more vulnerable as they have fewer chances of having better materials and design. Where people are located (urban or rural areas) can affect the nature and extent of community housing losses. These differences include people’s preparedness to cope during these events, the building’s exposure regarding its structure, building materials, building codes, and settlement density within the areas. 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 their role in the recovery program. To determine the interventions needed for successful disaster recovery.
Figure 1: Natural Catastrophe World Map

- Flooding: United Kingdom, January 2022
- Earthquakes: Mexico, February 2023
- Storms: USA, summer 2022
- Hailstorms: Canada, winter 2022–2023

Figure 2: Timeline of Major Natural Disasters

- Johnstown Flood: 1889
- Great Galveston Hurricane: 1900
- San Francisco Earthquake and Fire: 1906
- Great Mississippi Flood of 1927
- Hurricane Katrina: 2005
- Hurricane Maria: 2017
- Hurricane Harvey: 2017
- Hurricane Michael: 2018

Figure 3: Global Reported Natural Disaster by Type

- Floods: South Africa, 20–21 October
- Flash floods: Pakistan, 5–7 October
- Earthquakes: Italy, 26 June
- Typhoons: Philippines, 4–5 December

Figure 4: The Great Three Natural Disasters

1900–1950: Johnstown Flood 1889
1900–1950: The Great Galveston Hurricane of 1900
1900–1950: San Francisco Earthquake and Fire, 1906
1900–1950: Great Mississippi Flood of 1927
1900–1950: Hurricane Katrina, 2005
1900–1950: Hurricane Maria, 2017
1900–1950: Hurricane Harvey, 2017
1900–1950: Hurricane Michael, 2018

Increase in global scale displacement
2008–2013: 410 Million displaced in 153 countries
100 Million displaced, 90% displacement
22 Million displaced, 90% displacement
360 Million displaced

Geophysical
Part of a natural geological process
Building and structure influence vulnerability
Good design and better materials = comparatively safer

Hydrological
Part of a natural geological process
Buildings and structures influence vulnerability
Good design and better materials = comparatively safer

Climatological
Part of a natural geological process
Buildings and structures influence vulnerability
Good design and better materials = comparatively safer

Meteorological
Part of a natural geological process
Buildings and structures influence vulnerability
Good design and better materials = comparatively safer

Earthquakes
Part of a natural geological process
Buildings and structures influence vulnerability
Good design and better materials = comparatively safer

Floods
Part of a natural geological process
Buildings and structures influence vulnerability
Good design and better materials = comparatively safer

Storms
Part of a natural geological process
Buildings and structures influence vulnerability
Good design and better materials = comparatively safer

Tropical cyclones, hurricanes, typhoons
Related to atmospheric level = "unpredictable"
Warm world = frequency of hurricane is higher
Coastal urbanization = high risk of disaster

Medicating and Biological
Part of a natural geological process
Buildings and structures influence vulnerability
Good design and better materials = comparatively safer

Global scale displacement
2008–2013: 410 Million displaced in 153 countries
100 Million displaced, 90% displacement
22 Million displaced, 90% displacement
360 Million displaced
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 responses start immediately after a disaster and last for months, 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. But if FEMA realizes the need for temporary housing due to the lack of housing stock available for rent, they provide Manufactured Housing Units. These units are delivered to the site after roads have been cleared of debris and electrical power has been restored. Finally, after FEMA has phased out its support, it is up to the community to decide their needs and how they can be addressed.7

ROLE OF FEMA

FEMA’s role is to support the citizens and first responders to build and improve the conditions after a disaster. Immediately after a disaster, government organizations such as the Federal Emergency Management Agency (FEMA) take over the tasks to rescue people, to provide cash grants and emergency need assessments, temporary employment generation, critical public services, and micro-finance projects.8 Cash, grant, emergency need assessments, temporary employment generation, critical public services, and micro-finance projects 20 days to a few years

Travel Trailer Park Trailer Manufactured Housing Unit

Figure 6    Current Disaster Recovery Process

Disaster strikes
0-10 days
25 days
disaster response
0-10 days
Recovering life and property
14-45 days
damage and loss assessment
Baseline data, physical damage, economic losses, impact, disaster risk management

disaster relief
0-25 days
Cash, grant, emergency need assessments, temporary employment generation, critical public service
damage and loss assessment
Baselines physical damage, economic losses, impact, disaster risk management

Figure 5    Temporary Housing Distributed by FEMA

placement. 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 a group site, similar to commercial areas, yet must be built from scratch, including services and utilities.8 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.9 The trailers placed on the owner’s property made them focused on 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.10

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 quick 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.

