11-20-2009

ReLife: Transitional Housing for Victims of Natural Disaster

Alexander B. Smith
University of South Florida

ReLife: Transitional Housing for Victims of Natural Disaster

by

Alexander B. Smith

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Architecture
School of Architecture and Community Design
College of The Arts
University of South Florida

Major Professor: Stanley Russell, M.Arch
Timothy N. Clemmons, M.Arch
Kenneth Cowart, M.Arch

Date of Approval:
November 20, 2009

Keywords: humanitarian, aid, home, design, catastrophe, recovery

DEDICATION

I would like to dedicate this Thesis Document to my family who, with there love and support, inspired me to study architecture. They were always there to help me through school. Thanks to my parents for providing me the foundation for excellence in everything I commit to, my grandparents for there generosity in assisting me throughout college, my brothers for teaching me skills to endure when troubles arise, and my girlfriend for tolerating the long hours and late nights that school required of me.

I also want to dedicate this Thesis to all the past, present, and future victims of disasters, especially those of Hurricane Katrina. Your pain and suffering experienced during that disaster inspired me to act and commit my time to helping improve your quality of life and those who may be affected in the future.

ACKNOWLEDGEMENTS

I would like to thank my Thesis Committee for helping me throughout this process. In recognition of his confidence, guidance, wisdom, and assistance freely given in helping me complete this Thesis study I would like to recognize Professor Stanley Russell. He has helped me develop my skills to prepare me for architecture and design for the rest of my life. Also thank you to Tim Clemmons and Ken Cowart who always provided great insight into the design that kept me motivated to continue my research.

LIST OF FIGURES

RELIFE: TRANSITIONAL HOUSING FOR VICTIMS OF NATURAL DISASTER

ALEANDER B. SMITH

ABSTRACT

Recent natural disasters around the globe have left individuals without shelter. Governments have shown slow response for these victims with examples seen from the aftermath of Hurricane Katrina. People are still living in structures that are hazardous to their health, insufficient for normal day activity, and socially unacceptable. With the rising numbers of victims and the slow response of governments to provide solutions, a new typology must be designed.

This thesis proposes a new typology that will create a responsive design that is efficient, aesthetic, environmentally conscious, and ready for implementation. Transitional housing can be defined as housing that is used during the rebuilding phase for the victims. It is not just an emergency shelter, but a structure that provides a return to normalcy for the victim. For the design to be efficient it must be easily constructed, shipped, and assembled on site. Aesthetic design, for the purpose of

this project, refers to a typology that will be socially acceptable with the user and the surrounding community. Environmentally conscious design reflects energy independence and minimizing waste production. Design that is ready for implementation will include legislation that defines how what should be used for aid towards victims.

With my interest in the efficiency of the construction of the project I intend to build a full scale model of the typology to exhaust all the requirements of construction. Research into design for manufacturing and fabrication will be conducted in order to obtain knowledge of the aspect of construction. In order to produce efficient shipping and assembly methods, companies that utilize these systems will be researched. To achieve aesthetic design, a study of contemporary architecture for small scale structures will be used and interaction with victims and communities will be established, as well as reviewing previous works designed for humanitarian aid. By studying technologies for household environmental sustainability, new concepts can be developed for use in this typology. Detailed focus on passing legislation that allows victims to access these properly designed shelters can prevent the use of substandard living facilities found in FEMA trailer communities.

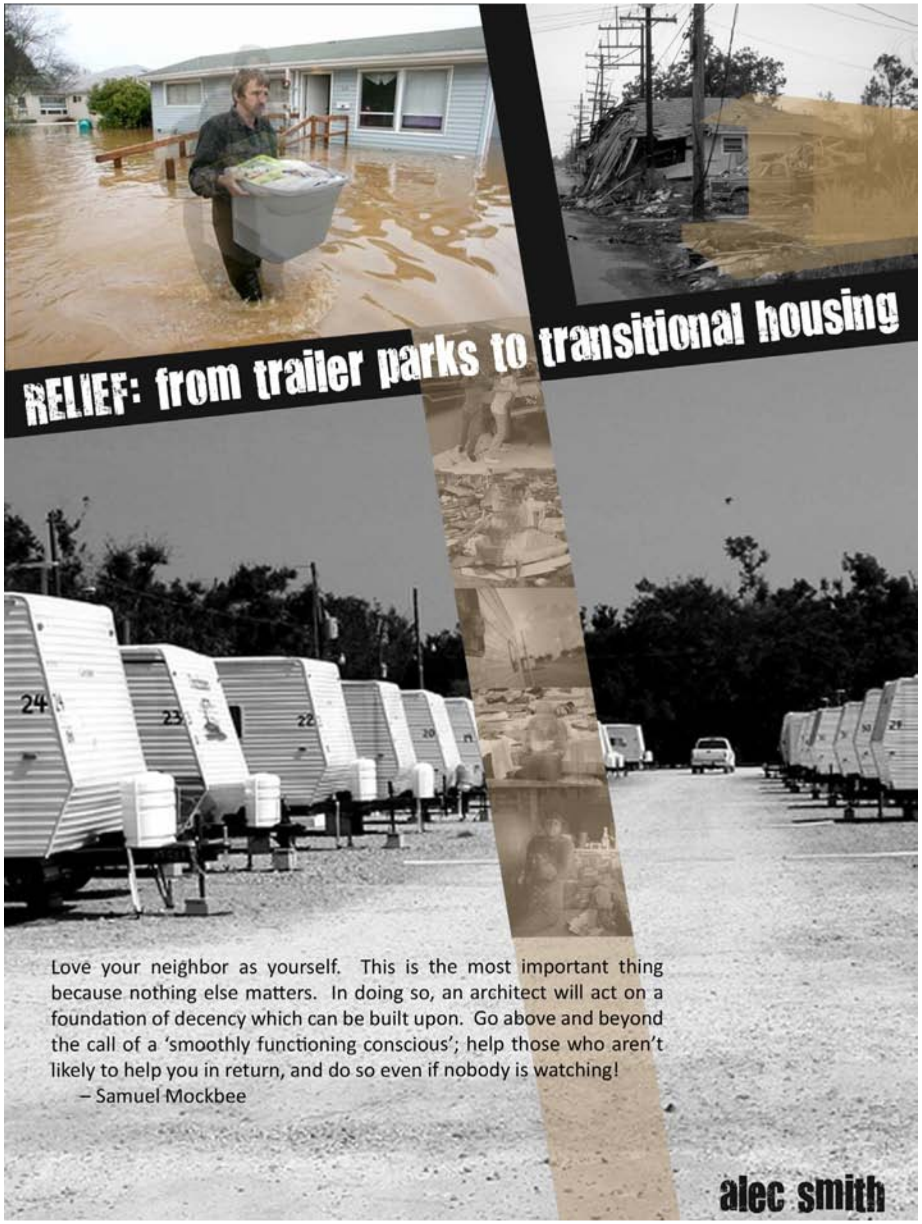

Figure 1. Thesis Poster.

Recent disasters around the world have left individuals without shelter. Governments have shown slow response for these victims with examples seen from the aftermath of Hurricane Katrina. Living conditions in current temporary housing units are causing health problems and are socially unacceptable. With the rising number of victims and the slow response of government to provide shelter, a new typology must be designed. This new typology will create a responsive design that is efficient, aesthetically acceptable, environmentally conscious, and ready for implementation into the current framework of society.


Figure 2. Hurricane destruction.


Figure 3. Wildfire destruction.


Figure 4. Flood destruction.

Issue

The Federal Emergency Management Agency (FEMA), part of the Department of Homeland Security, is responsible for disaster relief for catastrophic events in the United States. FEMA defines a major disaster as a "result from a hurricane, earthquake, flood, tornado, or major fire which the President determines warrants supplemental federal aid".[1] Looking at hurricanes only, the April predictions for the 2009 season predict that 12 storms will hit the Gulf Coast region.[2] The victims that are affected by these disasters are usually displaced from their homes during the initial emergency period, which has programs that are an effective means of response. Problems arise during the transitional period that lies between the initial emergency response and full recovery of their previous living standards. Areas where there are a large number of low income individuals are hit the worse because of their lack of ability to provide funds for recovery. These areas are where FEMA is needed the most but unfortunately not providing that needed support. "Disaster recovery programs are failing to provide long-term housing stability to low-income families because of the programmatic focus on temporary as opposed to permanent housing."[3] Recent disaster plans passed by the government have restricted the use of travel trailers in disaster situations by limiting occupancy time and only using them as a last resort. The government is also researching the specific needs of disaster victims to provide adequate support in

Figure 5. Earthquake destruction

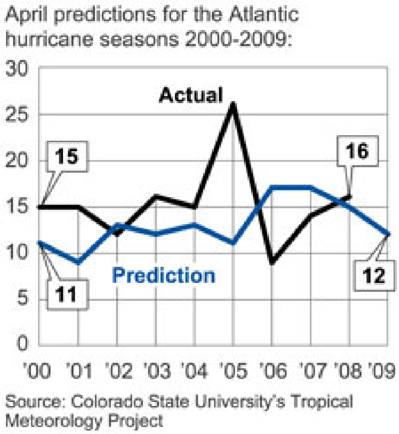

Figure 6. Hurricane prediction

Figure 7. Temporary shelters.

---
[1] FEMA: The Disaster Process and Disaster Aid Programs, 2006
[2] Stone, 2009
[3] Henneberger, 2008

a time of need.[4] Unfortunately these plans are being made after the fact and needed to be made before victims were left astray. Current housing units that are provided during this period are sub-standard and unhealthy.

Figure 8. Trailer interior.

Background

Currently about 19,000 Katrina units still remain occupied, down from 143,000 initially. This number is unbelievable because of the poor health conditions found in the travel trailers that were used for displaced victims. Not only were the environments poor, the cost that FEMA spent on purchasing and maintaining these trailers was astronomical. NBC News estimates expenses for each FEMA trailer at the Port Bienville site in Bay St. Louis, Mississippi could reach a staggering $229,000. Most of these expenses are attributed to the hiring of contractors to maintain the units including one who was paid $1.8 million by FEMA to clean septic tanks, but in turn the contractor hired a subcontractor for around $330,000 to do the same work.[5] The units themselves only cost around $14,000 but because of insufficient design cause severe health problems. The Center for Disease Control (CDC) performed a study of occupied FEMA-supplied travel trailers and mobile homes to determine the formaldehyde levels present. Formaldehyde is a common chemical in our environment and sources include: fiberglass, carpets, paper products, manufactured wood products,

[4] Press, 2009
[5] Myers & Gardella, 2007

tobacco products, and smog. Exposure to formaldehyde causes irritation of the eyes, nose, and throat and can cause cancer. The CDC found that on average 77 parts per billion of formaldehyde were found in all trailer types, with travel trailers having significantly higher levels than mobile homes.[6] Conventional homes have an average of 20 ppb of formaldehyde present in the air. The Sierra Club provided an independent study that found that 83 percent of 52 trailers they tested contained formaldehyde levels above 100 ppb, a level of concern for the National Cancer Institute.[7] Poor health conditions and increased financial burden on the government reinforces the need for a new design of transitional housing.

Figure 9. Trailer victim.

Design Intent

Efficient design is defined as one that is easily constructed, shipped, and assembled on site. The design for a transitional housing for victims looks at what materials will be used in the construction process. A transitional housing unit allows for occupancy longer than a year while still remaining temporary. Strictly temporary shelters only provide survival conditions are not means of transition back to normalcy. Modular design and the use of standardized units that are easily accessible in local communities benefit the design by reducing waste, allowing variability, and ultimately reducing the overall price of construction. The waste seen in modern day construction is because of lack of insight into apparent materials that are readily available in standardized sizes. For example, if design is

[6] FEMA-Provided Travel Trailer Study, 2008
[7] Kerensky, 2008

focused around the unit of measurement of a sheet of plywood, 4' x 8', insight can be seen in basing all formal qualities around that measurement. By working directly with a specific or set of materials, future preparations are already being made for construction processes. The framework that develops around this material, and within it, will also follow new techniques of construction. Because of the need to easily assemble these transitional housing units, the joint will serve as a key component of the construction process.

Figure 10. Prefab construction.

Already studied in great detail in all architecture, this project requires creativity in joinery systems that are quickly adaptable as well as stable at the same time. Lastly, efficient design will require easy shipment of the project. This process of inquiry enables new areas of study to be developed. In order to design something that is shipped with minimal space requirements, the final design will have to be deconstructed to provide further investigation into the manufacturing process. This deconstruction will allow for further standardization and creation of a kit of parts for construction. Once a kit of parts is designed, aspects of shipping these parts are incorporated into the holistic approach of the project. Efficient design of transitional housing incorporates material standardization, unique joinery, and manufacture processes.

Aesthetically acceptable design refers to a strategy that is socially acceptable to the user and especially to the community. Further design exploration for disaster mitigation is needed within the architecture community and creates collaboration between society and the designers. Projects need to push the boundaries of socially responsible design. Too many times designs are created by formulaic solutions that use little insight from users and the community.[8] The individuals affected by disaster vary from location to location. Also the different disasters vary the requirements for acceptable design solutions for the program. The community as a whole also affects the acceptability of the aesthetics, as seen in the discourse over the formation of FEMA trailer parks in the wake of disasters. Community engagement in the design implementation ensures that the community's needs are incorporated. During the 1970s there were around eighty community development centers sprinkled throughout the country. The centers brought design professionals, environmental engineers, government agencies, and clients together in the design process, usually through a series of workshops, site visits, and interviews. The approach called "community design" or "participatory design," combined the aspects of self-reliance and self determination that made the self-help model so compelling with the same emphasis on design, technical expertise, and sustainability usually provided to private clients.[9] With this focus towards community aesthetic comes also building aesthetic. Just because a project is for low income or costs little to construct does not mean it has to appear so. Architects today study materials and technology in ways that apply them towards unique situations. New palettes are created with these materials and budget limitations which invite creativity into the design implementations. Socially responsive

Figure 11. Trailer community.

[8] Design Like You Give a Damn, 2006
[9] Design Like You Give a Damn, 2006

architecture relies on the architect to remember the relationship to the client. Samuel Mockbee exemplifies the relation of the architect to the client, disregarding the economics of the situation.

Figure 12. Samuel Mockbee architecture.

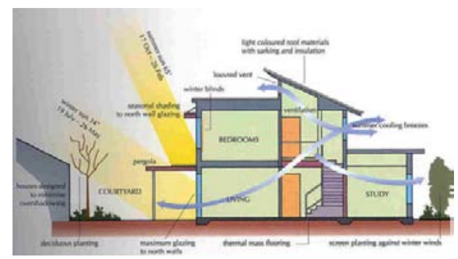

Figure 13. Passive design.

With the already present challenges to be efficient and aesthetic comes the need to be environmentally conscious. Sustainable architecture today is defined with many terms and variations. Sustainability will be defined as making conscious ecological decisions in every aspect of planning, design, construction, and manufacture.[10] By making this conscious effort to assess the “greenness” of a building, many design implications have to be taken into account. Material selection and use, as mentioned earlier in the efficiency of the construction, also contributes to the sustainability of the project. One third of all waste in landfills comes from building construction and demolition. Energy consumption from the running of buildings accounts for the larger source of energy use in the world today and therefore serves as a necessary study for all applications of architecture. Consumption of energy can be limited and offset by designing passive heating and cooling, use of daylight systems, and actively collecting the sun’s rays with photovoltaic systems. With the nature of the project temporary, it requires the design to incorporate better means of waste

[10] Stang & Hawthorne, 2005

removal because of the potential that these systems will be inaccessible because of the context of the site. Technologies have developed to create sustainable approaches that limit waste accumulation. Also the conservation of water needs to be implemented to reduce the strain on the supply source. Grey water technology systems not only reduce waste but also reuse the water for other uses and can be filtered by mean of passive treatment. This conscious effort for sustainable design at every stage leaves a final result open to variation and one that may not be evident until reached.

Figure 14. Grey water system.

Figure 15. Doors prototype.

Figure 16. Push Button House.

Architects throughout the country have designed many similar projects that follow these same principles and create relief for victims of disasters. Though many of these designs reflect immediate response, their concepts can be studied to reflect the mobility of design.[11] With these precedents that exist throughout the world, why were there so many shortcomings in aid for victims of Hurricane Katrina? One major problem is the lack of proper legislation describing what specifically should be used for aid. Federal aid comes in many forms as waivers, checks, and temporary housing for victims. Further complicating relief

[11] Siegal, 2008

operations in disaster situations are the large number of humanitarian organizations, UN and donor aid agencies, and Red Cross-related groups. This presents a wonderful challenge: Designing and effectively implementing a coherent strategy that maximizes the resources of each organization.[12] Bias committees have been formed in past disasters for distribution of aid such as the Committee of Fifty, a self appointed citizens' committee designated by President Hoover in the wake of the famous San Francisco earthquake and fire of 1906. This Committee was convinced that efficiency was the top priority and routinely refused to be pressured into what they regarded as "inefficient giving." This resulted in relief that benefitted business and lacked the responsibility and decency to take care of the needs of the poor and minority populations.[13] Improper planning also contributed to the insufficient aid for victims of hurricane Katrina. Detailed focus on passing legislation that allows victims to access these properly designed shelters could have prevented the substandard living qualities found in FEMA trailer communities. The design implications associated with an understanding of the political nature and selection of projects by the government opens up new concepts in design. These concepts should be rightfully studied and presented by the architect because of his/her knowledge of the project. You have already accepted the responsibility of design and should assist in reaching full fruition of the built form. A typology that creates responsive design that is efficient, aesthetic, environmentally conscious, and readily

Figure 17. Red Cross relief.

[12] Natsios, 1997
[13] Hartman & Squires, 2006

implemented requires intensive research that studies precedence in design of temporary structures, values of the community, emerging technological paradigms, and current policy.

Process

Figure 18. Manufacturing industry.

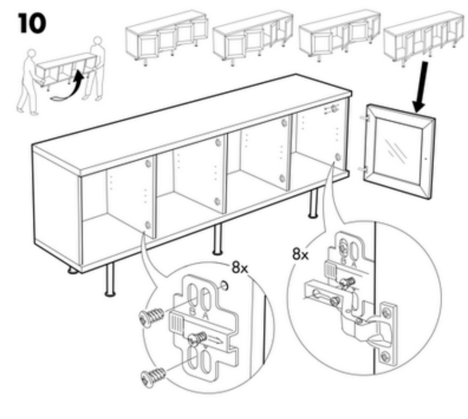

Figure 19. IKEA directions.

Efficient design renders many architectural implications. How we discover these implications is the result of exhaustive study. This research will dive into the study of materials in detail. Material knowledge will help to provide a building block for the overall design, beginning the kit of parts mentioned earlier. Not only is the material important, but the craft of construction serves a great role. Craft can be seen in the detailing work of shaker boxes and other great craftsmen of the past. Also analyzing current precedents of small scale, site assembled vernacular architecture will give insight into the joinery systems required of this typology. To ensure that the project is not wasteful during construction and that the deconstruction process further develops the design, research into companies that instill efficient manufacturing processes is needed. The IKEA Concept guides the way IKEA products are designed, manufactured, sold, and assembled. All of these factors contribute to transforming the IKEA Concept into a reality.[14] It is important to note that this research is to develop

[14] IKEA Concept, 2009

efficient standards for manufacture of the project and should not remove the importance of the client, architect relationship. Variation will be implemented to prevent the creation of a stale architecture that is merely replicated. These manufacturing companies provide important knowledge that reflects the quality control and cost efficiency of premade construction techniques.

When trying to design for the aesthetic of the client and the community the best method of data collection is direct interviews with the parties involved. Samuel Mockbee created a strong relation to the client's needs in the design. He said to "love your neighbor as yourself. This is the most important thing because nothing else matters. In doing so, an architect will act on a foundation of decency which can be built upon. Go above and beyond the call of a 'smoothly functioning conscious'; help those who aren't likely to help you in return, and do so even if nobody is watching!" The Rural Studio, under the direction of Samuel Mockbee, provided a strong dialogue with the client that allowed a free flow of information and a vast wealth of knowledge provided by the client on the soul of the project. Study of a transitional community in Sri Lanka also provides insight into the use of a series of workshops that collaborate with the families and the local government to design safe shelters that enable them to carry on with everyday tasks and a return to normalcy. This resulted in a design that met government approval and the displaced families' needs.[15]

Figure 20. Transitional house.

[15] Design Like You Give a Damn, 2006

Researching for the development of an environmentally conscious will study the emerging technology being invented by engineers and designers. Ever progressing techniques of energy conservation are being designed because of the strong influence to help preserve the nature we live in. Quantitative analysis of the recordings of electrical consumption will be assessed along with the qualitative analysis of living conditions within the structure. The precedence being set by current sustainable architecture is ever present in society with recent booms in this area of interest. Because the quality of life is so important, choosing the correct finishes on the interior will determine the air quality of the enveloped space. Also a lot of energy is used in the production of materials, embodied energy, which can be limited by choosing materials that need little fabrication or are recycled from previous architectural works in the area. Solar technology has advanced exponentially with a great number of materials for insulation of the heat as well as direct energy production by the collection of the sun's rays with photovoltaic. The quantitative data on this subject is very comprehensive. Close investigation occurs when the use of one technology is used in another way within the building.[16] For example, using photovoltaics to collect sun rays for energy production can also serve as a shading device that passively cools an area within the building. Suburban sprawl, with its low-density, low-rise development, has turned out to be one of mankind's more harmful intrusions on the environment. New movements have raised valid

Figure 21. Photovoltaic array.

[16] Schittich, 2003

concerns about suburban sprawl and neighborhoods that are scaled for cars rather than people. The detailing of shading devices is also very complex and variable within the design. All these analyses work collaboratively to help implement environmentally conscious design.

To implement design that coordinates with written legislature to enable the use of the project in these situations will depend on the intensive study of current regulations set by federal and non-government organizations. Limits on cost, building code restriction, and qualification standards are all set by organizations in HUD and FEMA. HUD is the US Department of Housing and Urban Development and was founded in 1965 to develop and execute policy on housing and cities. FEMA is the Federal Emergency Management Association and deals directly with federal aid provided to areas of disaster, declared by the President. A greater understanding of the guidelines set by these and other organizations at the beginning of the design process will provide a basis for argument for how this project will help benefit victims and actually be implemented.

Development

This new typology for victims of catastrophe will be efficient, aesthetically acceptable, environmentally conscious, and ready for implementation into the current framework of society. The design project will be developed through a series of models and a full scale production of one unit. It will be selected for a specific site, in a recent area declared as a natural disaster area, for study into the efficiency of the structure. A client or set of clients will be selected to provide insight into the needs of that displaced person or family. Not only are the functional needs of the user important, but also a sense of place in society and a feeling of home are necessary components of the design. Further analysis of the site will include its macro and micro location, climate, surrounding influences, history, access, views, topography, ecology, and hazards in the area that pose a concern. Along with a need to understand the context of the area is the need to develop a detailed program and problem statement for defining the issues of the project. Next is to develop goals and objectives, or benchmarks, along the way that will help to guide the design and solve the problems defined above. A concept for the project will reflect inherent qualities found in the context of the site and the client. Finally the solution will be implemented to fulfill all these requirements previously set. This method of design is a constructive approach that uses these classical problem solving techniques, its elements, sequencing, and feedback monitoring processes to create a built form that is more than just a solution to the problem.

CASE STUDIES

definition: an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident

Three projects were chosen at the beginning to investigate heavily into the framework and design of the project. These case studies follow a set of design criteria that were established before deciding on investigation of the case. The criteria were narrowed down from a list to include: programmatic space and variability, construction and assembly, mobility, and materiality.

Programmatic Space and Variability: This refers to the floor plan of the building. How this plan relates the number of individuals that are housed in the structure. It also refers to the ability of the structure to be varied in size and orientation.

Construction and Assembly: This criterion refers to the projects' methods of construction. Are they built prefab in a factory off site and assembled on site or are they constructed on site in a traditional matter?

Mobility: This refers to the projects' ease of changing its location once placed on site. Is it able to be moved or shifted once located in the certain scenario?

Materiality: This refers to the materials that are used in the construction of the project. Are they traditional materials or are they new age materials that are being used for the first time?

Figure 22. Disaster Pilot Project interior and exterior photos.

