



# EMERGENCY RESPONSE SHELTER PROTOTYPE

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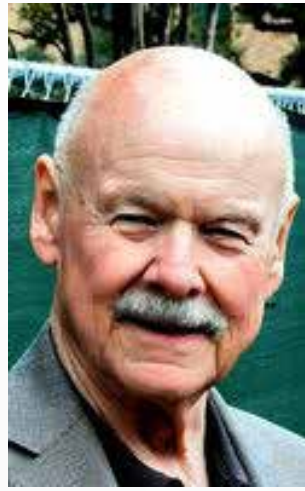
*God is our refuge and strength, an ever-present help in trouble. Therefore we will not fear, though the earth give way and the mountains fall into the heart of the sea.*

Psalm 46:1-2

Thank you to everyone and anyone who has ever guided and supported me through the challenges I have faced and overcome.

This is for you.

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## MASLOW'S HIERARCHY



# BACKGROUND

Maslow's hierarchy of needs is a psychological theory containing a five-tier model of human needs. The needs on the lower level need to be satisfied before the next level can be attained. **Physiological** needs are biological requirements for human survival like air, food, drink, shelter, etc. Once those needs are satisfied, the next level of needs includes **safety and security**. Individuals want order and control. Those needs are satisfied by family and society: police, schools, businesses and medical care for example. The next level of human needs is **love and belongingness**. Examples include friendship, trust and acceptance. This level talks about a sense of community and being part of a group. The fourth level of Maslow's hierarchy includes **esteem** needs. There are two categories, esteem for oneself (dignity, achievement, independence) and the desire for reputation or respect for others (status, prestige). The last level is **self-actualization** needs which refer to the realization of a person's potential, self-fulfillment, seeking personal growth and peak experiences. This project will address the first four levels of Maslow's hierarchy of needs.



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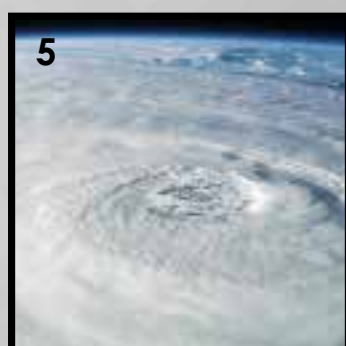




# INTRODUCTION

“Disasters happen. We still have no way to eliminate earthquakes, wildfires, hurricanes, floods or droughts. We cope as best we can by fortifying ourselves against danger with building codes and levees, and by setting aside money to clean up afterwards.”

- Seth Shostak



## INTRODUCTION

Merriam-Webster defines a natural disaster as a sudden and unfortunate event in nature that can result in serious damage and many deaths. These destructive events can kill around 90,000 people and affect about 160 million people worldwide per year. Those affected can have feelings of anxiety, constant worrying, and other depression-like symptoms before, during and after the event. These events can also create catastrophic destruction leaving individuals and their families without one of the most basic human needs: shelter.

Natural disasters are large-scale geological or meteorological events that have the potential to cause loss of life or property. They are naturally occurring physical phenomena caused by either rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis and volcanic activity), hydrological (avalanches and floods), climatological (extreme temperatures, drought and wildfires), meteorological (cyclones and storms/wave surges) or biological (disease epidemics and insect/animal plagues). There are different types of natural disasters which can include:

- Tornadoes and Severe Storms
- Hurricanes
- Floods
- Wildfires
- Earthquakes

Of the disasters listed, hurricanes can cause damage with similar methods such as high wind speeds, large amounts of rain, and catastrophic damage.



Texas National Guard soldiers arrive in Houston on August 27, 2017 to aid residents affected by Hurricane Harvey. (Texas Army National Guard photo)  
Retrieved from <https://www.fbi.gov/news/stories/avoid-hurricane-harvey-charity-schemes>



Survivors of the deadly tornado that struck Joplin, Missouri on May 22, 2011 search through the debris for personal belongings. (2018)  
Retrieved from <https://www.brainfacts.org/diseases-and-disorders/mental-health/2018/natural-disasters-take-a-toll-on-mental-health-062818>



An aerial view of homes that were destroyed by the Tubbs Fire, Oct. 11, 2017 in Santa Rosa, Calif. (2018)  
Retrieved from <https://abcnews.go.com/US/federal-report-2017-shattered-us-damage-record-natural/story?id=52507313>

## CATEGORY 1

74-95 MPH  
WINDS

SOME DAMAGE

## CATEGORY 2

96-110 MPH  
WINDS

EXTENSIVE  
DAMAGE

## CATEGORY 3

111-129 MPH  
WINDS

DEVASTATING  
DAMAGE

## CATEGORY 4

130-156 MPH  
WINDS

CATASTROPHIC  
DAMAGE

## CATEGORY 5

157+ MPH  
WINDS

CATASTROPHIC  
DAMAGE

# HURRICANES

Hurricane is a name that describes tropical storms with winds of at least 74 miles an hour. These storms are rated based upon the five-point Saffir-Simpson scale which is based on wind speeds. The hurricane season begins June 1st and runs through November 30th. The Atlantic Ocean's hurricane season averages five to six hurricanes per year. The season peaks from mid-August to late October.

Hurricanes begin in warm ocean waters of at least 80 degrees Fahrenheit. These storms draw heat from warm, moist ocean air and release it through condensation of water vapor in thunderstorms. They spin around a low-pressure center referred to as the eye. This area is known to be calm but is surrounded by an "eye wall" that contains the storm's strongest winds and rains.

Hurricanes can cause destruction in several different ways. When the storm initially makes landfall, it can produce a storm surge which happens when ocean water is pushed ashore by wind. The surge can reach 20 feet high and move several miles inland. Storm surges and flooding are the two most dangerous aspects of these storms. The high winds that come with hurricanes are destructive and may spawn tornadoes. The torrential rains can cause further damage from flooding and landslides.

These storms, along with the other natural disasters, can cause substantial damage to communities and individuals themselves. People can be injured or killed all while their homes and possessions are destroyed or lost. Most individuals are put into shelters while they determine what to do next. They can lose their sense of freedom because they become dependent on others to get what they need.

Hurricane Katrina Satellite Imagery Retrieved from <https://www.britannica.com/event/Hurricane-Katrina>

Hurricane Maria Satellite Imagery Retrieved from <https://www.nasa.gov/feature/goddard/2017/aria-atlantic-ocean>

Hurricane Florence Satellite Imagery Retrieved from <https://www.npr.org/2018/09/12/647005403/hurricane-florence-zeroes-in-on-carolinas-bringing-130-mph-winds>

Hurricane Harvey Satellite Imagery Retrieved from <https://www.ospo.noaa.gov/Organization/History/imagery/Harvey/index.html>



## Hurricane Katrina

Category 3

Damages: \$125 million

Fatalities: 1245-1836

Hurricane Katrina made landfall off the coast of Louisiana on August 29, 2005. This storm stretched 400 miles and caused significant damage to the coast. During its peak, hurricane evacuee shelters housed 273,000 people. FEMA housed at least 114,000 households.



## Hurricane Maria

Category 5

Damages: \$91.61 million

Fatalities: 3059

Hurricane Maria made landfall in Puerto Rico on September 20, 2017. A total of 64 people died as a direct result of the hurricane, but in the months following the hurricane, the death rate was 62 percent higher than the year prior due to conditions caused by the storm.



## Hurricane Florence

Category 4

Damages: \$24.23 million

Fatalities: 24 direct, 30 indirect

Hurricane Florence made landfall off the states of North and South Carolina on September 14, 2018. Both states received record amounts of rainfall and displaced more than 15,000 people.



## Hurricane Harvey

Category 4

Damages: \$125 million

Fatalities: 103

Hurricane Harvey made landfall in Texas on August 25, 2017. The storm damaged 204,000 homes. Flooding forced 39,000 people out of their homes.



Does the shelter generate its own electricity?



Does the shelter connect to standard electrical poles?



Does the shelter collect its own water?



Does the shelter connect to the water system?



Can the shelter be used in all climates?



Can the shelter be used in all terrains?



Does the shelter consider sanitation?

## CASE STUDIES

Essential to any project is the investigations phase. Existing case studies were reviewed and analyzed for opportunities within the design as well as constraints. The opportunities were developed within the new design and the constraints became areas that needed innovation. A series of characteristics were determined to analyze each case study so that the studies could be compared.

### Electricity

When designing for post-disaster shelters, access to electricity may be limited. Electrical poles may be damaged or destroyed causing the power to be out in those areas for a significant amount of time. Designs that are required to be connected to these types of outlets would be unusable in these conditions. Shelters that generate their own electricity through solar panels or generators would be more applicable in post-disaster situations.

### Water

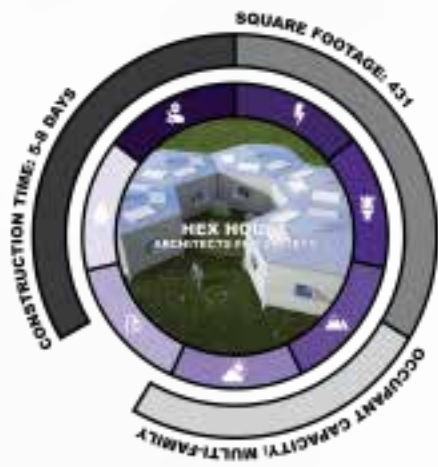
Similar to electricity, access to clean water may be inaccessible in a post-disaster situation. Shelters should provide a reliable source for sanitation when designing during post-disaster conditions.

### Sanitation

General sanitation is dependent on the access to electricity and water.

### Climate and Terrain

Disasters can happen anywhere and anytime. The shelter would need to be able to withstand not only the current condition in which it is built, but any future conditions that might arise. The shelter should also consider the different terrains that it could be deployed to.



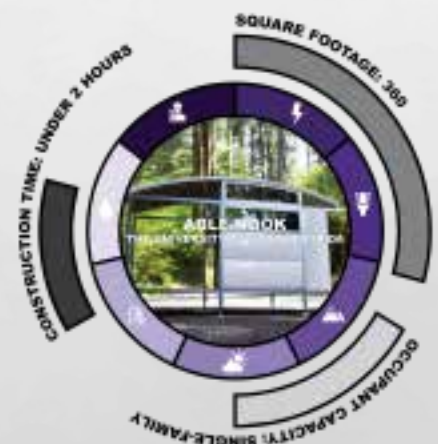
## Architects for Society | Hexagonal Shelters

- Largely made of steel and foam Structural Insulated Panels.
- Can be flat-packed and delivered by truck to a building site
- The design is meant to be scalable, and each home is intended to be occupied for 15 to 20 years.
- Designed to be self-supporting, the walls and roof panels are locked together using tongue and groove joints, and form a sturdy structural shell. The exteriors can be clad in stucco, wood, or other materials using typical mechanical fasteners.
- They are designed to be easily assembled onsite.



## IKEA | Refugee Shelter

- Comfortable, solar-powered shelter that can provide emergency housing for natural disaster victims and refugees.
- Comes flat packed, making for easy transport of lightweight plastic shelters at once.
- The homes have solar paneled roofing allowing for inhabitants to generate their own electricity which extinguishes the need for candles or kerosene lamps.
- The roof also deflects solar reflection by 70%, keeping the interior cool during the day and warmer at night.