1. “Temporary Housing Unit Program.”1
2. “Mississippi Hurricane Katrina.”8
3. “Formaldehyde Levels.”4
4. “Stafford Act.”10
5. “Travel Trailer Park Trailer Manufactured Housing Unit.”1
6. “Travel Trailer.”1
7. “Park Trailer.”1
8. “Manufactured Housing Unit.”1
9. “Formaldehyde Levels.”4
10. “Stafford Act.”10

6 7
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 successful.

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 the 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 temporary 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.
TRANSITIONAL ACCOMMODATION

The thesis follows the “Transitional Shelter Guidelines” by Shelter Center in May 2012, which defines a transitional shelter 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.

Figure 10. Transitional Housing

Figure 9. Transitional Housing

Building System
Prefab
Local
Placement
Same place
Near home
Far from home
Process
Prefab
Core
Mix (Prefab/Core)
Mix (Prefab-local)

15. Martinez, “Transitional Shelter.”
16. “Shelter after Disasters.”
17. “Widespread Hurricane Katrina.”

PRECEDE NTS

The precedent study provides an in-depth presentation of the existing transitional housing scenarios, needs, and important features to consider when designing for post-disaster resiliency. Analyzing post-disaster housing projects allowed for the categorization of desired architectural elements, to include: a gable roof on homes built with locally available materials like wood, stone, brick, or concrete, large doors and windows, covered front and back porches with seating, and a raised plinth level to make people feel safe in terms of flooding and other extreme weather conditions.

The precedent research has been divided into three categories where temporary (figure 11), permanent (figure 13), and transitional housing (figure 12) are individually investigated. A timeline of transitional housing has been drawn to show the development process over time. The following are the list of cases studies:

2. Permanent Housing: Biloxi Model, EcoMOD2, Make it Right, 9th Ward, Park One Model.
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; can be built without any expensive pieces of equipment
4. Cortex Shelter: environmentally-friendly; materials, quick, sustainable, affordable, and comfortable
5. Liina Transitional Shelter: dignified temporary shelter with control over privacy level

Figure 11 Temporary Housing Projects
1. FEMA Trailer
2. Paper Log House
3. Super Adobe House
4. Cortex Shelter
5. Liina Shelter

Figure 12 Transitional Housing Projects
1. Shacks in San Francisco
2. The Domino House
3. Dymaxion Development Units
4. Big Construction Kit House
5. Transitional Shelter Project
6. Villa Verde
7. Rapido
8. Back Home Rapid Recovery

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

Figure 13 Permanent Housing Projects
1. Biloxi Model Home
2. EcoMod2
3. Make it Right
4. Park One Model

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 deconstructed
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
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). The 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 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 environmental impact of the newly developed structures.

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.

An appropriate place for this design proposal includes an area 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.

**PROPOSAL**

**SITE SELECTION**
Figure 16: Parameters for Site Selection

Figure 17: Site Linked Services and Zoning

Figure 18: Site Photographs

Figure 19: Site Analysis

Figure 20: Site Context, Downtown Memphis
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 the 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 transitory housing from the plinth (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.