Disaster Housing Pilot Project - FEMA

In November of 2008 the Department of Homeland Security, Federal Emergency Management Agency, Disaster Assistance Section issued a solicitation in order to award up to five (5) contracts for the manufacture of temporary housing units, specifically travel trailer models. The travel trailers shall be built to meet FEMA's performance specifications, which include requirements to eliminate the use of formaldehyde emitting materials such that the unoccupied indoor air quality tests below .016 ppm.

Programmatic Space and Variability

The results for the bid generated many designs with 5 being selected by FEMA. These designs follow the strict guidelines and vary in size from 311ft2 to 640ft2 of interior space. The largest project, the Heston – Modular, features 2 bedrooms, 1 bath, and a kitchen/dining area.

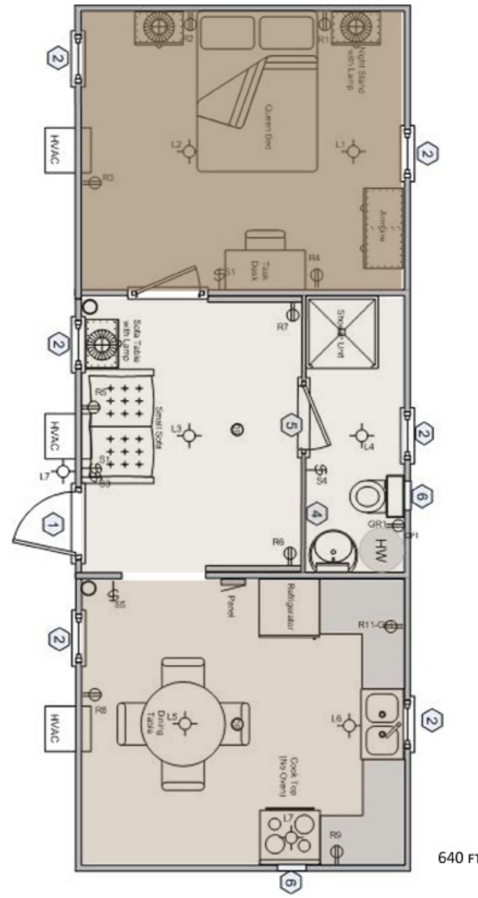

Figure 23. Heston Modular example plan.

Construction and Assembly

The Heston - Modular is shipped flat and assembled on site in a matter of days. Other models are completely constructed in a factory setting and shipped as one unit. A few of the units can be shipped by air and sea while all can be shipped by train and heavy truck.

Figure 25. Transportation of Heston Modular.

Mobility

These units are very mobile, especially the Frontier - Hybrid Travel Trailer, which has wheels attached. All units are easily detached from one another and moved via heavy truck equipment.

Materiality

Previous travel trailer designs included cheap materials that emitted harmful formaldehyde gases. These designs offer a variety of materials including interlocking panels, wheat board cabinetry, and fiberglass/wool blend insulation that is mechanically bonded, not using glues.

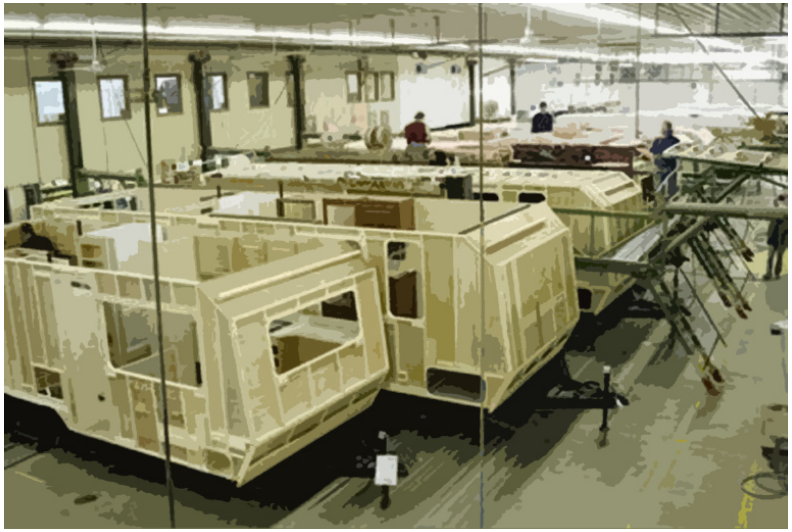

Figure 24. Construction of Disaster Pilot Project.

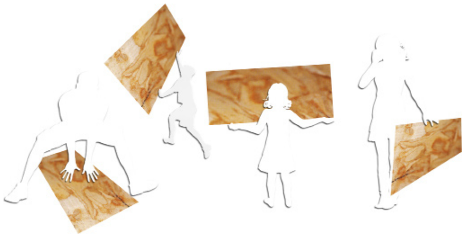

Figure 26. Individual plywood material unit.

Figure 27. Laminated plywood sheathing.

Figure 28. Construction of paper log houses.

Paper Log Houses – Shigeru Ban

Natural disasters have provided the context for some of Ban's most publicized and challenging projects, particularly three great earthquakes that struck Kobe, Japan, Kaynasli, Turkey, and Bhuj, India. After each of these tragedies, his Paper Log House answered the dire housing needs of dozens of families left homeless. In Kobe the shelters were primarily built for Vietnamese refugees who remained in the vicinity because of jobs, schools and a supportive community. In Turkey and India, earthquake victims also wished to remain near their damaged homes for the sake of their community and to begin the process of rebuilding.

Programmatic Space and Variability

The space within the log houses varies dependent on the need. The original houses were small, 4m2 interior. Second renditions included an open veranda and larger interiors for larger families. Depending on the weather conditions of the area, certain steps are made to further insulate the paper tubes.

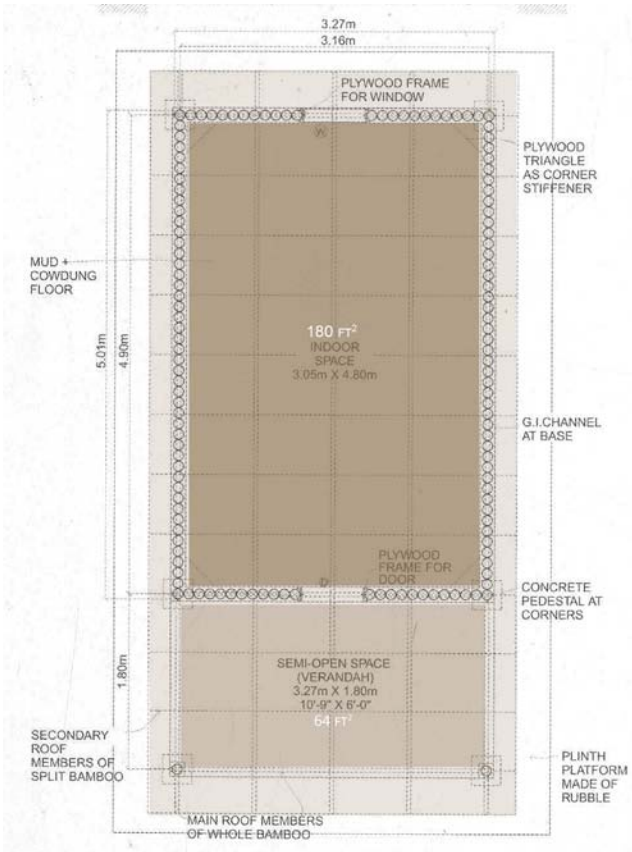

Figure 29. Paper log house plan in India.

Construction and Assembly
A construction leader is assigned to each house. Prefabricated elements are prepared off-site and trucked on-site the morning of assembly. The first 6 houses are assembled after 8 hours and 21 are built within a month. Since the paper tubes are lightweight, everyone can get involved in assembly process.

Mobility
The material is very lightweight but durable and strong which allows for easy transportation of the pieces. Since the tubes are standardized units with a hollow space in the interior, they take up a lot of space when shipping. There are both benefits and disadvantages to the tube.

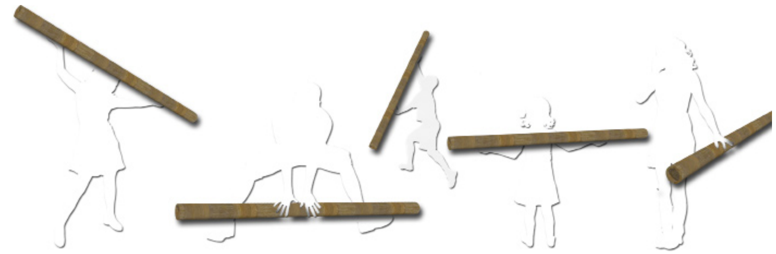

Figure 30. Individual bamboo material unit.

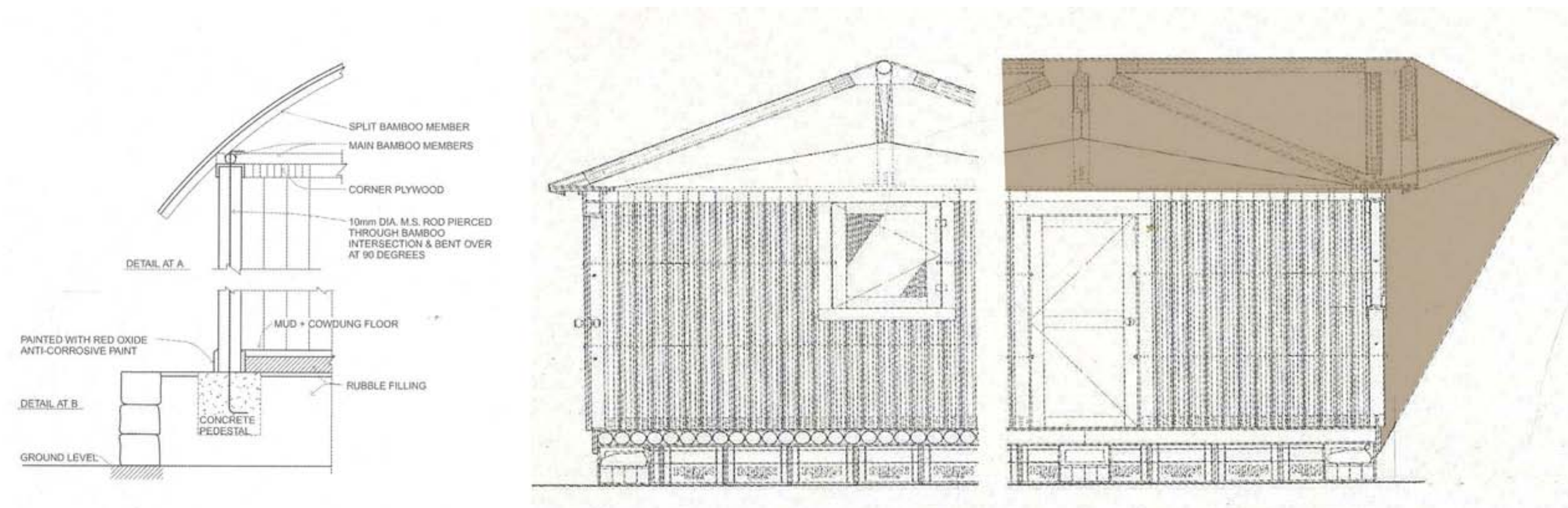

Figure 31. Paper Log House elevation and canopy.

Materiality
The log house is made from ridge-beam construction with walls made of paper tubes. Self-adhesive, waterproof sponge tape between the tubes insures a watertight fit. The plinth is constructed of borrowed beer crates filled with sandbags. The ceiling and roof, made of PVC tent membrane, is separated to allow air circulation between them.

Figure 32. Paper Log Houses in Japan.

Figure 33. Paper Log Houses in Turkey.

Figure 34. Paper Log Houses in India.

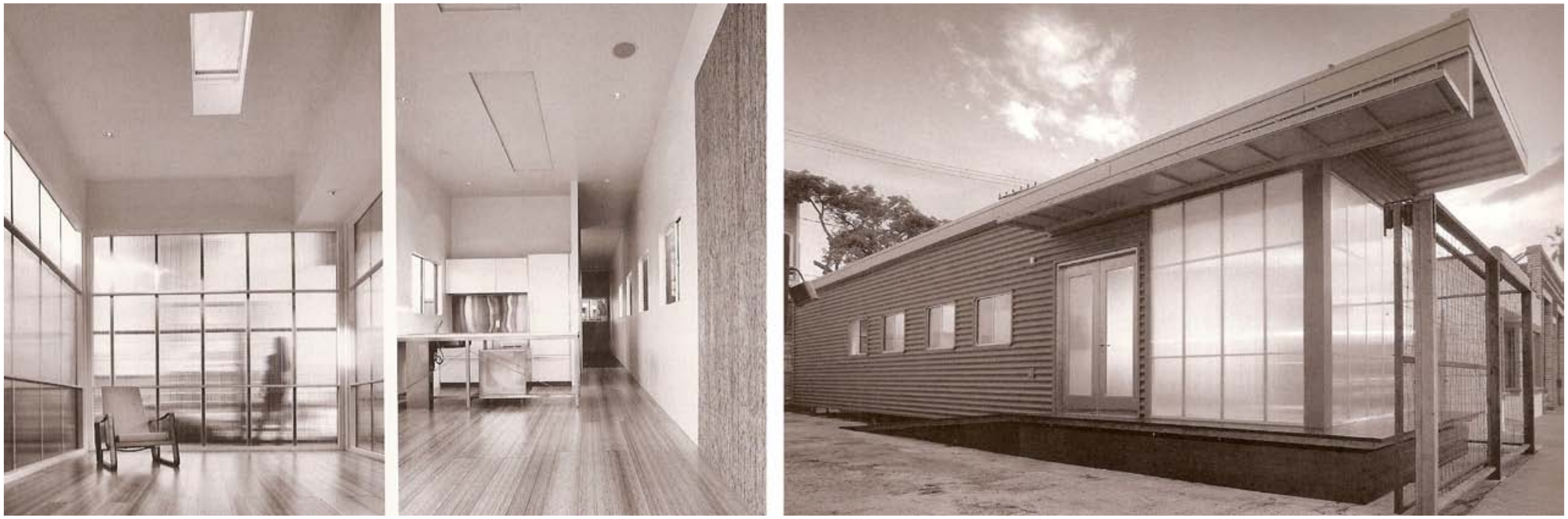

Figure 35. Portable house interior and exterior photos.

Portable House – Office of Mobile Design
Jennifer Siegal, the founder of OMD, challenges preconceived notions of the trailer park and has created Portable House as a "provocative counterpoint" to the assumptions of the mainstream housing unit. OMD is based in Los Angeles, a city where many buildings are temporary fixtures constructed to serve a limited purpose and then demolished.

Programmatic Space and Variability
Central to the Portable Houses is its kitchen and bathroom facility, which also serves as a division between the sleeping area and the lounge. The

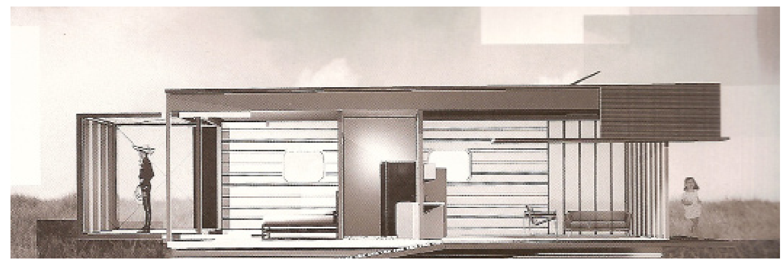

Figure 36. Exterior facade of portable house.

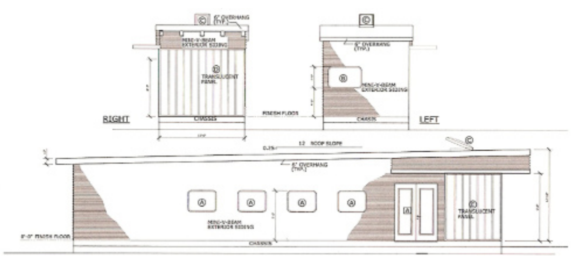

Figure 37. Portable house elevations.

compact house can be enlarged when extra space is needed by sliding out and extending the structure containing the lounge area.

Construction and Assembly
The houses are factory-made and consequently relatively cheap to buy, however, for the same reason they are also constructed to a higher standard. The basic module steel frame is 12' x 60'. The home takes 4-8 weeks to construct depending on specs and is trucked fully assembled.

Mobility
It is much quicker to build, is capable of relocation, and costs about 15% less than a comparable conventionally built house. On site assembly for the single module ShowHouse took only 2 hours. More complex projects are unlikely to relocate once installed.

Materiality
A primary aim for the Portable House is to make the fullest use of sustainable building materials. The interior partitions are made with fiberboard derived from recycled waste paper, the flooring is made from bamboo, Polygal is used in place of glass, and structural wall paneling is used for its added insulation properties.

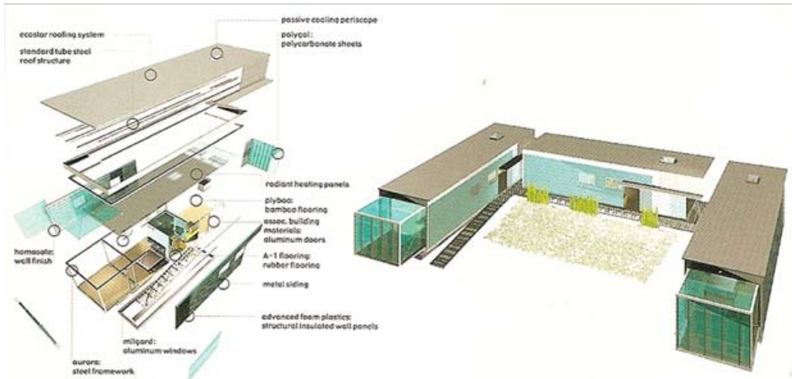

Figure 38. 3-D exploded axonometrics of Portable House.

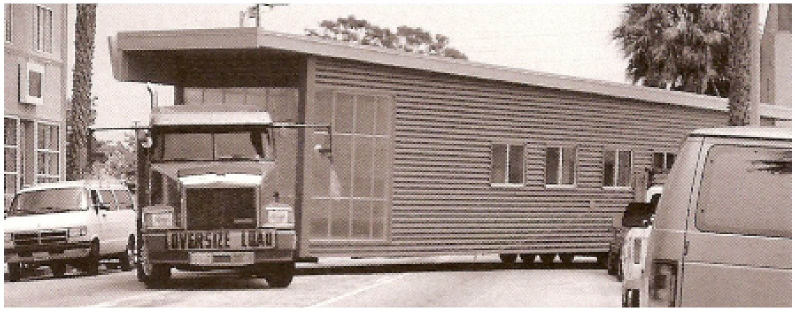

Figure 39. Transportation of Portable House.

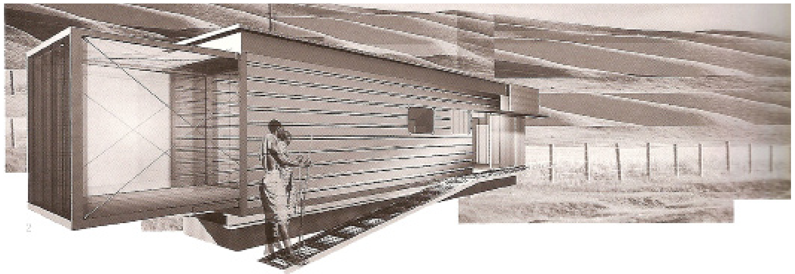

Figure 40. Rendering of Portable House.

Case Study Benefits

Each of these case studies proved to be very beneficial towards the research of new and traditional construction techniques. The most important derivation from each case is the unit established within the encompassing whole. Each case creates some standard of construction and simplifies it to a group of units that are combined to create the greater whole. Discovering these units provides me with the parts to the kit of each project. These parts deal directly with the material makeup of each case and how that material is incorporated into the design.

Disaster Pilot Projects

These projects use very standardized construction techniques. The material used within each project is oriented strand board (OSB). This is a very inexpensive material that is made of compressed wood and adhesives. It is a typical material found in temporary mobile housing. The material has some disadvantages because it has to be protected somehow from the elements by another fenestration material. The material is also hidden under the skin of the project, hiding all tectonics of the structure. This diagram shows the unit within the whole and the visual aspects of the material.

Figure 41. Pilot Project Diagram.

Paper Log Houses

The material used in these log houses is a standardized tube made of recycled paper. Shigeru Ban is known for using this material throughout the world and is very accustomed to its properties. The tube is very lightweight, easily manageable by one individual, and is combined with others to form the skin and structure of the house. It is a sustainable material also because it composed of recycled tubes from other projects. The tubes are arranged consecutively to form the outer structure of the house. Since the units are rather small they are easy to handle but require lots of labor to assemble the large amount required to form a house. The diagram shows the floor plan reflected in the shape and the unit within the structure.

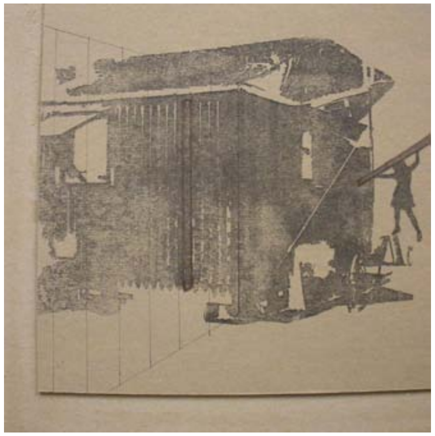

Figure 42. Log House Diagram.

Portable House

This house uses a number of materials but the most unique is the polygal material found in place of the windows. This material is very lightweight and flexible but much stronger than traditional glass with its multi layer system. This material expresses the tectonics by showing the structure between the panels, which is a standardized shape. The diagram shows the unit within the structure and displays is multi layer aspects of the material.

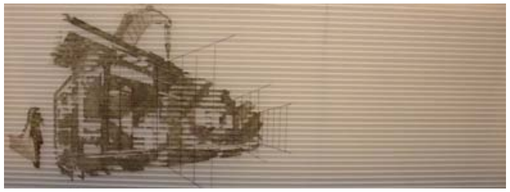

Figure 43. Portable House Diagram.

Other Studies

triPOD: a Plug and Play housing system

This housing system is a prefabricated pod-like structure that uses a core center to supply all systems required to function. A core serving as the spine contains all the mechanical equipment of the building and serves as the main circulation space. The entire structure is designed with modular widths allowing for ease of assembly and disassembly of the pod structure. Standardized pods are placed as needed by the occupants in connections within the central core. The pods can be recycled completely and used at other sites, allowing families to personalize their home as they need certain spaces. This study employs the use of complete prefabrication off site and installs these PODS after fabrication. The pods must meet dimensions of the core leaving little chance for much variation within the unit. The project benefits from the use of factory made objects preventing the loss of material found at traditional building site.

Figure 44. Construction of triPOD prefabricated modular system.

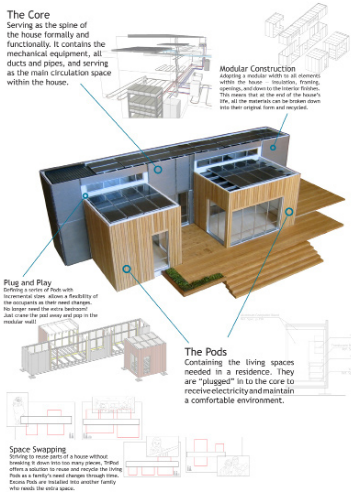

Figure 45. Diagram of triPOD.

ME:LU   Modular Expandable Living Unit

This living unit takes advantage of the large amount of shipping containers found throughout the world. These containers provide a modular unit that is structurally sound within itself and a standardized size. Not only do they employ green technologies like solar energy and hot water heating, passive heating and cooling, electrical and water conservation, and recycled materials, but they also distill the design down to the needs of an individual to live. This utilitarian design provides an attractive solution to the needs of the community.