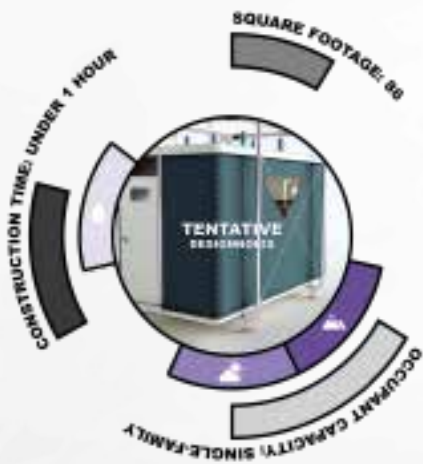
## Sean Verdecia + Jason Ross | AbleNook

- Can be assembled in about two hours without any tools and no skilled labor and can be deployed on uneven terrain.
- The flexible design is modular and can be expanded as needed and can serve as more than just housing.
- The modular design is based on identical and universal aluminum structural insulated panels and extruded aluminum structural members that clip together without the use of any tools.



## Christian Weber | Shiftpod

- Their goal is to set up kits for individuals to take with them that have a shelter, water filtration, and everything you need for a family of four to survive for 30 days.
- The company is developing a low-cost, easy-to-ship, easy-to-set-up unit that people can live in for up to five years.
- Shiftpods can withstand up to 110 miles per hour winds.



## Designnobis | Tentative

- Compact, all-in-one, deployable emergency shelter.
- Can be deployed in almost any terrain and climate.
- The structure consists of a weather resistant textile that is quilted together, with insulating perlite sandwiched between layers, held by an aluminum frame.
- Water is collected via the roof, which also provides lighting and ventilation.
- Heat-insulating recyclable composite decks make up the floor, with legs keeping the floor above ground to prevent heat loss.



## MMAS + Cipriano Chas | The buBbLe Prototype

- Designed to be an independent living facility, nomadic and flexible, that allows the occupants to respond to diverse environmental contexts within a given amount of time.
- The walls of the cubic house feature an insulating chamber that can be filled with a variety of materials ranging from water, to air, to grass, to clothing, to whatever the occupant desires.
- Works to manage external conditions by providing adjustable eco-friendly insulation as well as offering privacy from the curious eyes which will surely be drawn to the unique structure.



## Carter Williamson | GRID

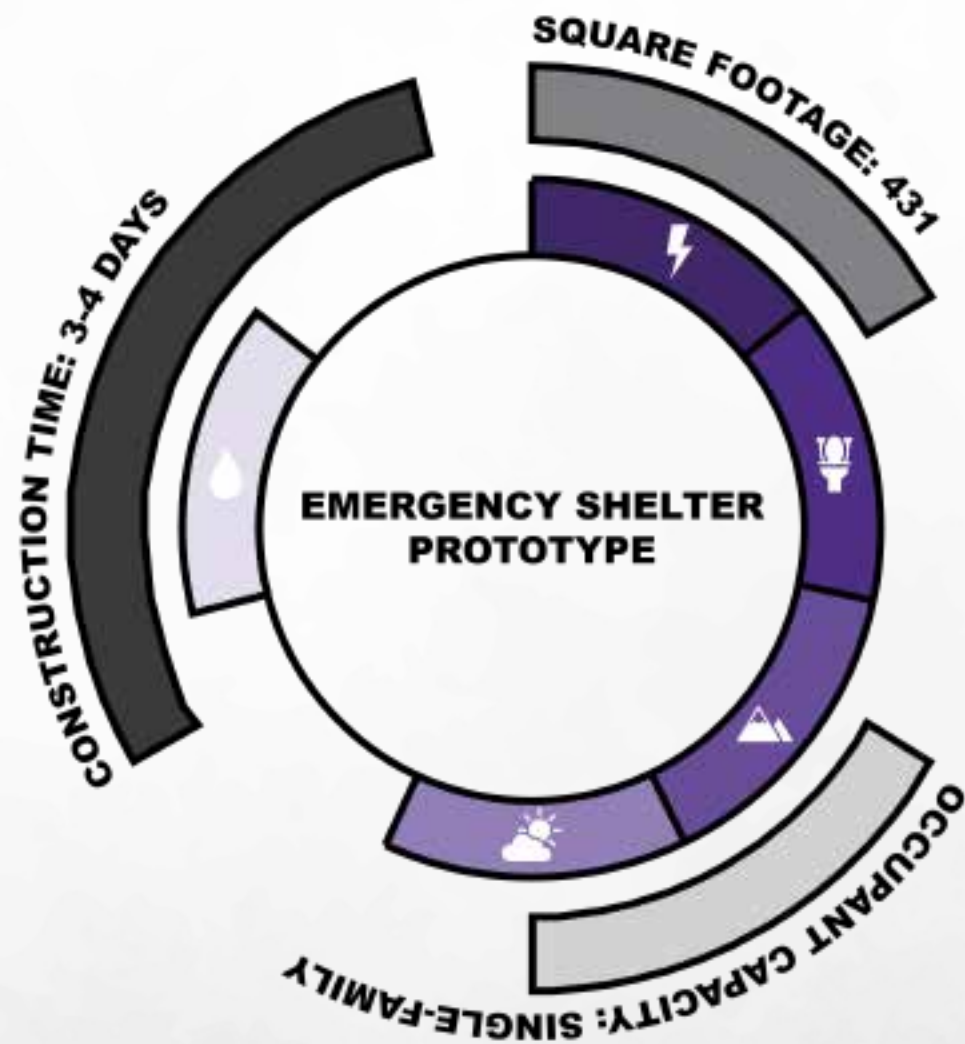
- Disaster zones the materials would composite materials retrieved from debris.
- In less compromised circumstances, the shelters, prefabricated off-site, can be transported “flat-packed” by either road or rail to remote communities.
- Able to operate using either local municipal services or independently off-grid.
- The ultra-fit, fully insulated, steel-frame structure utilizes photovoltaic cells and a roof-mounted solar hot water system; rainwater tanks collect roof water; and barn-door windows ensure the building is thoroughly ventilated.



## Daiwa Lease | EDV-1 Shelter

- Can be set up on any terrain.
- Can sustain itself without any outside resources for up to a month by catching and reusing water and generating electricity with a sizable built-in solar array.
- Can be deployed anywhere a truck or helicopter can travel.
- Four hydraulic legs quickly stabilize the structure on rugged terrain, and an outer wall rises to create a second story, providing shelter in less than five minutes.





## EMERGENCY RESPONSE SHELTER PROTOTYPE

From the case study analysis, it was determined that the shelter would need to be able to be built in all terrains and climates. Electricity and water connections are important, but not always accessible in post-disaster conditions. The shelter would need to be able to generate its own electricity, and retain its own water without being dependent on the standard utility connections. The amount of time for construction of the shelter is crucial, because the displaced and in urgent need of a place to reside.

The goal of this project is to create a set of modular buildings that can be deployed to areas that have been devastated by natural disasters. These buildings can serve as a community for the displaced residents of the area devastated.

The design was created with the mindset of it being "semi-permanent". These modules can become permanent fixtures in the community as affordable housing or homeless communities. They can also be deconstructed, and the parts can be evaluated and reused if found applicable. This would depend on how the city or county want these to be used for. After an undecided length of time, the city or county will become "owners" and use the modules to their discretion.



# PHYSIOLOGICAL

“One can choose to go back toward safety or forward toward growth. Growth must be chosen again and again; fear must be overcome again and again.”

- Abraham Maslow

# PHYSIOLOGICAL

When disaster strikes, people are left without the basic needs. Maslow refers to these needs as physiological needs. Maslow's theory states that humans are compelled to fulfill these needs first. If these needs are not met, it can lead to an increase in displeasure within the person. Physiological needs can include food, water and shelter. While food and water can be readily available to these people after the disaster, shelter is not always available. People could be left homeless or in tents or housed in shelters with many others. They lose the freedom they had before the disaster.

The Emergency Response Shelter Prototype is designed to be constructed quickly and allow for families to start over in their own space. This project focuses on providing basic amenities in a modular design which shows that the design can be connected and expanded into larger spaces. This structure is designed using easily constructible materials that are fit in a container and shipped to disaster sites. The characteristics analyzed in the case study analysis were applied during the design of the shelter throughout the process.



# TRANSPORTATION

This project was designed with the idea of it being transported to disaster sites. Using simple construction methods, inhabitants can assemble the shelter using simple tools and little training. The components are designed to be packed and shipped flat in multiple modes of transportation. The total weight of one unit while in a box is around 7,200 lbs.

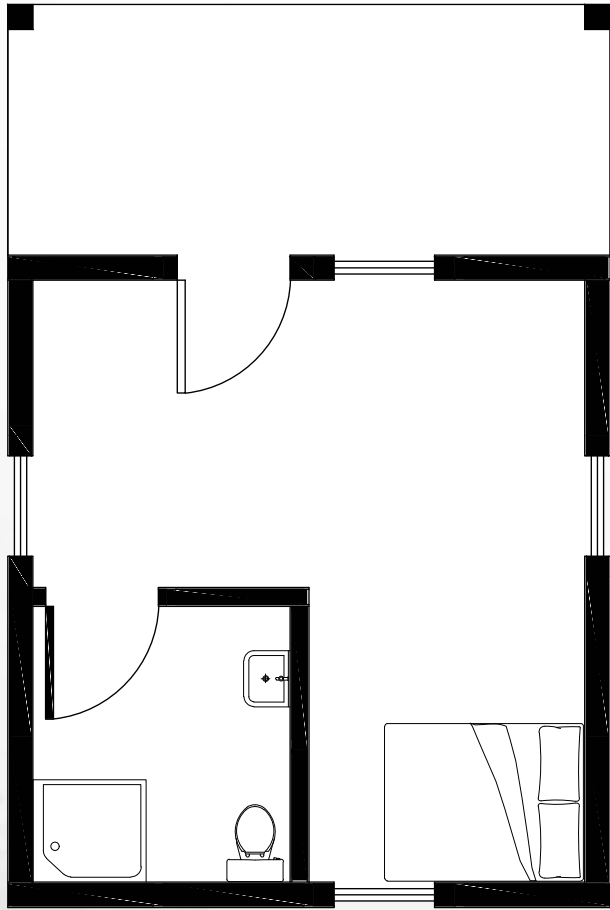
## ***Ground Transportation***

There are two main types of ground transportation that the project would utilize: auto and train. Semi-trailers on a single axle can carry up to 20,000 lbs while a double axle can carry up to 34,000 lbs. One semi-trailer can carry 2 units to the disaster site. While trains are limited to where the shelter can be delivered, they can help get the units there faster. Each train cart can carry up to 3 units.

## ***Air Transportation***

Planes and helicopters are the fastest way to get the units to the disaster site. There are numerous kinds of cargo planes that can be used. A DC10-30 Freighter is one of the largest and most available to use. It can carry up to eight units at once. A tilt-rotor helicopter can carry one unit to the site.

