EMERGENCY RESPONSE ARCHITECTURE

ALA MASTER'S THESIS
NORTH DAKOTA STATE UNIVERSITY

A DESIGN THESIS BY:
ADAM REYNOLDS

EMERGENCY RESPONSE ARCHITECTURE:
UPGRADING THE NATIONAL GUARD RESPONSE INFRASTRUCTURE

A Design Thesis Submitted to the
Department of Architecture
North Dakota State University

By
Adam Reynolds

In Partial Fulfillment of the Requirements for the
Degree of
Master of Architecture

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OSAL

THESIS **ABSTRACT**

Military conflict and natural disasters are sometimes unavoidable leading to human casualties and damage to building infrastructure. Military conflicts are human nature, they are a part of our history and will continue to happen in our future. Natural disasters destroy lives and homes across the world and have been increasingly more common due to climate change. We are often out of control when these tragedies strike leading us to panic in need of emergency response. Our emergency response is one of the only things we can control during military conflict and natural disasters. When we respond we attempt to save lives and preserve the damage done. Our response to these events should be fast, safe, and effective. We must be able to innovate using the best building technologies available to support our emergency response, because our response is what saves lives.

The current architecture of our emergency responses is usually made up of tents, mobile trailers, and Conex box like shacks. These buildings get the job done and have proven to be successful. But a lot of the response infrastructure we use today was designed using building technologies from the 1950s or earlier. If we want to have the fastest, safest, and most effective response, a look into new building technologies will help.

What this thesis aims to answer is how we can innovate deployable units and incorporate new technologies for military and natural disaster response. The current response system isn't broken, but can be updated to new building technologies to ensure we have the fastest, safest, and most effective response to emergencies. By providing this we can ensure lives are saved from military conflict, natural disasters and whatever else threatens humanity.

Figure 2: Tent City in Desert

Figure 3: Airmen Setup Tent in Wind

THESIS **NARRATIVE**

As an enlisted member of the Minnesota Air National Guard I have witnessed and contributed to our emergency response in real life and in training. The response planning and infrastructure varies from situation to situation and depends on the certain mission we are set to accomplish. A mission is what we set out to achieve in the military whether that be responding to a riot to keep the peace, giving aid to a community after a natural disaster, or taking military control of a region.

Oftentimes when the mission requires us to respond as fast as possible we use tents called Small Shelter Systems. These tents are durable, light, and have a great packed to erect volume ratio. They are great for shipping and durable in the field. Although they do have their downsides, when it rains they often get water inside on the ground if not perfectly level, lack insulation, provide little protection from physical projectiles, don't come with furniture, and require setup. Setup of these tents is quite simple with a group of trained individuals. The setup of one tent should take about 45 minutes but that doesn't include the installation of the applications that make the tent usable. Trained individuals can set up the tents but they need lighting, HVAC, and power to actually use them to their full capability. Setting up these applications requires more time, collaboration, and specifically trained individuals. Setting up a "tent city" of around 4 tents with all applications, on paper should only take about four hours, but in reality will usually take a whole work day due lack of collaboration, and limited experience.

A whole work day or even 4 hours is too long if a rapid response is needed. Rethinking and redesigning our response infrastructure keeping in mind that good communication and reliable experience are not always available would provide our rapid response missions faster, safer, and more effective infrastructure.

THESIS **TYPOLOGY**

Proposed building typology:
"All Inclusive Deployable Unit"

1. All Inclusive:
All applications required for operation from lighting, HVAC, power, furniture, etc. are included in unit

2. Deployable:
Can be transported using multiple methods from sea, air, rail, and road.

3. Unit:
Small structure produced in mass numbers, able to be transported, able to be connected with other units of the same type.

Proposed design:
Conex box sized unit that expands when in use, and retracts when shipped. It will have HVAC, lighting, power, and furniture pre-installed. Have many shipping options like airlift, cargo plane, rail, and road.

Figure 4: Soldier Installs Lighting

Figure 5: Nat'l Gaurd Respond to Tornado Damage

MAJOR THESIS **ELEMENTS**

1. Modular

The unit should have a modularity aspect to it so it can expand and retract for ease of shipping while maximizing floor area while in use. The modularity should also be set up so the unit can be connected to other units and tents.

2. Transportation

The unit should be designed to include many methods of transportation. Fork-lift openings, tie downs for airlift, rail, cargo plane, flatbed, and possibly a wheel attachment.

3. Applications

The unit will be used for rapid response to emergencies so it can be expected to be used for medical, kitchen, housing, and command. For each specific use of the unit, it should have specific furniture that comes with. Also each unit should have the HVAC, and lighting pre-installed.

4. Durability

The unit should be designed for extreme durability. If it will be responsible for responding to military conflict and natural disasters it should be able to with-stand projectiles, wind, rain, snow, and more. It should be insulated enough to withstand summer highs and winter low temperatures.

THESIS **USER**

1. Military

The military would use this building type for an emergency response to a natural disaster, or field deployment. When designing military equipment it is important to use the military's specific building codes and regulations. Items like deployable units are often painted to blend in with the environment, usually a tan or green color.

Areas of Utilization:

- General Medical
- Medical Operations
- Command Posts
- Housing
- Communications Equipment
- Kitchens
- Bathrooms & Showers

2. Commercial

The commercial market for this building type would be limited to similar operations that are done by the military, like Red Cross and surveillance companies to name a few. If a commercial company uses the unit for their operations it would help to paint it the company's correlated color scheme.

Areas of Utilization:

- General Medical
- Medical Operations
- Housing
- Communications Equipment
- Kitchens
- Bathrooms & Showers

Figure 6: Nat'l Guard Respond to COVID

Figure 7: Nat'l Gaurd Flyover Flood

THESIS **CONTEXT**

The design project for this thesis is focused on deployable units that respond to emergencies. The overall design of the unit isn't for a specific site but designed to be used for a variety of sites and situations. To show the full capabilities of how the units can be deployed three separate sites with three separate response situations are chosen.

1. Military Beddown Exercise in Arizona

Mission: Leadership has run down the chain of command that the military needs control of a certain region in a hostile country. The use of rapidly deployable units will give the mission a fast, safe, and effective beddown. They will provide protection for members of the military as well as a head-start on building infrastructure needed for the mission.

2. Nat'l Guard Hurricane Response in New Orleans, LA

Mission: New Orleans was smacked by another hurricane destroying houses and buildings needed for the civilians living there. The National Guard was activated to provide aid to the community. The community will need medical assistance, and living necessities like water, food, and hygiene products. The use of deployable units will be used to provide the community with aid.

3. Nat'l Guard Respond to Infectious Disease in Fargo, ND

Mission: Fargo, North Dakota is the center of an outbreak of an infectious deadly disease. The Red Cross is needed for rapid response to the outbreak. They need deployable infrastructure for the medical response needed to quarantine this disease off and limit the spread.

THESIS **EMPHASIS**

The emphasis of the thesis is not only what my design can provide for the military and emergency response teams but what it can do for the people affected by tragedy.

1. Emergency Response Users

This thesis is about providing emergency response teams updated infrastructure so they are given the best possible chance to have successful missions. Response teams need to be able to set up their services as soon as possible to start providing aid as soon as possible. By giving the response teams better infrastructure they will have the chance to save more lives and prevent more damage.

2. Tragedy Stuck Individuals

This thesis is about providing support to people struck by uncontrollable tragedies. Whether it is a military conflict, natural disaster, or anything else, supporting the people affected with the best response infrastructure will give them the best opportunity to recover. Updating rapidly deployable units is meant to help the individuals and their communities. The individuals will be able to use the services they provide for them like medical care, mental health consultation, public serving kitchens, housing, and more. The communities will benefit from the individuals receiving the aid needed, and the community will have temporary infrastructure for the time in need of it.

Figure 8: Nat'l Guard Respond to Earthquake

Figure 9: Nat'l Guard Respond to Flood

THESIS **GOALS OF PROJECT**

1. Research

Research and find what current building methods are used for emergency response. Research should include modularity, shipping size and weight, year designed, cost, transportation types, materials, and environmental durability.

2. Design

Use research findings to design a rapidly deployable unit. The design should include findings from research to provide an updated deployable unit competitive with others on the market. When designing the unit it is important to think with an innovative mind but still keep things simple.

3. Present

Provide final design in presentation. The last goal is to clearly present the findings from research and the final design. The thesis book, slide show, design boards, video, and interactive models can be used for presentation visuals. Developing as many visuals needed will help the audience visualize this thesis project.

PLAN FOR THE PROCEEDING

1. Research Direction

Research done for this thesis will focus on case studies of similar building typologies, site context, methods of renewable energies for sustainability, and technology. When an expert's opinion is needed or questions arise that cannot be answered by the internet, interviews will be used by either email, phone call, or Zoom. The two types of research gathered are considered either quantitative or qualitative research.

2. Design Methodology

The design methodology during the design process will mainly focus on functionality of the building. When designing for the military, especially for deployable unit types, function comes first before aesthetics. For this project the form of the building will follow its desired function. It will be a design challenge to try and make the deployable unit as aesthetically pleasing as possible. The correct military building codes and regulations shall be used when designing.

3. Documentation of Design

Documentation for this thesis will be done for research, design process, and final presentation. The research will be completed first to develop the design program. The research will be documented through the research document due at the semester break. Once the design program is developed the design process will start. The design process will be documented for use in the final presentation. Once the design is finished it will be included in the final presentation and will be documented as a physical book and digitally through the NDSU Library Database.

Figure 10: Nat'l Guard Protect Capital

THESIS TIMELINE

THESIS TITLE	Emergency Response Architecture	**UNIVERSITY**	North Dakota State University
STUDENT	Adam Reynolds	**DATE UPDATED**	3/12/18

PHASE		DATE DUE
	THESIS PHASE:	
1	PRELIMINARY PROPOSAL	- Sept. 14 2021
2	PROPOSAL FINAL	- Oct. 14 2021
3	RESEARCH FINAL	- Dec. 16 2021
4	PROGRAM	- Feb. 4 2022
5	DESIGN	- Mar. 31 2022
6	PRODUCTION	- May. 6 2022

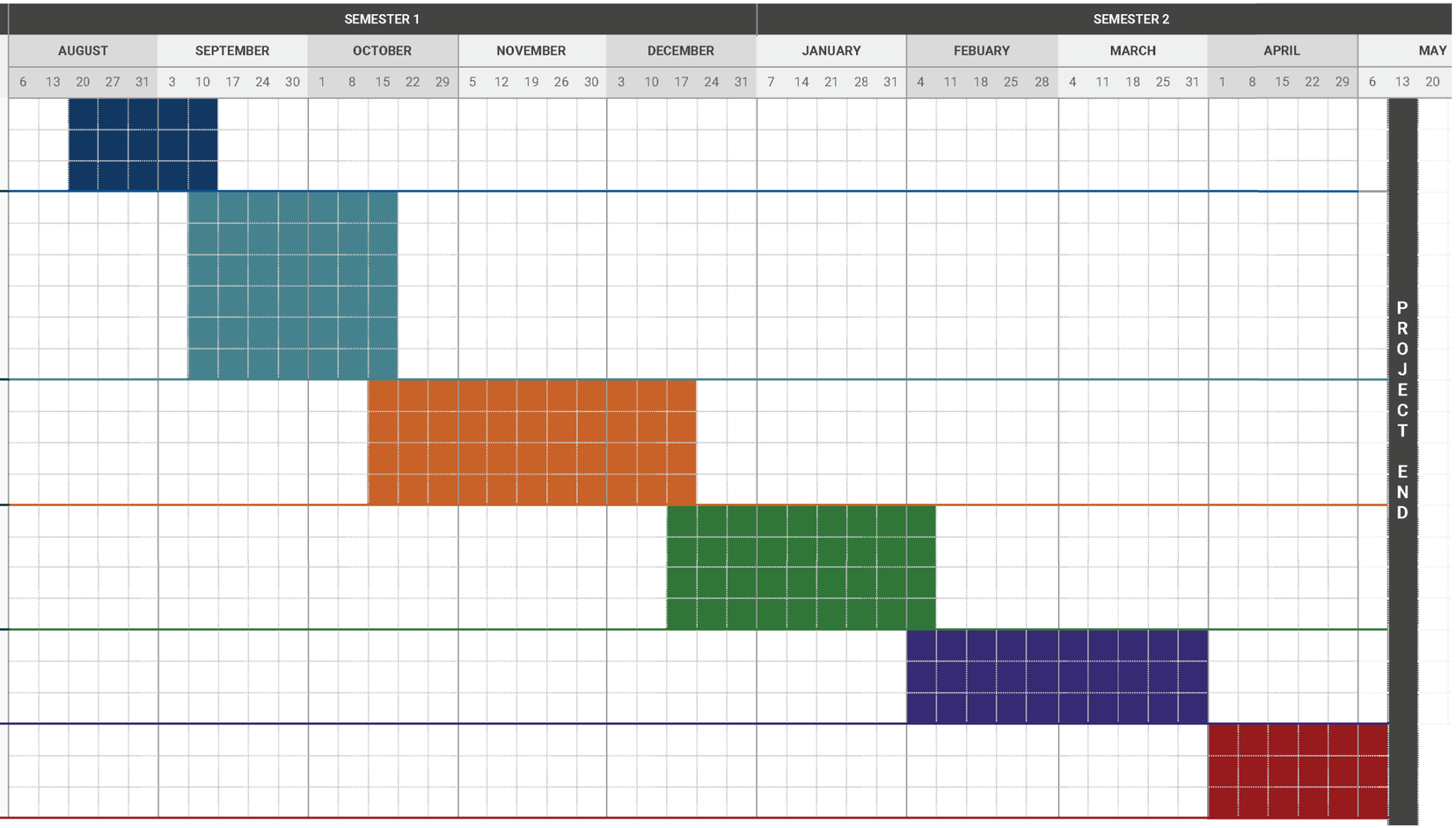

Figure 11: Thesis Schedule

PRESE

Figure 12: Tent Setup

ARCH

THEORETICAL PREMISE RESULTS

Summary From Thesis Proposal

With natural disaster frequency and intensity increasing, the disasters inflict more damage on the built environment and human populations. When these disasters hit our communities we often don't have much to deter them meaning all we can control is our response to the disaster. Our response teams should have reliable response infrastructure to best do there job to save lives. By researching how we can improve our response infrastructure we can have faster, safer, and overall better responses to disasters. The research ahead will look into how can response infrastructure weigh less, ship smaller, cost less, be more flexible, more durable and increase ability to deploy.

Next: Typological Research Categories & Case Study

Figure 13: Nat'l Guard Help Flood Victims

Figure 14: Nat'l Guard Setup Tent

TYPOLOGICAL **RESEARCH**

Case Study Research Topics

1. Modularity
Search for creative ways to reduce and expand the size of the unit.

2. Shipping Size
Search for what size and weight other deployable units ship at.

3. Year Designed
Note and compare the year of case study project was designed

4. Cost
Note and compare the cost of the case study project

5. Transportation Types
Not and compare the different methods of shipping the case study.

6. Materials
Search for types of materials used for insulation, structure, etc.

7. Environmental Durability
Search for units with environmental durability in wind, snow, rain, etc.

Case Study Projects
1. BLU-MED Medical Response
2. Boxabl
3. HELAMS
4. Energy & Water Sources
5. Deployment Dorms

CASE STUDY:
BLU-MED MEDICAL SHELTERS

Typology: Rapid Response Medical Tents
Manufacturer: BLU-MED Response Systems
Erect Square Feet: 520 sq.ft. (single tent)
Transportation Size: 7'x14' trailer
Year Designed: 1975
Cost: $xxx

Background:

BLU-MED Response Systems was formed in 2004 as a division of Alaska Structures Inc. which is the manufacturer for the tents used by the U.S. military. These tents are used by the U.S. Air Force Expeditionary Medical Support (EMEDS) mobile medical system as well as humanitarian disaster response. These tents are the leader-of-the-industry portable fabric shelters. They allow emergency response teams to rapidly respond to disasters providing shelters mainly used for medical care, but can also be used for housing, kitchens, and more. The tents usually take about 45 minutes to set up with an experienced team of four.

Configurations:

- Emergency Rooms
- Operating Rooms
- Trauma Centers
- Outpatient Clinics
- Drive-Through Testing
- Negative Pressure Rooms
- Command Centers
- Connects to Other Tents

Erection of Tent:

- Dimensions: 16' x 32.5'
- Square Feet: 520 sq.ft.
- Height: 10'
- 30 Minute setup with 4 experienced people.

Structure / Materials:

- Aluminum Arches
- Mold and rot resistant, fire resistant vinyl fabric.
- Solar Fly: reduces ECU power consumption by 17%
- EnerLayer: reduces ECU power consumption by 33%

Figure 15: BLU-MED Tent

Figure 16: BLU-MED Tent Floor Plans

Figure 17: BLU-MED Tent

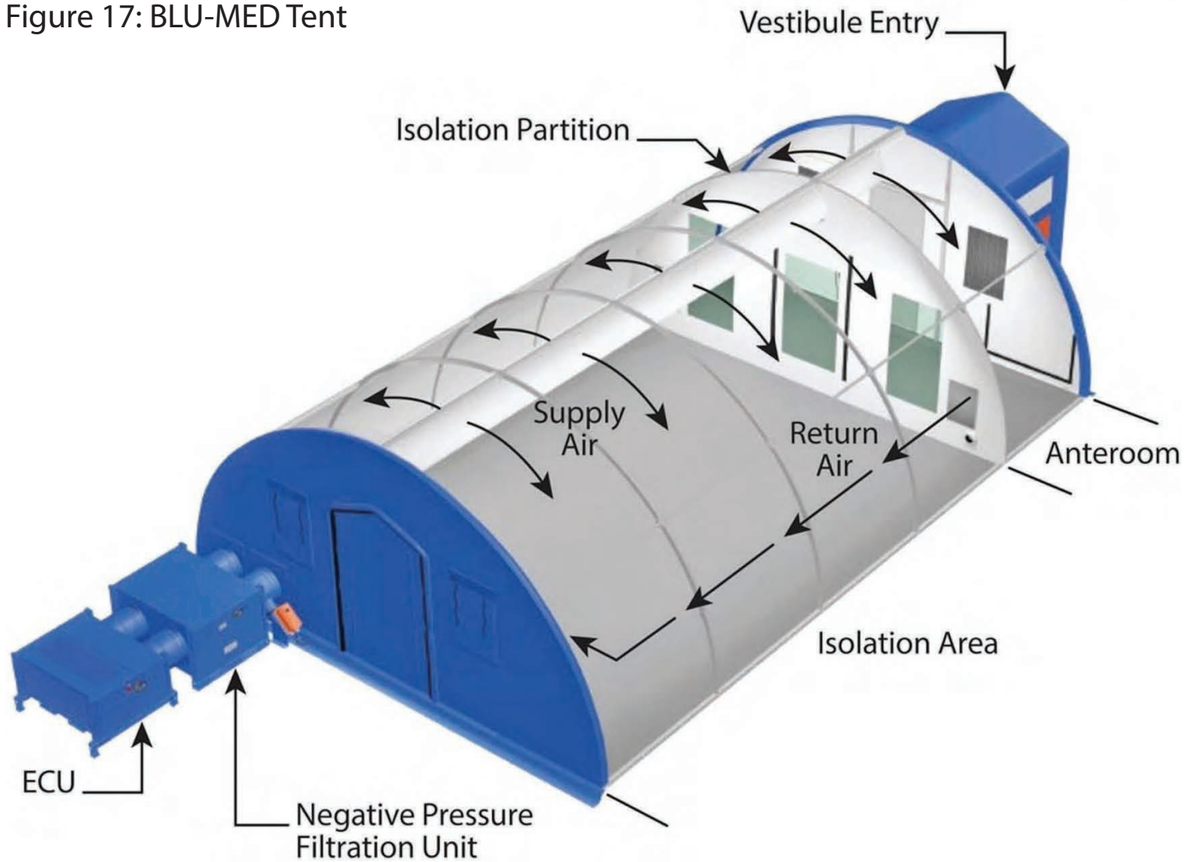

Figure 18: BLU-MED Tent Isometric

Figure 19: BLU-MED Trailer

Figure 20: BLU-MED Tent Storage

Figure 21: BLU-MED Hand Carry Bags

Figure 22: BLU-MED Generator

Figure 23: BLU-MED Circuit Box

Figure 24: BLU-MED Medical Op.

CASE STUDY:
BLU-MED MEDICAL SHELTERS

Transportation Types:

1. Shipment Container (tent only)
    - 102" Long x 40" wide x 49" tall.
    - 2,500 Lbs (HVAC, & medical equip not included)
    - (4) Shipping containers fit on 463L pallet
    - 50% Less cubic volume than one piece units
2. Trailer
    - Includes HVAC, generator, medical equipment
    - Trailer is 14' long x 7' wide
    - 45 Gallon tank for 2-3 days of operation
3. Manual Carry
    - Tent components put in carry bags
    - Transport bags by semi truck, or multiple small vehicles

Environmental Durability

- 80 Mph winds
- 100 Mph gusts
- 15 Lbs. Per sq.ft. Snow load
- 4" Of rain/hour with 40 mph winds
- 100 Setup cycles

HVAC Systems (5-ton ECU)

- Exceeds 12 air changes per hour (CDC req.)
- Maintains 40 F in -25 F
- Maintains 80 F in 125 F

Summary:

The BLU-MED tents are the industry leader in rapidly deployable emergency response structures. The tents can be configured for any medical operations, the structure and materials they use make the tent environmentally durable, and the shipping to erection size is a large pack for the punch.

CASE STUDY: **BOXABL**

Typology: Modular House
Manufacturer: Boxabl
Erect Square Feet: 750 sq.ft. (large), 374 sq.ft. (small)
Transportation Size: 42'-0" x 8'-6"
Year Designed: 2017
Cost: $90,000 (large), $50,000 (small)

Background:

Boxabl was formed in 2017 as a company that mass produces modular housing. These modular houses come shipped as a condensed form then fold out to become the erect modular house. They can be shipped from the factory to the home owner and be set up on site within an hour. Boxabl has also created a plan to provide their product as shelters for emergency responses to natural disasters. Boxabl buildings conform to and exceed most building codes. They will also come with state modular approval, reducing local inspections and the plans are pre approved at the state level.

Configurations:

Boxabl has developed two modular houses. They are the Casita Small and the Casita Large. The small ships as 8' x 20' and fold out to 374 sq.ft. While the large ships as 8' x 42' and fold out to 750 sq.ft. These units can be combined with other units to expand the floor area as well as stacked on top of each other up to seven stories tall.

Construction / Materials

- Structurally laminated panels
- Steel, concrete, EPS foam
- Mold, rot, fire resistant
- Last longer than wood framing
- Comes with flat roof, but pitched roof can be provided
- Plumbing, electric, and HVAC come pre-installed

Figure 25: Boxabl Unfolding

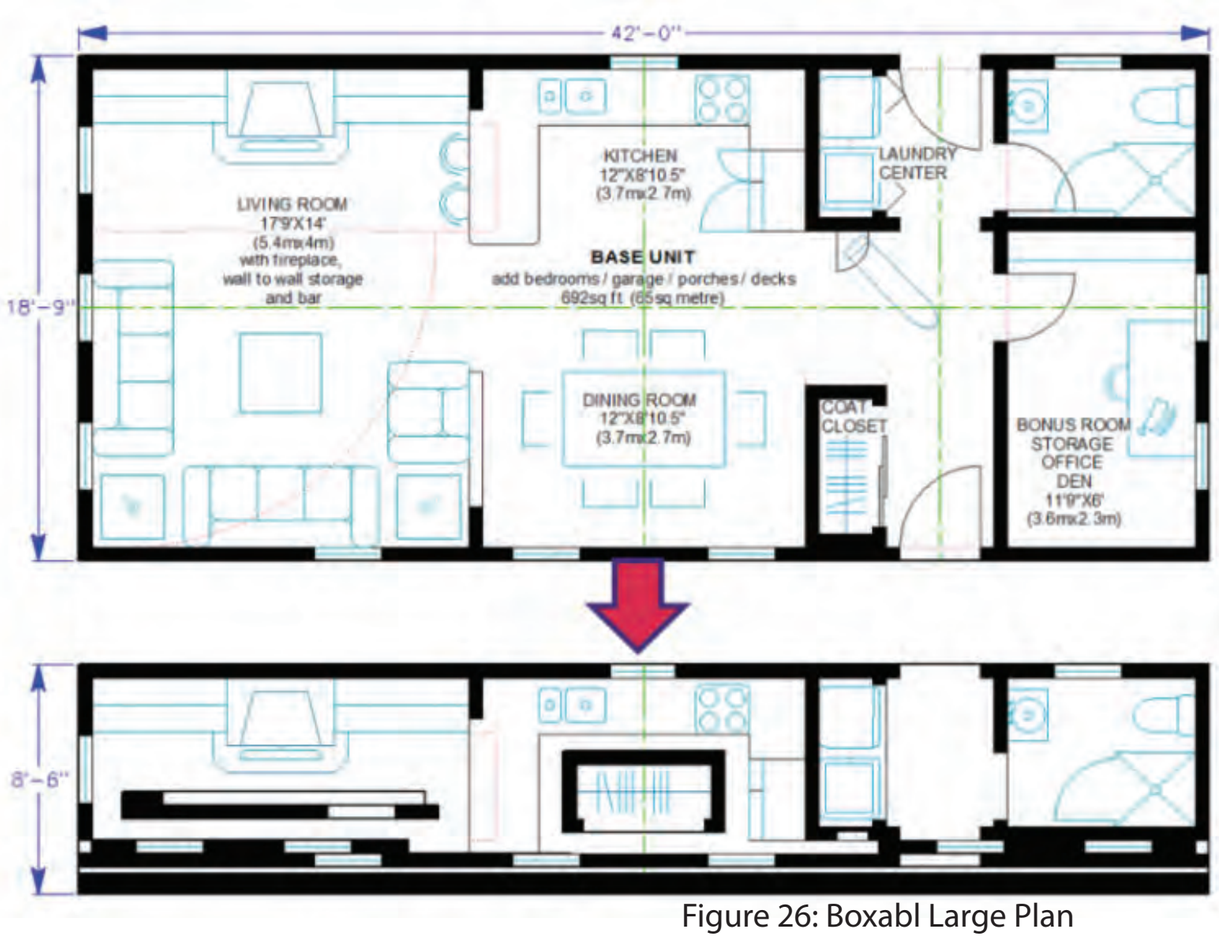

Figure 26: Boxabl Large Plan

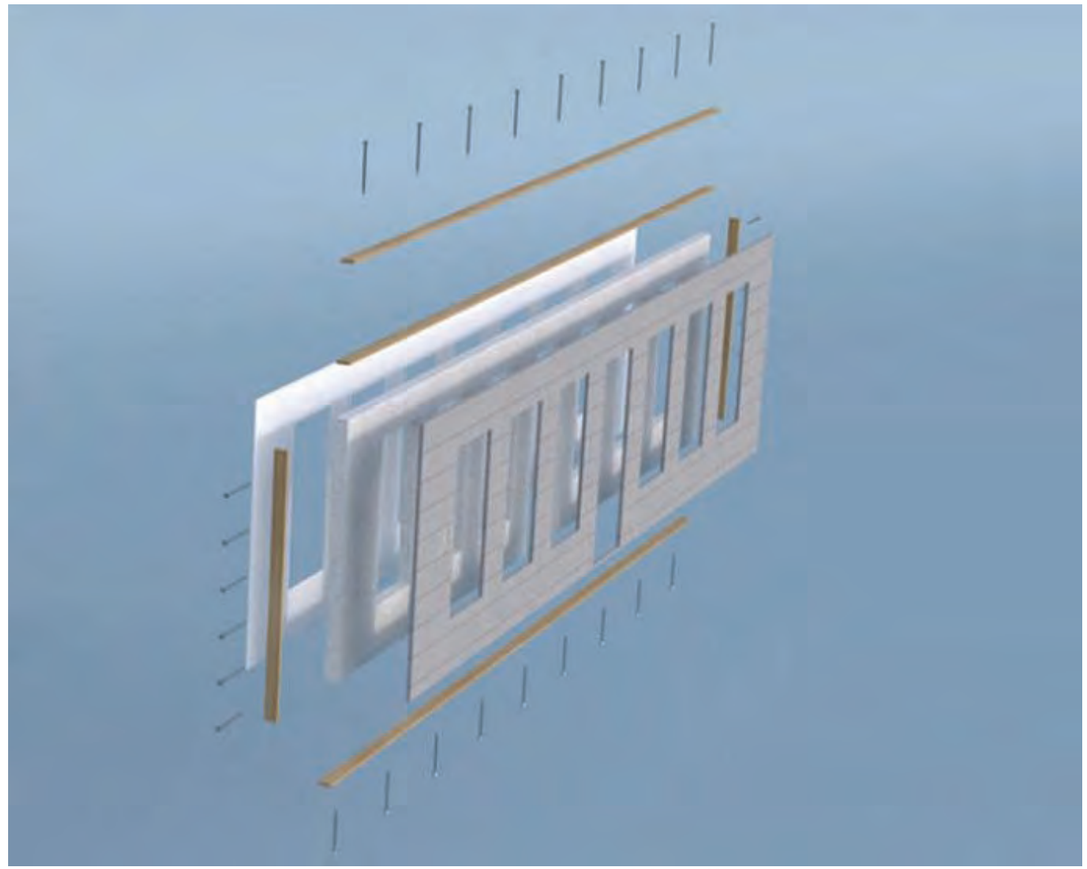

Figure 27: Boxabl Wall Construction

Figure 28: Boxabl Unit Isometrics

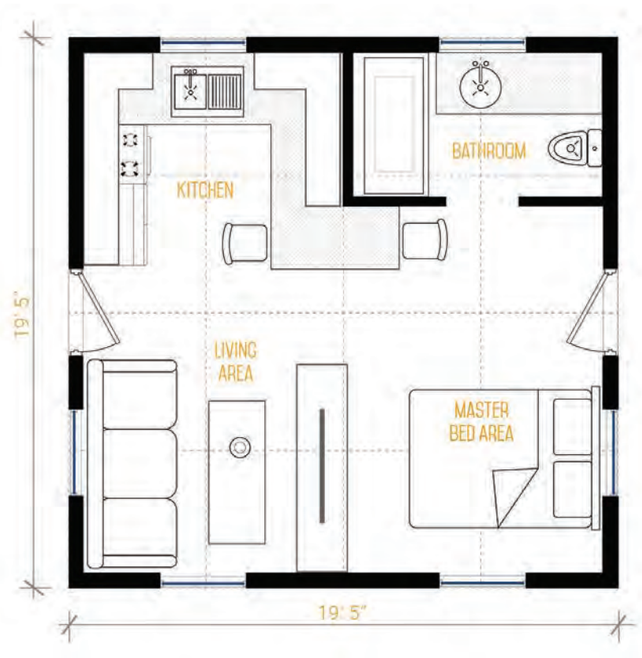

Figure 29: Boxabl Small Plan

Figure 30: Boxabl Stacked

Figure 31: Boxabl Interior

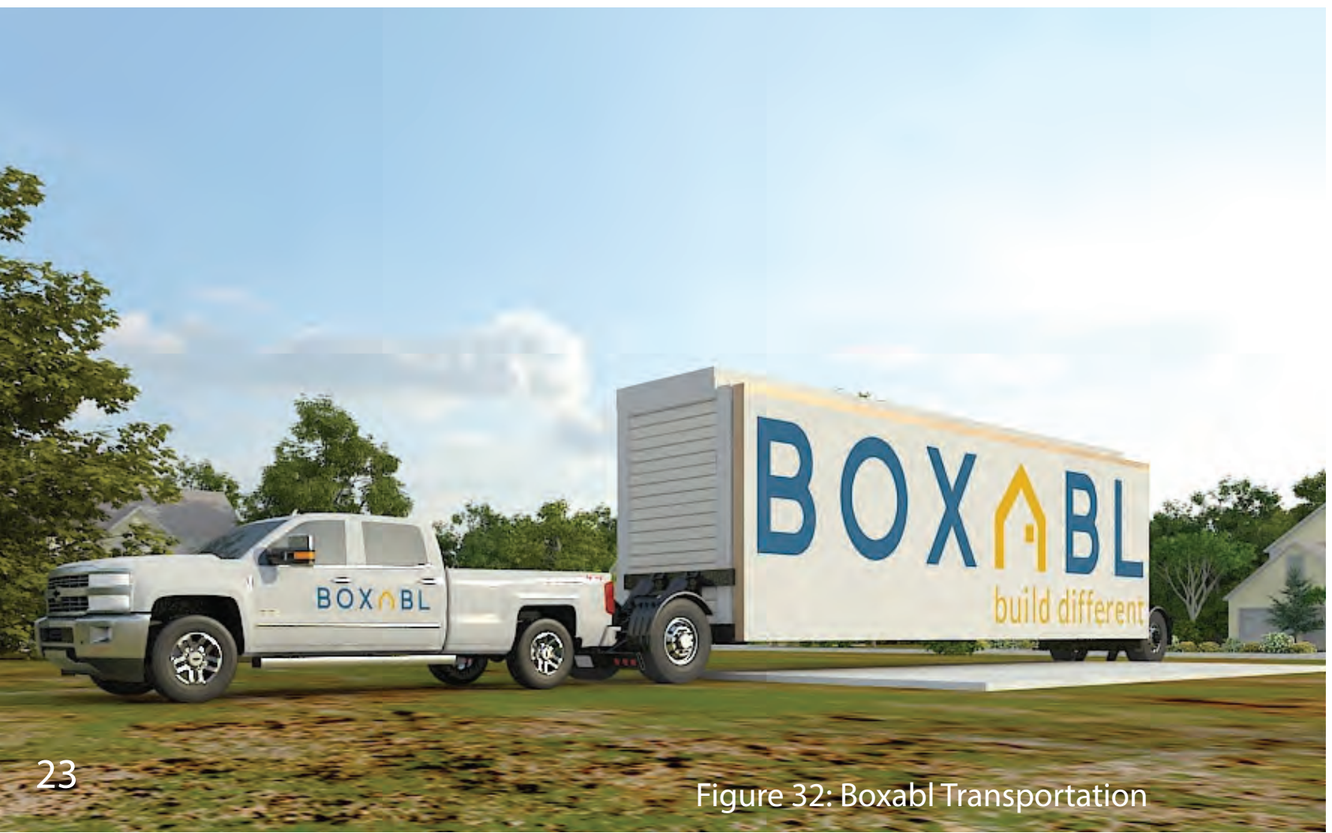

Figure 32: Boxabl Transportation

Figure 33: Boxabl Doors

CASE STUDY: BOXABL

Transportation:

- Ships anywhere in the world
- Units are designed to fold down to 8' - 6" wide (highway legal)
- Casita small can be towed by car
- Casita large can be towed by pickup truck
- Weight varies from 8,000 lbs to 12,000 Lbs

Environmental Durability

- Rated for hurricane speed winds
- Snow load rated for 90% of U.S. can be upgraded to 100%
- Flooding will cause no damage to structure
- High R-value
- Virtually no thermal bridging due to tight envelope

Summary:

The Boxabl modular houses are planning on disrupting the traditional construction industry by using the assembly line to lower production costs. The 10,000 lbs houses ship from the factory condensed then folded out to enlarge. They can be configured to connect with each other side by side and stacked on top of each other. The structure and materials of the house is constructed to make it extremely environmentally durable. The cost per square footage is around $130.00.