**OFF-SITE CONSTRUCTION**

<table>
<thead>
<tr>
<th>1. COMMUNITY RESEARCH</th>
<th>2. OUTREACH + FAMILY INTAKE</th>
<th>3. SITE ASSESSMENT + CONSTRUCTION</th>
<th>4. DELIVER + ASSEMBLE</th>
<th>5. EXPAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTRUCTION RESPONSE</td>
<td>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.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASSESS CONDITION</td>
<td>The number of families is determined from the outreach team, which helps to determine the number of homes to be built.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAMILY EVALUATION</td>
<td>The families are contacted to determine the home layout.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>SITE EVALUATION</td>
<td>The concrete slabs are constructed (Slab-on-Grade).</td>
<td></td>
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<tr>
<td>CONCRETE SLAB</td>
<td>The core is constructed on-site with CMU walls and a flat roof.</td>
<td></td>
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<tr>
<td>CORE</td>
<td>The lumber structure is attached to the core, providing living space until expansion happens and the entire roof is constructed.</td>
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<tr>
<td>TEMPORARY HOUSING</td>
<td>Panels constructed in local yards or warehouses after a disaster event are brought onto the site. Wall and floor panels are constructed per the plan layout.</td>
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<tr>
<td>ADD-ON CONSTRUCTION RESPONSE</td>
<td>Panels constructed in local yards or warehouses after a disaster event are brought onto the site. Wall and floor panels are constructed per the plan layout.</td>
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**CONSTRUCTION RESPONSE**

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

**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 transitory housing from the plinth (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.

**SITE EVALUATION**

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

**FAMILY EVALUATION**

The families are contacted to determine the home layout.

**ADD-ON CONSTRUCTION RESPONSE**

Panels constructed in local yards or warehouses after a disaster event are brought onto the site. Wall and floor panels are constructed per the plan layout.
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 temporary houses. 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.

The super roof also adds a large shaded space on the back, which can be used for multiple semi-outdoor activities. The platform and steps (or ramp) are built together with the core.
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
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.

**CORE**

The dignified dwelling begins with an essential core structure (figure 27). Rapido’s housing model has highly influenced the design of the core. The core is made up of a fully equipped kitchen (refrigerator, sink, cooktop, storage spaces), a dining area, a bathroom, a mechanical room, and an additional room that can be converted into a second bathroom in the future (figures 24 and 25).

The study of the FEMA trailer houses 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.

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

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**Figure 24: Core: Floor Plan**

1. Kitchen + Dining  
2. Water closet  
3. Mechanical room  
4. Future water closet  
5. Closet (future washer and dryer)  
6. Storage (future replace)

**Figure 25: Core: Sections**

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**Figure 26: Core: CMU Wall Section**
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.
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 backyard construction work (figure 37).

Figure 31    Temporary Housing: Floor Plan
Figure 32    Adaptability of the Space
Figure 33    Temporary Housing: Wall Section

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 bed 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 and at a minimum.
Figure 34  Temporary Housing: Roof Type 1 Sections

Figure 35  Temporary Housing: Roof Type 2 Sections

Figure 36  Temporary Housing: Front Yard Development
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.

Figure 38  Interior Development: Initial phase

Figure 39  Interior Development: After 1 Month
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 46 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 48 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.

Figure 40. Permanent Housing: Four Layouts

22 Fracassini, “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.
Figure 50  Main Plaza

Figure 51  Shaded Pavilion at Park

Figure 52  Main Plaza: Salvaged Roof
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.
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).
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.

Figure 59  Transition of Shared Courtyard

Figure 60  Site Section
CONCLUSION

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 consideration 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, gardens, 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, bathroom, 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 person’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 design is like a blank canvas where the inhabitants can decide what they want. It is intended to provide a framework from which the residents can plan their lives in this new community. The core is the foundation 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 then they return to their homes. The 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 the transitional solutions 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.

ANOTATED BIBLIOGRAPHY


Architecture for Humanity inspires designers to take part in the humanitarian crises and offer their creativity in response to disasters worldwide. There are a total of seven examples of architectural inventions and projects grouped under the categories ‘Housing’, ‘Community’, ‘Water, Energy and Sanitation’, and Politics, Policy and Planning. Cameron Sinclair is a writer and designer, focusing on reconstruction and social impact projects. He co-founded a charitable organization, Architecture for Humanity, in 1999. Deborah Aaronsen edited the book. She works as a group publisher for Phaidon Press.


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 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 normalcy. Along with that, community engagement should also be made a main 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 project. 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.