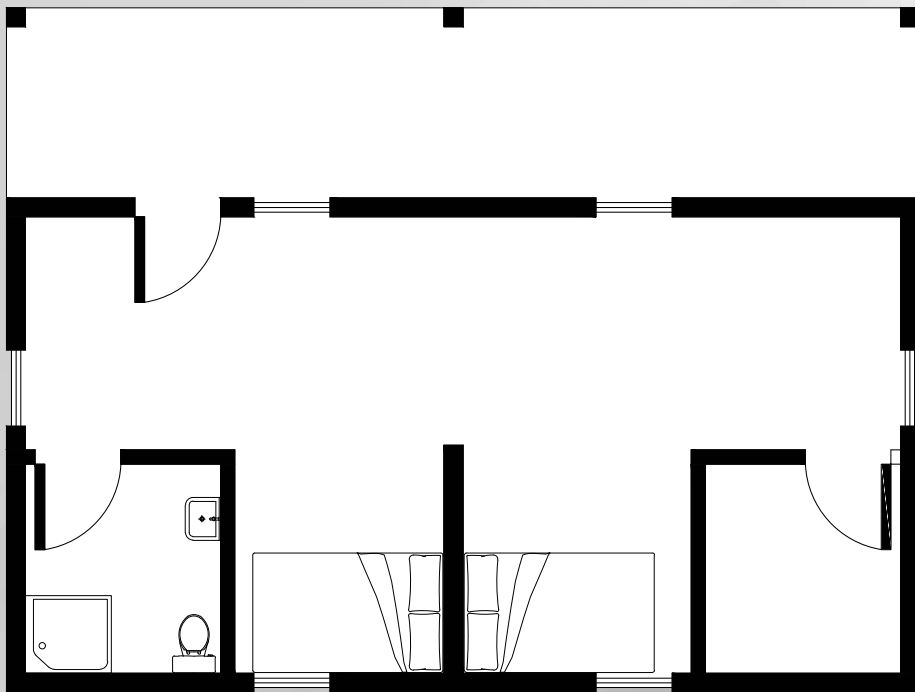




## SINGLE-FAMILY UNIT

235 sf

This is a private space for families to utilize while they rebuild or relocate after being displaced from their homes. This module includes a single bed that has an additional sleeper underneath it to accommodate more people. The rest of the module has a single bathroom and a living area.



## MULTI-FAMILY UNIT

491 SF

*2 Beds | 1 Bath | 1 Storage*

This module is for larger families who may need more room than what the single unit can provide. Similar to the single module, the multi-family unit has one bathroom. The other room would be a storage place for the family.

## **SOLAR PANELS**

Solar panels would be used to generate the electricity in the module.

Amount of electricity that could be used within the module:

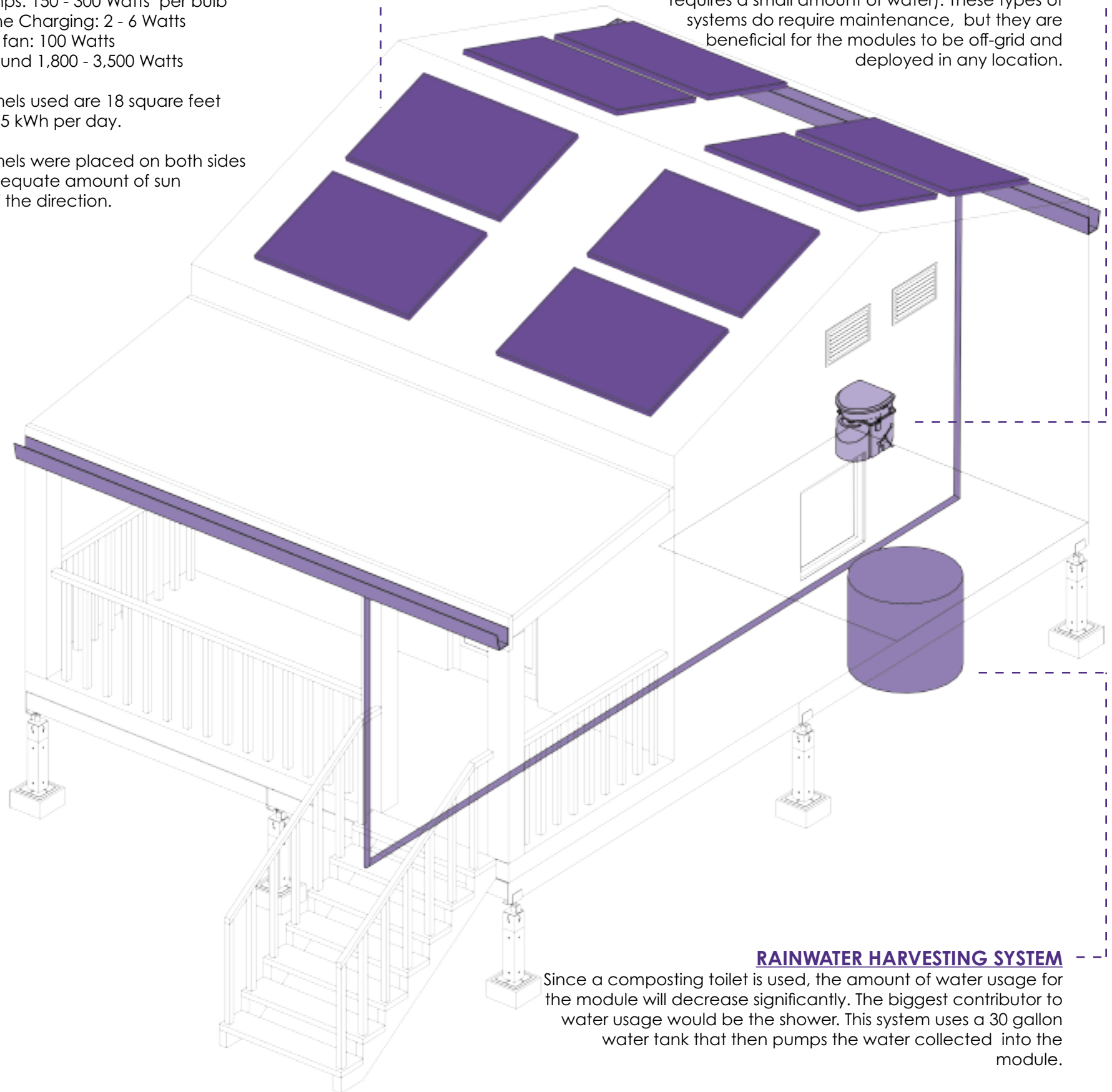
- Water pump: 1,500 - 3,000 Watts
- Floor Lamps: 150 - 300 Watts per bulb
- Cell Phone Charging: 2 - 6 Watts
- Standing fan: 100 Watts
- Total: around 1,800 - 3,500 Watts

The solar panels used are 18 square feet producing 1.5 kWh per day.

The solar panels were placed on both sides to get an adequate amount of sun regardless of the direction.

## **COMPOSTING TOILET**

A composting toilet would be placed in each module. These toilets do not use electricity and most do not require running water. The different types of composting toilets are: slow composting or moldering toilets, active composters (self-contained), and vermifilter toilet (which requires a small amount of water). These types of systems do require maintenance, but they are beneficial for the modules to be off-grid and deployed in any location.



## **RAINWATER HARVESTING SYSTEM**

Since a composting toilet is used, the amount of water usage for the module will decrease significantly. The biggest contributor to water usage would be the shower. This system uses a 30 gallon water tank that then pumps the water collected into the module.

## **SOLAR PANELS**

Solar panels provide power for lighting and small electronics. The roof allows for optimal solar panel placement, due to the orientation that maximizes the amount of solar instances.

## **RAIN WATER COLLECTION**

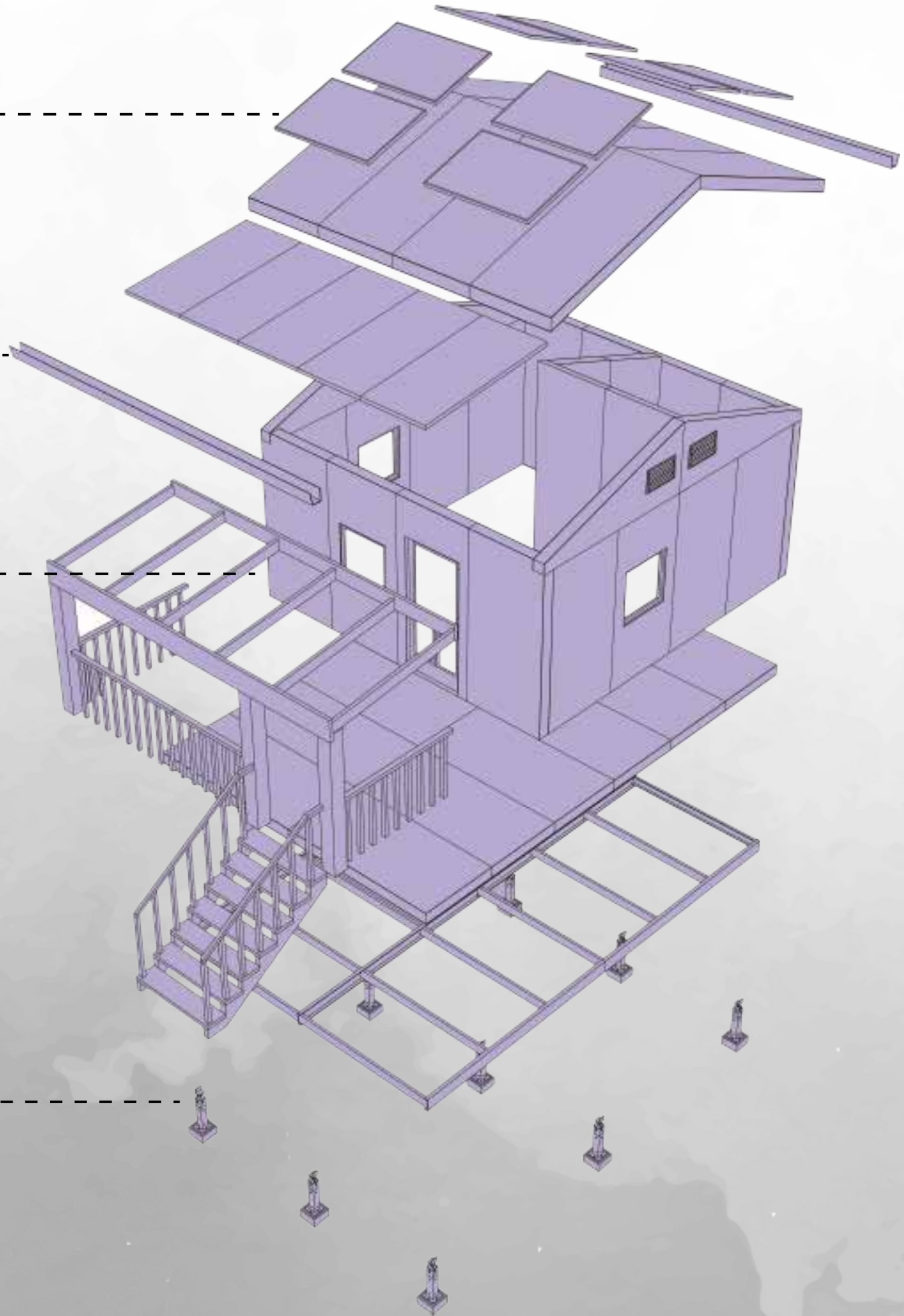
Rain water is collected through the gutter and downspout system and filtered into a storage tank. It is then manually pumped back into the house.

## **WALL PANELS**

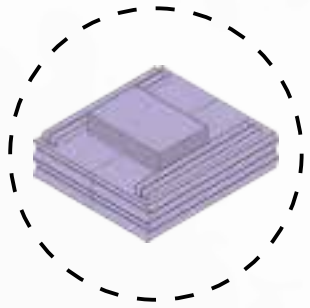
Each 6" thick panel is connected with common nails. The panels are self-supporting without any additional structure. The exterior walls can be clad with stucco, wood cladding, or other materials using mechanical fasteners.

