

FALL 2024
SILVERTON

ARCH 484/584: TIMBER TECTONICS IN THE DIGITAL AGE
SCHOOL OF ARCHITECTURE & ENVIRONMENT

Timber Tectonics in the Digital Age: Multi-use Structures for Silverton

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Acknowledgments

The author of this report would like to thank the following university faculty and city officials for their support of this project:

Nastaran Hasani, Teaching Assistant, supported this studio with software help and design feedback.

Cory Misley, City Manager for the City of Silverton, for expressing interest in this project.

Oregon State University's Wood Science and Engineering Department and University of Oregon's Department of Architecture supported this partnership.

Tallwood Design Institute (TDI) provided space, skilled personnel, tools, and equipment, making this effort possible.

This project has been developed in collaboration with the USDA Borlaug Fellow Marco Aurelio Rebaza Rodriguez, and supported by the USDA Borlaug Fellowship Program – Softwoods, Architectural Technology and Structural Design

Timber Pro Coatings USA President Shari Steber (WBE Certified) supported this effort with a donation of the fluid-applied water-resistive barrier used for this project.

This report represents original student work and recommendations prepared by students in the University of Oregon's Sustainable City Year Program for the City of Silverton. Text and images contained in this report may not be used without permission from the University of Oregon.

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About SCI

The Sustainable Cities Institute (SCI) is an applied think tank focusing on sustainability and cities through applied research, teaching, and community partnerships. We work across disciplines that match the complexity of cities to address sustainability challenges, from regional planning to building design and from enhancing engagement of diverse communities to understanding the impacts on municipal budgets from disruptive technologies and many issues in between.

SCI focuses on sustainability-based research and teaching opportunities through two primary efforts:

1. Our Sustainable City Year Program (SCYP), a massively scaled university-community partnership program that matches the resources of the University with one Oregon community each year to help advance that community's sustainability goals; and

2. Our Urbanism Next Center, which focuses on how autonomous vehicles, e-commerce, and the sharing economy will impact the form and function of cities.

In all cases, we share our expertise and experiences with scholars, policymakers, community leaders, and project partners. We further extend our impact via an annual Expert-in-Residence Program, SCI China visiting scholars program, study abroad course on redesigning cities for people on bicycle, and through our co-leadership of the Educational Partnerships for Innovation in Communities Network (EPIC-N), which is transferring SCYP to universities and communities across the globe. Our work connects student passion, faculty experience, and community needs to produce innovative, tangible solutions for the creation of a sustainable society.

About SCYP

The Sustainable City Year Program (SCYP) is a yearlong partnership between SCI and a partner in Oregon, in which students and faculty in courses from across the university collaborate with a public entity on sustainability and livability projects. SCYP faculty and students work in collaboration with staff from the partner agency through a variety of studio projects and service-learning courses to provide students with real-world projects to investigate. Students bring energy, enthusiasm, and innovative approaches

to difficult, persistent problems. SCYP's primary value derives from collaborations that result in on-the-ground impact and expanded conversations for a community ready to transition to a more sustainable and livable future.

Community partnerships are possible in part due to support from U.S. Senators Ron Wyden and Jeff Merkley, as well as former Congressman Peter DeFazio, who secured federal funding for SCYP through Congressionally Directed Spending.

About City of Silverton

The first settlers came to the banks of Silver Creek in the 1800s, following timber and waterpower. The City of Silverton incorporated in 1885 and was seen as a trading and banking center of prominence, ranking among the most progressive towns of western Oregon.



By 1921, Silverton industries produced exports for other areas and even some foreign countries, including the Fischer Flour Mills on South Water Street. The mill obtained power by damming Silver Creek at a point near the present pool, diverting water into a millrace that ran along the creek to the mill and then dumped back into the creek.

The development and opening of the Oregon Garden in the 1990s signify the success of a partnership between the Garden, a private enterprise attracting tourists to botanical displays, and the City of Silverton. The Oregon Garden's expansive wetlands area has benefited

from the City's excess reclaimed water since 2000, while the community benefits from trade the Garden draws to the area. Silverton was recognized for these reuse efforts as a "Community Water Champion" by the National Water Reuse Association in 2018.

Today, approximately 10,380 residents call the city of Silverton home. In addition to the Oregon Garden, the city features a historic downtown, hospital, community pool, and access to nature activities including nearby Silver Falls State Park. It combines a small-town charm with a strong community spirit, welcoming both residents and visitors alike.

Course Participants

UNIVERSITY OF OREGON

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Course Description

ARCH 484/584: TIMBER TECTONICS IN THE DIGITAL AGE

This is a collaborative course between the University of Oregon's Department of Architecture and the Oregon State University's Department of Wood Science and Engineering that focuses on creating novel solutions for a community need. Design projects require comprehensive and integrative study over a wide range of project options to include individual criticism, group discussions, lectures and seminars by visiting specialists, and public review of projects.

Executive Summary

Exploring kit-of-parts construction, the Timber Tectonics team designed and prototyped an emergency shelter using modular stressed-skin panels, facilitating building expansion and sustainable reuse in alternative configurations.

A kit-of-parts is a subset of building prefabrication in which building components are pre-engineered and prefabricated into standardized units from raw materials. The benefits of kit-of-parts construction are that it allows for rapid deployment as well as repeatable and reusable units that require little to no modification to be repurposed. To familiarize themselves with kit-of-parts theory and wood shelter construction, students first studied and modeled design precedents to establish a baseline of knowledge around wood shelters.

The University of Oregon and Oregon State University combined diverse knowledge in the fields of architecture and engineering that was used to generate several creative design proposals. Working in groups, students from both universities met in person and

on video calls throughout the project to draft, prototype, and model elements and ideas for the project. After a review from industry professionals, the student designs were consolidated into one. Students then regrouped to refine seven areas of the project: architectural design, stressed-skin panel design, connections, enclosure, structural analysis, construction, and project management. Student-led fabrication and assembly of the full-scale final prototype took place at Oregon State University's Emerson Lab, concluding with a final review. After the term, additional work was done to complete the components and disassemble them for future reuse. Lessons learned from this experience will be used to create a future of more sustainable, adaptable, expandable, and reusable buildings.

Introduction

Timber Tectonics in the Digital Age is a design studio that seeks to explore building methods based on a kit-of-parts with a focus on stressed-skin panels (SSPs).

This approach involves assembling a limited number of unique pieces into various configurations to create complete structures. The basic modular unit, the stressed-skin panel, is an insulated structural unit made from dimensional lumber frames and plywood skins that can be joined to make habitable structures. Acknowledging that emergency shelters are often inhabited longer than anticipated, the Timber Tectonics team proposed and prototyped a lightweight modular shelter unit that can be extended, aggregated, and repurposed. The flexible set was designed to address the City of Silverton's interest in multi-purpose structures that could be used as pop-up temporary retail booths as well as emergency shelters.

KIT-OF-PARTS AND DESIGN CONSTRAINTS

- The design must prioritize stressed-skin panel construction.
- The design should minimize component variety.
- The design must be under 120 square feet.
- Panels must be made of half-inch plywood and dimensional lumber.
- The structure should be able to be deployed by a team of ten people.
- The structural connections should meet structural requirements, prioritize off-the-shelf materials/products, and facilitate disassembly and component reuse.

Emergency Shelter Case Studies

To gain an understanding of emergency shelters, student groups investigated seven unique wood-construction small emergency shelters to learning how each precedent handles structure, enclosure, joinery, and design. In addition to these precedents, students were familiarized with a shelter design proposed by Marco Aurelio Rebaza Rodriguez, a visiting scholar from the Antenor Orrego Private University in Trujillo, Peru and its considerations for ventilation and occupant health. The knowledge gained from these case studies became the baseline that informed initial team designs and in turn the final proposal. The precedents most pertinent to the proposals by the Timber Tectonics students are Kobayashi Maki Design Workshop's Veneer House Kumamoto and

Aalto University Wood Program's Liina Transitional Shelter.

KOBAYASHI MAKI DESIGN WORKSHOP'S VENEER HOUSE KUMAMOTO

Veneer House Kumamoto uses stressed-skin panels to create a small wood shelter. The shelter features an operable platform that allows it to double as a market stall. This precedent showed a practical application of what scale was possible with modular wood panel construction by a small team as well as the versatility to serve as something other than a living space. The spatial organization and fenestration layout of Veneer House Kumamoto became the basis on which the Timber Tectonics team's final retail kiosk proposal was built.



FIG. 1

Veneer House Kumamoto in its market stall configuration, courtesy of Kobayashi Maki Design Workshop.

COMPLETED MODEL

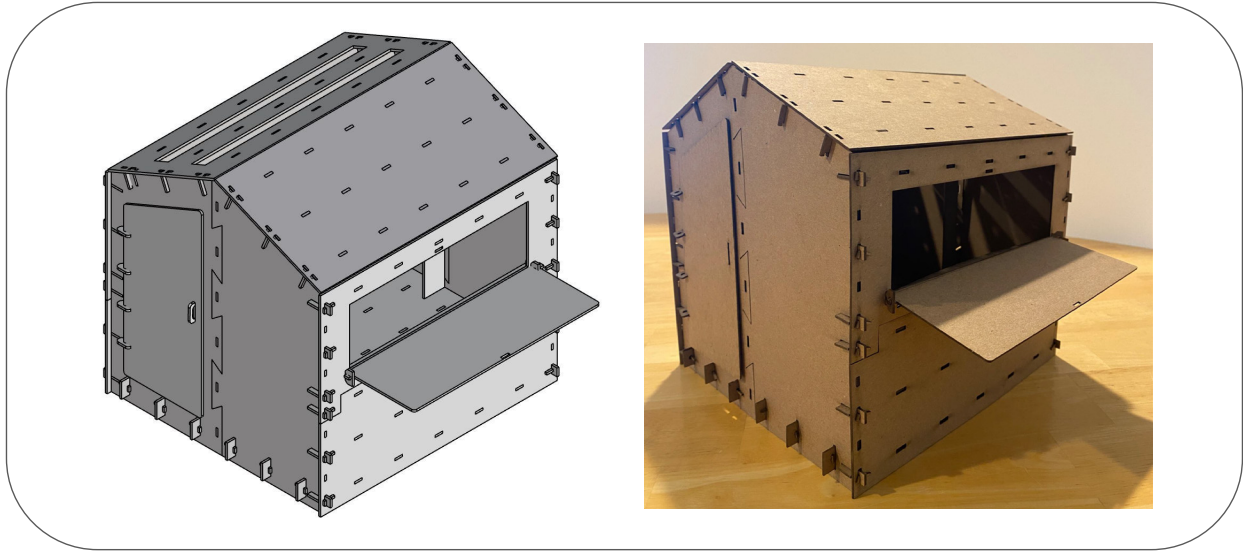


FIG. 2
Student-made digital and scale model of Veneer House Kumamoto.

AALTO UNIVERSITY WOOD PROGRAM'S LIINA TRANSITIONAL SHELTER

Aalto University Wood Program's Liina Transitional Shelter utilizes wooden stressed-skin panels in an innovative type of "bread-slice" tilt-up construction, which would become the largest inspiration for the final design. The Liina Transitional Shelter uses ratchet straps to cinch together wall, floor, and roof

panels into sectional slices. These slices are then tilted up to each other to erect the structure and connected to one another with horizontal straps. University of Oregon Master of Architecture alumna Rebecca Littman-Smith of Scott Edwards Architects who was part of the design/build team, explained the project to the Timber Tectonics class over Zoom.



FIG. 3

Liina Transitional Shelter exterior, courtesy of Aalto University Wood Program.

FIG. 4

Liina Transitional Shelter slice assembly, courtesy of Aalto University Wood Program.

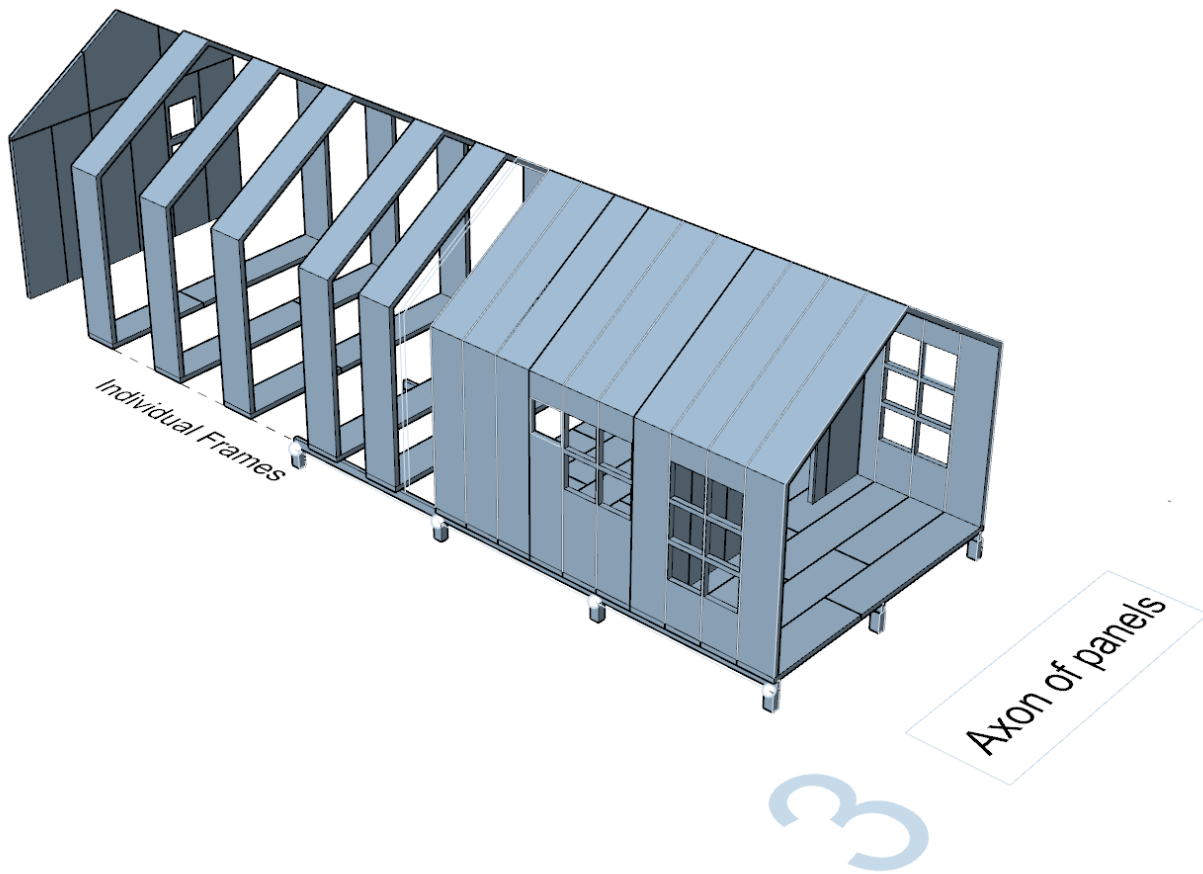


FIG. 5

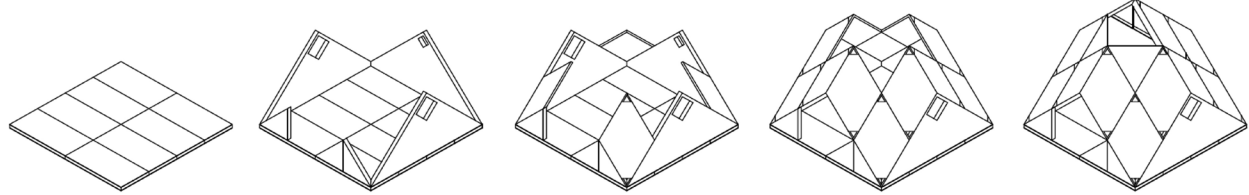
Student-made digital model of Liina Shelter.

MARCO REBAZA'S PERU SHELTER

Marco Aurelio Rebaza Rodriguez's Peru shelter design is a triangulated two-story emergency modular structural wood panel shelter that features carefully placed fenestration that promotes cross-ventilation to regulate thermal

comfort and improve occupant health and wellbeing. Rodriguez's use of fenestration to improve thermal comfort and occupant health became a feature the Timber Tectonics team ended up implementing, improving the final design.

PHASES OF THE CONSTRUCTION PROCESS



PHASE 1- THE GROUND
Made up of 8 rectangular panels, whose dimensions are exactly the same as the plywood sheets.

PHASE 2 - TRIANGULAR WALLS
They are the only construction elements that connect perpendicular to the ground. Three of the four sizes are identical, except for the one at the entrance to the house, which contains two smaller panels.

PHASE 3 - FIRST ROW OF RHOMBOID PANELS
Types of panels made up of two equilateral triangles and is the one that is most repeated in the formation of the entire envelope of the house.

PHASE 5 - ROOF CLOSURE
Placement of 4 more panels, 2 identical to those of the previous rows and 2 smaller panels, triangular in shape. Placement of the only horizontal size that the roof has.

PHASE 4- SECOND ROW OF RHOMBOID PANELS
8 more rhomboidal panels, exactly the same as those of the previous phase, continue to close the envelope. These panels are supported by those that make up the first row, as if it were the construction of a dome.

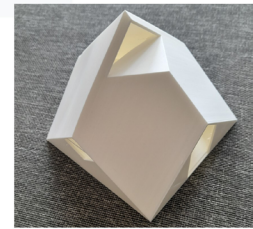
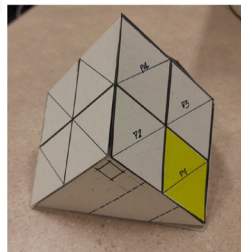
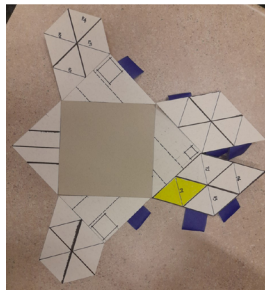


FIG. 6

Assembly diagram of Rebaza's Peru shelter.

**KOBAYASHI MAKI DESIGN
WORKSHOP'S MINAMISANRIKU
VENEER HOUSE**

The Minamisanriku Veneer House was the first phase of a public bath project in the aftermath of the Great East Japan Earthquake. The building was quickly assembled using veneer boards from local forest thinnings. This approach is cost-effective, eco-friendly, and supports

local industry while allowing amateurs to construct durable structures efficiently. In the construction of the Minamisanriku Veneer House, veneer boards are divided into units, interlocked via pre-cut notches, and reinforced with wood battens and screws. The structure is easily assembled, disassembled, and relocated, making it ideal for disaster relief and urgent temporary housing.



FIG. 8

The exterior of the Minamisanriku Veneer House.

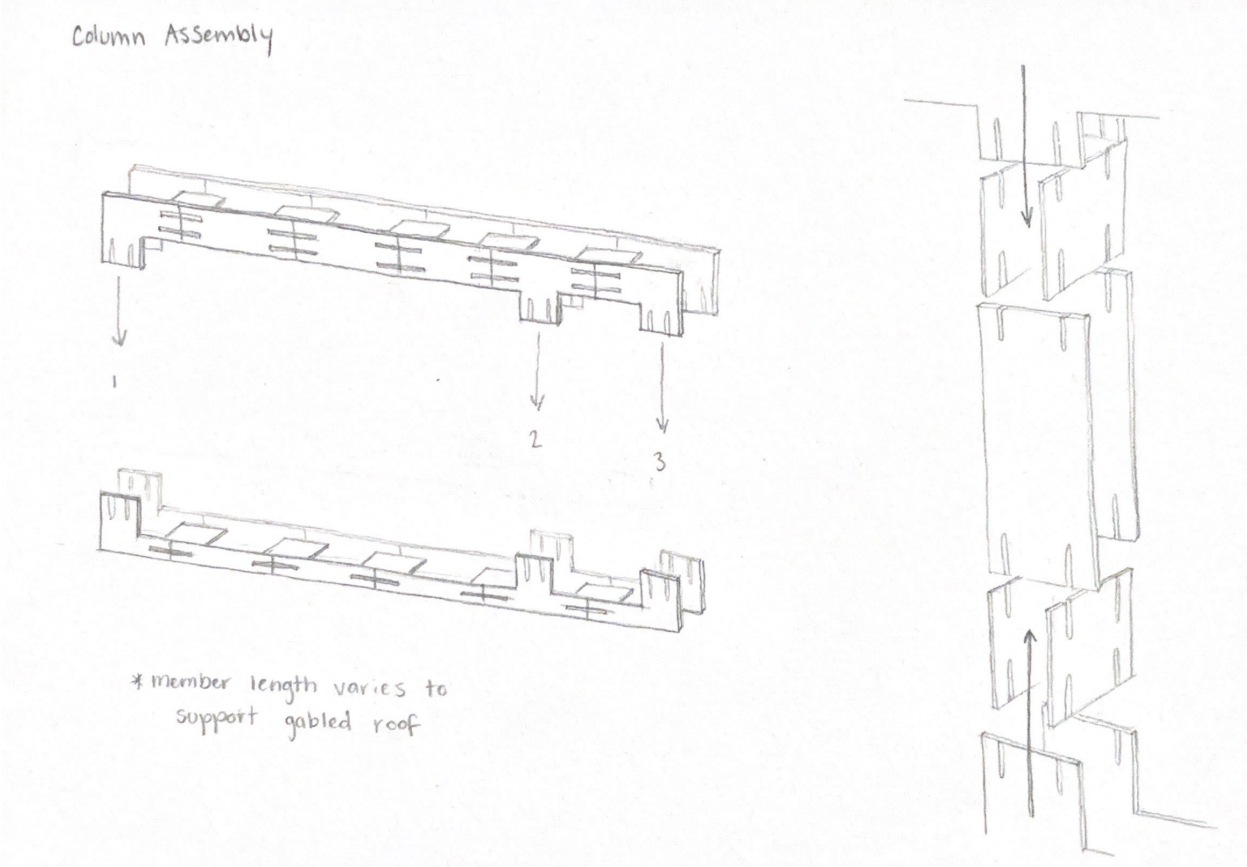


FIG. 9
Student-made diagram of a column from Minamisanriku Veneer House.

**KOBAYASHI MAKI DESIGN
WORKSHOP'S PALU COMMUNITY
CENTER**

On September 28, 2018, a 7.5 magnitude earthquake struck 77 km off Palu, Indonesia's coast. The earthquake triggered a tsunami and landslides that devastated the city. With 68,000 homes damaged and 1.5 million people affected, it was the deadliest earthquake of 2018, causing around 2,200 deaths and 4,400

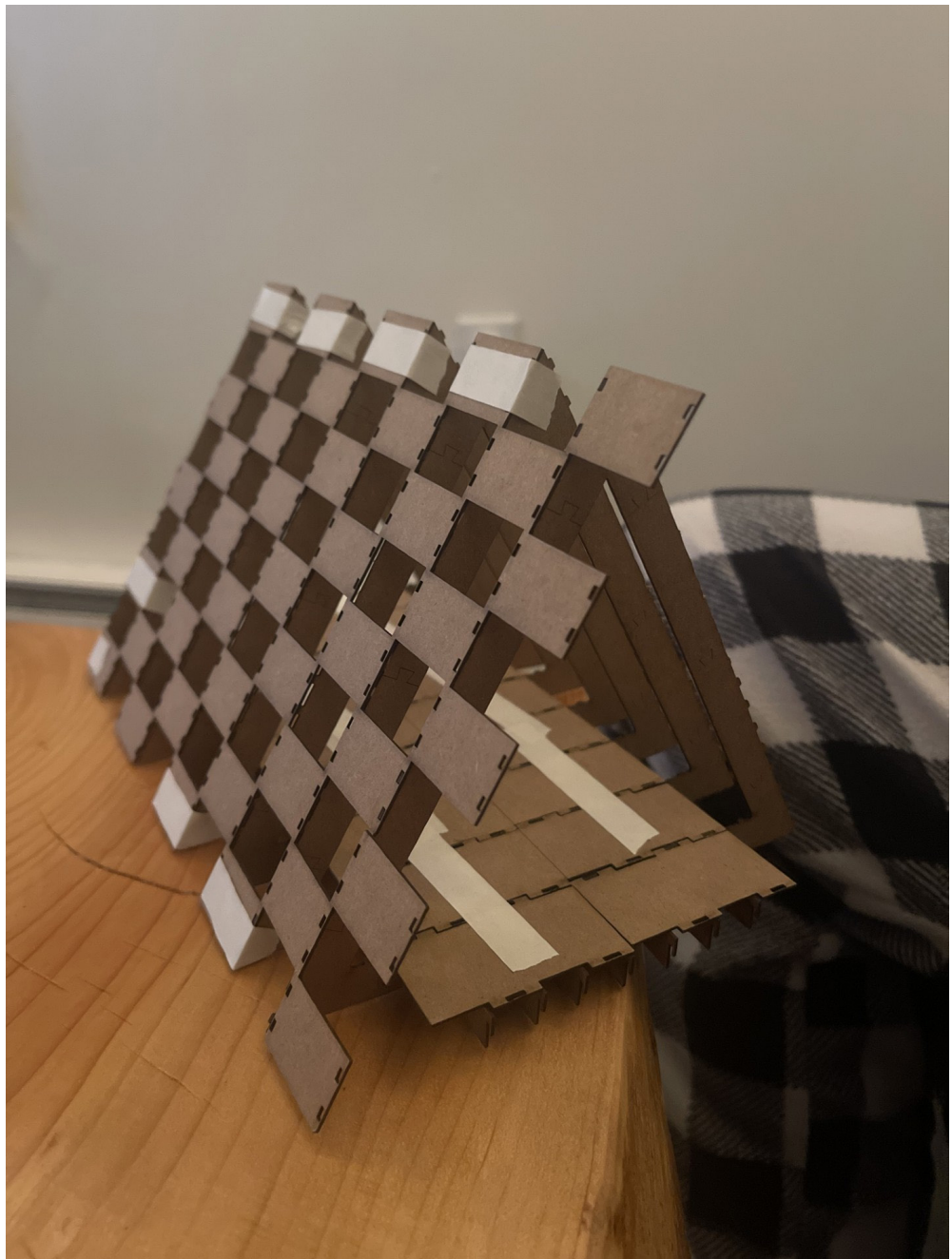
injuries. The Palu Community Center, built near a refugee camp, features a triangular design inspired by traditional Rumah Tambi houses. Locally sourced plywood was pre-cut into panels with dovetail and box joints and subsequently assembled with the help of residents and students from Bandung Institute of Technology and Tadulako University to create an open-air gathering space for the affected community.



FIG. 10

The interior of Palu Community Center.

FIG. 11
Student-made scale
model of the Palu
Community Center.



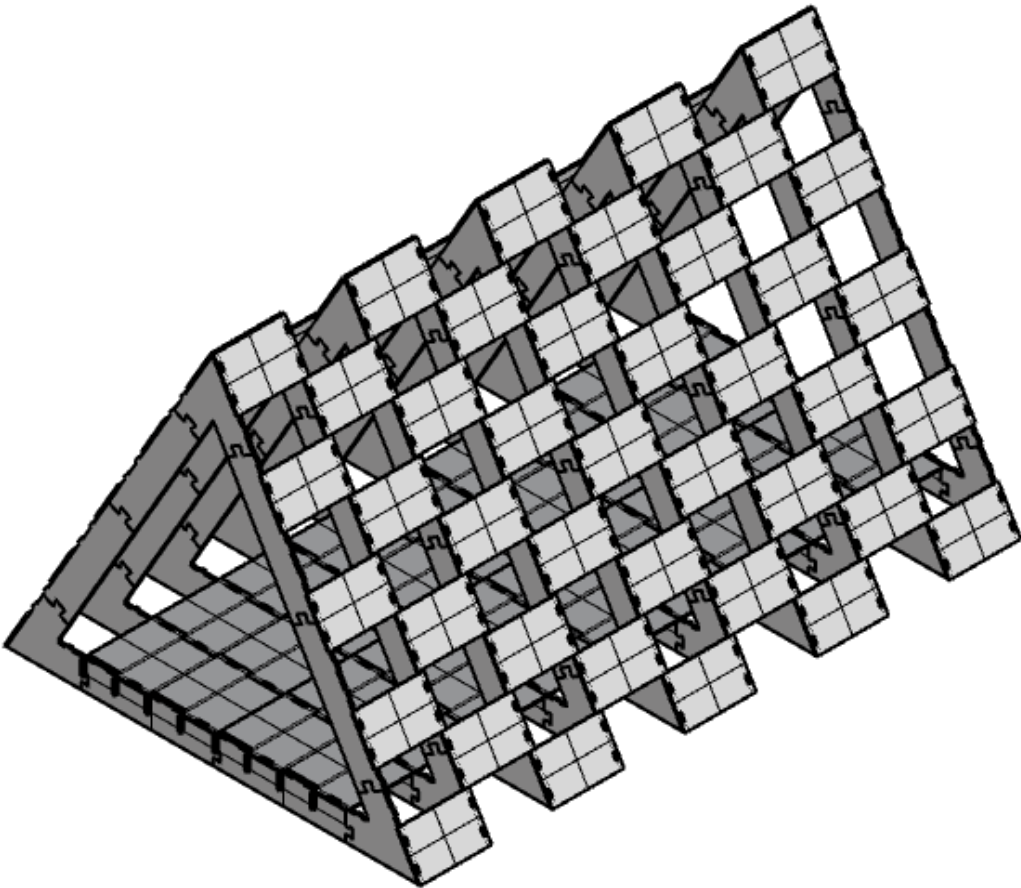


FIG. 12
Student-made digital model of the Palu Community Center.