Aaronsen and Sinclair. “Architectural Responses to Humanitarian Crises.” 11564

The thesis represents housing reconstruction as an activity that can touch the notions of basic human dignity, identity, and community rebuilding. Instead of providing ready-made solutions, the focus was on working with individuals and families and their needs. The thesis uses the idea of using locally sourced materials and tools to be built quickly. The transitional solution is affordable, quick, safe, and secure homes that are termite, water, and rust-resistant. They can last for more than 2 years without worrying about the perfect foundation. The shelters are designed to provide long-term housing solutions that are simple, secure, and sustainable. Current temporary solutions make less and less sense as they are not economical and sustainable. More permanent solutions should replace temporary installations. Cortex shelter was designed with a shelter built up in a single day that lasts up to 30 years. The shelter is built with cortex composite, which is a flat-pack concrete sheathing that can be rolled in place and harder permanently when water is added into it. The houses are flat-pack shipped and constructed within two days. This thesis uses minimum skills and labor to build a house and presents the importance of materials in improving temporary housing conditions. The houses also incorporate high windows and air in place of walls, which give the residents some privacy, and uses solar panels to generate power.


The ecohOMD project as an organization of the UVA School of Engineering and School of Building and Connected Science. This research and design/build/evaluate project created a series of green, modular, and affordable housing units. Since 2004, the ecohOMD project has built five units for RedShell Housing Alliance (PHA) and Habitat for Humanity (HFH) throughout three projects. The ecohOMD project strives to address the notable environmental impact of current building and lives by increasing differences between high-income and low-income groups. This project intends to provide affordable housing to low-income people to give them a home to space and invest in their community. This thesis uses a similar strategy to create a temporary community where families could contribute to the reestablishment of their community and recover better than just getting by until the next disaster. This program did not prescribe a universal design for families; instead, it presented them with several design solutions, as per their needs and want, which has been the main idea in this project.

Dickenson, Du. “Make It Right Goes Wrong in New Orleans.” ArchDaily. November 1, 2020. www.archdaily.com/950523/make-it-right-goes-wrong-in-new-orleans. Actor Brad Pitt set up a foundation to rebuild 150 secure and affordable housing for families who lost their homes during Hurricane Katrina in New Orleans. Current temporary solutions make less and less sense as they are not economical and sustainable. 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 Teller fiber, a material said to be free from toxic ingredients, but it could not withstand the humid moisture of New Orleans. The houses were built hastily, with poor quality materials that did not consider New Orleans’s humid, rainy climate. Thus, the houses 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 sustainable but also be maintainable. 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 mostly depend on electrical equipment. However, the shelter uses a new patented tool-free jack, similar to a carpenter’s style jack, making it easy to assemble with a locking mechanism that eliminates the need for electricity. They use eco-friendly materials, i.e., 100% recycled wood fiber material, which has been cut with computerized technology to reduce waste. They can be simply assembled and placed on an existing slab or on local materials like stone, rubber pavers, or even mud. They are already made 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, wood, and rust-resistant. They can last for more than 2 years and can be moved to different places. The concepts from this project are used as a precedent. This project follows a similar concept of constructing with local materials and tools to design a house that is built using cheap, locally available lumber. The shelter is quick, safe, and secure.
The Dymaxion House or the Dymaxion Deployment unit 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 Butlert Manufacturing Company and were deployed worldwide. They were mass produced inexpensively, ideal spaces for wartime production, and made from galvanized steel. 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 dismantled. The ceiling is dome-like and has a hole in the top with a cover for ventilation. It consists of a 20-foot-long, 8-foot-wide and 8-foot-high of corrugated steel, looking much like a cut of the top of a metal silo. The interior was designed with cupboards, shelves, openings, and a door. This thesis uses the concept of a low-cost, quick and demountable structure that can easily house a family of four or more.


RAPIDO is a new approach to post-disaster housing assistance 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 provides a social, architectural and structural, and political solution so the entire community is rebuilding. The teams comprise the community corporation of Brownsville, Inc. 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 mass-produce the cores to serve additional families affected by the storm. The main idea was to have a RAPIDO core built where the family will reside in temporary housing. Later, as people return to normality and their housing needs increase, the entire framework is built on the other side. Then the residents move over to the new extended side while the final modification is made to the core they resided 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 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 mechanical room. The unique thing about this thesis is that during temporary housing construction, is the declaration of a state of emergency, and a call for governmental support. This declaration has the cost and the technical difficulty of adding on to the existing structure are reduced, creating an open, shared space that locates social interests to be exchanged, foods, and storms. These data were used to identify the number of people affected and to provide 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 given to people after Hurricane Katrina. 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 substandard 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 it was meant to be temporary, it should be healthy for people to live in it. This thesis provides housing that is larger and better ventilated than the typical FEMA trailers. They are better ventilated and have controlled private and social spaces. The houses use locally sourced materials like timber, bricks, and concrete mausoleum units (CMUs) that are not toxic in nature, readily available, and cheaper.