## **FOUNDATION**

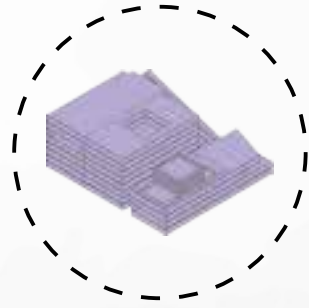
Wall are supported on lightweight steel joists and adjustable steel supports that are anchored to concrete foundations which vary depending on soil. The steel members are connected with bolts through per-drilled holes. The floor panels are fixed on top and span the horizontal supports.



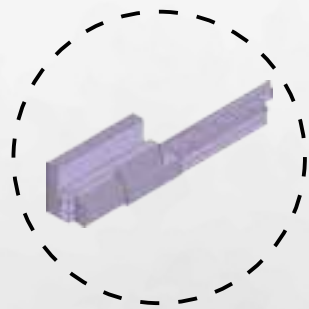




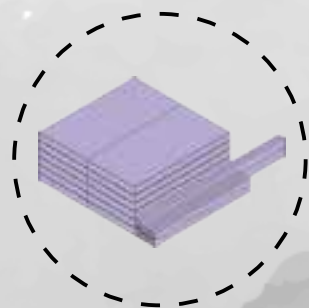
ROOF COMPONENTS



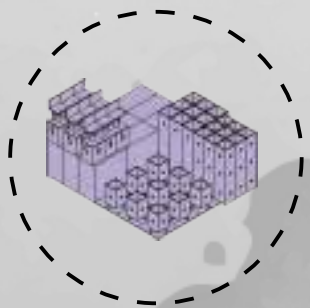
WALL COMPONENTS



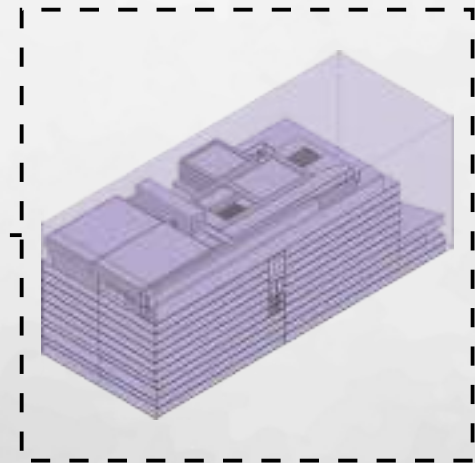
DECK COMPONENTS



FLOOR COMPONENTS



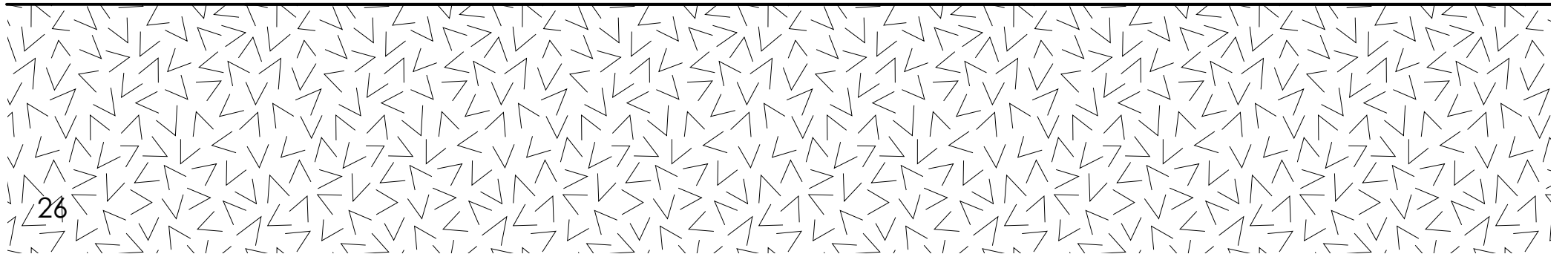
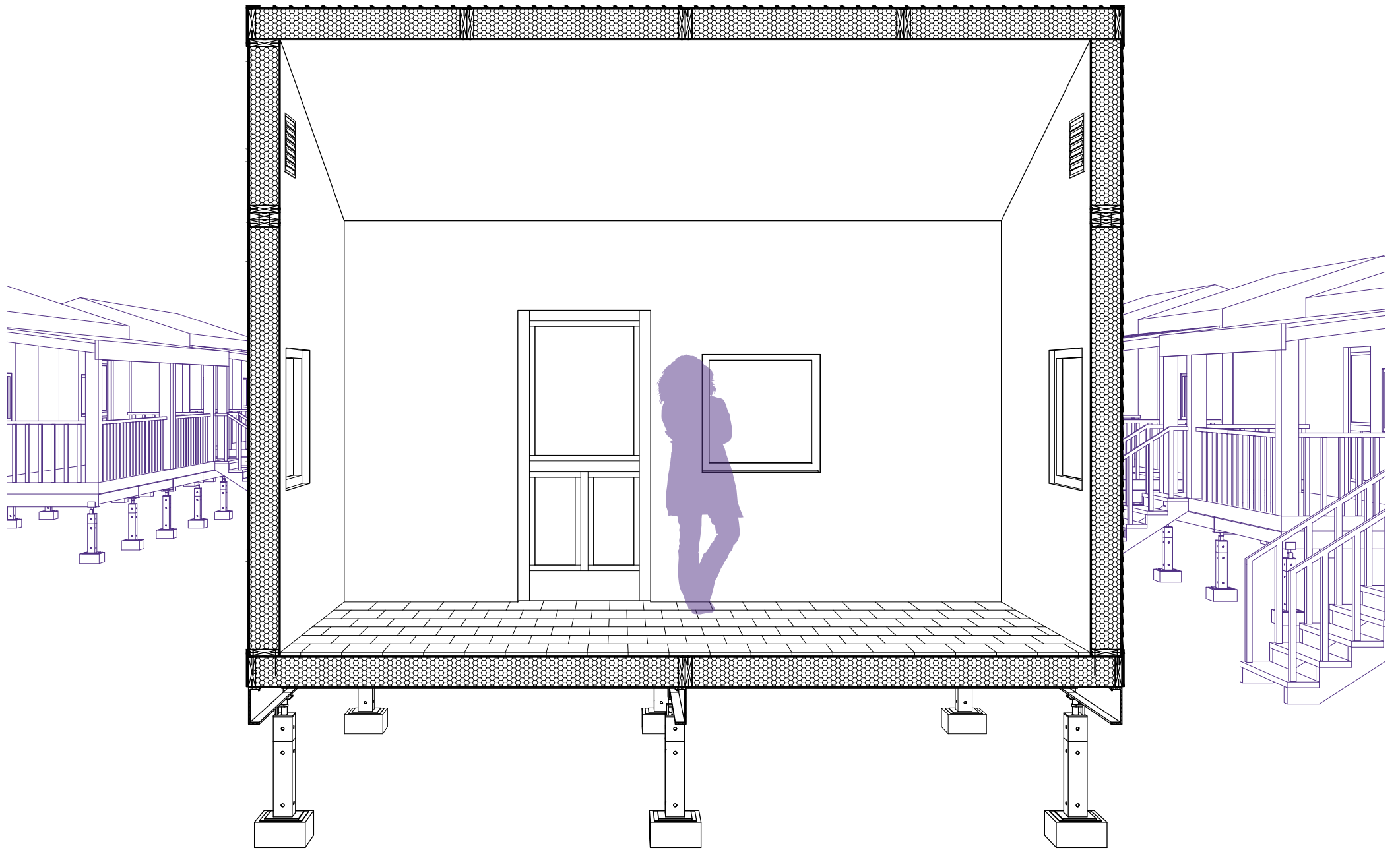
FOUNDATION COMPONENTS

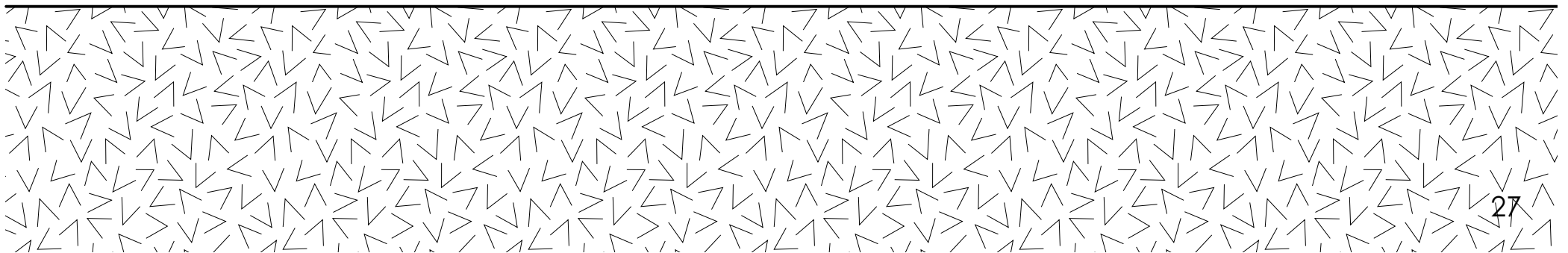
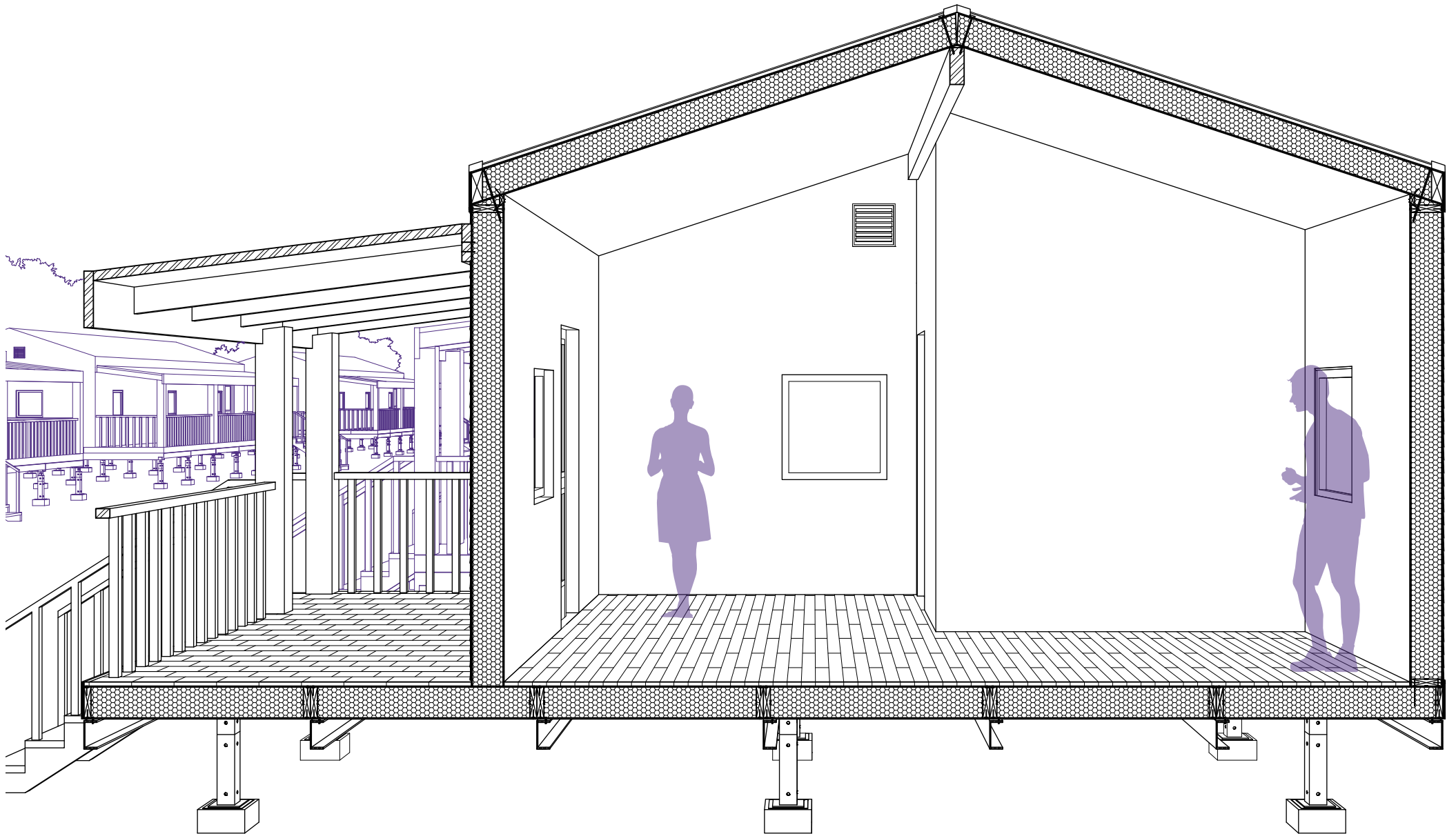