Figure 34: Boxabl Interior

CASE STUDY:
HARDSIDE EXPANDABLE LIGHT AIR MOBILE SHELTER (HELAMS)

Typology: Military Mobile Shelter
Manufacturer: AAR Corp
Erect Square Feet: 308 sq.ft. (large)
Transportation Size: 14'-10" x 8'-0"
Year Designed: 2003
Cost: $xxx

Background:

HELAMS was integrated into the U.S. military in 2003 as a hard-side expandable mobile shelter made by AAR Corp. The HELAMS come shipped as a stowed form then two wings slide out to become the full deployed size. They can be set up in 30 minutes with an experienced four person team. The HELAMS provides an environmentally controlled, weather resistant, hard-side shelter, great for classified briefings and communications security.

Configurations:

- Exterior Stowed(closed) Dimensions: 8'-0"W x 14'-10"L x 8'-0"H
- Interior Deployed(open) Dimensions: 21'-4"W x 14'-6"L x 7'-9"H

Construction / Materials

- Structurally laminated panels
- Rubber membrane threshold system
- Leveling jacks
- Eight windows with blackout shades
- Electric, and HVAC come pre-installed, no plumbing

Figure 35: HELAMS Deployed

Figure 36: HELAMS Isometric Stowed

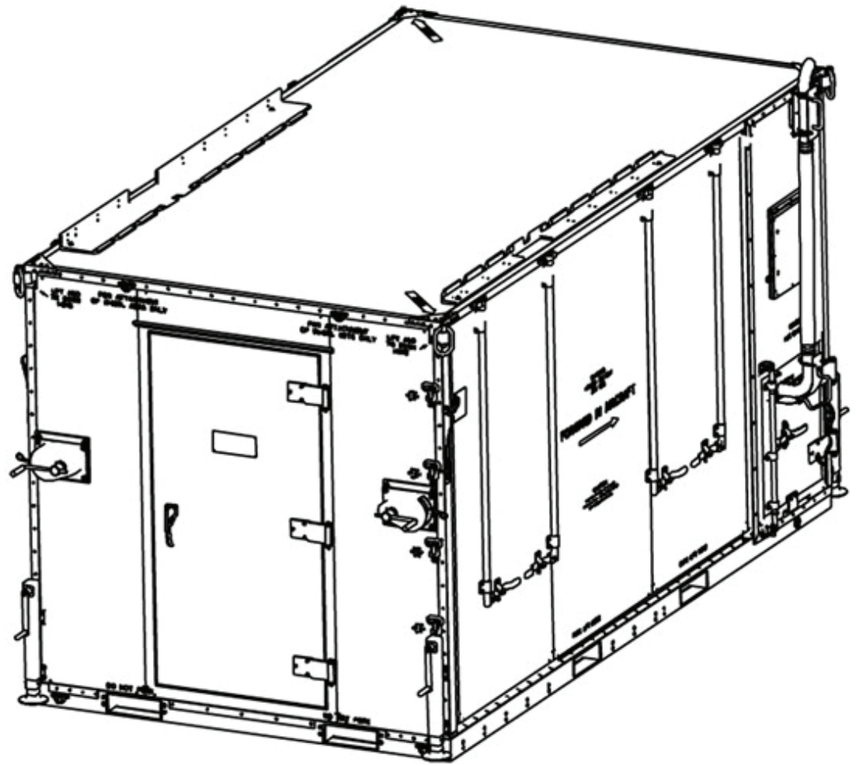

Figure 37: HELAMS Interior

Figure 38: HELAMS Interior

Figure 39: HELAMS Isometric Deployed

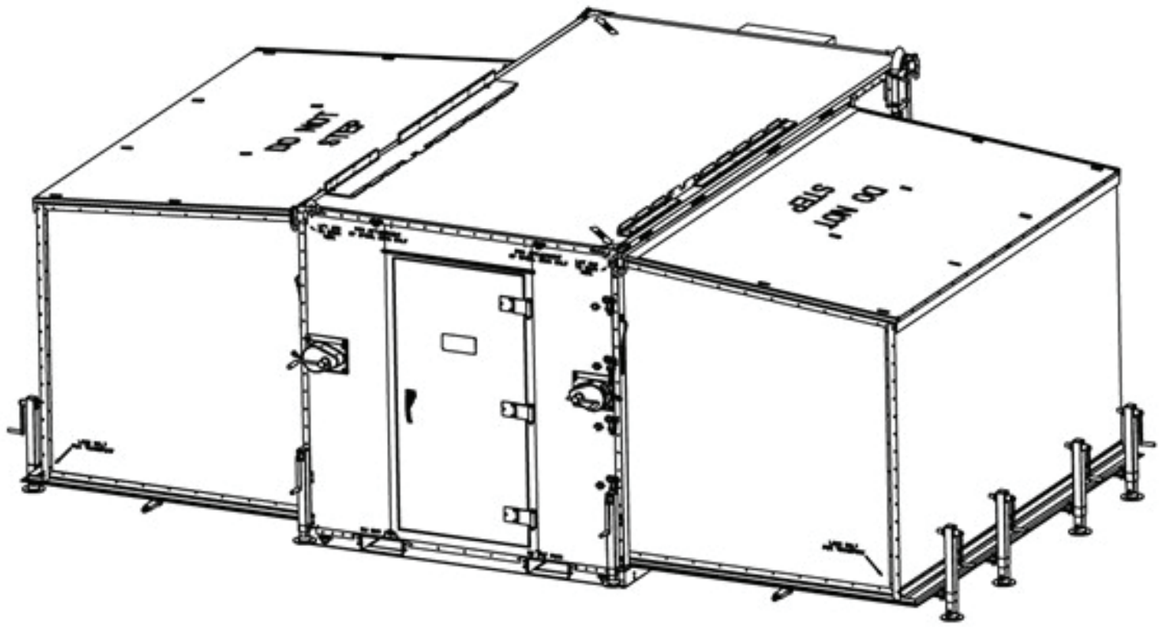

Figure 40: HELAMS Interior

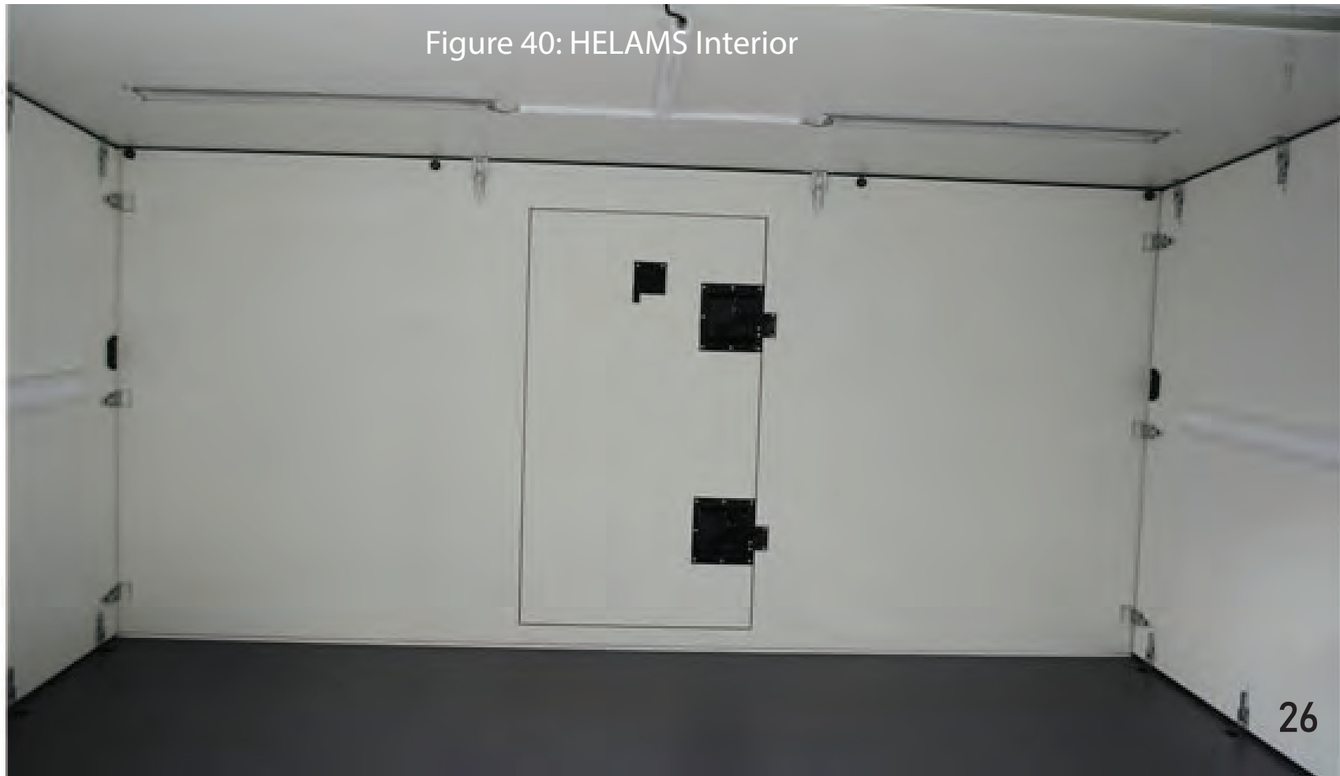

Figure 41: HELAMS Setup

Figure 42: HELAMS Transportation

Figure 43: HELAMS Worked On

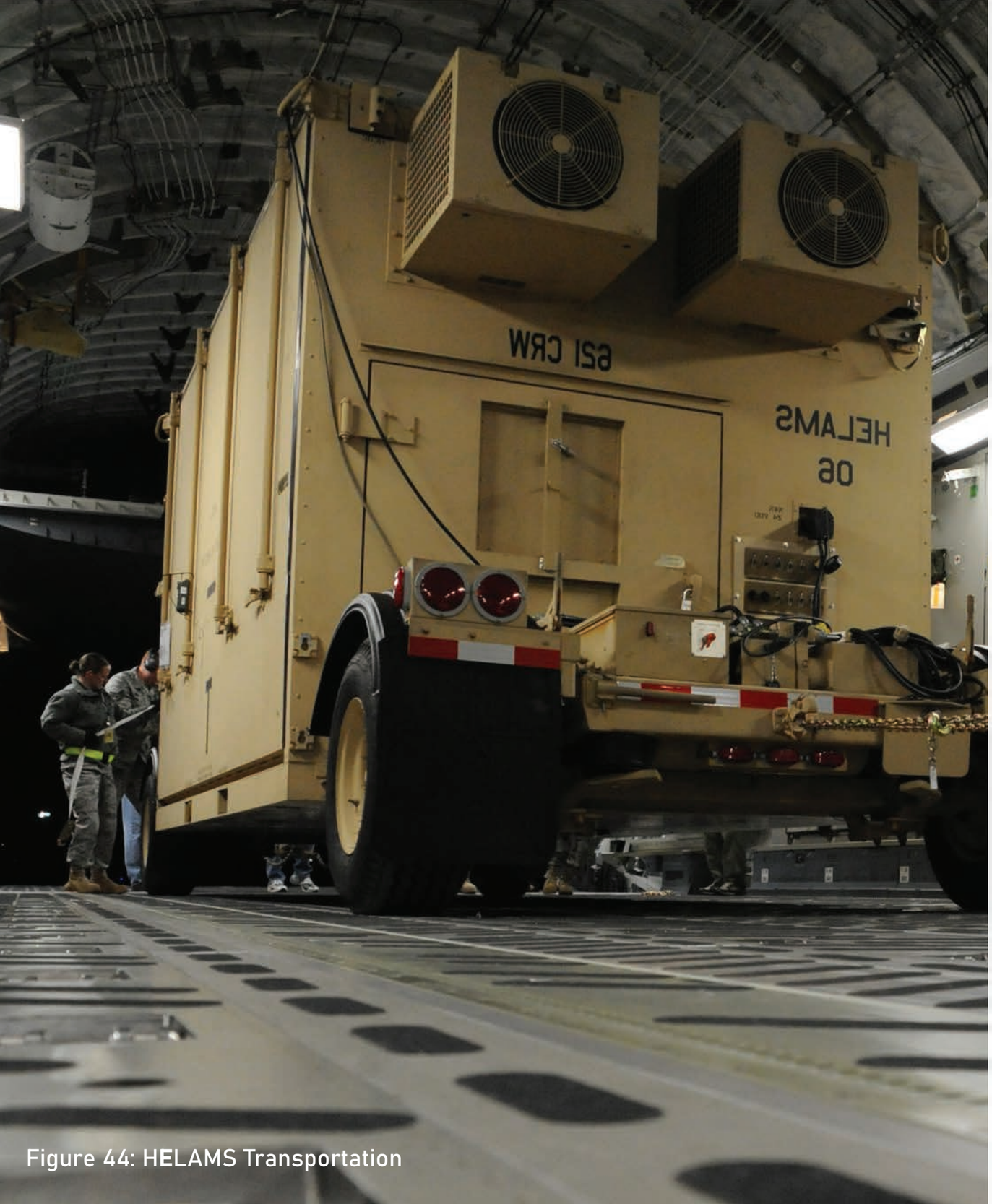

Figure 44: HELAMS Transportation

CASE STUDY: HARDSIDE EXPANDABLE LIGHT AIR MOBILE SHELTER (HELAMS)

Transportation:

- Two-Way Forklift-able
- Tie Down Rings
- Trailer
- Air Lift Certified
- Rail Transport
- Cargo Plane
- Mobility wheel set for transport by towing
- Two pallet position when stowed
- Weight of unit: 6,585 lbs
- Payload Capacity: 8,415 lbs
- Stowed position holds equipment for operation of unit

Applications

- Administration Security
- Security
- Kitchens
- Medical Clinics
- Laboratories
- Communications Security

Summary:

The 6,585 lbs HELAMS is a hard sided shelter used for environmentally controlled applications which may need more security than what tents provide. HELAMS comes in a stowed position which is filled with equipment needed for its specific mission, then expands by sliding out its wings. HELAMS is also one of the most transportable units, specifically designed to be transported by rail, air, trailer, and forklifts. The cost per square footage is around $xxx.

CASE STUDY:
ENERGY AND WATER SOURCES

Typology: Access to Energy and Water

Background:

During the U.S. military conflict with Iraq the leading cause of casualties was transportation of fuel and water for our field operations. Implementing sustainable and more efficient types of energy would cut down on the transportation needed to sustain field operations, reducing casualties in the field.

Needs:

- Potable water for hydration
- Potable water for hygiene
- Potable water for medical, kitchen, other operations
- Energy to sustain lighting, other applications
- Energy to sustain HVAC/R
- Energy to sustain communications
- Fuel for Vehicles

Energy Types:

1. Transported Fuel
2. Field Solar
3. Field Wind
4. Field Hydro
5. Field Fission and Fusion

Water Types:

1. Transported Water
2. Field Well Water
3. Field Rain Water
4. Wastewater Treatment

Figure 45: Solar Field

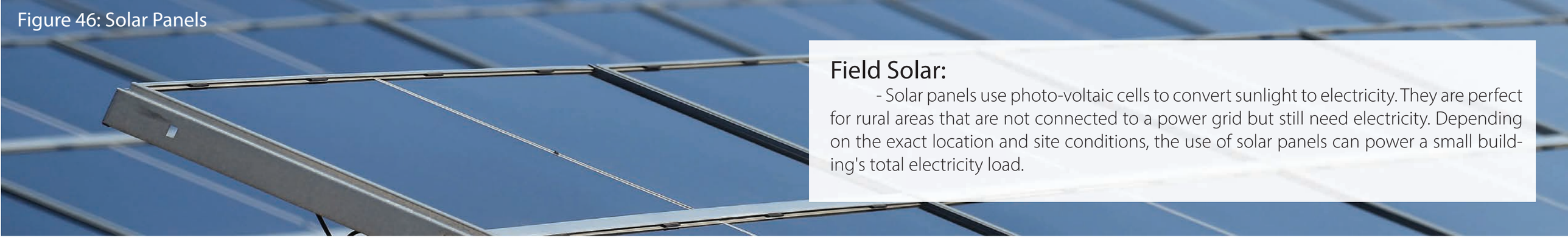

Figure 46: Solar Panels

Field Solar:

- Solar panels use photo-voltaic cells to convert sunlight to electricity. They are perfect for rural areas that are not connected to a power grid but still need electricity. Depending on the exact location and site conditions, the use of solar panels can power a small building's total electricity load.

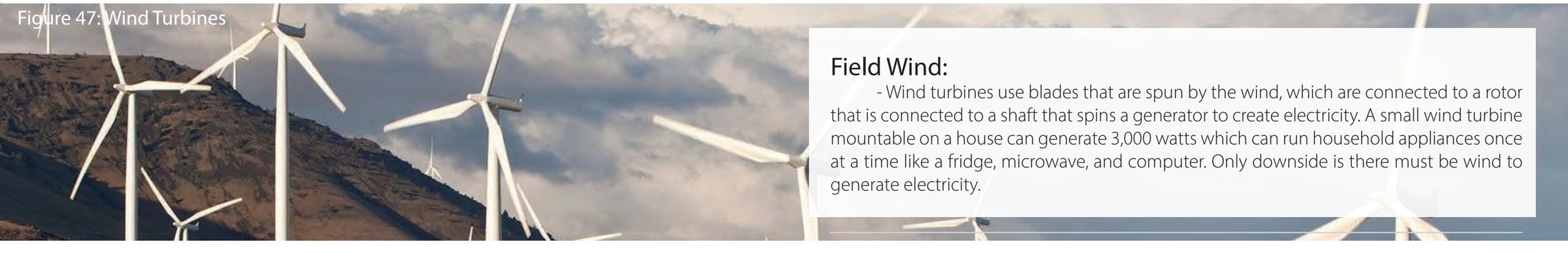

Figure 47: Wind Turbines

Field Wind:

- Wind turbines use blades that are spun by the wind, which are connected to a rotor that is connected to a shaft that spins a generator to create electricity. A small wind turbine mountable on a house can generate 3,000 watts which can run household appliances once at a time like a fridge, microwave, and computer. Only downside is there must be wind to generate electricity.

Figure 48: Micro-Hydro Generator

Field Hydro:

- Hydro electricity is produced by using flowing water to spin a turbine which turns a shaft that's connected to an electric generator. A micro hydro electric generator can vary from 3,000 to 10,000 watts depending on the drop in the stream and amount of water flowing through the stream. Downside is hydro power can only be used in close proximity to a running stream or river.

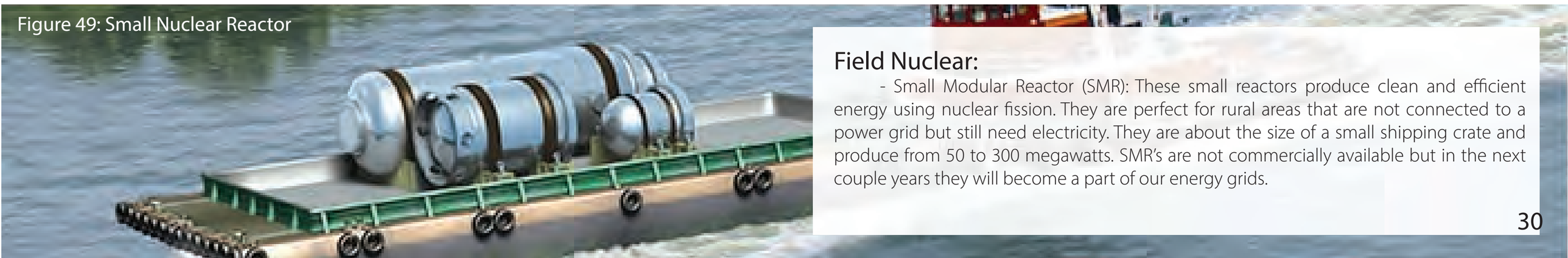

Figure 49: Small Nuclear Reactor

Field Nuclear:

- Small Modular Reactor (SMR): These small reactors produce clean and efficient energy using nuclear fission. They are perfect for rural areas that are not connected to a power grid but still need electricity. They are about the size of a small shipping crate and produce from 50 to 300 megawatts. SMR's are not commercially available but in the next couple years they will become a part of our energy grids.

Figure 50: Water Trucks Convoy

Transported Water:

- The usual way field operations receive water is by water trucks. This is a reliable way to get massive amounts of water for operations. The downside is transportation can be dangerous. During Iraq the vast majority of casualties came from convoys transporting water, fuel, and food. If water cannot be taken from the operations site then water by transport is the next option.

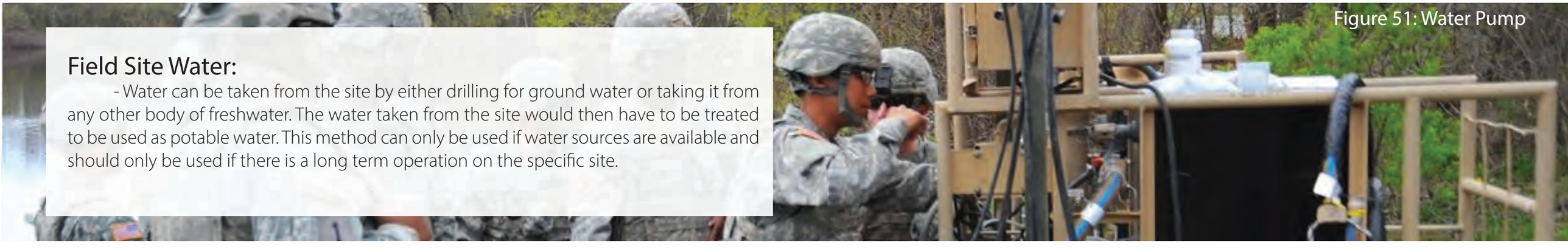

Figure 51: Water Pump

Field Site Water:

- Water can be taken from the site by either drilling for ground water or taking it from any other body of freshwater. The water taken from the site would then have to be treated to be used as potable water. This method can only be used if water sources are available and should only be used if there is a long term operation on the specific site.

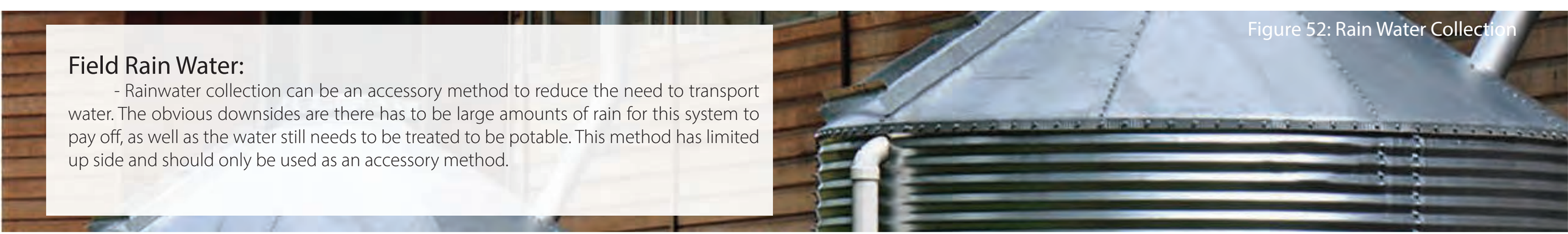

Figure 52: Rain Water Collection

Field Rain Water:

- Rainwater collection can be an accessory method to reduce the need to transport water. The obvious downsides are there has to be large amounts of rain for this system to pay off, as well as the water still needs to be treated to be potable. This method has limited up side and should only be used as an accessory method.

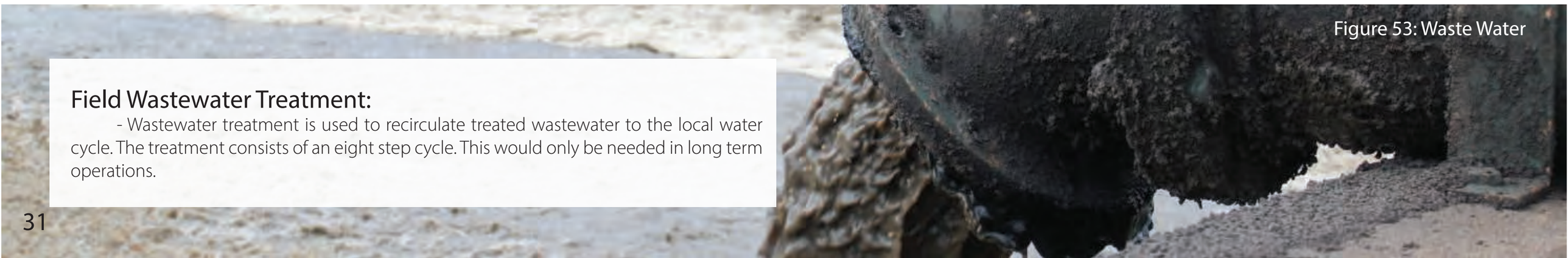

Figure 53: Waste Water

Field Wastewater Treatment:

- Wastewater treatment is used to recirculate treated wastewater to the local water cycle. The treatment consists of an eight step cycle. This would only be needed in long term operations.

CASE STUDY:
ENERGY AND WATER SOURCES

Summary:

There are pros and cons to each energy and water source. If possible the best case scenario would be fully sustainable buildings and operations by maximizing the opportunities the specific site allows for energy production and water sources. If the buildings part of a field operation can be sustained with renewables it reduces the need for transportation saving lives in areas prone to convoy attacks.

Figure 54: Water Treatment Facility

CASE STUDY:
DEPLOYMENT DORMS

Typology: Military Housing

Background:

During military deployments, members of the military can expect to stay in either tents similar to the Blu-Med tents covered earlier, or they will stay in dorms. These dorms are very simple buildings built with the bare minimum structure, finishes, and envelopes.

Building:

- Size: This specific set of dorms have four of the same buildings connected to create a larger building of dorms. The building has two floors and about 25 dorms per floor. If four buildings were to combine they would create a larger dorm with about 200 dorms.

- Circulation: The dorms have hallways that run down the center. Stairs are located on the exterior for access to the second floors.

- Rooms: Each room is about 100 square feet allowing three people to share the rooms somewhat comfortably. A single building has a set of bathrooms and showers for the building occupants.

Building Materials:

- Exterior Walls: Light Metal Siding
- Roof: Low pitched Metal Roofing
- Interior Walls: Drywall w/Paint
- Floors: Vinyl Flooring
- Ceiling: Drywall w/Paint
- Stairs: Metal Stairs
- Structure: Wood Framing
- Foundations: CMU Masonry Courses

Figure 55: Dorm

Figure 56: Bunker Interior

Figure 57: Dorm Foundation

Figure 58: Dorm Connection

Figure 59: Bunker Exterior

Figure 60: HVAC Line Set

Figure 41: Water Trucks Convoy

Figure 61: Inbetween Dorms

CASE STUDY:
DEPLOYMENT DORMS

Building MEP Systems:

- Plumbing: Each building has plumbing ran for showers and bathrooms. The showers and bathrooms are located on the ends so the plumbing lines can be shorter.

- Air Conditioning: Each room has its own mini split air conditioner. The mini split is cheaper than window shakers.

- Lighting: The lighting in the dorms are white fluorescent lights.

- Alarm: The dorms have an speaker system that allow the residents to be alarmed when attacks are imminent so they can seek shelter.

Summary:

Using the bare minimum of structure, and materials these dorms are a cheap way to house many people in a small area. While the dorms are cheap, the structure is made up of wood framing requiring the residences to seek a hardened shelter if they were to be attacked. Having two stories doubles the amount of rooms while staying in the same base of square feet. The MEP systems are very simple to save on cost. An overall summary statement would say this building is the bare minimum so the military can save money.

Figure 62: HVAC System

CASE STUDY:
Design to Minimize Stress, Anxiety, and Promote Health/Healing

Typology: Theoretical

Background:

The effect of human conflict and natural disasters cause physical trauma to people as well as increase their stress and anxiety levels. The healing of physical trauma, stress, and anxiety should be priorities of emergency response. The design of emergency response infrastructure should incorporate building design techniques which promote physical healing and reduce stress and anxiety.

Designing to Reduce Stress & Anxiety:

When designing to reduce stress it important to note what kind of stress. Workplace stress is a lot different than stress induced by a disaster, so the usual "daylighting and open floor plans" may not be the correct stress reducing design answer. To figure out what design techniques help people reduce stress from disasters we must first ask what is causing the stress and then provide design solutions to combat that cause of stress.

Stress Causes from Disasters:

- Loss of life, friends, family
- Community Destruction
- Financial Hardships
- Post Traumatic Stress Disorder

Stress Solutions through building design:

-Create Sense of community through response layout

-Provide structural reliable buildings to make victims feel safe

-Dim lighting in comfy areas vs bright lights in productive areas.

Figure 63: Stress

Figure 64: Family Through Rough Times

CASE STUDY:
Design to Minimize Stress, Anxiety, and Promote Health/Healing

Designing to Promote Health & Healing:

When designing to promote healing and health it is important to note what kind of healing and health needs are required. To figure out what design techniques are needed to help people heal from disasters we must first ask what is causing the health damage and then provide design solutions to combat that cause.

Health Needs from Disasters

-Surgeries
-Dead Bodies
-Medical Supplies Handout
- Mental Health/Shock/Trauma

Design For Healing from Disasters

-General Medical Ops
-Operation Room
-Morgue

Summary:

During disasters victims are left physically and emotionally injured. The disaster response can provide an environment that can physically and emotionally heal or at least help the process of healing victim's. Emotional healing can be positively influenced by creating a sense of community within the victim's camp area, providing strong structures, and using dynamic lighting to match the victim's vibe. Physical healing can be done by providing the required medical operations provided with medical teams.

CASE STUDY:
National Guard Response Systems

Typology: Theoretical

Background:

The US National Guard is a military force maintained by each state, but can be activated for federal use as well. Each state has at least one National Guard unit and they are available to be activated by the state governor when they are needed. The national guard provides many services when activated stateside that include, medical operations such as COVID-19 field hospitals, riot control and natural disaster responses. For each activation mission the National Guard has designed response teams to best suit the emergency response.

Types of Response Teams:

- Medical Operations
- Riot Control Operations
- Disaster Response Operations

Medical Operations:

- EMEDS HRT
- EMEDS +10
- EMEDS +25
- CERFP

Riot Control Operations:

- Immediate Reaction Force
- Riot Control

Disaster Response Operations:

- DRBS

Figure 51: HVAC Line Set

Figure 65: DRBS Setup

Figure 66: DRBS Setup

CASE STUDY:
National Guard Response Systems

Disaster Response Operations:

This thesis project is going to focus on the Disaster Relief Beddown System (DRBS) and how it can be improved. The DRBS primary function is to house responders and support personnel on disaster relief response. The DRBS allows the National Guard to respond with large numbers of troops to large scale disasters. DRBS systems have been used during hurricanes, winter storms in the south, earthquakes

Stats:

- Supports 150 Personnel
- Includes Billets, laundry, showers, latrines, kitchen, water purification.
- Ships in about 6-8 C-130's

LITERATURE REVIEW

Pretext:

This literature review summarizes the academic text "Deep Adaptation: A Map for Navigating Climate Tragedy" to compare ideas for this thesis project. The analysis of the academic text is focused on disaster frequency. Disaster frequency gives reasoning for why this thesis project is useful.

Deep adaptation: a map for navigating climate tragedy:

From 1980 to 2020 the U.S. annual average for climate disaster events was 7.1. The annual average for the most recent 5 years (2016–2020) has risen to 16.2 for climate disaster events. We have seen an increase in climate disaster events over time because increasing global surface temperatures causes the water on the earth's surface to evaporate to water vapor into the atmosphere. When there is less water on the earth surface there is a greater chance of droughts and storms. Water vapor is the fuel for storms so when there is more water vapor present there is a higher frequency of storms, as well as more intense storms. Combine the increased surface temperature with more water vapor in the atmosphere it is a recipe for more and more intense storms. Storms that would develop due to an increase in humidity would be tornadoes, hurricanes, tropical storms, thunderstorms, and rainstorms meaning regions that already flood from the rainy season will flood more in the future. Since the surface temperature is already rising, the ice sheets on the poles will be melting as well raising sea levels across the world. People who live next to the sea at very low elevations can expect to see the sea levels start rise. 410 Million humans live within a 2-meter altitude difference from sea level in the world. Even though the sea level rise may not affect their residence directly, combine the rising sea levels with more intense storms means that on occasion these storms can take the heightened sea levels and flood new lands that they usually didn't flood before.