SCHNETZERPILS REFUGEE TUBE

SchnetzlerPils' Refugee Tube is a reciprocal frame structure comprised of only wooden pallets and dimensional lumber. The structure is constructed by slotting dimensional lumber into the voids of a pallet then slotting another pallet onto said lumber, then slotting lumber into the second pallet, repeating these steps until a reciprocal frame arch is created. Multiple of these arches

are then assembled in a line to create a canopy structure. The strengths of this solution are that it is quick to deploy, only taking a few minutes, and the raw materials to create it are affordable and readily available globally. The drawbacks of this design are that it is only a canopy, providing minimal protection against the elements, and the lack of resistance to thrusting force due to the nature of reciprocal frame arches.



FIG. 13

Pallets being installed on a pallet reciprocal frame.

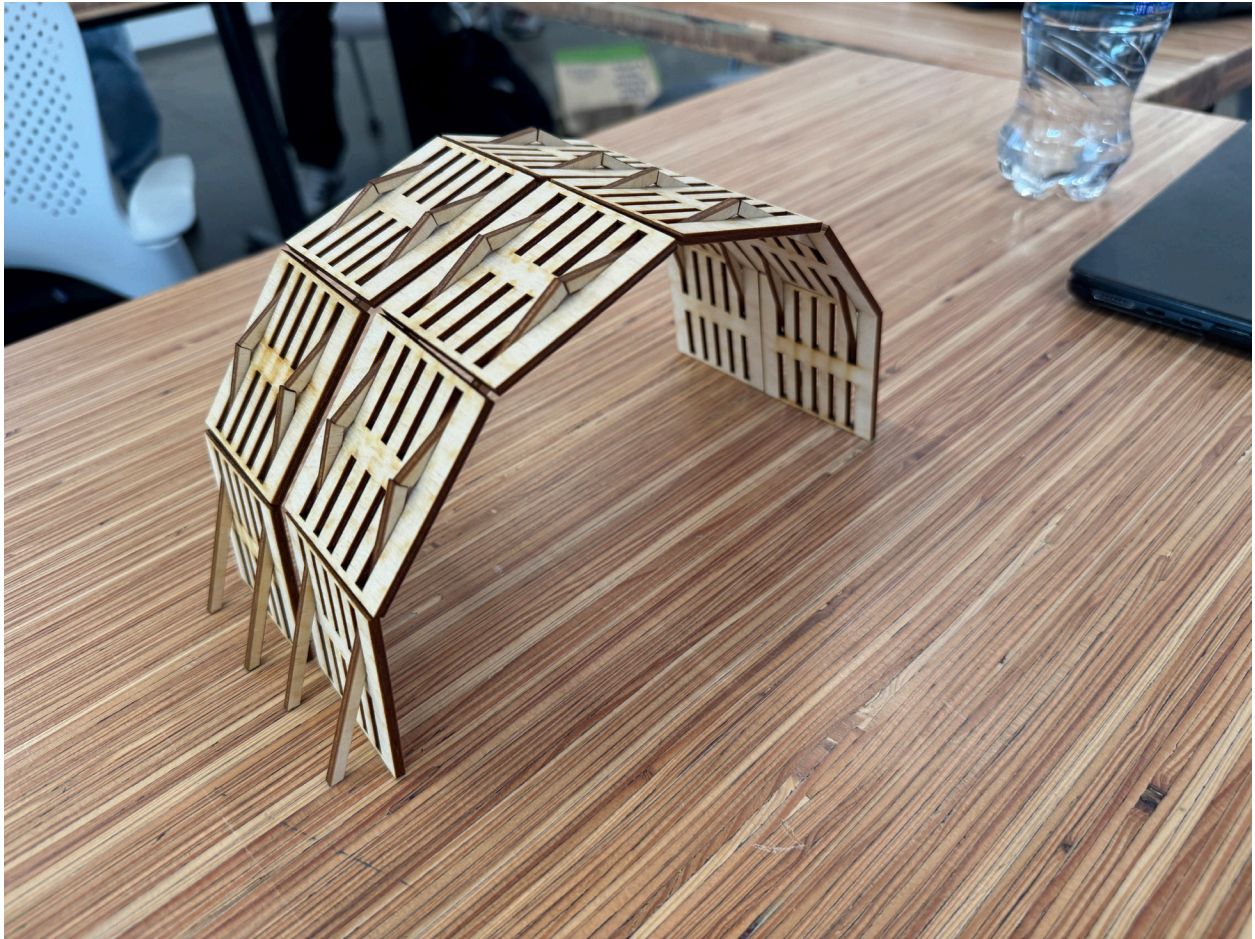


FIG. 14
Student-made scale model of the Refugee Tube reciprocal frame canopy.

WHOME'S WIKIHOUSE SHELTER

WikiHouse uses computer numerical control (CNC) to fabricate precise plywood skins with pre-cut box and dovetail joints that are filled with cellulose

insulation. The shelter is modular, allowing for floorplate expansion and varied fenestration sizing. Pieces are flat-packed, shipped on trucks and able to be assembled in 10-14 days.



FIG. 15

WikiHouse interior during construction.

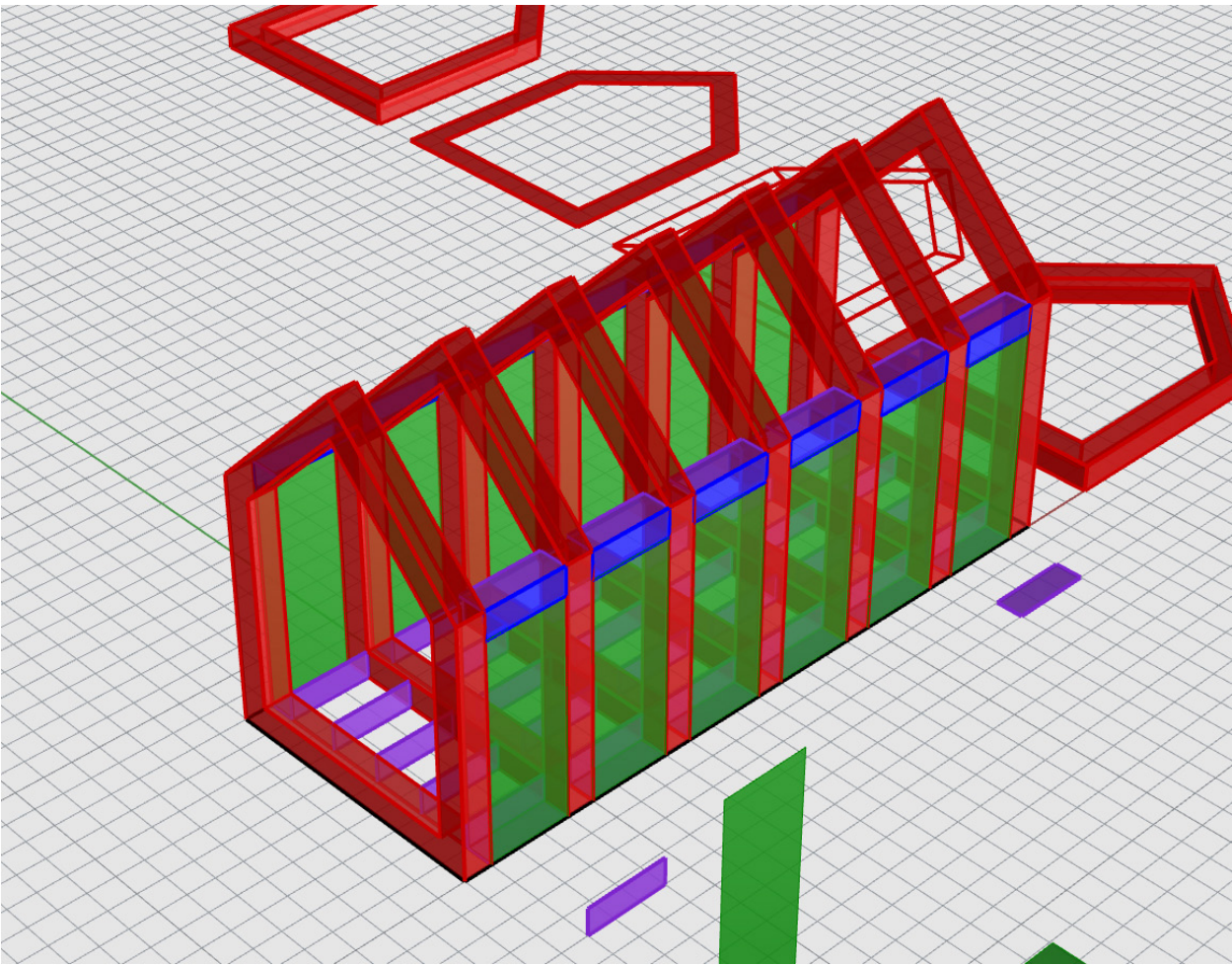


FIG. 16
Student-made digital model of WikiHouse Shelter.

SHIGERU BAN'S PAPER LOG HOUSE

Shigeru Ban's Paper Log House is a response to the earthquake that struck the Noto region of Japan on May 5, 2023. The structure consists of tubular paper columns and beams with prefabricated plywood wall and roof panels, supported

by a foundation of milk crates and sandbags. Students from Kanazawa Institute of Technology, Shibaura Institute of Technology, and Keio University SFC participated in the construction, deploying the structure in 13 hours.



FIG. 17

Paper Log House's exterior during construction.

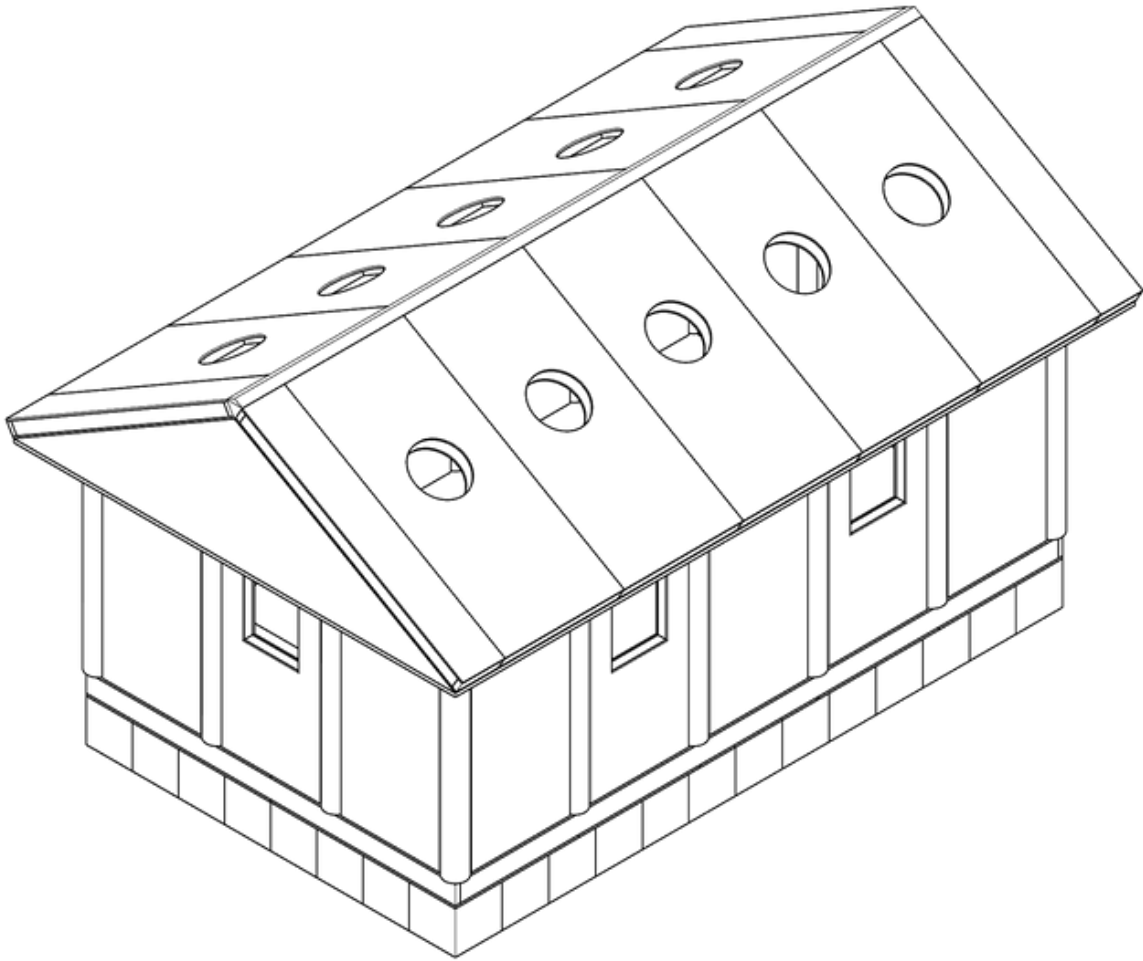


FIG. 18

Student-made digital model of Paper Log House.

Initial Team Designs

After concluding the case studies, course participants broke into five new groups, spending the next four weeks developing five preliminary designs, later to be consolidated into a singular final proposal, taking the strongest ideas from each design.

TEAM 1

FIG. 19

Team 1 design.



Team 1 designed a shelter with a rectangular floor plate and shed roof, seeking to create an elegant yet easy to understand structure that efficiently uses materials. The design uses tilt-up construction and panels that result in few wasted off-cuts from standard size four-foot by eight-foot plywood and eight-foot lumber. Strengths of this

design include panelized windows using the same assembly process as SSPs, tilt-up construction for rapid deployment, efficient material usage, and the simplicity of a linear rectangular floor plate. The drawback of this design is the connection fin system potentially being difficult to fabricate while lacking structural robustness.

TEAM 2**FIG. 20**

Team 2 design.

Team 2 designed a hexagonal shelter with an emphasis on community clusters of multiple shelters and interior experience, made possible by a custom interstitial insulated pentagonal column. Units from this design feature sleeping areas pushed to the sides, making room for communal space within the units with the possibility to combine multiple units in various ways,

increasing program support. Strengths of this design include clerestory windows for private daylighting, insulated interstitial connections, and the easy clustering of units to create larger communities. The drawback of this design is that the hexagonal form results in sizable off-cut material and difficult panel fabrication.

TEAM 3



FIG. 21

Team 3 design.

The Team 3 shelter design is a double height shed roof structure that features a large focal window and additional light wells. Their design is comprised almost entirely of four-foot by eight-foot panels, resulting in a scheme that leaves no plywood waste in off-cuts. The design goals for Team 3 were to create a shelter that is spacious, well lit, and provides

ample storage. The standout strength of this design is the connection system using custom wood brackets as an element in the kit of parts. The drawback of this design is that the double height nature of the space would make it difficult to construct without roof jacks, specialized equipment, and a large team.

TEAM 4**FIG. 22**

Team 4 design.

Taking inspiration from the Liina Shelter, Team 4 designed a shelter with a rectangular floor plate, two-slope roof, and loft space, increasing interior volume and floor square footage. The design goals for this team were to maximize comfort, interior space, privacy, and flexibility.

Strengths of this design include loft space for extra storage and flexibility, screening for privacy, and a comfortable community space. The drawback of this design is the two-slope roof raises concerns surrounding weight, connection detailing, and deployment feasibility.

TEAM 5

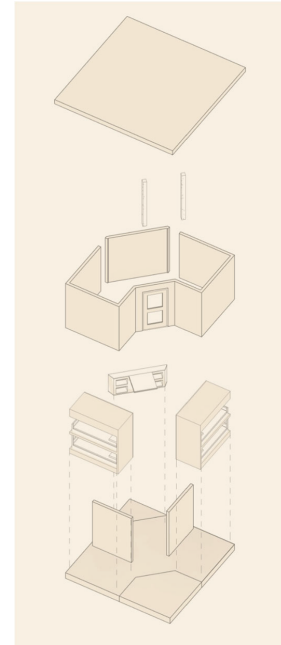
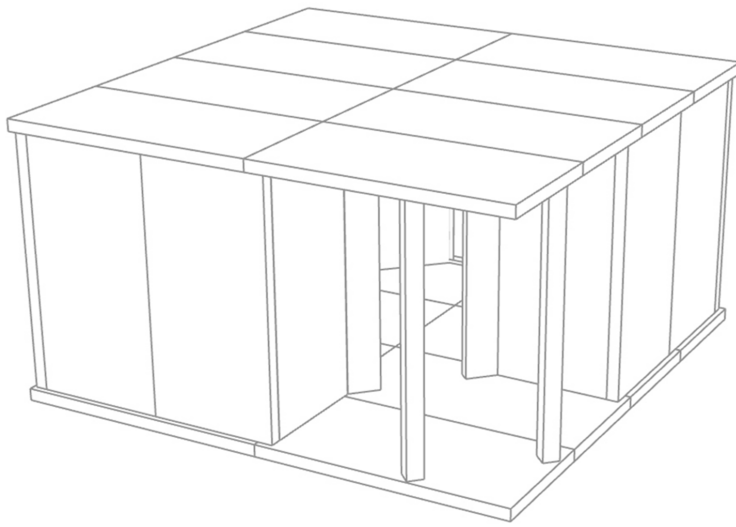


FIG. 23

Team 5 design.

Team 5 designed a shelter with octagonal interior organization on a rectangular floor plate, generating abundant covered outdoor space, and private interior nooks for occupants with a central gathering space. The flat roof is a mirror reflection of the floor plate, reducing the number of unique panels that need to be fabricated. The strengths of this design are the

opportunity for vertical expansion due to the flat roof, varying levels of privacy support, and a sizable covered outdoor space. The drawbacks of this design are concerns about waterproofing and constructability due to having a zero-slope roof and partially fleshed out connections.

Class Design Development

INITIAL CLASS DESIGN



FIG. 24

Rendering of the initial design proposed by the Timber Tectonics team.

Incorporating feedback from their first midterm review, the Timber Tectonics class identified the strongest ideas from each team's designs and began consolidating their designs into one proposal. The Timber Tectonics class landed on a design with a single-sloped roof, rectangular floor plate, wooden

bracket connections, and clerestory windows. Seven final student groups addressed seven specialized areas of the project: architectural design, stressed-skin panel design, connections, enclosure, structural analysis, construction planning, and project management.

CONNECTION PROTOTYPE 1

HIDDEN METAL BOLT JOINERY



FIG. 25

Connection prototypes shown at the second midterm.

At this stage, connections were prototyped and tested.

DESIGN REFINEMENT

Building off the foundation of the initial class design and utilizing reviewer feedback from a second midterm review, the specialized groups narrowed in on

a final proposal to be prototyped at full scale. Considering the limited time frame of the project and the practical needs of the occupants, the Timber Tectonics class decided to halve the square footage of the design while maintaining the basic organization and construction system of the initial class design.

FINAL DESIGN**FIG. 26**

Rendering of the final design proposed by the Timber Tectonics team.

The final design is a modular 64-square-foot SSP shelter comprised of primarily rectangular prefabricated panels, paneled clerestory windows, a paneled operable view window, and a shed roof. The scheme uses tilt-up construction, inspired by the Aalto University Wood Program's Liina Shelter, resulting in a structure that is possible to deploy primarily with hand tools. The floor plan of the final shelter is an eight-foot by eight-foot square with the potential to support various programs

including housing, bathrooms, and kitchen space. Using a nearly identical kit-of-parts, the architectural design team created a retail kiosk scheme that shares the same floor plate as the basic shelter. Additionally, an expanded shelter that extends the floorplate of the basic shelter to create a sixteen-foot by eight-foot structure was presented. These supplementary shelters serve as examples of how the structures may be used, expanded, and adapted over time.

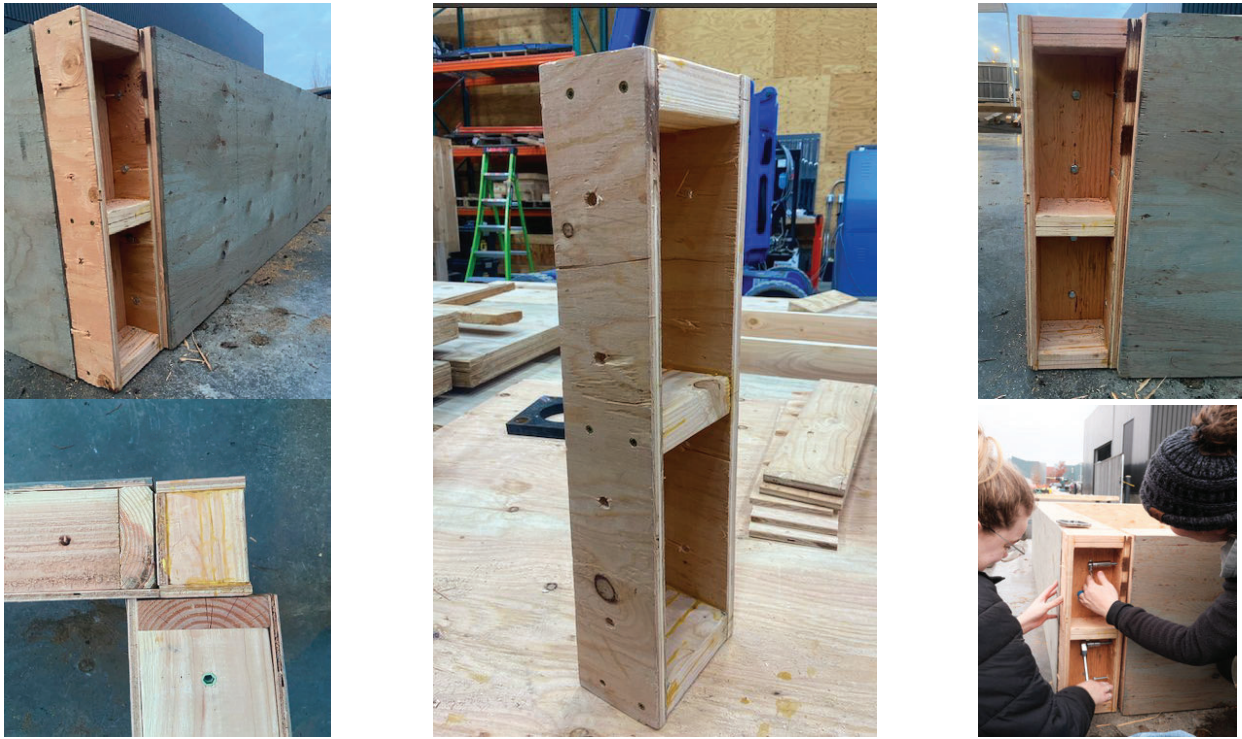


FIG. 27

The final bracket connections used in the structure.

The final connections were rectangular brackets that bridge panels and secure to the foundation. The reason these were chosen was because they provide access

to the fasteners for quick assembly and disassembly and support for insulation, which would improve thermal and acoustic comfort.

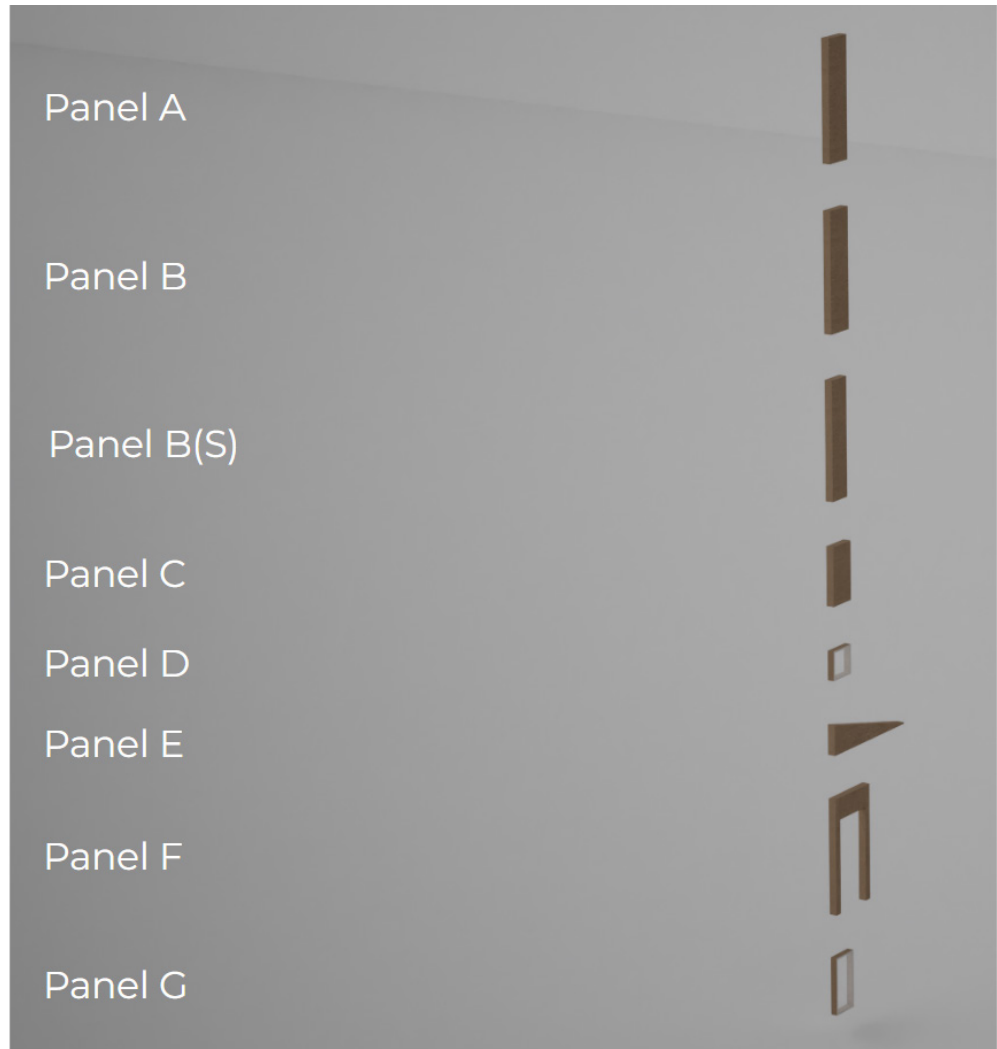


FIG. 28
The final two-foot by eight-foot wall with interior skin (left) and without interior skin (right).

8 Panel Modular System

FIG. 29

Rendering of the final eight panel types used in the prototype.



The final design is comprised of eight unique modular panels that can be configured into various shelters. The Timber Tectonics team sought to create as few unique panels as possible to

streamline production and increase versatility as more panel types would result in panels that are too case-specific to be used for multiple purposes.