1 UNIT = 1428 CF  
1 UNIT = 7263 LBS

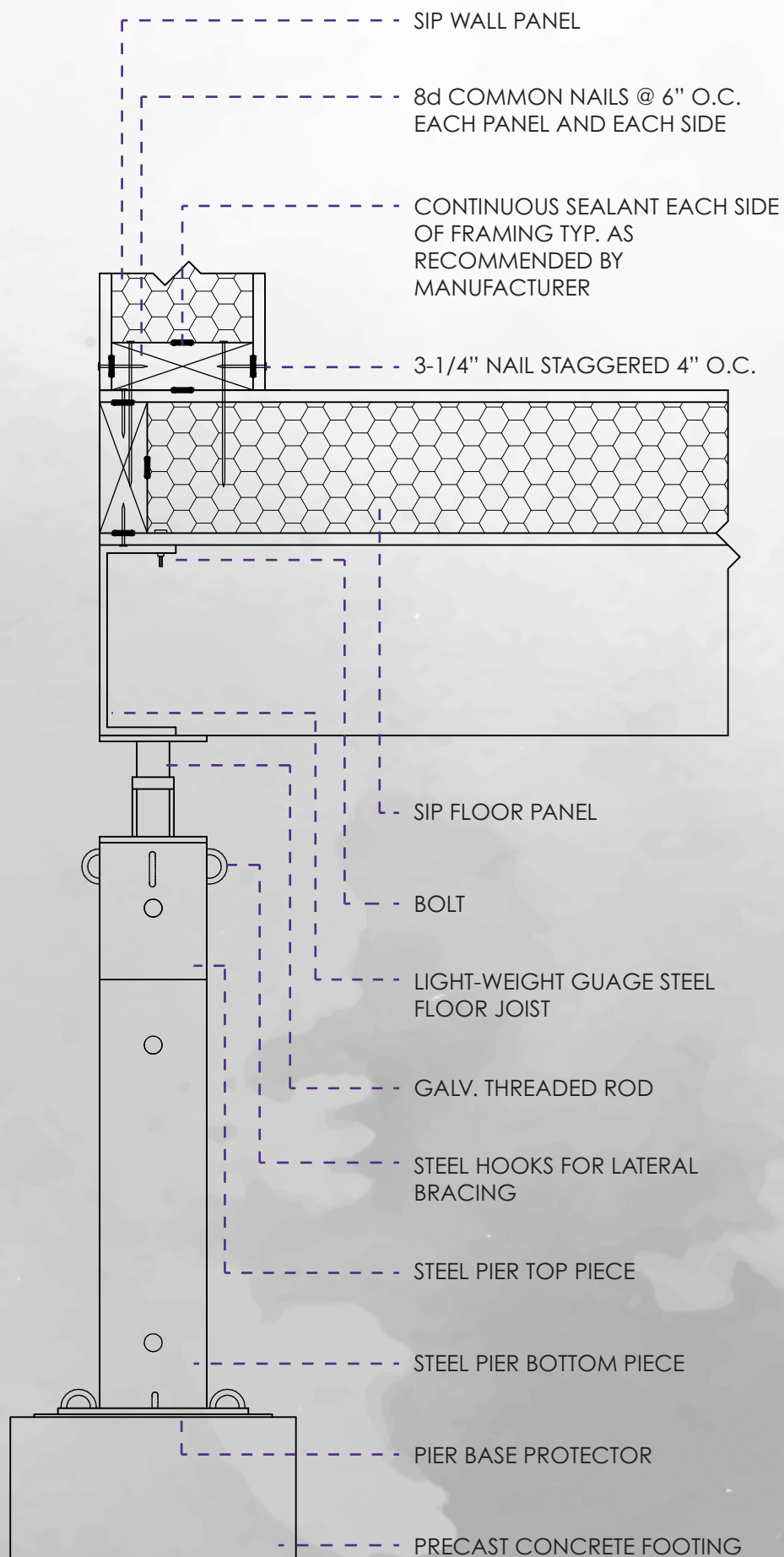
### **PACKING AND TRANSPORT**

Using simple construction methods, inhabitants can assemble the shelter using simple tools and little training. The components are designed to be packed and shipped flat in multiple modes of transportation.





## FOOTING DETAIL



## CONSTRUCTION METHODS

The shelter was designed to be assembled without the need for special tools or specialized trades people. These were meant to be able to be constructed by anyone with tools most people have on hand.

Structurally Insulated Panels (SIPs) are a building system for residential or light commercial construction. These panels have two structural faces, usually oriented strand board (OSB) with insulating foam core sandwiched between them. They can be fabricated to fit any building design. This building system is extremely strong, energy efficient and cost effective.

SIPs were chosen because of the modularity design of the shelter. The added benefit of the insulation would benefit the occupant using the shelter and decrease the time it takes to construct the shelter.

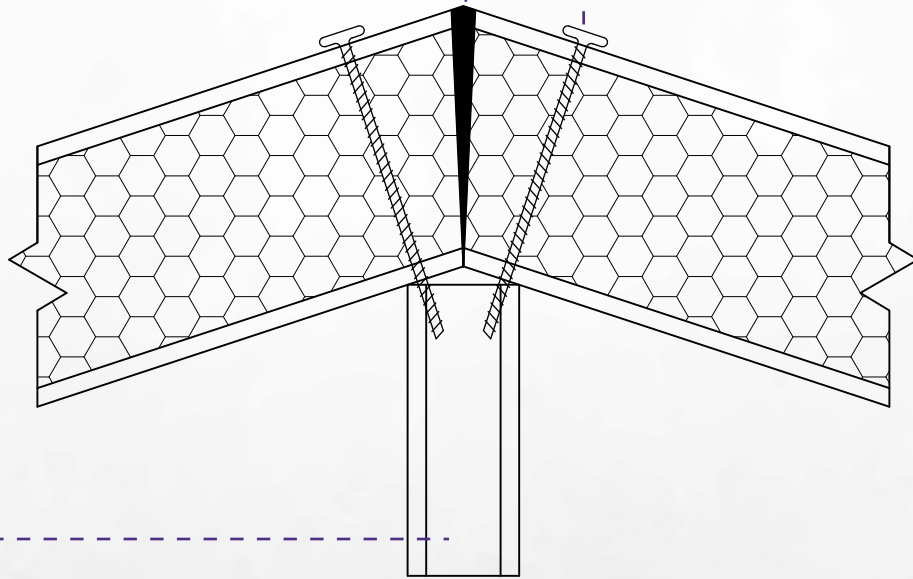
The adjustable footing of the module is designed to be assembled on site similar to the other components of the module and was chosen to broaden the range that the shelter can be built in. The base is a precast concrete block with rods already placed so that the steel pier can be easily bolted to it. Each piece is bolted to the next. Inside the bottom piece is an adjustable piece that can be interchange with a longer piece in extreme situations. The middle piece connects to the top piece the same way as the other pieces. The top piece includes a threaded rod for the small adjustments that may be needed. The top piece is then bolted to the floor joist. Lateral bracing is achieved by steel cables that attach to hooks attached at different spots on the footing.

## ROOF PANEL CONNECTION DETAIL

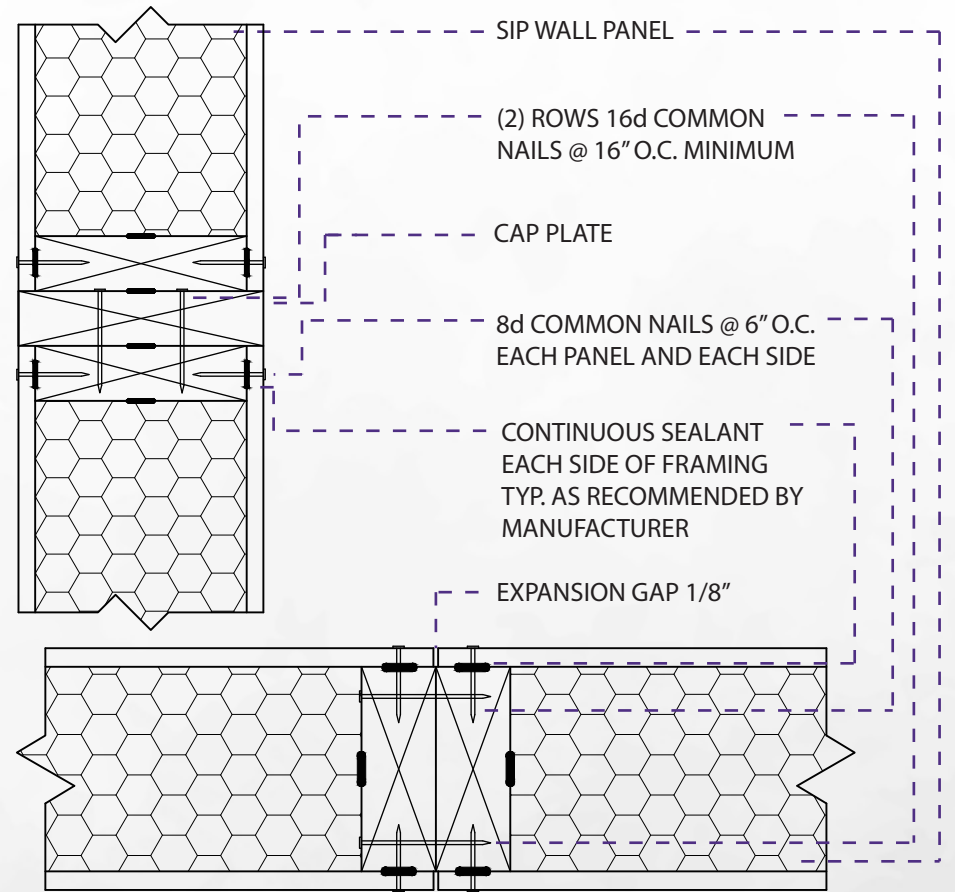
SIPS SCREWS W/ MINIMUM 1" PENETRATION INTO STRUCTURAL SUPPORT @ 24" O.C. MINIMUM