Figure 67: Earthquake Aftermath

Figure 68: Volcano Exploding

LITERATURE REVIEW

Comparison To This Thesis:

The literature clearly states that we can expect to see an increase in frequency of storms and intensity of storms, along with rising sea levels which will affect hundreds of millions of people. This trend of increasing natural disaster frequency and intensity is affecting people today and will continue to affect more humans exponentially in the future. Not only do we have to plan for storms that come from the oceans, but land storms as well like tornadoes, rainstorms, and thunderstorms. Since we can't perfectly predict storms and evacuate everyone one from the affected area, we are reliant on a disaster response team which is often the National Guard, or similar trained organizations like American Red Cross. These disaster response teams help communities save lives from the disaster, give aid to the survivors, and rebuild the communities. The disaster response team must have the required infrastructure to quickly deploy to the location of the disaster and start giving the relief to the victims and community. The required infrastructure the response teams need is what this thesis focuses on.

Literature Summary:

The academic text states that due to increasing temperatures from climate change we can expect more frequent and intense storms. As storms inflict damage on people and their communities we need to have disaster response teams that are equipped with the best response infrastructure so they can quickly save lives, give aid, and rebuild communities.

LITERATURE REVIEW

Pretext:

This literature review summarizes the academic text "Systematic Literature Review of Methodologies for Assessing the Cost of Disasters" to compare and contrast ideas for this thesis project. The analysis of the academic text is focused on disaster cost. Disaster cost gives reasoning for why this thesis project is useful.

Systematic literature review of methodologies for assessing the costs of disasters:

Cost of Disasters: In the year 2021 in the United States there has been 18 weather disaster events with losses of more than $1 billion each. The line chart below showcases how much money is lost each year to natural disasters. It is clear that hundreds of billions of dollars each year is lost to climate disasters. We can't do much to reduce the losses due to the climate disasters but if we start rebuilding as soon as possible after disaster events we can start to rebuild what was lost.

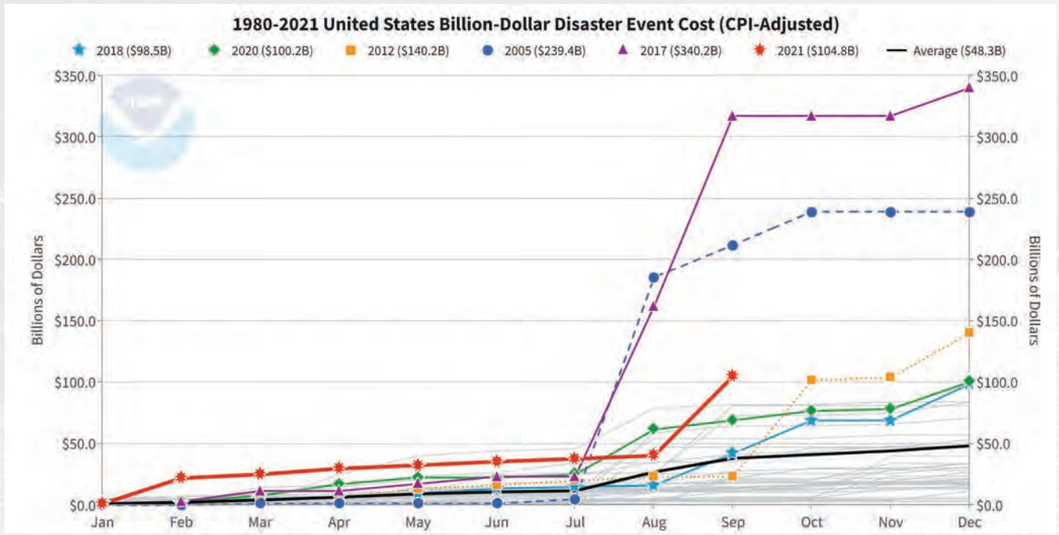

Figure 69: Tornado Twisting

Figure 70: Tsunami Aftermath

LITERATURE REVIEW

Cost of Responding to Disasters: A lot of time when the media talks about climate disasters, they focus on the damage done in dollars caused by the disaster. But one of the most important cost analyses that should be done is researching how much funding was available for the disaster response teams. Wherever the funding comes from whether it be locally or federally, it would be best if the disaster response could be fully funded to save more lives but that is not always the case. Since the region effected by the climate disaster will already need economic aid to rebuild its economy after the damage done the funding for the response might be reduced. Response funding may be reduced as well due to the economic impact of the area hit by the climate disaster. As seen from Hurricane Katrina in New Orleans the low-income areas received less to almost nothing in aid due to the federal government's view of it not being as important as the higher income areas. From the disaster response to the earthquake in Haiti recently the response infrastructure requested to be delivered cost too much to airlift. The result was having the response infrastructure arrive late due to communication issues as well as less response infrastructure due to the expense of airlifting it there. If the response infrastructure could be lighter, more compact, etc. The airlift cost could come down giving more availability and accessibility to the communities in need of disaster relief.

Literature Summary:

Climate disasters are becoming more and more common causing the cost of the damage done by these disasters to increase over time. The cost of the disasters damages the local economy and require aid to rebuild the economy as well as physically rebuild the community. Sometimes the funding for the disaster response to help save lives and rebuild the community isn't available whether it be lack of economic impact of the area like the low-income areas from Hurricane Katrina, or the response team and infrastructure is too expensive to deploy to the disaster area. This thesis will try to provide a way to deploy more response infrastructure while minimizing the cost to deliver it to the disaster area.

PROJECT JUSTIFICATION

Q: Why is the project that you have defined important to you as a person?
A: This project is important to me because it can help emergency response teams which I am a part of. I can contribute what I have learned through my college education and use research to help our military.

Q: Why is it important for you to do this project at this stage of your professional development?
A: This project is important because it will give direction to my future career. I may want to get an architecture job in a research related field for typologies such as mine, or I may want to work as an architect for the military. This project will help me find my career path.

Q: How can you justify this project economically?
A: This project is economically justified because the project is about providing the best emergency response architecture which helps save lives.

Q: How is the project site location justified?
A: There will be multiple site locations for this project since it is a relocatable building. The site locations will be located at natural disasters/tragedies, where the building is meant to be used to save lives.

Q: Can your project be left for someone else in the profession to solve? If so, why should you solve it?
A: Yes, someone can solve this project. But since I am in my thesis year doing a research thesis and deployed, I have a unique firsthand opportunity to do this project where we are currently using and in need of such building. I have plenty of resources and subject material to observe where I am making this research thesis perfect for me to work on.

Figure 71: Nat'l Guard Fly Over Flood

THESIS **CONTEXT**

The design project for this thesis is focused on deployable units that respond to emergencies. The overall design of the unit isn't for a specific site but designed to be used for a variety of sites and situations. To show the full capabilities of how the units can be deployed three separate sites with three separate response situations are chosen.

1. Military Beddown Exercise in Arizona

Exercise: Leadership has run down the chain of command that the military needs control of a certain region in a hostile country(Arizona desert). The use of rapidly deployable units will give the exercise a fast, safe, and effective bed-down. They will provide protection for members of the military as well as a head-start on building infrastructure needed for the mission.

2. Nat'l Guard Hurricane Response in New Orleans, LA

Mission: New Orleans was smacked by another hurricane destroying houses and buildings needed for the civilians living there. The National Guard is activated to provide aid to the community. The community will need medical assistance, and humanitarian aid like water, food, and hygiene products. The use of deployable units will be used to provide the community with aid.

3. Nat'l Guard Respond to Infectious Disease in Fargo, ND

Mission: Fargo, North Dakota is the center of an outbreak of an infectious deadly disease. The North Dakota Nat'l Guard is needed for rapid response to the outbreak. They need deployable infrastructure for the medical response needed to quarantine this disease off and limit the spread.

Figure 72: Nat'l Gaurd Fly Over Flood

PERFORMANCE CRITERIA

Q: What aspect of the performance of your design is measured? What are the kinds and units of data involved in the measurement?
A: The measured aspects of the project will be maximizing usable space, use of environmentally safe materials, shipping size, cost, and weight. The actual units of measurements will be in square footage, LEED points, dimensions in feet & inches and US dollars.

Q: How and where will you obtain the performance measure?
A: I will obtain the performance measure for the thesis project throughout the design of the project to stay up to date on the goals I have set out. Then finally share the final performance measure when finished with the project.

Q: What kind of analysis is done, if any, to generate the performance measure? What tools or instruments will be used (drawings, scale models, computer simulations, etc.)?
A: To do the performance analysis I will use addition and subtraction calculations for the cost in US dollars. For LEED I will use the LEED website and charts made for architects. For shipping dimensions and square footage, I will use the data provided through the design of the project.

Q: How will you judge that you have met the performance criterion or criteria? Explain the reasoning behind your judgment.
A: I will judge my performance criteria by having set goals to reach a certain criterion. And use those goals to compare to the final results and design of the thesis project. The goals will be set once the design has started for more realistic and accurate goal setting.

Performance Categories

1. Usable Square Feet
2. Energy Consumption
3. LEED
4. Code Compliance
5. Cost
6. Shipping Dimensions
7. Environmental Impact
8. Flexibility
9. Aesthetics

Figure 73: Nat'l Guard Protect Capital

Figure 74: Nat'l Guard Firefighters

PERFORMANCE CRITERIA

Performance Goals:

1. Usable Square Feet:
The interior usable space should be about (190 square feet)

2. Energy Consumption:
The goal is to provide a thermally efficient structure. The structure will need to have a tight envelope to reduce thermal bridging. Walls (R15), Roof (R50), Floor (R25)

3. LEED:
(Record progress) towards LEED certification. Not expecting LEED certification due to the nature of the project but making an effort to see how close the project can get to LEED certification is the goal.

4. Code Compliance:
There is no modular building code. The military defaults to the most recent International Building Code. (IBC 2021)

5. Cost:
The cost of a 20' storage container is about $5,000. The goal of this project will have to stay somewhat close to that $5,000 amount. Although if the unit designed for the project can be used for both shipping storage while having a usable interior space the price of the project can increase. It will be hard but the goal is to stay around $10,000.

6. Shipping Dimensions:
The maximum load space of a C-130 is 55' long x 10' wide x 9' tall with a payload of 45,000 lbs. The goal is to have exterior dimensions of < 20' long x < 10' wide x < 9' tall.

PRO

Figure 75: Nat'l Gaurd at US Capitol

GRAM

THESIS **CONTEXT**

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Figure 76: Nat'l Gaurd Fly Over Flood

SITE CONTEXT - **CLIMATE**

1. Military Beddown Exercise in Arizona
34°35'33.0"N 110°05'03.7"W

The climate of the site in Arizona is considered a semi arid to arid climate meaning it is a very dry region. The high temperatures to be expected can be above 125 degrees Fahrenheit.

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F	94	91	85	73	60	49
Average low in °F	62	61	52	39	28	21
Av. precipitation in inch	1.04	1.20	0.88	0.53	0.51	0.56
Av. snowfall in inch	0	0	0	0	1	3

AIR TEMPERATURE:

128 F

2. Hurricane Response in New Orleans
29.9511° N 90.0812° W

The climate of the site in Louisiana is considered a humid subtropical meaning it is a very wet humid region. The temperature will be around 80 Fahrenheit with 80% humidity.

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F	79	86	90	90	88	83
Average low in °F	64	73	76	76	74	68
Days with precipitation	7	10	14	15	12	9
Hours of sunshine	260	241	269	260	287	292
Av. precipitation in inch	3.66	5.83	6.42	7.09	5.55	5.43

HURRICANE WIND SPEED:

160 MPH

3. Infectious Disease in Fargo
46.9030° N, 96.8001° W

Fargo, ND is ground zero for a new deadly strain called COVID-22. Red cross and the disease response teams must contain and eliminate the spread of the deadly disease.

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F	18	24	36	56	69	77
Average low in °F	0	6	19	33	45	55
Av. precipitation in inch	0.70	0.61	1.30	1.36	2.81	3.90
Av. snowfall in inch	11	7	9	3	0	0

GROUND SNOW LOAD:

50 PSF

Figure 77: Climate Tables

HISTORICAL CONTEXT

Recent History of Disaster Response

Disaster relief over time has evolved to better suit the response team. This thesis aims to make better our disaster response infrastructure. What the response teams currently use and have used for many years now is called the DRBS (Disaster Relief Beddown System). The DRBS is a complete disaster relief system that is standing by to deploy. The DBRS can be shipped by airlift, rail, or trucked to the response site, where trained personnel are able to erect the contents of the relief system. The relief system consists of:

- The system can house 150 personnel

- Includes 16 Alaskan Small Shelter tents

- ECU's for the 16 tents

- Reverse osmosis water purification kit (30,000 gallons per day)

- Power generators and lights

-The complete DRBS needs 30 large aluminum shipping containers for transport

- Aluminum shipping containers are transportable by Forklifts either on site already or shipped with the DRBS

- Complete DRBS weighs 300,000 lbs.

- It takes 6 to 8 C-130's to airlift the complete DRBS

Figure 78: DRBS Setup

Figure 79: Nat'l Guard Deliver DRBS

HISTORICAL CONTEXT

The Mission Impact of The DRBS

Cost

It takes 6 to 8 C-130's to airlift the complete DRBS which is extremely costly since C-130's cost about $10,000 per flying hour. Transporting 30 large aluminum containers will get costly very quickly when transporting this way. The calculation below is an example of what the estimated dollar cost amount is for the transportation a complete DRBS 6 hours away:

- (8) C-130 Airlifts
- (6) Hours of Flight per Airlift
- ($10,000) per flying hours

(8 C-130 Airlifts) * (6 Hours Flight Time) * ($10,000 Per Flight Hour) =
= $480,000

The rough estimated cost of a 6-hour airlift of just one DRBS is half a million dollars. If a disaster struck area needs immediate disaster relief, it not only takes time to get the DRBS ready but the leadership must have the funds readily available so the DRBS can be transported. Having a high transportation price such as this may infract on the ability to transport the DRBS as fast as possible while leadership is waiting on funding, or the transport price may even eliminate the use of the DRBS at all.

Flexibility

The DRMS ships in 30 large aluminum containers. The containers are about 7'6" tall x 8'6" long x 4'0" wide. The containers hold everything needed to setup and operate a 16 tent, tent city. The containers have forklift slots to be easily maneuvered and placed around the tent city site. When a complete DRBS is constructed, there will be 30 empty containers sitting on the site taking up space and not in use. The 30 empty containers could be re-purposed and take on a new role in the disaster response.

SITE CONTEXT - **LOCATION**

1. Military Beddown Exercise in Arizona
34°35'33.0"N 110°05'03.7"W

An Air Force wing that specializes at initial beddown for military bases holds an exercise to train the airmen. The airmen must successfully beddown a DRBS tent city

Site: The site is located in the desert. The ground is dirt and not perfectly level so the building must be able to evenly disperse footings to maintain a level interior floor. A river is near to extract water for the base.

2. Hurricane Response in New Orleans
29.9511° N 90.0812° W

Another hurricane is on its path to demolish the lively city of New Orleans, LA. The Louisiana National Guard is activated to help assist in providing humanitarian aid during and after the Hurricane hits.

Site: The site is located on top of the parking ramp for the Superdome. The flood levels from the hurricane will most likely not reach the top of the parking ramp.

3. Infectious Disease in Fargo
46.9030° N, 96.8001° W

Fargo, ND is ground zero for a new deadly strain called COVID-22. Red cross and the disease response teams must contain and eliminate the spread of the deadly disease.

Site: The site is located at ground level at the Fargodome. It is less than a mile away from the North Dakota Air National Guard Base. There will be heavy snowfall on the site.

Figure 80: Site Map Locations

Figure 48: Nat'l Gaurd Flyover Flood

Figure 81: Site Isometric Locations

SITE CONTEXT - **NEEDS OF RESPONSE**

Beddown Exercise:

During a beddown exercise the goal is to quickly set up a field operational tent city. Certain areas must be constructed so the tent city can be fully operational. These areas include but are not limited to:

1. Housing Tents
2. Barracks & Latrines
3. Kitchen
4. Medical
5. Command
6. Required Utilities

For the sake of this exercise the beddown will include all of the above. The buildings will be oriented in a geometric shape that defines the controlled area of the exercise. The exercise will need to successfully construct these areas to be fully operational including power generation, electricity, air conditioning, and plumbing where needed.

Hurricane Response:

During hurricane Katrina the Superdome in downtown New Orleans was used as a last resort shelter by citizens of the city who couldn't evacuate in time. The Superdome is a huge interior space for citizens to seek refuge, but it doesn't have the required medical and humanitarian equipment for those hurricane refugees. The hurricane response teams needs to airlift the following humanitarian equipment to the Superdome:

1. General Medical
2. Medical Operation Room
3. Humanitarian Needs

Due to the flood heights the Louisiana Nat'l Guard will be activated to airlift the required relief to the Superdome. The Nat'l Guard will need to set up medical operations to tend to the citizens who need medical attention. They will also need to give out humanitarian aid like water, clothes, blankets and hygiene.

Infectious Disease Response:

During COVID-19 the Fargodome was used as a temporary field hospital to test citizens for COVID. Now that a new deadly strain of COVID-22 has begun the Nat'l Guard will be activated again to set up and operate a field hospital to prevent the spread of the disease. The field hospital will need to provide:

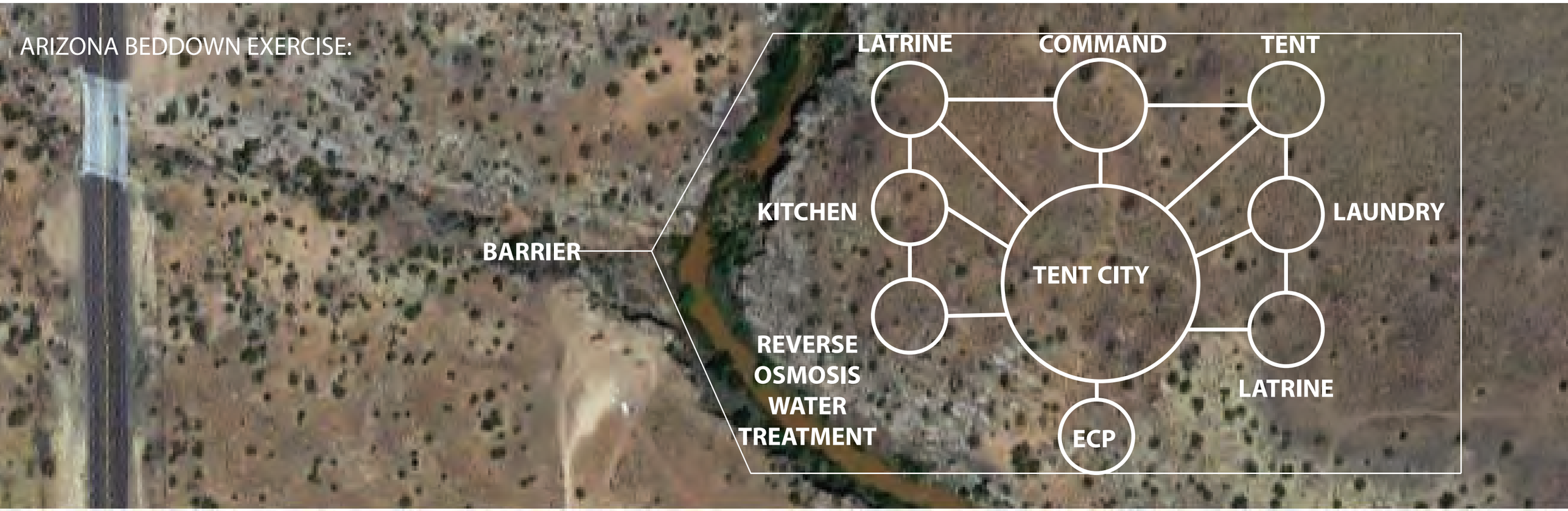
The Nat'l Guard will have to rapidly deploy the field hospital so testing and quarantine can be set up as soon as possible to prevent the spread of COVID-22.
This setting will be set in winter.

1. Testing sites
2. Quarantined Holding
3. Entry Control Points
4. Medical Command

SPACE ALLOCATION **ARIZONA**

Figure 82: Space Allocation Figures - Arizona

ARIZONA BEDDOWN EXERCISE:



SPACE ALLOCATION TABLE:

Spaces:	Percentage:
Entry Control Point:	5%
Tent City:	70%
Latrine:	5%
Laundry:	5%
Command:	5%
Kitchen:	5%
ROWT:	5%

SPACE INTERACTION MATRIX:

ADJACENT

NEARBY

NOT NEARBY

EXEMPT (×)

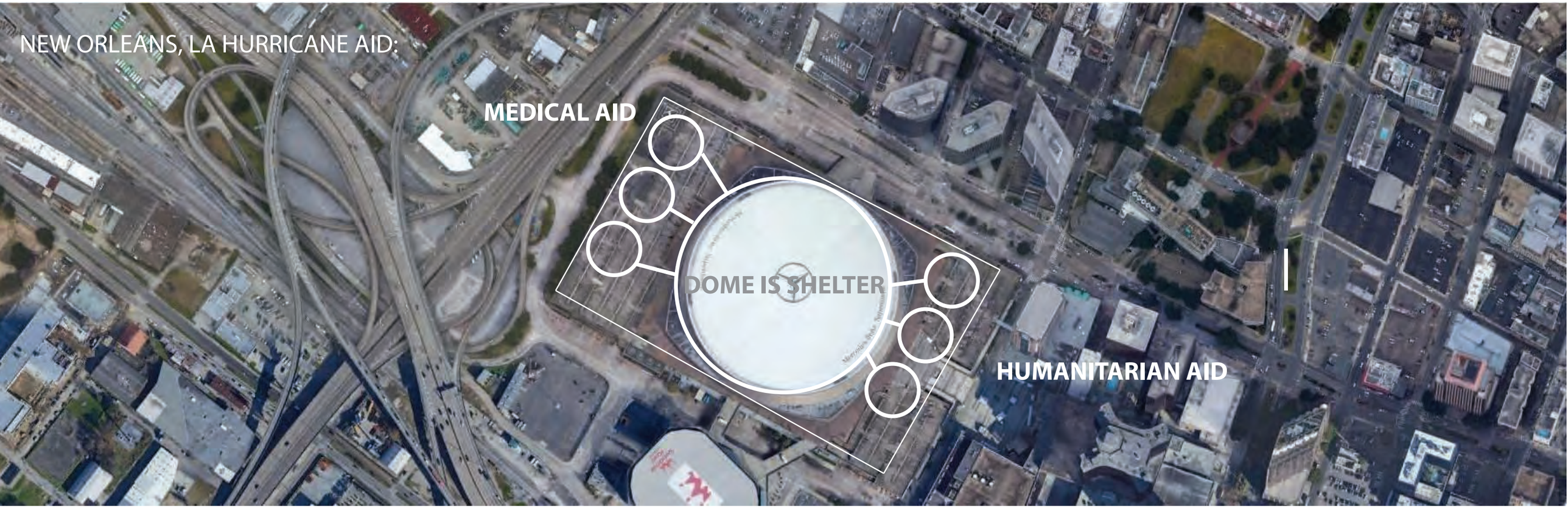
	ECP	Tent City	Latrine	Laundry	Command	Kitchen	ROWT
ECP	×		NEARBY	NOT NEARBY	NOT NEARBY	NOT NEARBY	NEARBY	NOT NEARBY
Tent City		×						NEARBY
Latrine	NEARBY		NOT NEARBY				NOT NEARBY	NOT NEARBY
Laundry	NOT NEARBY			×	NEARBY	NEARBY	NEARBY	
Command	NOT NEARBY			NEARBY	×	NOT NEARBY	NOT NEARBY	
Kitchen	NOT NEARBY			NEARBY	NOT NEARBY	×		NEARBY
ROWT	NEARBY		NOT NEARBY	NEARBY	NOT NEARBY		×	NOT NEARBY
	NOT NEARBY	NEARBY	NOT NEARBY			NEARBY	NOT NEARBY	×

SPACE ALLOCATION **ARIZONA**

Figure 83: Space Allocation Figures - Arizona

SPACE ALLOCATION **NEW ORLEANS, LA**

Figure 84: Space Allocation Figures - New Orleans, LA



SPACE ALLOCATION TABLE:

Spaces:	Percentage:
Superdome Shelter:	70%
Medical Aid:	15%
Humanitarian Aid:	15%

SPACE INTERACTION MATRIX:

ADJACENT

NEARBY

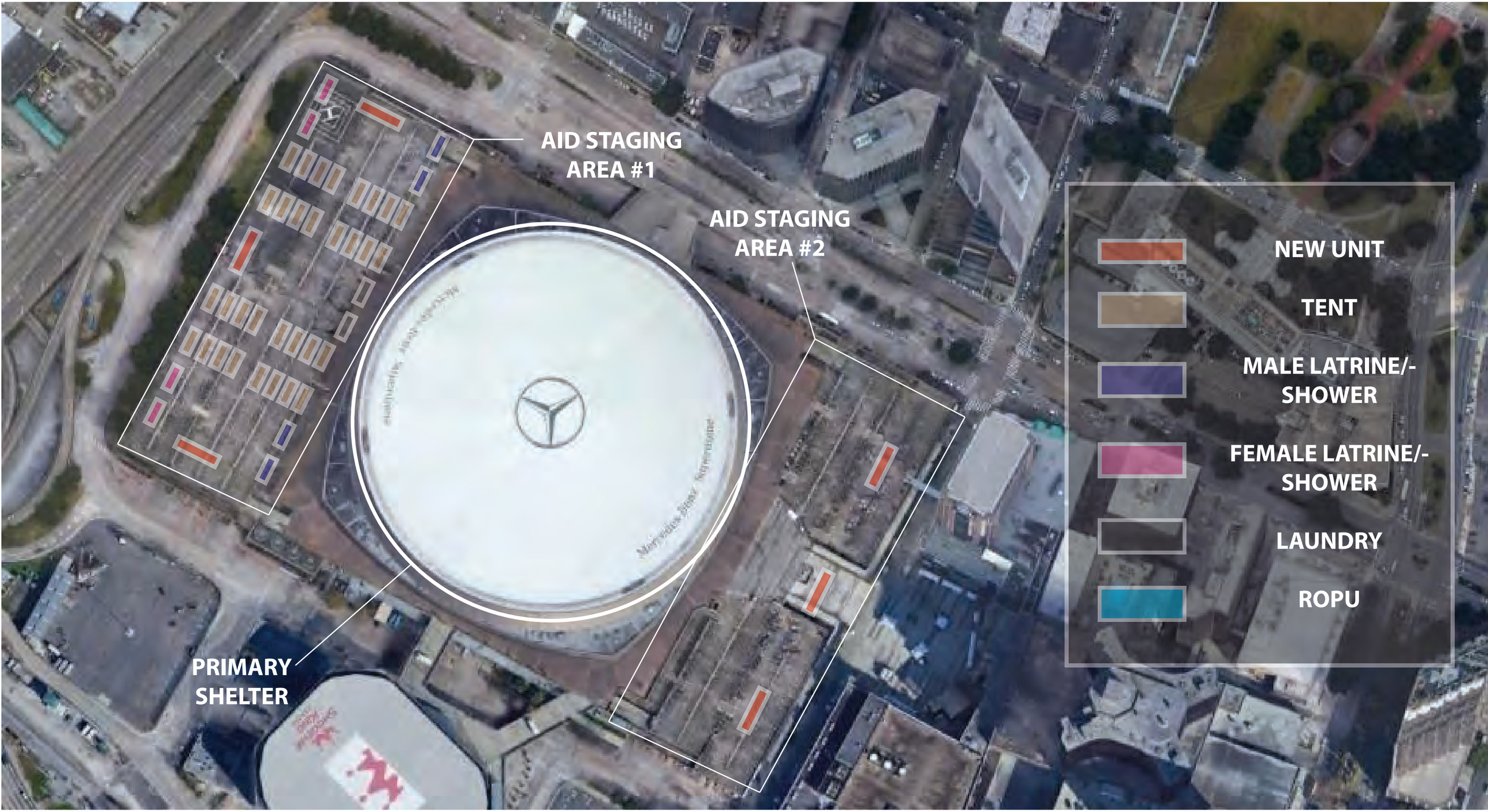
NOT NEARBY

EXEMPT

	Superdome	Medical Aid	Human. Aid
Superdome	×		
Medical Aid		×	
Human. Aid			×

SPACE ALLOCATION **NEW ORLEANS, LA**

Figure 85: Space Allocation Figures - New Orleans, LA



SPACE ALLOCATION **FARGO, ND**

Figure 86: Space Allocation Figures - Fargo, ND

SPACE ALLOCATION TABLE:

Spaces:	Percentage:
Entry Control Point:	10%
Medical Tent City:	40%
Medical Operations:	5%
Initial Quarantine:	20%
Overflow Quarantine:	20%
Testing:	5%

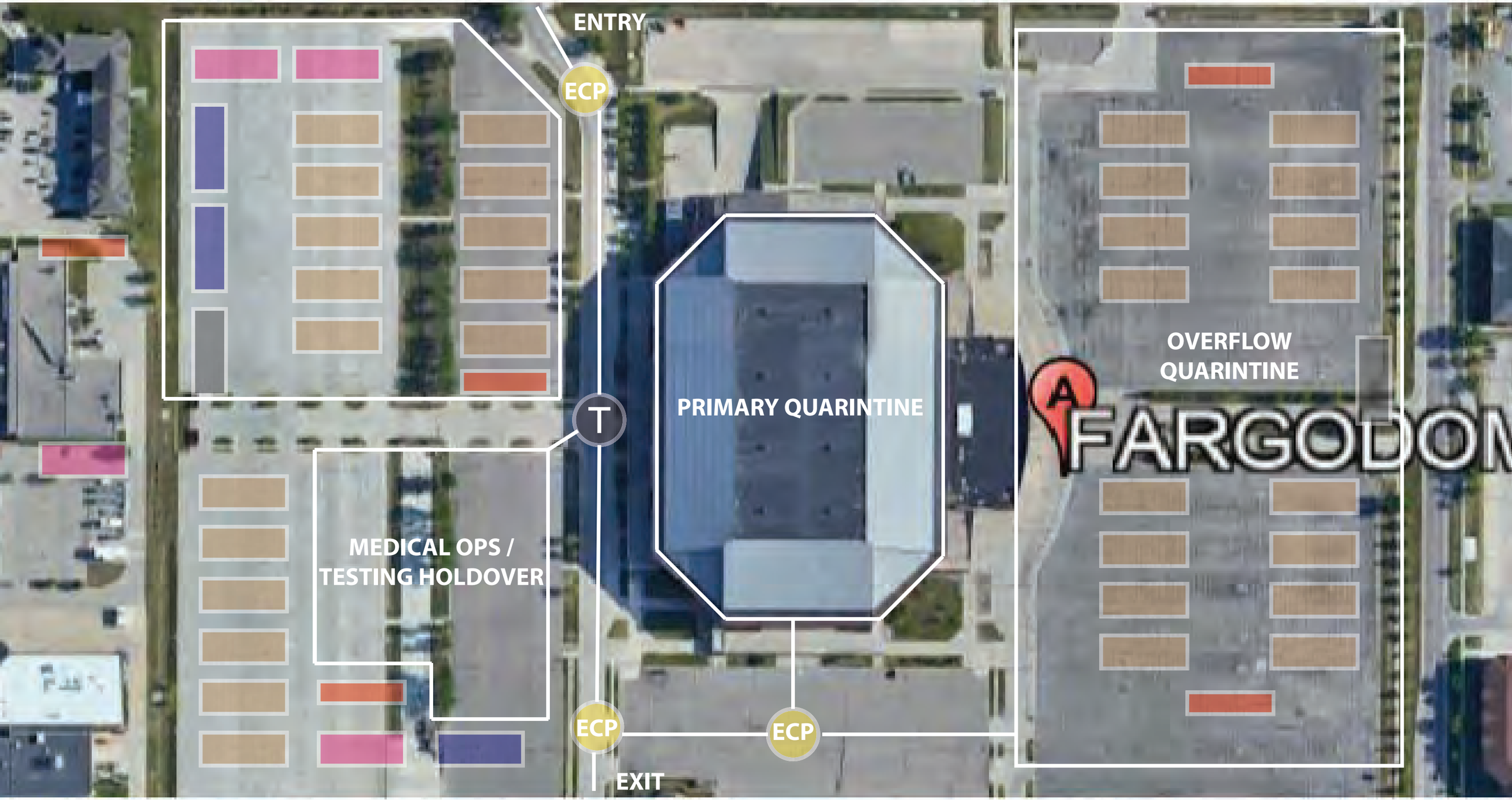
SPACE INTERACTION MATRIX:

ADJACENT □
NEARBY ■
NOT NEARBY ▒
EXEMPT ⊠

	ECP	Medical Tent City	Medical Operations	Initial Quarantine	Overflow Quarantine	Testing
ECP	⊠	■	■	▒	▒	▒
Medical Tent City	■	⊠	▒	▒	■	□
Medical Operations	■	▒	⊠	□	□	■
Initial Quarantine	▒	▒	□	⊠	□	▒
Overflow Quarantine	▒	■	□	□	⊠	▒
Testing	▒	□	■	▒	▒	⊠

SPACE ALLOCATION **FARGO, ND**

Figure 87: Space Allocation Figures - Fargo, ND



EXISTING DRBS SHORTCOMINGS - **THINGS TO FIX**

- Expensive to deploy causing lack of use
- Does not have any hard sided structures
- Requires 6-8 C-130s to airlift complete DRBS
- Old building technology, ready to update
- Does not include communications embedded within
- Tents of DRBS tend to flood with heavy rains
- Most likely not designed with preserving mental health in mind

HOW TO IMPROVE DRBS - **GOALS**

Project Goals / Performance Criteria	Exploring the Extreme	Removing the Bad	Amping up the Good
Increase DRBS Availability to Deploy Reduce Cost Of Deploying DRBS Create Multiple Shipping Configurations Reduce Mass Shipment Weight	Reduce cost of shipment by consolidating DRBS packing while reducing weight by selecting lightest materials to construct unit. Shipping configurations should be available in airlift(cargo planes & heli), road(semi, own wheels & hitch), train, ship, space, more?	Consolidate certain DRBS aspects that WILL fit in shipment containers. Balance light materials with cost effectiveness, energy efficiency, etc. Probably will not need to go to space, all other configuration on the table.	New shipment containers designed to be livable once unloaded resulting in consolidating shipping while reducing extra infrastructure. Using light in weight yet well rounded materials reduce weight of shipment without sacrificing durability, thermal envelope, and cost.
Innovate DRBS Infastructure Increase Flexibility of DRBS Infastructure Provide Structural Safe and Protective Shelters Decrease Camp Setup Time	The new storage/living units can be combined at all ends as well as stacked on each other to create large hard sided structures. When combining the hard sided structures they must easily be able to "click into place" to make setup as quick, seamless, and efficient. The combination of units must be structural for disaster settings.	To save on expenses the combination of the units must be simple and not "over-engineered". By using simple connections stacking units may be a stretch as well as reducing the setup time.	To provide the DRBS system with flexibility while reducing cost and setup time there must be a compromise or evaluation of how to best design the connection of units. By researching and design the best compromise outcome can be achieved.
Reduce Stress & Anxiety Communitize Camp Layout Design Interiors to reduce stress (colors & lighting) Provide Hard Shelters	By planning a community layout for the DRBS system personnel staying in the camp will have a "sense of community" which helps people get through tough times. The Layout will consist of tents and structures facing each other creating public outdoor areas everyone shares. Interior areas will be daylight, with LEDs and relaxing colors.	Depending on the size of the beddown area the community layout may be limited. Windows/skylights/other must be used for daylighting but must not be to large to minimize thermal bridging. LED lights have a higher upfront cost.	Depending on the response situation the layout may be different to serve both response personnel and victims. Energy efficient windows and openings can provide daylight while reducing thermal bridging. LED lights are much more energy efficient while reducing heat gain.
Materiality & Sustainability Research cheap/strong/durable Materials Cross Ref. Which of Those Materials are Sustainable MEP System Effectivness MEP System Effieciencies	Find the cheapest yet strong, durable, weather resistant, sustainable building materials for both interior and exterior. Mechanical, and electrical, must be easy to hookup and energy efficient, possibly energy is produced by small renewables on the unit.	There will have to be a compromise to allow a balance between cost, durability, and sustainability for material selection. Mechanical and electrical should be designed to match existing mechanical and electrical configurations.	When selecting the best possible materials and finishes they will also contribute to the units functionality of the spaces(storage & living). Give the option to use renewable energy sources like small wind turbines while designing the unit to be configured to existing M&E systems.