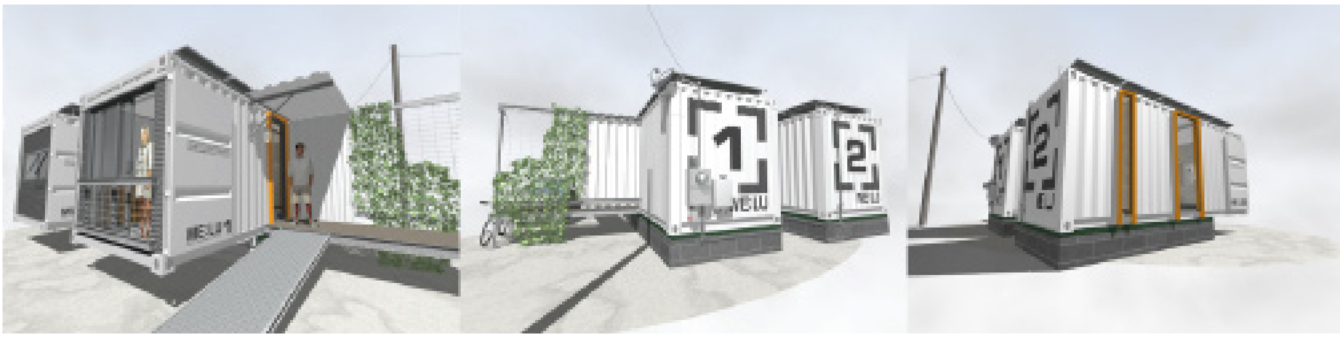

Figure 46. Perspectives of ME:LU.

Figure 47. Section-perspective of ME:LU.

Figure 48. 3-D rendering of ME:LU.

Second-Life Iraqi Housing

This housing typology is designed for displaced Iraqi families from the conflict currently in Iraq. Typically houses are commandeered by Marine forces in order to set a camp of operations in the field. This displaces the families in that area. This house is designed to be easily erected by Marine forces. The structure is made of mesh panel that are filled with rocks to provide support for the roof. The layout is similar to the typical house found in Iraq except with a unique structural system. The system allows for ease of transportation and assembly once on site.

Figure 49. Modes of transport for Second-Life Iraqi Housing.

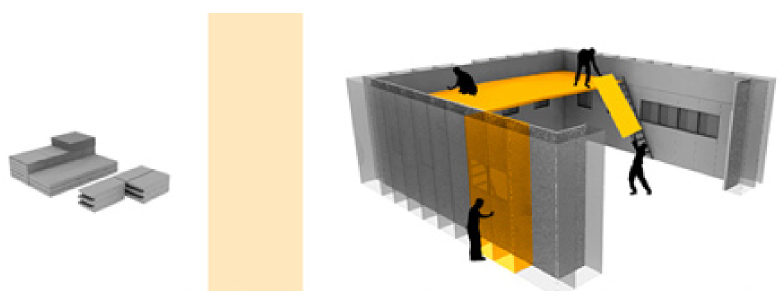

Figure 50. Assembly of Second-Life Housing.

Figure 51. Perspective of Second-Life.

PROGRAMMATIC SPACES

Designing for the programmatic spaces of your structure starts to regulate the limits of the project. This is the first step to assigning a scope of work to the design and begins to set parameters. These parameters will define what spaces are included, how much space will be there, and what the user expects to get out of these spaces. The methods for developing the program is either design based, knowledge based, agreement based, value based, or a combination of one or all of these. Certain attributes are assigned to the project that include general properties that are applied to one or a number of the spaces and start to talk about the quality of space. Once the quality is determined a scale is set and orientation on the site is determined.

Qualities of Space

The quality of the space lists a number of attributes that are assigned to each space and describe its character. This design strives for certain qualities and they are listed below.

- Allow for interaction between the user and the surrounding community.
- Provide space for gathering of groups or multiple users within the unit.
- Incorporate space for seating and dining for the main occupants of the unit.
- Create a functional, efficient cooking area that allows ease of movement, but does not occupy too much interior space.
- Provide a bathing area that allows extreme privacy while still being intensely well lit.
- Include a sleeping area that is private and peaceful but also adaptable to multiple users.
- All spaces should be flexible and adaptable to different users.
- Include transitional spaces that define levels of privacy within the structure.
- Provide space for mechanical systems and services so that the structure may function on its own.

Space Usage and Relationships

To get a better understanding of the spaces a daytime use breakdown was assessed for each space to determine what spaces were used the most and required the most floor area. I looked at the space based on a weekday and weekend and compared the hourly usage. During a weekday and weekend the bedroom space still used the most time, about eight (8) hours per day, though most of that time is spent asleep. The majority of the other time was spent in the living room, two (2) hours during a weekday and five (5) hours during a weekend day. The porch was the 3rd most occupied space, depending on the family style and weather, and the living and dining areas usually equaled each other comparatively. Obviously hours were higher during weekends because of lack of work on those days. Both on weekdays and weekends more hours were spent at home than not. The table below shows a comparison of the hourly usage of each space to one another during the week and weekend.

Room	Weekday Use	Weekend Use
Living	2 hours	5 hours
Porch	2 hours	4 hours
Dining	1 hour	3 hours
Bedroom	8 hours	8 hours
Kitchen	1 hour	2 hours
Bathroom	1 hour	2 hours

Figure 52. Daytime Usage Breakdown.

Below is a list of associations found in each room that describes the atmosphere that would hopefully be found in that space. They are listed in hierarchical order from most time spent to least time spent in each room.

Bedroom – quiet, calm, relaxed, tranquil, private

Living/Porch – very public, loud, exciting, bright

Dining – interactive, semi-public, conversational

Kitchen – workable, functional, efficient

Bathroom – very private, very light, sedate, exclusive

Service – hidden, protected, restricted

Figure 53. Diagram of spaces with associations.

Though some rooms reflected high hourly usage, those rooms do not always accommodate for the most people at once. These numbers vary depending on the associations with those rooms. Rooms that are very private tend to accommodate only a few individuals even though those people occupy those rooms the most hours. The bedroom used the most hours during the day and only accommodates a couple people. The living area accommodates the most individuals. The bedroom, porch, and dining areas all hold the same amount of people and depend on the number of individuals the residence houses. The table below lists the number of people each room would accommodate.

Room	Max Occupants at 1 Time
Living	10 people
Porch	6 people
Dining	6 people
Bedroom	6 people
Kitchen	2 people
Bathroom	1 person

Figure 54. Maximum occucpancy level for each room.

Levels of Privacy

The levels of privacy are usually dictated by the transitional spaces that are found between the areas. These spaces help to shift one from one space to the next without interrupting the mood or the setting. Some spaces tend to group together based on these levels of privacy, which start to generate alliances between spaces. These alliances start to form the path of the building and create a flow of spaces. Simple associations can be seen between the bedroom-bathroom, kitchen-dining, and living-porch. The level of privacy in most housing units can be seen in this order from private to public: bathroom, bedroom, dining room, kitchen, living room, and porch.

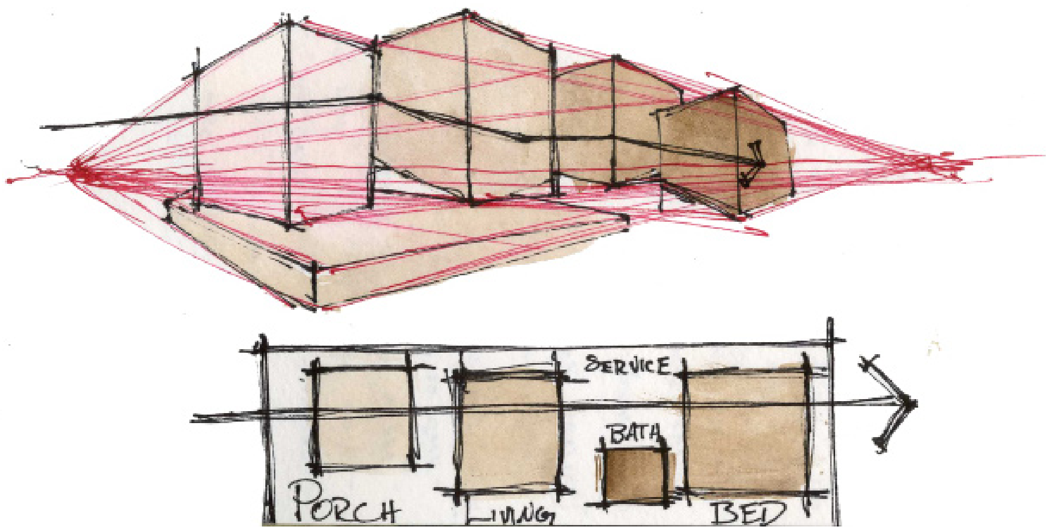

Figure 55. Levels of privacy in plan and perspective.

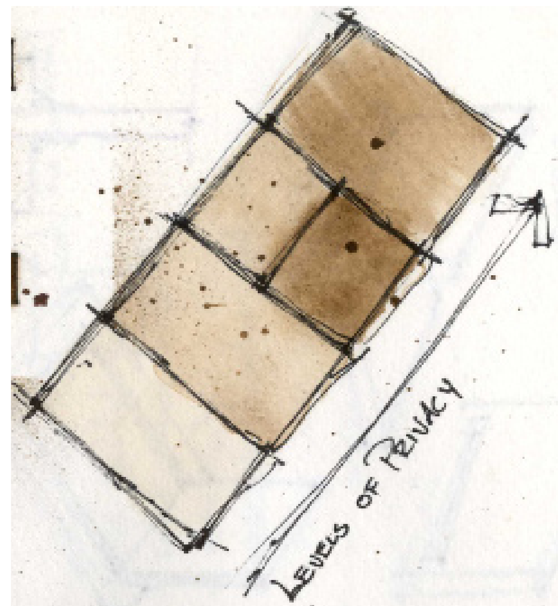

Figure 56. Privacy with floor plan.

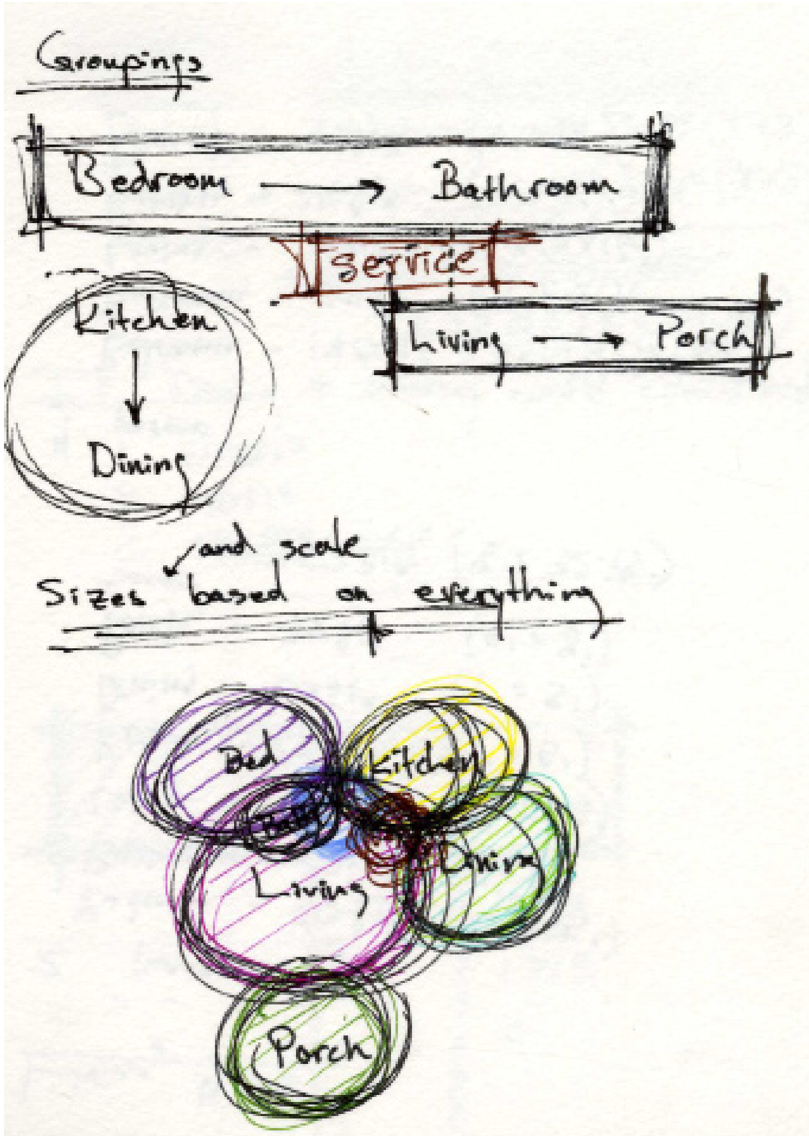

Figure 57. Early groupings of spaces with one another.

Unit Areas

When determining the unit areas, minimum requirements for manufactured homes were used as a starting point. These guidelines set a basic requirement for each space, including required openings and certain dimensions. These requirements state:

- heights of at least 7' in each room for at least 50% of the area
- minimum of 2 exterior doors
- minimum of 8% glazing for each room of its gross floor area
- at least one (1) living area of 150ft2 of gross floor area
- bedrooms have at least 50ft2
- two (2) or more person bedrooms must have at least 70ft2 plus 50ft2/person in excess of 2
- minimum closet per bedroom with 22" of depth
- no horizontal dimension less than 5' for room width
- toilet room minimum of 30" wide
- at least 21" of clearance in front of the toilet

When FEMA put out a bid for the design of disaster housing relief homes they also set a minimum standard for these homes. These requirements stated:

- 8' minimum width
- 30' maximum box width
- 1 bedroom that sleeps at least 2-4 people

- 1 bathroom
- 14 cubic foot (c.f.) refrigerator, electric oven/cooktop range
- furnace, rooftop A/C, microwave
- 20 gallon water heater
- living room with at least 70ft2
- kitchen with at least 20ft2
- bathroom with at least 20ft2
- bedroom with at least 35ft2
- estimated total of around 250ft2

These guidelines help to provide a base starting point for determining the floor areas of the different spaces. In order to provide adequate space for different family sizes, it was determined that 3 different unit sizes would be designed and distributed based on family size and occupancy levels. Another contributing factor of the floor dimensions is the standard width of a trailer on an 18-wheeler truck. Since these units will be delivered to residents in their neighborhood, a key design aspect is that they fit on a standard truck. All these room dimensions were based on that width. Below is a list of the 3 unit sizes with their associated room sizes for each. The diagram shows the relationship between the 3 unit areas. Unit B is about 50% larger than Unit A and Unit C is more than two (2) times the size of Unit A.

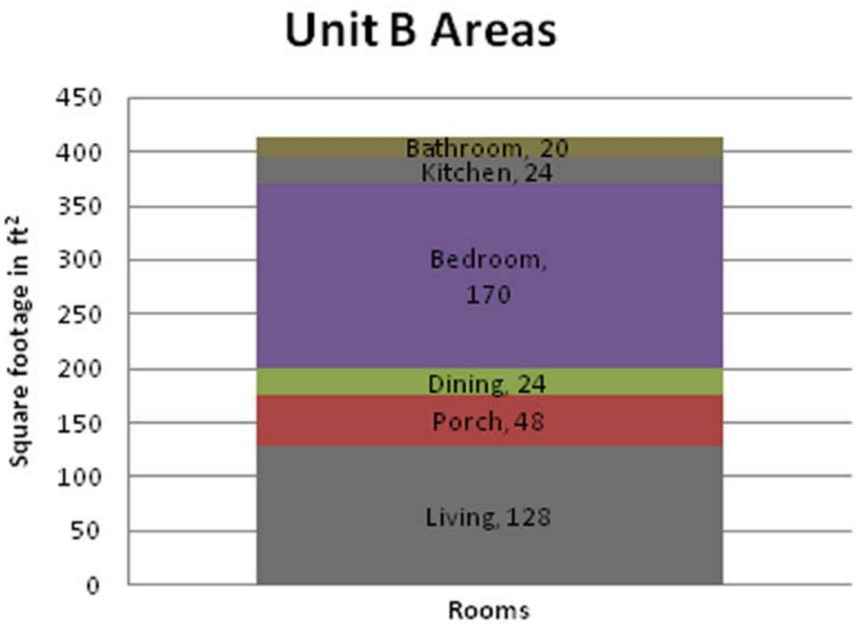

Figure 58. Space Areas within Unit B.

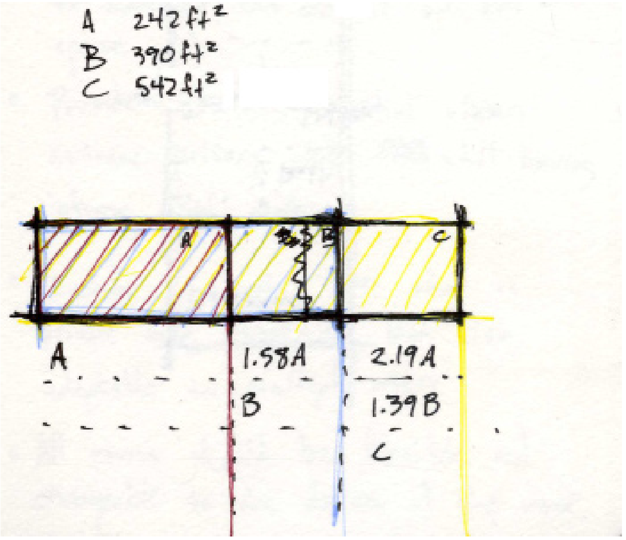

Figure 59. Ratio of Unit Areas to one another.

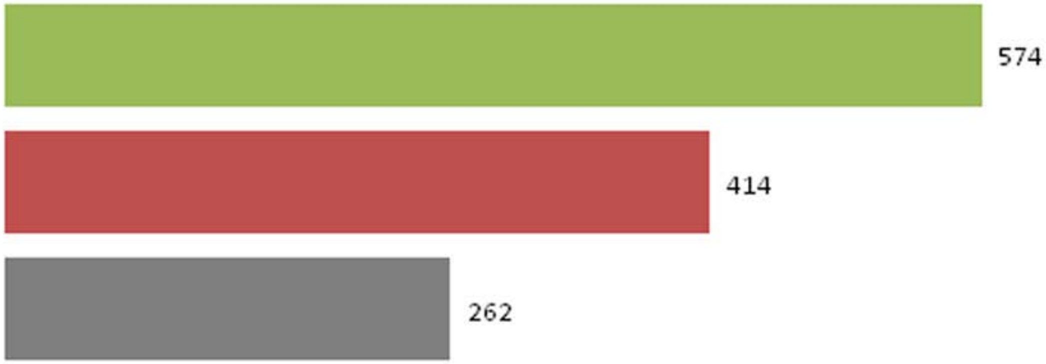

Figure 60. Comparison of Unit Areas.

SCENARIO ANALYSIS

When determining the site for this design normal conditions do not face the situation. Traditionally designs are focused around an already predetermined site that is selected by either the architect or the client. Since this design is based on the occurrence of a natural disaster, the site could potentially be anywhere in the world.

Site Selection

Due to its abundance of disaster-prone areas the United States will be the site or focus area of this transitional unit. Throughout the US areas have been hit heavily by a number of different natural disasters mainly including wildfires, floods, tornadoes, earthquakes, and hurricanes.

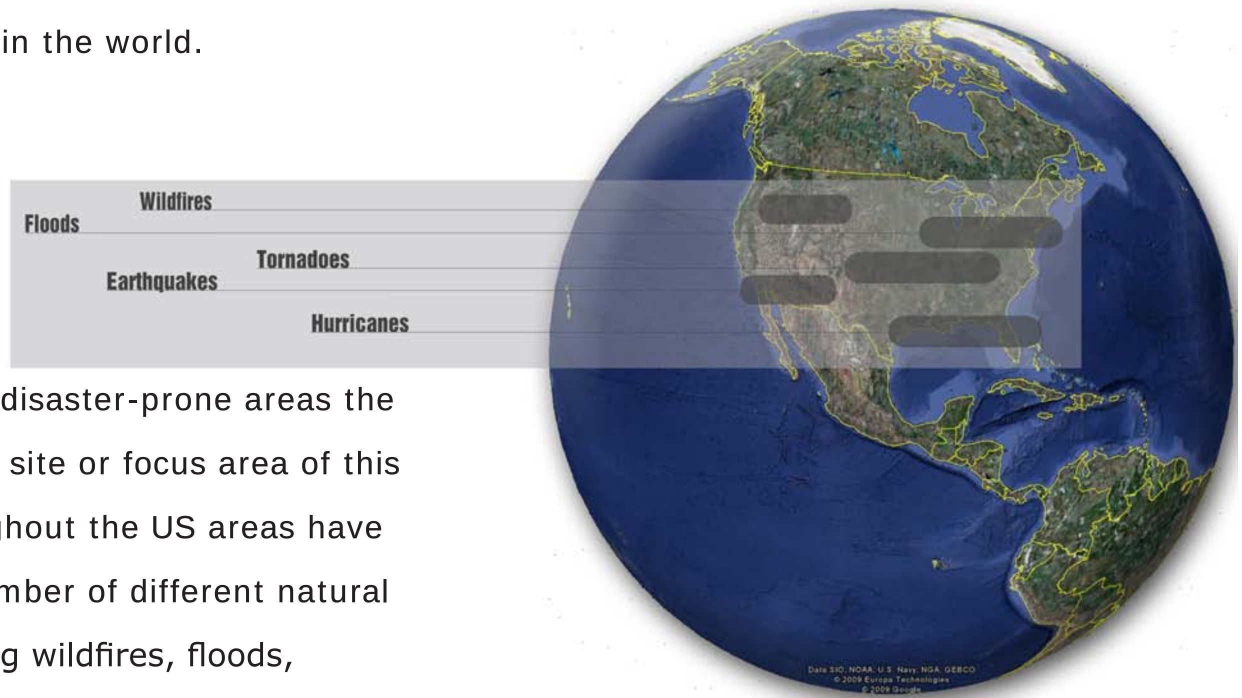

Figure 61. Diagram of sites US wide.

Because of my familiarity with the state of Florida and its constant occurrence of natural disasters, it will be used as the secondary site for code enforcement of the design. Since this design is for disaster preparation and mitigation the Tampa Bay region will be used as the primary site because it has yet been hit by a large disaster in recent years. Specific sites throughout Florida were chosen as precedent areas that had already been affected by disaster in past years. Certain site selection criteria are used in determining the appropriate study sites for this transitional unit. These criteria include:

- middle to low class neighborhood
- history of natural disaster occurrence
- high density of homes in neighborhood
- variation of lot size and orientation
- proximity to water
- relation to woodland areas
- elevation and flood zone category

In recent months the state of Florida has experienced moderate rainfalls, especially in the middle of the state. These rainfalls were needed desperately in most areas but have proven to be costly in some counties, especially Volusia County on the East Coast. This county has seen water levels above four (4) feet in most areas for the past few weeks in May. It is in part due to its proximity to water but also because it is in the lowest category of elevation which is very prone to flood. Many residents have been displaced during this time to local shelters in the area. This is a typical example of flood in the state and affects thousands each year.

The last major wildfire to affect Florida was in 1999 when one destroyed a number of homes in Port St. Lucie, FL. The wildfire started from a small brush fire that quickly spread because of high winds. All in all the fire destroyed over a dozen homes and 2,400 acres of land. Another contributing factor to the devastation was the lack of adequate fire hydrants in the neighborhood. This area is a very dense neighborhood with lots of trees, located close to the wooded areas on Gaitland Boulevard.

In 2004 hurricane Charley struck the southwest coast of Florida near Port Charlotte, FL. The area was devastated by the category 4 hurricane, the largest to hit the state since hurricane Andrew struck 12 years earlier. The hurricane was expected to make landfall further north in Tampa but changed course suddenly and hit Hardee and DeSoto counties instead. It was a very strong but fast moving storm; otherwise damage would have been much more severe.