MINIMUM 3/8" GAP FOR SEALANT AS RECOMMENDED BY MANUFACTURER

RIDGE SUPPORT BEAM



## WALL-TO-WALL CONNECTION DETAILS



## CORNER WALL-TO-WALL CONNECTION DETAIL

SIPS SCREWS WITH MINIMUM 1" PENETRATION IN WOOD MEMBER IN SIP WALL PANEL CONNECTED TO @ 24" O.C. MAXIMUM

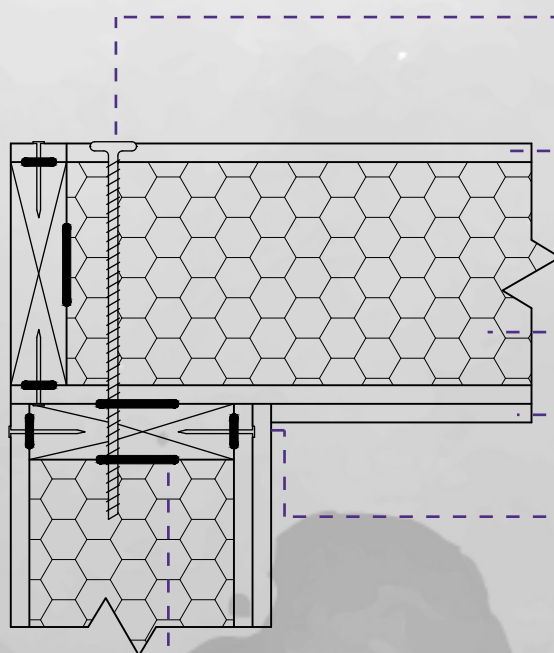
OUTSIDE SKIN

FOAM CORE

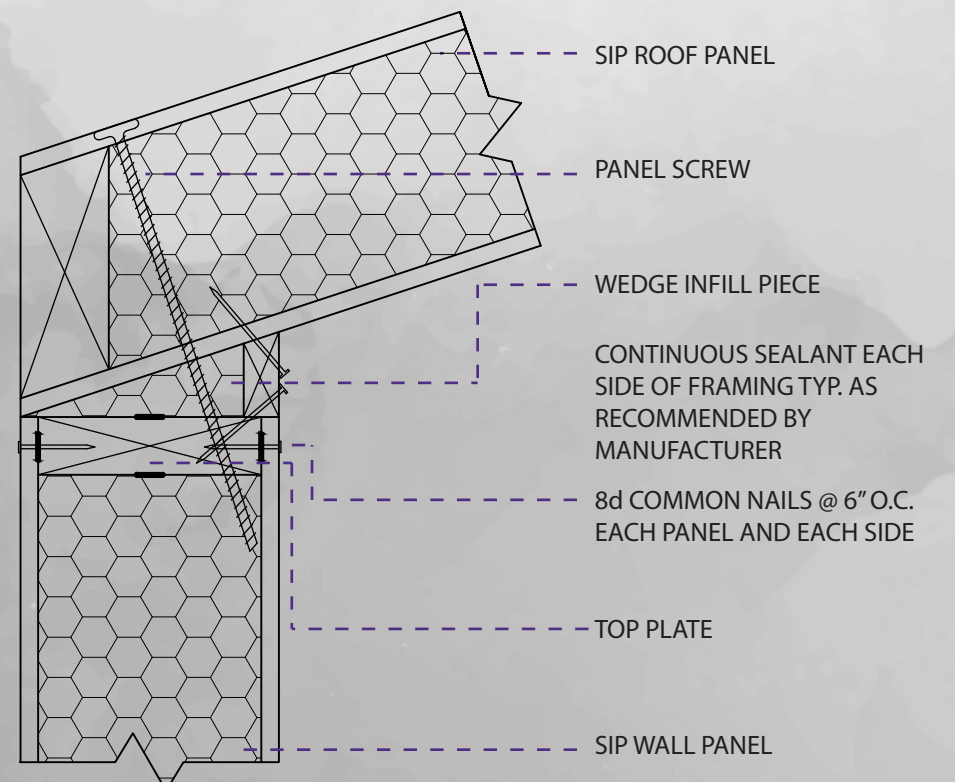
DRYWALL

8d COMMON NAILS @ 6" O.C. EACH PANEL AND EACH SIDE

CONTINUOUS SEALANT EACH SIDE OF FRAMING TYP. AS RECOMMENDED BY MANUFACTURER



## ROOF-TO-WALL CONNECTION DETAIL





# SAFETY

“Although the world is full of suffering, it is also full of the overcoming of it.”

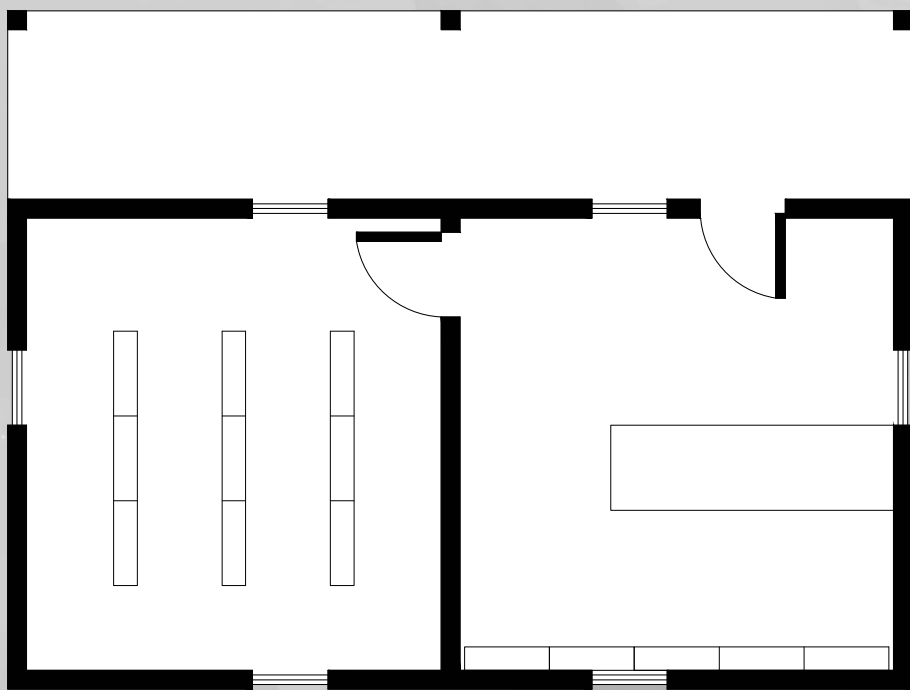
- Helen Keller

# SAFETY

Once an individual's physiological needs are satisfied, the need for safety and security begin to form. These needs form primarily after a traumatic event like a natural disaster. These needs are about keeping an individual safe from harm physically and psychologically. Safety and security needs can include personal security, emotional security, financial security, and health and well-being. Safety needs can also include the person wanting a sense of order and control. This can be achieved by adding areas for schools, businesses, and medical care.

The Emergency Response Shelter is designed to be adaptable and expand its space to create larger areas that allow different activities to take place. While these spaces can be determined based on the community needs, a series of examples were considered based on needs after a disaster.

In the aftermath of a disaster, items are donated to those in need, but in most cases, there is not a single place they can be stored and distributed. The storage unit can be that place. The single unit does not include a place where food can be prepared. The community unit is a place where donated food can be stored and distributed as well as a place for the community to gather and receive the latest update during the aftermath. The medical unit is the space where first aid can be provided.



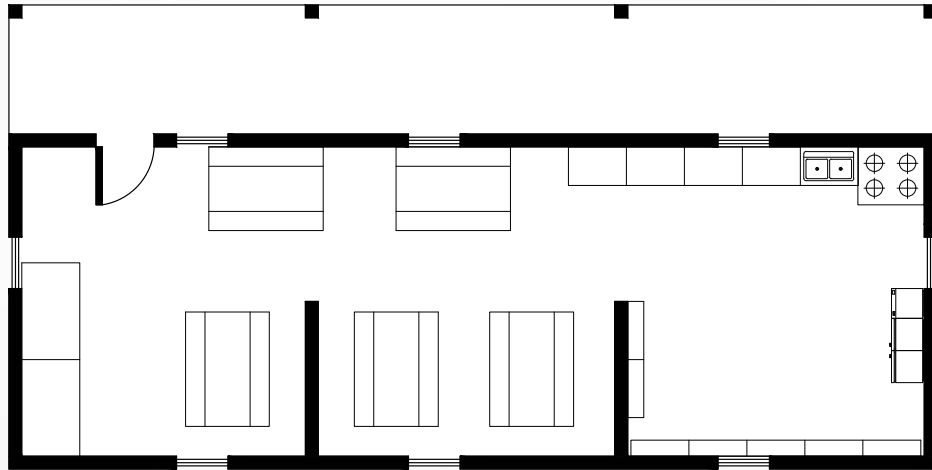
## STORAGE UNIT

491 SF

*Large Areas used for storage and distribution*

This module is a place that donated items as well as items misplaced during the disaster. This area will have a small reception desk to keep tabs on the donated items, but will mainly be storage.



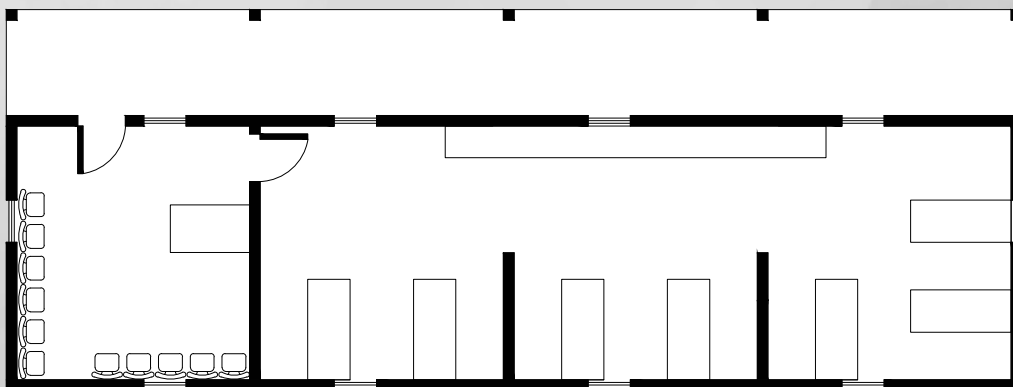


## COMMUNITY UNIT

747 SF

*5 Tables | Large Kitchen Area*

This module is a place to store and prepare donated food. There are 5 large tables for families as well as a serving table. The main dining area ties seamlessly into the kitchen area.



## MEDICAL UNIT

1003 SF

*7 Beds | 1 Reception*

An emergency medical unit that would have the capabilities for triage and treatment of the injured during and after a disaster. If necessary, this would be the place to prep patients to transfer to an off-site hospital. There is a seating area for waiting or small medical injuries and seven beds for more critical patients. There is an abundance of spaces for medical supplies.



# LOVE & BELONGING

“Bad things do happen in the world, like war, natural disasters, disease. But out of those situations always arise stories of ordinary people doing extraordinary things.”

- Daryn Kagan

# LOVE & BELONGING



Once the physiological and safety needs are met, the next needs to satisfy are social needs. The need for emotional relationships drives human behavior. Examples of ways to fulfill this need are friendships, family, social groups, community groups and churches or religious organizations. If these needs are not met, an individual can begin to develop problems like loneliness, depression, and anxiety. Those are also common side effects of someone who experiences a disaster of some sort.



The arrangement of the shelters can provide areas that the community can gather and perform activities that can reduce the affect of those problems that can occur. These areas can be used for children to play, people to gather and worship, or for a family to have a picnic.