Figure 88: Design Goals

Pillars of Disaster Response:

- Basis for successful emergency response
- Basis for design program

1. Transportation:
Response teams must have rapid mobility to site

2. Communication:
Must be able to communicate with other response teams, victims, outside sources

3. Operation:
Able to provide relief by either saving lives, protecting and rebuilding the community

Disaster Response Goal:
- Save Lives
- Protect/Rebuild Community

Unit Program

Transportation:
Unit configured for transport (flatbed semi, helicopter & cargo plane, rail, etc.)
Lightweight —> Less expensive to airlift
Durable to sustain transportation
Maximize interior space for equipment storage
Resistant interior materials for entering and exiting cargo

Communication:
Provide communication ports for wifi
Provide communication equipment for radio signal

Operation:
Consolidate current DRBS system from non usable storage containers into containers providing livable spaces
Flexible unit connections to maximize interior spaces
Efficient MEP systems
Daylighting
Flexible furniture for work spaces
Storage space
Durable, easily cleaned, cheap
Sustainability
Accessibility
Mental Health / Trauma in mind

DES

IGN

Figure 89 - Design Blueprints

PROCESS: **SELECTING THE CANVAS**

1. New Design:

Pros
Custom to fit most needs
Mass produced

Cons
New materials = carbon footprint / less sustainable
New design/production/shipping (expensive)

2a. Retrofitted Shipping Container:

Pros
Sustainable (17 mil containers in world, 6 mil in use)
Find used for cheap ($1,000 - $3,000)
Modified Conex already used (bathrooms, showers, etc.)
Built for durability
Made of corten steel
Sized for shipping on planes, trucks, ships, train

Cons
No insulation
4,400 Lbs

2b. Retrofitted Reefer Container:

Pros
Similar Pros to conventional
Insulated (R-20)

Cons
Can be Expensive ($3,000 - $5,000)
Less Common
6,500 Lbs

Figure 90 - Shipping Container Image

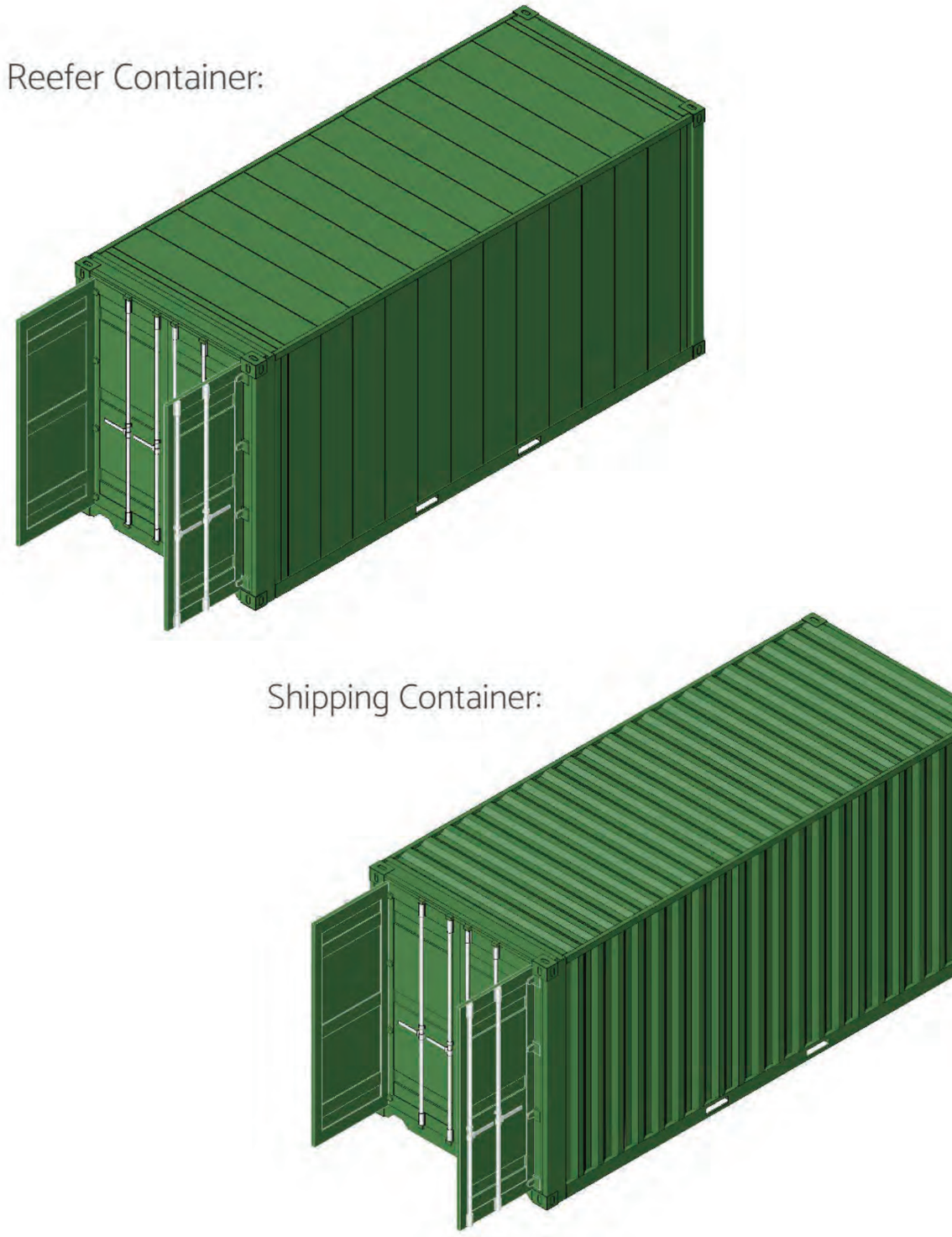


Figure 91 - Shipping Container Isometrics

PROCESS:
SELECTING THE CANVAS

End Unit Shell:

Prototypes of the conventional shipping container and reefer container will be designed to showcase how both can be modified to provide the DRBS upgraded transportation, communication, and operation.

Reasons for selecting the renovated shipping containers:
Sustainability
Low cost
Familiarity in use (container buildings already in use)
Familiarity in shipping

PROCESS:
SHIPPING CONFIGURATIONS

Shipping Configurations:

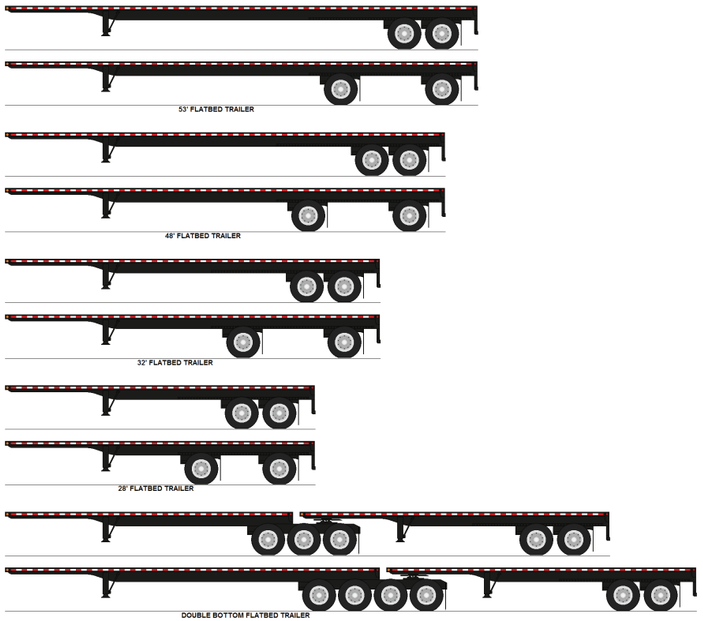
Flat Bed Semi:

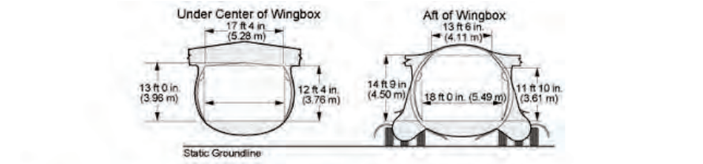
C-130 Plane:

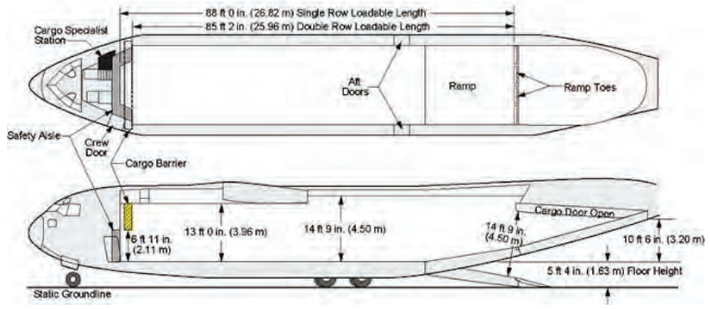
C-17 Plane:

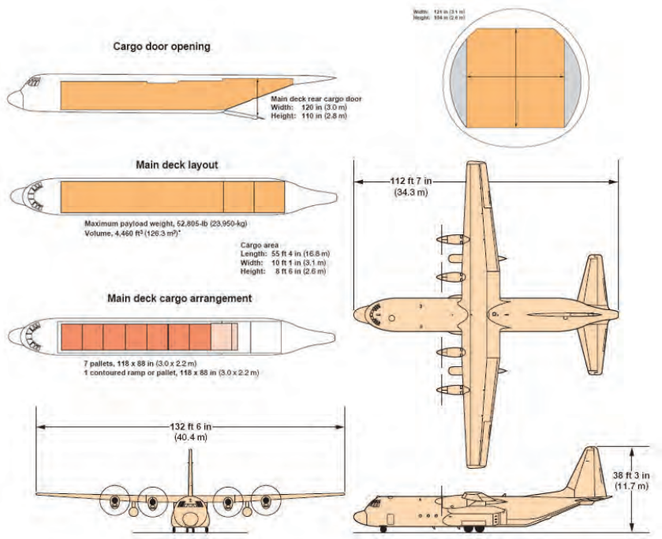
Train:

Figure 92 - Shipping Configurations









PROJECT SOLUTION:
EXISTING VS NEW COMPARISON

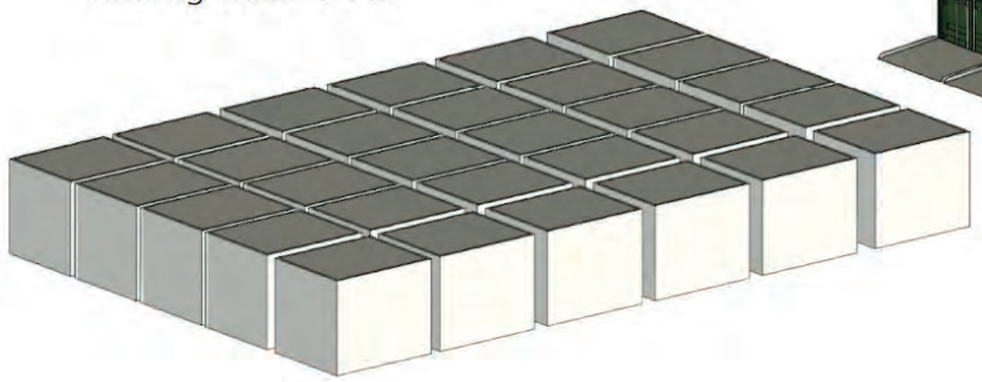
Existing Cube DRBS Totals:

30 Cubic units provides
1,860 sq.ft. of floor area
13,950 cu.ft. volume storage
Empty Weight: 51,600 lbs
Only used for storage
One cube = $14,000

New Conex Units Totals:

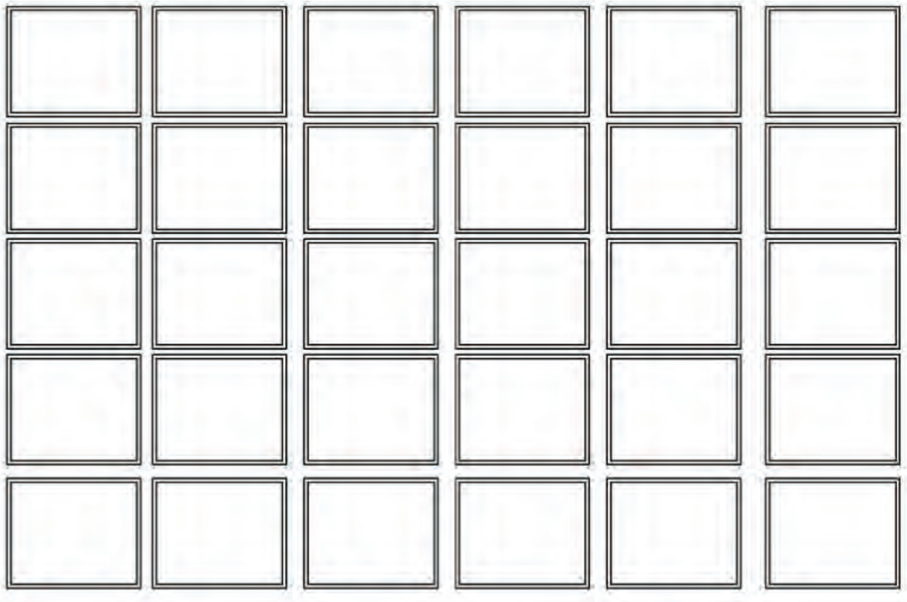
11 Conex Units provides
1,760 sq.ft. of floor area
13,915 cu.ft. volume storage
Empty Weight: 49,800 Lbs
Used as storage
Provides hard shelter
Comm / Internet availability
Flexible interior use
While maintaining similar totals in weight/volume
One container = +/- $3,000 w/out renovations

Existing Cubic Units:



New Conex Units:

Existing Cubic Units Plan View:



New Conex Units Plan View:

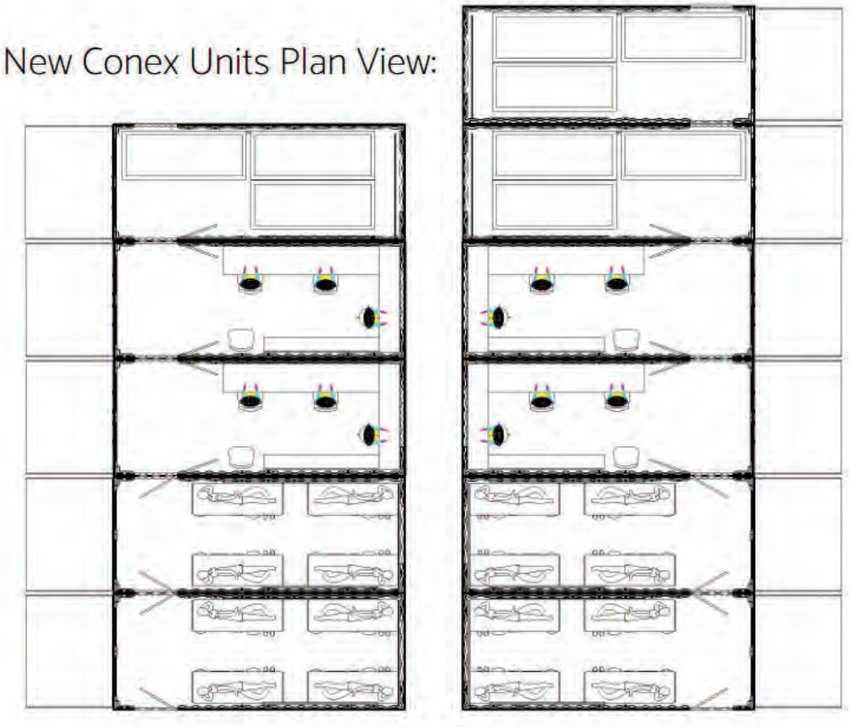


Figure 93 - Existing & New Unit Comparisons

PROCESS: **SCHEME ONE**

Summary:

Design scheme one uses fully customizable units to allow for limitless combinations of how they can connect. Limitless connections provide the response team with ultimate flexibility and creativity while setting up the site infrastructure.

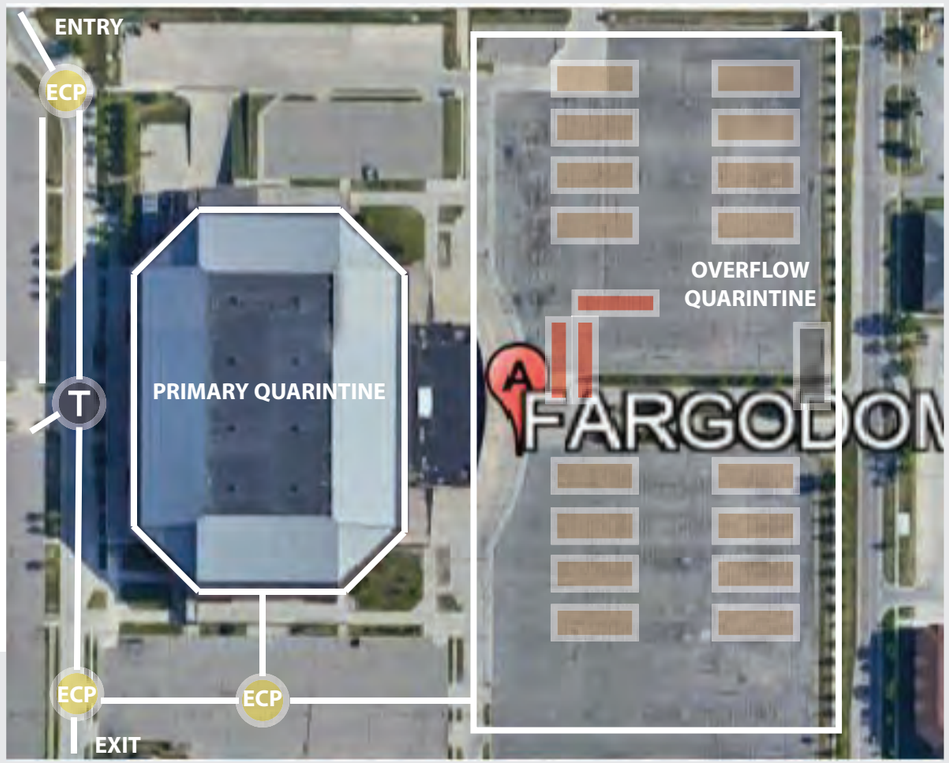
Pros

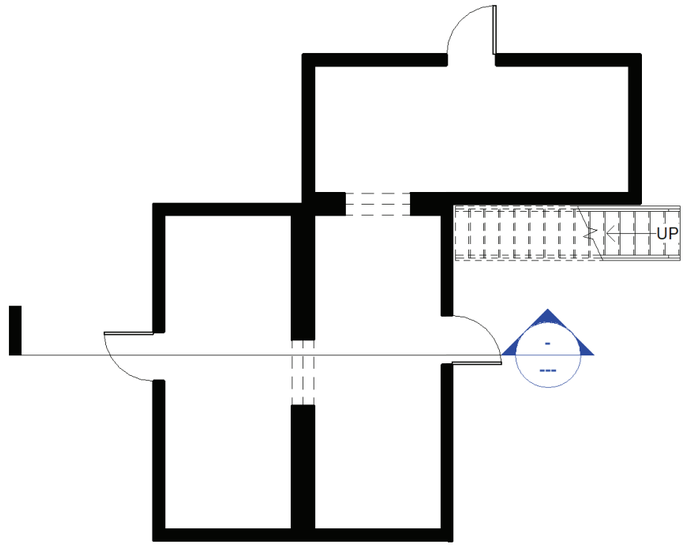
- Maximum Flexibility
- Tall Central Point on Site (Node)
- Entirely Custom - All Sides

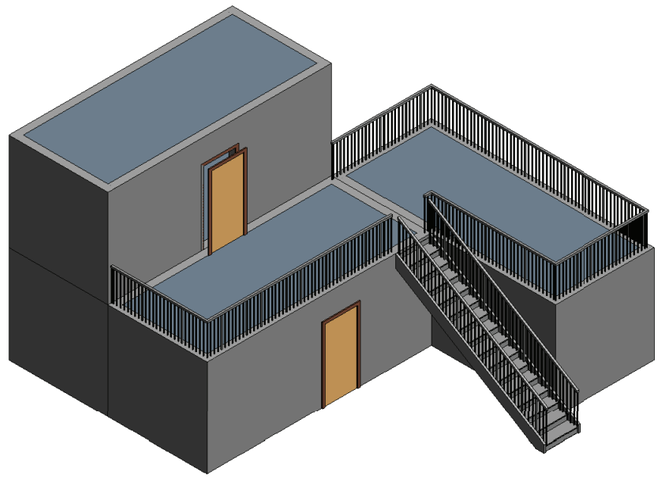
Cons

- More Customization/ More Money
- Structure Reinforcement
- More Openings / More Thermal Bridging

Main Takeaway: Ultimate flexibility, but most expensive and complex.







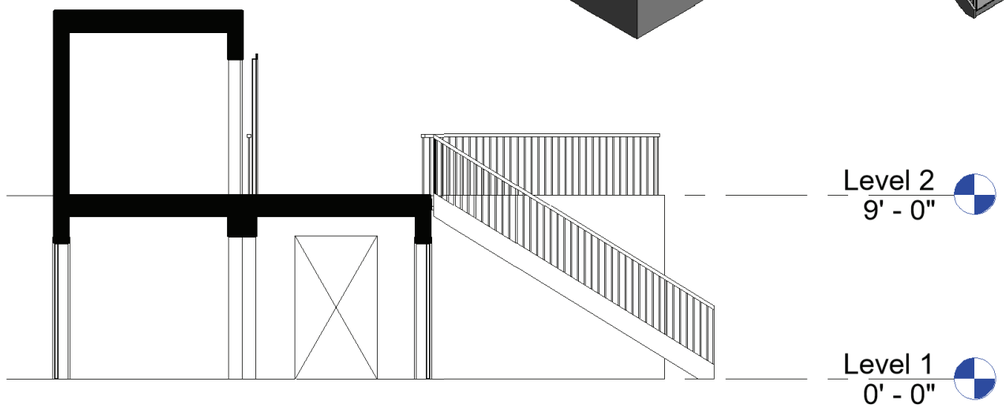


Figure 94 - Design Scheme One

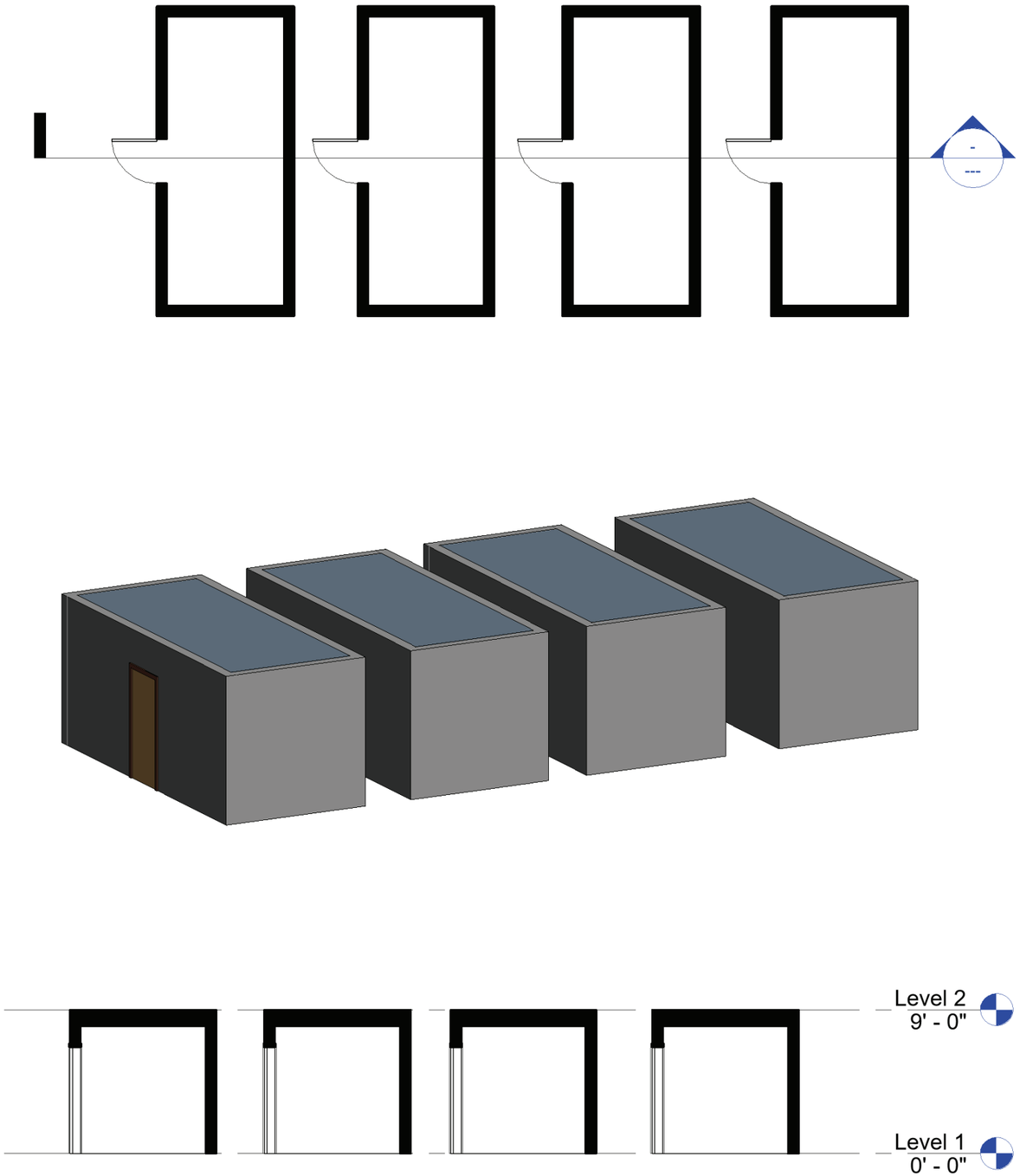


Figure 95 - Design Scheme Two

PROCESS: **SCHEME TWO**

Summary:

Scheme two has no unit-to-unit connections. The units can either be dispersed across the site or can be located near each other, they just can't share interior space. This option reduces flexibility, while decreasing cost of production.

Pros

- Least amount of customization
- Less Openings / Better Envelope

Cons

- Can't connect to each other
- Only used by themselves

Main Takeaway: Lacks flexibility, least expensive and easiest to produce.

PROCESS: **SCHEME THREE**

Summary:

In scheme three there are a fixed number of connection possibilities to reduce the amount of customization - reducing price. In this option the units can still be connected creating a large flexible use interior space and central mass on the response site.

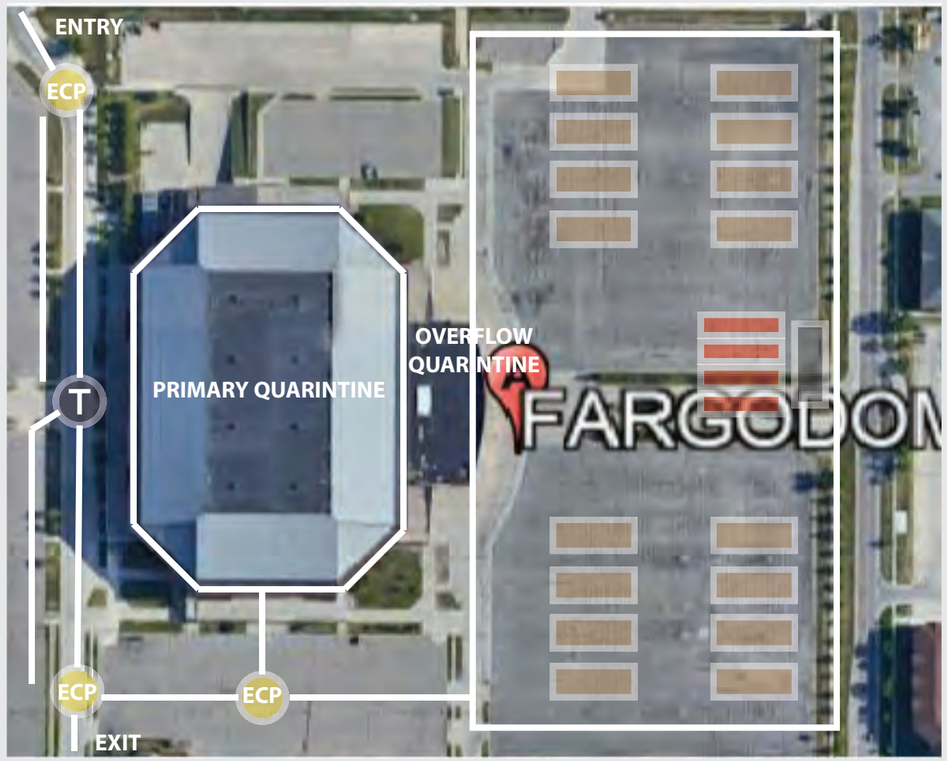
Pros

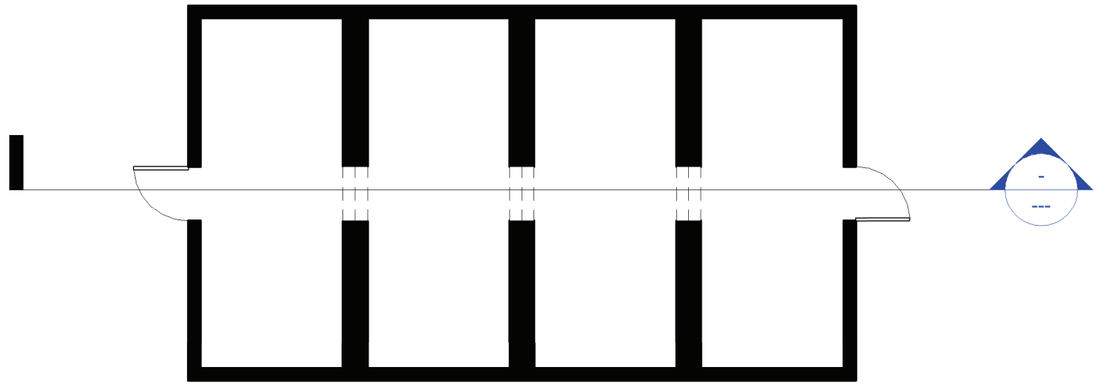
- Still able to connect units
- Provides large interior space
- Central Node by mass

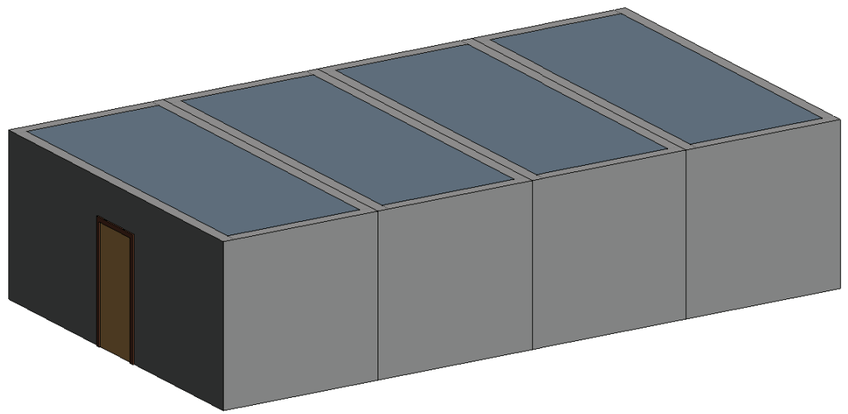
Cons

- Still requires connection customization
- Limits interior wall space for storage/work space.