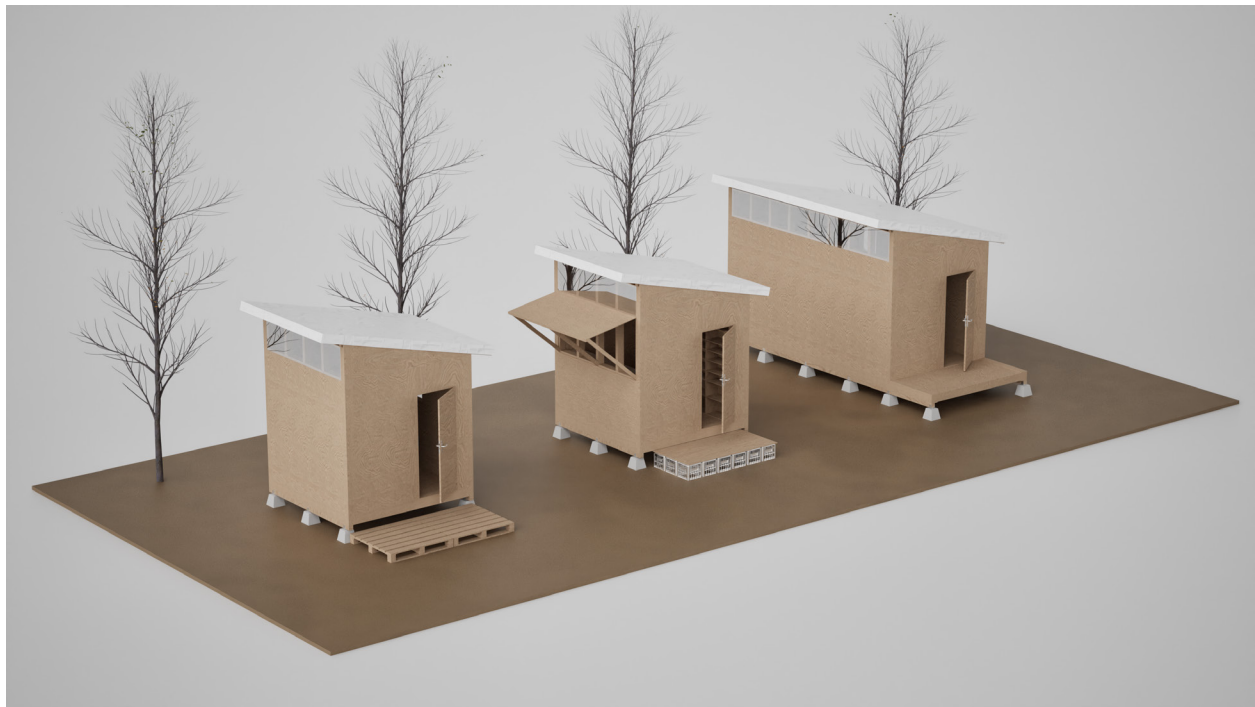


FIG. 30
Rendering of the three building types possible from the final kit-of-parts.

8' x 8' (Basic Shelter)

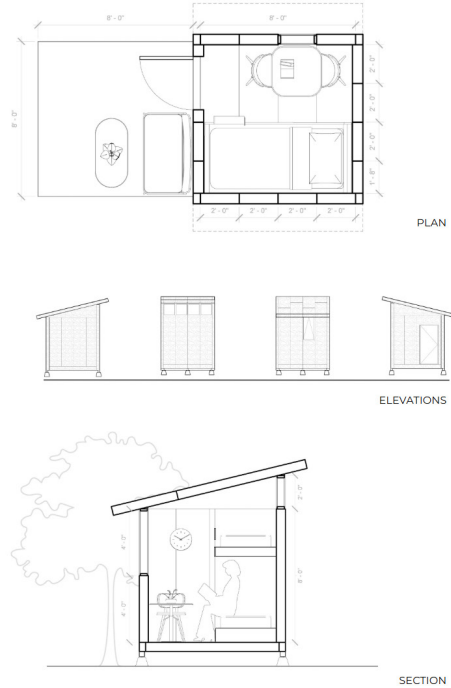


FIG. 31
Rendering of the basic eight-foot by eight-foot shelter unit.

8' x 8' (Retail Kiosk)

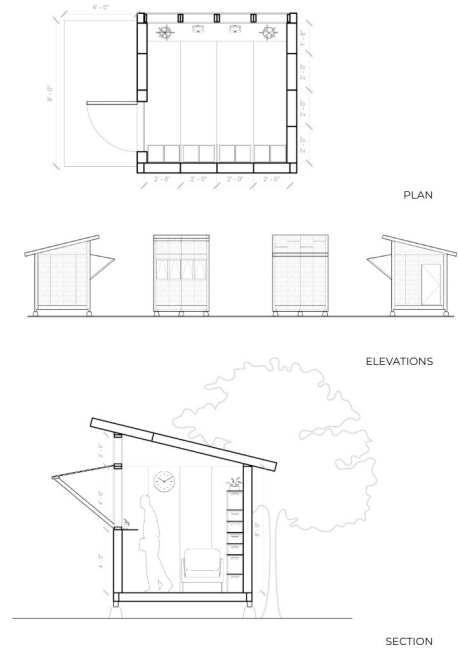


FIG. 32

Rendering of the basic eight-foot by eight-foot retail kiosk unit.

8' x 16' Unit (Expanded Shelter)

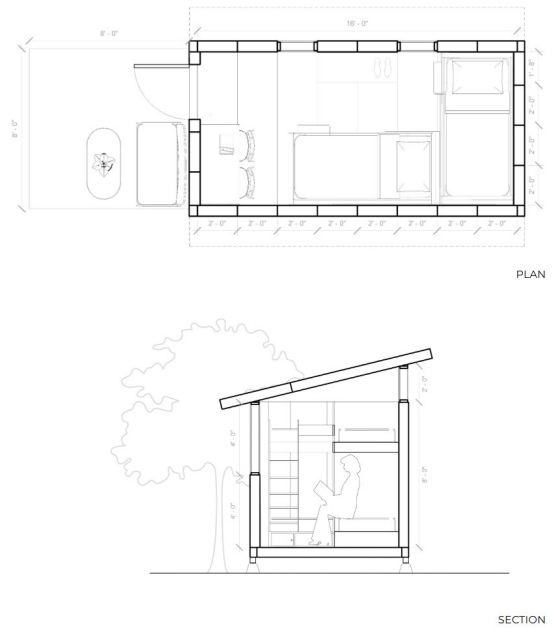


FIG. 33

Rendering of the basic eight-foot by 16-foot shelter unit.

The architectural design team created three distinct shelters using the kit-of-parts, displaying the versatility of use and expandability of the concept, including a retail kiosk that draws from Kobayashi Maki Design Workshop’s Veneer House Kumamoto in form and spatial organization. The rectangular

floor plate of the shelter allows for simple fabrication, expansion, and easy assembly. Clerestory windows supply daylighting while maintaining occupant privacy and the operable view window provides exterior connectivity and ventilation.

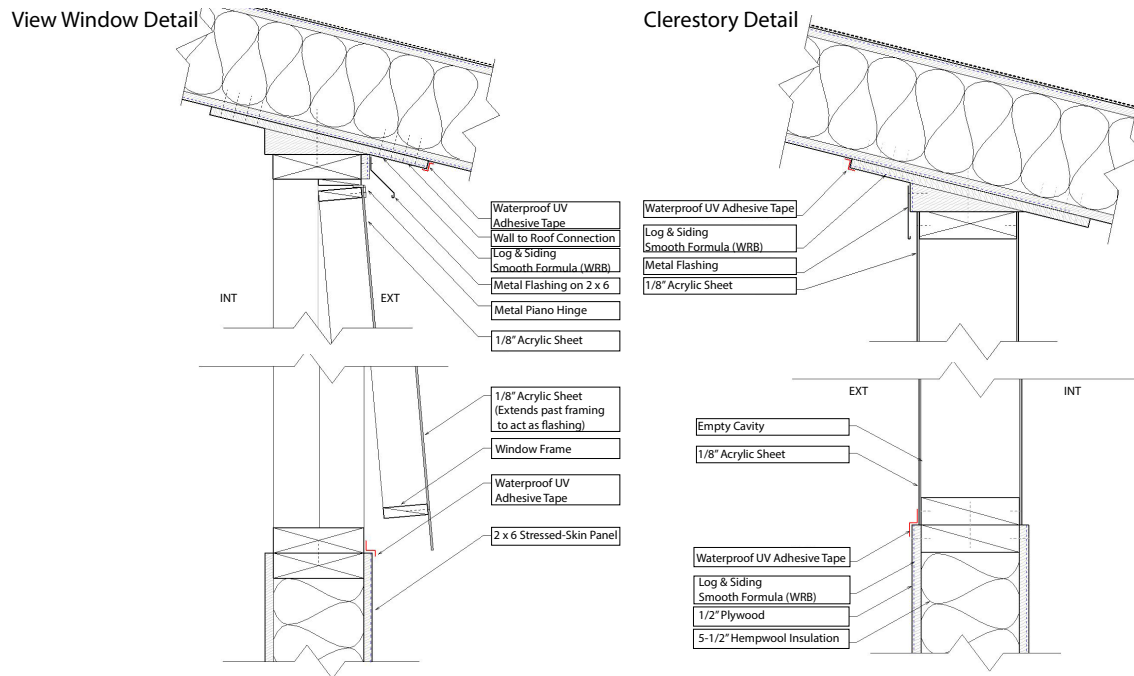


FIG. 34
A wall/window enclosure detail.

The enclosure and structural design teams drew construction details and ran structural analysis simulations of crucial locations to ensure that the final proposal

would be safe to construct and occupy, accounting for water resistance and dead/live loads.

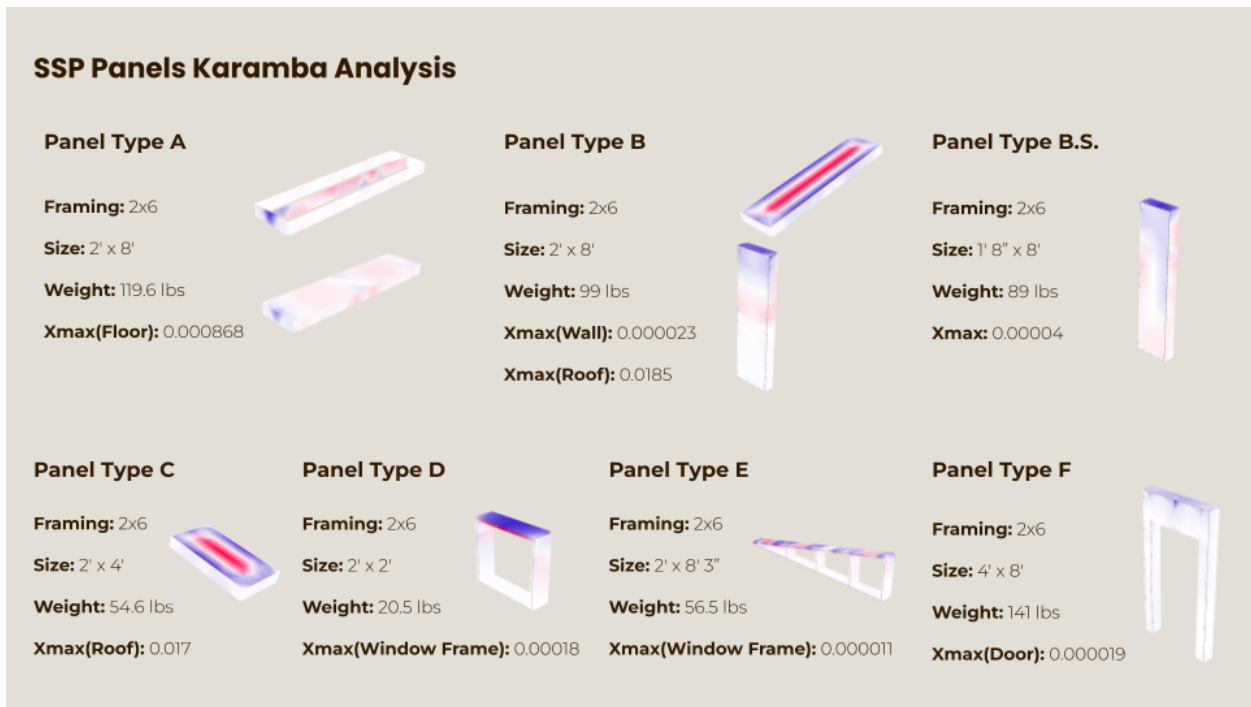


FIG. 35
Structural analysis models from the final build.

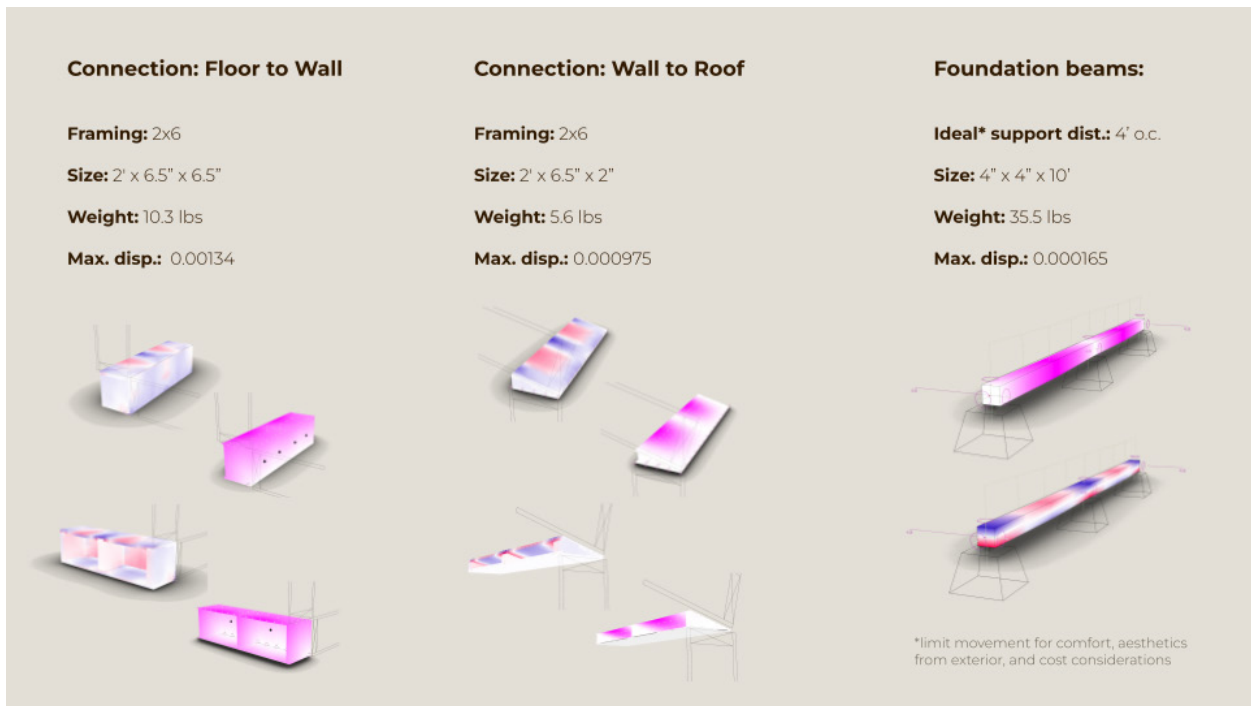


FIG. 36
Structural analysis models from the final build cont.

ASSEMBLY

The assembly and fabrication of the full-scale prototype took place at Oregon State University's Emmerson Lab. The process began with the cutting of the plywood and dimensional lumber to size.

After this, fastener access holes were drilled into the interior plywood skins and the exterior skins were painted with two coats of a fluid-applied water-resistant barrier and left to dry.

**FIG. 37**

Access holes on the interior of an SSP.

FIG. 38
A painted exterior skin
drying.



While the exterior skins were drying, the lumber frames were nailed together using a pneumatic nail gun then marked

and drilled at precise intervals to accommodate the fasteners being used.



FIG. 39

An SSP being framed with 2x6s.

FIG. 40

Fastener holes being drilled into the side of an SSP.



These holes were subsequently outfitted with threaded inserts, that were to be bolted through to affix the panels to one another. Once the exterior skins were dry, both the interior and exterior skins were nailed to their frames, completing the stressed skin panels. With all the panels complete, they were then moved to the

construction site outside and laid out sequentially in slices to be joined with bolted connections and tilted up. These slices were lifted onto a foundation of concrete pier blocks and 4x4 nominal lumber beams and tilted into place by hand by a group of students.



FIG. 41
Connection of panels through the bracket connections.

FIG. 42
The foundation of concrete piers and 4x4 lumber used for the build.



**FIG. 43**

A slice of panels being tilted into place by students.

Slices were bolted to one another and the foundation as they were put up until the structure was fully erected. After the completion of the structure, a grommeted tarp would be supported with an air gap above the roof, acting as a water-shedding surface. Due to time constraints, the building was not seen to completion. The

Timber Tectonics team ended up installing half of the basic shelter and finishing all the panels. After the term, components were completed by student Hillary Johnson with help from the TDI team and Timber Tectonics team members tested assembly and disassembly.

FIG. 44
Two slices of SSPs being deployed by a group of students.



Conclusion



FIG. 45

The Timber Tectonics team.

The process of designing and constructing a modular shelter provided the Timber Tectonics class with valuable insights and lessons for future iterations. One proposed idea for revising the shelter was to redesign the connections to use either wood joints or direct panel-to-panel metal fasteners to streamline assembly and disassembly while reducing deployment time. Ideas for improved

waterproofing include replacing the exterior skin of the stressed-skin panels with fiber cement board to make the panels structural-insulated panels (SIPs) and examining other cladding and sealant possibilities. This project marks the beginning of an ongoing exploration into the potential of kit-of-parts wood construction, with vast possibilities for future applications.

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Appendix A:

Construction Plan

CONSTRUCTION PLAN

TIMBER TECTONICS
PROF. NANCY CHENG & RIGGIO

UNIVERSITY OF OREGON
ARCHITECTURE 4/584
&
OREGON STATE UNIVERSITY
WOOD SCIENCE & ENGINEERING 4/525

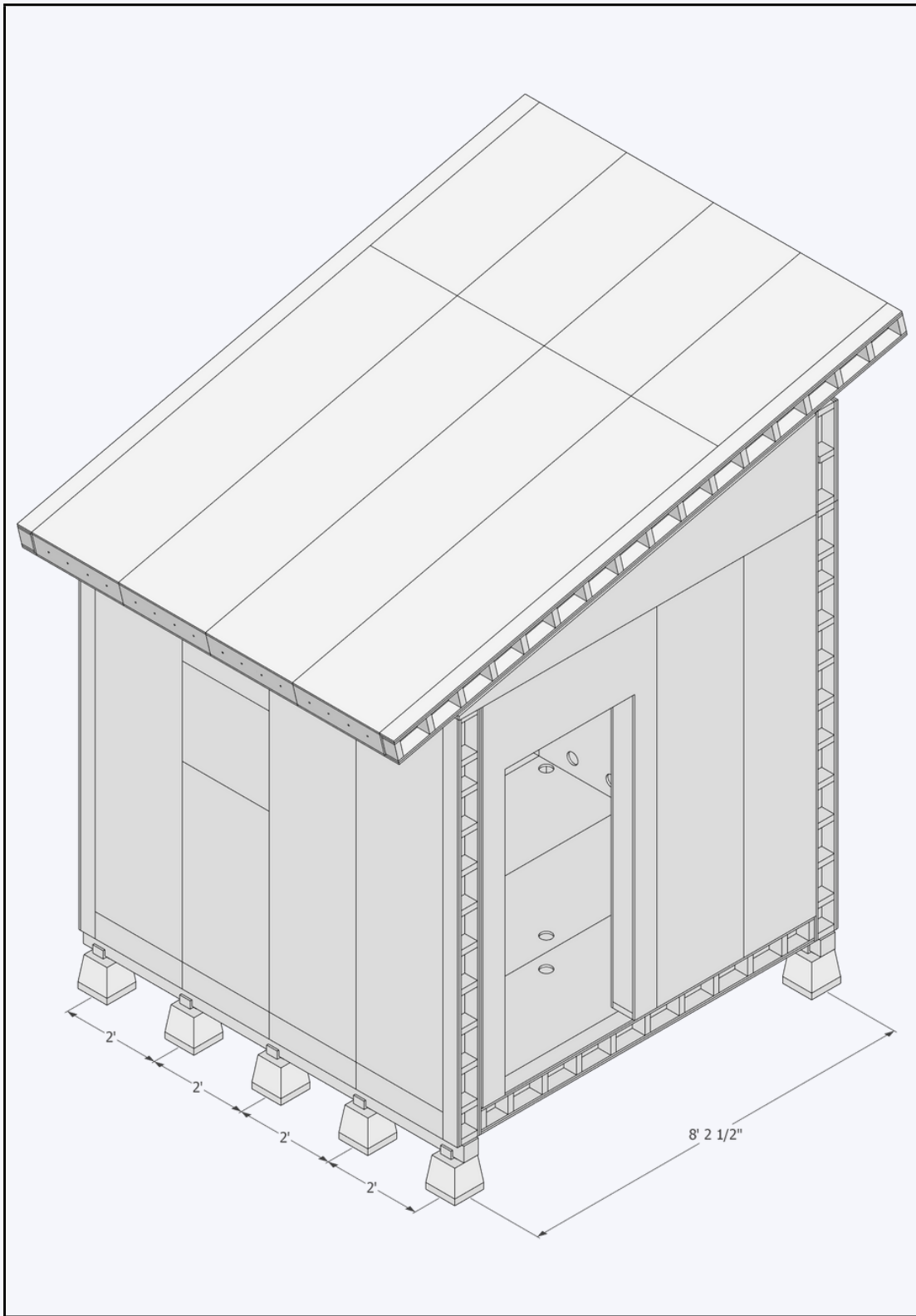


TABLE OF CONTENTS

- LIST OF PARTS (PRE-FAB)
- LIST OF PARTS (REPAIR / REPLACEMENT)
- LIST OF TOOLS
- LIST OF ROLES
- SITE SELECTION
- SITE PREPARATION
- MATERIAL STORAGE
- WEATHER COUNTERMEASURES
- LOGISTICS

CONSTRUCTION

- A..... CONCRETE BLOCKS
- B..... GIRDERS
- C..... ASSEMBLING A SLICE
- D..... RAISING THE SLICE
- E..... SECURING THE SLICE
- F..... ASSEMBLING THE DOOR WALL
- G..... RAISING THE DOOR WALL
- H..... SECURING THE DOOR WALL
- I SECOND BASIC SLICE
- J ASSEMBLING THE WINDOW SLICE
- K..... ASSEMBLING THE BACK WALL
- L..... WATERPROOFING
- M..... ATTACHING THE TARP

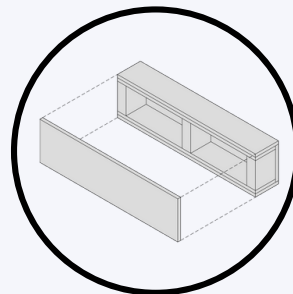
LIST OF PARTS (PRE-FAB)

- Panel **A1** (has center member) x 4
- Panel **A2** (no center member) x 16
- Panel **B** x 4
- Panel **C** x 2
- Panel **D** x 5

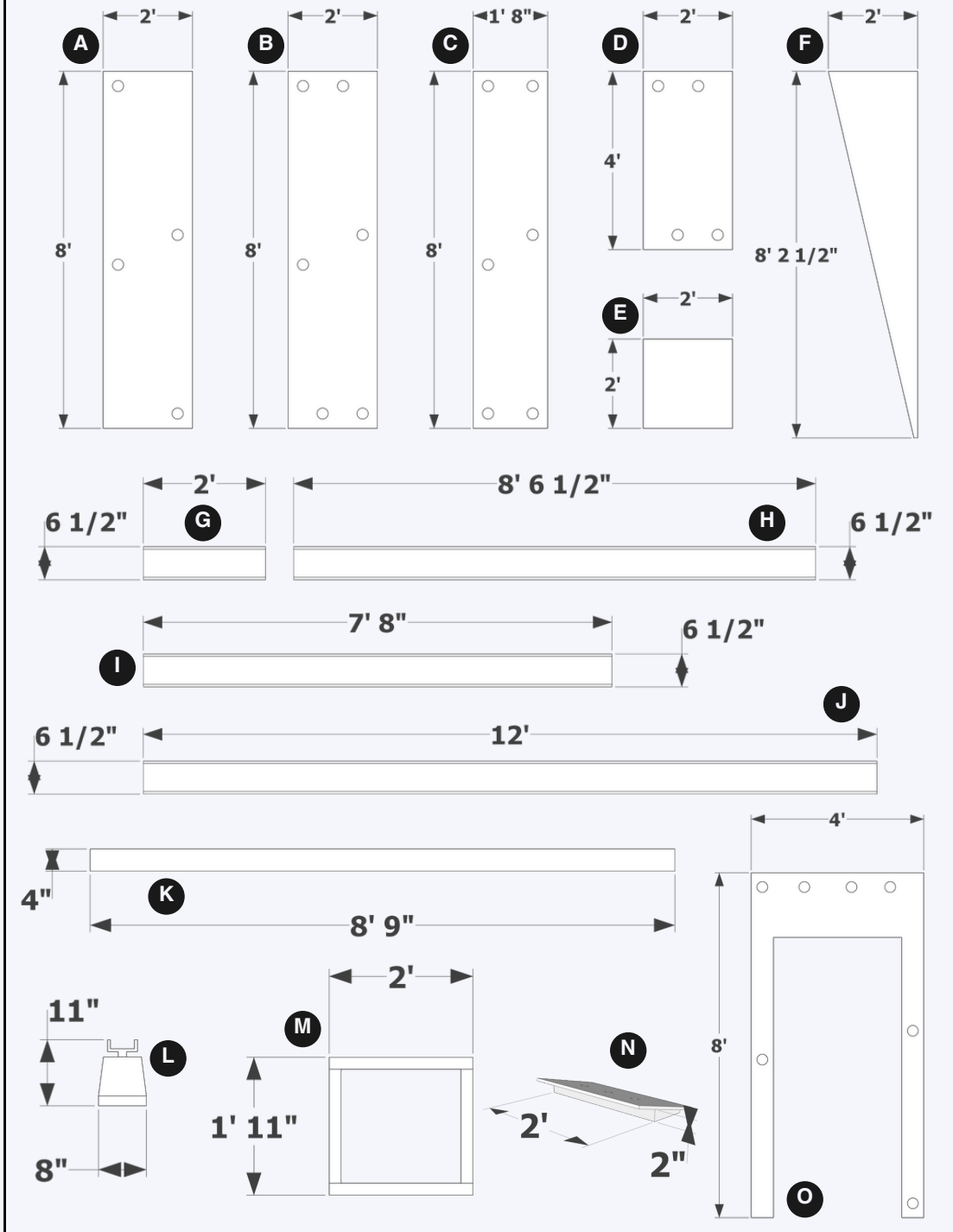
- Panel **E** x 2
- **or**
- Operable Window **P** (not pictured) x 1

- Panel **F** x 1
- Connector **G** x 18
- Connector **H** x 4
- Connector **I** x 2
- Connector **J** x 2
- Girder **K** x 2
- Concrete Pier **L** x 14
- Clerestory Panel **M** x 4
- Roof Brackets **N** x 8
- Door Frame **O** x 1
- Door **P** (not pictured) x 1

All connectors (G-J) have a corresponding front panel that is detachable and should not be attached prior to construction



LIST OF PARTS (PRE-FAB)



LIST OF TOOLS / PARTS (BUILD / REPAIR)

- Chalk
- Masking Tape x 1 roll
- Measuring Tape x 1
- Hammer x 2
- Framing Nails x 2 boxes
- Cordless Drill x 1
- 3/8" Bolts x 1 box
- 3/8" Socket Wrench x 2
- 3/8" Threaded Inserts x 2 boxes
- Tarp x 5
- Screw-in Hooks x 24
- Level x 1
- Ladder x 2
- WRB Tape x 4 rolls

LIST OF ROLES

The majority of tasks necessary for the construction of this shelter are designed to be done by untrained laborers guided by one or a small number of individuals familiar with construction practices. Therefore, there are few roles that require specialized knowledge, physical ability or training.

Those that do are listed here:

Cordless Drill User
Heavy Lifting
Hammer User
Rope Tying

SITE SELECTION

The site must be

- Flat and solid
- A minimum of 16 feet wide
- A minimum of 26 feet long
- Without obstruction to a height of 12 feet

SITE PREPARATION

Before assembly, the site should be divided into two zones. Both zones are 16 feet wide.

Zone A (Assembly) should be 10 feet long.

Zone B (Build) should be 16 feet long.

Both zones are divided into a central working space and 4 feet of circulation.

These zones can be delineated by chalk, tape, rope, or paint. In areas with an excess of available space, these markings are not required.

MATERIAL STORAGE

While shipped globally in 9' x 9' x 4.5' containers, the panels of the shelter are all sized to be able to be transported by pickup truck - a long bed pickup will be able to hold even the largest panels with a closed tailgate.