When designing a project like the Emergency Response Shelter, consideration for how the shelter and its counterparts will arrive on the site and be arranged to form these communities. At this stage, some assumptions were made to generate a set of iterations that show the shelters arranged in different ways to promote community and companionship.



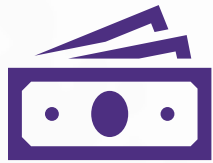
## ***San Augustine, Texas | April 2019***

In the early hours of April 25th, an EF-2 tornado ripped through the small town of San Augustine, Texas. This tornado caused over 2 million dollars in damages. The tornado destroyed or damaged 23 businesses and 114 homes, displacing an estimated 250 people. The Federal Emergency Management Agency (FEMA) has a distribution center in Atlanta, Georgia that will house the shelters until they are needed. Once the initial danger has passed, a team of twelve volunteers will transfer the first two shelters to the site via a tilt rotor helicopter. These individuals will speak to the county officials and determine the proper site for the shelters as well as get a head count of how many shelters would be needed to house the displaced individuals.



The volunteers will begin building the first shelter while the other shelters are being shipped from Georgia. The timeline of how long each shelter takes to build is dependent on how many individuals are working on it. If six people are working on the shelter, it is estimated that it would take three days to complete. Tables A.1, A.2, and A.3 will reflect the timeframe on building enough shelters to accommodate the amount of individuals that were displaced.

# SAN AUGUSTINE, TX | EF 2 TORNADO | APRIL 24-25, 2019



Over 2 million dollars worth of damages



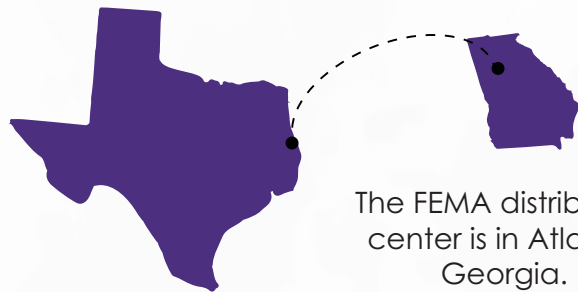
23 business destroyed or damaged



114 homes destroyed or damaged



Estimated 250 people displaced for at least 30 days



The FEMA distribution center is in Atlanta, Georgia.



about 2 hours



unknown



10.5 hours

**DAY 1**



An EF 2 tornado touched down near CR 1277 at 11:13 p.m. The tornado caused damage to many homes and businesses.

**DAY 2**



ERSs are deployed via tilt rotor aircrafts. 2 ERSs are delivered with 12 volunteers that begin building the shelters.\*

**DAY 3**



ERSs begin arriving on site along with volunteers.

**DAY 10**



22 ERSs are complete and ready for people to move in. The community center is established as well as two storage facilities. 12 families are ready to move in.

The first 2 ERSs are complete with more in the construction process.

**DAY 4**



**DAY 15**



30 more ERSs are complete.

**DAY 20**



20 more ERSs are complete. Families have moved in and a community is being formed.

**DAY 25**



Most of the ERSs are constructed. The displaced people have all retreated from various shelters/family homes into their own spaces while they begin rebuilding their lives.

After a survey of the damages, it is determined that around 40 ERSs are needed to accommodate the displaced people. In addition, an additional 20 were ordered for the community, storage, and medical modules.

## DAY 1: DISASTER STRIKES

- An ERS is loaded into a tilt rotor aircraft along with six volunteers.
- The first ERS is transported to the disaster site where the volunteers survey the site and begin constructing the ERS.

## DAY 2-5: TRANSPORTATION

- As the first ERS is being built, more are being transported to the site.
- Each ERS takes about 3-4 days to construct.
- After the initial survey, officials are determining how many ERS will be needed to accommodate the amount of displaced people.

## DAY 6+: CONSTRUCTION

- More ERSs are being constructed.
- Families are able to move in and begin the process of rebuilding.
- Community, medical, and storage models are being constructed to provide amenities for the families.



## FEMA

## ORGANIZATIONS HELPING WITH DISASTER RELIEF

FEMA is an agency of the United States Department of Homeland security that's primary purpose is to coordinate the response to a disaster that overwhelms the resources of local and state authorities. In order for FEMA to respond to a disaster, the governor must declare a state of emergency then formally request that FEMA respond to the disaster.

The American Red Cross is a humanitarian organization that provides emergency assistance, disaster relief, and disaster preparedness education in the United States. ARC responds to more than 60,000 disasters every year. These disasters can include small house fires to multi-state natural disasters. They go wherever they are needed to ensure people have clean water, safe shelter and hot meals when they need it most. 95% of their disaster relief workers are volunteers and 90% of the disasters that ARC responds to are home fires. After the emergency phase of response, The ARC helps people recover and address lingering community needs. They work together with community leaders and government and relief agencies to organize and execute recovery strategies like financial assistance for immediate and long-term situations.

The National Voluntary Organizations Active in Disaster work to assist communities affected by disasters. They are a coalition of the major national voluntary organizations in the US. Their mission is to promote cooperation, communication, coordination and collaboration during disasters. They foster a more effective delivery of services to communities affected by disaster.



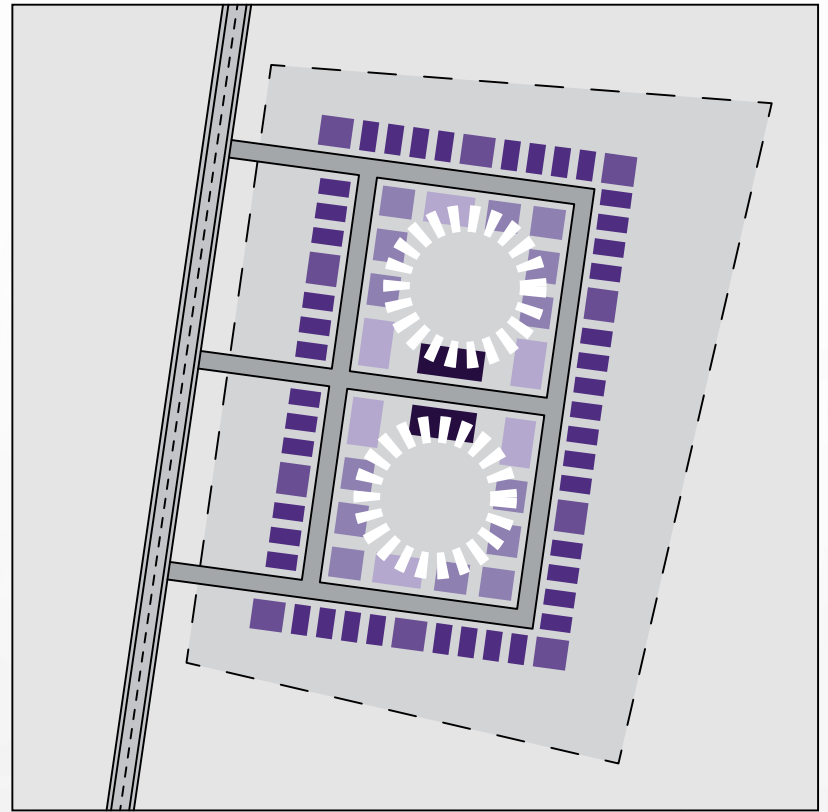
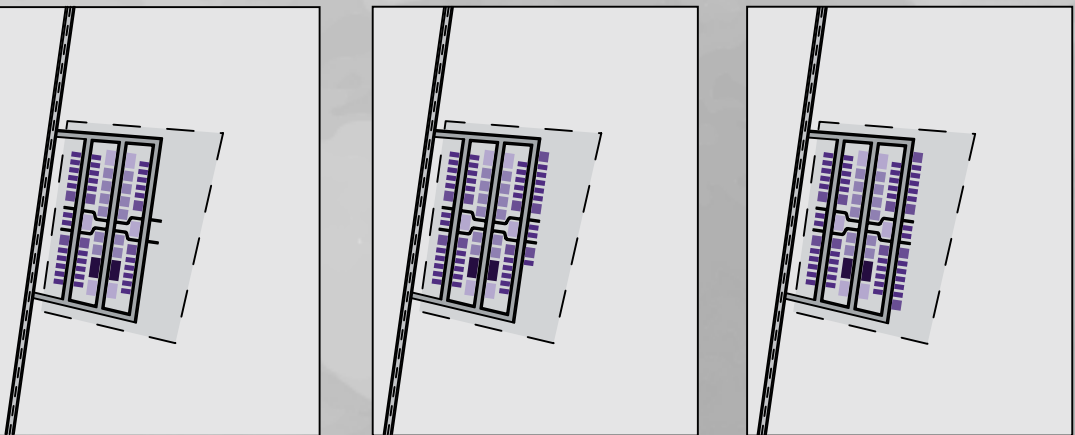
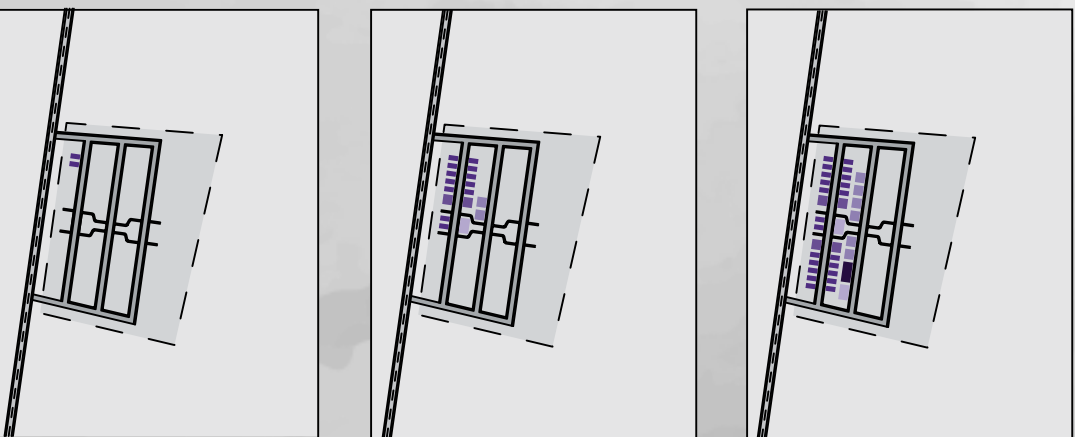
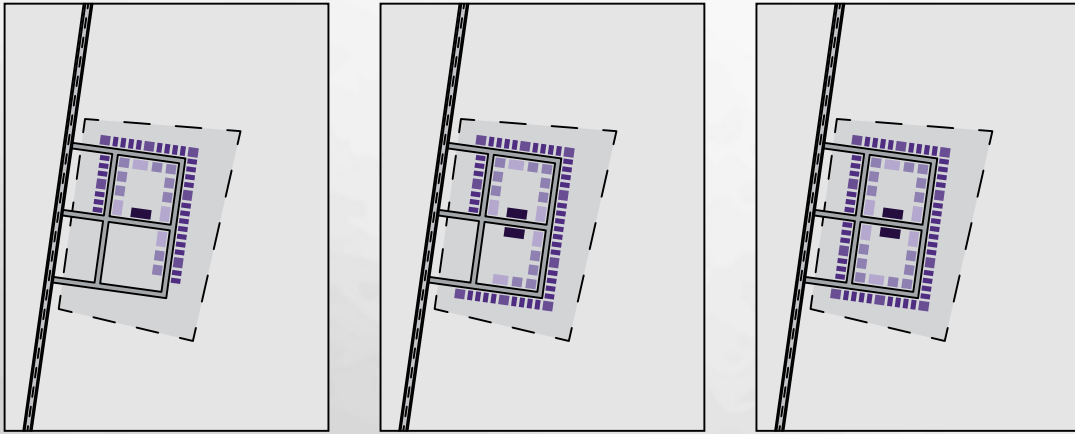
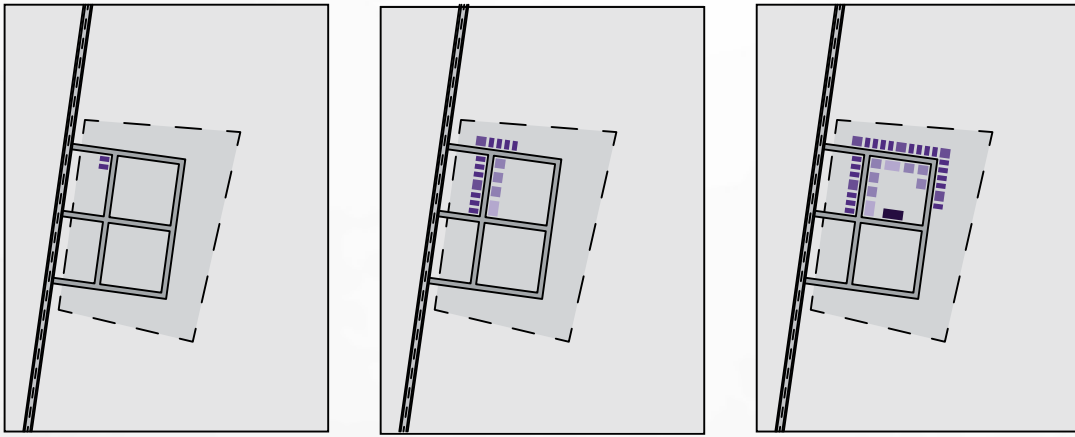
## American Red Cross