In this thesis, the authors make a model for something that can be modified so that when the living areas and bedrooms can be easily added as...
riserance and disaster recovery funds become available.

This thesis uses the idea of reusing temporary housing units for permanent homes. Further, it is designed to take advantage of the reuse potential, remaining consistent from the temporary housing phase to the permanent. The core has all the basic services and is advantageous strategy because the units are a relevant resource for a recovering community. The temporary units can be reused to be a permanent structure, where the units act as a core for permanent housing. This might be an attractive social, cultural, and environmentally sustainable way of reuse.

This thesis uses the ideas of reusing temporary housing units for permanent housing. Further, this project considered designing to take advantage of the reuse potential, remaining consistent from the temporary housing phase to the permanent. The permanent housing phase is added to the core during the initial phase after a disaster. Later, when the families attain normalcy and decide to expand their houses, they can add to their existing temporary house to build a more permanent structure. There are no dismantling costs or transportation costs; thus, they have a fixed place to call home, which is flexible, economical, and sustainable.

The Katrina Cottage, also referred to as the Park One Mobile Home, was made to produce better housing than the FEMA trailers. The houses are small, substantial, and can withstand a hurricane. They can be delivered at the cost of a FEMA trailer. The houses meet the International Building Code (IBC) adopted by Mississippi and Louisiana and follow FEMA flood elevation guidelines as much as possible. These houses can be pre-manufactured, use panel systems, or be built on-site and have less cost than FEMA trailers. One issue was people did not want to live in them because they still looked like mobile homes. Also, they did not meet the zoning requirements for permanent homes. However, this project considered what a community wanted, was site-specific to include vernacular materials from the area and was climate responsive—all attributes that are considered in this thesis.

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 disaster, the temporary housing that has been underestimated for 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.


This paper proposes a strategic framework for developing temporary housing to prepare ahead of disasters and to avoid existing issues like high cost, late delivery, 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. 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 disaster, the temporary housing that has been underestimated for 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.

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This thesis keeps in mind that the construction and characterization of the house and its housing units 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.


This book is the output of the Transitional Shelter Task Group of the Red Cross, which is to provide a series of defined shelter solutions to inform the post-disaster shelter response. The book establishes transitional shelters as "rapid, post-disaster household shelters made from materials that can be upgraded or re-used in more permanent structures, or that can be re-disposed of if the situation changes."

This thesis follows a particular design timeline where three cardinal Herrera, architecture department. Her research work is mainly based on emergency architecture, cultural history, urban history, and environmental history.

The transitional shelters are designed to facilitate the transition by affected populations from more durable shelters. Since the action plan is built 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 design be in the site responses and project. Transitional shelter design and orientations are different in each place; thus, the layout should be adapted to the site, culture, and orientation. Therefore, the design brief should always encourage design flexibility to allow occupants to change their space as they start living inside it. Planning is crucial, including detailed analysis 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 the transitional shelter because the more complete 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 on the quality of 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 house and design preferences, and materials to be used. Earthquakes are and are typically targeted for low-income communities because they are vulnerable to disasters and have few opportunities to have better and materials better materials. The homes are built with locally available materials such as wood, stone, brick, or concrete and 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.


The Federal Emergency Management Agency (FEMA) as an agency of the Department of Homeland Security was established by Congress in the Post-Disaster Housing Act of 1988 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 improved. 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 living room with a kitchen and a bathroom, and a shower. Pieces of furniture are also available, which are attached to the trailer. Painting on the outside and inside walls are available, which are attached to the trailer. FEMA, the Federal Emergency Management Agency, provides temporary housing for disaster victims using mobile homes, which are mass-produced, so nearly all trailers have the same general layout.

Shigeru Ban is a Japanese architect known for designing quick and efficient houses for disaster victims using mainly 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 made an instant emergency shelter using tubes that later caused health problems, had an unpleasant smell, and are composed using aluminum and synthetic substances that later caused health problems. Hishäuser, as they are also illegal to build in the other hand, behave predictably. As a result, they are swimming pools 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.