In storage, the panels should be kept in a dry environment away from the elements to ensure maximum lifespan upon deployment.

On site, the materials should be stored in between tarps when not in use. The tarp covering the panels can be secured by any heavy object - stones, for example, or the concrete piers used for the foundation.

Transport of panels should be done by the appropriate number of able-bodied individuals, as detailed on the next page. Transport over longer distances or lifting to a height above waist level will require more workers.

MATERIAL STORAGE

PANEL	WEIGHT	WORKERS
A	130 lb	4
B	112 lb	3
C	60 lb	2
D	25 lb	1
E	82 lb	3

WEATHER COUNTERMEASURES

If possible, construction work should not be done during inclement weather that could pose any risk to the workers. Follow local guidelines to the best of your ability.

Kits made for areas with rain will include a tent that should be assembled during site preparation and placed over the construction area. When construction is complete, the tent can be repurposed for use by the occupants of the shelter. An assembly guide for the tent is included within its packaging.

For areas with heavy winds, extra care should be taken to secure the tarps used to protect the materials. Weighted tie-downs are included in kits for high-wind areas.

LOGISTICS

Some storage solutions will allow for the distribution of materials as they are needed. Others will demand that all materials be held on site. For ease of transport and use, all materials are labeled as denoted in the list of parts.

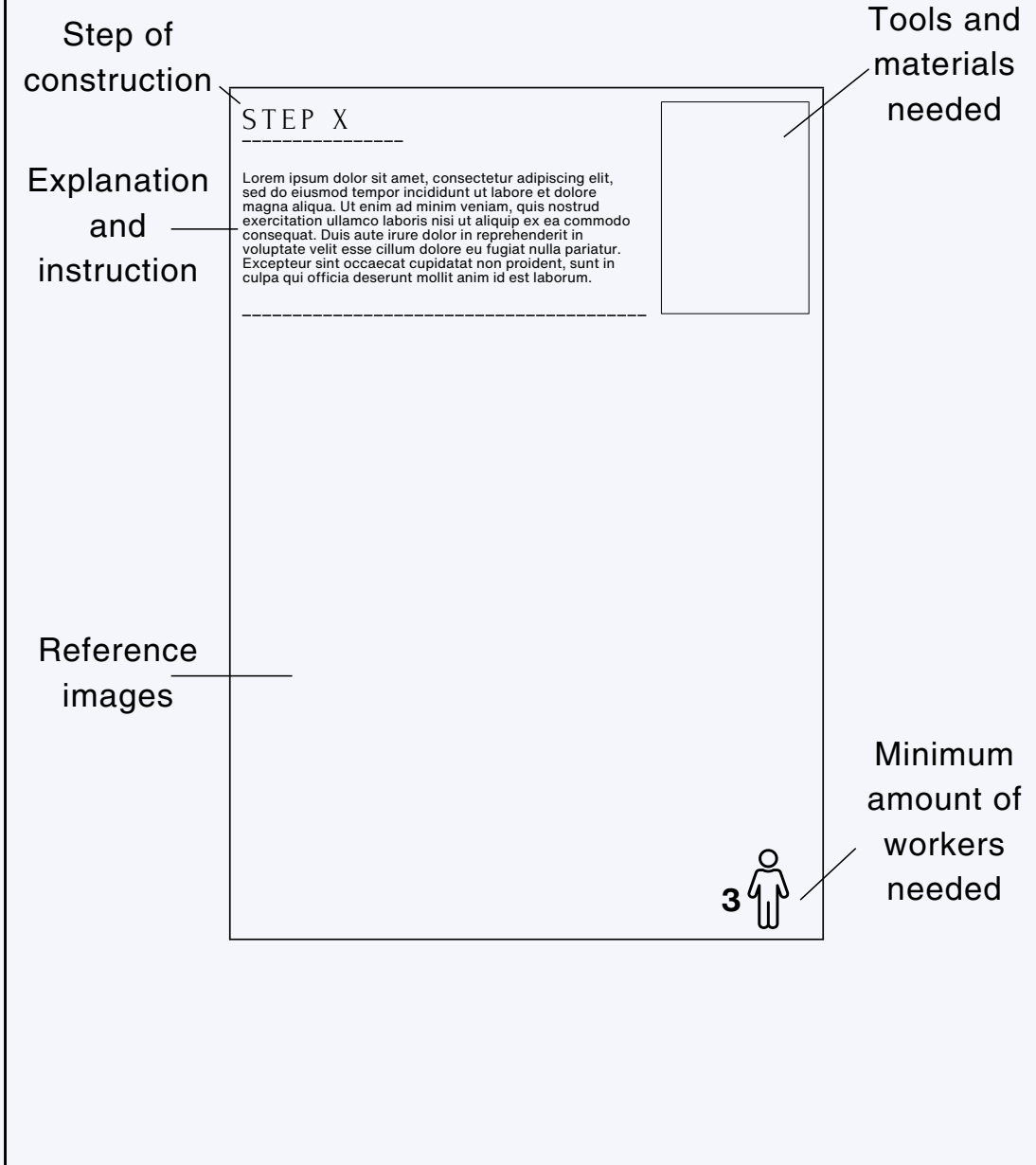
In the following construction steps, each portion of construction is listed as it becomes necessary. However, some of these steps could be completed ahead of time - or at a separate location, if robust transport options are available. Those steps are listed below.

- Step B - girders can be attached before placement of concrete piers.
- Step C - all slices can be assembled ahead of time to speed up construction.
- Step F - as with step C
- Step I - as with step C
- Step J - as with step C

Keep in mind that any assembly done off-site will significantly increase the weight and size of those parts - do not assemble any pieces off-site without a plan in place for their transport and safe placement.

CONSTRUCTION

Throughout this section, certain information will be listed on each page for quick reference. An explanation of this notation is found below.



STEP A - CONCRETE PIERS

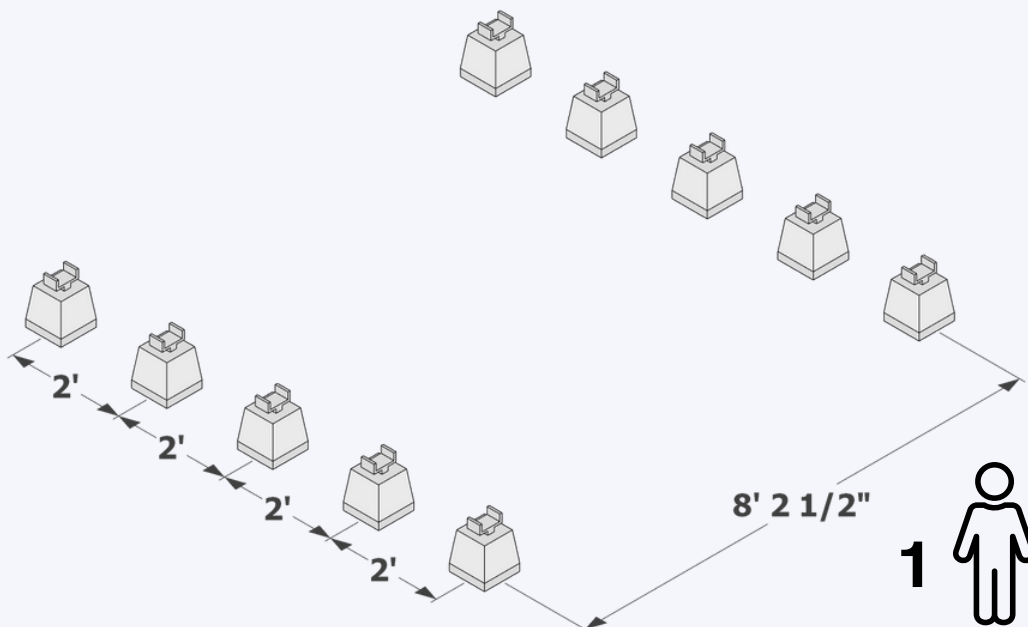
Lay out the concrete blocks, spaced as below.

To aid in your placement, use a measuring tape alongside a non-permanent method of marking the ground (tape, chalk, paint, etc.).

Orient the connectors along the long edge.

Tools
Measuring Tape
Tape, Chalk or
Paint

Roles
None



STEP B - GIRDERS

Place the 4" x 4" wooden girders into the metal connectors, centered along the long axis.

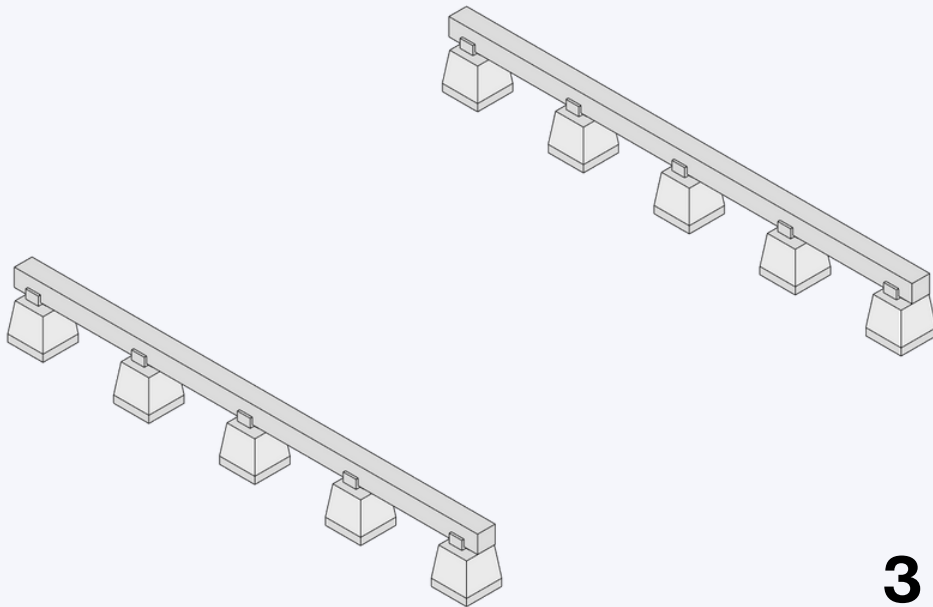
Drill them into place from the outside with bolts placed through the openings of the metal connectors, keeping the bottoms of the girders 1/2" above the flat surfaces of the connectors for air flow.

Tools

Measuring Tape
Level
Drill

Roles

Drill



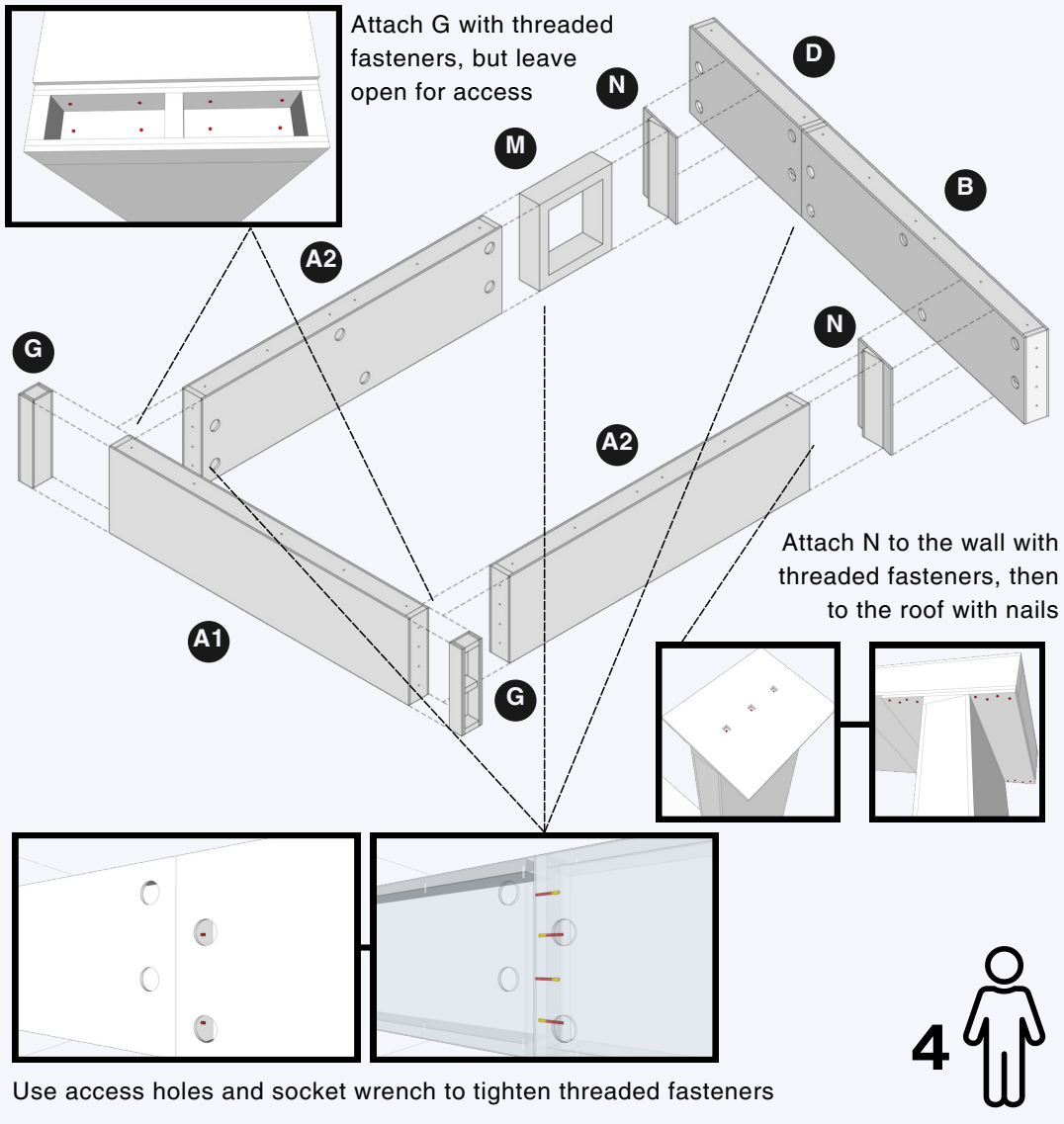
STEP C - ASSEMBLING A SLICE

Laying the panels on their sides over a tarp or on a solid man-made surface, construct a basic slice of the shelter, making sure all access holes are on the interior.

The wall panels should extend beyond the floor to be flush with the G connectors (including their 1/2" finish panel, which will not be attached at this stage.)

Tools
Socket Wrench
3/8" Fasteners
Hammer
Nails

Roles
Heavy Lifting
Hammer



STEP D - RAISING THE SLICE

As a team, push or carry the slice up to the edge of the foundation and lift its lower edge onto the girders.

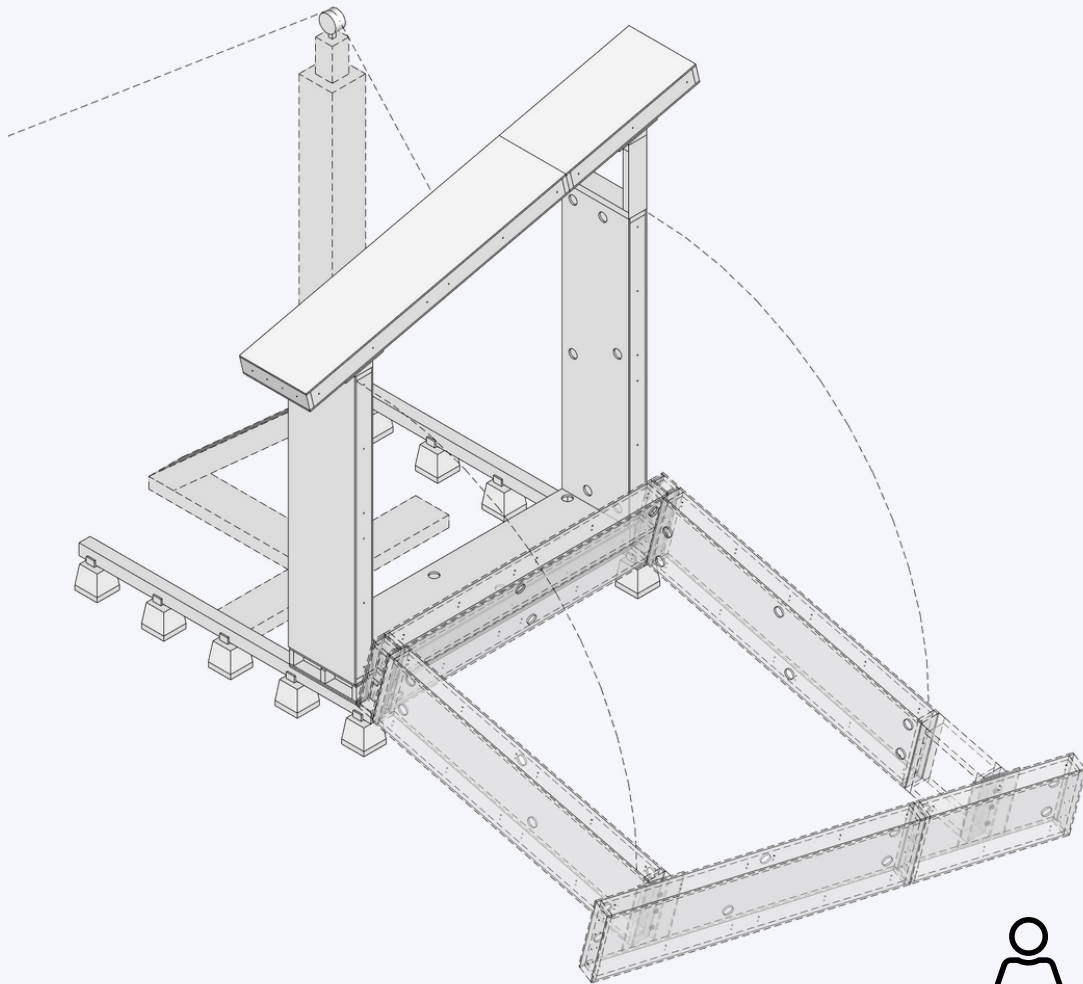
With at least two workers guiding / supporting the slice, attach a rope to the pulley system (WIP) and pull it up to a vertical position, centered and resting perpendicular atop the girders.

Tools

Ladder
Pulley
Rope

Roles

Heavy Lifting



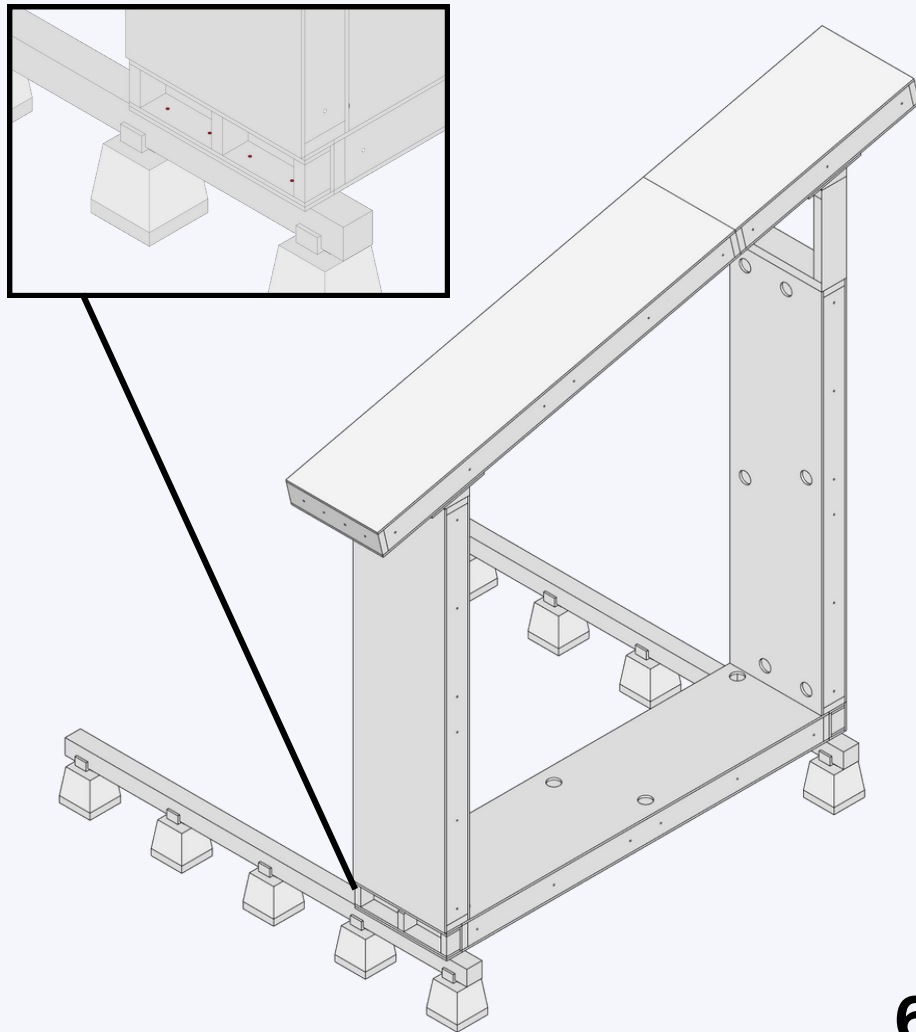
STEP E - SECURING THE SLICE

With the slice atop the girders, align it so that its edges align with the centers of the piers below on the long axis.

Then use a socket wrench to secure the slice to the girders with threaded inserts.

Tools
Socket Wrench
Fasteners

Roles
None



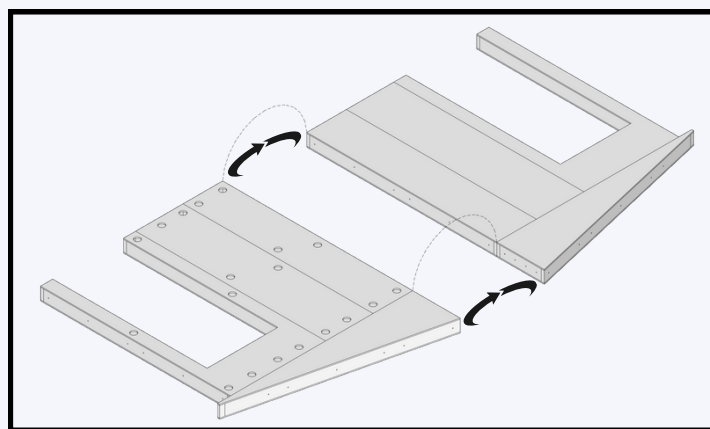
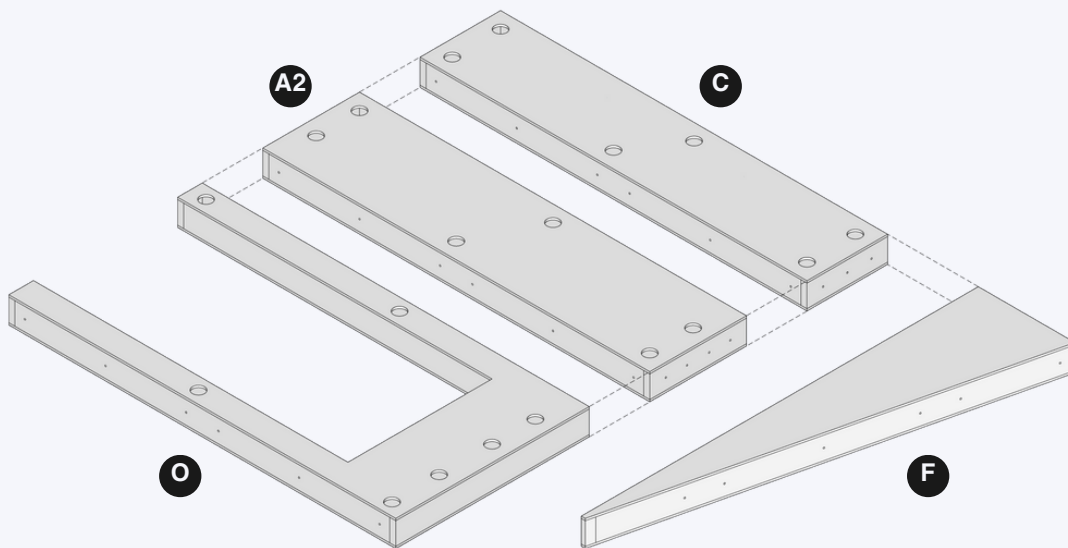
STEP F - DOOR WALL ASSEMBLY

Lay the main panels of the door wall flat with their access holes facing upward and connect them through threaded inserts inserted into pre-drilled holes.

Then, flip the entire panel over.

Tools
Socket Wrench
Fasteners

Roles
Heavy Lifting



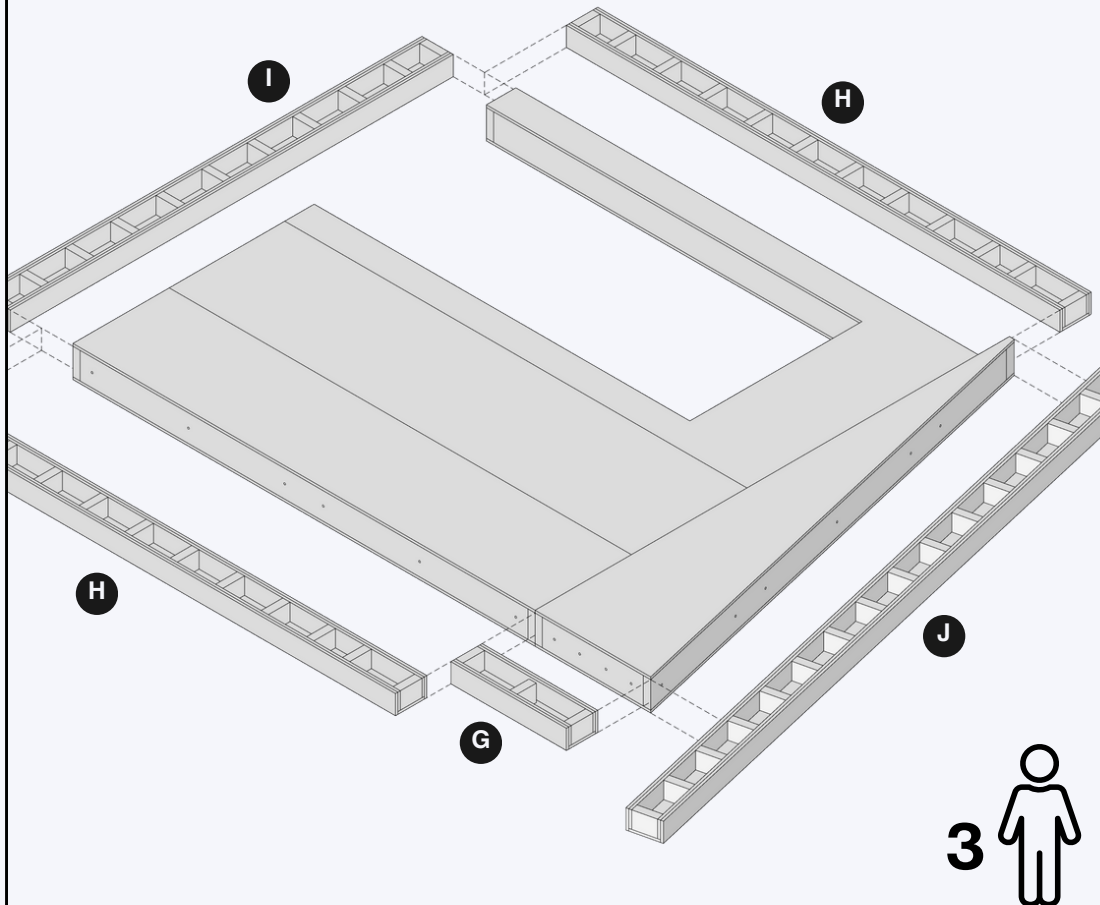
STEP F - DOOR WALL ASSEMBLY

Attach connectors to the door wall with threaded fasteners inserted into pre-drilled holes. Align connector J to these holes.

Make sure to keep these connectors 1/2" lower than the faces of the panels so as to ensure a flush surface when the outward-facing panels are attached.