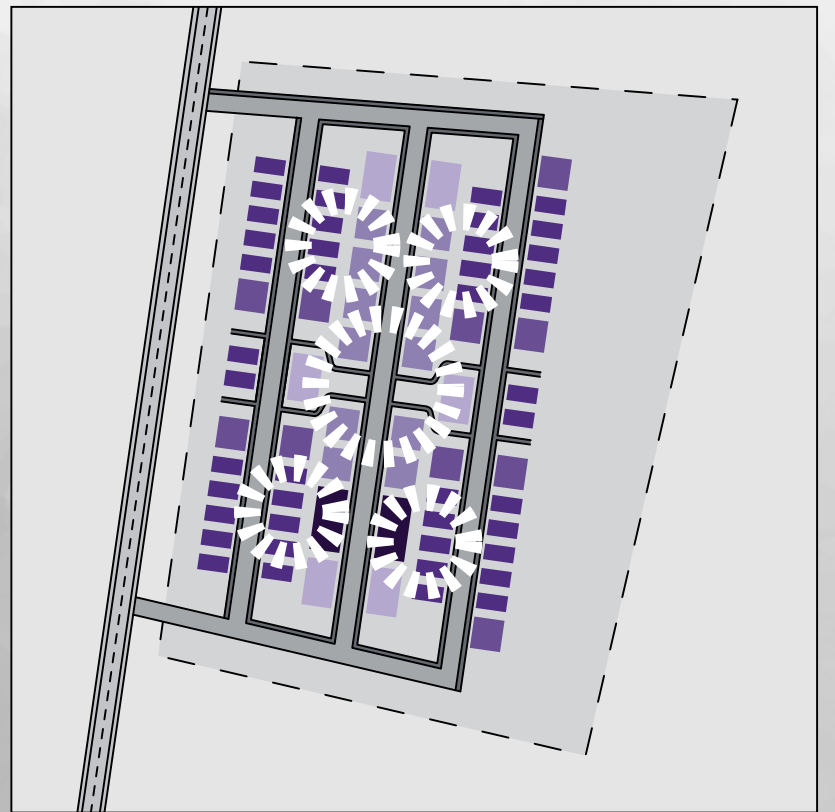
**Sacramento Region  
Voluntary Organizations  
Active in Disaster**

COOPERATION | COMMUNICATION | COORDINATION | COLLABORATION





- Single Units    ■ Storage Units    ■ Medical Units
- Multi-Units    ■ Community Units    ☀ Community Areas



- Single Units    ■ Storage Units    ■ Medical Units
- Multi-Units    ■ Community Units    ☀ Community Areas





Images Retrieved from <https://redemptionparker.org/ongoing-events-1/outdoor-worship-night>



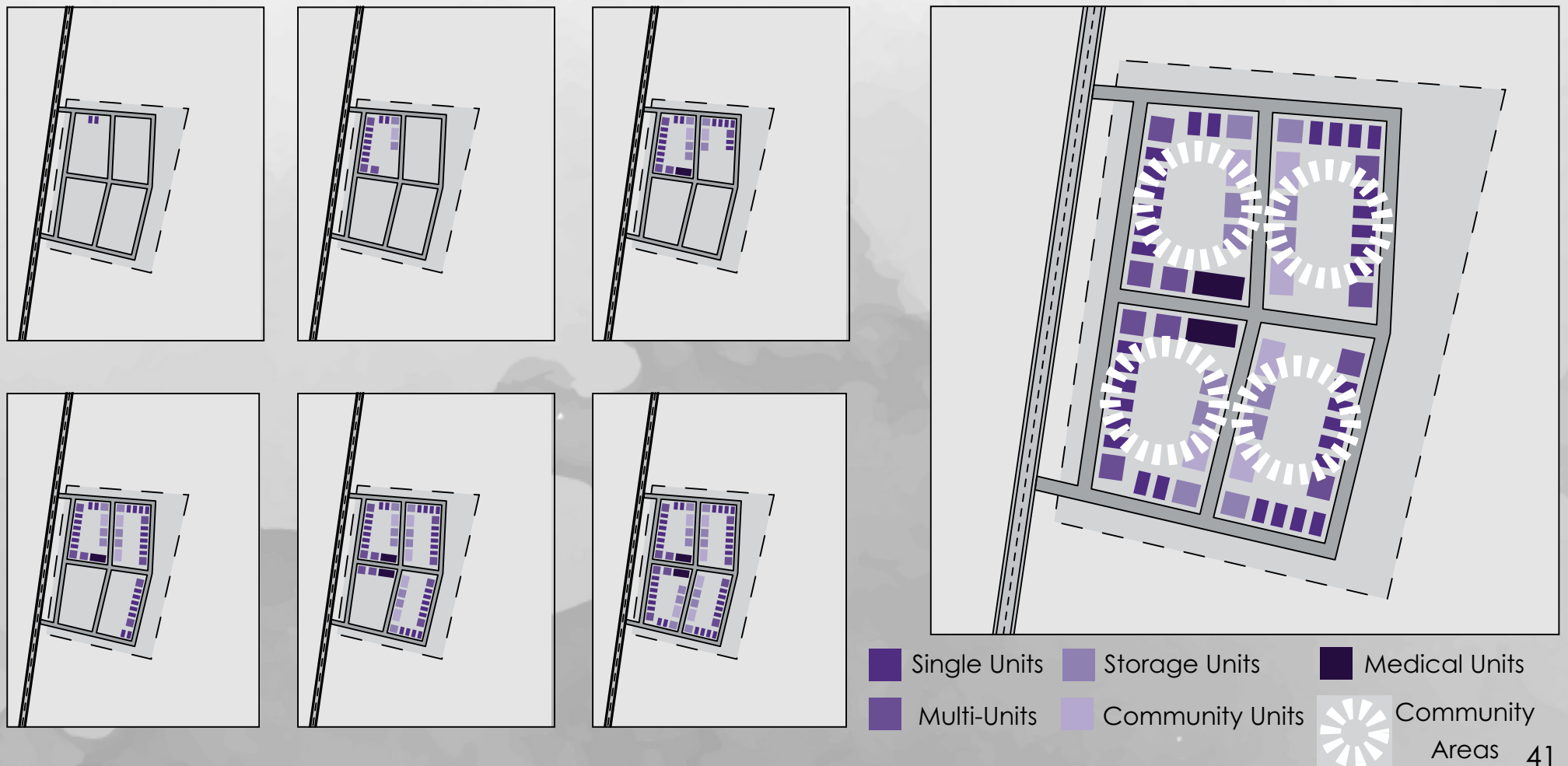
Images Retrieved from <http://www.carolinaparent.com/Plan-the-Perfect-Spring-Family-Picnic/>



Images Retrieved from <https://www.verywellhealth.com/best-sports-for-kids-with-autism-260157>

## COMMUNITY SPACES

Areas created by the arrangement of units will generate possible community areas that allow for activities like family picnics and outdoor worship. This is also an area where children can play while still being observed by adults from the community. In the aftermath of disasters, individuals can feel a sense of loneliness and anxiety. These areas promote companionship in the times where someone can feel most alone.





# ESTEEM

“Disasters will always come and go, leaving their victims either completely broken or steeled and seasoned and better able to face the next crop of challenges that may occur. “

- Nelson Mandela

## **ESTEEM**

There are two different categories of esteem in Maslow's hierarchy: esteem for oneself (dignity, achievement, mastery, independence) and the desire for reputation or respect from others (status, prestige). In the aftermath of a disaster, an individual loses more than just their personal items, they lose more intimate items like their independence and dignity.. Their sense of freedom is gone, for now they are completely dependent on others to meet their basic needs.

The shelters and the communities established aid the individuals to regain their self-esteem. They can regain control over their lives, while they begin the process of rebuilding.

After the victims have rebuilt and relocated to their new homes, there are multiple options of the use of the shelters. The shelters can be disassembled and brought back to the distribution center to be evaluated. Pieces that are able to be reused can be put back in circulation. The shelters can also be given to the county or city, to be used at their discretion. The communities may also be used as affordable housing or residences for homeless communities

The Emergency Response Shelter Prototype can provide individuals in the aftermath of a disaster with more than shelter. They may provide a sense of community, independence, safety, and hope.





# **APPENDIX & REFERENCES**

# APPENDIX

Table A.1

NUMBER OF DAYS IT TAKES TO BUILD 1 UNIT	3
NUMBER OF VOLUNTEERS IT TAKES TO BUILD 1 UNIT IN 3 DAYS	6

Table A.2

VOLUNTEERS		
FEMA	24	12 originally then 12 more upon delivery   they stay 10 days
RED CROSS	30	Red Cross sends around 30 to help around day 5 and stay for about 10 days
NVOA	30	Arrives day 5 and stays for 20 days
LOCAL	20	20 people helping out at a given day

Table A.3

DAY	# OF VOLUNTEERS ON SITE	IN CONSTRUCTION	MODULES COMPLETED THAT DAY	TOTAL BUILT AT THAT TIME
1	12	2	0	0
2	12	2	0	0
3	44	6	0	0
4	44	6	2	2
5	104	16	0	2
6	104	16	4	6
7	104	16	2	8
8	104	16	10	18
9	104	16	4	22
10	104	16	2	24
11	80	13	10	34
12	80	13	4	38
13	80	13	2	40
14	80	13	7	47
15	80	13	5	52
16	50	8	3	55
17	50	8	7	62
18	50	8	5	67
19	50	8	1	68
20	50	8	5	73
21	50	8	5	78
22	50	8	1	79
23	50	8	5	84
24	50	8	5	89
25	50	8	5	94
26	20	3	3	97



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