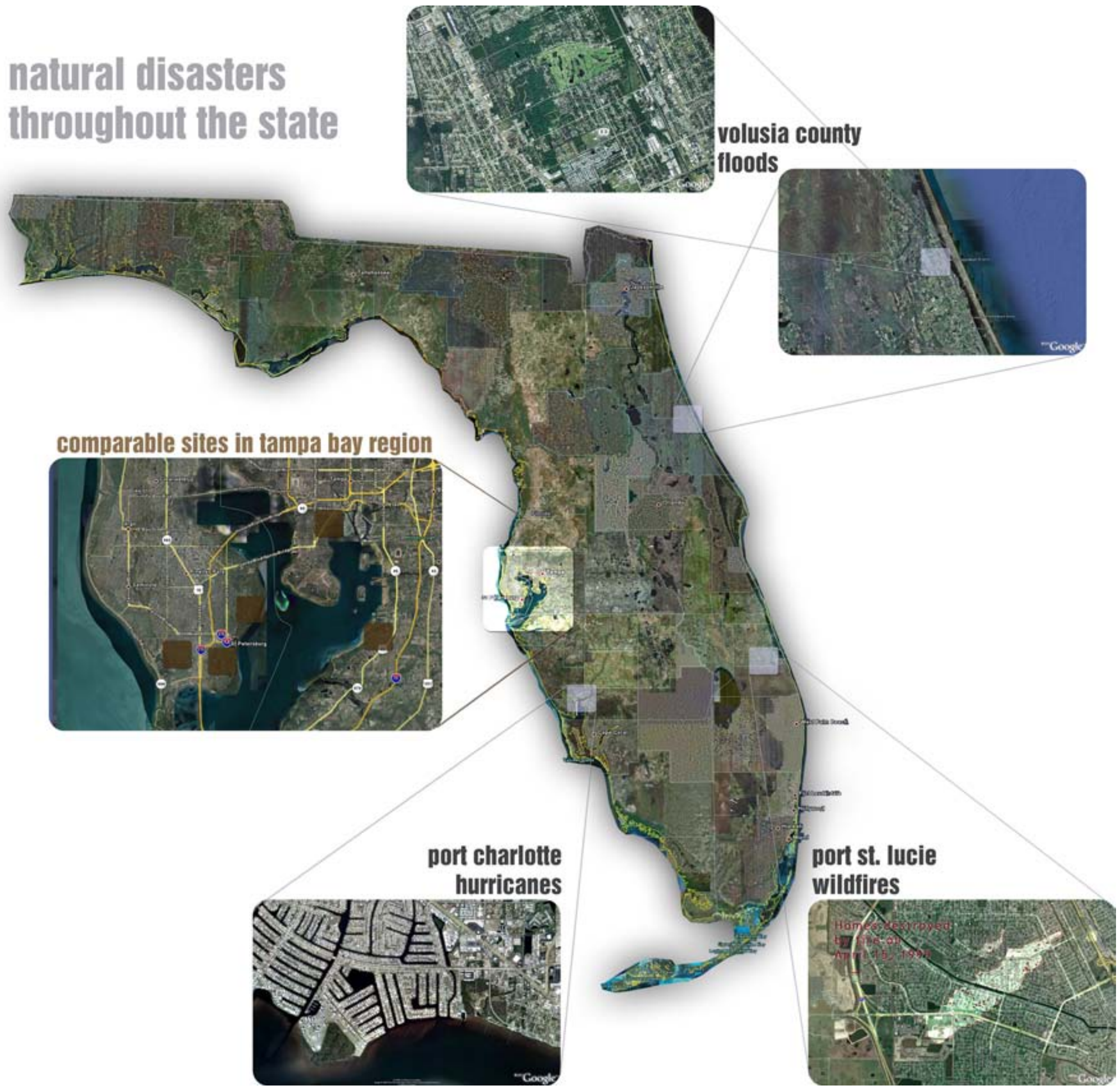

Figure 62. Diagram of natural disasters throughout Florida.

Flood Scenario

An area in Tampa Bay that is very prone to flood is a neighborhood called Shore Acres. Located on the Tampa Bay in Pinellas County this neighborhood sees high levels of water every time any moderate level of rain falls. The area varies in property value from high end to moderate income. The very low elevation is cause for much of the flooding and proximity to the bay. Storm drains often flood when high tide rises. This area sees constant flooding is a prime example for a flood scenario to take place.

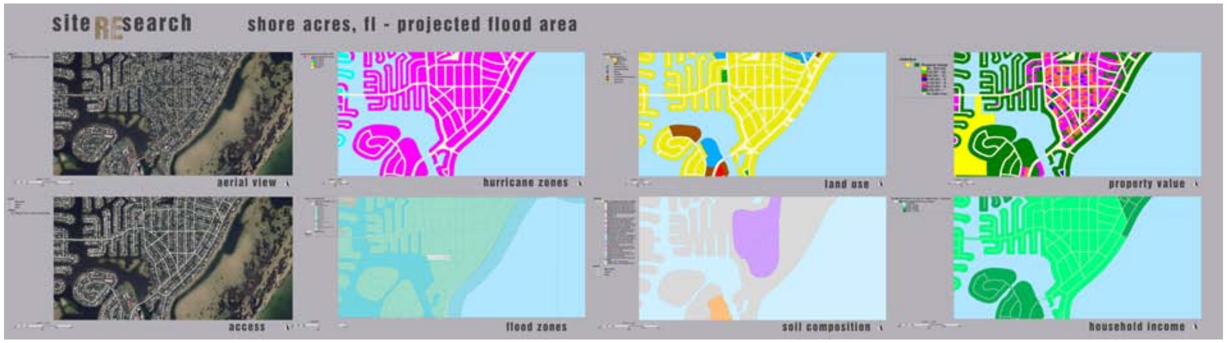

Figure 63. Site research for flood scenario.

Figure 64. Map of flood scenario.

Wildfire Scenario

Because of the Pinellas County's high density of homes, if wildfire was to strike the area many homes would be devastated. One of these prone areas would be in south St. Pete, Lake Maggiore Shores. This area is located just north of Boyd Hill Nature Park, a dense natural reserve with thick tree cover. The neighborhood is relatively low income and very densely populated.

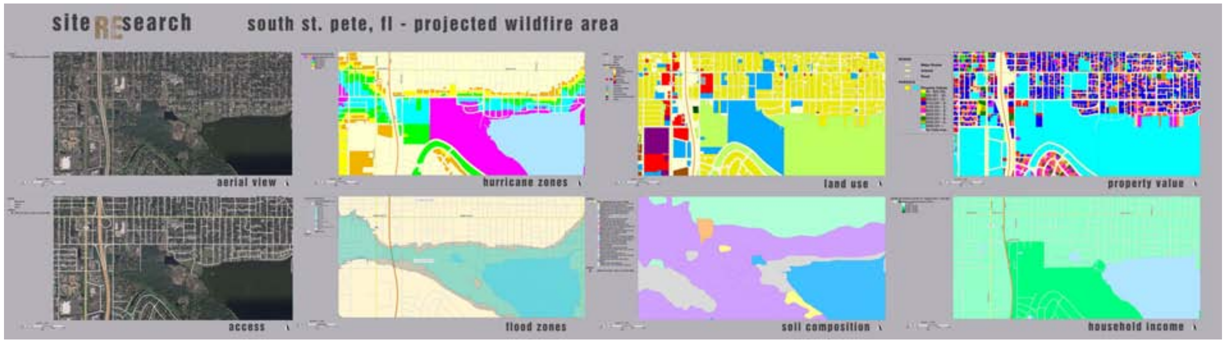

Figure 65. Site research for wildfire scenario.

Figure 66. Map of wildfire scenario.

Hurricane Scenario

Hurricane is the most probable scenario to prepare for in the Tampa Bay Region because of its proximity to the Gulf of Mexico and surrounding water areas. Two sites that are at great risk for landfall are Gulfport in Pinellas County and Apollo Beach in Hillsborough County. Gulfport sits on the Boca Ciega Bay in St. Petersburg. It is the most unprotected site in St. Pete other than the beaches themselves. The area is also in a low lying elevation/flood zone and is part of Hurricane Evacuation Zone A. The neighborhood follows a strict grid of streets and avenues with back alleys behind the homes. The density is very high with little room to fit transitional units. Another difficulty is the narrow streets which provide an interesting challenge for delivery of the unit. Located just east of the mouth of Tampa Bay, Apollo Beach is very prone to hurricane landfall. This neighborhood is surrounded by water and sits in a very low lying flood zone. It is a category A hurricane evacuation area, meaning it is to be evacuated first if a hurricane were approaching. The houses consist of 1500ft2 to 2500ft2 homes. The area around the homes varies widely with some large set backs and some narrow lot spaces.

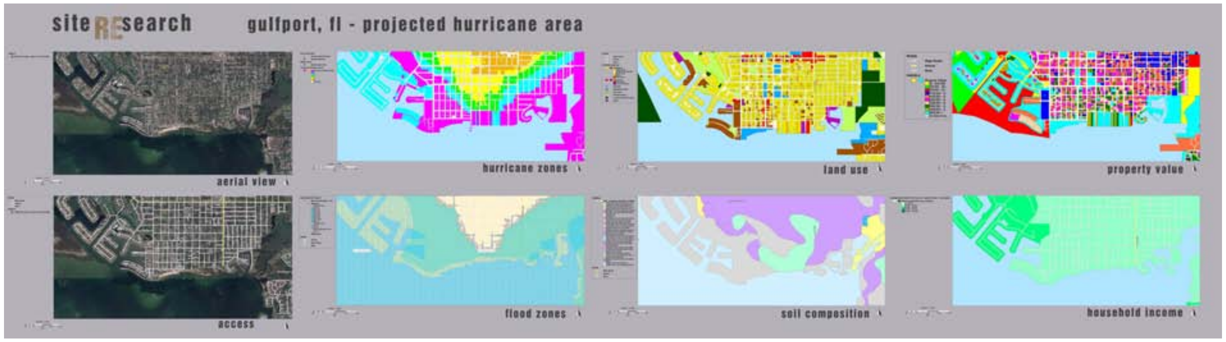

Figure 67. Site research for hurricane scenario.

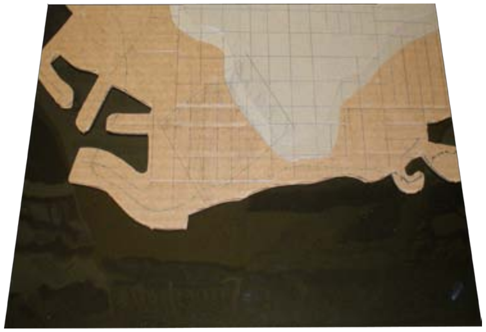
Figure 68. Map of Gulfport hurricane scenario.


Figure 69. Map of Apollo Beach hurricane scenario.

CONCEPT DEVELOPMENT

The concept is driven from the repetitive use of a standardized unit. The initial models show the dimension repeated within the spaces but keeps the spaces represented individually. As the process further developed the conceptual ideas focused more on the unit itself, keeping these units separate and later distinguishing the spaces within the grid. This grid-like organization is a systematic approach to a conceptual idea. The grid represents the structural system that is being created and the units within the grid are then added as needed. By standardizing the increments the overall unit becomes very modular in design. The conceptual idea is focused on practical application of the transitional unit on site in the given context. Further development of the individual units investigated more specific structural systems which evolved into a paneling system.

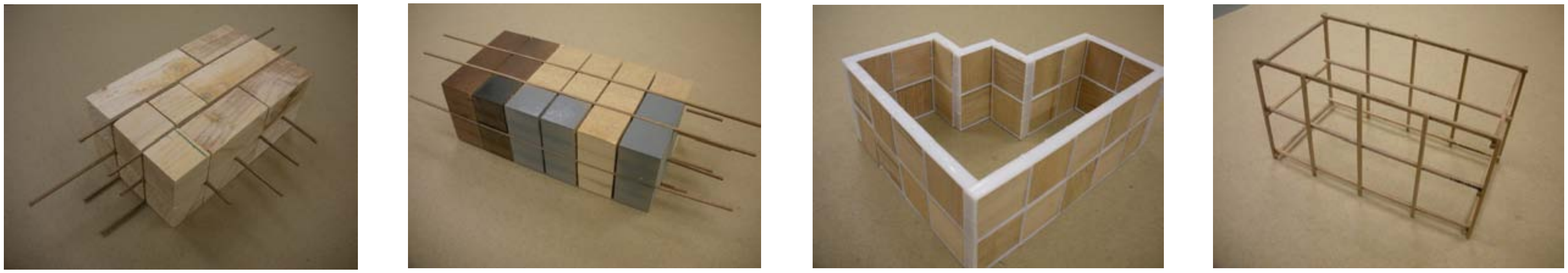

Figure 70. Models of conceptual development.

CONCEPTUAL SCHEMATICS

Further evolution of the concept led to variation in size of each unit. Base knowledge of a structural systems and SIP (structural insulated panel) systems led to the development of a 4' x 4' grid. This size was determined to be an adequate size for 1-2 individuals to easily handle and assemble on site. This new grid produced new unit areas that followed this standard. These areas include: Unit A – 288ft2, Unit B – 432ft2, Unit C – 624ft2. The structural system is comprised of aluminum columns and beams. These members allow easy assembly of the structure. They are lightweight, stronger than conventional building technologies, and easily connect with one another in any direction. The structure is modular and allows customization on site.

Figure 71. Detail of structural member with SIP panel.

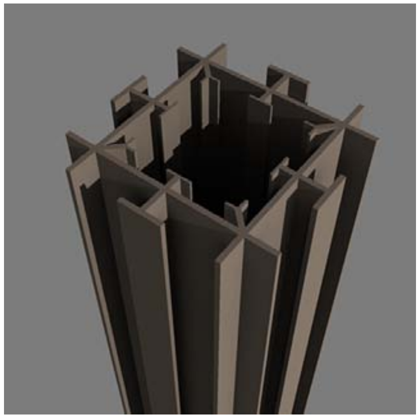

Figure 72. 3-D detail of structural system.

Investigation into adaptablility of the unit shows variation capabilities of Unit B on a number of sites. Seven (7) variation were adapted to show this customization on site. Further development shows room orientation within each unit and starts to break down the paneling system into standardized 4' x 8' sections. When exploded 3-dimensionally the structural system starts to expose walls, floors, and ceiling conditions.

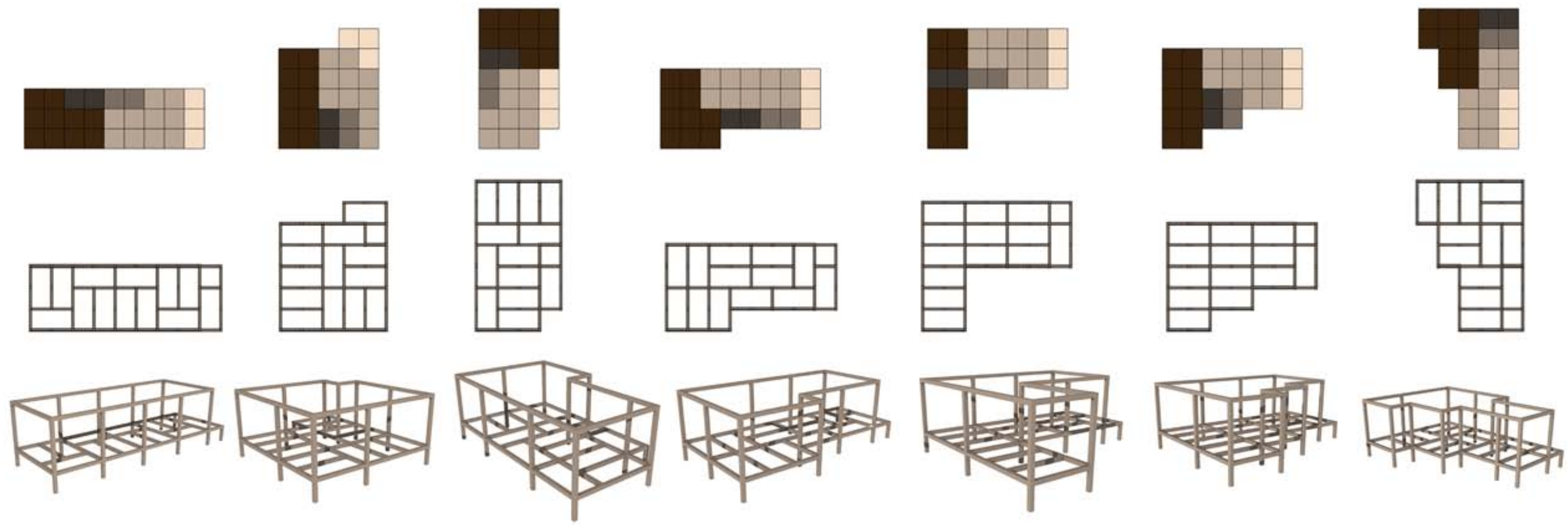

Figure 73. Seven variations of unit B.

Scenario analysis and placement determined that certain areas would change based on site orientation and size of previous residence. To determine which unit was appropriate for each household and ratio was generated. The new areas of each unit reflected 30% of the previous square footage and fell within certain ranges. Houses with a previous square footage of 1080ft2 or less would be provided Unit A. Houses with a previous square footage between 1081ft2 and 1470ft2 would be provided Unit B. Houses with a previous square footage of 1471ft2 or more would be provided Unit C.

Five (5) specific properties were selected on each hurricane scenario and on each location a schematic plan was designed that reflected site context, unit area, and orientation. These schematic plans and sections reflect those designed for Gulfport, FL. Two A Units, one B unit, and two C Units were determined to be adequate areas for these 5 properties.

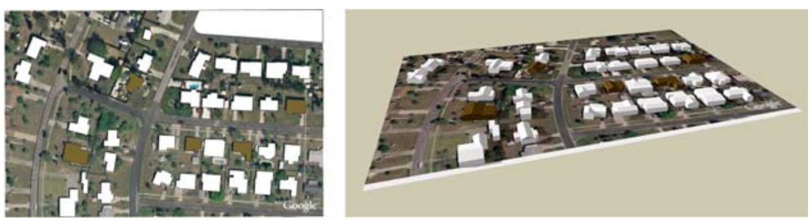

Figure 74. Five sites within Apollo Beach scenario.

Figure 75. Five sites within Gulfport scenario.

Figure 76. Schematic plan and section of Unit A1.

Figure 77. Schematic plan and section of Unit A2.

Figure 78. Schematic plan and section of Unit B1.

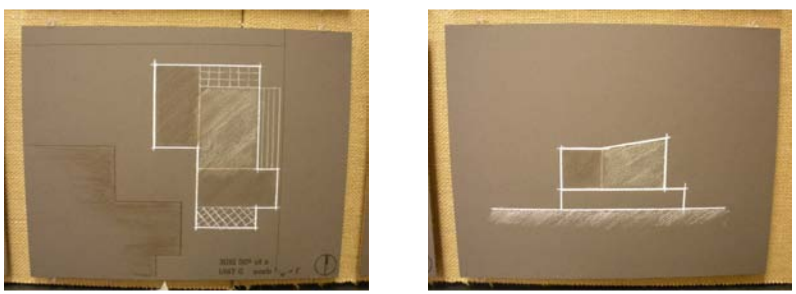

Figure 79. Schematic plan and section of Unit C1.

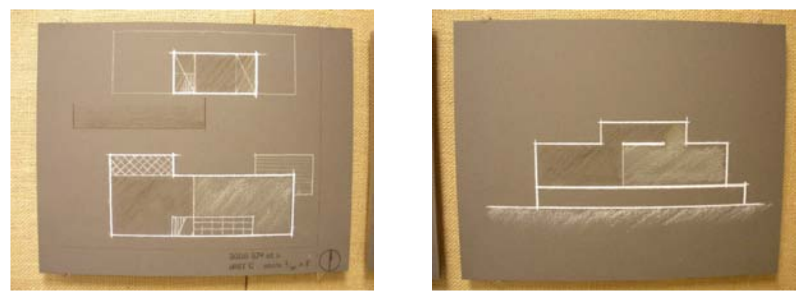

Figure 80. Schematic plan and section of Unit C2.

DESIGN DEVELOPMENT

Initial schematic design looked at the scenario present in each site and reacted to found attributes. To further the development of the design a set of criteria would have to be written that would drive the shaping of the unit. These principles would also begin to define who, specifically, would be provided with assistance and when it would be provided. Defining the time period where transitional housing fell in the overall situation is important.

Disaster Timeline

Current professionals working for the Task Force on Disaster Planning in Hillsborough County have estimated a time of 3-5 years for victims to recover from a natural disaster. This diagram shows the breakdown of a natural disaster, making sure to point out when the transitional housing unit is to be used. The timeline is separated into 4 sections: the disaster, emergency response, transitional housing, and recovery. The two paths that run across the diagram are those associated with the ReLife transitional housing unit and that of FEMA current strategies. It is important to point out that

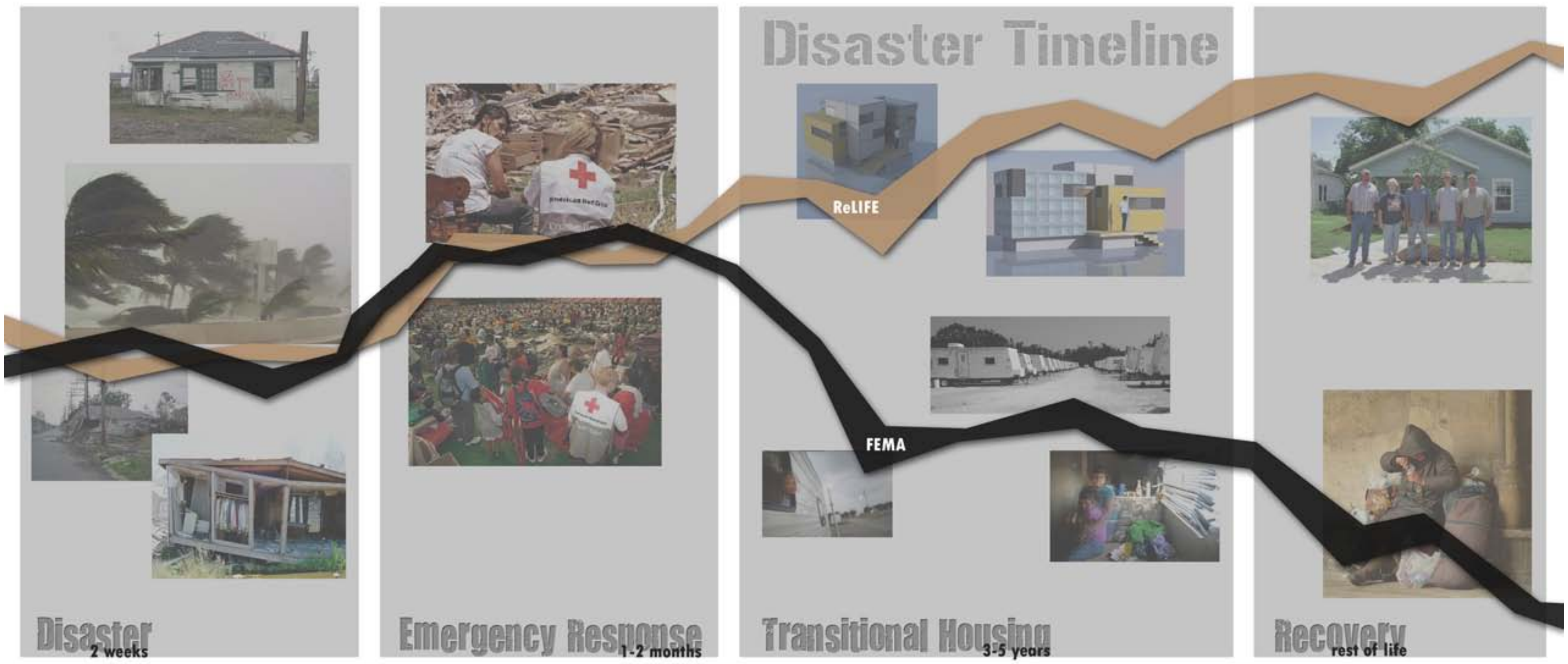

Figure 81. Disaster Timeline.

the time when the ReLife Unit is used is after the American Red Cross or similar organization has provided immediate disaster response to the area. Most likely power and other utilities would have been re-established by then and plans would be started for recovery. The unit is used during the extended period where victims are starting to rebuild there previous homes.

Principles of Design

Defining a set of criteria for design helps establish a starting point that can be built upon throughout the process. This set of criteria guides the development of the unit, and clearly delineates who the unit is for and what it will include. Earlier research started to define these principles. The unit is designed for single family homes, not multi-family disaster housing and not emergency housing but transitional housing. It also designed to be efficient, on site, adaptable, environmentally conscious, and aesthetically pleasing. These criteria were established very early in the design process and have evolved throughout. The ability to be on site of the previous home allows it to be either next to the damaged house or replacing the totally destroyed home. The adaptability of the unit is key to its design; allowing to fit any site, user customization, varying in size for families, and varying in terms of destruction. The units adaptability also provides space for systems that allow the unit to function independent of city utilities if the need arises. The efficiency of the unit is its ability to be easily shipped to the site and assembled.