Tools
Socket Wrench
Fasteners

Roles
None

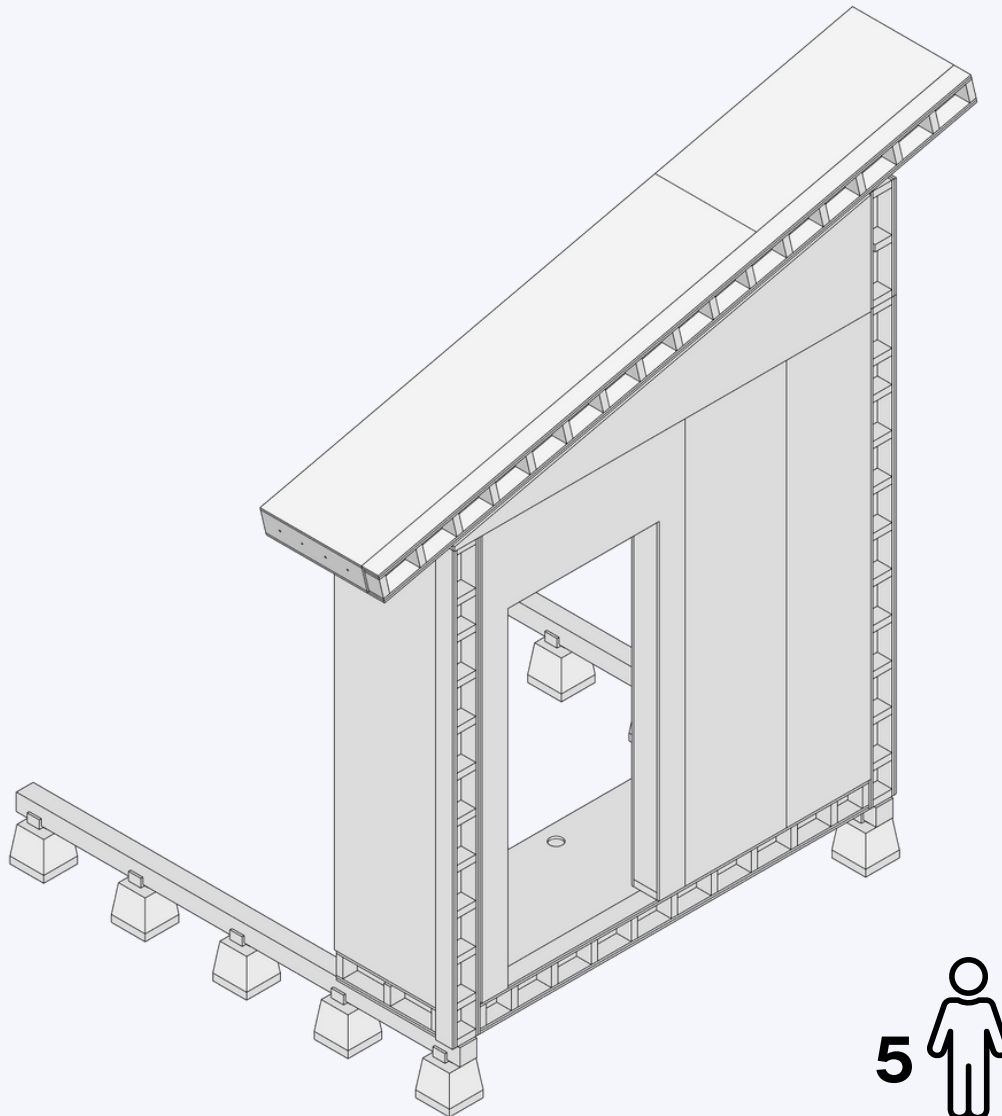


STEP H - SECURING THE DOOR WALL

With the slice atop the girders and flat against the edge of the secured slice, use a socket wrench to secure the slice to the girders and slice with threaded inserts.

Tools
Socket Wrench
Fasteners

Roles
None

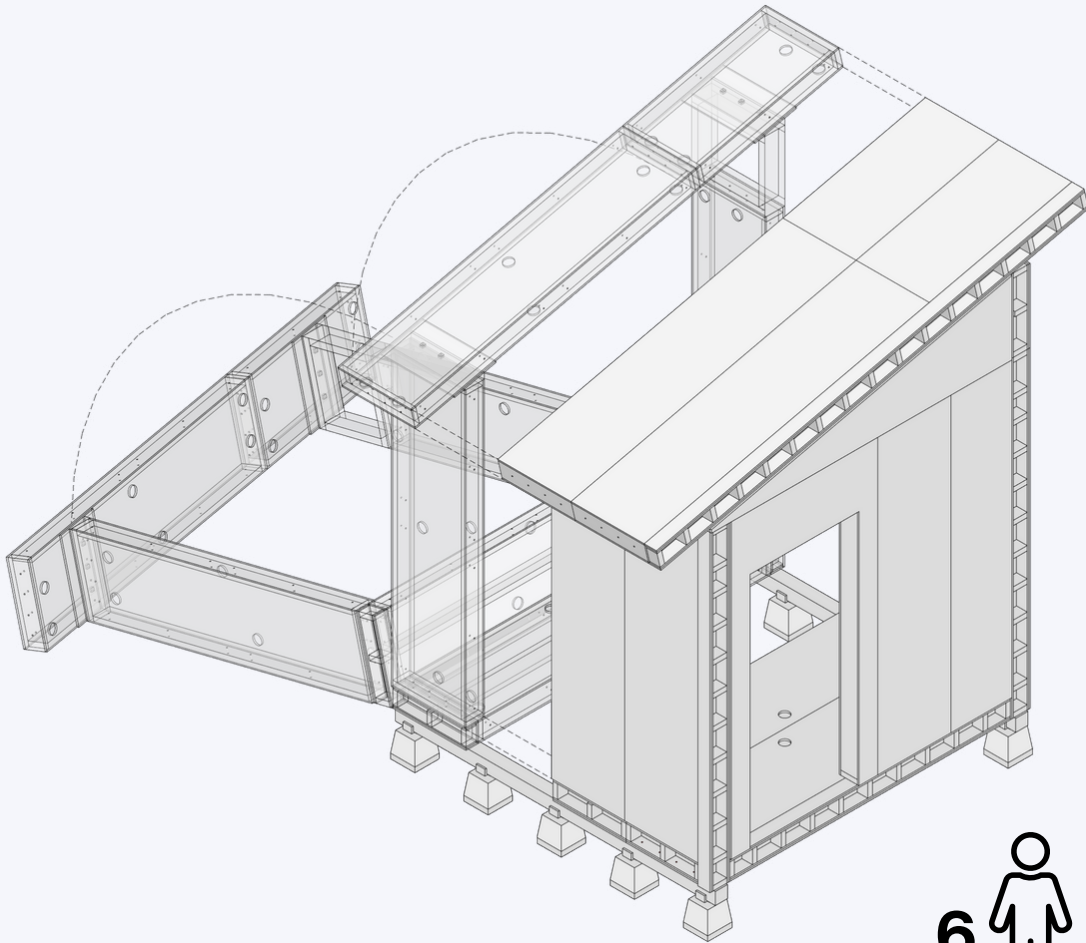


STEP I - SECOND BASIC SLICE

Repeat Steps C, D, and E, creating a second slice and lifting it onto the girders from the side opposite the door, sliding it into place, and securing it both to the girders and to the existing structure using threaded inserts.

Tools
Socket Wrench
Fasteners

Roles
Heavy Lifting



STEP J - WINDOW SLICE

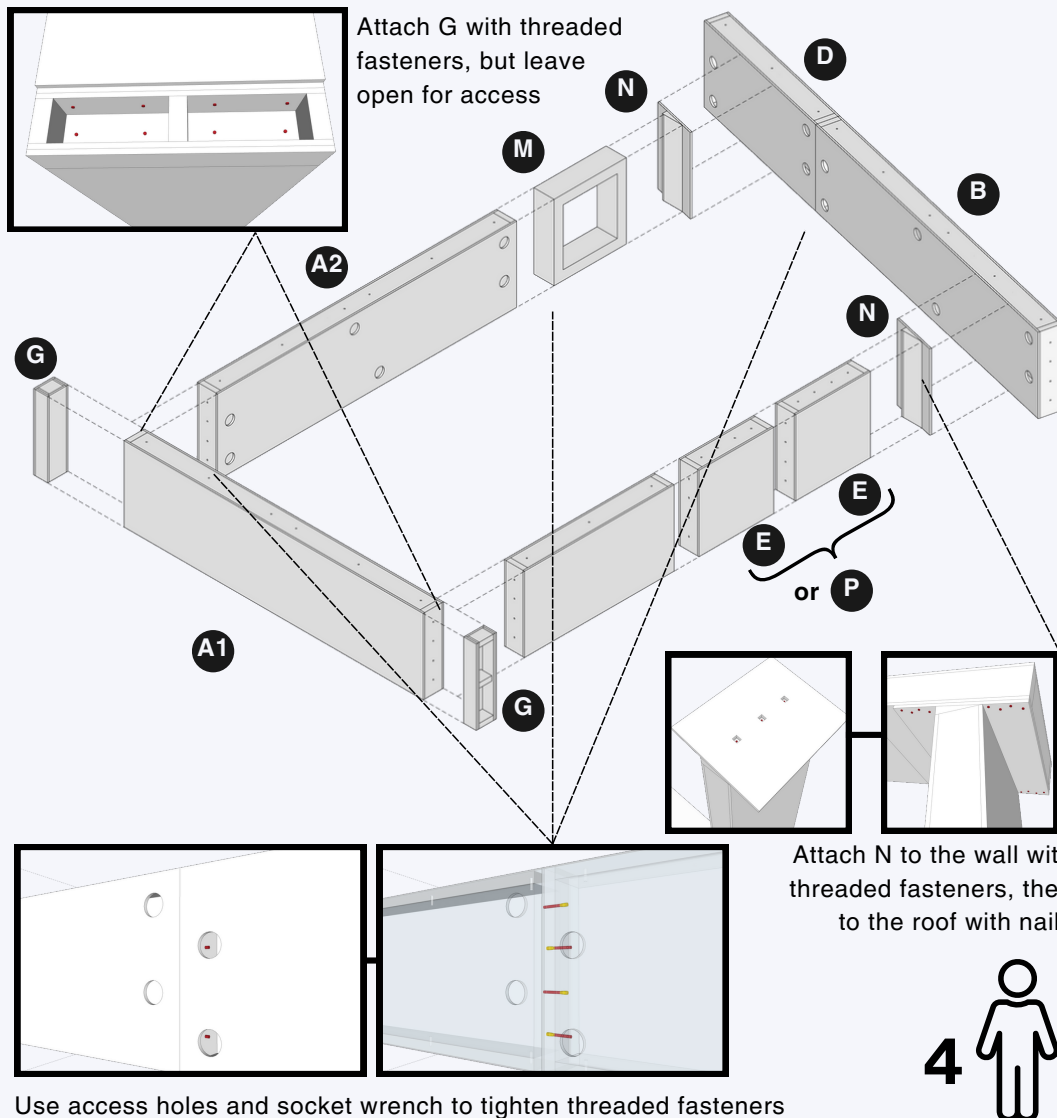
Repeat Step I (using the diagram below in place of the image for step C) to create a window slice. Then lift it onto the girders from the side opposite the door, slide it into place, and secure it both to the girders and to the existing structure using threaded inserts.

Tools

Socket Wrench
Fasteners
Hammer
Nails

Roles

Heavy Lifting
Hammer

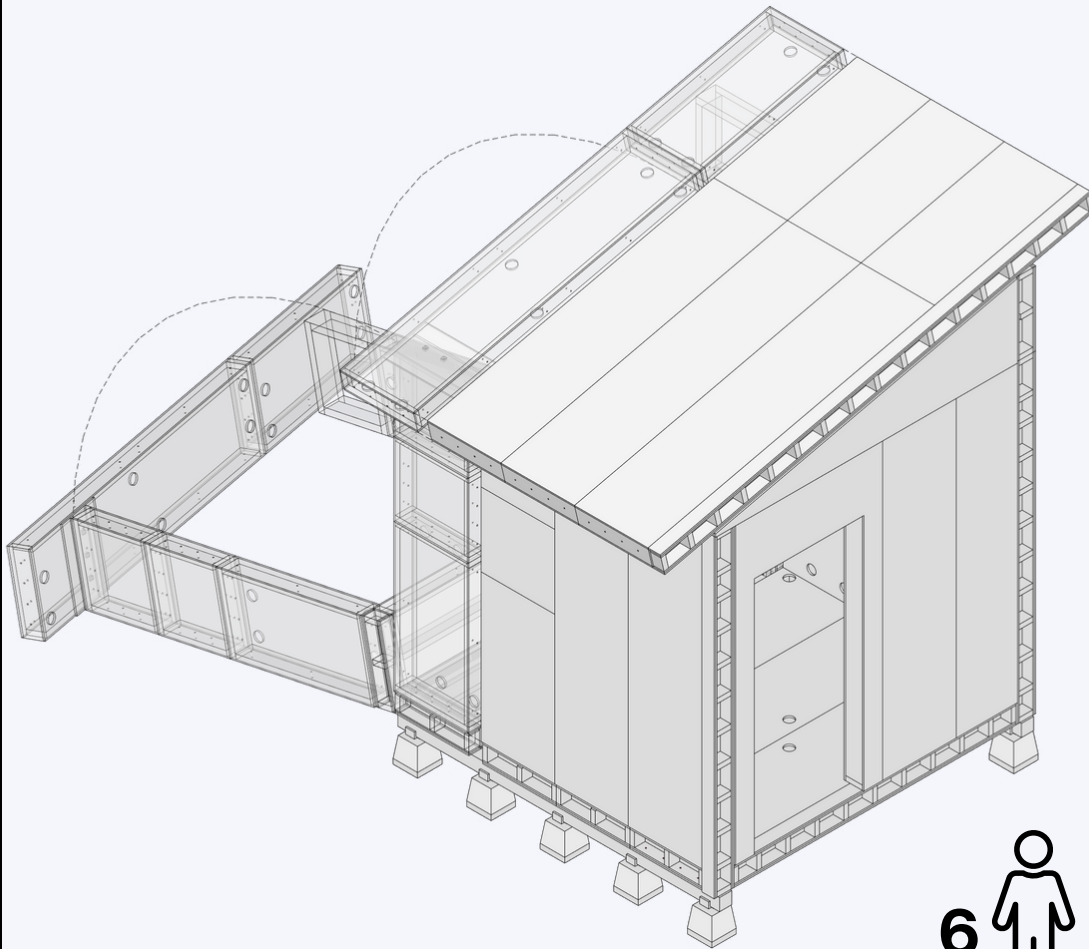


STEP J - WINDOW SLICE

Repeat Step I (using the diagram below in place of the image for step C) to create a window slice. Then lift it onto the girders from the side opposite the door, slide it into place, and secure it both to the girders and to the existing structure using threaded inserts.

Tools
Socket Wrench
Fasteners

Roles
Heavy Lifting



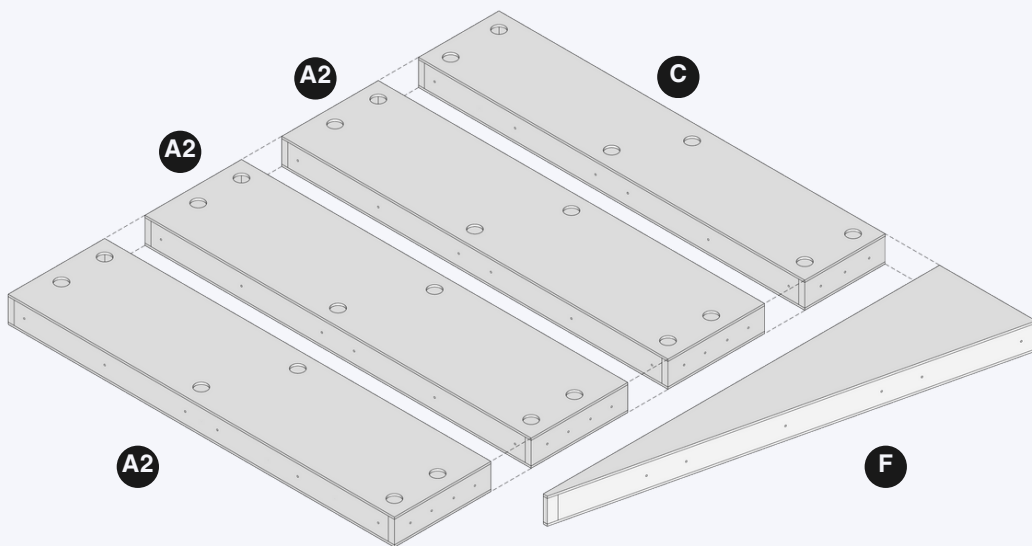
STEP K - BACK WALL

Repeat the first half of Step F (using the diagram below), laying the main panels with access holes facing upwards and attaching them by tightening fasteners into the pre-drilled holes located within the 3" access holes.

Then, flip the panel over.

Tools
Socket Wrench
Fasteners

Roles
Heavy Lifting



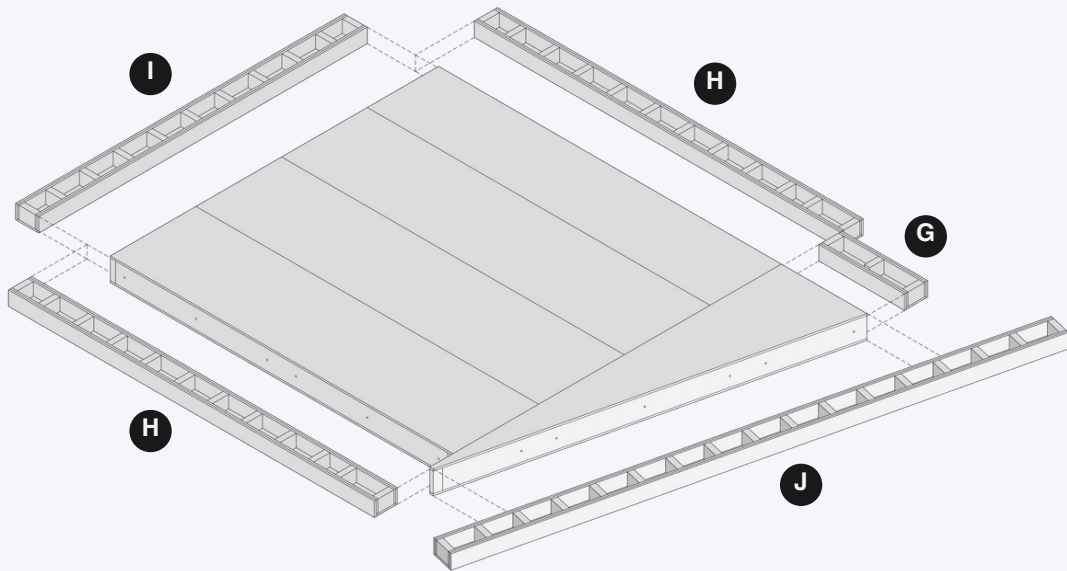
STEP K - BACK WALL

Attach connectors to the back wall with threaded fasteners inserted into pre-drilled holes. Align connector J to these holes.

Make sure to keep these connectors 1/2" lower than the faces of the panels so as to ensure a flush surface when the outward-facing panels are attached.

Tools
Socket Wrench
Fasteners

Roles
None

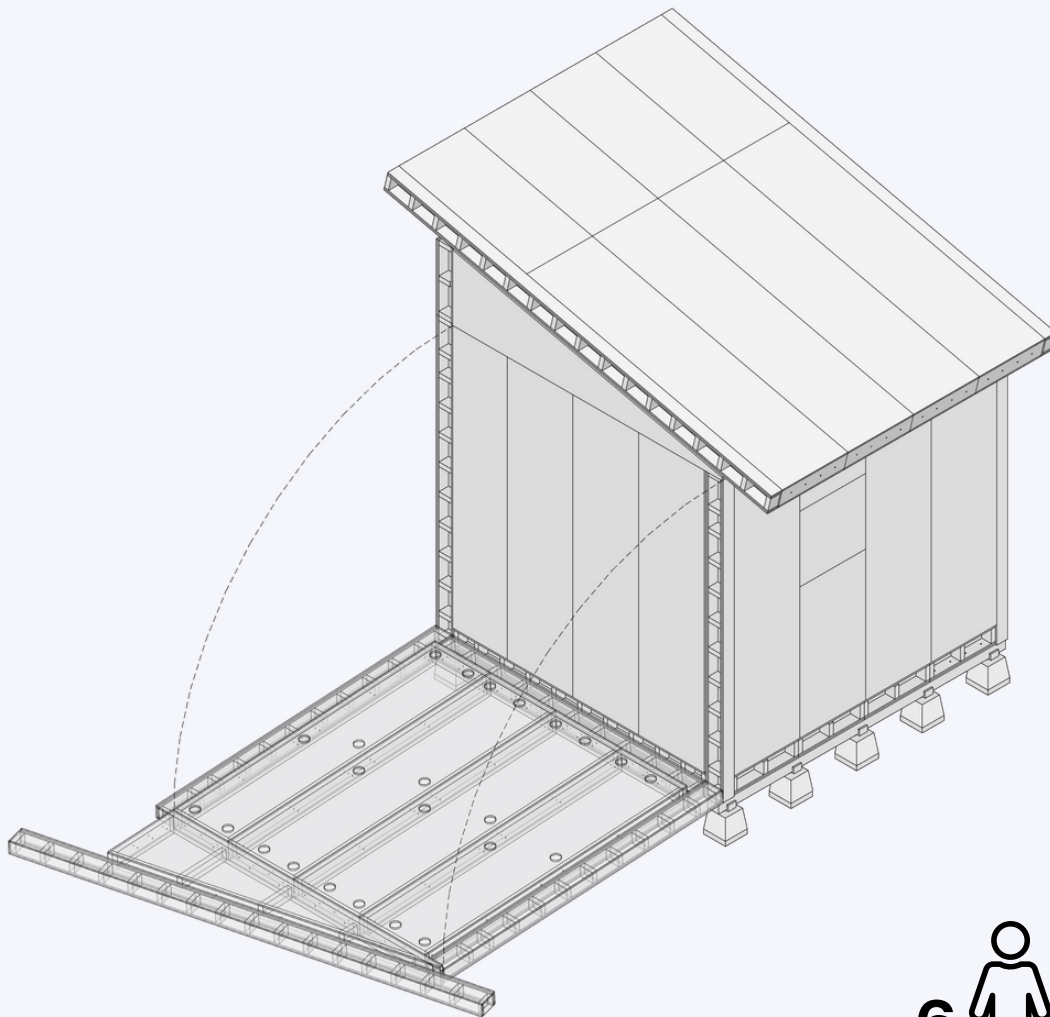


STEP K - BACK WALL (CONT.)

Repeat Steps G & H using the back wall, raising it into place and attaching it to the girders and existing structure.

Tools
Socket Wrench
Fasteners

Roles
Heavy Lifting



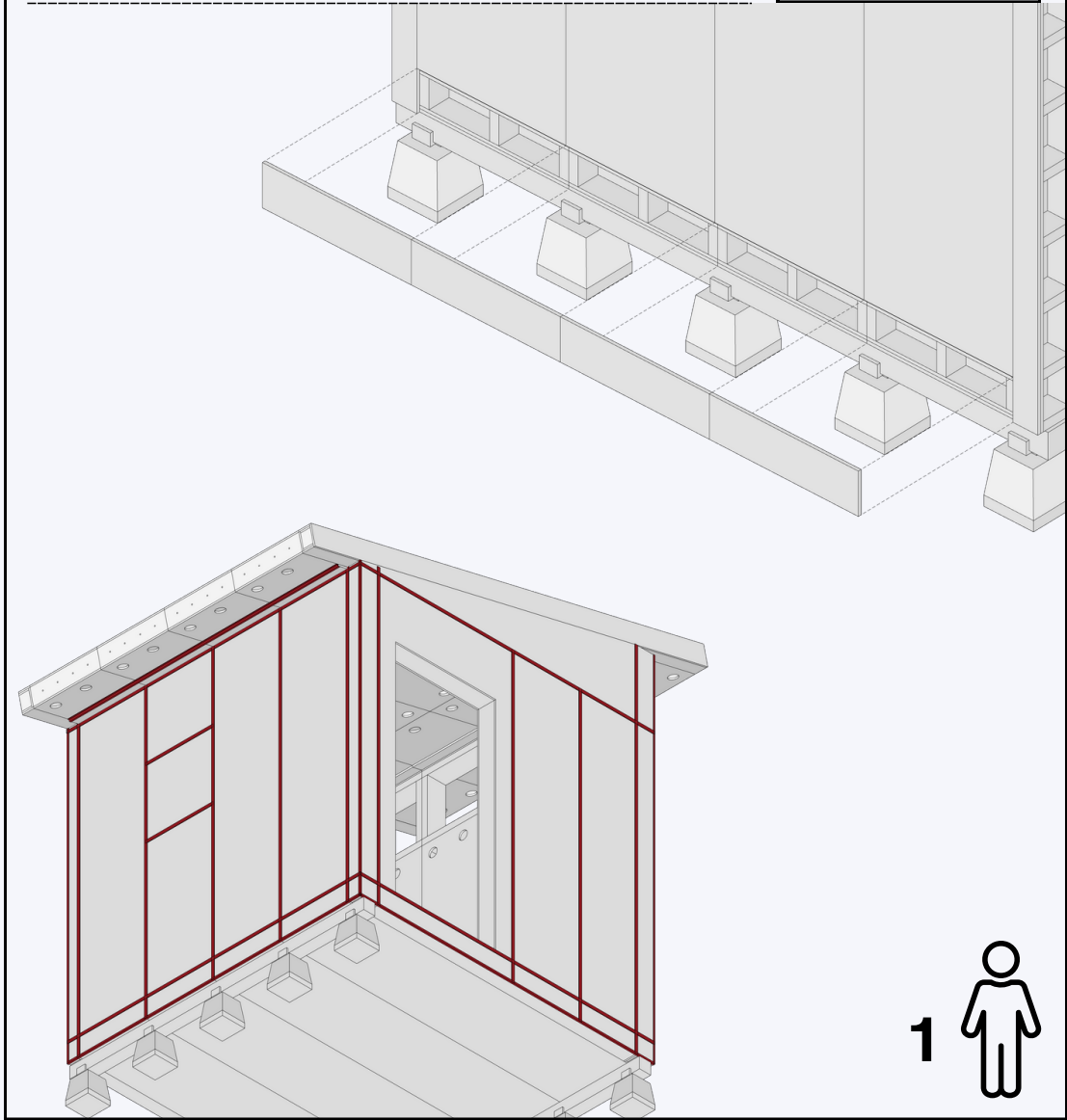
STEP L - WATERPROOFING

Attach the finishing panels to the connectors with nails.

Cover all external seams with WRB tape.

Attach the door to the door frame as indicated in the included door installation manual.

- Tools**
Hammer
Nails
WRB Tape
Ladder
- Roles**
Hammer



STEP L - ATTACHING THE TARP

Center the tarp over the roof, and thread rope through the grommets at its edges.