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Eventually, the criteria for the transitional housing given by the Government was the way to transform the traditional house design into a transitional design. The criteria for the transitional housing included: the need for a secure roof, the ability to expand or transform the temporary housing into permanent housing, and the use of materials that can be locally sourced. This thesis also allows the residents to construct houses quickly and expand them as per their need, with locally sourced materials.

Perrucci, Daniel V., Blanca A. Vazquez, and Can B. Aktas, Ph.D., is an assistant professor and the program director for the Sustainable Engineering, the University of New Haven, to discuss the research in Turkey, after the 1999 earthquake, where the temporary housing was successful and affordable compared to the existing temporary housing solutions. Furthermore, the ease of expanding and deteriorating the housing unit made the housing more sustainable and reliable. In this thesis, the shelter also follows a similar approach by transforming the temporary shelter into a permanent one. The sustainability is achieved by replacing the temporary aspect with a more permanent one using local resources as much as possible. The sustainable solution understands the needs and wants based on cultural or regional norms and adaptability to local geographic and climatic conditions.

The housing was successful and affordable compared to the existing temporary housing solutions. Furthermore, the reforms are fast, more affordable, and facilitate the residents more vulnerable to future disasters. Their study aims to prepare for disasters in terms of adaptation and infrastructure resilience through the implementation of local and sustainable solutions. A temporary shelter with a permanent aspect could be used to provide a more straightforward and affordable solution to the existing temporary housing needs.

The housing phase is combined to minimize the existing housing gap between temporary and permanent housing. Thus, the transitional housing transitions into a permanent one without a need to resettle or rebuild a new structure. The relief system should be introduced through local community structures rather than through local governments. It should be built using construction methods that promote community participation and minimize the reliance on imported materials. The construction process should be adaptable to local conditions and resources, allowing for flexibility and scalability.

This report on ReliefWeb is the first comprehensive study of the shelter after disaster guidelines for assistance. It refines the principle to be followed, and how to address the survivors’ need to reduce distress and homelessness. Shelter does not refer to a place of stay immediately after a disaster, and daily activities. He organized the emergency shelter, temporary shelter, transitional housing, and permanent housing, where each of them has different objectives and focuses. Similarly, temporary housing is a place for survivors to reside temporarily, usually planned for six to three years to return to normal daily activities, whereas permanent housing or prefabricated housing is the final result of the transitional housing and the housing is a new one to live permanently.

The Office of the United Nations Disaster Relief (UNDRO) analyzed the shelter from the survivor’s perspective, rather than the assistance groups and traditional perspective of disasters. They organized relief in four phases: the emergency period, the relief period, the reconstruction period, and the development period. The relief period is focused on providing temporary shelter and basic needs, such as food, water, and shelter. The reconstruction period is focused on rebuilding homes and infrastructure, and the development period is focused on creating sustainable livelihoods and economic opportunities for the survivors.

The shelter has a sustainability approach by replacing the temporary shelter into a permanent one. The sustainable solution understands the needs and wants based on cultural or regional norms and adaptability to local geographic and climatic conditions. The relief system should be introduced through local community structures rather than through local governments. It should be built using construction methods that promote community participation and minimize the reliance on imported materials. The construction process should be adaptable to local conditions and resources, allowing for flexibility and scalability.

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This thesis focuses on constructing low-rise, high-density, post-disaster housing. In the tradition of mass housing construction methods, i.e., lumber construction and concrete masonry units, utilizes locally available lumber and technology. In prefabrication, there is an effort to ensure that the work is cheaper and faster than importing outside sources. Salvaged roofing materials and locally available concrete are to design something more affordable alternative to the initial housing phase’s roof system, which is efficient and strong and supports the local community structure. Thus, the house is built fast, more affordable, and technically more straightforward.


As developed by Walter Gropius and Adolf Meyer, the construction kit featured the qualities of precision and mass production. Walter Gropius developed a construction kit featured by the similarity of different sizes which could be combined and put together for mass housing. Atli Magnus Seelow is an architect and architectural historian. His work focuses on in the history and theory of 19th and 20th-Century architecture.