Efficient Shipping

Using a SIP panel kit of parts allows the ease of stacking units inside of a shipping container. Multiples of these units can be shipped at once providing assistance for more than one family at a time. The unit to the right is Unit A which can easily fit 3 sets of units within one shipping container. The size of the panel also makes it easy for individuals to load/unload them. A standard shipping container dimensions are 39'5"L x 7'8"W x 7'10"H, inside dimensions. The floor area is about 300ft^2 and volume is 2390ft^3. If Unit C, the largest unit, was stacked its size would be 25'L x 7'6"W x 7'H with a floor coverage of 187.5ft^2 and volume of 1312ft^3. This unit size unfolds and assembles to 624ft^2 of interior space. One container can almost hold two Unit C's which would unfold to shelter 1248ft^2. Popular designs today use shipping containers as shelters. If this was the case one container would only shelter 300ft^2 of space when you could ship stack-able units and shelter 4 times the that amount of space of pre-assembled units.

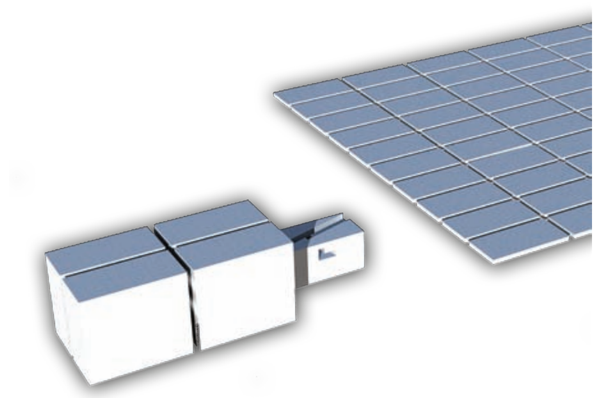

Figure 82. Unit A Panels Stacked.

Figure 83. Unit Stacked in Shipping Container.

Connection to the Ground

Using pre-cast concrete piles allow for easy assembly on site. The piles also allow the unit to adapt to any site attributes found. Installation of the piles require little work with an auger drill that is easily manageable by two individuals. The spun piles come in standard sizes and are simply placed in the hole that is formed by the auger bit.

The modular housing system supplies ground plate connections that are easily attached to the installed concrete piles. The extruded aluminum supports slip over the ground plate and bolt into the sides of the post. This system creates a strong connection to the ground, linking the entire structure with the earth preventing any uplift that could be foreseen in hurricane prone areas. It also creates a strong base for the entire structure to help prevent uneven settling over time.

Figure 84. Auger Drill.

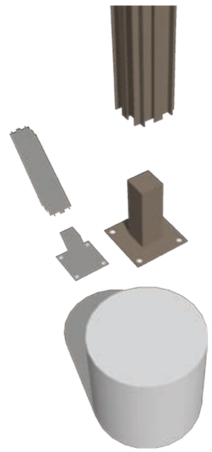

Figure 85. Footing Assembly.

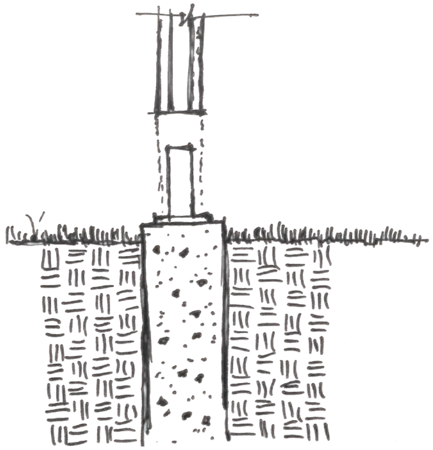

Figure 86. Footing Cross-Section

SPECIFIC SITE ATTRIBUTES AND DESIGN

Narrowing down the scenarios to design for a hurricane seemed to be the most important decision to properly prepare the state of Florida. The two sites chosen were Gulfport and Apollo Beach, both very prone areas for hurricane landfall. Within each of these scenarios 3 sites were chosen for study, developing attributes that varied to show the adaptability of the ReLife Transitional Housing Unit. These sites varied in size, foundation, orientation, and destruction. The main difference between these two selections was the density found in the neighborhood. Gulfport is located in St. Petersburg and because of this its streets are smaller and the houses are situated on smaller lots, closer to one another. Apollo Beach on the other hand is located in a suburban neighborhood with larger streets and space between the homes.

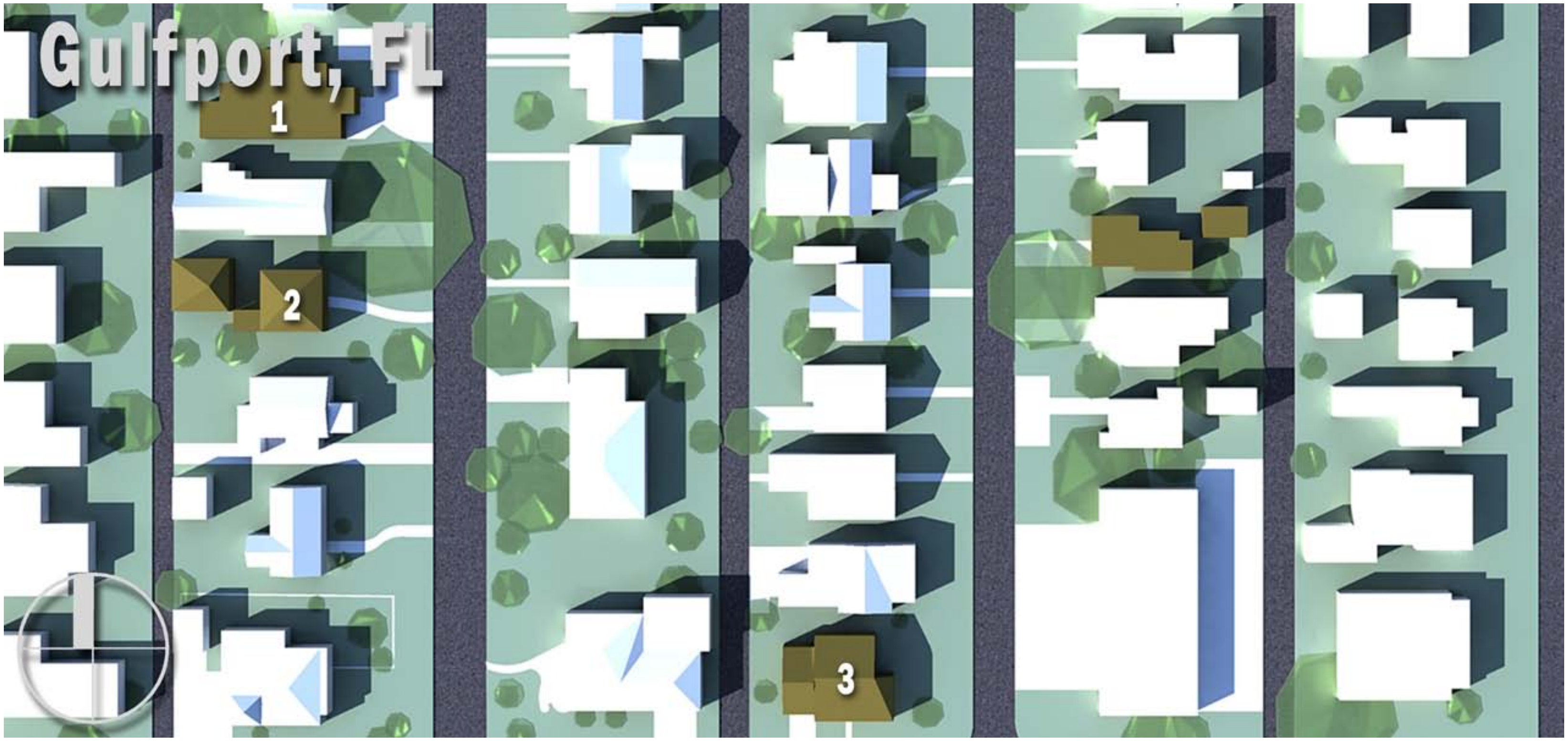

Figure 87. Gulfport Site Graphic.

Gulfport Site Attributes

A set of statistics are set for each site in order to regulate the design. By creating specific scenarios, the unit can be design to adapt to any and all situations. The house were selected based on size, foundation and construction, and year built. Each house was given a hypothetical amount of damage and from that the design was determined.

Figure 88. Gulfport Site Model.

Gulfport House 1

Foundation: Continuous Footing

Floor System: Slab on Grade

Exterior Wall: Stucco

Year Built: 1950 Living Area Ft^2: 1791ft^2

Minor damage, Temporary Unit C built next to home.

Gulfport House 2

Foundation: Continuous Footing

Floor System: Pier and Beam

Exterior Wall: Frame/Custom Wood

Year Built: 1938 Living Area Ft^2: 1313ft^2

Minor damage, Temporary Unit B built next to home.

Gulfport House 3

Foundation: Continuous Footing

Floor System: Slab on Grade

Exterior Wall: Concrete Block

Year Built: 1957 Living Area Ft^2: 923ft^2

Total destruction, Permanent Unit A built on existing slab.

Figure 89. Gulfport House 1.

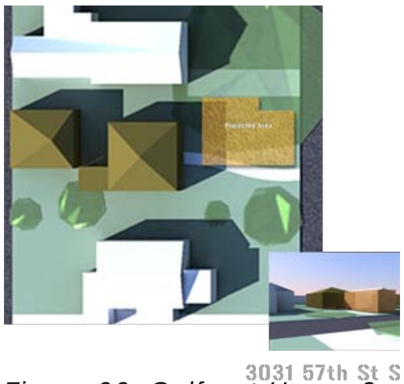

Figure 90. Gulfport House 2.

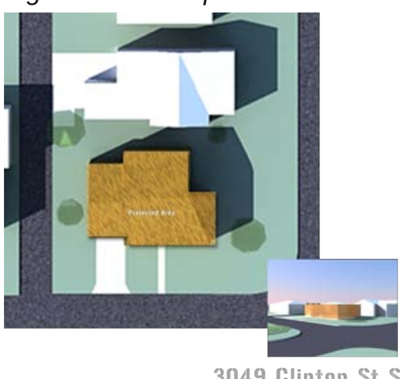

Figure 91. Gulfport House 1.

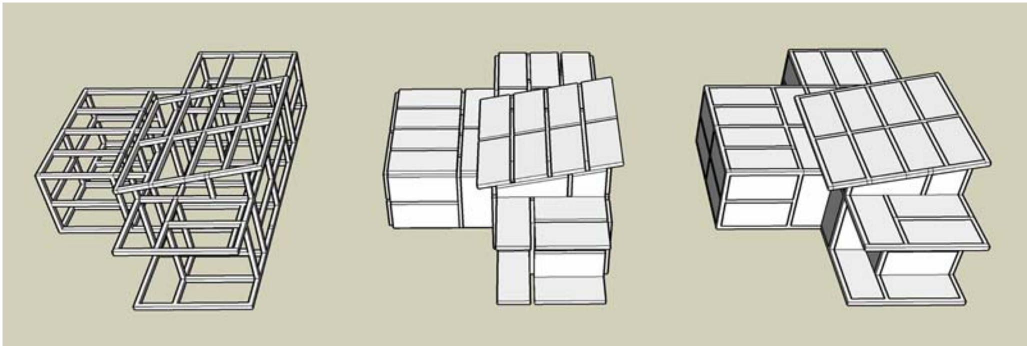

Figure 92. Unit 1 Initial Design.

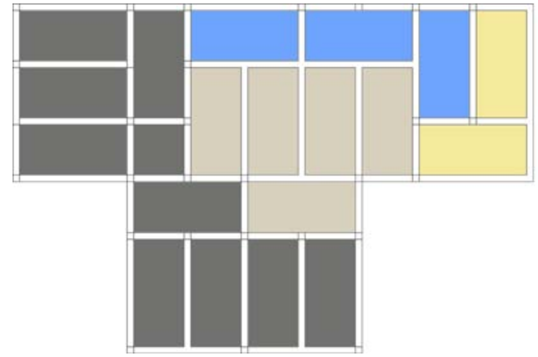

Figure 93. Unit 1 Initial Plan.

Gulfport Unit Designs

Gulfport Unit 1

The initial design of unit 1 was completely driven by the structural system and layout on site. Two large bedrooms flanked the living space. The secondary design utilized 3 bedrooms. The spaces also began to push/pull the outside facade of the building and create a more interesting aesthetic. Using the tatami floor plan design, the living space became more harmonious.

Figure 94. Unit 1 Initial Model.

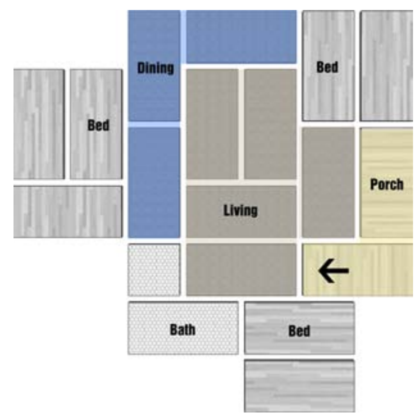

Figure 95. Unit 1 Secondary Plan.

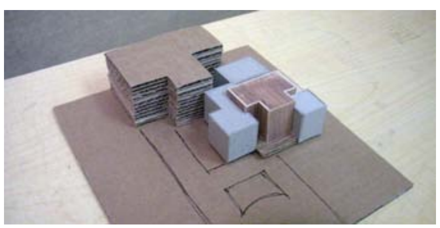

Figure 97. Unit 1 Secondary Model.

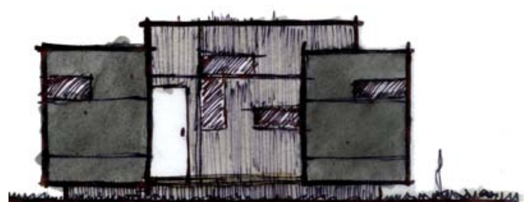

Figure 96. Unit 1 Secondary Design.

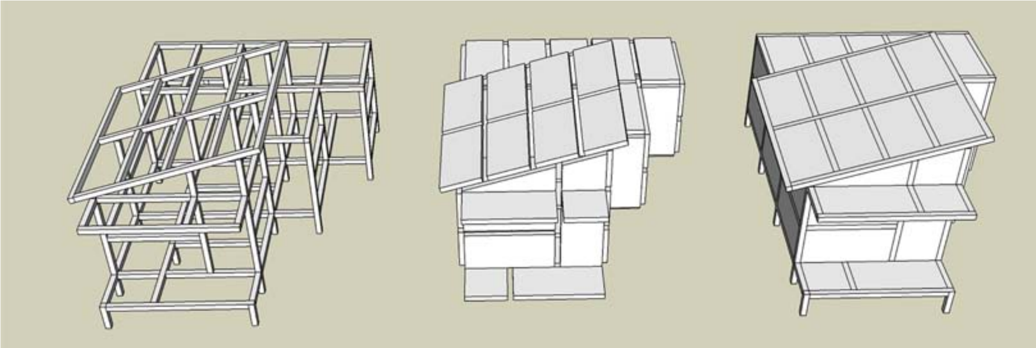

Figure 98. Unit 2 Initial Design.

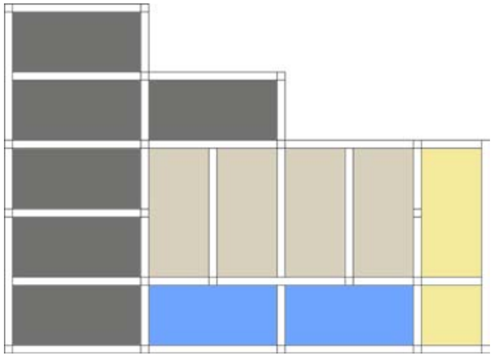

Figure 99. Unit 2 Initial Plan.

Gulfport Unit 2

Like that of unit 1, unit 2 lacked aesthetics when initially designed. The plan and section were completely restricted by the rigid structural system being used. After rethinking the entire design and working with facades that push and pull on one another, the overall design evolved into the secondary design.

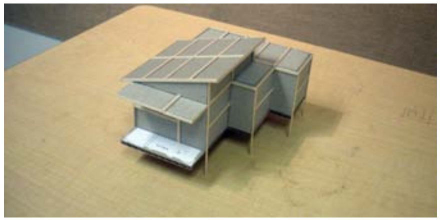

Figure 100. Unit 2 Initial Model.

Figure 101. Unit 2 Secondary Plan.

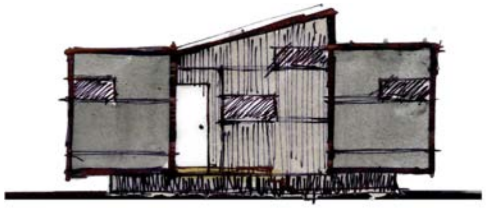

Figure 102. Unit 2 Secondary Design.

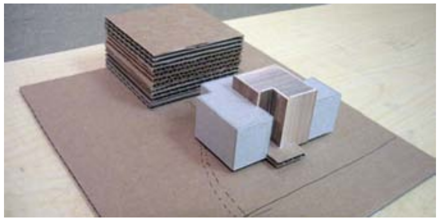

Figure 103. Unit 2 Secondary Model.

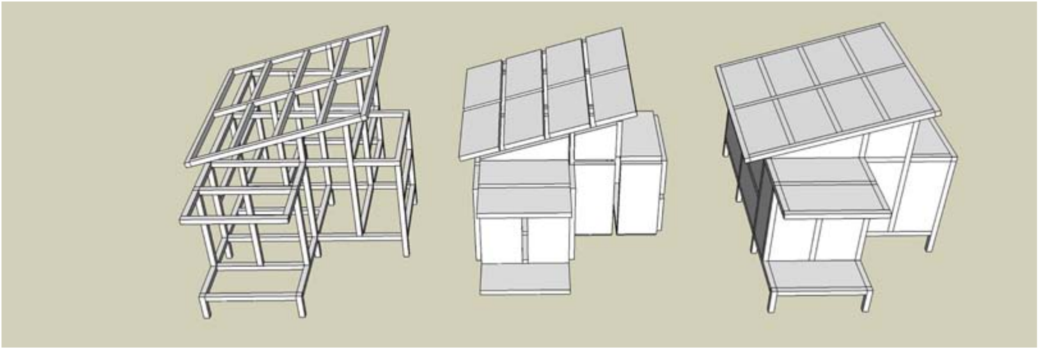

Figure 104. Unit 3 Initial Design.

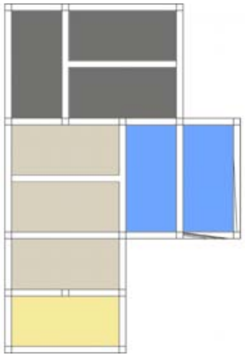

Figure 105. Unit 3 Initial Plan.

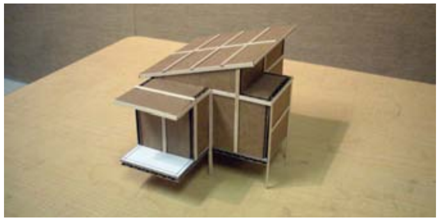

Figure 106. Unit 3 Initial Model.

Gulfport Unit 3

Unit 3 differed a lot in size tothe rest and creativity was enlightened on this design because of those small size restrictions. Initially the design was very simple but unfortunately boring. The secondary design looked at showing signifigance to the entrance and created a lateral partii within the floor plan that drew the eye across the length of the unit. Spaces were organized along this datum, connecting all of them together.

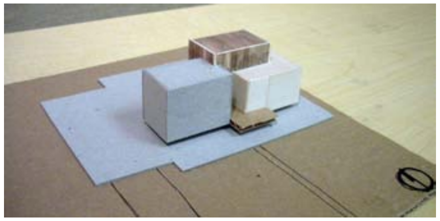

Figure 109. Unit 3 Secondary Model.

Figure 108. Unit 3 Secondary Design.

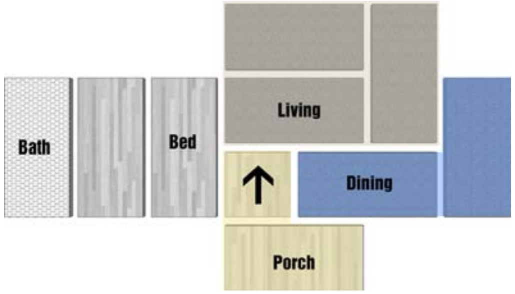

Figure 107. Unit 3 Secondary Plan.

Figure 110. Apollo Beach Site Graphic.

Apollo Beach Site Attributes

A set of statistics are set for each site in order to regulate the design. By creating specific scenarios, the unit can be design to adapt to any and all situations. The house were selected based on size, foundation and construction, and year built. Each house was given a hypothetical amount of damage and from that the design was determined.

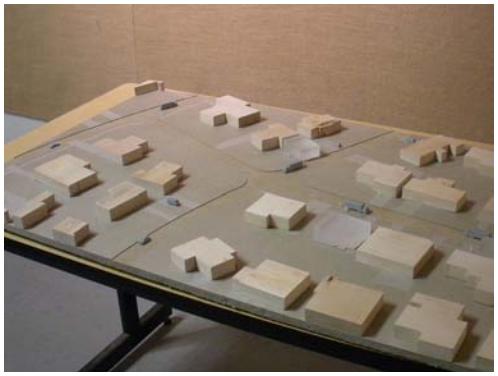
Figure 111. Apollo Beach Site Model.

Apollo Beach House 4

Foundation: Continuous Footing

Floor System: Slab on Grade

Exterior Wall: Concrete Block

Year Built: 1974 Living Area Ft^2: 1398ft^2

Minor damage, Temporary Unit B built next to home.

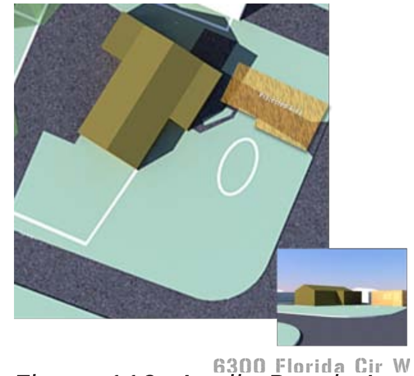

Figure 112. Apollo Beach 4.

Apollo Beach House 5

Foundation: Continuous Footing

Floor System: Slab on Grade

Exterior Wall: Concrete Block

Year Built: 1968 Living Area Ft^2: 1144ft^2

Total destruction, Permanent Unit B built on existing slab.

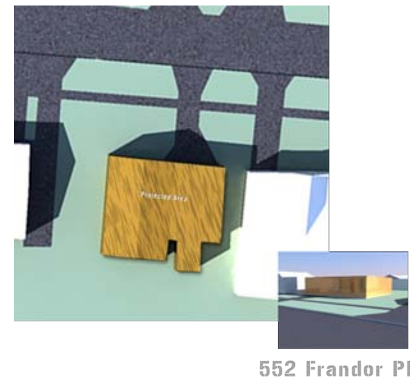

Figure 113. Apollo Beach 5.

Apollo Beach House 6

Foundation: Continuous Footing

Floor System: Slab on Grade

Exterior Wall: Concrete Block

Year Built: 1968 Living Area Ft^2: 1735ft^2

Minor damage, Temporary Unit C built next to home.

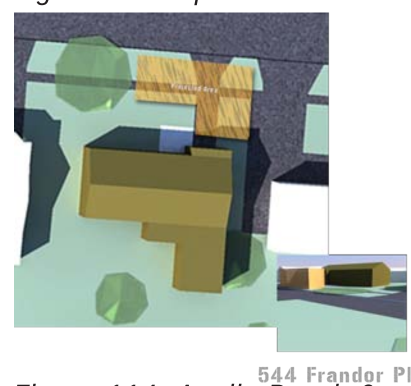

Figure 114. Apollo Beach 6.

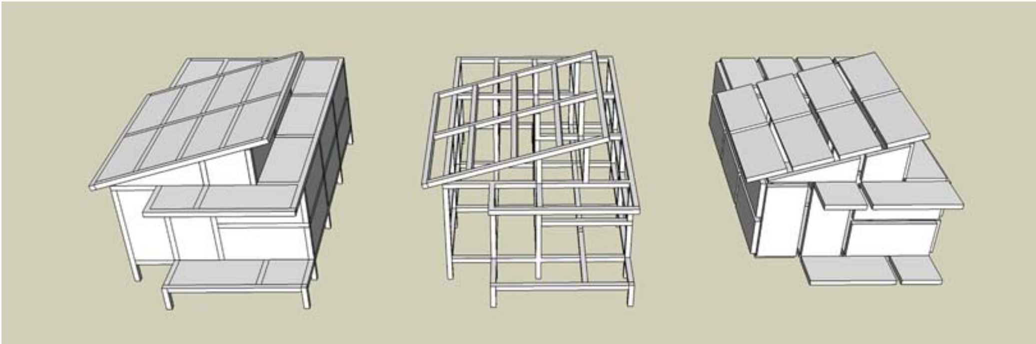

Figure 115. Unit 4 Initial Design.