Main Takeaway: Provides flexible plans while keeping unit to unit connection simple. Balance between option one and option two.







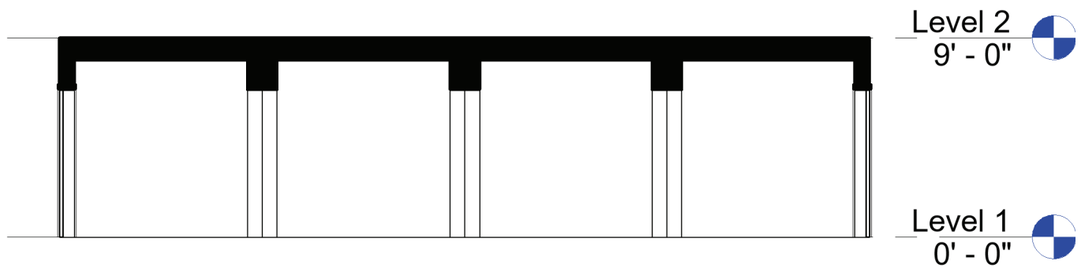


Figure 96 - Design Scheme Three

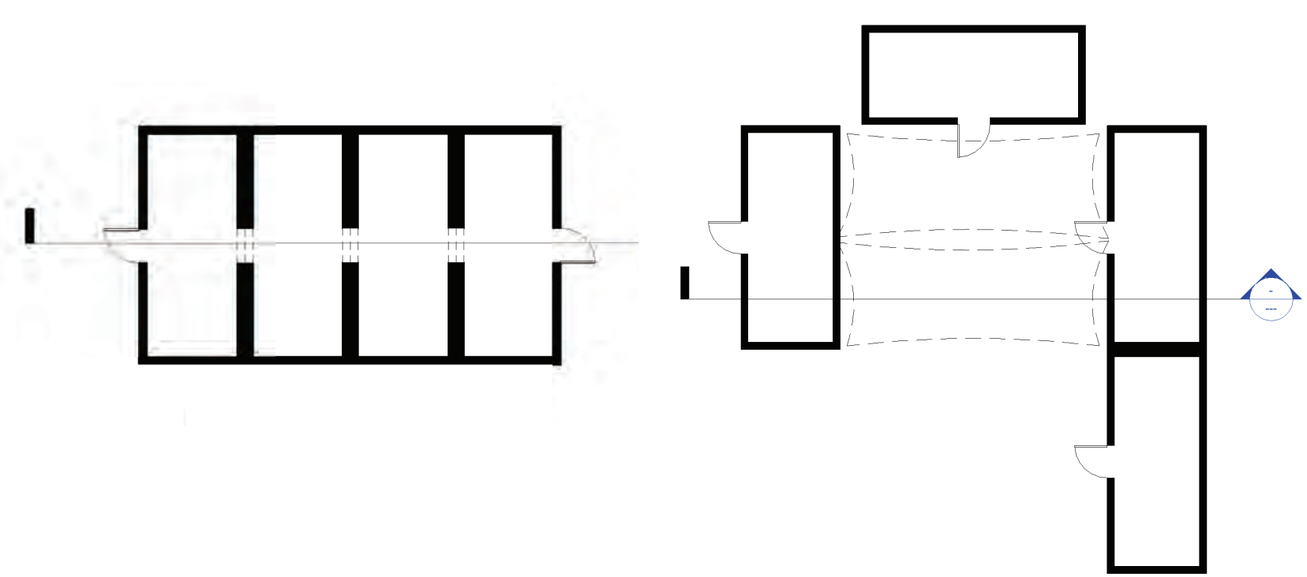


Figure 97 - Design Scheme Three Inbetween

PROCESS: **SCHEME THREE**
SPACE BETWEEN

Summary:

Design scheme three allows the units to completely connect to each unit, but still gives the opportunity to have the unit's standalone. When the unit's standalone they can be placed in an orientation that allows a "space in between" to be utilized as an outdoor common space for whatever the units may be used for

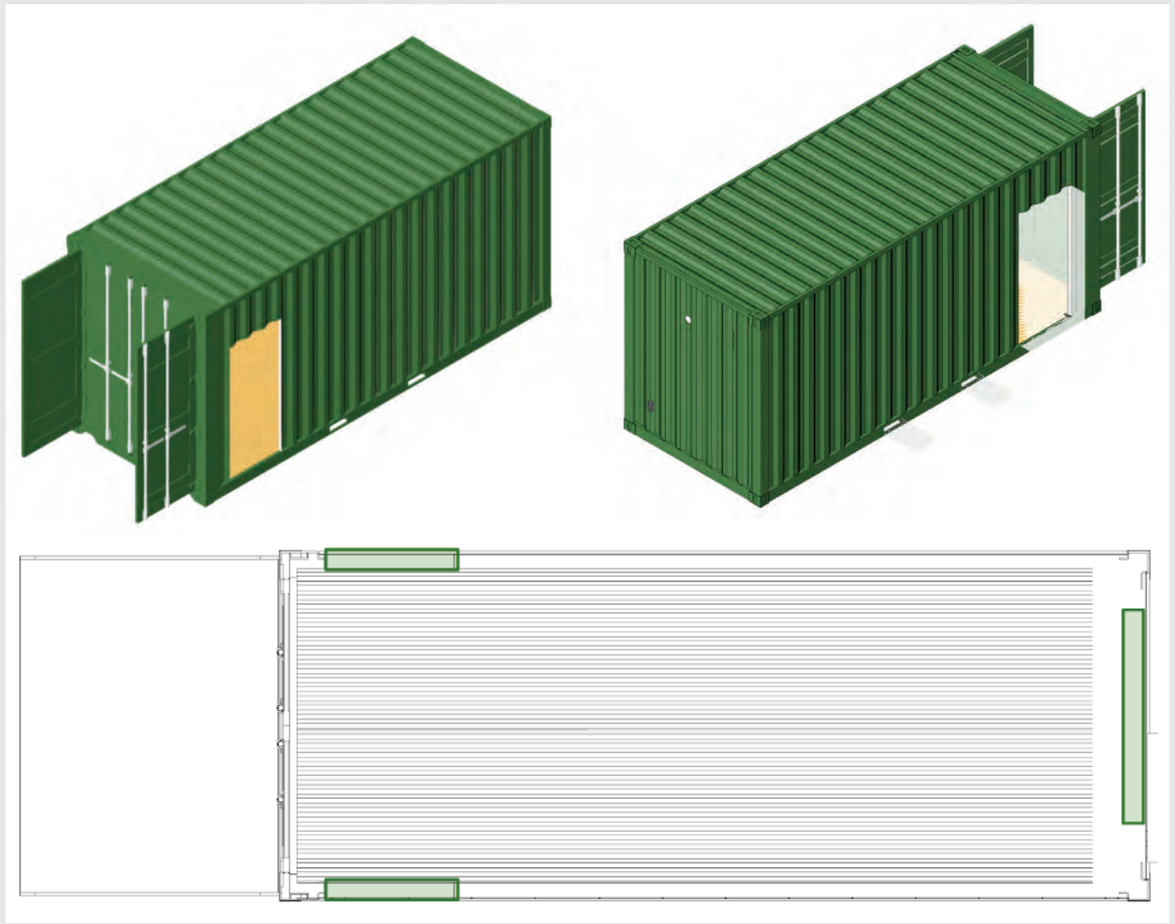
Sail Sunshades:

By using a sail sunshade, the outdoor common space is capped off on the top enclosing the space. This simple sunshade allows for shading from the sun, protection from rain, and an enclosure to the common space.

PROCESS:
INTERIOR LAYOUT

Openings Plan:

Three total openings cut into containers. One window and two service doors. The window is located on the end so daylight is brought inside when units connect to eachother, rather than having windows on the long side where daylight would be blocked when the units connect. The service doors are located opposite from the window creating an opening for a hallway when units connect.



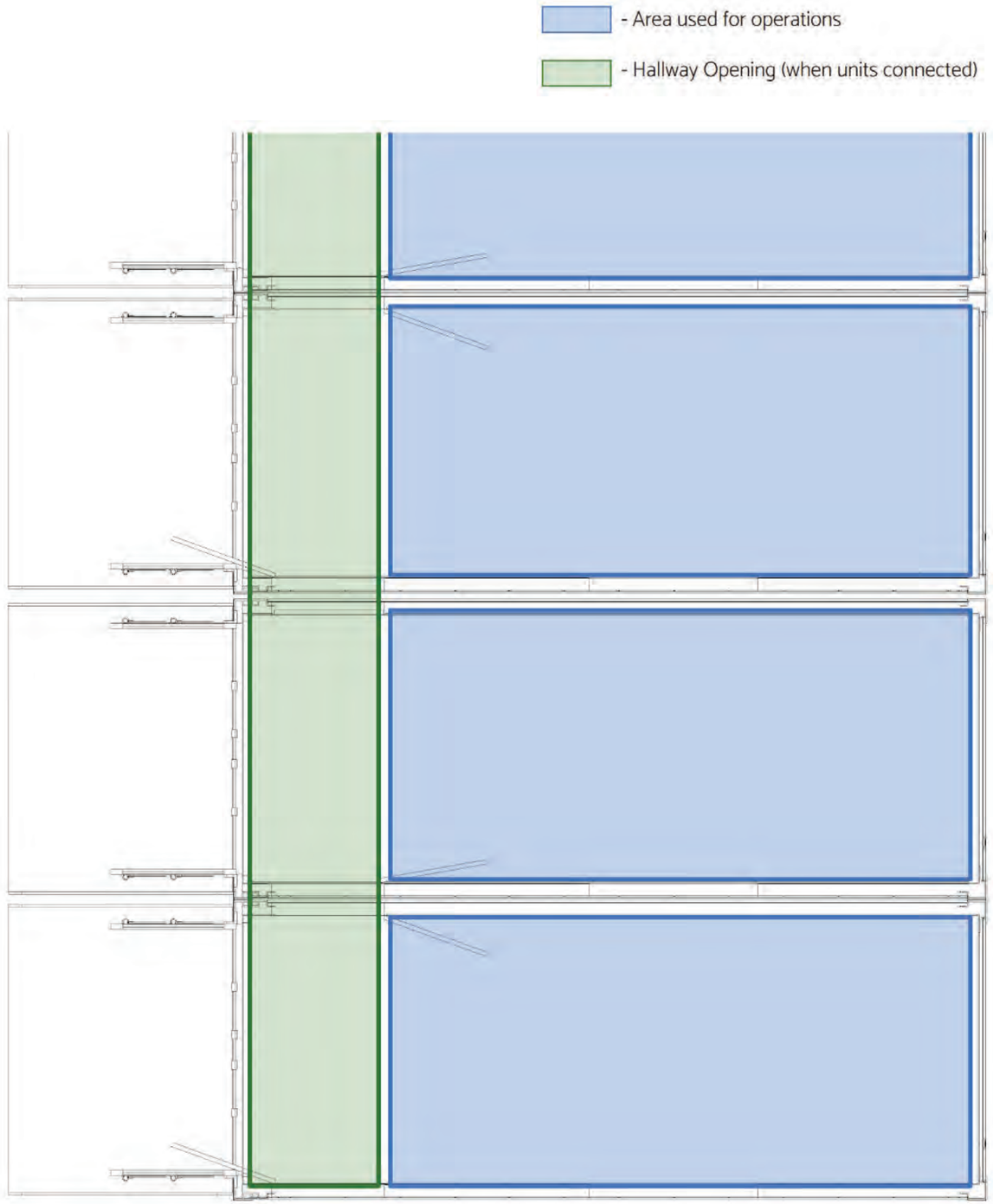
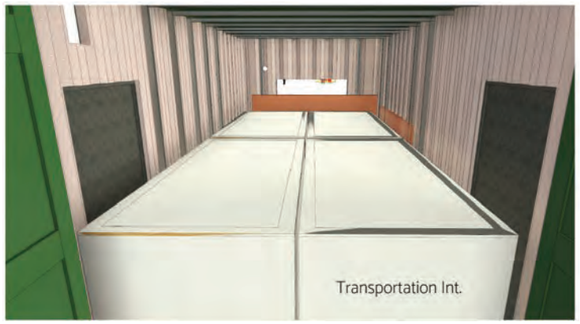
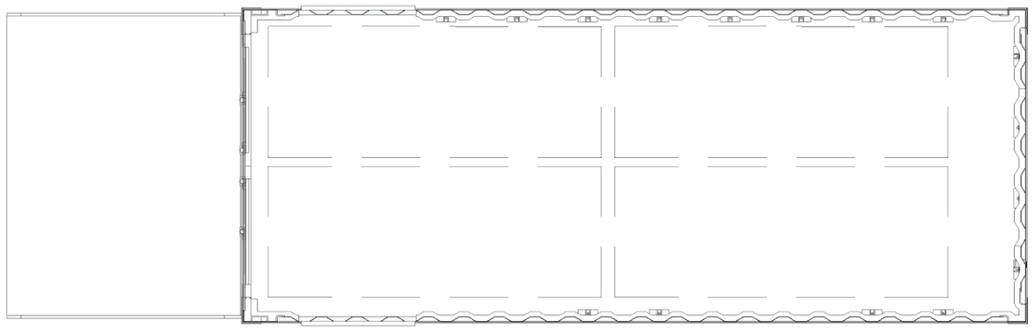
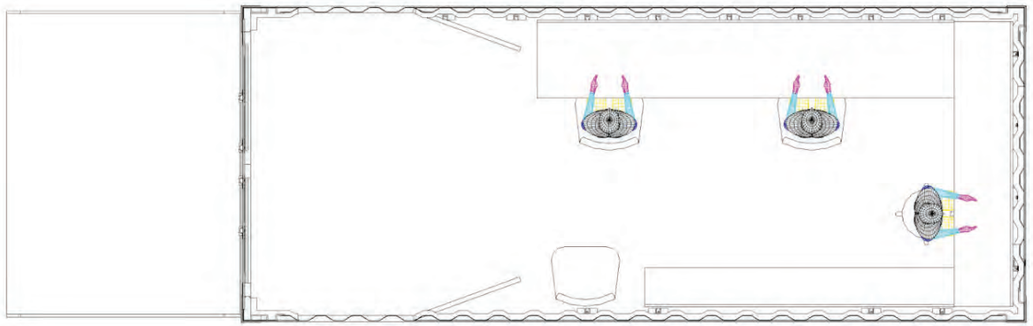
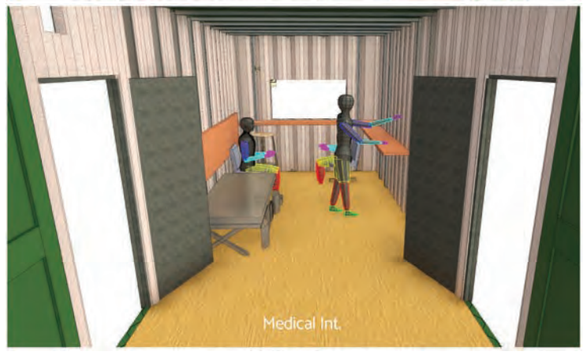


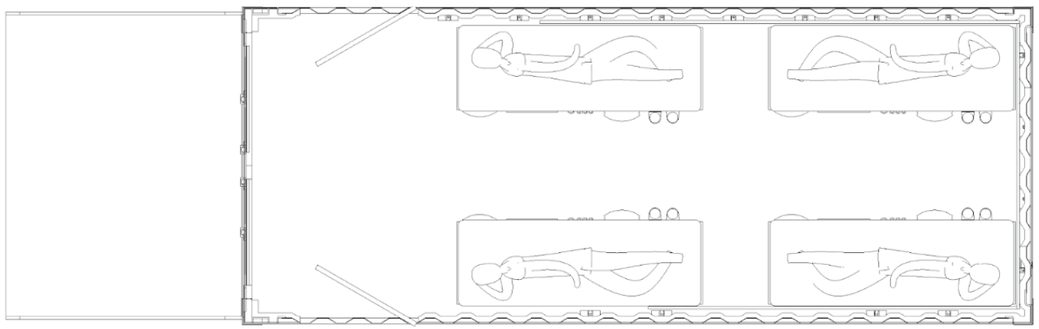
Figure 98 - Openings Plans & Isometrics











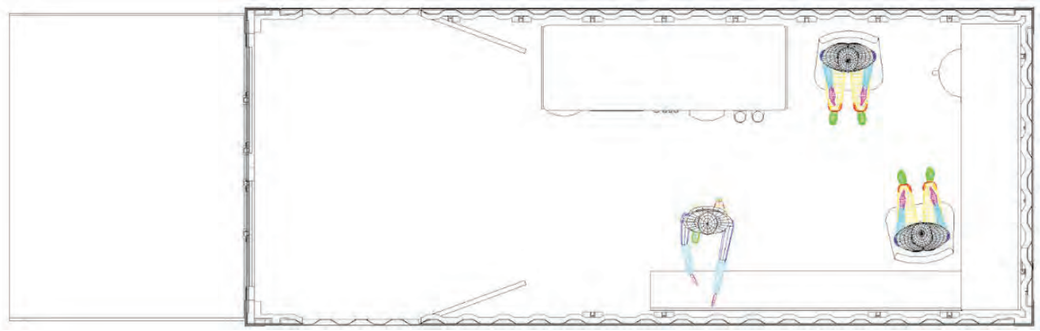


Figure 99 - Plans & Interior Perspectives

PROJECT SOLUTION:
INTERIOR LAYOUT

Storage Plan:
- All doors closed
- All Desks folded in travel position
- Allows to maximize interior space for shipment

Barracks Plan:
- All desks folded up
- Sleeps 4 people on 4 standard military cots

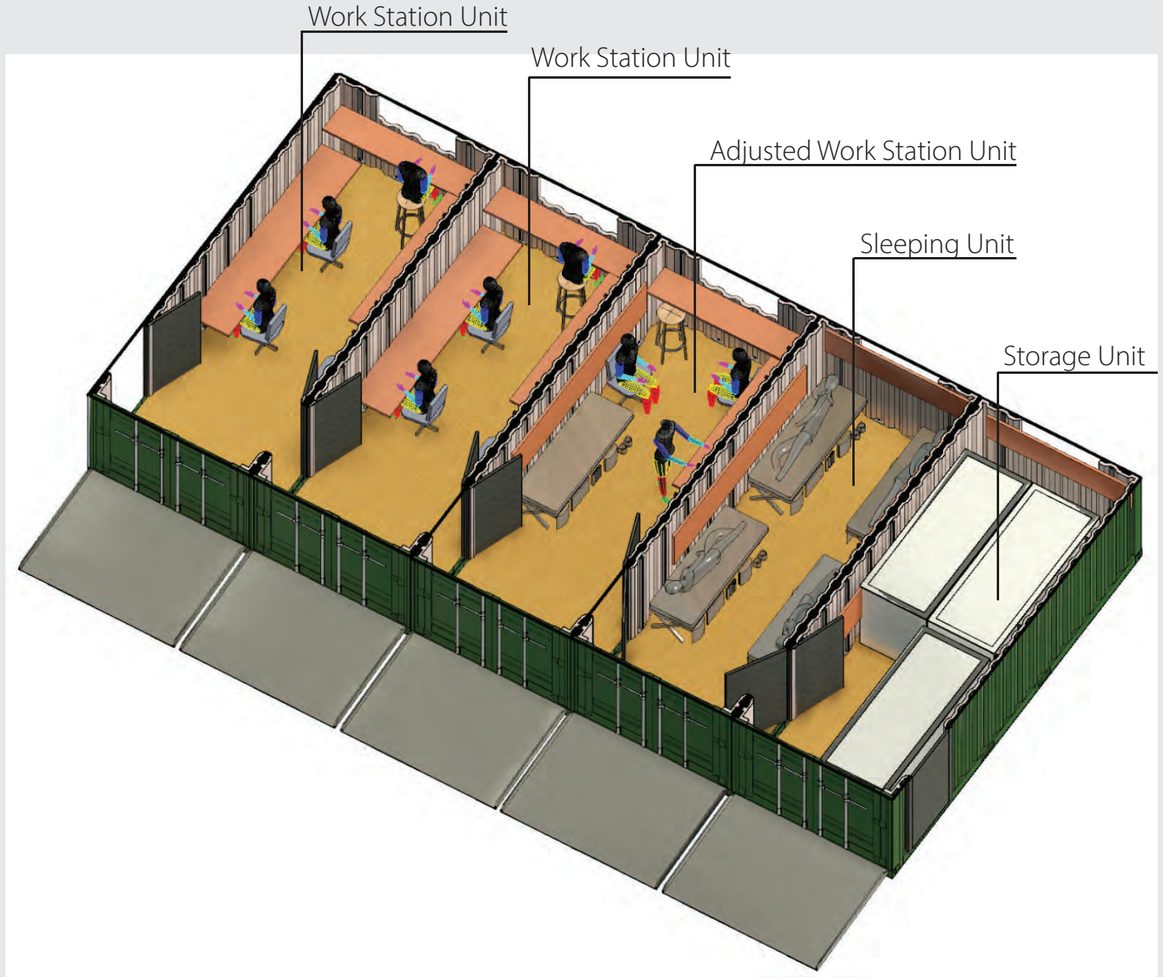
Workstation Plan:
- Used as hard sided work area
- (DRBS currently doesn't have)
- Allows for three workstations

Medical Plan:
- Main 26" desk fold up
- Add standard military cot for patient
- Now has space for a patient, doctor, and nurse

PROJECT SOLUTION: **INTERIOR LAYOUT**

Connected Containers:

The shipping containers can connect allowing a larger interior space. The different container types of use can be mixed and matched for what the specific need is during a mission. All of the service doors line up when the containers connect and when the service doors are opened they create a hallway for the modular building.



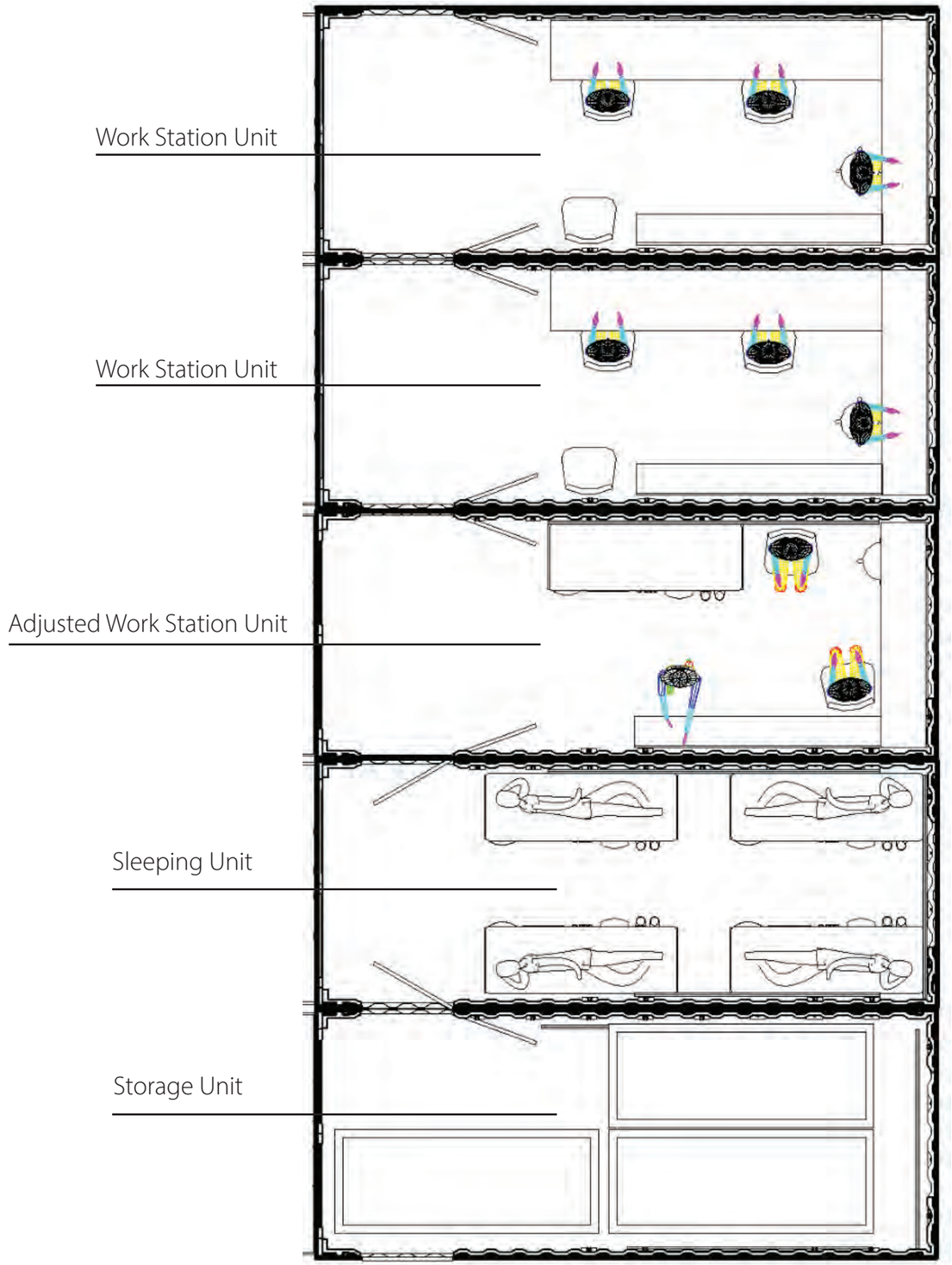
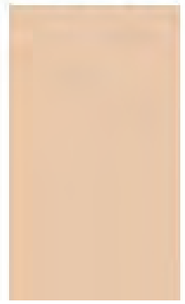


Figure 100 - Connected Unit Plans & Isometric



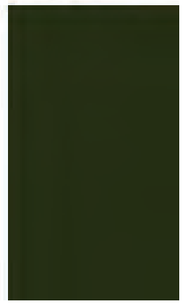


Figure 101 - Material Research

PROCESS:
MATERIALS RESEARCH

Colors of Materials:

Colors can subconsciously trigger emotions

Units will be used during traumatic events so color selection is important

Green/Blue: Makes us feel refreshed, at peace, at rest, and secure.

White: Gives sense of cleanliness, and peacefulness

Interior Walls: White
Interior Ceiling: White
Interior Floor: Dull Blue
Exterior Walls: Green

Textures of Materials:

Textures of a space can also affect emotions

Certain textures can soften rooms that have harsh lines

Curtains, plants, rugs, fabrics, water features

Curtains: Provides privacy at the doors and windows while softening the interior

PROJECT SOLUTION:
MATERIAL SELECTIONS

Finish Materials:

Interior Materials must be durable so storage can come in and out without damage done

Easily cleaned and washed

Cheap in price

Interior Floor: Epoxy poured - Light blue tint

Interior Walls: PVC Panels - White

Interior Ceiling: PVC Panels - White

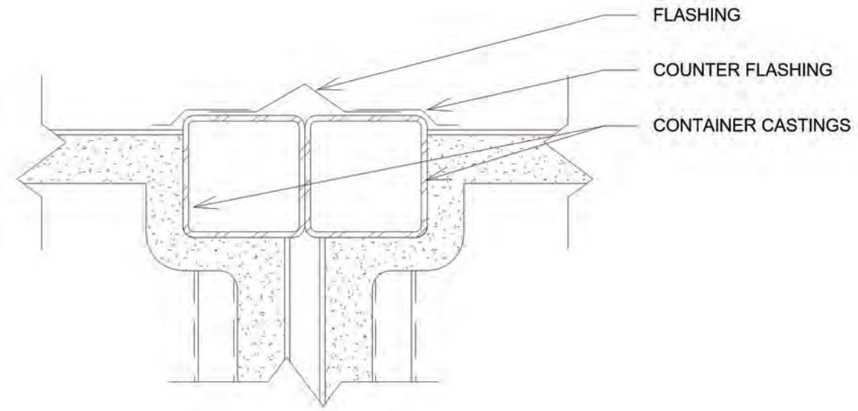
Exterior: Existing container - Painted green

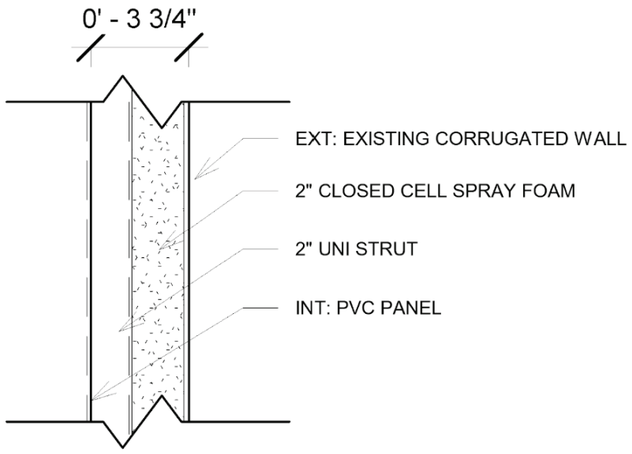
Windows & Doors: Hollow Metal

Figure 102 - Material Selections

Figure 103 - Material Example

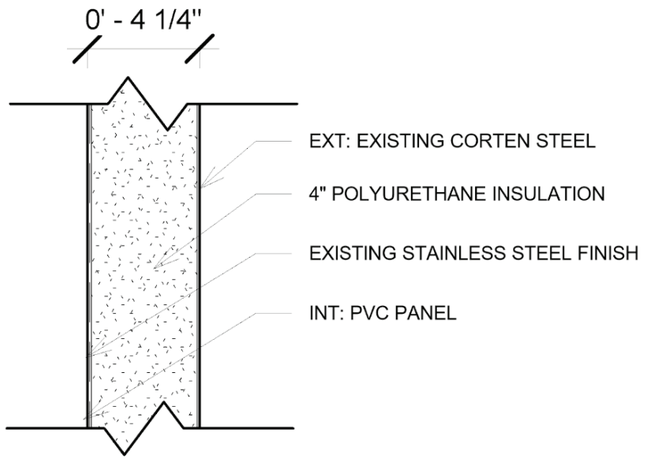
PROJECT SOLUTION:
DETAIL DRAWINGS





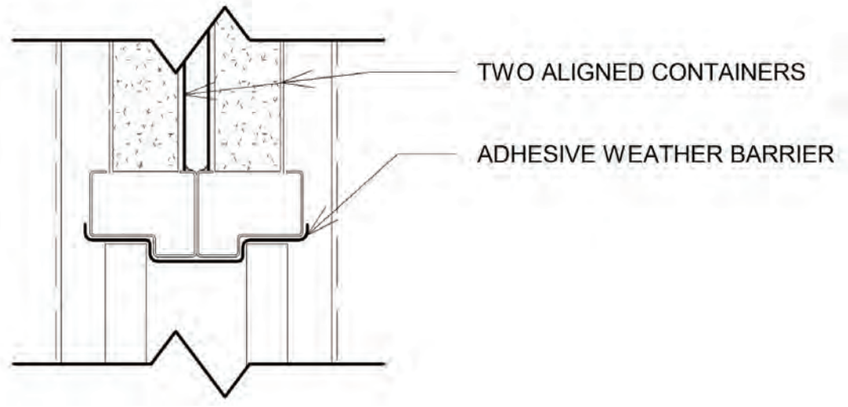
Shipping Container:

2" Spray Foam existing corrugated wall
Tight and consistent air seal up to openings
R-value of 13
Frame and interior finish



Reefer Container:

Existing Wall just add interior finish
Tight and consistent air seal up to openings
R-value of 20

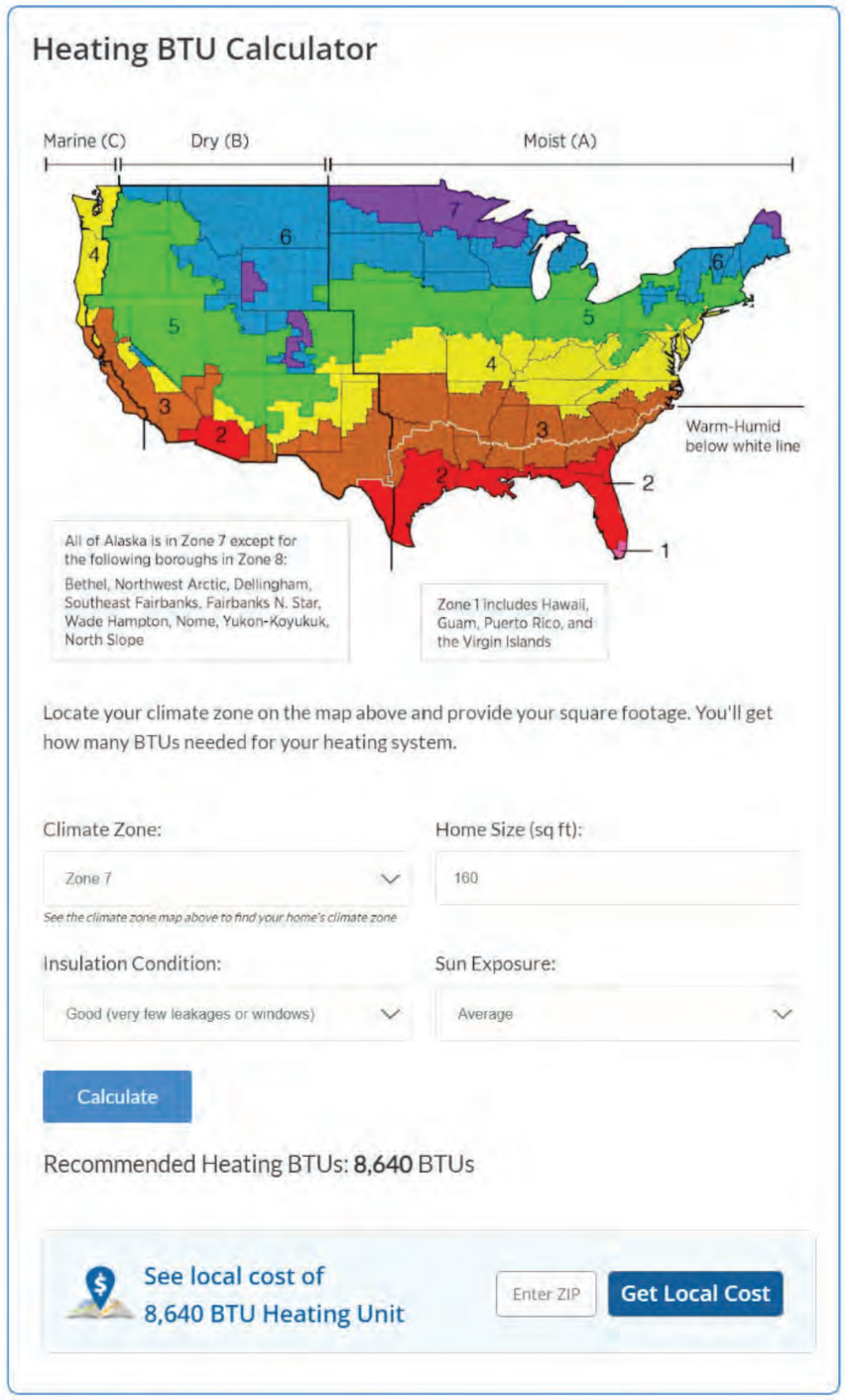


Container Door Connection:

Containers connect where service doors meet.
Adhesive weather barrier applied to interior head, jamb, and foot of doorway.