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Figure 1: Natural Catastrophes World Map. Image by Munich Re. Retrieved from https://reliefweb.int/map/world/natural-catastrophes-world-map-2012.


Figure 3: Global Reported Natural Disaster by Type. Image by EM-DAT 2020. Retrieved from https://ourworldindata.org/natural-disasters.


Figure 5: FEMA Park Trailer. Image by Christopher Mardorf / FEMA. Retrieved from https://listen.sdpb.org/post/fema-housing-lands-pine-ridge-following-disaster.


Figure 7: Existing Housing Recovery phases. Image by Elizabeth Wagemann. Retrieved from https://www.researchgate.net/publication/312375462.

Figure 8: Transitional Housing. Image by Elizabeth Wagemann. Adapted by author. Retrieved from https://www.researchgate.net/publication/312375462.


Figure 11: Park Log House. Retrieved from https://www.architectmagazine.com/project-gallery/paper-log-house.

Figure 12: Biloxi Model Home. Retrieved from https://architectureforhumanity.org/projects/biloxi_model_home.

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.
INTRODUCTION

1.COMMUNITY RESEARCH

THESIS STATEMENT:

There was chaos; there were screams. I turned back one last time to see, in a moment, it all fell into rubble. Where I found my comfort zone, with that, I wished this bad dream to pass by. Life at that moment felt pale and blue. Some were not even found. Not a proper way to say the final goodbye. And tears rolled down again as that fear overpowers. But togetherness held us all near. It rained; it felt cold; many broken people living under, together, free to roam. With a hungry stomach and nowhere to go, crying and waiting for help. And yes, help came. It came late. Be worried about people trapped under the concrete structures, I could not react and think with the constant screams.

Figure 65  Presentation Board: Disaster Relief Timeline

Figure 66  Presentation Boards: Renderings
Figure 67  Presentation Boards: Backyard Construction

Figure 68  Presentation Boards: Dwelling on Memories
Figure 69 Final Defense Layout

Figure 70 Transitional Housing Model
INTRODUCTION

THESIS STATEMENT:

Help; help me; Help me please.

I remember the dusty floors with bloodstreams.

my happy place where I could no longer be.

In a moment, it all fell into rubble.

where I found my comfort zone,

As I looked back, the building collapsed in front of my eyes.

I knew the truth, but I hoped for it not to be true.

clear.

Some were not even found.

Not a proper way to say the final goodbye.

call ours;

We cheered, laughed, and sang hiding our pain and fear.

But togetherness held us all near

It felt scary; it felt dark.

It rained; it felt cold;

Blue plastic tents were our new home,

With a hungry stomach and nowhere to go,

Should I be worried about myself? My close one?

I could not react and think with the constant screams.

APPENDIX 2: PROCESS PIECE

The continuous structure of the drawings and diagrams (figure 73) depicts the consistent processes of work that happen 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.

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.

Nader Khalili is an Iranian-American architect who designed the super adobe system for NASA’s challenge to create housing for future human settlements on the moon (figure 76). The similar method and technologies he developed were then applied to build an emergency shelter project to provide a safe harbor for Iraqi refugees seeking shelter in Khuzestan, Iran. This is a fast and flexible building system that integrates traditional earth architecture with global safety requirements.

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.

Figure 74   FEMA Trailer

Figure 75   Paper Log House

Figure 76   Super Adobe System

Figure 77   Cortex Shelter
Handbendable metallic tubes form the framework where waterproof and washable insulation sheets are snapped and locked.4

**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.5

**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: Multiple Architects
Location: Biloxi, Mississippi
Size: 1,807 sq. ft.
Type of Construction: Prefabricated house
Key Takeaways: Assembled together by community, affordable, cost effective, vernacular coastal design.

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.6

**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.7

**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 homes.8
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 not fully 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.”
BAUHAUS IN GROBEN

Walter Gropius and Adolf Meyer developed these housing solutions, which are also called big building blocks (figure 86). 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

TRANSITIONAL SHELTER PROJECT

The 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 some pre-manufactured elements

The main goal of this project was to allow the community to grow along with the families, within 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

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. They allowed them to be prefabricated; they were joined together on-site by the community, which allowed community engagement as well.17