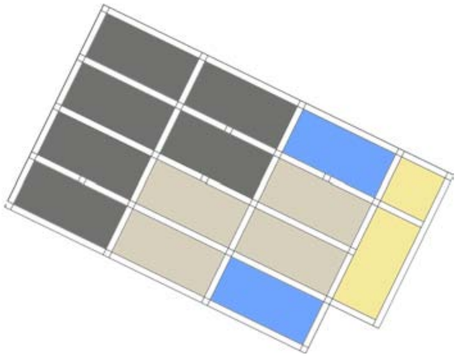

Figure 116. Unit 4 Initial Plan.

Apollo Beach Unit Designs

Apollo Beach Unit 4

Initially unit 4 was limited by the small area on the driveway for building the unit. Looking strictly at the shape and orientation of this pad, the design was formulated. After rethinking the design principles the spaces began to react like those of the previous units, organizing themselves around the central living space.

Figure 117. Unit 4 Initial Model.

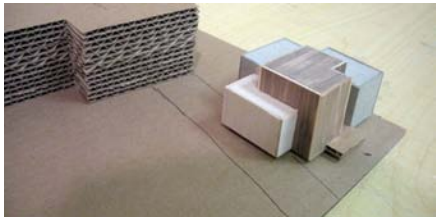

Figure 120. Unit 4 Secondary Model.

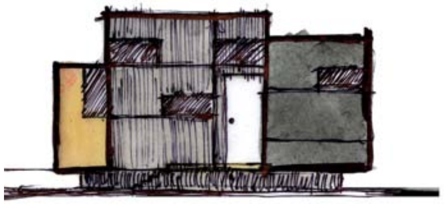

Figure 119. Unit 4 Secondary Design.

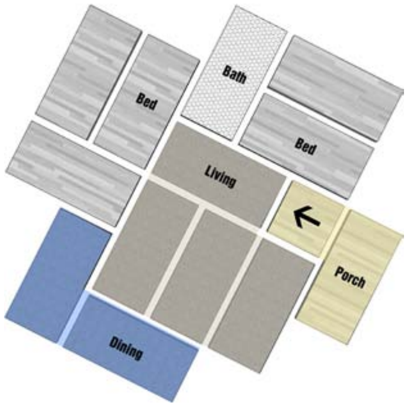

Figure 118. Unit 4 Secondary Plan.

Figure 121. Unit 5 Initial Design.

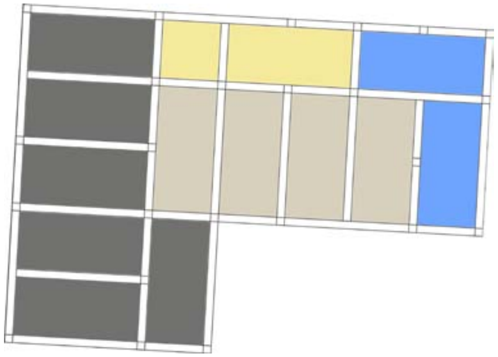

Figure 122. Unit 5 Initial Plan.

Apollo Beach Unit 5

Initially unit 5 was interesting because it enclosed the outside porch space, but the interior did not provide any variation. The secondary design created interior spaces that changed in ceiling heights and had lots of variation. It also started to pay close attention to how the dining space acted as a temporary space, popping up as needed from the wall.

Figure 123. Unit 5 Initial Model.

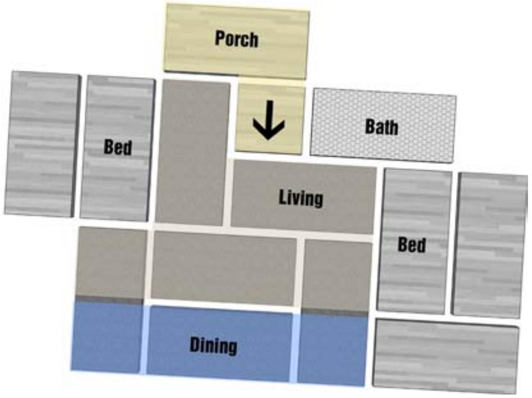

Figure 124. Unit 5 Secondary Plan.

Figure 125. Unit 5 Secondary Design.

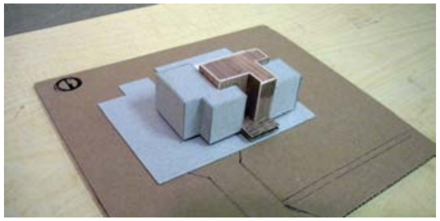

Figure 126. Unit 5 Secondary Model.

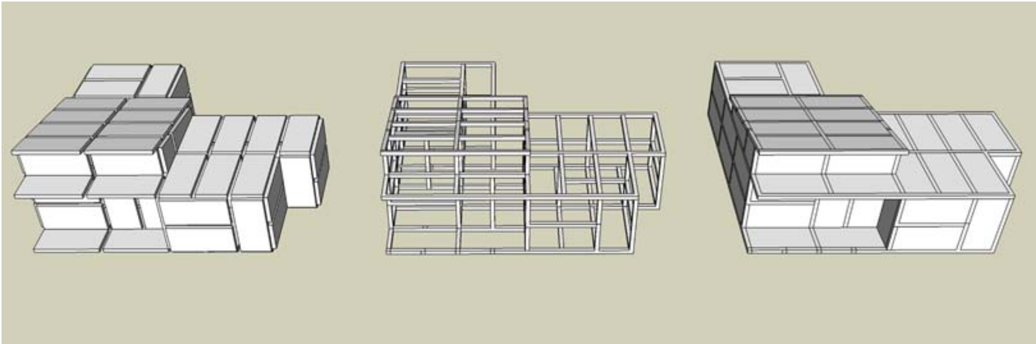

Figure 127. Unit 6 Initial Design.

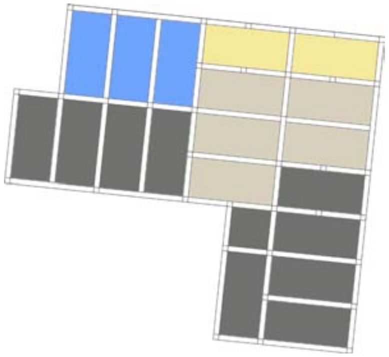

Figure 128. Unit 6 Initial Plan.

Apollo Beach Unit 6

Unit 6 is another quite large unit that initially provided some variation within the space, creating two large bedrooms on two corners of the unit. The secondary design shows an immense amount of variation in the facade and the open living and dining space stretches the length of the unit. This unit especially provides privacy for all the inhabitants with three separate bedrooms.

Figure 129. Unit 6 Initial Model.

Figure 130. Unit 6 Secondary Plan.

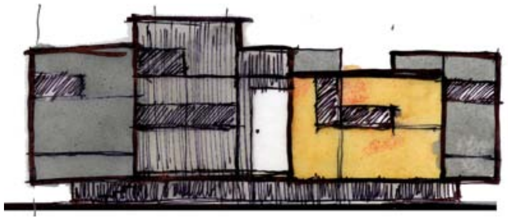

Figure 131. Unit 6 Secondary Design.

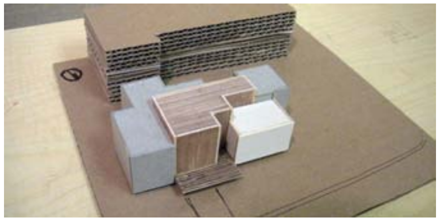

Figure 132. Unit 6 Secondary Model.

Sectional Qualities

The section models were created after the secondary designs to look at the interior spaces within the unit. Initially the living space had 12’ high ceilings, the living/dining space had 8’ high ceilings, and the bedroom space was 8’ tall interiorly with a 2’ step up inside. This provided variation in heights that created interesting feeling within each space, either enclosure or openness. After defense of the unit, my committee noted that the unit needed to remain rather simple for assembly by non-professionals and it also needed to give access to all peoples, including the handicapped. From that the interior spaces changed, mainly the bedroom space increased to 10’ high ceilings and the step up was eliminated. These studies also started to look at the materials used in the different spaces.

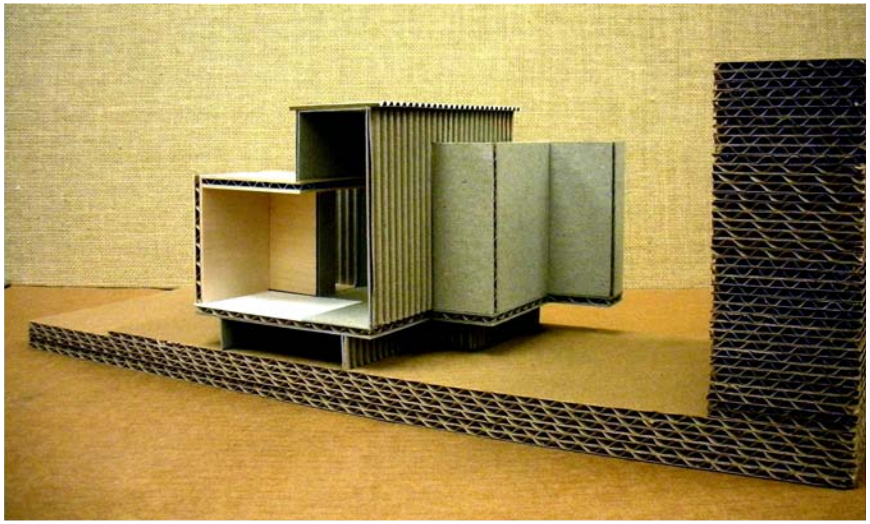

Figure 133. Section Model 1.

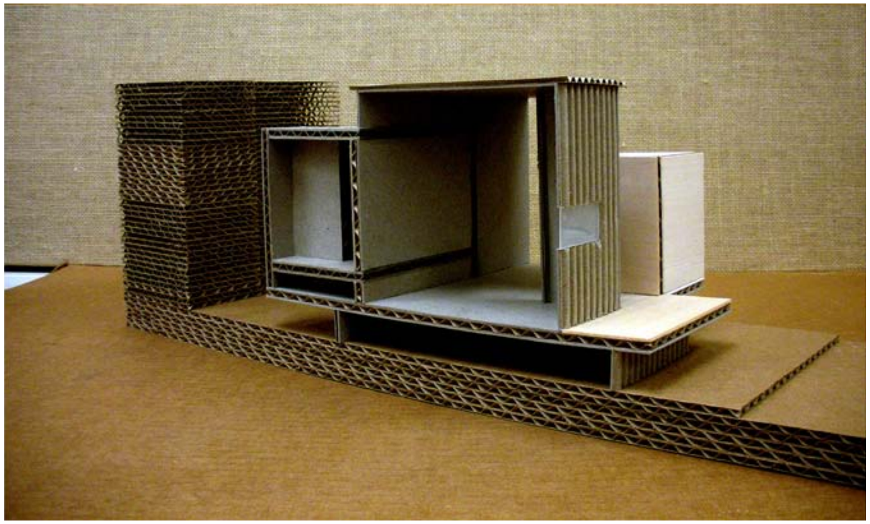

Figure 134. Section Model 2.

Material Study

After looking at the sectional qualities of the units, certain materials were studied. These materials were assigned to different spaces in the unit to show significance to that space. The living space is clad with corrugated metal, the bathroom and dining spaces are covered with finished woodwork, and the bedrooms are wrapped in finished metal panels. These three materials accentuate each space within the overall design and provide and interesting aesthetic to the unit.

Figure 135. Unit 3 Render.

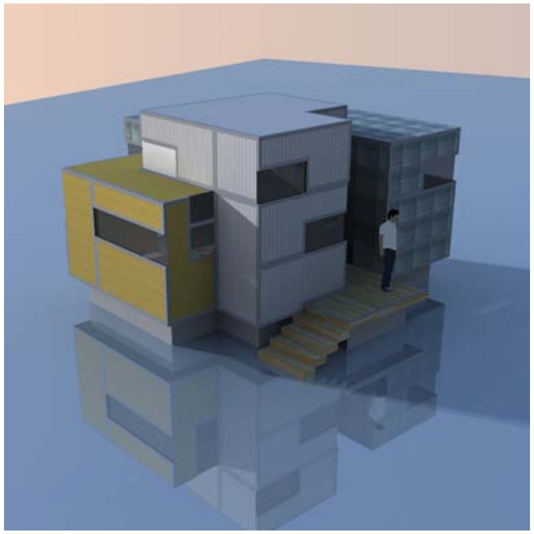

Figure 138. Unit 4 Render.

Figure 137. Unit 1 Render.

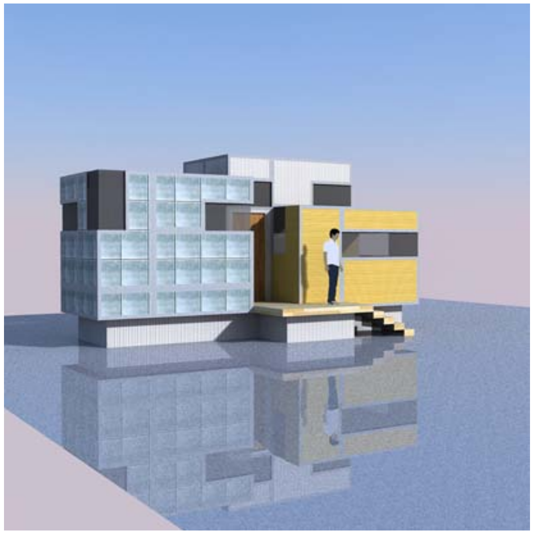

Figure 136. Unit 6 Render.

PROCESS OF DESIGNING A UNIT

By combining frames, panels, and doors from the ReLIFE series with energy conserving devices, you can create exactly the transitional housing unit that fits you and your family's needs. Alternatively you can choose different wall, roof, and floor systems and add or remove interior panels as you wish. Either way, the result is a transitional housing unit that is custom-designed to suit both your site conditions and the space that you require.

How To Build

Whether you are thinking of designing your own transitional housing unit or buying one of the existing solutions, there are 3 simple steps to follow

1. Pick your type. Has your home been only partially damaged or is it completely destroyed? There are selections that are for long-term temporary use, located next to your previous house. There are also units that are designed to expand as you can afford, eventually replacing your original home.

2. Choose your size. Your size unit is determined by the previous square footage of your home, size of your family, and space available on site. The unit is offered in 3 sizes that are roughly 1/3 the size of your original home.

3. Choose panels. There are a number of panel options to choose from. These panels help to distinguish areas within your unit, let light into the space, and serve as the functioning systems of the unit. They are easily exchangeable and standardized for easy installation.

Once you have decided on the panels it's time to add any finishing touches. This includes porch systems, steps, energy saving systems, etc.

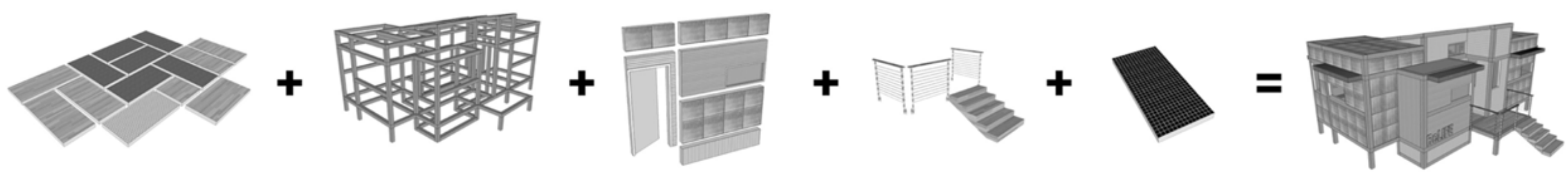

Figure 139. How To Build Diagram.

How To Choose Type

Below you see the two different types of ReLIFE Housing Unit. The first is temporary, built on site of the previous home. The other is permanent and is built on the foundation of the previous home. These units can be designed to fit the site and the foundation, allowing multiple combinations to occur. Depending on the extent of damage to your home caused by the natural disaster, you will choose whether the unit will be temporary or remain permanently.

Temporary ReLife Transitional Housing Unit

This unit remains one size throughout its use during the rebuilding of your previous home.

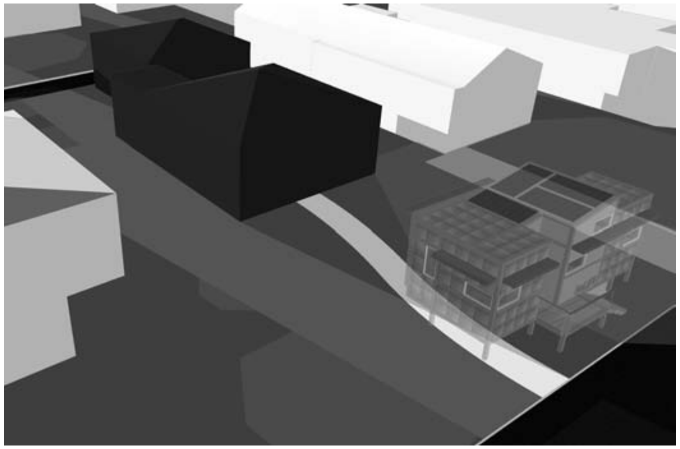

Figure 140. Temporary ReLife Unit.

Permanent ReLife Transitional Housing Unit

This unit expands multiple times throughout its life, eventually covering the entire foundation of your previous home, replacing your lost house.

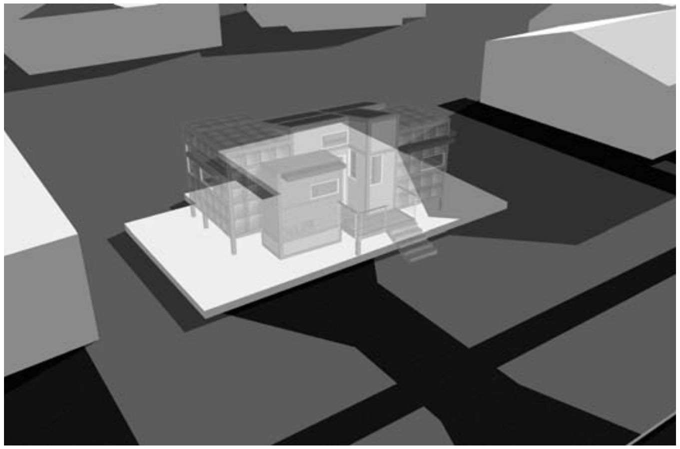

Figure 141. Permanent ReLife Unit.

Permanent Floor Plan Expansion

This progression of a unit shows how the permanent ReLIFE Unit adapts to the given foundation and evolves into a house that fits the old shape of your original home. The designers pay close attention to the original floor plate and design an expandable unit that resembles the design and floor area of your original home. Using this system of design provides efficient response when in need and allows you to remain in your community.

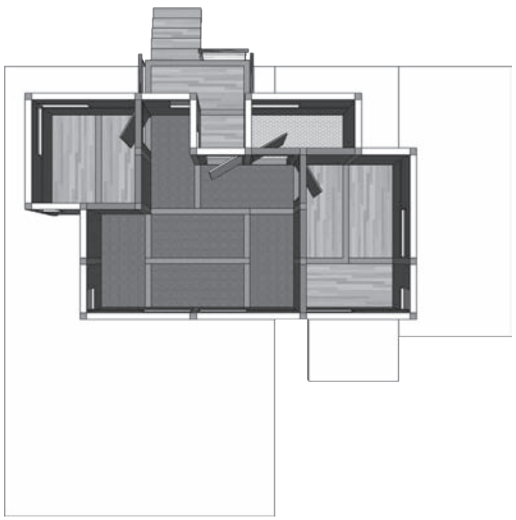

Figure 142. Permanent Unit Stage 1.

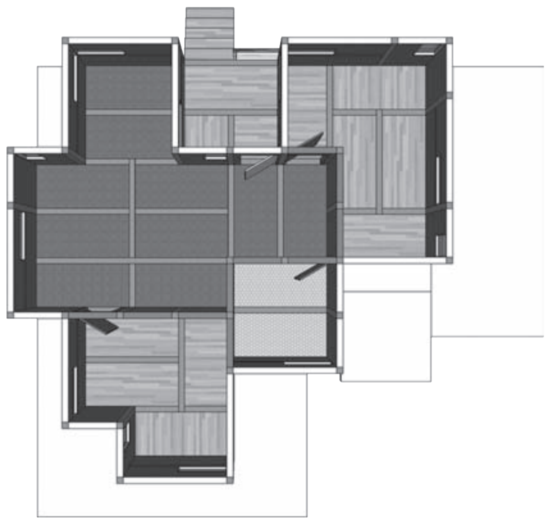

Figure 143. Permanent Unit Stage 2.

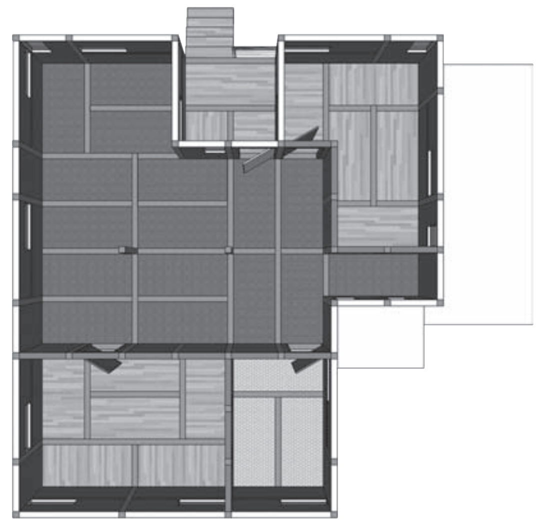

Figure 144. Permanent Unit Stage 3.

How To Choose Unit Size

Below are the 3 options for size of unit based on the original square footage of your home. These units are roughly one third of your original home and consist of a living room, dining room/kitchen, bathroom, and 1-3 bedrooms depending on unit size. These spaces are shown with different panels and represent the area that would be found in each space. Each panel is 4′ x 8′ and fits easily into different configurations.

Unit Size A

Floor Area = $288ft^2$

For Homes $0ft^2$ - $1080ft^2$

1 Bedroom/1Bath

Accommodates up to 2 people.

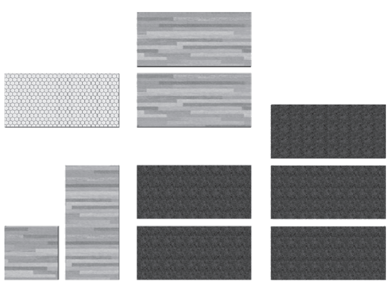

Figure 145. Unit A Spaces.

Unit Size B

Floor Area = $432ft^2$

For Homes $1081ft^2$ - $1470ft^2$

2 Bedroom/1Bath

Accommodates up to 4 people.

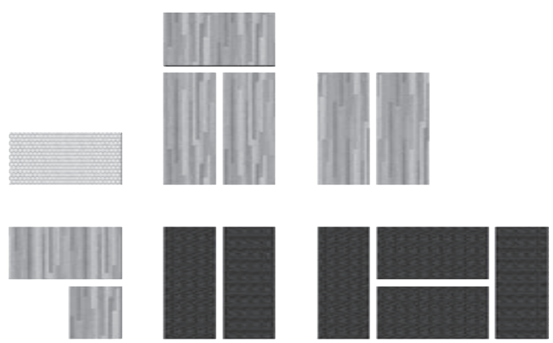

Figure 146. Unit B Spaces.

Unit Size C

Floor Area = $624ft^2$

For Homes $1471ft^2$ - $2400ft^2$

3 Bedroom/1Bath

Accommodates up to 6 people.