For long term sites, addition of flashing to the exterior of the container roof and walls can be used if needed.

Figure 104 - Detail Drawings



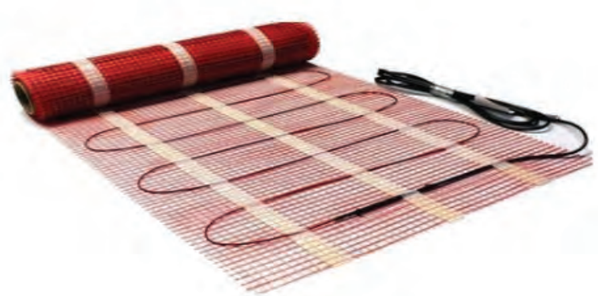


Figure 105 - HVAC Equipment Research

PROCESS:
HVAC SYSTEMS

HVAC Loads:

Floor Area: 160 sq.ft.
Max Heating Load: 8,500 btus
Max Cooling Load: 5,200 btus

Air Conditioning:

Half Ton Mini split heat pump
6,000 BTUs
Efficient way to cool small space with large cooling load

Heating:

Underfloor Electric Heat (15w = 50 btus/sq.ft.)
(50 btus/sq.ft.)(160 sq.ft.) = 8,000 btus
Efficient way to heat small space with a large heating load

Ventilation:

Active: Mini Split fan for air movement
Passive: Natural ventilation openings for fresh air (one high one low)

SOLUTION:
HVAC SYSTEMS

Air Conditioning:

- Half Ton Mini split heat pump

Heating:

- Underfloor Electric Heat
- Mini split heat pump to supplement

Ventilation:

- Mini Split fan
- Fresh air vents

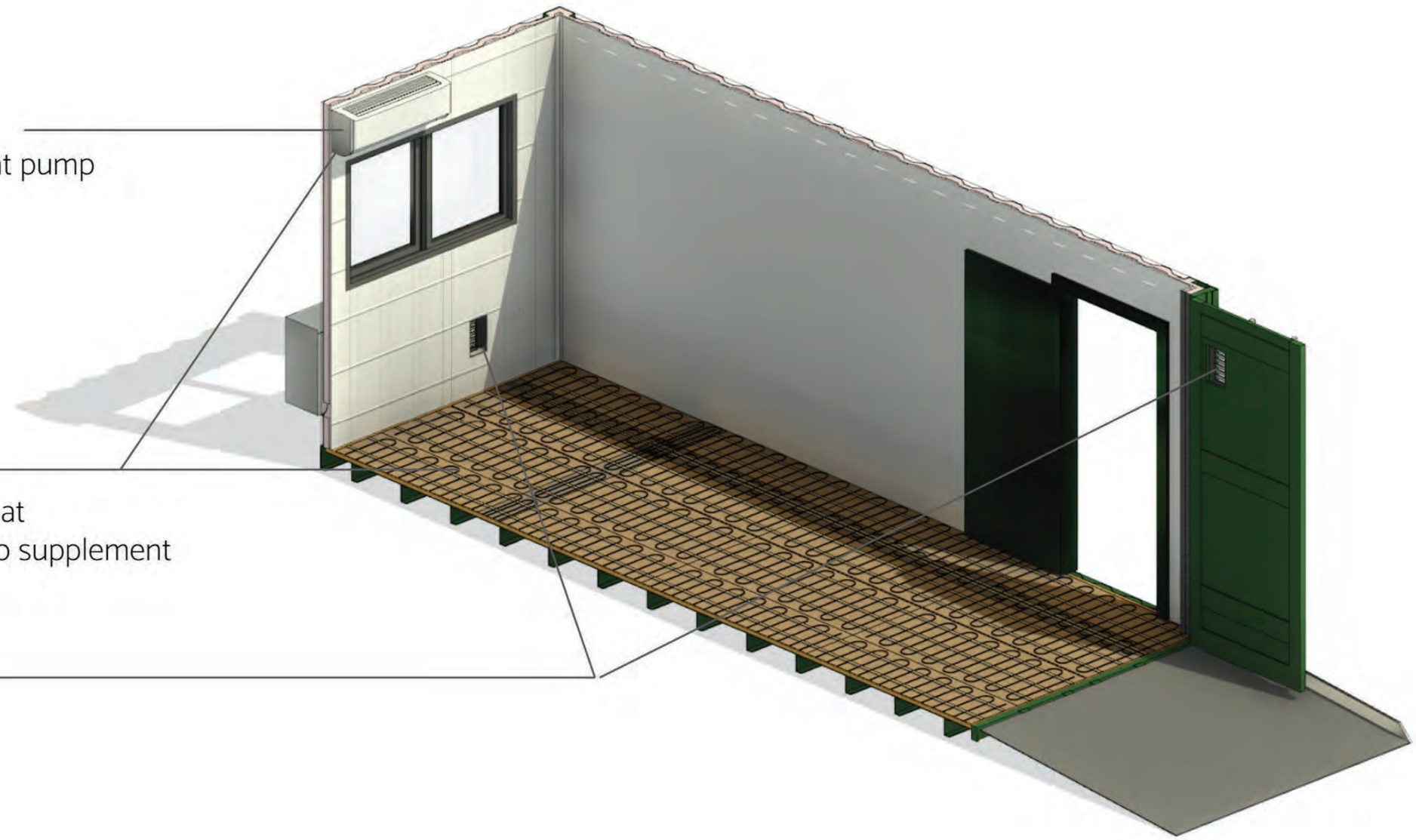


Figure 106 - HVAC Equipment Example

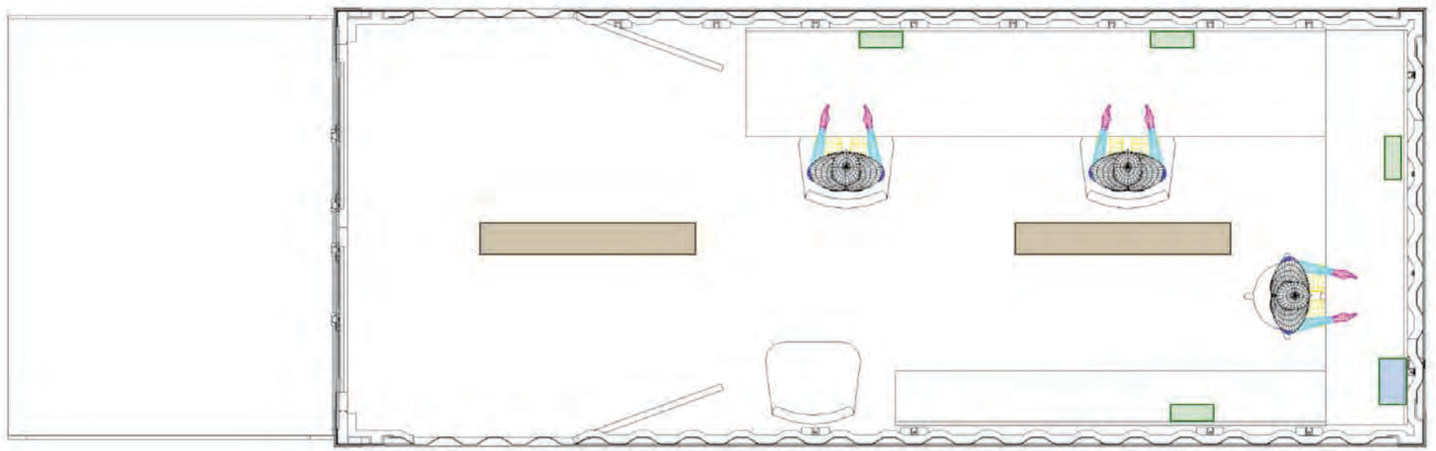


Figure 107 - Electrical Equipment Example

SOLUTION:
ELECTRICAL SYSTEMS

Electrical:

- Can be wired into the existing generator system that comes with the DRBS, or connected to the sites electrical grid if available

- Two different incoming 240 vac exterior wall receptacle

- Circuit breaker located inside

- Four interior 120 vac wall receptacles

- Two dimmable shop lights

- Mini Split requiring 120 vac

- Shop Lights - Wall Receptacles - Circuit Breaker

SOLUTION:
COMMUNICATION SYSTEMS

Communications:

For communications a wired access point mounted on the ceiling of the container provides WiFi when connected to a network. For a network two ethernet wall port locations are on both long walls of the unit providing direct internet access through the ports. All of these communication

- Two CAT6 wall ports

- One ceiling mounted (WAP) Wireless Access Point

CAT6 Wall Ports

WAP Ceiling Mount

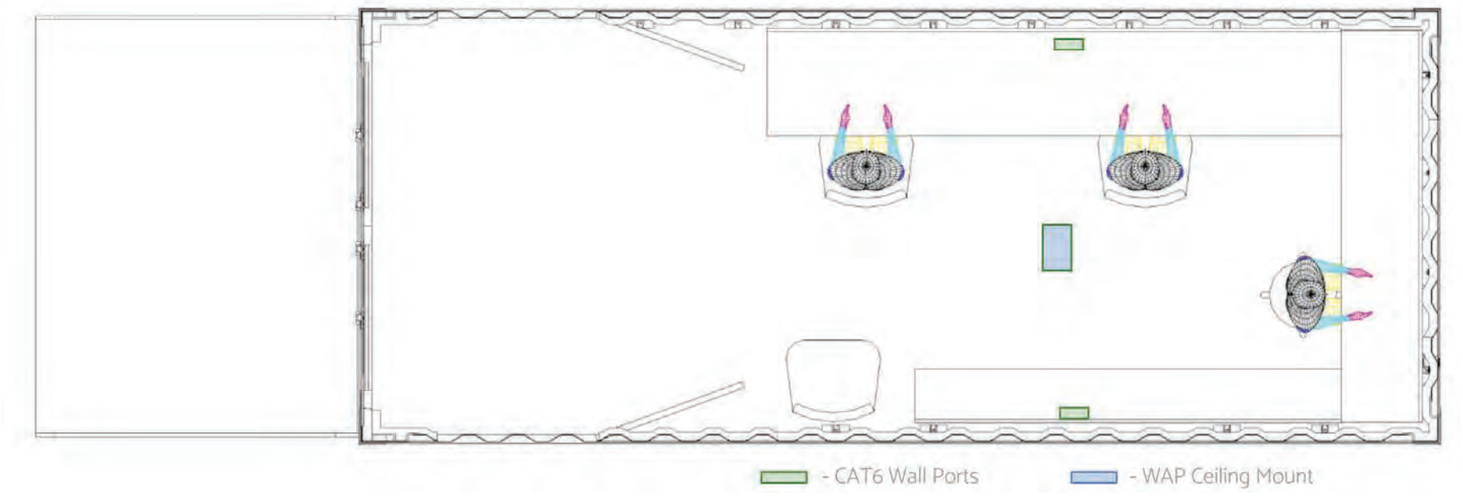


Figure 108 - Communication Equipment

Figure 109 - Sustainable Equipment

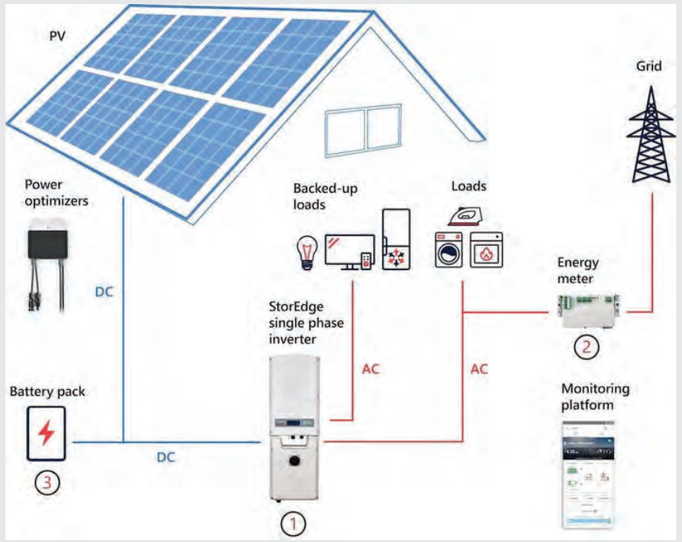
SOLUTION:
SUSTAINABLE SYSTEMS

Sustainability:

Sustainable systems can be used to provide supplemental energy. Adding sustainable energy sources like solar panels and wind turbines can also provide energy in rural places without an electric grid to plugin to.

- Field wind turbine can be added for supplemental electricity

- Similarly solar panels can be used for off grid electricity



SOLUTION:
END DESIGN

End Container Design:

The following images represent an example of the final shipping container renovation. The renovation starts with either a conventional or reefer container. Three holes are cut in the walls for two service doors, and one window. The building systems consist of mechanical, electrical, and communication. The interior finish materials consist of a light blue epoxy floor, glossy white PVC panel walls and ceiling. The interior has fold-able desks for work spaces. All of the program points noted below were achieved through this design:

Transportation:

Unit configured for transport (flatbed semi, helicopter & cargo plane, rail, etc.)
Lightweight —> Less expensive to airlift
Durable to sustain transportation
Maximize interior space for equipment storage

Communication:

Provide communication ports for wifi

Operation:

Consolidate current DRBS system from non usable storage containers into containers providing livable spaces
Flexible unit connections to maximize interior spaces
Efficient MEP systems
Daylighting
Flexible furniture for work spaces
Storage space
Durable, easily cleaned, cost effective
Sustainability
Mental Health / Trauma in mind

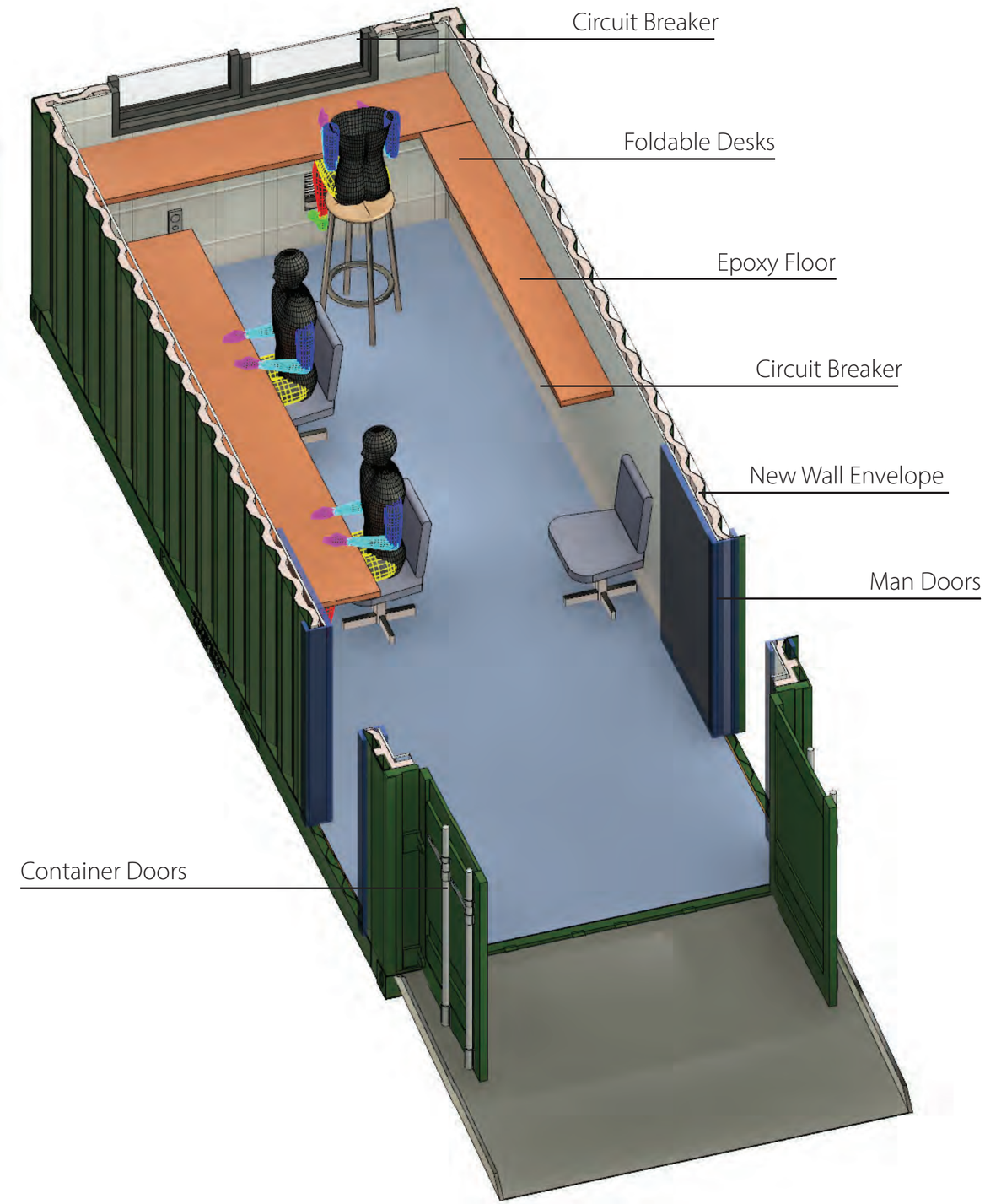


Figure 110 - End Design of Unit 1

Figure 111 - End Design of Unit 2

SOLUTION:
END DESIGN

End Container Design (connected):

When the containers are emptied of all DRBS equipment they are compatible with each other to connect along the long sides of each container. A sunshade can be included to provide a closed off outdoor space between the connected containers. The end result of the connections create a linear modular multi-use building.

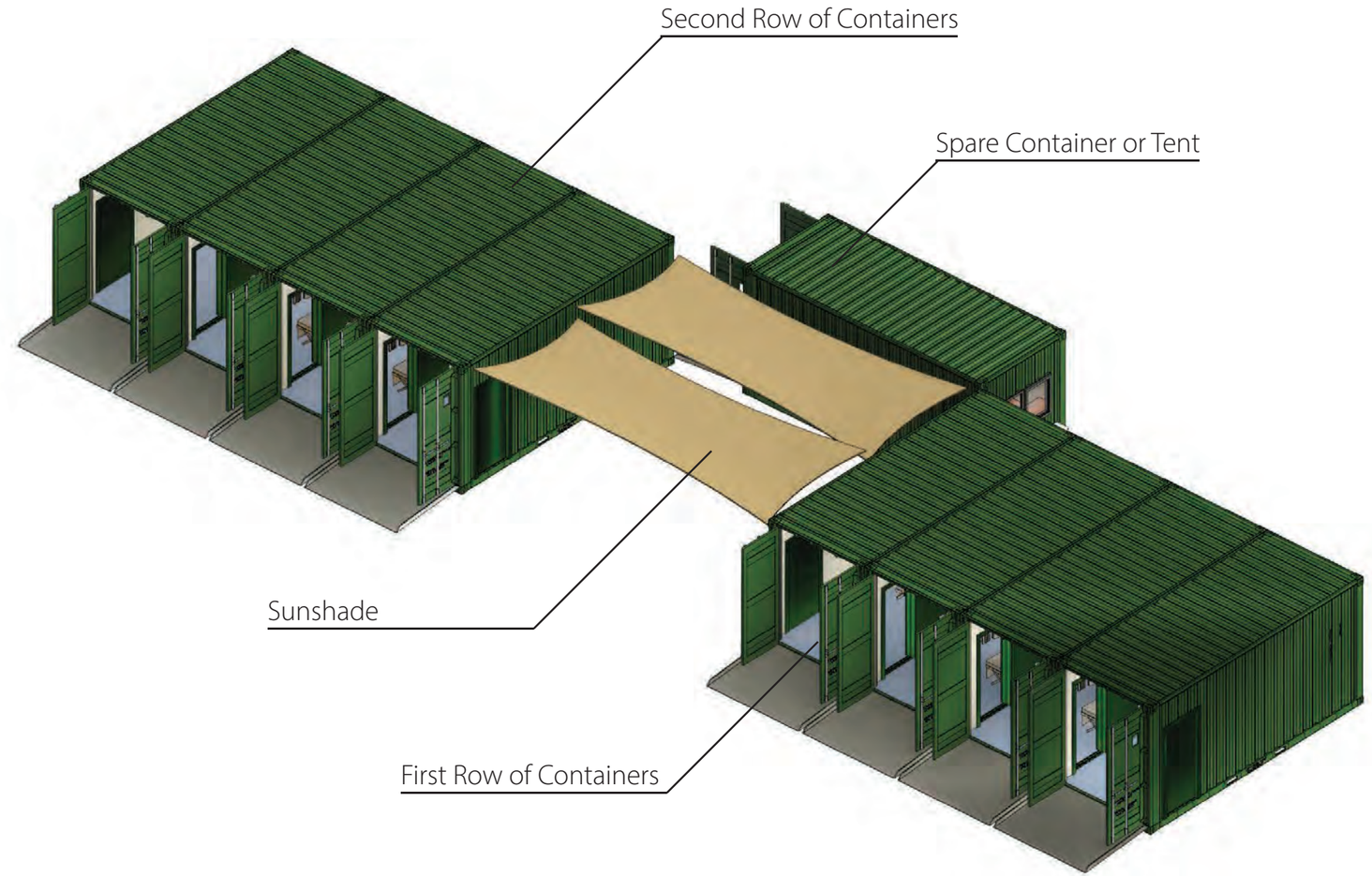


Figure 112 - End Design of Unit 1

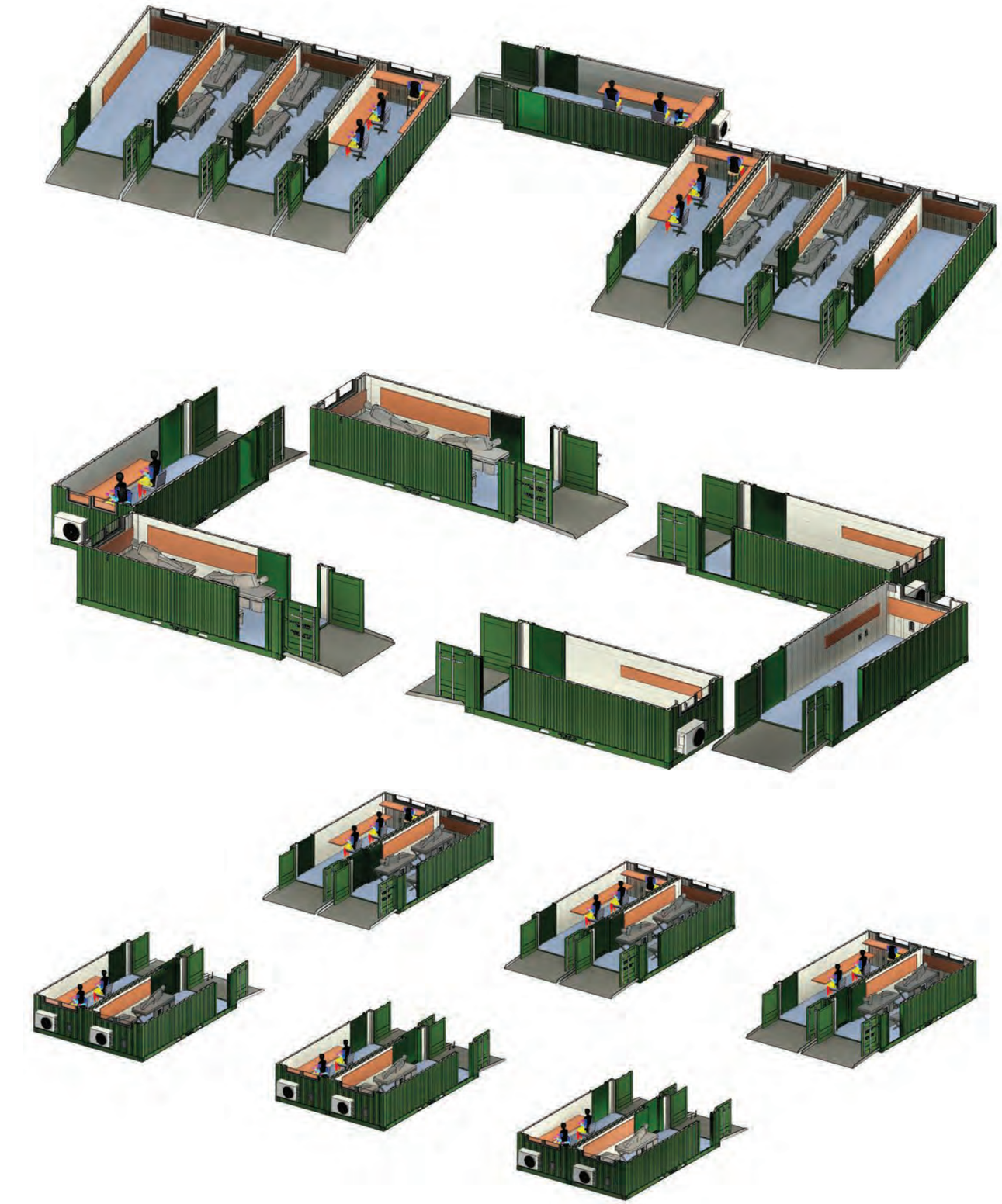


Figure 113 - End Design of Unit 2

SOLUTION:
END DESIGN

End Container Design (connected):

The interior floor plan of this linear, modular, multi-use building is customizable as well. The interior options for a single container are storage, workspace, adjusted workspace, and sleeping space. When the containers connect to each other, these interior options can be mixed and matched so a modular building consisting of 9 container units could have 4 sleeping units, 3 working units, and 2 storage units, or any other combination that is needed.

The units can only connect to each other on the long walls of the containers. But the number of units that must connect is not fixed, and the outdoor space in between the units can also be used to provide new layouts.

In-between the flexibility of the interior floor plan options and the customizable exterior configurations this container building system allows extreme flexibility to fulfill the infrastructure needs of disaster response teams.

AINA

Figure 114 - Site Teaser

Construction:

Regional Construction:

Due to the many different climate regions across the United States the construction of the new shipping container units may vary per region. A container built for a desert climate in the southwest will have slight differences in construction needs compared to a container in a northern climate.

To tackle this regional issue regional National Guard units could be responsible for construction of these new shipping container retrofits. Each state has at least one National Guard and depending on the type of units they have they will have the required personnel to retrofit these shipping containers.

On Air National Guard bases there is in most cases a Civil Engineering squadron responsible for building, and maintaining the base. This CE Squadron has engineers, architects, HVAC techs, electricians, carpenters, and plumbers. This teams of tradesman are well capable to complete the retrofits of the proposed shipping container design.

Figure 115 - HVAC Working

Figure 116 - Container Construction

Construction:

Beddown Exercise:

Before Construction starts the containers must be shipped to the base first. To minimize cost the National Guard bases responsible for the retrofitting of the containers should be the bases located where there are a lot of surplus containers. This way the containers can be purchased for less and will require shorter transportation to the base where they will be retrofitted.

Once at the specific base construction will start.

- Holes punched through walls for man doors, the window, vents, and electrical

- Interior framed with uni-strut

- Electrical, communication, HVAC systems installed

- Spray foamed insulation

- Finishes for floor, walls & ceiling.

- Exterior painted and identification markers added

- Put into ready line

Once the container retrofits have been completed the DRBS equipment will move from the old containers into the new so they will be ready to deploy at a moments notice.