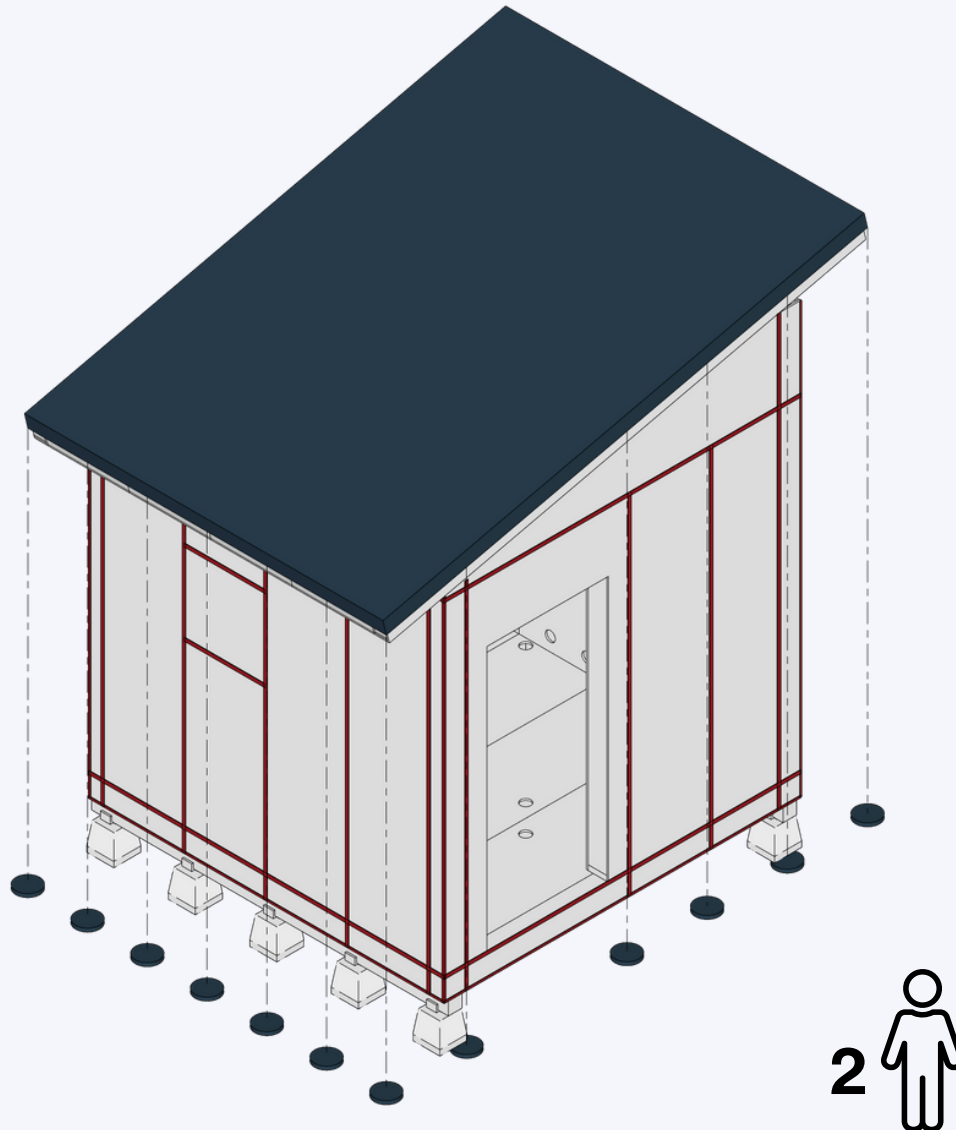
Take these ropes and attach them to stakes or weights on the ground directly beneath their grommets, making sure the rope is taut. A single grommet can go unused to leave the door unblocked.

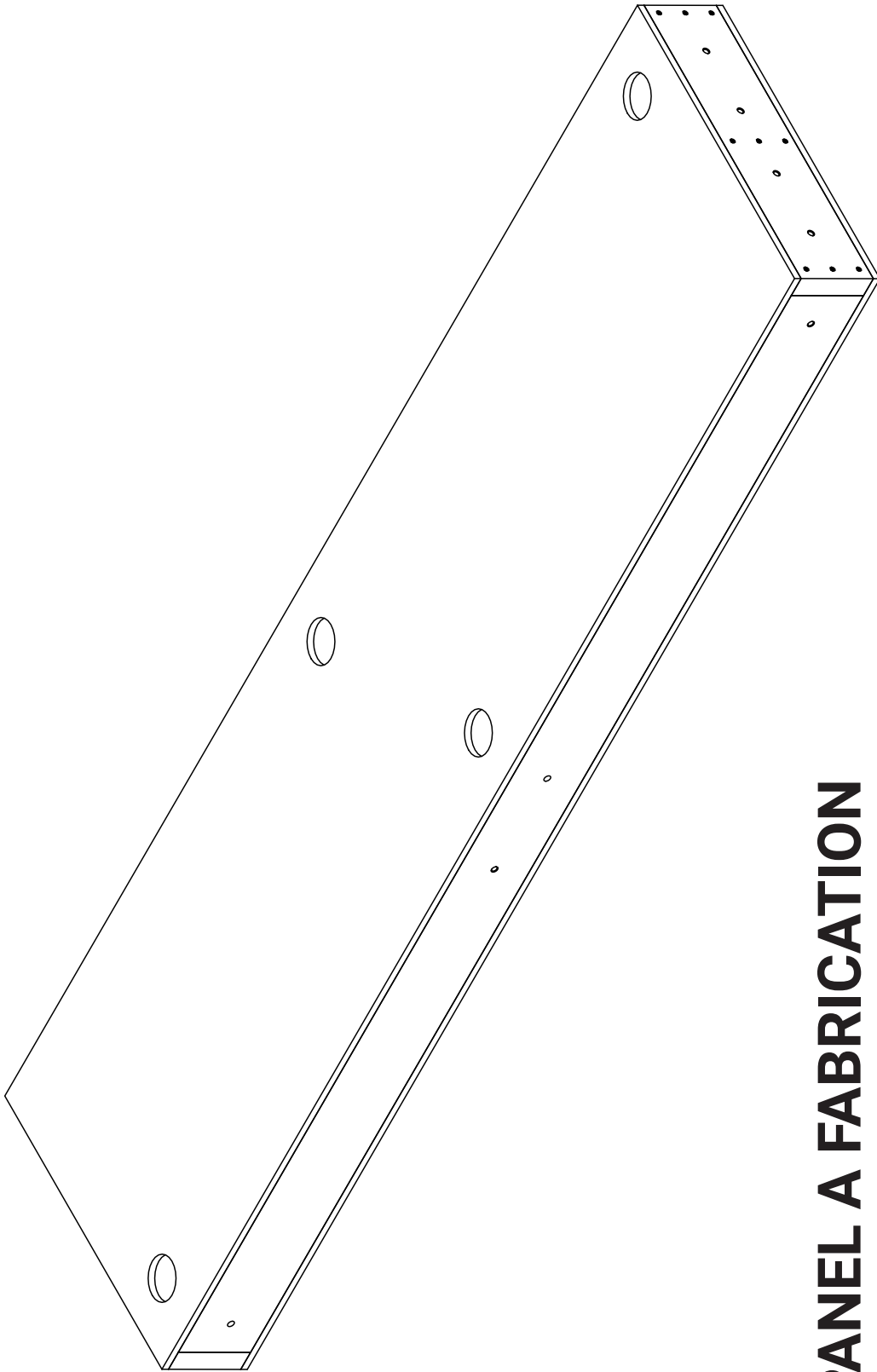
Tools

Ladder
Rope
Tarp

Roles

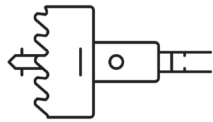
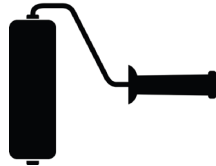
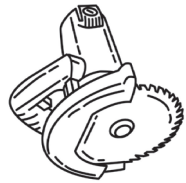
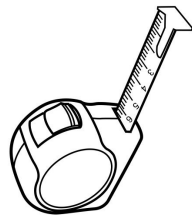
Rope Tying



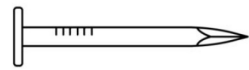


PANEL A FABRICATION

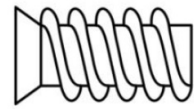
TOOLS NEEDED



FASTENERS NEEDED

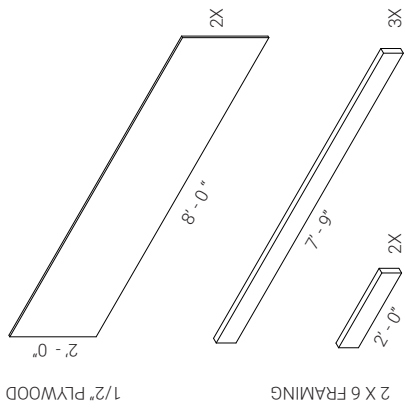


18X



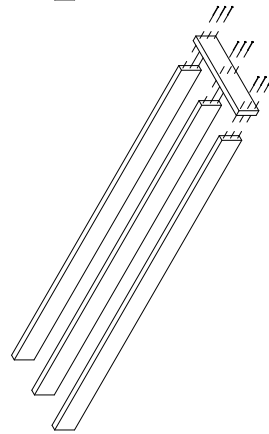
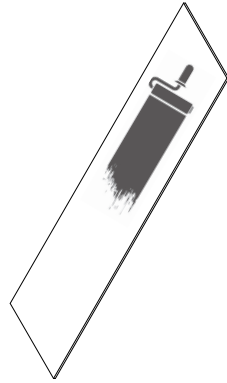
12X

PANEL A

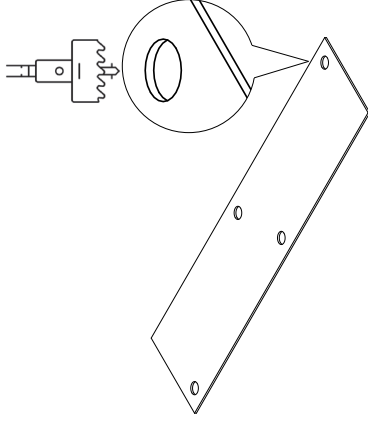


1 CUT ALL MATERIAL TO SIZE

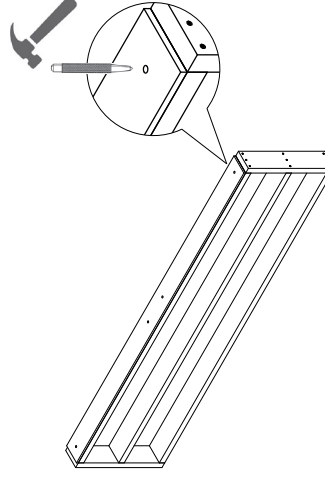
2 PREP EXTERIOR PLYWOOD SKIN WITH 2 COATS OF WRB PAINT ALLOWING TO DRY COMPLETELY BETWEEN COATS



4 BUILD PANEL FRAME

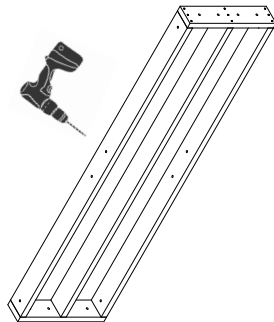


3 PREP INTERIOR PLYWOOD SKIN WITH CONNECTION ACCESS HOLES

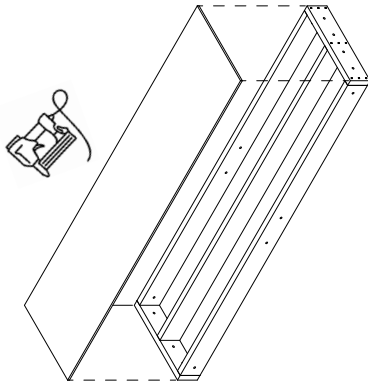


5 USE PRE MADE JIG & CENTER PUNCH TO MARK ALL BOLT HOLE LOCATIONS

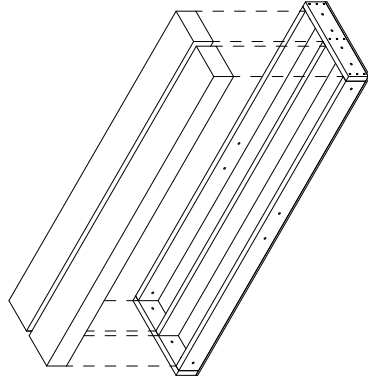
PANEL A



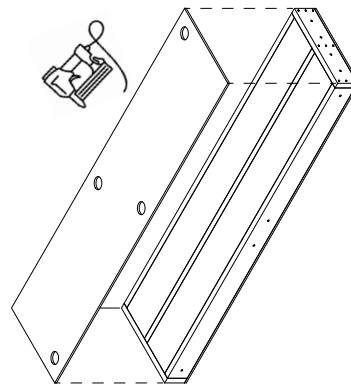
6 DRILL ALL BOLT HOLES (15/32")



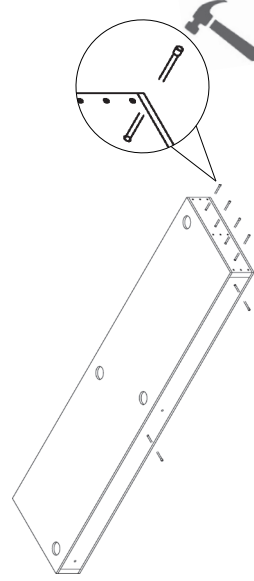
7 ATTACH EXTERIOR PLYWOOD SKIN



8 ADD INSULATION



9 ATTACH INTERIOR PLYWOOD SKIN




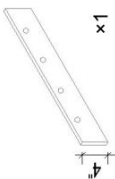


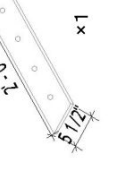


10 EMBED THREADED INSERTS

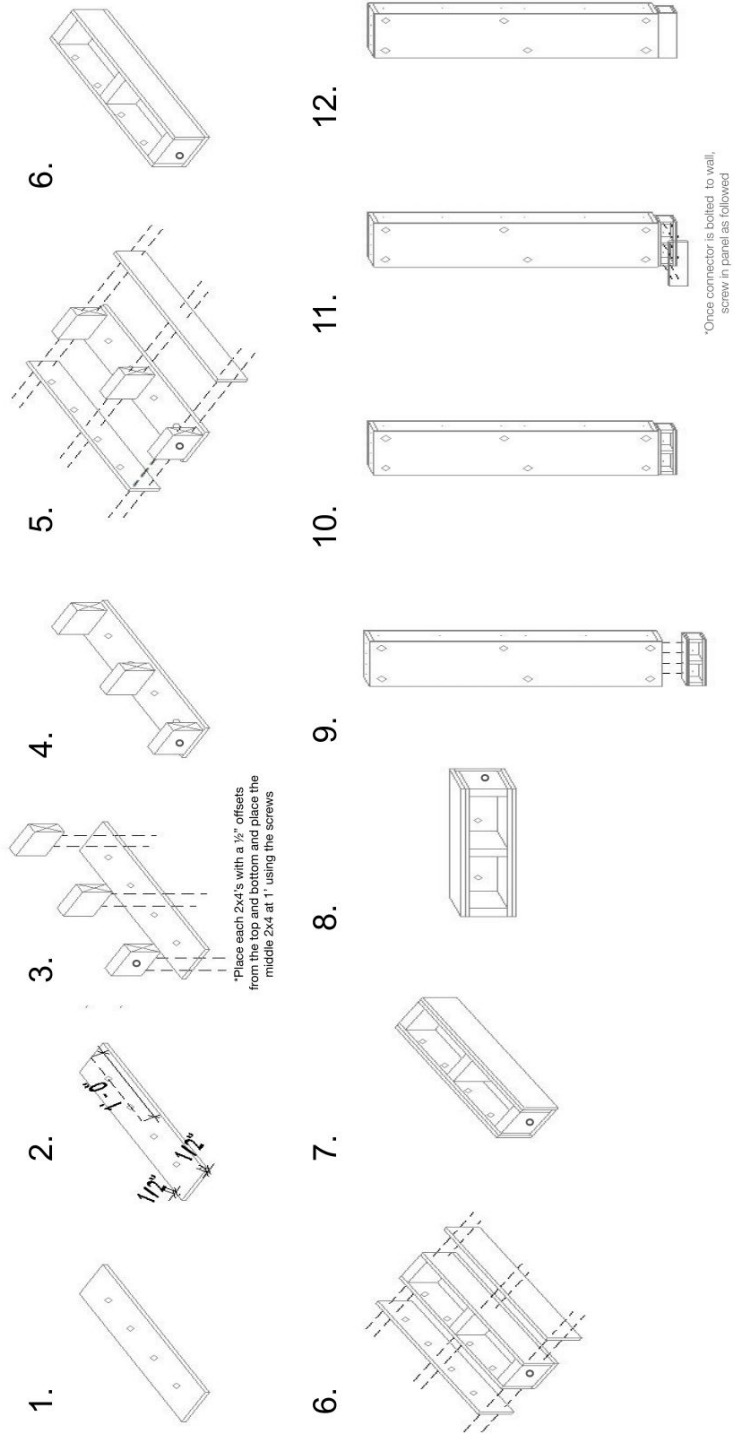
PANEL A

Connection Type - A

(Used for floor to wall connection & Roof Panels)

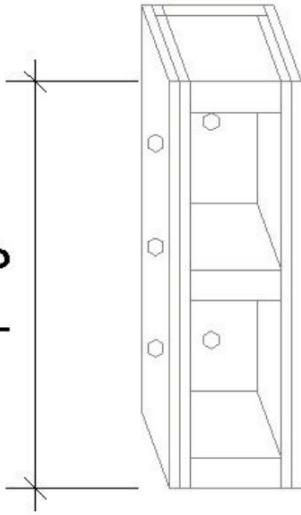
PIECES NEEDED

	x1
	x1
	x1
	x1
	x1
	x2
	x1



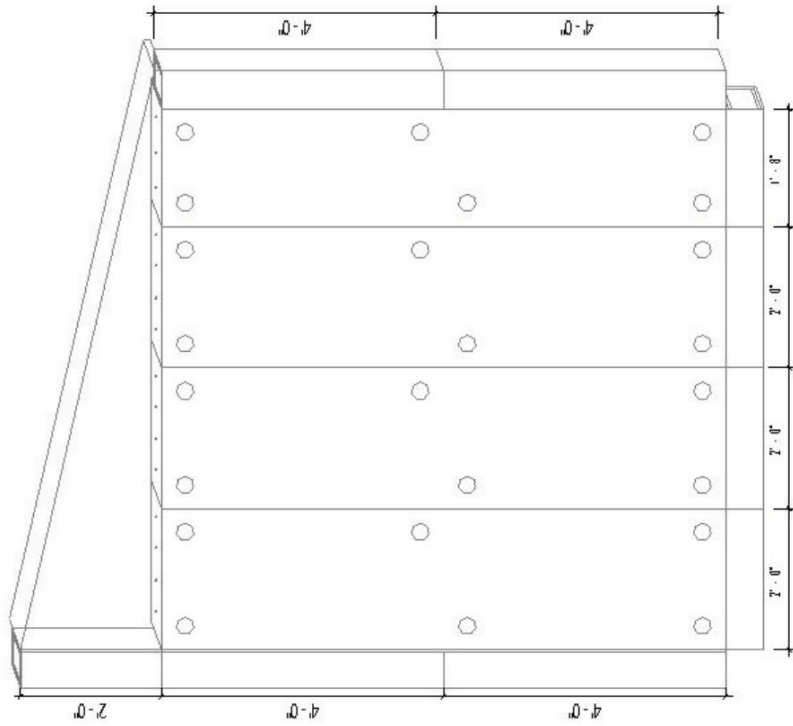
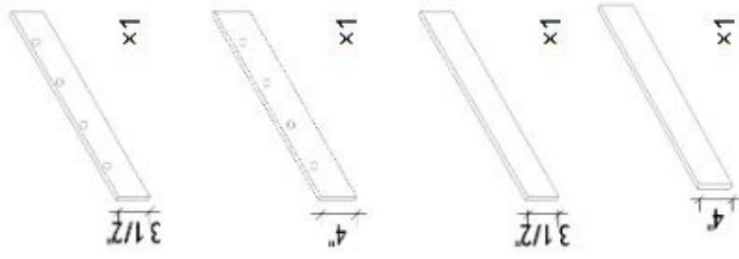
Special connection A.2

1' - 8"



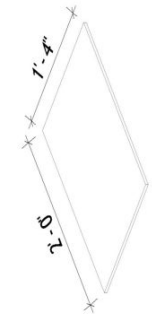
*same concept as the 2' connection but shrunk down to 1'8" for the shorter ssp panel, Hole layouts are 5" from one another

PIECES NEEDED



Roof to Wall Connection

Fabrication:



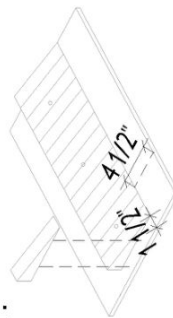
*Cut the following rectangle piece from a sheet of 3/4" plywood



*Cut 16 of the following Triangles From a 2X4 piece of lumber using a Miter Saw

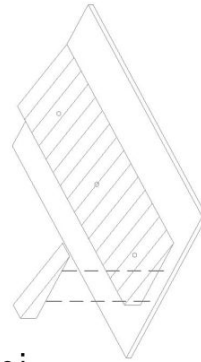
Construction:

1.



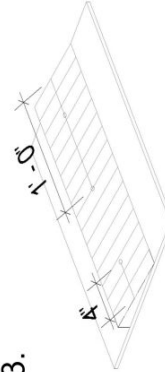
*Using Wood glue, stick the 16 triangles in a line at the middle of the rectangle of plywood giving you a offset of 4 1/2" from the top and bottom of the 1'-4" side of the rectangle.

2.



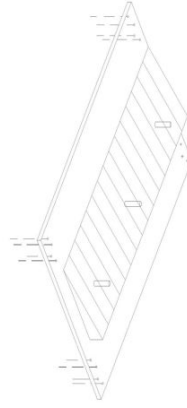
*Once the triangles are dry and placed in location you can move on to the next step

3.




*Now use a 15/64" drill bit and make 3 holes. 2 at 4" and one at 1" as shown above

4.




*Flip the Connection piece around and it can now have the bolts inserted to the wall and use screws to fasten it to the roof

TOOLS USED




-Drill




-Miter Saw




- 15/64" Drill bit




-Tape measure



-3/8" bolt
Length 2.5"

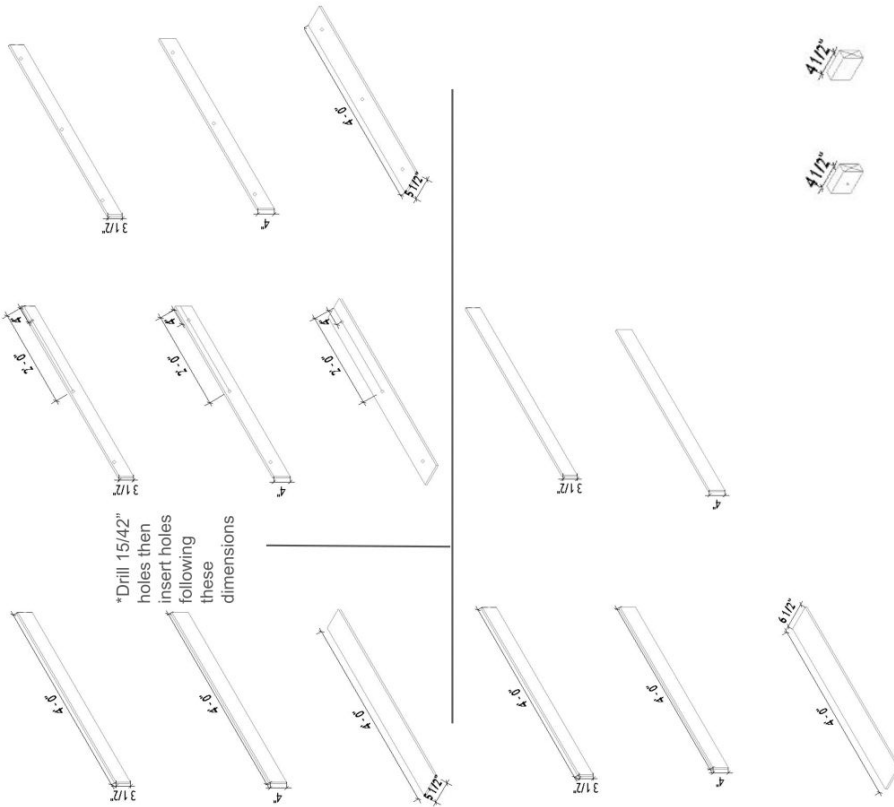


-Socket wrench



-Wood Glue

Fabrication of Type - C Connection

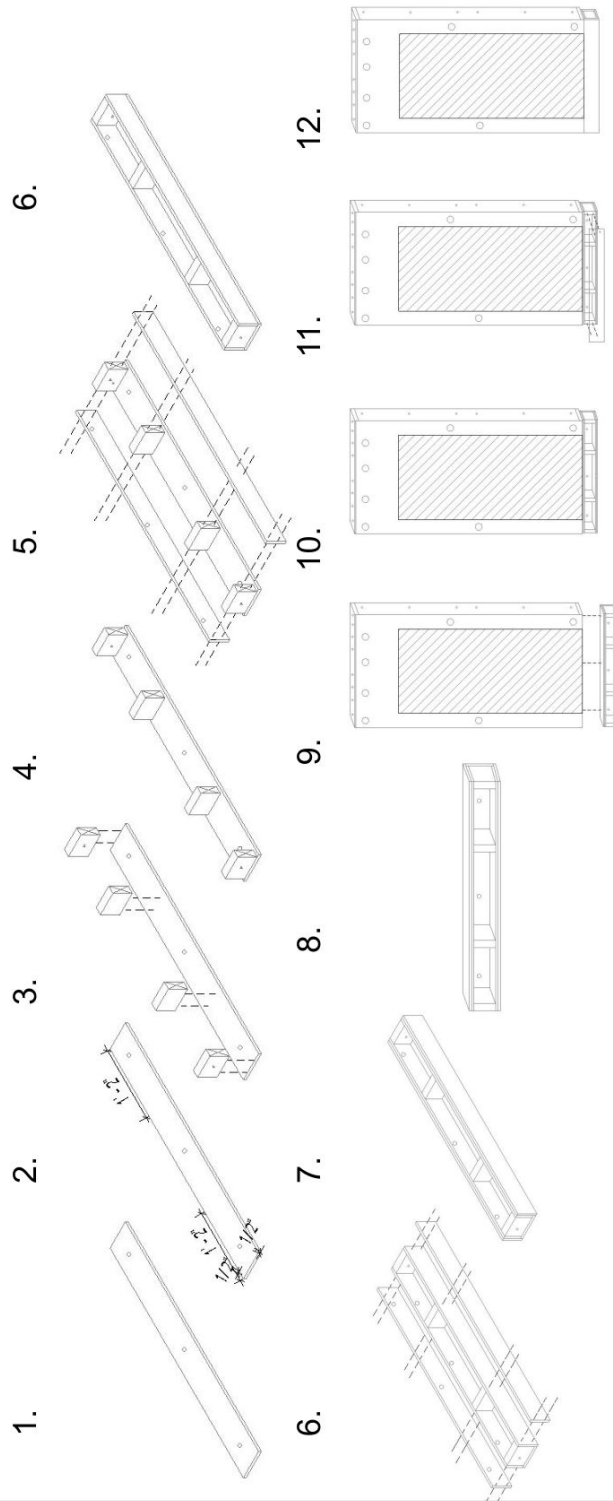


TOOLS USED



Connection Type - C (Used for Door Panel/wall corner connection/ roof panels)

--	--	--	--	--	--	--	--



*Once connector is bolted to wall, screw in panel as followed

Appendix B:

Structural Report

Structural Design Report

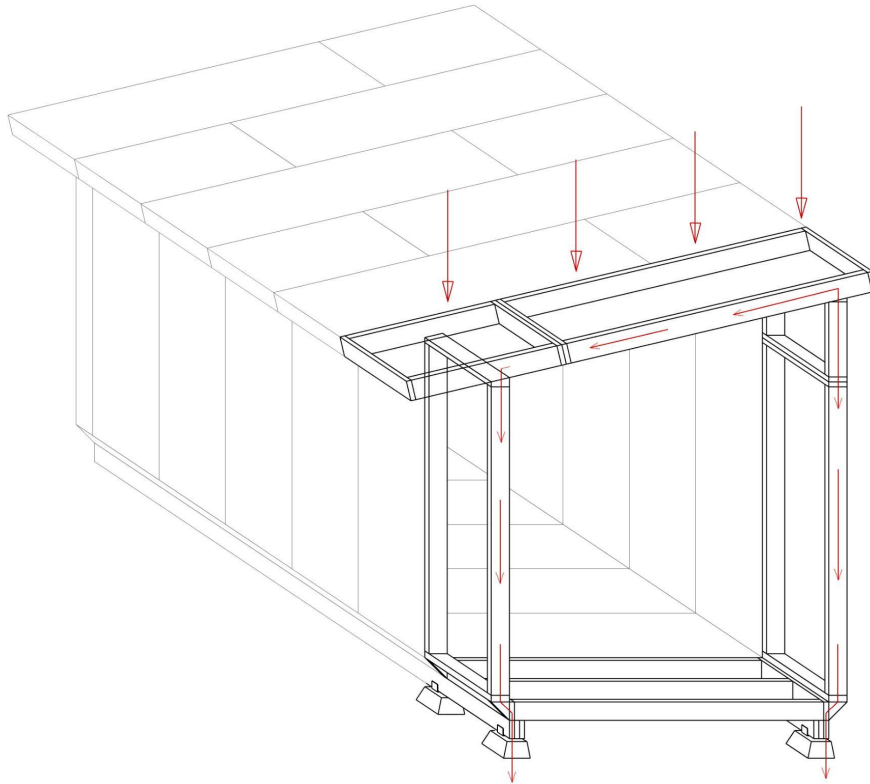
Team: Bryce O, Wilka M, Clara D
Fall 2024

Table of Contents

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Project Overview	3
Design Assumptions	4
Material Properties	5
Karamba and Grasshopper analysis	6
Loading Limitations	8
Shear and Bending	9
Recommendations	10
Codes	10

Project Overview

This SSP shelter uses 2x6 light wood framing components, arranged in slices which carry the assumed loads through these framing pieces, aligned top to bottom. At the bottom, these loads are distributed along 4" x 4" beam foundations placed perpendicular to the slices at either end, which carry the loads into the ground through concrete pier blocks. The roof, walls, and floor are connected with intermediary wooden joints, and each piece is connected together using metal bolts.