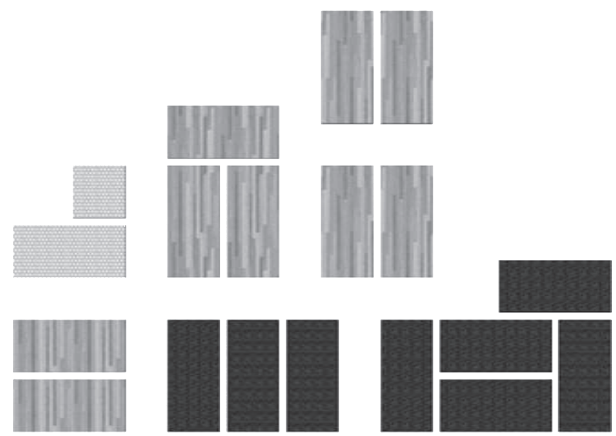

Figure 147. Unit C Spaces.

Unit Components

Footings

Each unit either attaches to the existing foundation with metal plates or attaches to cylindrical footers that are placed on site.

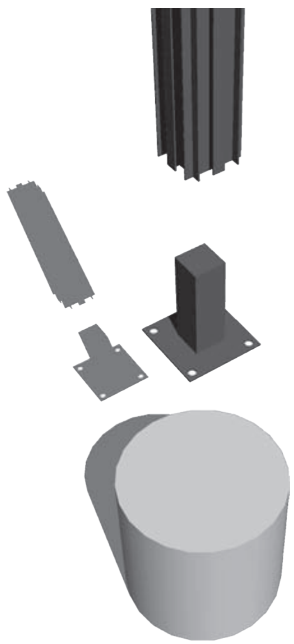

Figure 148. Footings.

Living Space

The main public space within the unit, the living space has 12ft high ceilings and sub-flooring for water and electrical utilities.

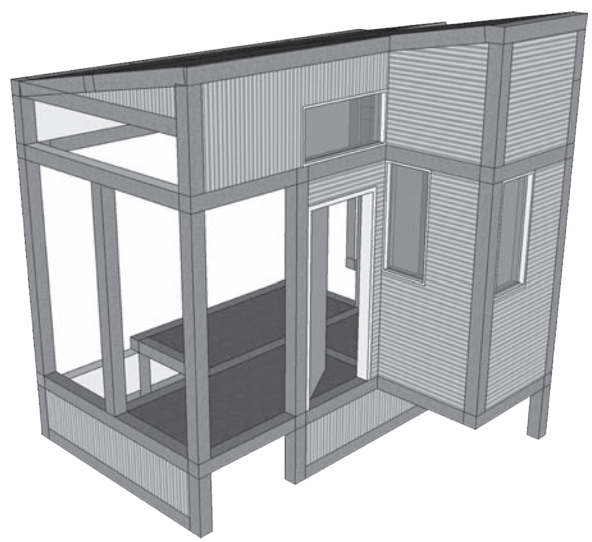

Figure 149. Living Space.

Bedroom Space

Each bedroom space has roof extensions that raise the ceiling height to 10ft. Window shades help block out summer sun but allow in winter sun.

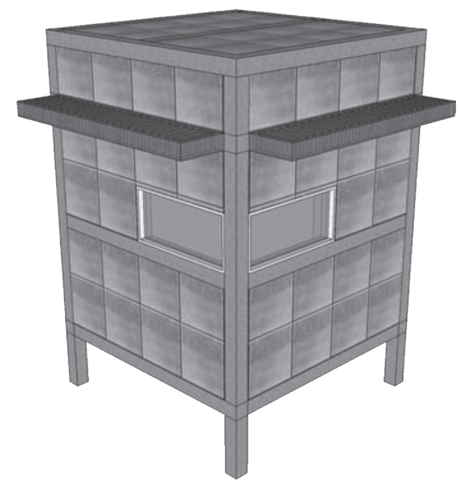

Figure 150. Bedroom Space.

Porch Space

The porch space provides a public space for interaction within the neighborhood. It is very adaptable with options for ADA standards.

Bathroom Space

The bathroom space is the smallest of all the spaces. It too feels intimate with 8ft ceilings. It provides sub-flooring for space for the water utilities.

Kitchen/Dining Space

The dining space provides an intimate feeling with 8ft ceilings. These spaces are on the perimeter of the building with views to the outside.

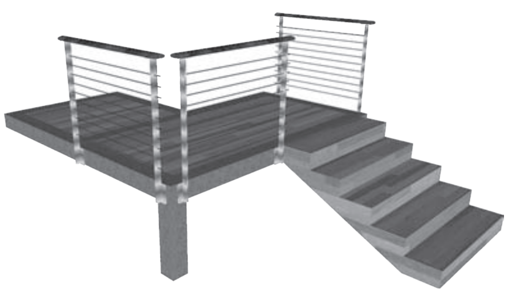

Figure 151. Porch.

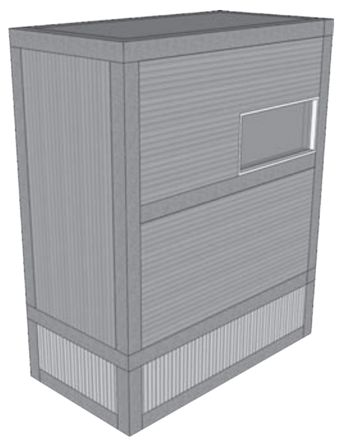

Figure 152. Bathroom Space.

Figure 153. Kitchen/Dining Space.

SIP Panel Options

Window Wall Panel

This panel can be arranged in any direction providing ample interior light.

Dimensions:	8’ x 3’9” x 6”
Window Dim.:	4’ x 1’11.5”, with 2” mullion
Available Surfaces:	Corrugated Steel
	Finished Metal Panel
	Finished Wood
	Hardi-Panel
	Gypsum Interior

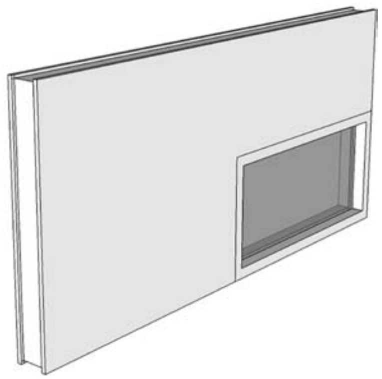

Figure 154. Window Wall Panel.

Wall Panel

This panel is universal throughout the unit.

Dimensions:	8’ x 3’9” x 6”
Available Surfaces:	Corrugated Steel
	Finished Metal Panel
	Finished Wood
	Hardi-Panel
	Gypsum Interior

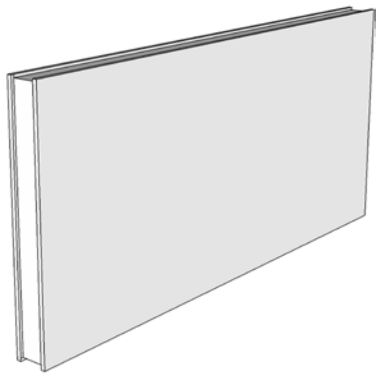

Figure 155. Wall Panel.

Floor Panel

This panel provides extra support for traffic inside and out of the unit.

Dimensions:	8’ x 3’9” x 6”
Available Surfaces:	Hardwood Flooring
	Bamboo Flooring
	Cork Flooring
	Tile Flooring
	Glass with HOG Water Storage

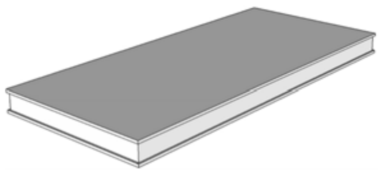

Figure 156. Floor Panel.

Sub-Floor/Roof Extension Panel

These panels provide storage for utilities under the unit and also extend ceiling heights in the bedrooms and living room.

Dimensions: 8' x 1'7.5" x 6"

Available Surfaces: Corrugated Steel
- Finished Metal Panel
- Finished Wood
- Hardi-Panel
- Gypsum Interior

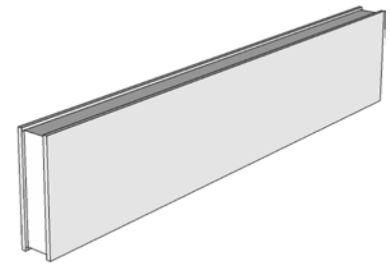

Figure 157. SF-RE Panel.

Door Panel

These panels provide openings in spaces and can be used interior or exterior, depending on surfaces.

Dimensions: 8' x 3'9" x 6"

Door Dim.: 7' x 3', with 2" door frame

Available Surfaces: Corrugated Steel
- Finished Metal Panel
- Finished Wood
- Hardi-Panel
- Gypsum Interior

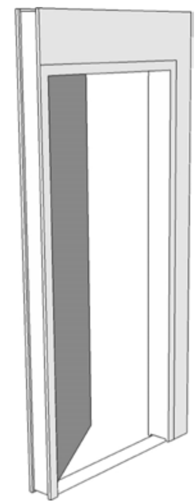

Figure 158. Door Panel.

Roof/Ceiling Panel

This panel is lightweight for ease of installation above spaces.

Dimensions: 8' x 3'9" x 6"

Available Surfaces: Corrugated Steel
- Finished Metal Panel
- Finished Wood
- Photovoltaic Cells
- Gypsum Interior

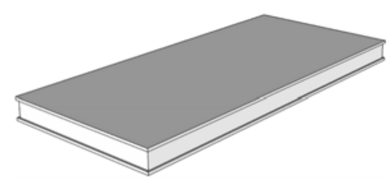

Figure 159. Roof/Ceiling Panel.

Other Accessories

Railings

Figure 160. Railings.

These railing provide support on the porch and meet ADA requirements. They easily attach to the same structural system of the unit.

Dimensions: 4′W x 3′above floor

Steps

Figure 161. Steps.

Made from solid wood these steps provide easy access to the front porch.

Dimensions: Step - 6” x 1’ x 4’

Ramp

This ramp meets ADA standards of a 1:12 slope and uses the same structural system of the unit.

Dimensions: 4’W

Figure 162. Ramp.

Utility Lines In SIP Panels

Each SIP panel is lined with a protective weatherproofing on its edges with conduits running within the panel. These conduits allow the panels to run hot/cold water and electricity to all parts of the transitional unit at the ease of plug and play. These are pre-assembled in a factory for quality control and efficiency. Once on site the assembly team can easily hook up all necessary equipment within the unit at a great ease.

Extruded Structural System

The structural extruded aluminum system was developed by U.S. Systems. It easily adapts to different situations, snapping to one another with ease. It allows SIP panels to easily slip into the pre-made grooves and securely connect to the frame. The system has been rated to withstand winds in excess of 150mph and meets all ADA requirements for construction. The main benefit of the system is its modularity and efficiency.

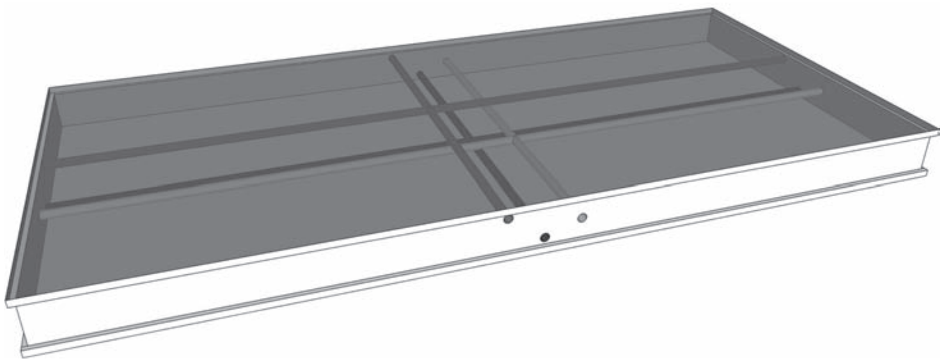

Figure 163. SIP Panel Utilities.

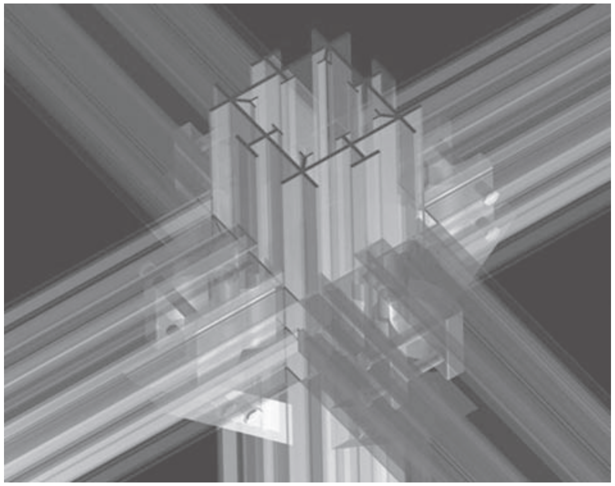

Figure 164. Extruded Structural System.

CONSTRUCTION ASSEMBLY OF UNIT

This time line further breaks down and details the time period when the Transitional Housing Unit is in use. One time line is for a temporary unit and the other is for a permanent unit. After each time line is a diagram of the steps that are detailed in the time line.

Temporary Unit Timeline

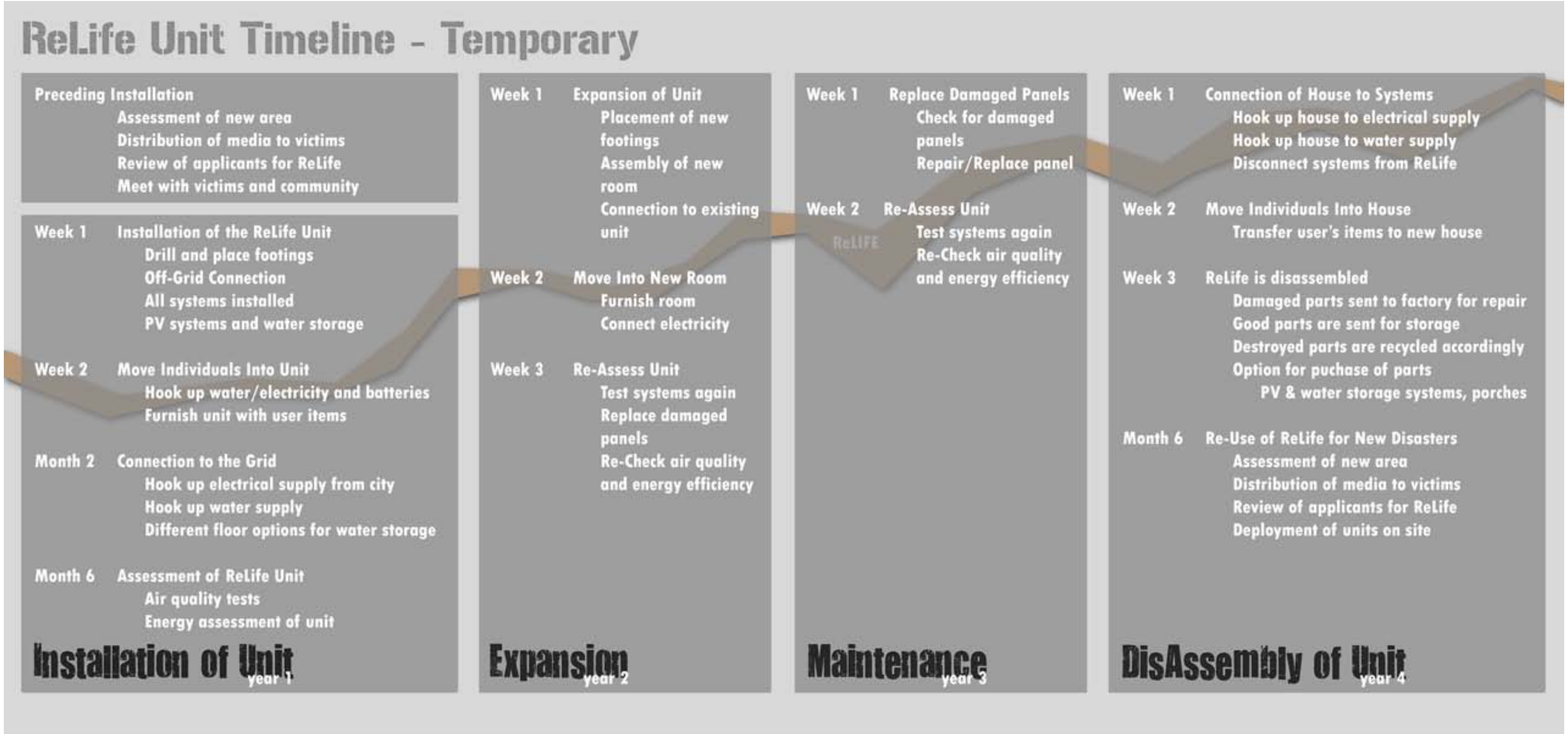

Figure 165. Temporary Unit Timeline.

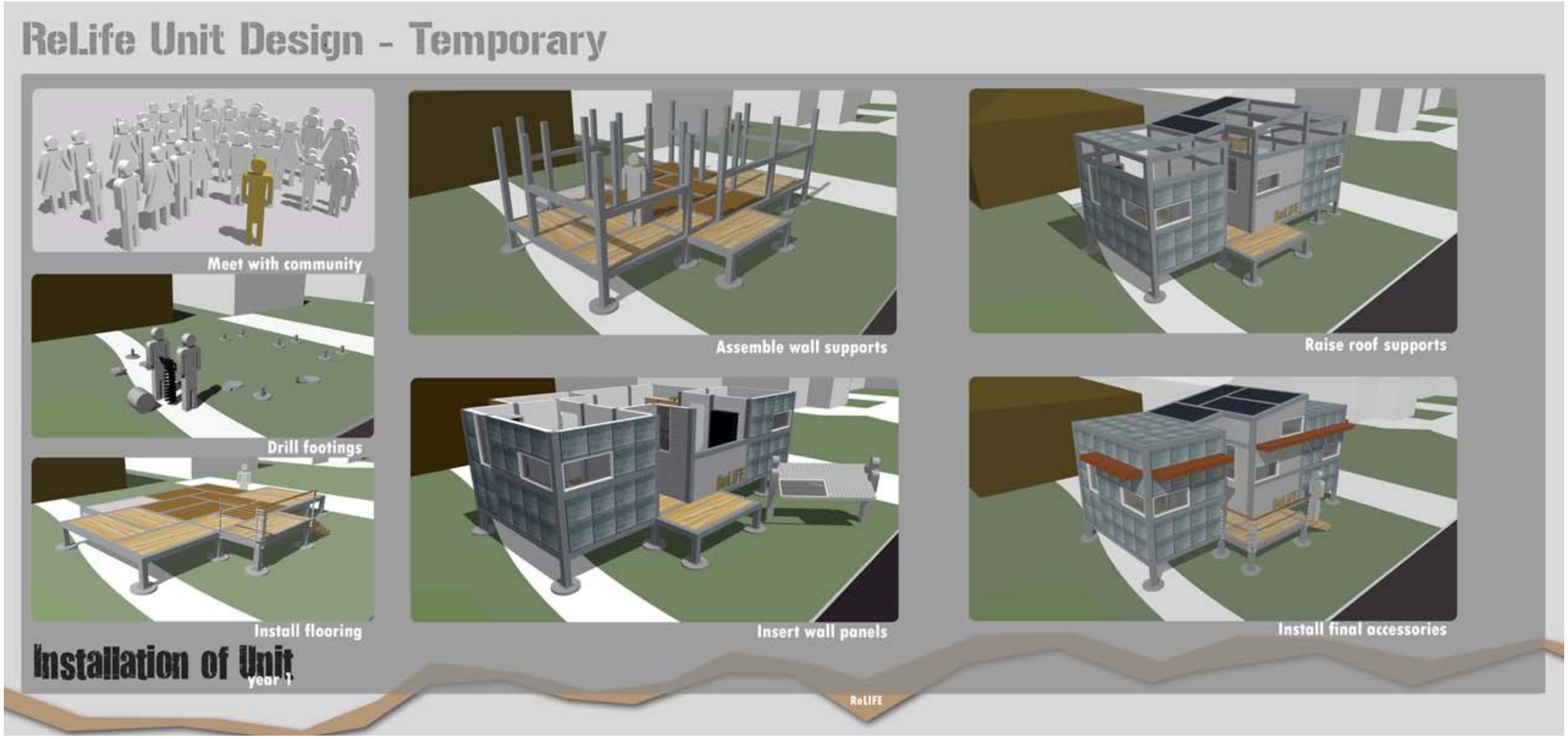

Figure 166. Temporary Unit Digram.

Permanent Unit Timeline

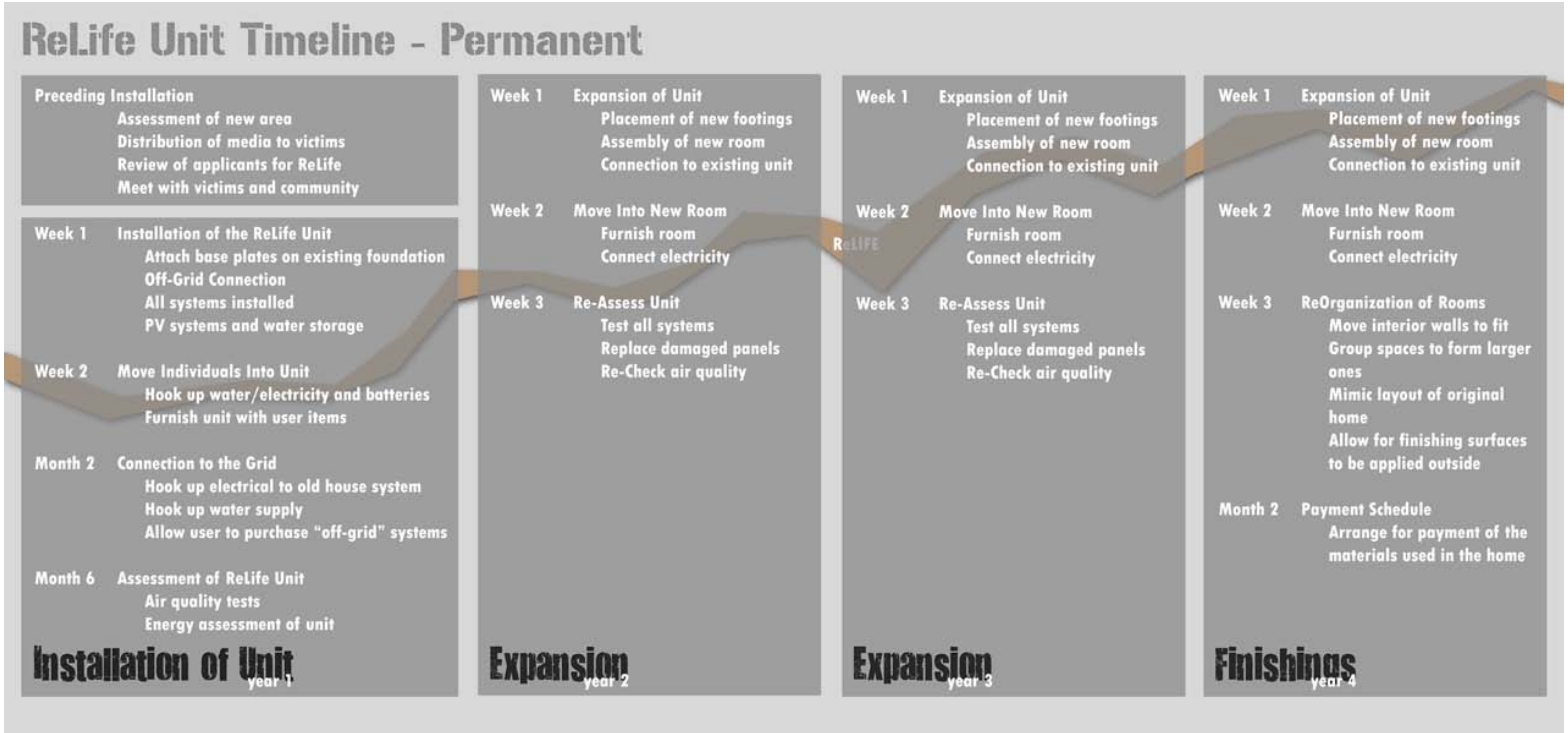

Figure 167. Permanent Unit Timeline.