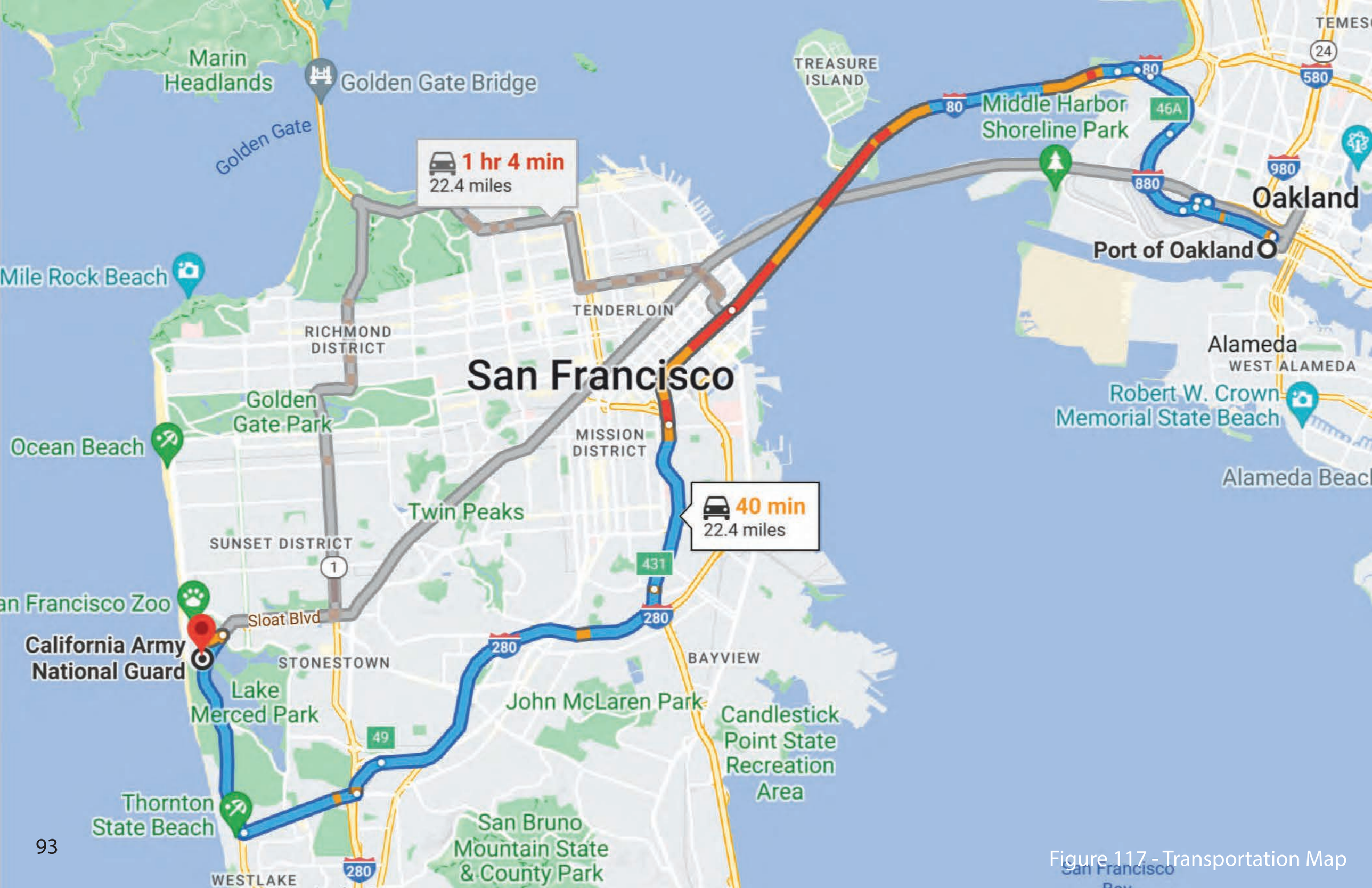


Figure 117 - Transportation Map

Final Cost Analysis:

Container:
The cost of purchasing the container unit for the National Guard will vary from location due to local supply and demand. For this example, the San Francisco, CA National Guard will be used due to their close location to a surplus of shipping containers. Cost of used shipping container: **$3,000**

Transportation:
The cost to transport the container by truck can vary from $1 to $4 per mile. The container will need to cross about 15 miles to the San Francisco National Guard Base. Cost to transport: **$60**

Structure Work:
Service Window: $1,500
(2) Hollow Metal Doors: $3,800
(30) 10' Uni-strut Framing: $315
2" Spray Foam Insulation: $2,000
Total: $7,615

Materials:
PVC Wall Panel: $1,000
($5/sqft) Epoxy Floor: $750
Exterior Paint: $250
Total: $2,000

MEC Systems:
1-ton Mini Split: $1500
Electric Heat Strips: $1300
(2) Ventilation Vents: $90
Circuit Breaker: $75
(4) Wall Outlets: $40
(2) Light Switches: $20
(2) Shop Lights: $200
Wireless Access Point: $150
(2) CAT6 Wall Ports: $20
Wiring: $200
Total: $3,600

DRBS Project Analysis

Single Unit			Complete Single DRBS Replacement	
Expense	Cost ($)		Expense	Cost ($)
Container:	3,000	(x11)	Conatiners:	33,000
Transportation	60	(x11)	Transportation	660
Structure Work	7,615	(x11)	Structure Work	83,765
Materials	2,000	(x11)	Materials	22,000
MEC Systems	3,600	(x11)	MEC Systems	39,600
Total	16,275		Total	179,025
Existing Single Cube:	14,000	(x30)	Existing Cube Totals:	420,000
	-2,275			241,000

Figure 118 - Cost Analysis Table

Regular 20’ Shipping Conatiner:

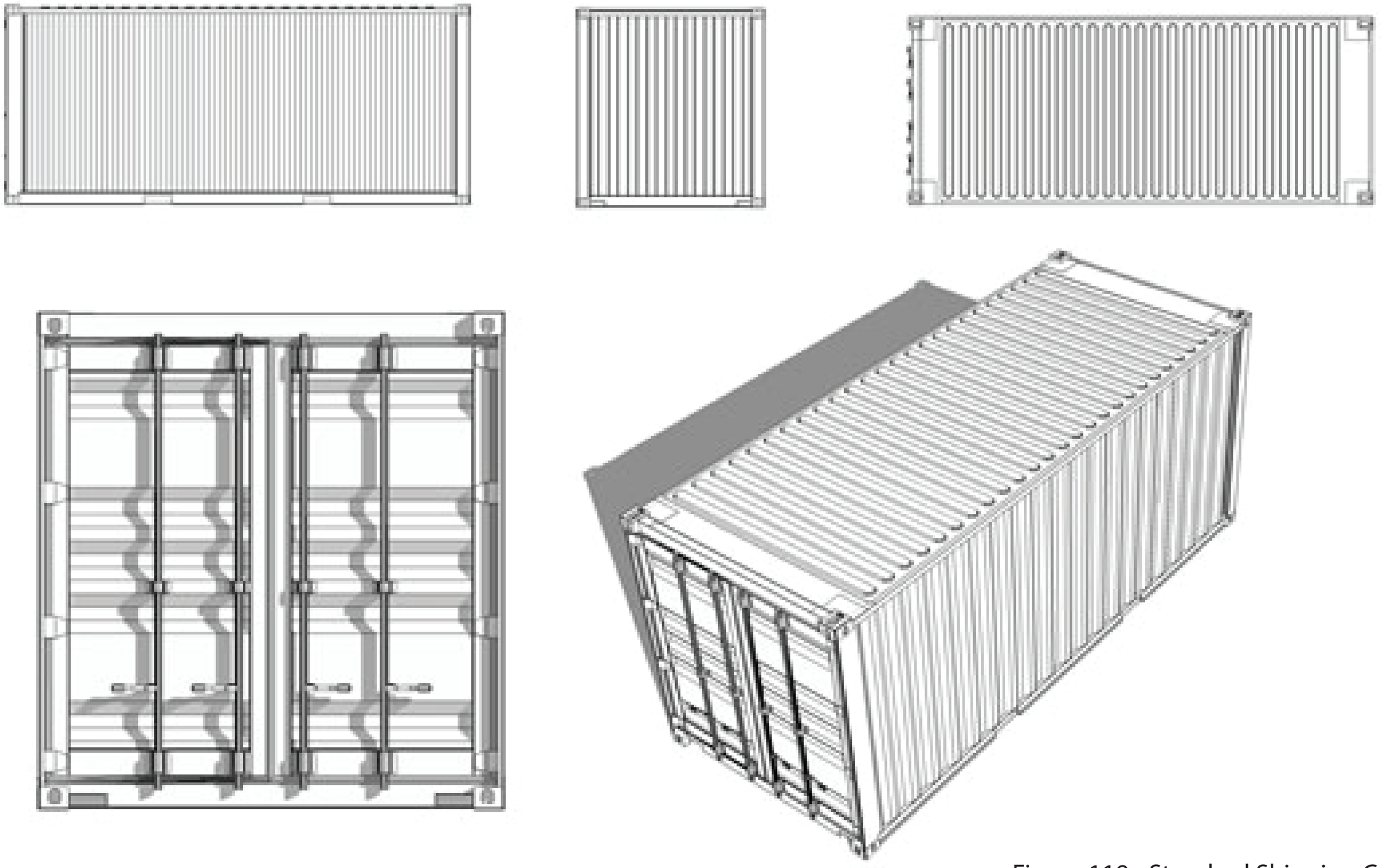


Figure 119 - Standard Shipping Container

Retro Fitted 20' Shipping Container:

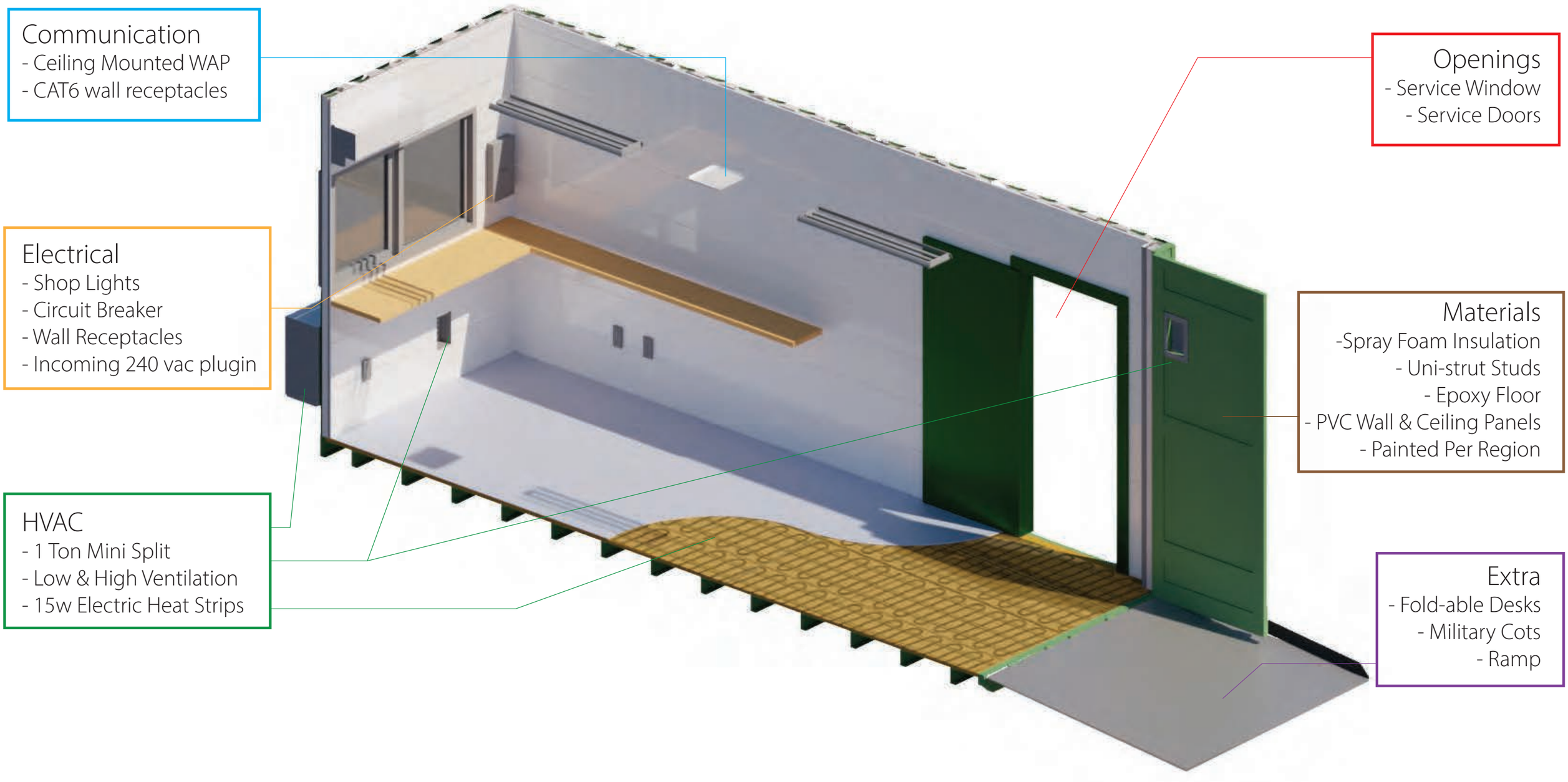
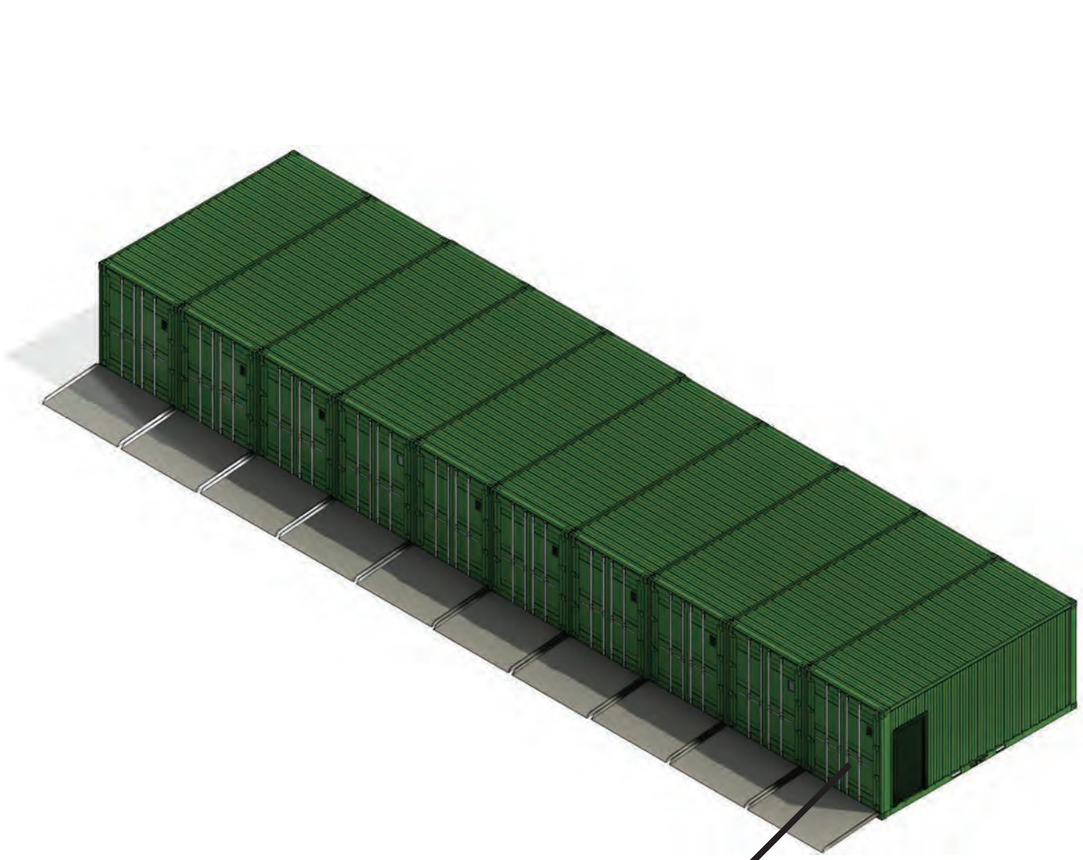


Figure 120 - New Container Design

Container Configuration Possibilities:



All Containers Connected

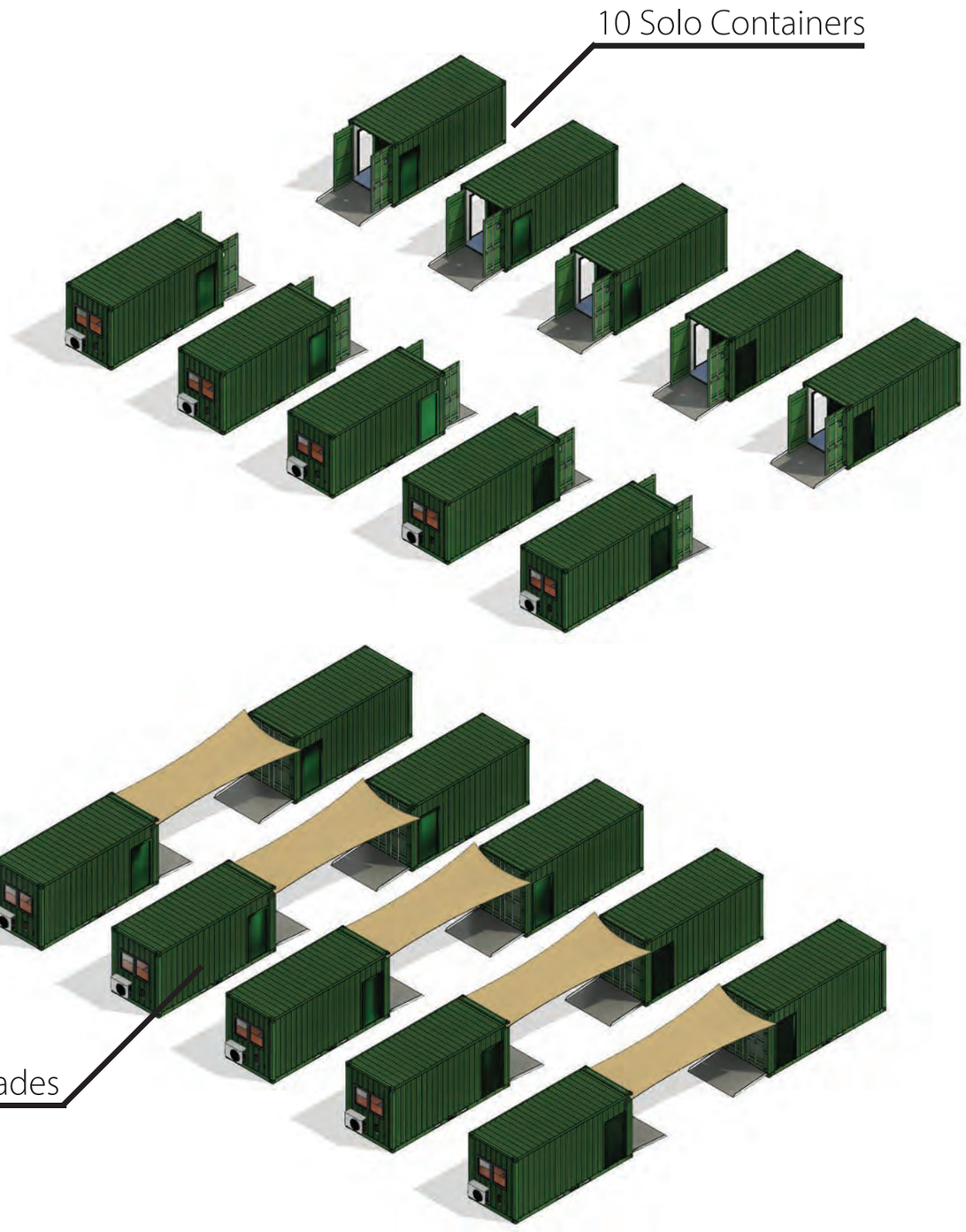
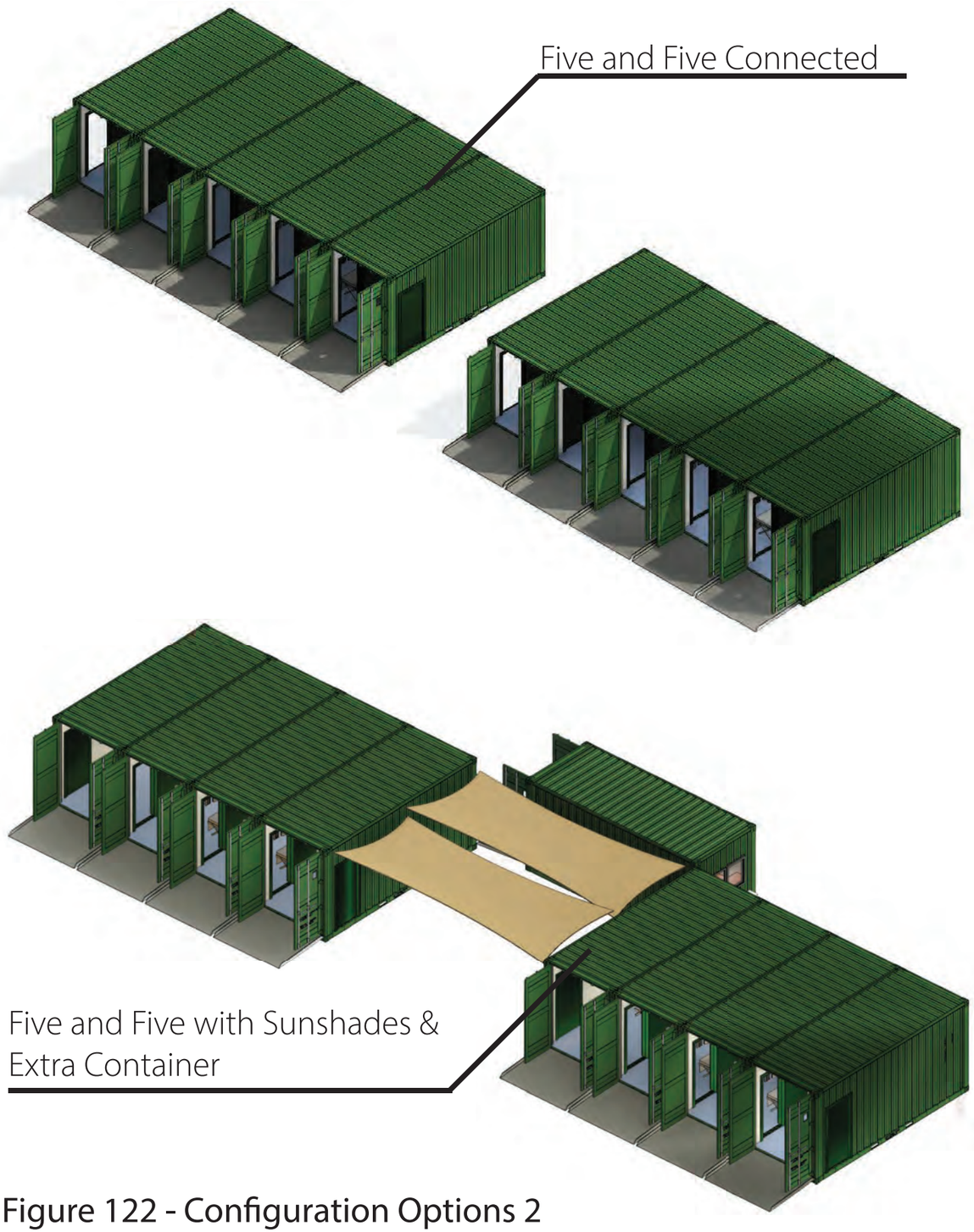


Figure 121 - Configuration Options

Container Configuration Possibilities:



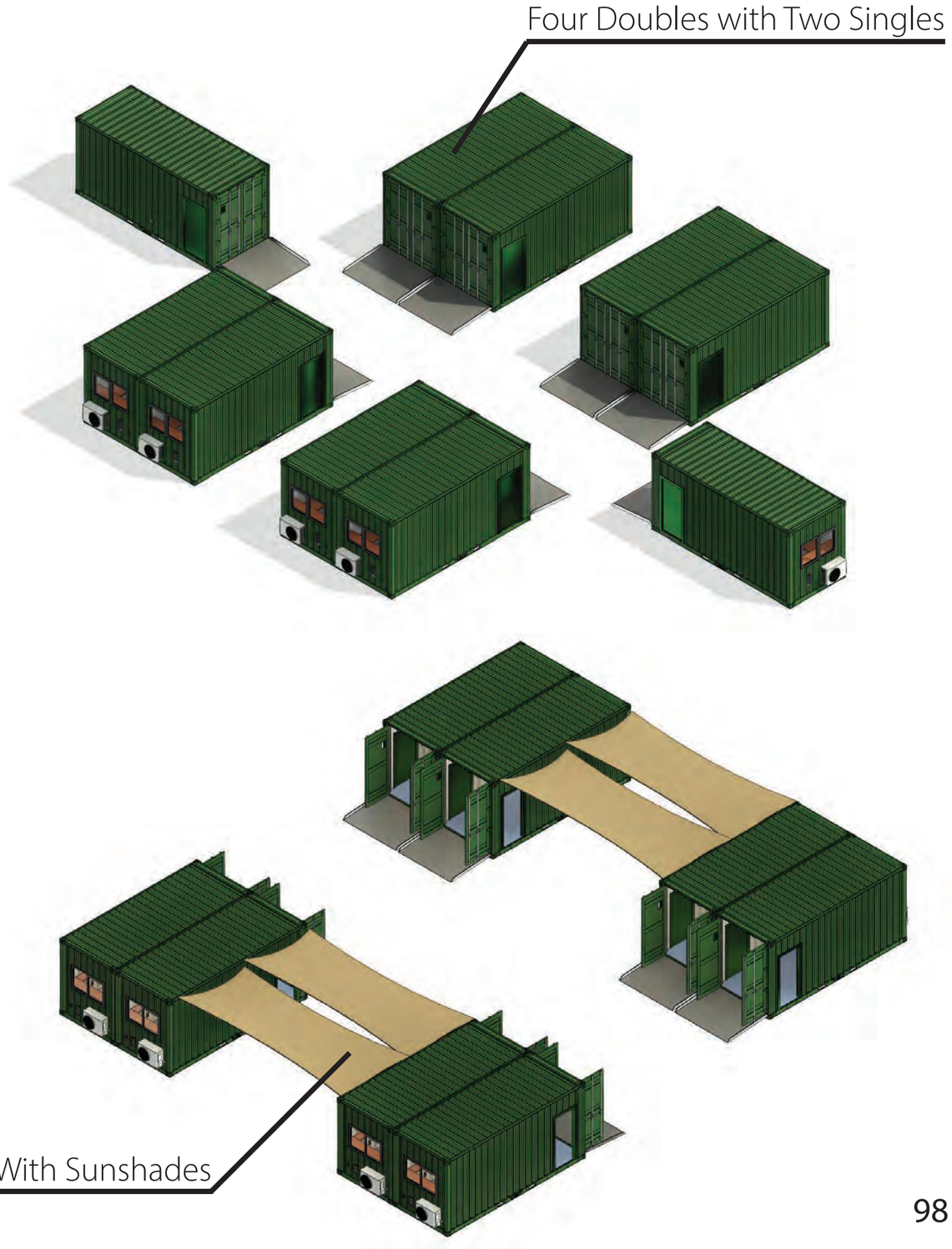


Figure 122 - Configuration Options 2

Example Configuration:

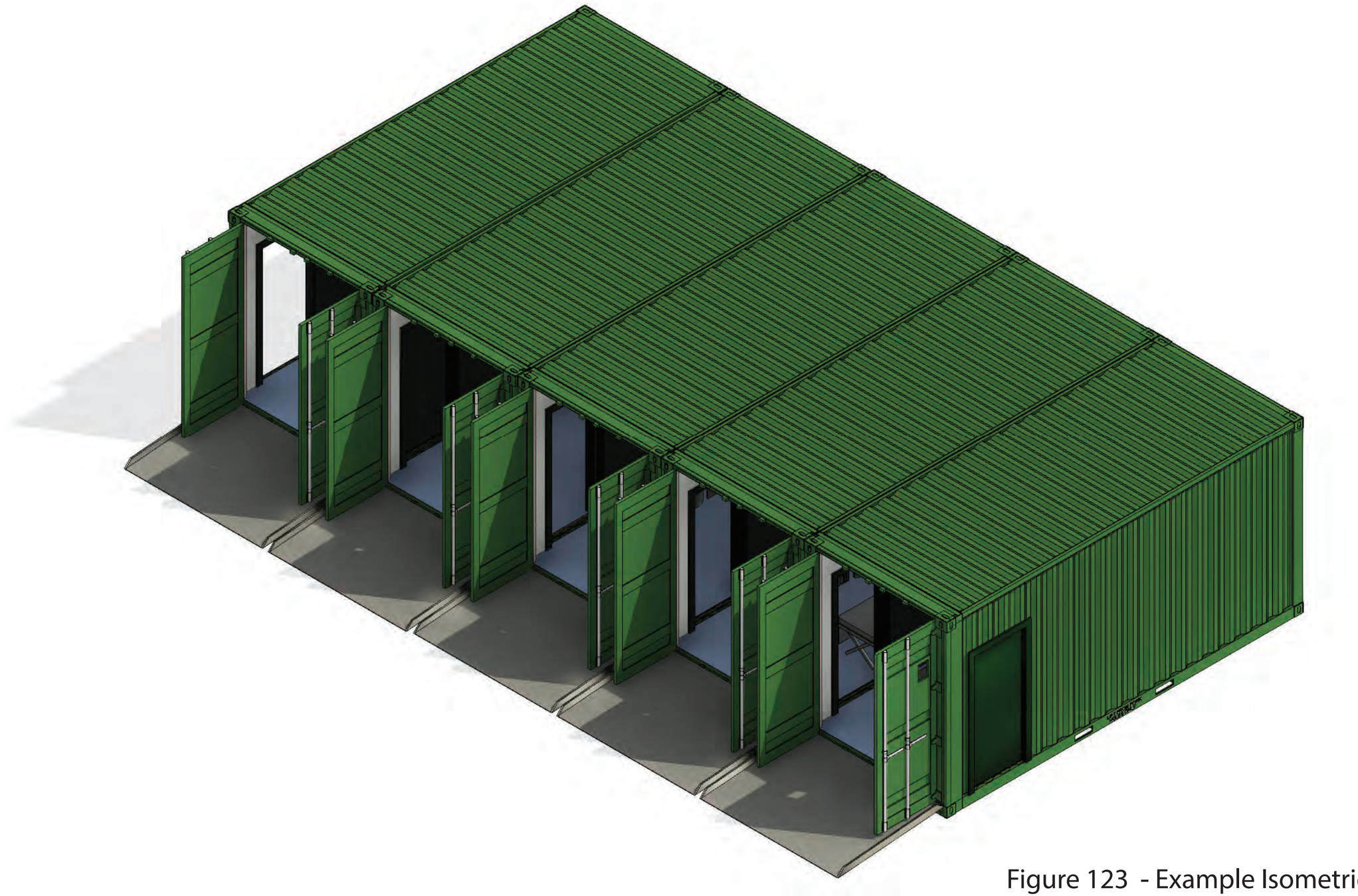
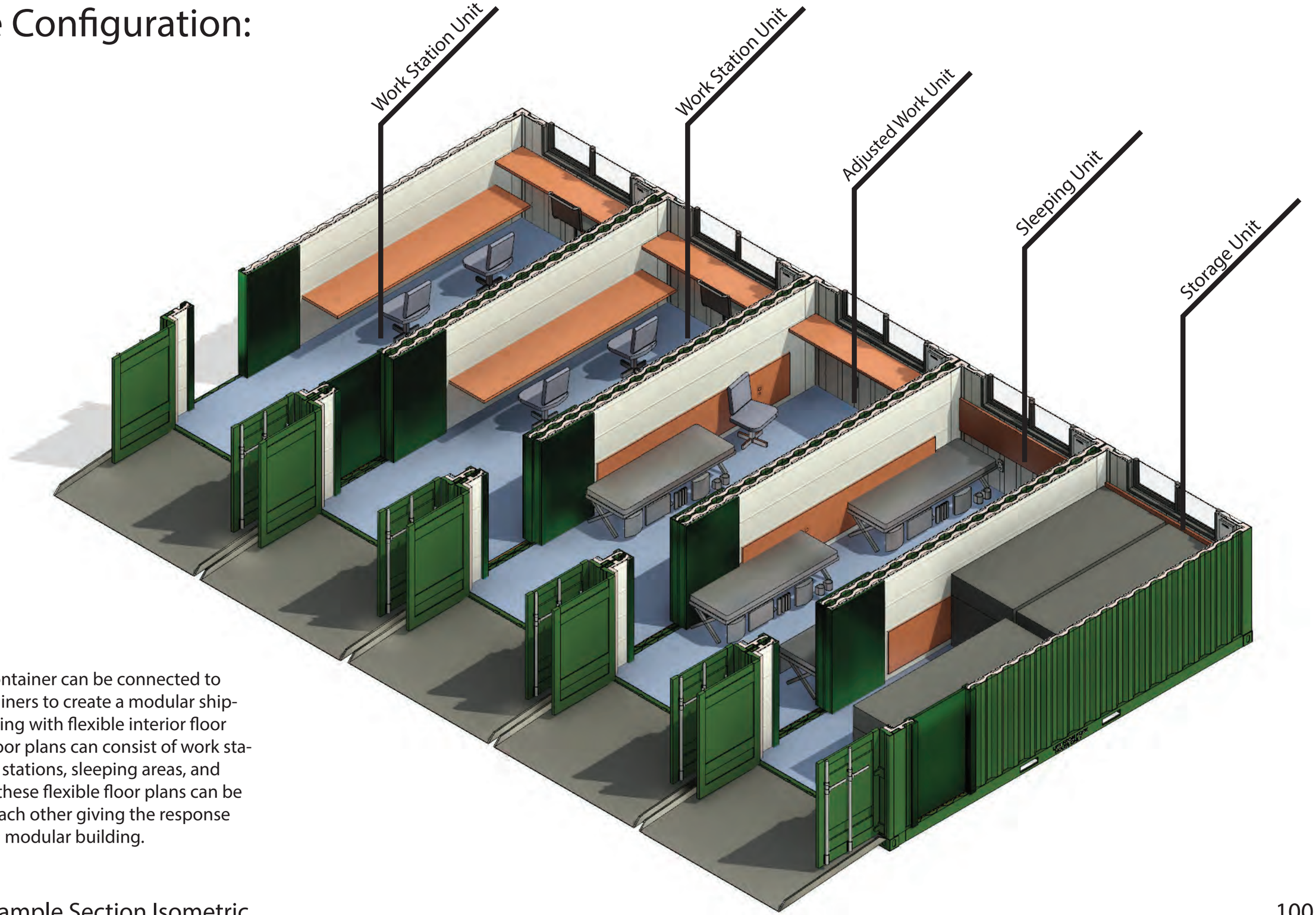


Figure 123 - Example Isometric

Example Configuration:



Note: Each single container can be connected to multiple other containers to create a modular shipping container building with flexible interior floor plans. The interior floor plans can consist of work stations, adjusted work stations, sleeping areas, and storage areas. All of these flexible floor plans can be interchanged with each other giving the response teams a flexible plan modular building.

Figure 124 - Example Section Isometric

Work Unit:

Work Unit:

Adjusted Work

Figure 125 - Example Section

Unit:

Sleeping Unit:

Storage Unit:

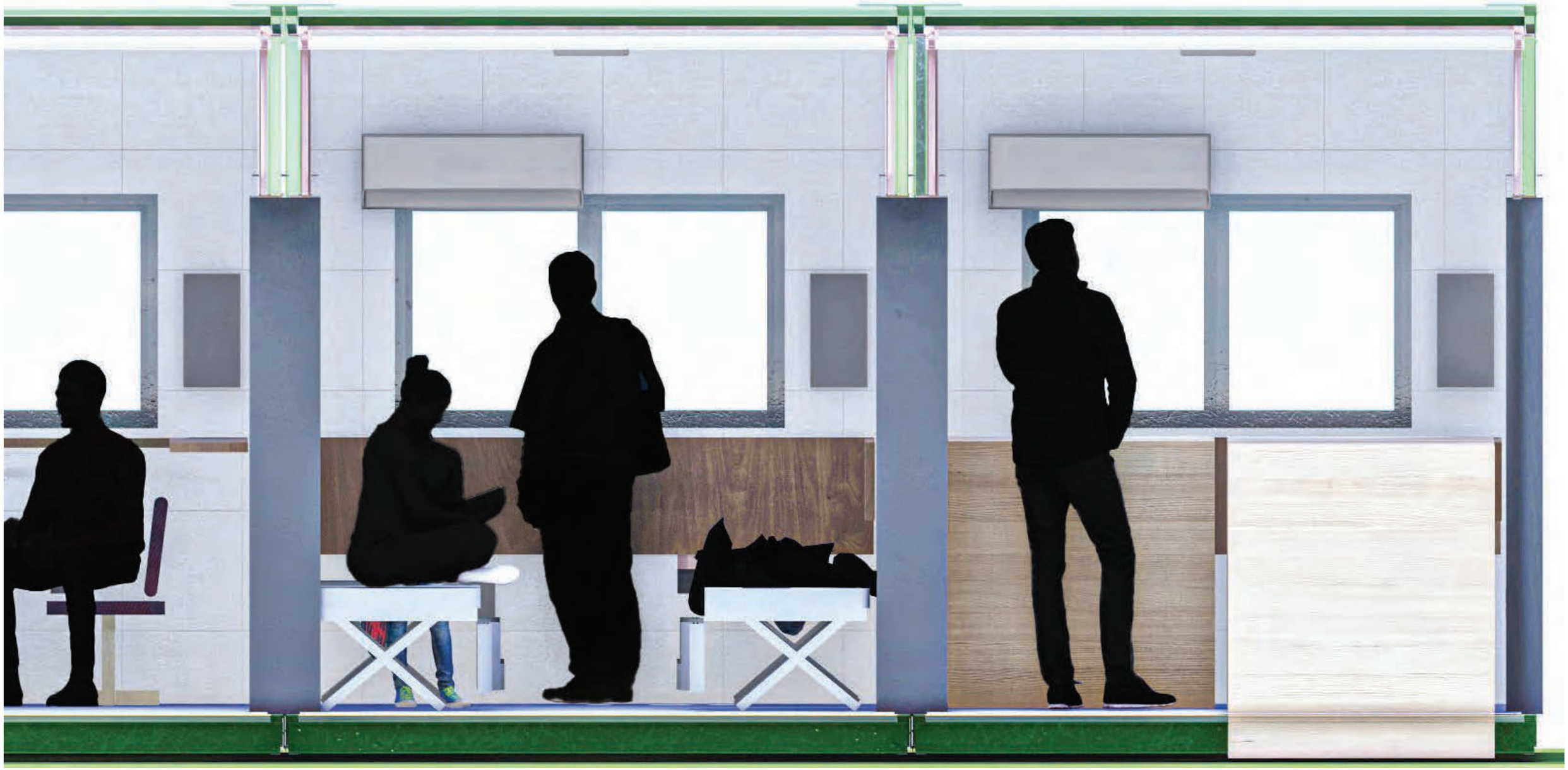


Figure 126 - Work Station Interior

Figure 127 - Adjusted Work Station Interior

Figure 128 - Sleeping Interior

Figure 129 - Storage Interior

DRBS Beddown Exercise: Arizona Desert

Beddown Exercise:

During a beddown exercise the goal is to quickly set up a field operational tent city. Certain areas must be constructed so the tent city can be fully operational. These areas include but are not limited to:

1. Housing Tents
2. Barracks & Latrines
3. Kitchen
4. Medical
5. Command
6. Required Utilities

For the sake of this exercise the beddown will include all of the above. The buildings will be oriented in a geometric shape that defines the controlled area of the exercise. The exercise will need to successfully construct these areas to be fully operational including power generation, electricity, air conditioning, and plumbing where needed.