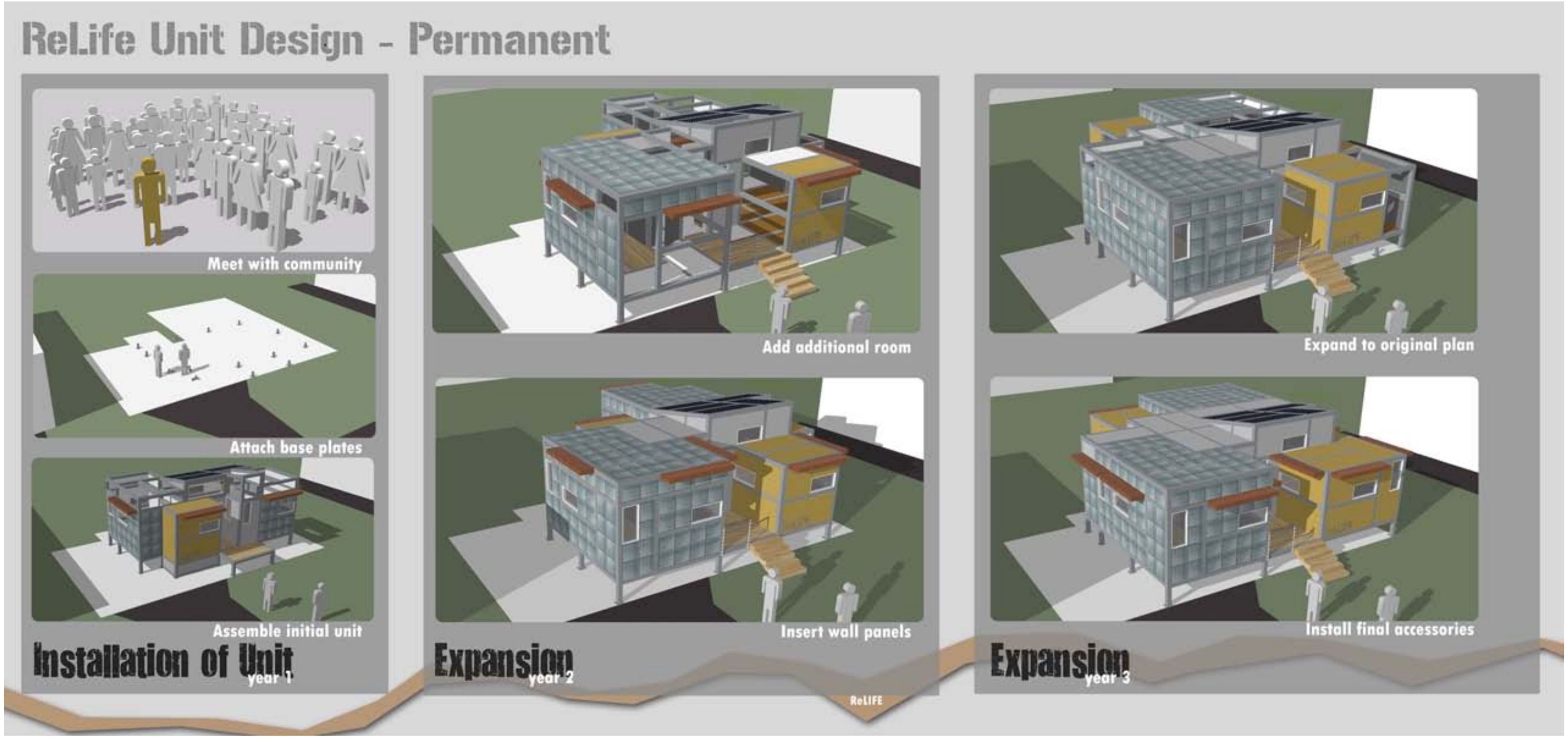

Figure 168. Permanent Unit Digram.

Final Designs

Temporary Unit

The design of the Temporary Unit is a compilation of the initial design and secondary designs. After the sectional and material studies the design evolved into a cohesive unit that represents all the design principles laid out early in the process. The roof line angles towards the south in order to capture the most sun for the photovoltaic cells on the top. The plan shows the layout of the interior spaces with finishes that would be found in a typical unit. There is a visual connection across the unit that connects all the spaces around the living space.

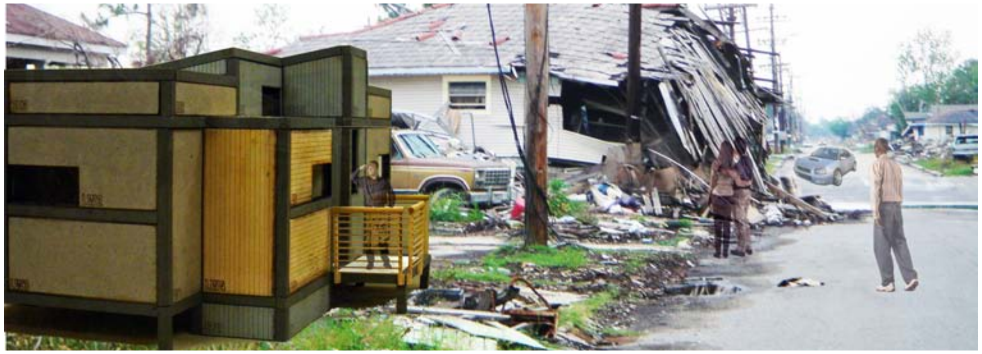

Figure 169. Temporary Unit Render.

Figure 170. Temporary Unit Plan.

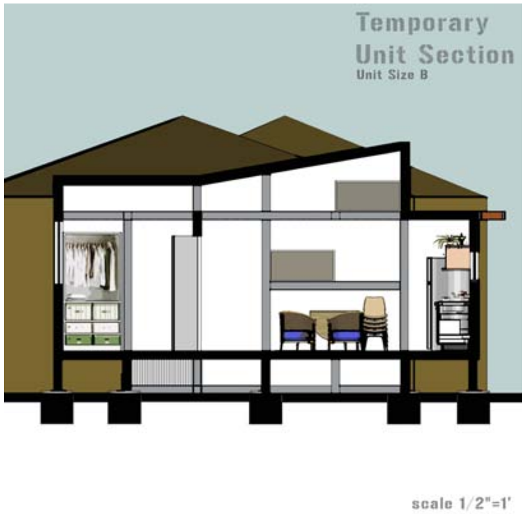

Figure 171. Temporary Unit Section.

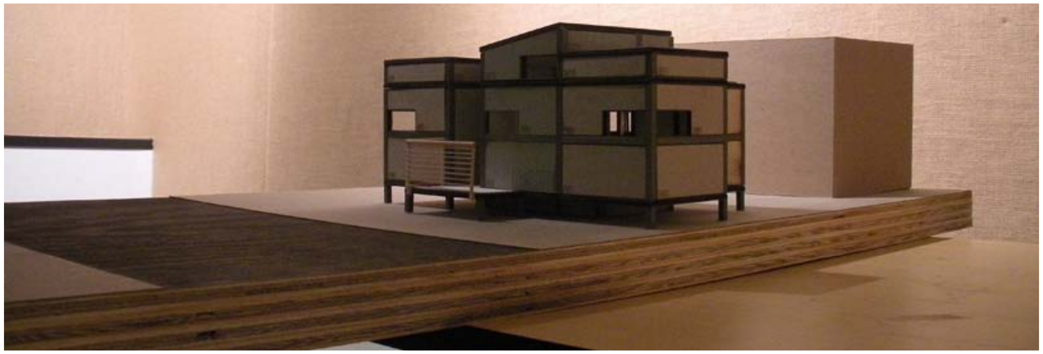

Figure 172. Temporary Unit Model.

Figure 173. Temporary Unit Model.

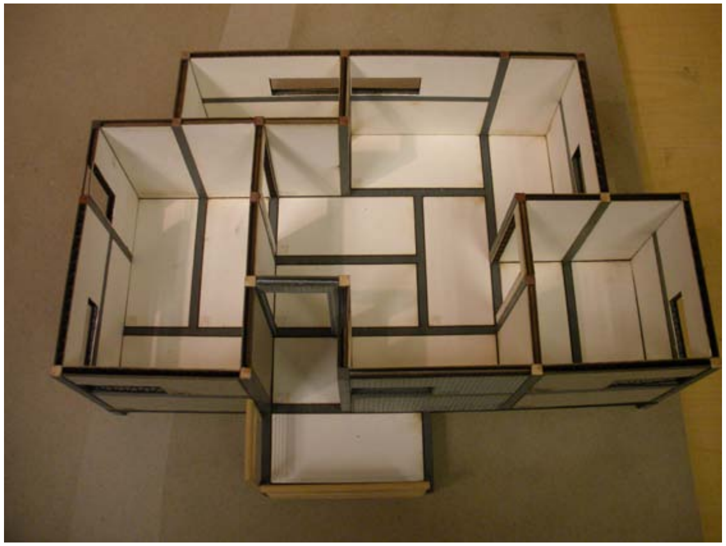

Figure 174. Temporary Unit Model.

Permanent Unit

The permanent unit follows the outlines of the original foundation and expands to reach its edges. Close study of the previous home took place prior to the initial design since this unit will remain permanent. After a year at the early stage the unit begins to add additional floors and wall to expand the rooms. Originally the idea was to add individual walls and coverings but after further investigation it was found to be easier to add entire rooms or spaces to the central space. That way the exterior envelope remains enclosed. After all the spaces have been added the entire unit is re-assessed for sealed joints around fenestrations.

Figure 175. Permanent Unit Render.

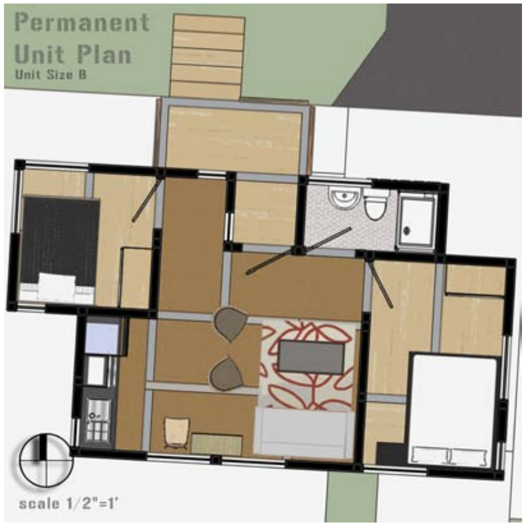

Figure 176. Permanent Unit Plan.

Figure 177. Permanent Unit Section.


Figure 178. Permanent Unit Model.

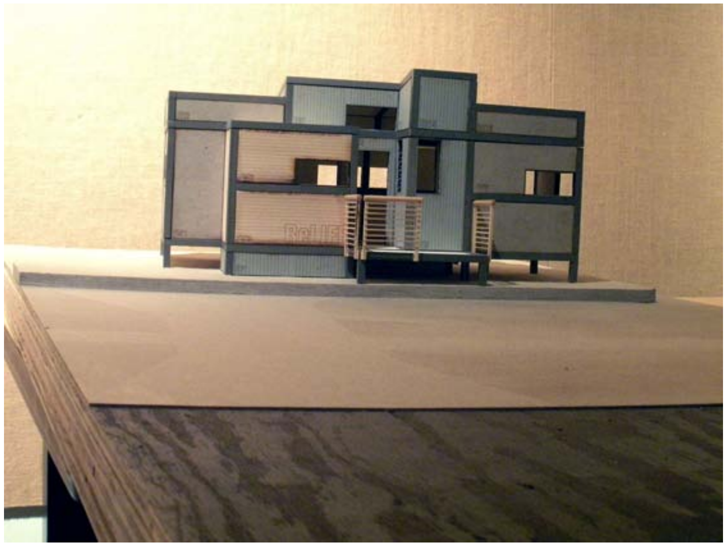
Figure 179. Permanent Unit Model.

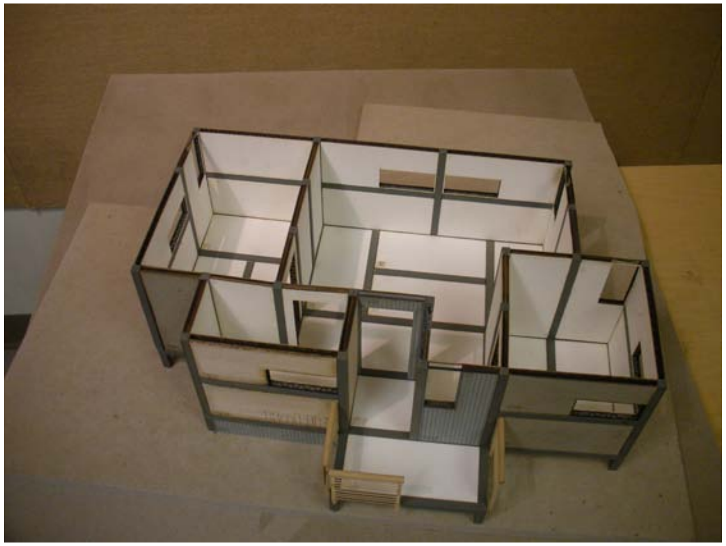
Figure 180. Permanent Unit Model.

PRODUCT MEDIA

One of the key points of this research is to provide a solution to solve the current problems. For this plan to be truly ready for implementation it must have the documents prepared for it to be used. One of these such documents is a Product Guide that will guide the victim through the process of selecting a size, type, configuration, and all the components of the transitional housing unit. The following pages form the Product Guide for the ReLIFE Transitional Housing Unit. This product guide develops this design from a fictional idea into a reality that is ready to be tested with the public.

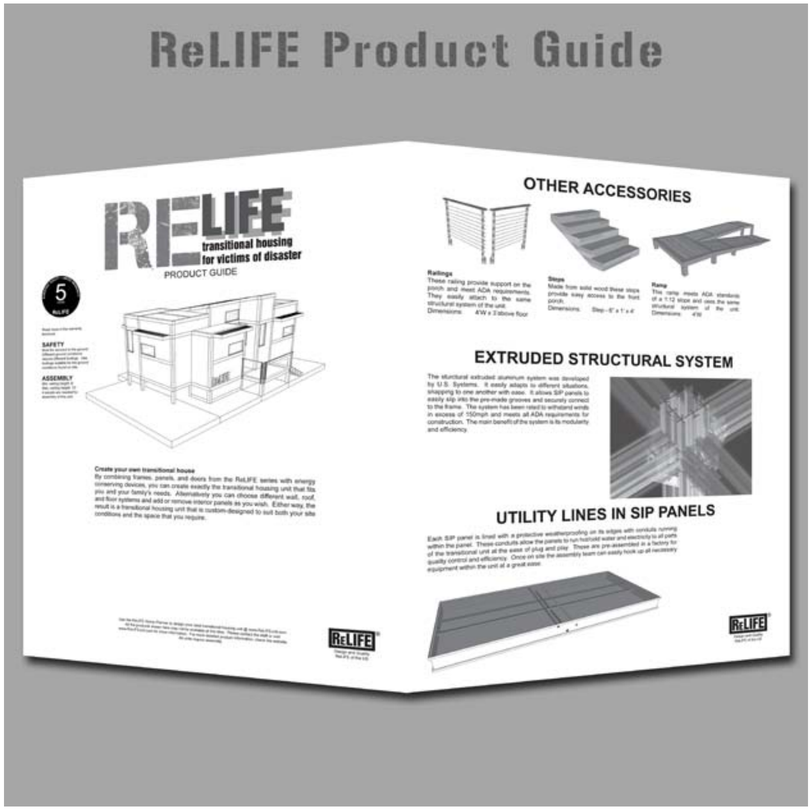

Figure 181. Product Guide P1,P8.

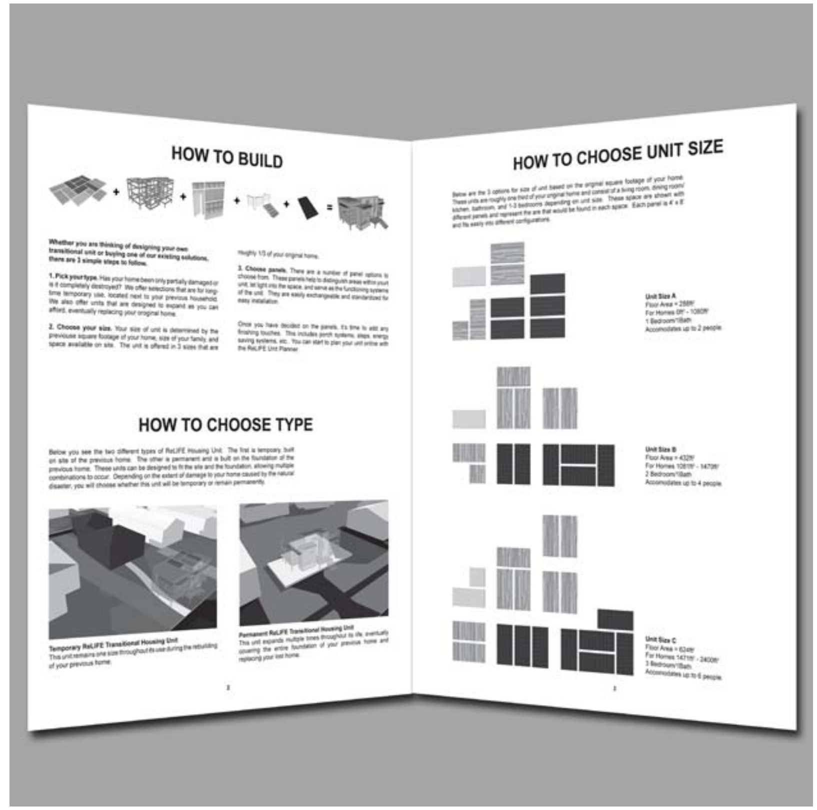

Figure 182. Product Guide P2,P3.

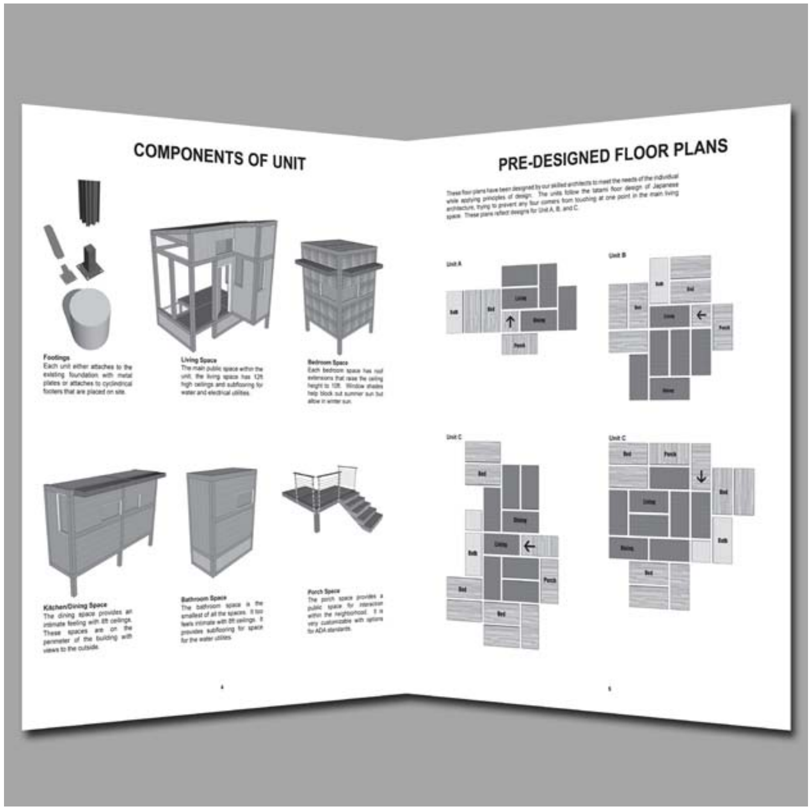

Figure 183. Product Guide P4,P5.

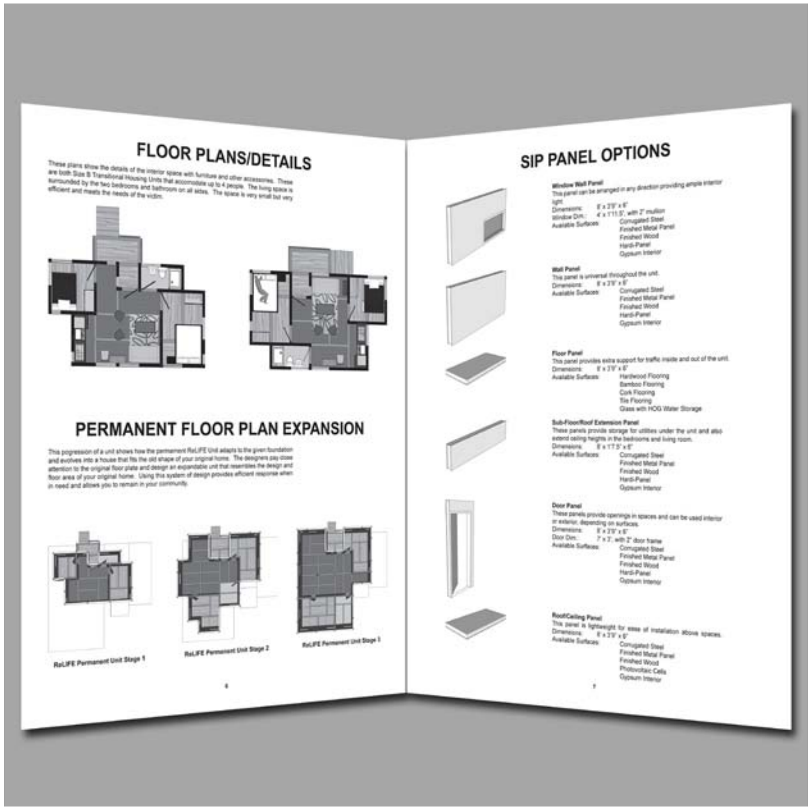

Figure 184. Product Guide P6,P7.

BIBLIOGRAPHY

Design Like You Give a Damn. (2006). New York: Metropolis Books.

FEMA: The Disaster Process and Disaster Aid Programs. (2006, September 13). Retrieved April 2009, from FEMA: http://www.fema.gov/hazard/dproc.shtm

FEMA-Provided Travel Trailer Study. (2008, November 13). Retrieved April 2009, from Center for Disease Control and Prevention: http://www.cdc.gov/nceh/ehhe/trailerstudy/formaldehyde.htm

Hartman, C., & Squires, G. D. (2006). There is No Such Thing as a Natural Disaster: Race, Class, and Hurrican Katrina. New York: Taylor and Francis Group, LLC.

Henneberger, J. (2008, December 15). Put an end to FEMA trailers by moving people quickly into permanent housing. Retrieved April 2009, from Texas Housers: http://texashousers.net/2008/12/15/put-an-end-to-the-fema-trailer-by-moving-directly-to-permanent-housing/

Hurricane Charley. (2009, July 20). Retrieved July 26, 2009, from Wikipedia: http://en.wikipedia.org/wiki/Hurricane_Charley

IKEA Concept. (2009, March 11). Retrieved March 11, 2009, from IKEA: http://www.ikea.com/ms/en_US/about_ikea_new/about/index.html

Institue, S., & Institute, S. (2007). Design for the Other 90%. New York: Cooper-Hewitt National Design Museum.

Kerensky, B. (2008, July 11). TOP STORY: Toxic trailers from FEMA still source of debate and concern . Retrieved April 2009, from Oh My Gov: http://ohmygov.com/blogs/general_news/archive/2008/07/11/toxic-trailers-from-fema-still-source-of-debate-and-concern.aspx

Kronenburg, R. (2008). Portable Architecture: Design and Technology. Boston: Architectural Press.

Kronenburg, R. (2003). Transportable Environments 2. New York: Spon Press.

Myers, L., & Gardella, R. (2007, November 15). $229,000 FEMA Trailers. Retrieved April 2009, from MSNBC: http://www.msnbc.msn.com/id/21824609

Natsios, A. S. (1997). U.S. Foreign Policy and the Four Horsemen of the Apocalypse: Humanitarian relief in complex emergencies. Connecticut: Praeger Publishers.

Press, A. (2009, January 17). USA Today. Bush administration finishes disaster housing plan .

Schittich, C. (2003). In Detail: solar architecture. Switzerland: Publishers for Architecture.

Siegal, J. (2008). More Mobile: Portable Architecture for Today. New York: Princeton Architectural Press.

Stang, A., & Hawthorne, C. (2005). The Green House: new directions in sustainable architecture. New York: Princeton Architectural Press.

Stone, J. (2009, April 9). USA Today. More communication, education needed in hurricanes .

Topham, S. (2004). Move House. Munich: Prestel.