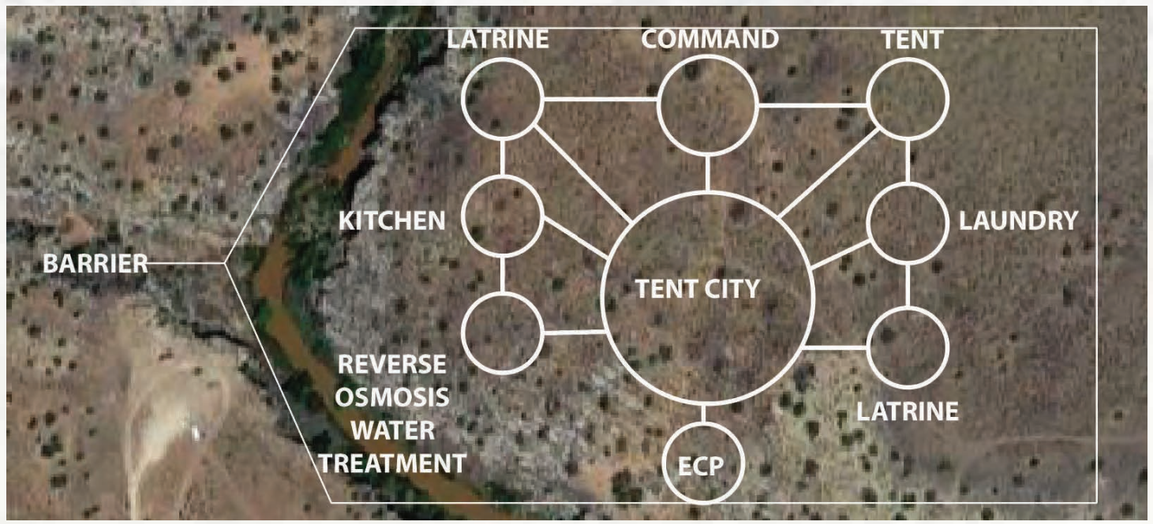


Figure 130 - Arizona Site Preview

PRE-EXERCISE SITE PLAN

Figure 131 - Arizona Site Overview

ARIZONA SITE PLAN

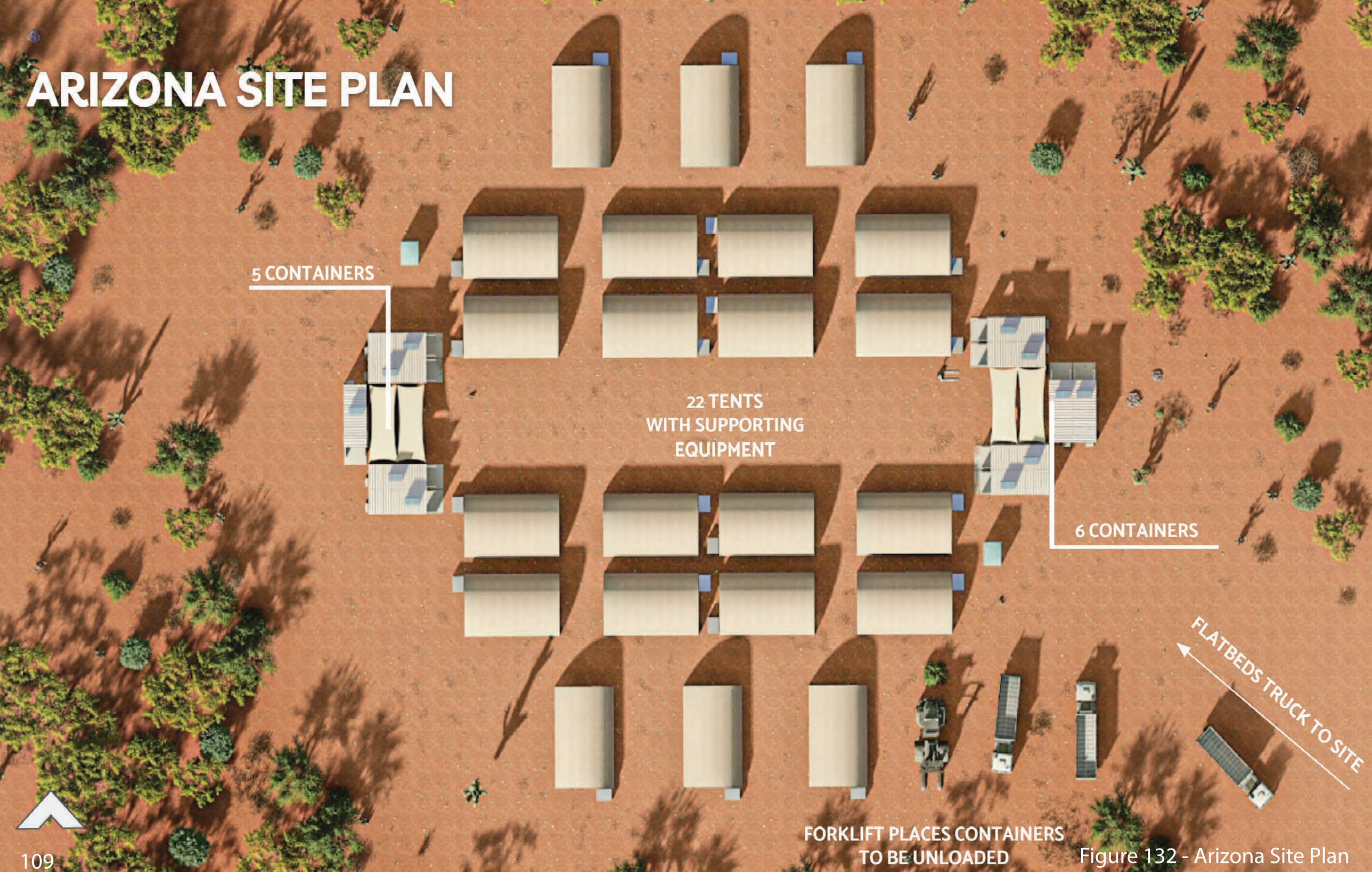


Figure 132 - Arizona Site Plan

Figure 133 - Arizona Site Perspective

SOLAR PANELS

Solar panels can be added for rural response locations. Solar panels give the response team off the grid electricity and help the tent city obtain self sustainability

MINI SPLIT

Mini Split provides for air conditioning for hot locations. Air conditioning is necessary for comfort of response teams and victims

DRBS TENTS

SSS Tent that come with the DRBS system are setup and house the response personnel. The tents make up most of the square footage of the entire DRBS

Figure 134 - Container Wormview

SLEEP UNITS

Sleep units included to provide livable spaces for response teams other than the tents. provides hard shelter for security and safety

COVERED OUTDOOR SPACE

Sun shades connecting units provide covered outdoor spaces. Creating community space for the response teams and victims. Sense of community is important when people experience loss & disaster

WORK UNITS

Work units give response teams work specific areas that are hard sheltered, giving security and safety during an emergency response

Figure 135 - Container Outdoor View

SERVICE DOOR OPENING HALLWAY

Service doors align and open to create hallway for circulation through connected containers

DESKS FOLDED DOWN FOR WORK SPACE

Foldable desks allow for flexible interior use of the containers. can be used for sleeping areas, workstations, or storage

CAT6 WALL PORTS FOR INTERNET

CAT6 wall ports provide internet in the containers while WiFi can be limited due to the metal exterior

Figure 136 - Container Interior View

Figure 137 - Last of Arizona Images

DRBS Hurricane Response: New Orleans, LA

Hurricane Response:

During hurricane Katrina the Superdome in downtown New Orleans was used as a last resort shelter by citizens of the city who couldn't evacuate in time. The Superdome is a huge interior space for citizens to seek refuge, but it doesn't have the required medical and humanitarian equipment for those hurricane refugees. The hurricane response teams needs to airlift the following humanitarian equipment to the Superdome:

Due to the flood heights the Louisiana National Guard will be activated to airlift the required relief to the Superdome. The National Guard will need to set up medical operations to tend to the citizens who need medical attention. They will also need to give out humanitarian aid like water, clothes, blankets and hygiene.

Figure 138 - New Orleans Site Preview

PRE-HURRICANE SITE PLAN

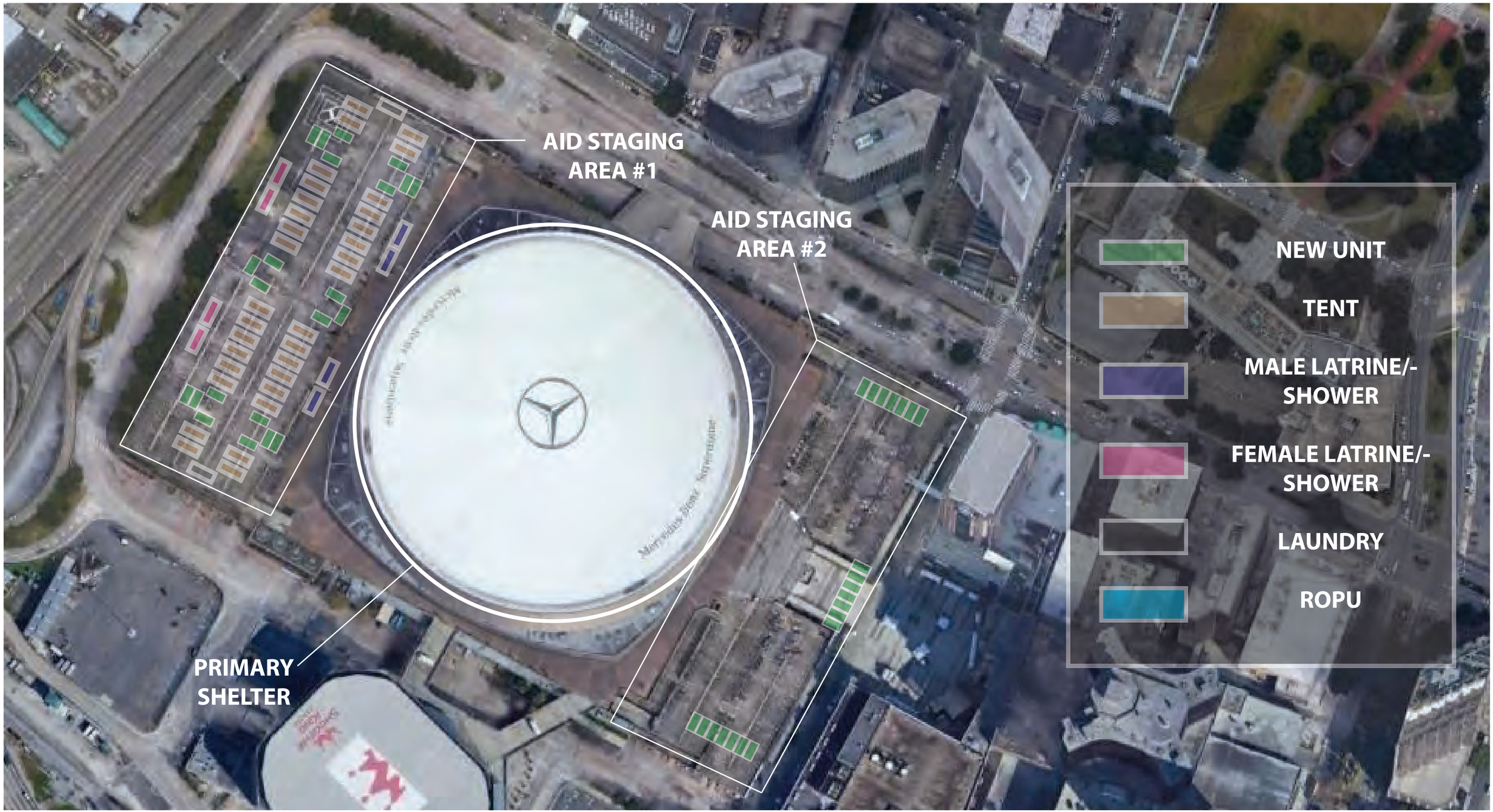


Figure 139 - New Orleans Site Overview

NEW ORLEANS SITE PLAN:

Figure 140 - New Orleans Site Plan

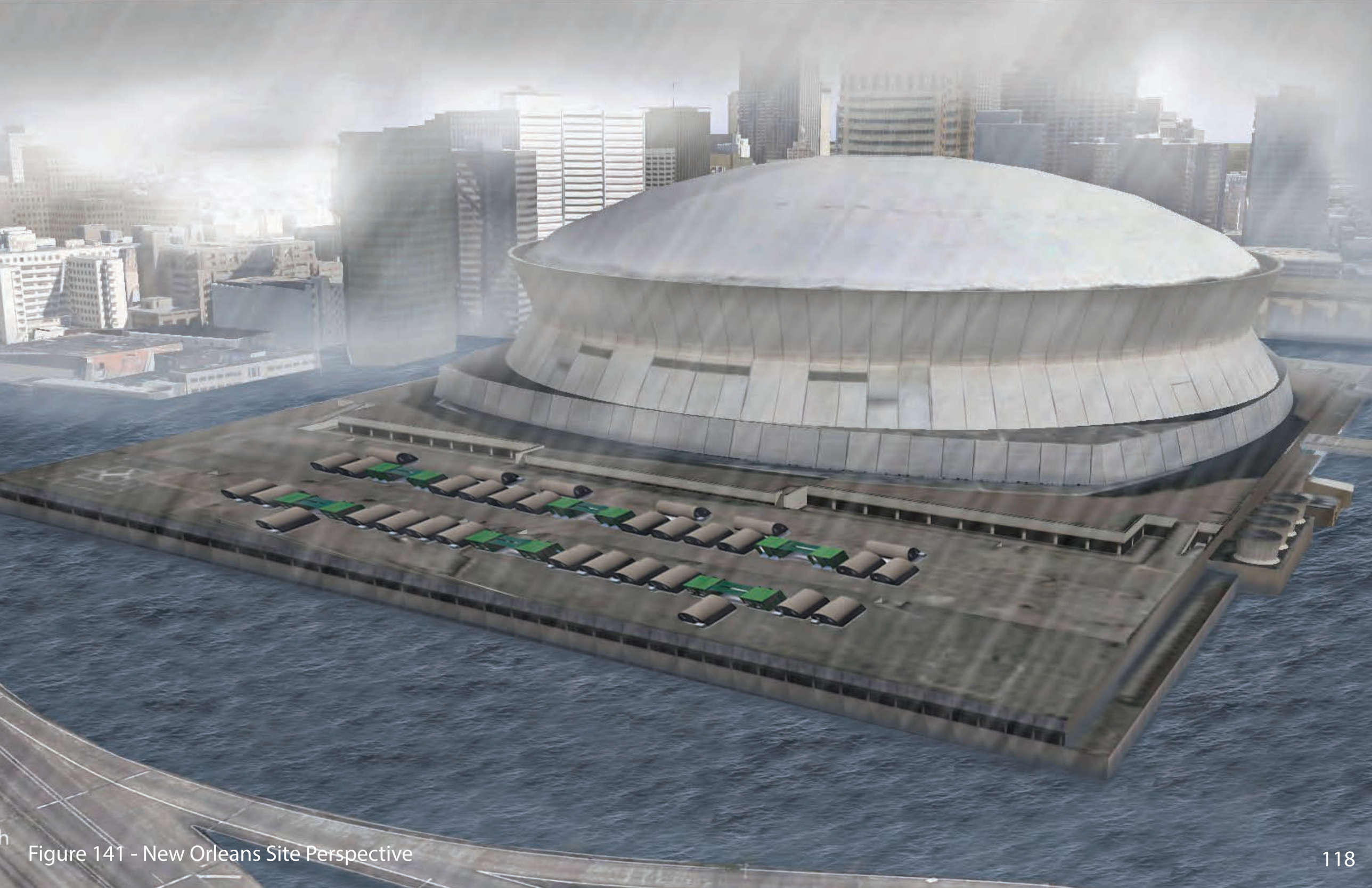


Figure 141 - New Orleans Site Perspective

Tent City #1

Tent City #1 is the primary emergency response location the national guard will setup and operate. It will house the response personnel, house overflow victims, and provide handouts of medical, hygiene, and food products

Tent City #2 (staged)

Due to the unpredictable nature of natural disasters a second tent city would be staged consisting of tents, and extra aid products. If there happens to be a surge of displaced victims the extra tents and aid can be setup and handout

Figure 142 - New Orleans Site Perspective 2

Figure 143 - New Orleans Human View

DISPLACED VICTIMS RECEIVING AID FROM CONTAINER SERVICE WINDOWS

Container service windows give response team and victims specific area to hand out and receive aid. When large amounts of victims need aid the service window bottlenecks the flow to keep order

TWO DOUBLES CONNECTED WITH CANOPY

Two containers connected to two other containers using sun shades for shelter.

RAIN COVERED AREA BETWEEN CONTAINERS

Rain covered area gives place to take shelter from the elements and gives gathering space for victims

Figure 144 - New Orleans Human View 2

DRBS Disease Response:
Fargo, ND

Infectious Disease Response:

During COVID-19 the Fargodome was used as a temporary field hospital to test citizens for COVID. Now that a new deadly strain of COVID-22 has begun the Nat'l Guard will be activated again to set up and operate a field hospital to prevent the spread of the disease. The field hospital will need to provide:

The Nat'l Gaurd will have to rapidly deploy the field hospital so testing and quarantine can be set up as soon as possible to prevent the spread of COVID-22.
This setting will be set in winter.

1. Testing sites
2. Quarantined Holding
3. Entry Control Points
4. Medical Command Post

Figure 145 - Fargo Site Preview

PRE-DISEASE SITE PLAN

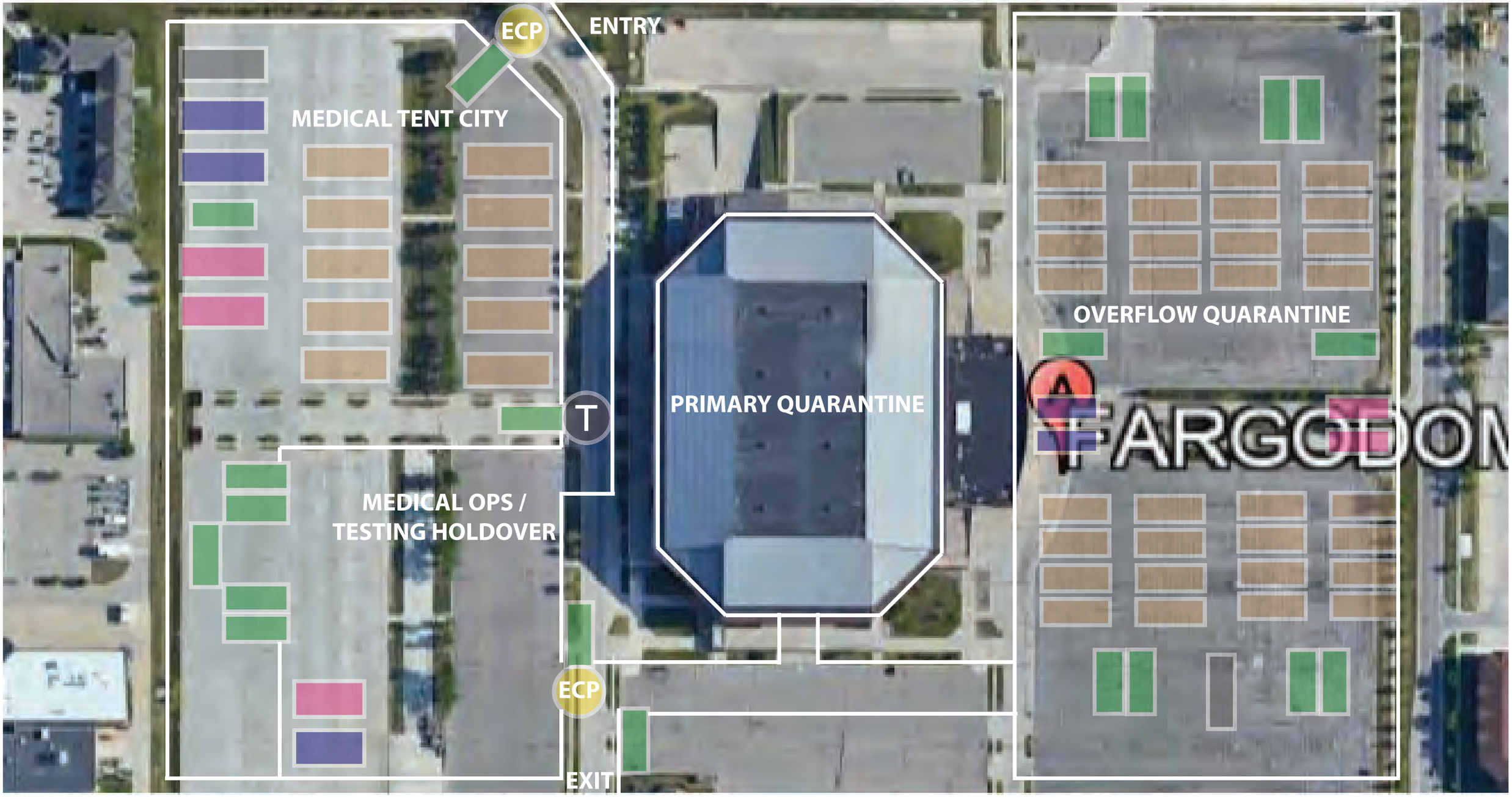


Figure 146 - Fargo Site Preview

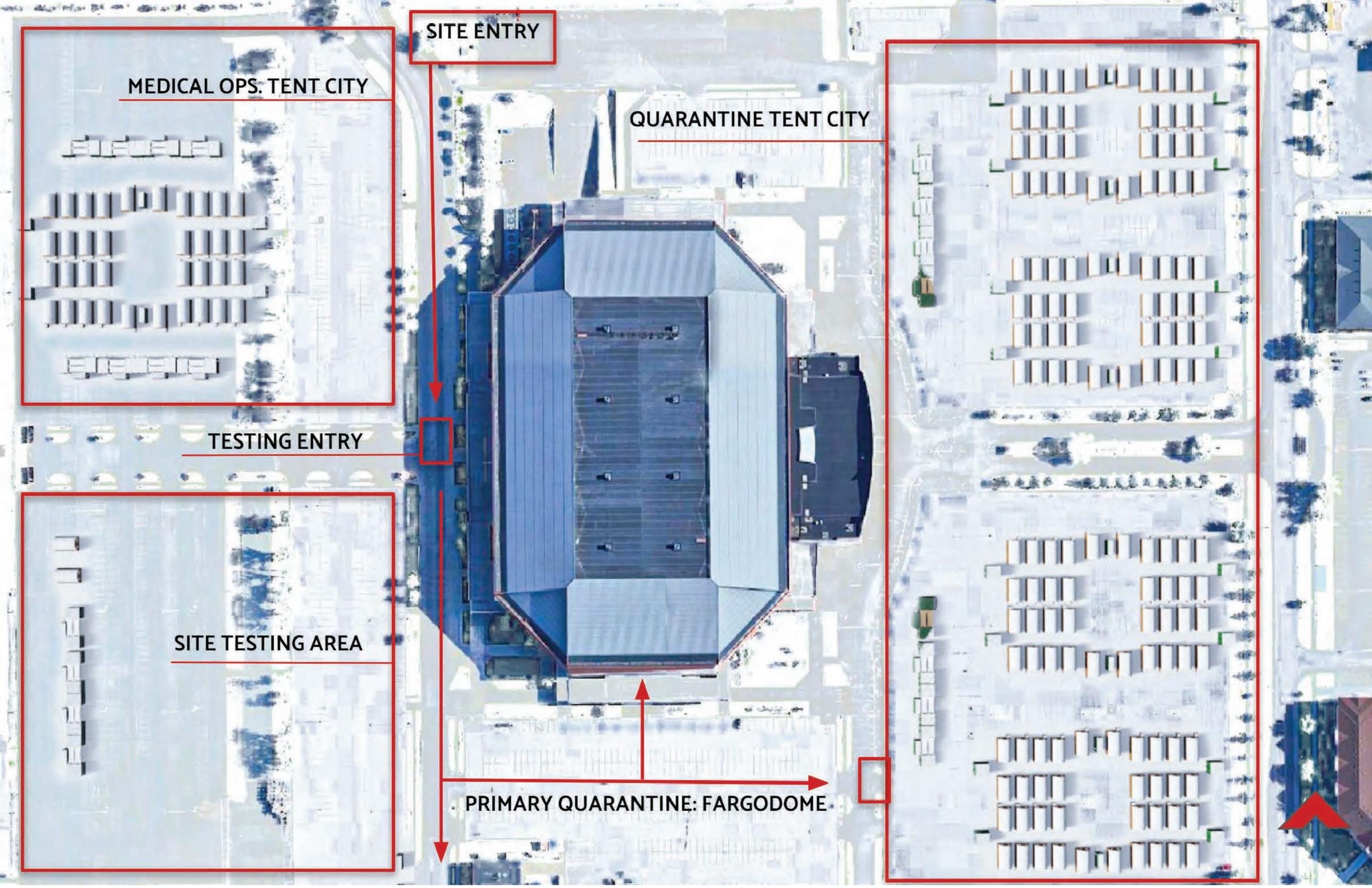

SITE ENTRY
MEDICAL OPS. TENT CITY
QUARANTINE TENT CITY
TESTING ENTRY
SITE TESTING AREA
PRIMARY QUARANTINE: FARGODOME

Figure 148 - Fargo Site Isometric

Figure 149 - Fargo Site Perspective

CROWD OF THE INFECTED GATHERING

The tent city and containers are used for the infected victims of the disease

TENTS USED AS PERSONAL AND SLEEPING AREAS

Tents make up the majority of square footage for the tent city. The tents will give the infected victims there personal space and sleeping space.

CONTAINERS USED FOR COMMUNITY OR ISOLATION SPACES

The containers are accessory to the tents giving the tent city modular container buildings. Some container buildings are isolated giving people who want to be isolated that environment. Other containers are combined to create large modular buildings for people who would rather want a community environment

Figure 150 - Fargo Human View 1

CONTAINER BUILDING USED FOR ENTERTAINMENT, EDUCATION, EATING, GATHERING SPACES

These large rows of containers provides community spaces for people who want community while the single containers located on the perimeter of the tent city provide isolation spaces for those who prefer to be isolated

Figure 151 - Fargo Human View 2

PERFORMANCE ANALYSIS OF:
Upgrading the National Guards Response Infrastructure

PERFORMANCE CONCLUSIONS:

Transportation:

Background: The first step of emergency response is to get to the site. Response teams must have rapid mobility to the site they are responsible for. The response infrastructure must be readily available to be transported at a moments notice while flexible enough to be transported multiple types of ways.

Goals: Unit configured for transport (flatbed semi, helicopter & cargo plane, rail, etc.)
Lightweight —> Less expensive to airlift
Durable to sustain transportation
Maximize interior space for equipment storage

Solution: The dimensions of the new DRBS shipping containers are pre-designed to be transported on flatbed semi-trucks, cargo planes, boats, and rail. The shipping containers are constructed with Corten steel giving the exterior an extremely durable material that can withstand transportation. Lastly, the use of shipping containers give more open interior space for storage of the DRBS equipment. Using the shipping containers for the base of the unit design meets the goals for transportation with the exception of being lighter in weight.

Communication:

Background: Response teams must have communication with other teams, victims, and outside sources for aid if the emergency response wants to be successful. The current DRBS does not come with communications pre-installed so providing pre-installed modern communication such as WiFi and internet should be required.

Goals: Provide communication ports for wifi

Solution: The new DRBS shipping container units are not ideal for providing WiFi but are better suited to provide wired internet connection. Due to the metal exterior of the shipping container the WiFi signal provided would be weak. To provide modern communication for the emergency response teams and victims, wired CAT6 wall ports are provided to give the best connection for internet. Having internet greatly enhances the response teams communication efforts greatly enhancing the response teams operation.

PERFORMANCE CONCLUSIONS:

Operation:

Background: Once response teams are at the site and communications are setup then they can start operations. The end goal of disaster response is to save lives, protect, and rebuild the community. To achieve these three goals the units must be used for multiple purposes. They must be flexible enough to be used as a medical space or something as simple as a relaxing/sleeping space.

Goals: Consolidate current DRBS system from non usable storage containers into containers providing livable spaces
Flexible unit connections to maximize interior spaces
Efficient MEC systems
Daylighting
Flexible furniture for work spaces
Storage space
Durable, easily cleaned, cost effective
Sustainability
Mental Health / Trauma in mind

Solution: The new DRBS shipping containers were consolidated from unusable storage containers into shipping containers that can be configured in an unlimited number of ways providing extreme level of flexibility for workable and livable spaces. This amount of flexibility is needed since each response situation is different and unknown until it happens real world. The containers can be used as single containers for isolation purposes or combined together to be used as a community focused modular mixed use container building. The containers are connected to each other through their service doors creating a hallway for circulation between them. The interior use of the containers can be customized by the user for whatever the response needs are. The interior can be used for work stations, medical spaces, sleeping areas, storage areas, or any combination when multiple containers are connected to make the modular mixed use container building. Daylighting is provided through the service window located on the end while the service window can be used to hand out aid to victims of the disaster. The daylighting eases mental trauma and so does the blue and reflective white colors selected for the interior of the containers. The containers are outfitted with insulation, interior finishes, electrical, communication, and mechanical equipment to make these steel boxes a livable and workable space. Lastly the carbon footprint of the project is lowered by renovating used shipping containers while limiting the use and production of new materials. The combination of all of these features gives response teams and victims a flexible configured, modular, mixed use, sustainable container building enhancing the operation for emergency response


APPE

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Figure 152: National Guard Gather

APPENDIX - **REFERENCES**

1. Publications

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2. Websites

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3. Databases

NDSU Library Repository
NOAA National Centers for Environmental Information
American Architects and Buildings
Google Scholar

4. People

Brian Nohr, AIA Emeritus, LEED AP
TSGT Scott Nelson, HVAC Tech, CES, 148th FW
SMSGT Richard Kaufman, CS, 148th FW
MSGT Anthony Bartlett, HVAC Superintendent, CES, 148th FW
Jennifer Brandel, Assistant Professor, Dept. of Architecture, NDSU

APPENDIX - **STUDIO EXPERIENCE**

1st Year // 2017-18

Spring 2018 - ENVD 1XX - Prof. Heather Fischer
Projects: *Various Projects*

2nd Year // 2018-19

Fall 2018 - ARCH 271 - Prof. Charlotte Greub
Projects: *Meditation Park - Row House*

Spring 2019 - ARCH 272 - Prof. Milt Yergens
Projects: *Dwelling - Downtown Apartments*

3rd Year // 2019-20

Fall 2019 - ARCH 371 - Prof. Bakr Aly Ahmed
Projects: *Olympic Stadium - Resort Design*

Spring 2020 - ARCH 372 - Prof. Emily Guo
Projects: *Here & Now Comp. - North Dakota Capital Comp.*

4th Year // 2020-21

Fall 2020 - ARCH 471 - Prof. Mark Barnhouse
Project: *High Rise*

Spring 2021 - ARCH 472 - Prof. Kristi Hanson
Projects: *Marvin Windows Comp. - Medora Master Plan*

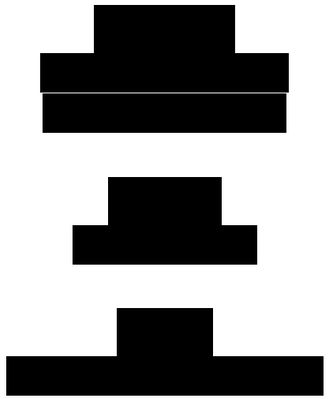
5th Year // 2021-22

Fall 2021 - ARCH 771 - Prof. Bakr Aly Ahmed
Projects: *Compact Urban Design*

Fall 2022 - ARCH 772 - Prof. Jennifer Brandel
Projects: *Thesis*

APPENDIX - **PERSONAL INFORMATION**

Name
Adam Reynolds



Quote:
“Sometimes it takes an L to get a W”
-Brofessor Nelson

About NDSU
Good place to get some education.
Thanks to all the staff and students.