Design Assumptions

For the design of this structure, we have assumed that it is being constructed per ASCE 7-22 and the OSSC modifications that would modify the current ASCE 7-22. This structural analysis is assumed to take place in Silverton, Oregon, allowing for the following calculations of the controlling wind and snow loads.

snow				
	Pg		31 lb/ft ²	OSSC T7.2 modification
	W2		0.35	elevation 320.1 ft
rain on snow surcharge	if slope = 1/12		5 lb/ft ²	mod 0.04 PSF/ft
				12.804 lb/ft ²
				therefore Pg 43.804 lb/ft ²
7.3-1	flat roof	=0.7CeCtPg	=Pf	33.115824 lb/ft ²
7.4-1	sloped	=CePf		
T73-2	Ct		1.2	
T7.3-1	Ce		0.9	
Minimum according to T7.3-4			25 lb/ft ²	
final snow load			33.115824 lb/ft ²	

wind					windward			leeward		wind pressures	
floor height(ft)	Kz(ASCE T26.10-1)	Ke(ASCE T26.9-1)	V(mph)	qz	Kd	G	Cp	Pz			
10.00	0.70	1.00	90.00	14.52		0.85	0.85	0.80	8.39	lb/ft ²	
						0.85	0.85	0.80	0.00	lb/ft ²	
								-0.50	-5.24	lb/ft ²	
								-0.50	0.00	lb/ft ²	
N-W frame											
10.00	0.70	1.00	90.00	14.52		0.85	0.85	0.80	8.39	lb/ft ²	
						0.85	0.85	0.80	0.00	lb/ft ²	
								-0.50	-5.24	lb/ft ²	
								-0.50	0.00	lb/ft ²	

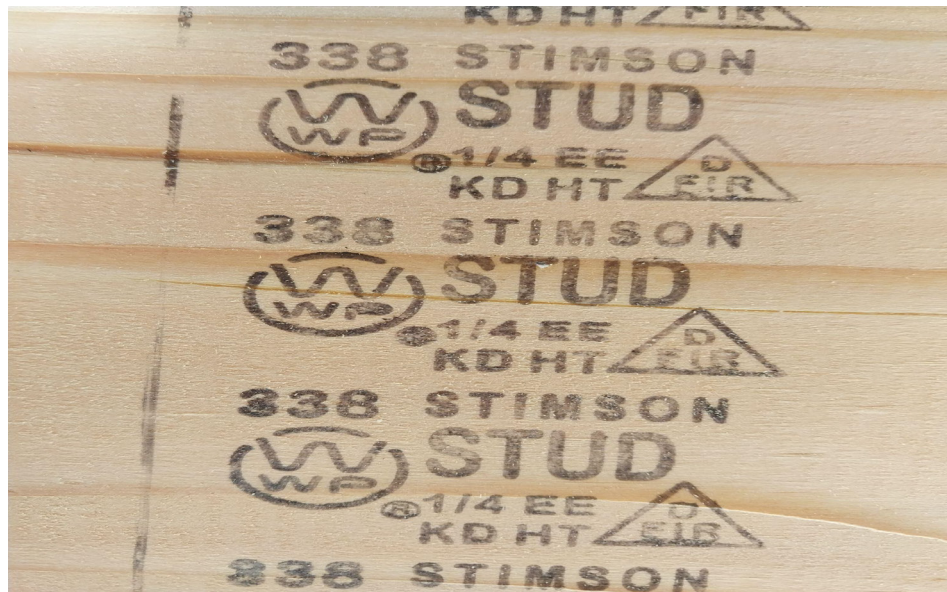
The modifications necessary for the snow load were not necessary for this project as the slope of the roof is greater than the 1/12 limitation listed by OSSC for the addition of rain on snow loading. The use of the ASCE 7 hazard tool was key in discovering the factors for the region that we selected using the city of Silverton as the site rather than a specific location in Silverton. The ASCE 7-22 load combination used was 1.2DL+1S+0.5W resulting in a load of 45 psf.

Material Properties

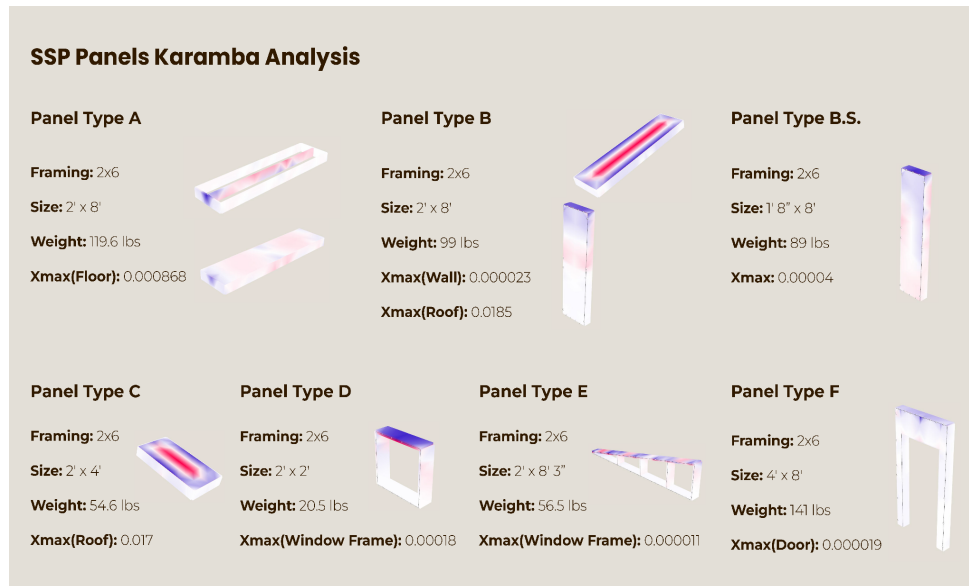
The material utilized for the construction of the SSPs were 2x6s at the length of 8 ft and ½ inch thick plywood. For purposes of design and calculations, the following properties were used.

Part of SSP	Young's Modulus
Plywood	1738000
Stringers(Douglas Fir)	1627400

Location of SSP	Deflection Limit(8ft lengths)(in)
Floor	0.267
Roof	0.4



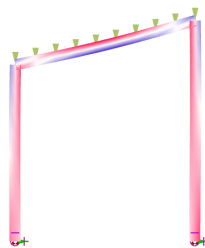
Karamba and Grasshopper Analysis



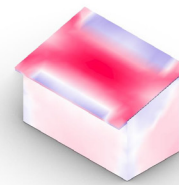
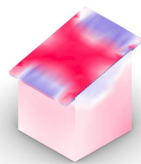
The Karamba analysis above highlights the areas of maximum stress for each type of structural panel. Each panel's stress concentration is shown in color gradients, with the darker parts indicating regions of maximum strength. This analysis helped us determine the size of the lumber that was used. The results validate the effectiveness of the panels in their designated roles and provide useful data for optimizing the design.



The models above show the points of most stress and deformation on individual wooden components, the values of which fall within an acceptable range for the construction of our prototype. Physical modeling of this prototype confirmed these results, showing sufficient strength to stand as a completed slice and be stood in.



Plan: 8' x 8' (Basic Shelter)
Xmax: .006098

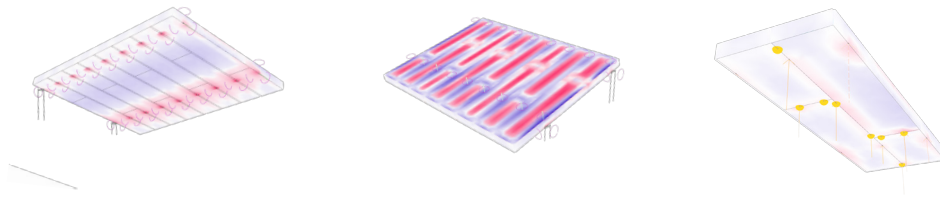


Plan: 8' x 16' (Expanded Shelter)
Xmax: .015306

The sectional analysis on the left shows the distribution of the LRFD loading on a two-foot slice. The loading in question shows the tensile stress experienced on the lower half of each roof slice and the load pathing of the

distribution. This expresses the importance of monitoring deflection as weight is added to a slice and potentially increasing thickness.

The analysis on the right shows the stress experienced by the whole shelter. The whole is experiencing compressive stress along the middle and tensile across the connections. The greatest deflection X_{max} is found in the center of the shells and would need the most reinforcement there should the deflection increase past the limit of 0.4in for the roof.



These models provide a more comprehensive analysis with assembled components. The most common weakness occurs at the center span of the roof SSPs. Bolt properties need more thorough analysis to determine their ability to support the in-plane roof connections fully, but were successful in physical prototyping.

Loading Limitations

The loads according to the APA supplement provided show that the limitations of the 2'x8' SSP would be the following.

Load Summary			
allowable based on deflection	Wdelta	178.8227377	psf
bending stress limit bottom	Wbb	3905.149337	psf
bending stress limit top	Wbt	151.9245967	psf
splice botom	Wpb	79.01170348	psf
rolling shear	Wst	52.37654856	psf
allowable based on horiz shear	Wv	133.5878568	psf

The limit shown here is rolling shear which is below the listed weight of 48psf for an SSP considering the load combination from ASCE 7-22.

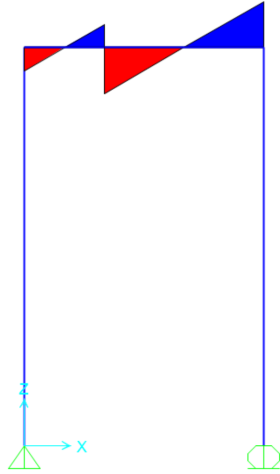
The bolts and nails that are used in connections for the system are limited through pull-out and shearing

nail cap			
Table 12.2C	W	21	lb/in

eq 12.3-1	Im	$= (D * L_m * F_{em}) / R_d$	1815	lb
eq 12.3-2	Is	$= (D * L_s * F_{es}) / R_d$	1815	lb
eq 12.3-3	II	$= (K_1 * D * L_s * F_{es}) / R_d$	835.3306841	lb
eq 12.3-6	IV	$= (D^2 / R_d) \sqrt{(2 * F_e * F_{yb}) / (3 * (1 + R_e))}$	102.9233869	lb

The bolts are seemingly appropriate for shear with a limit of bending being the difficult reference point being 102 lbs so the recommended method of mitigation would be to increase the bolts in the connection. NDS lists the pull-out limit to the nails used to being 21 lb/in of embed so the 3 in of embedment of the nails would result in nearly 65 lbs of resistance per nail so using 7 nails would result in 455 lbs of resistance.

Shear and Bending



The highest shear experienced by the bolts in the roof is found to be 144 lbs of shear in the downward direction and 95 lbs in the upward direction. The simplified frame is used as the actual values have not differed largely from the simplified values therefore using the simplified frame as a basis for design was used. The bending will be greatest clearly at the seam and reinforced with a splice on the bottom of the SSP to support the tension forces that would be experienced at the seam. According to our design calculations, a bolt of the quality and diameter that is being utilized is capable of taking 510 lbs of shear. The NDS recommendations for shear capacities of the connection to the best of our knowledge are accurate and show the functionality of our seam connection with minor connection changes due to angle resulting in small changes.

yield modes	reduction term (Im,Is)4Ktheta, (II)3.6Ktheta, (III,III,IV)3.2Ktheta			
eq 12.3-1	Im	$= (D \cdot L_m \cdot F_{em}) / R_d$		1815 lb
eq 12.3-2	Is	$= (D \cdot L_s \cdot F_{es}) / R_d$		1815 lb
eq 12.3-3	II	$= (K_1 \cdot D \cdot L_s \cdot F_{es}) / R_d$		835.3306841 lb
eq 12.3-6	IV	$= (D^2 / R_d) \sqrt{(2 \cdot F_e \cdot F_{yb}) / (3 \cdot (1 + R_e))}$		102.9233869 lb

Recommendations

The recommendations that we would make towards the construction of this shelter is to look into how one would plan to reinforce a larger structure, understanding that the center bending that we have limited by utilizing a smaller structure would face increased bending stress as the space increases in square footage. Methods for reinforcing the bending stress would include a splice width for each 2-foot slice of the shelter additional reinforcement could come from the support of the center through columns which would change our load pathing requiring additional foundational support therefore it is preferred to increase splice width increasing its capacity at the seam. During the assembly process, if the end wall cannot be attached relatively quickly, or a variation is being made that omits the end walls, another source of shear resistance is necessary to improve the lateral strength of this structure, as it showed weakness in prototyping which posed a risk to the structure and the safety of those assembling it. Our design does not account for the ground conditions of these sites so any geotechnical effects that can be considered will make the functionality of the shelter that much better.

Codes

ASCE 7-22:

- EQ 7.3-1
- EQ 7.4-1
- T 7.3-1
- T 7.3-2
- T 7.3-4
- T 26.9-1
- T 26.10-1
- Hazard Tool

OSSC:

- T 7.2

APA Supplement 3-23

- 3.4.2
- 3.4.3
- 3.4.4
- 3.4.5
- 3.5.2
- 3.5.3

- 3.5.4
- 3.5.5
- 3.5.6
- 3.6.3
- 3.6.4
- 3.6.5
- 3.7.1
- 3.7.3

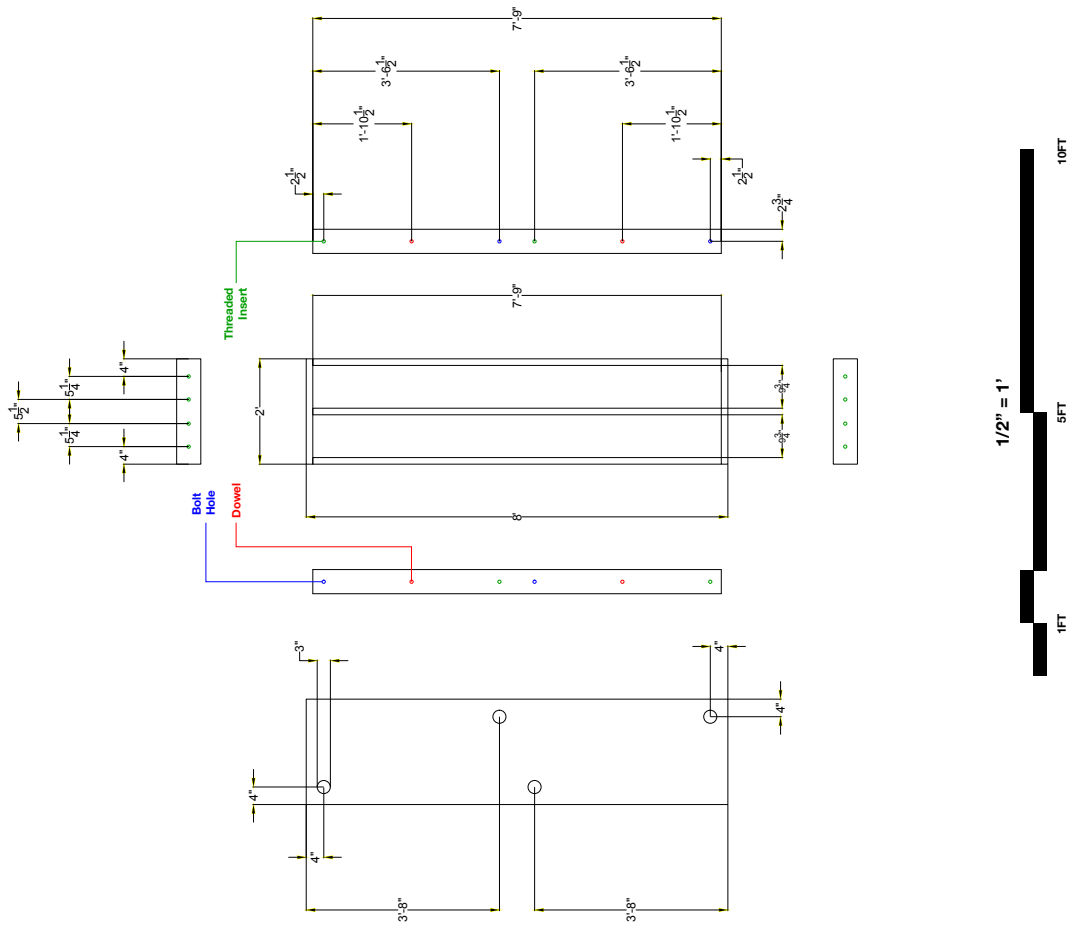
NDS:

- 12.5.1
- 12.5.1.2
- 12.5.1.2a
- EQ 12.3-1
- EQ 12.3-2
- EQ 12.3-3
- EQ 12.3-4
- EQ 12.3-5
- EQ 12.3-6
- T 12.2C

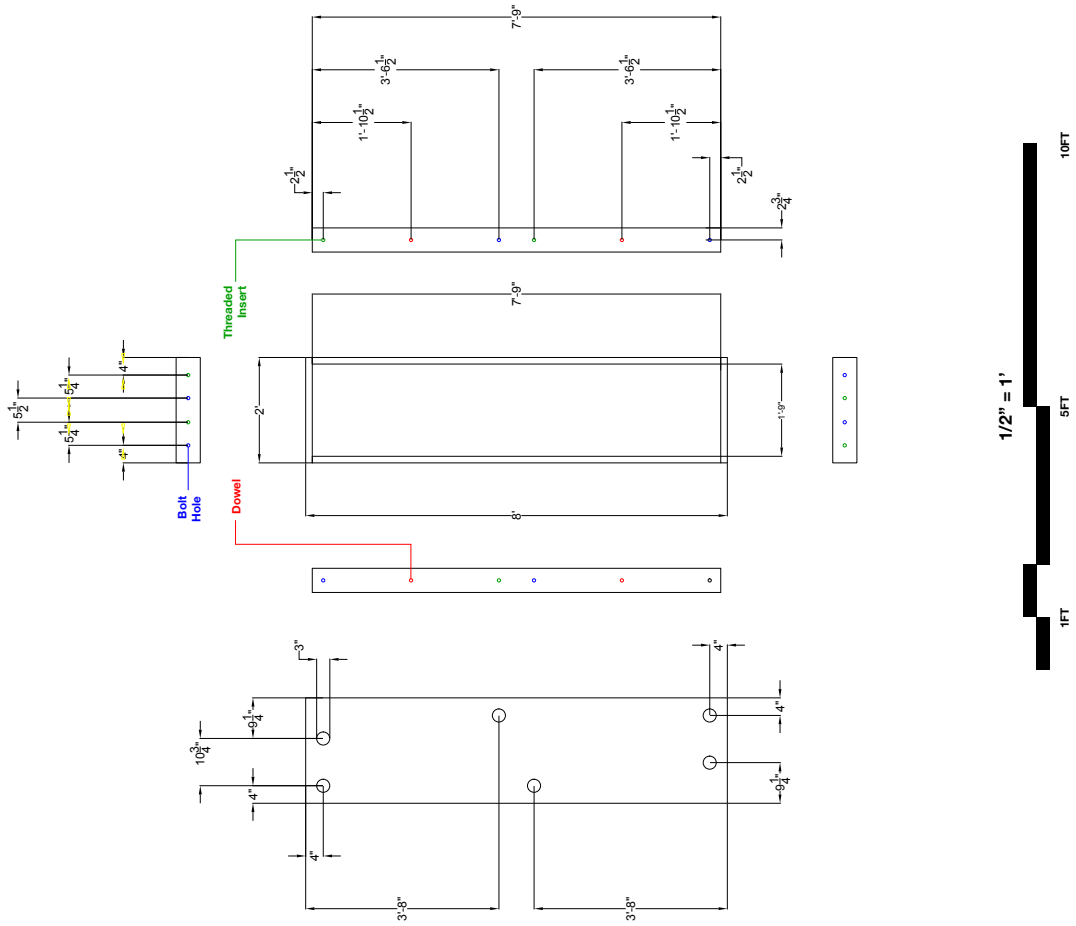
Appendix C:

Stressed-Skin Panel Framing

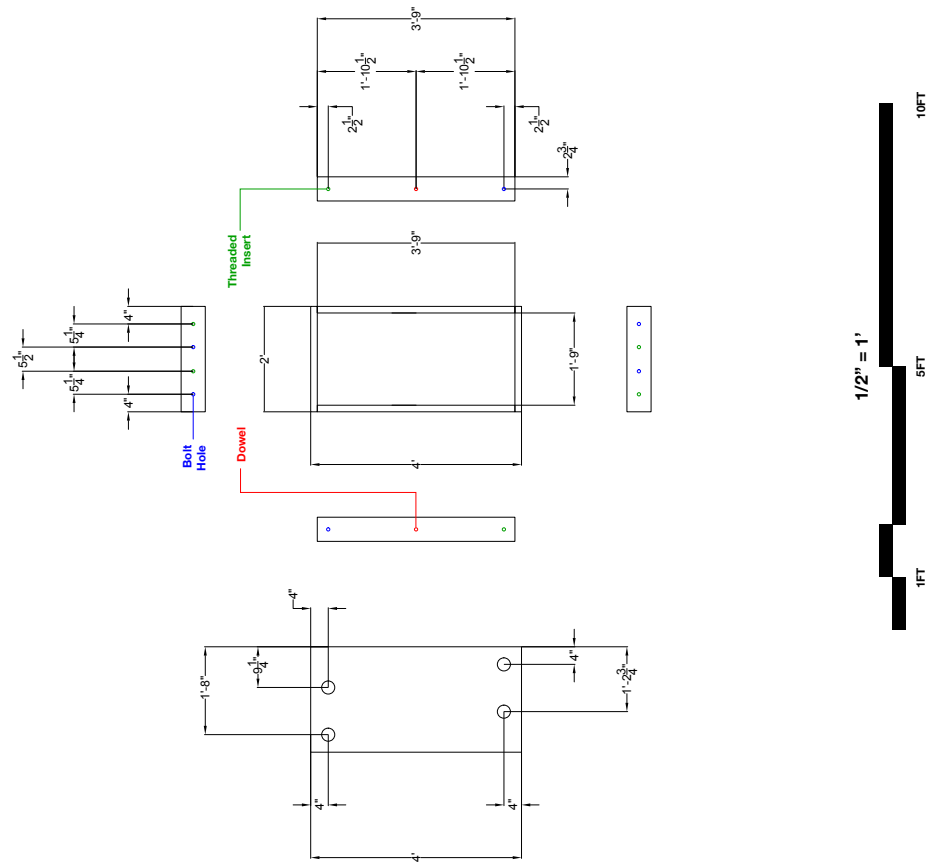
Panel Type A



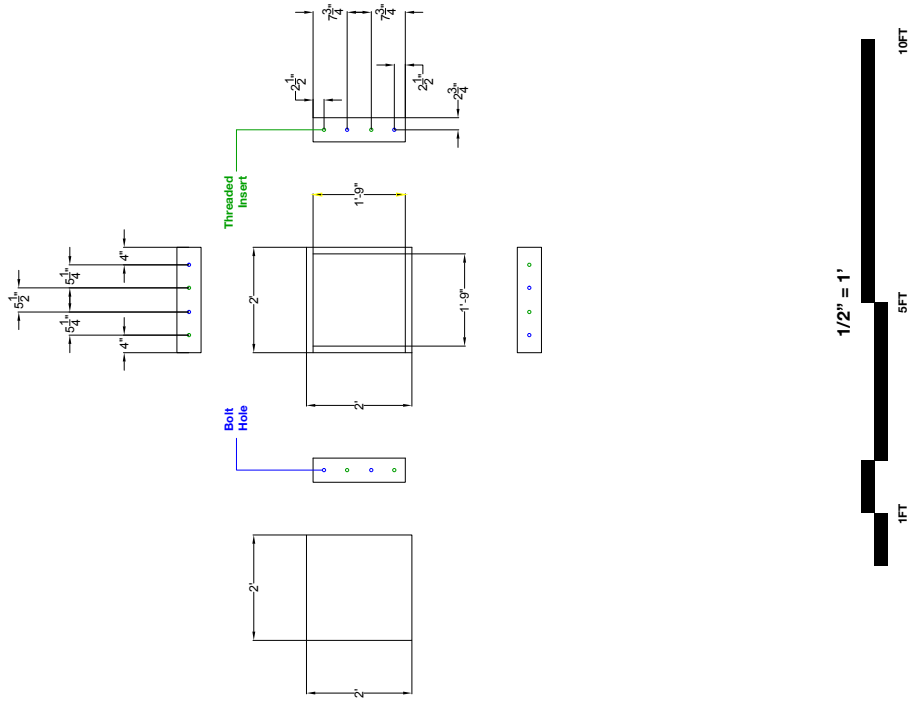
Panel Type B



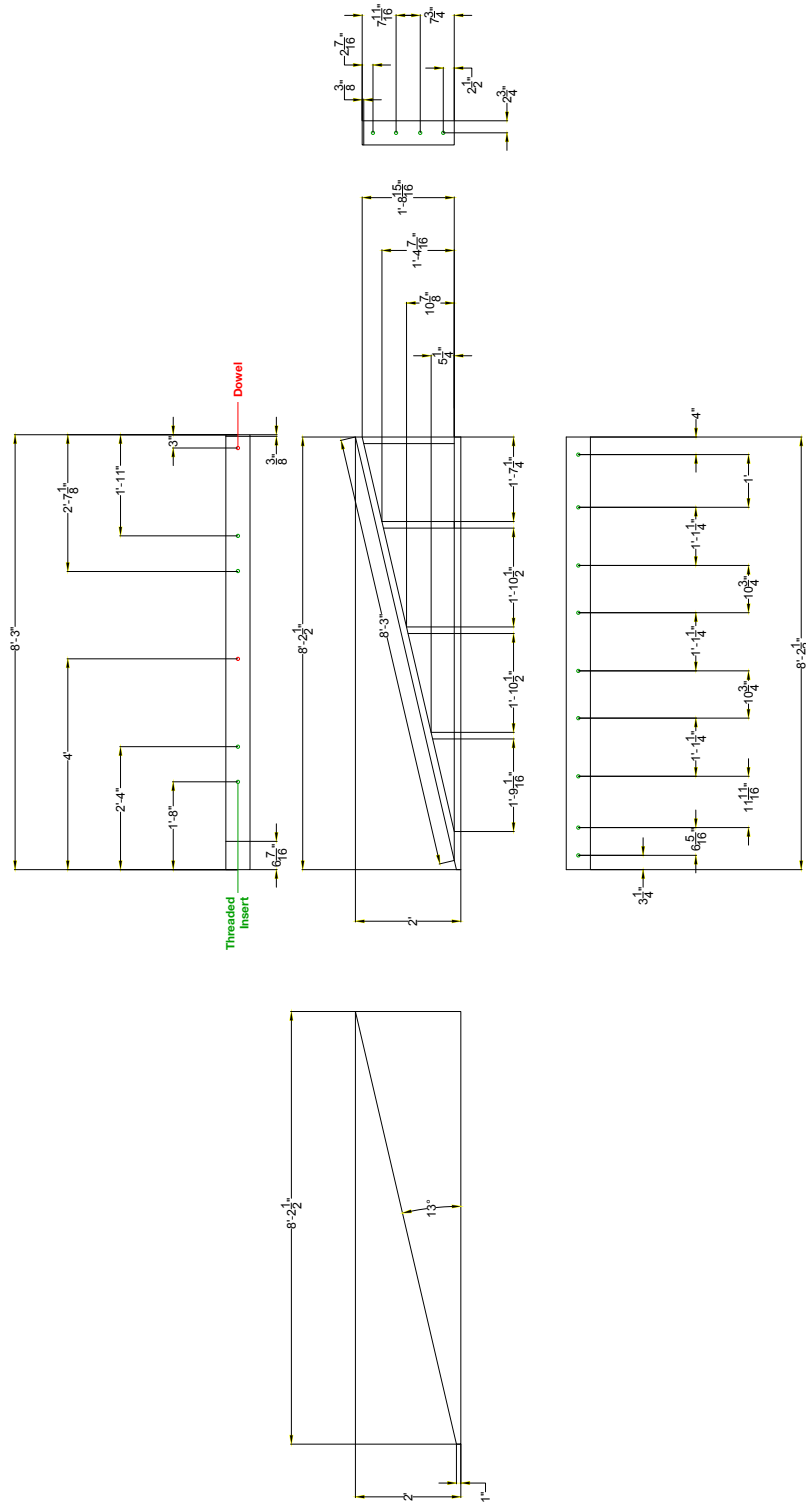
Panel Type C



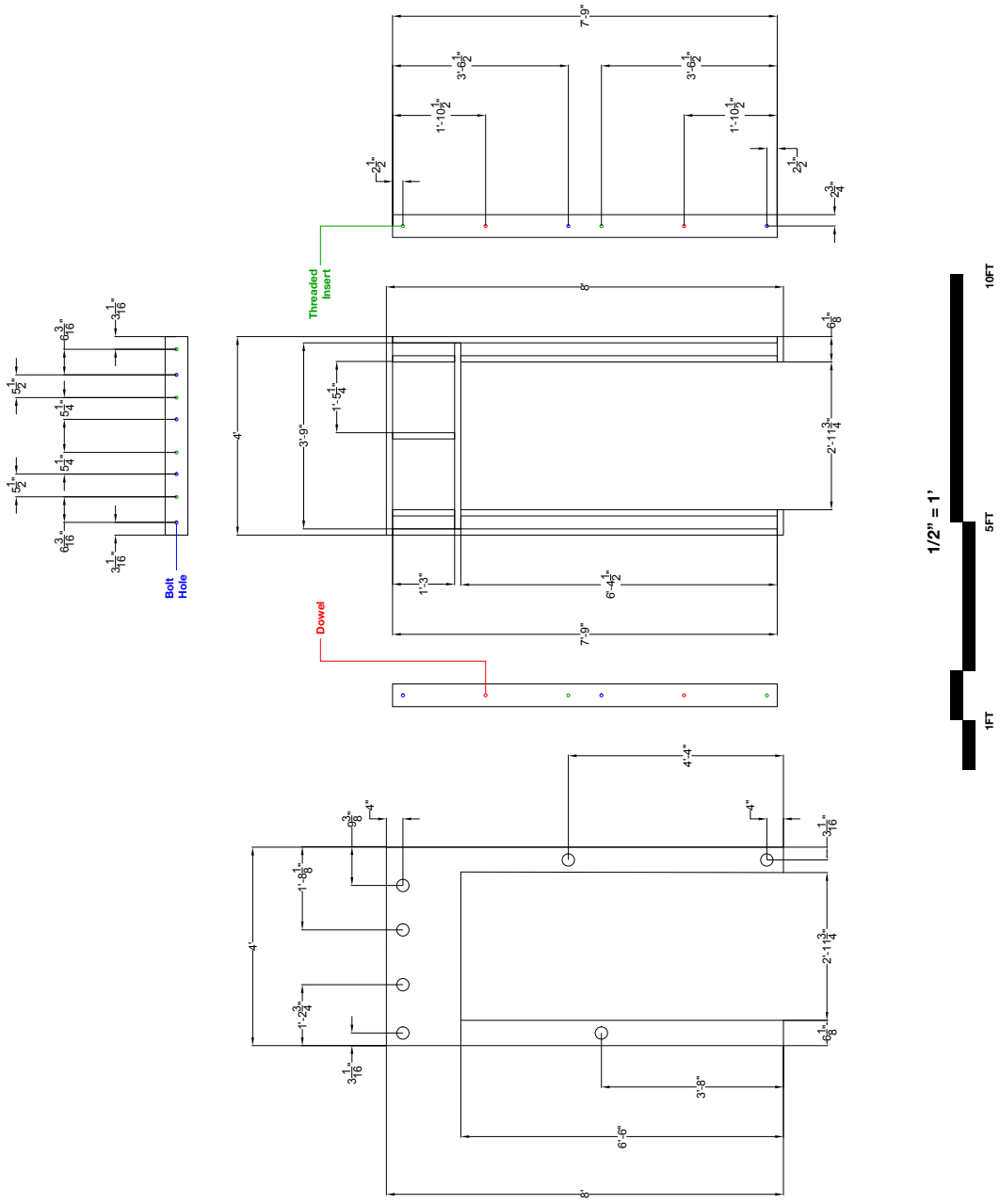
Panel Type D



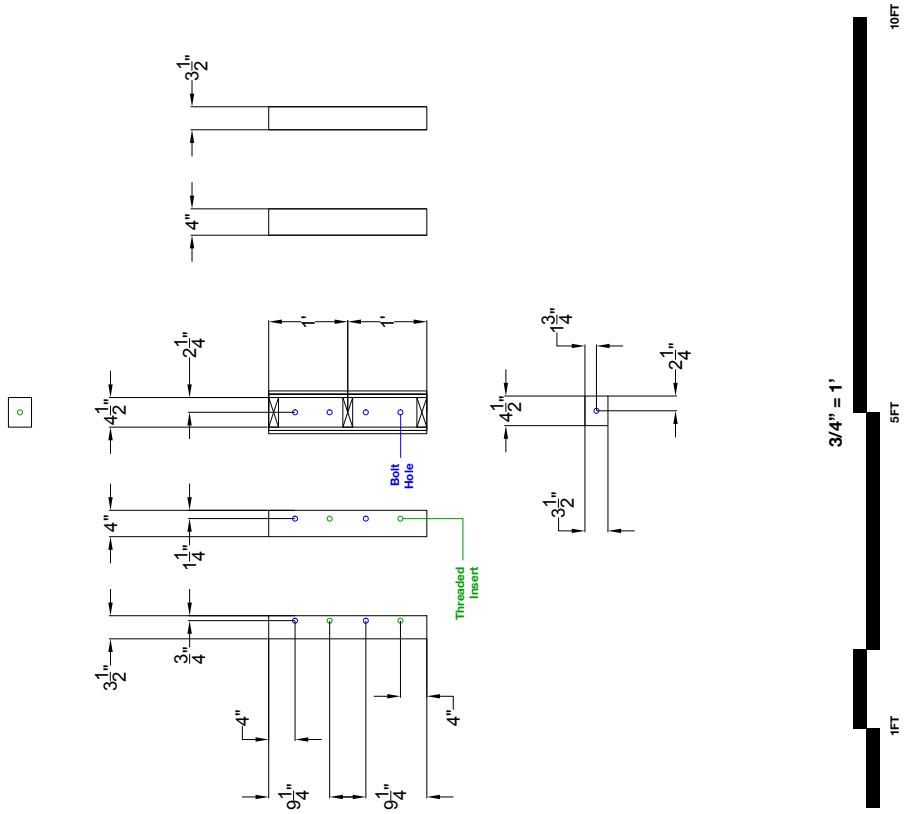
Panel Type E



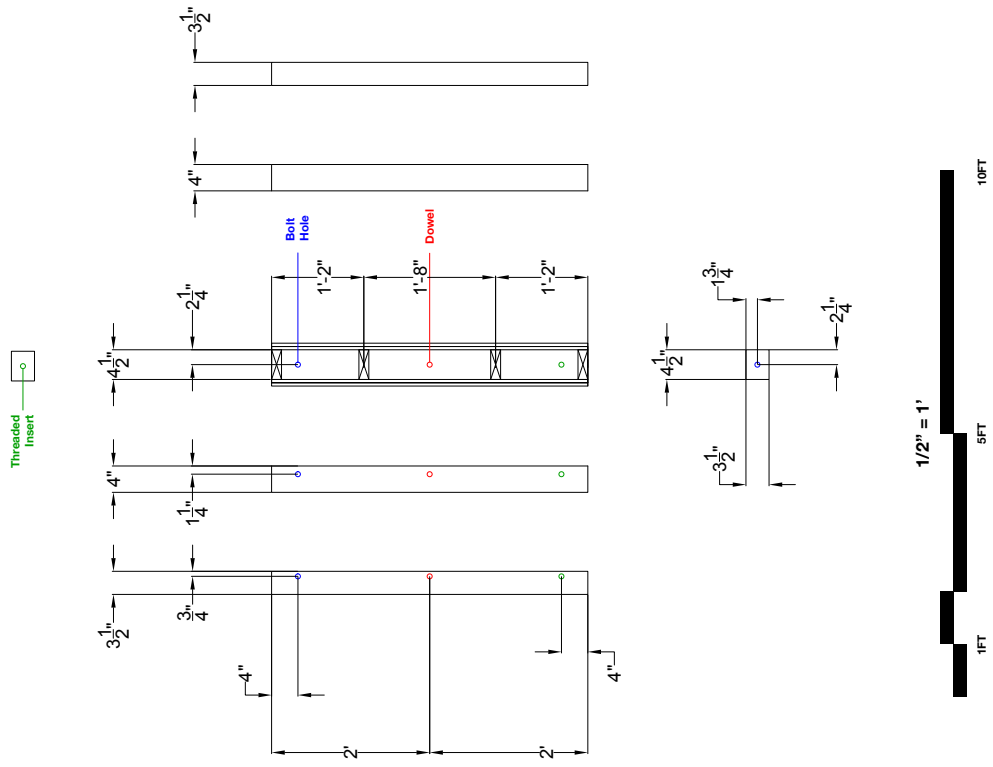
Panel Type F



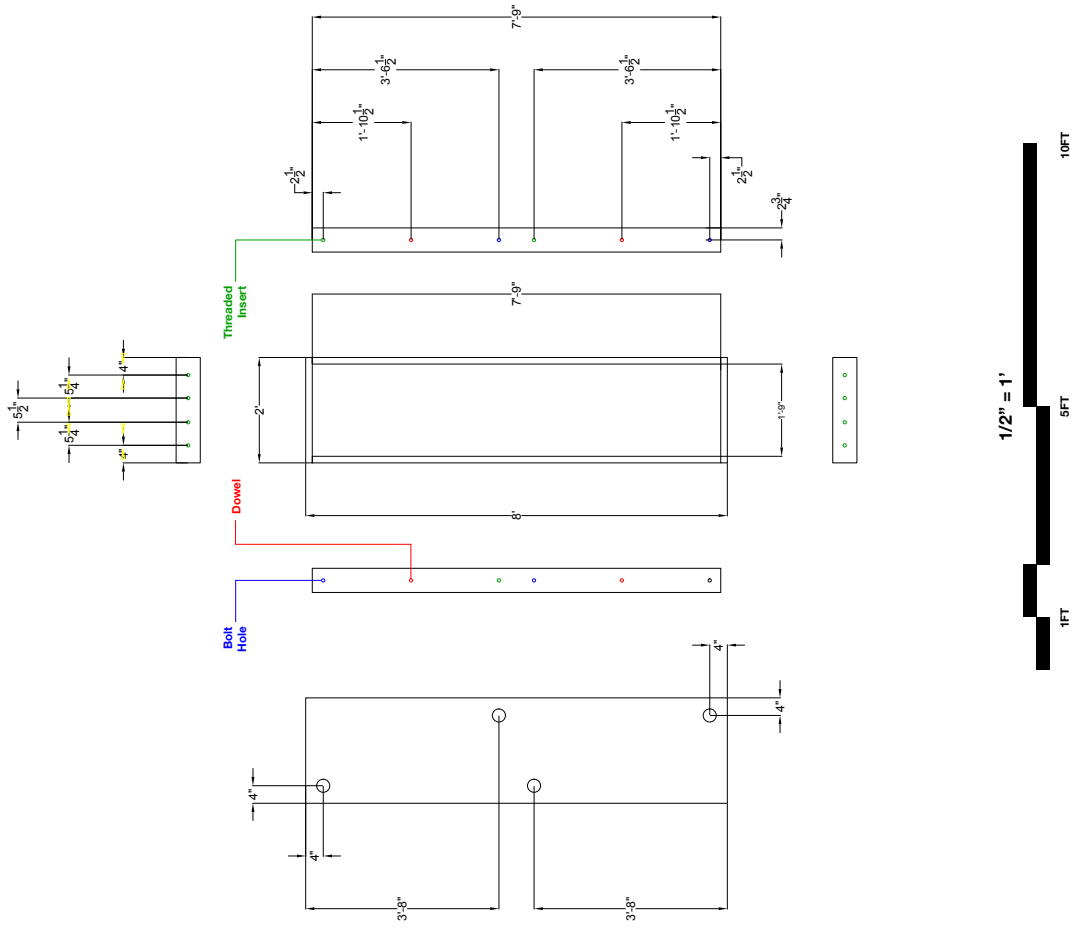
Connection Type A



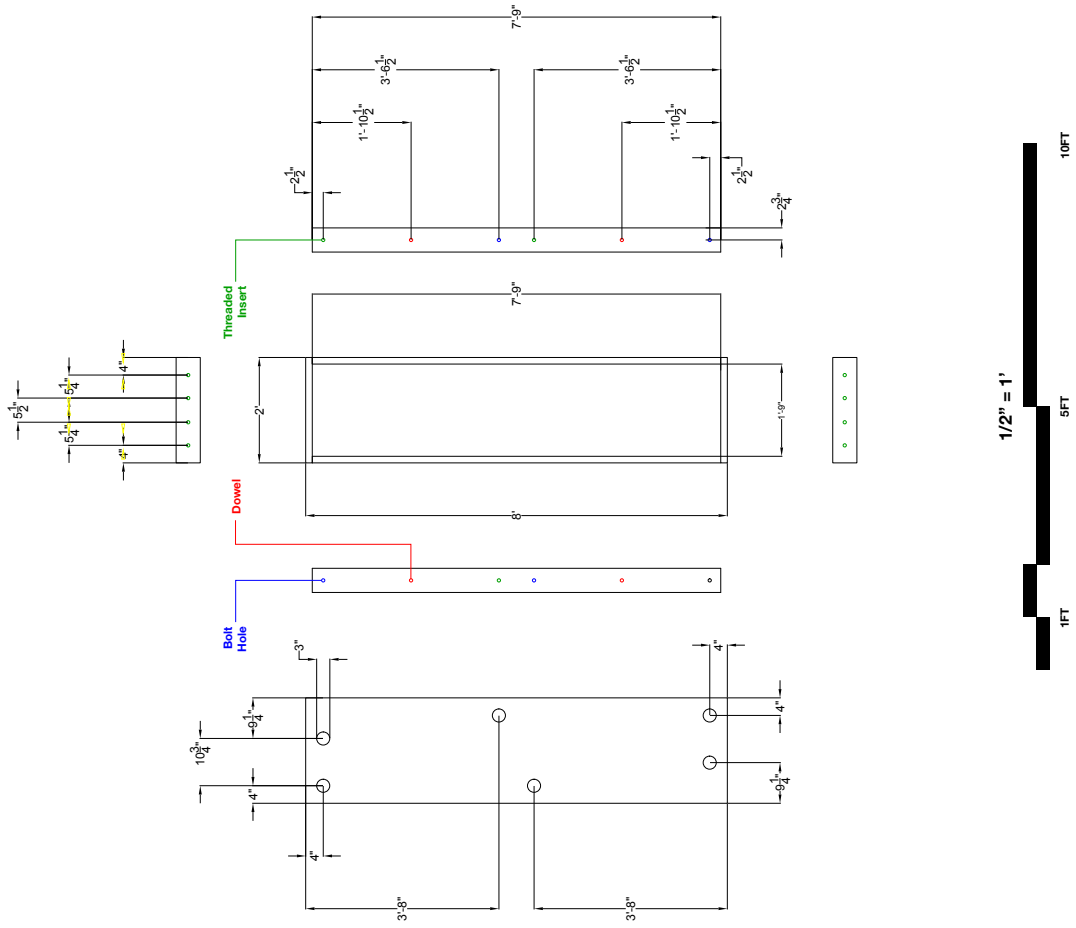
Connection Type C



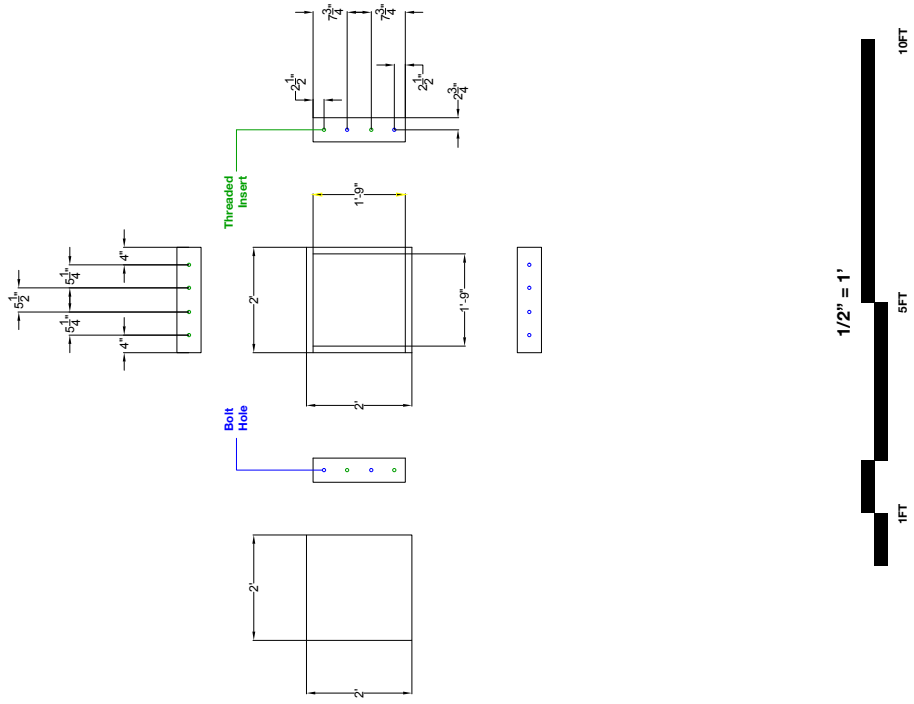
Panel Type B.2



Panel Type B



Panel Type D



Appendix D:

Final Class Submittal



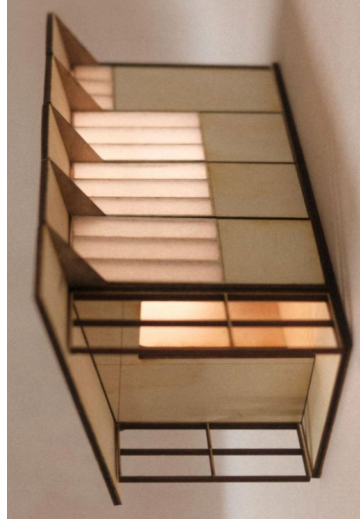
PROFESSORS NANCY CHENG & MARIAPAOLA RIGGIO

TIMBER TECTONICS

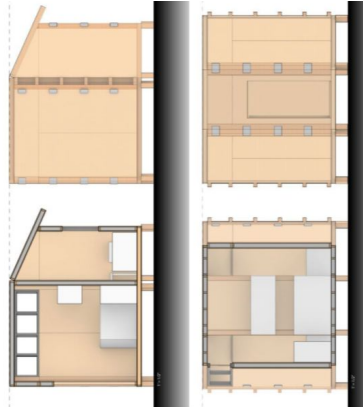
01	PROCESS WORK
02	ARCHITECTURAL DESIGN
03	SSP DESIGN
04	CONNECTIONS
05	ENCLOSURE
06	STRUCTURAL ANALYSIS
07	CONSTRUCTION PLAN
08	PROJECT MANAGEMENT
09	FINAL RESULT

PROCESS WORK

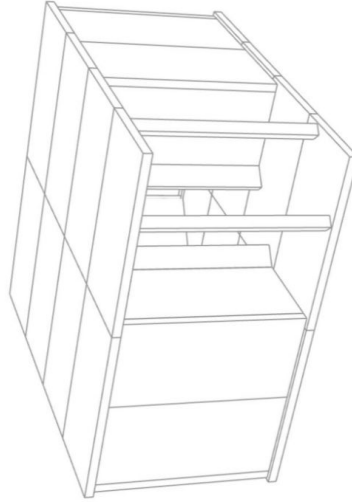
For the first four weeks, five teams created five different designs. Each design had pieces which have been integrated into our final proposal...



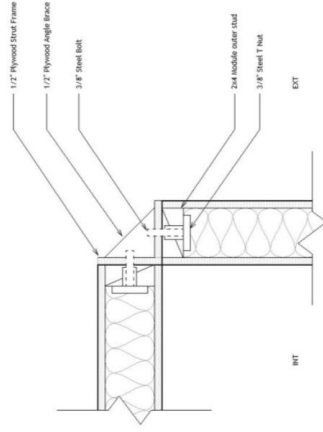
Overall shape, window strategy



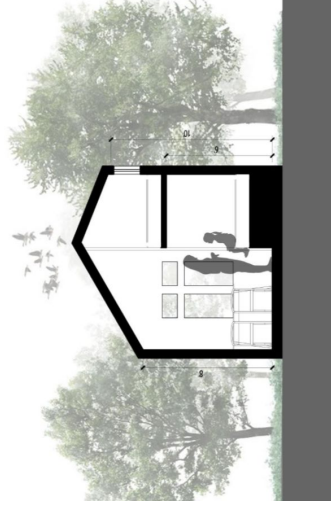
Foundation to lift structure



Integrated porch

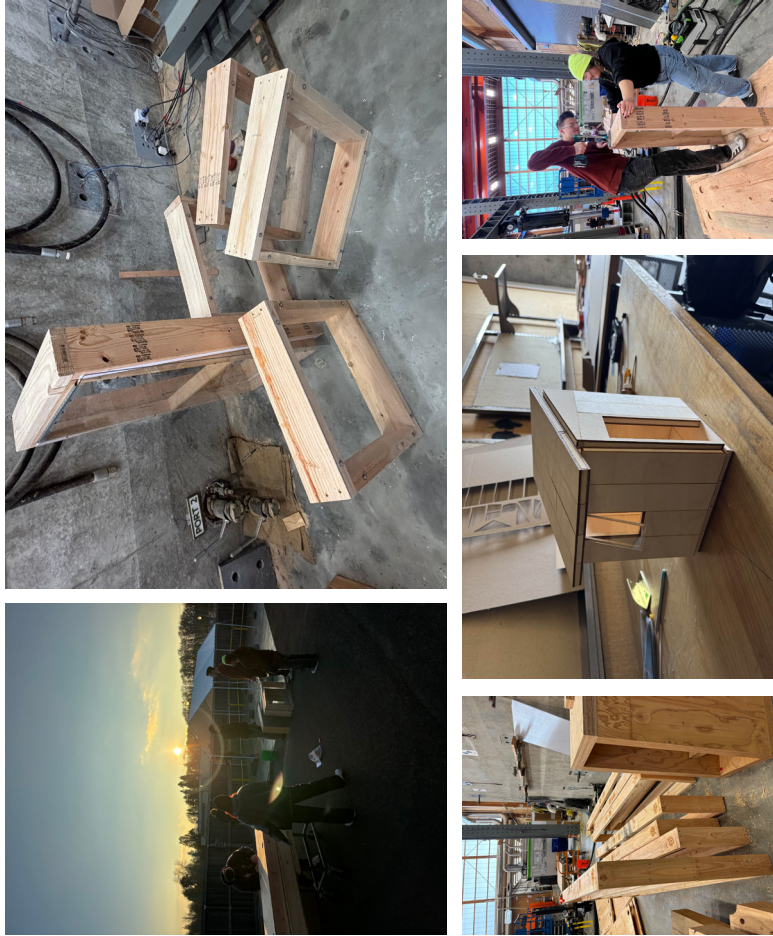


Primary Wall to Roof Connection
Corner connection method



Interior loft, clerestory windows

BUILDING PROCESS



ARCHITECTURAL DESIGN

KB, Molly, Sarah

A Modular Solution for Stability and Community

Our timber prefabricated emergency shelter provides an immediate, adaptable housing solution for individuals and families displaced by crises. Designed with modularity and comfort in mind, this system offers more than just a place to stay—it serves as a foundation for rebuilding lives and fostering community.

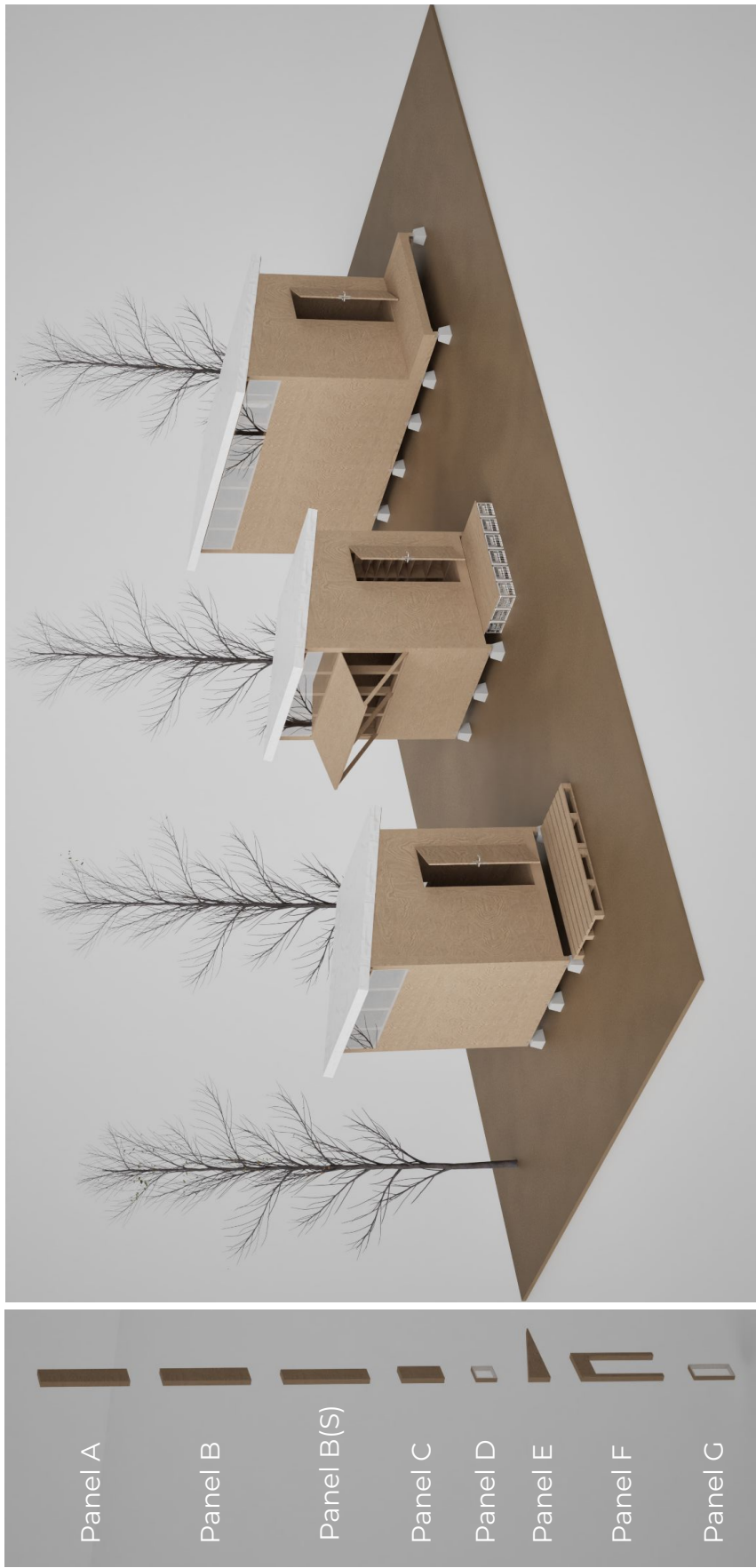
Each shelter begins with a versatile 8'x8' module, functioning as a bedroom, bathroom, or kitchen. For larger families or evolving needs, the modules can expand into 8x16 units, accommodating diverse household sizes and activities like sleeping, cooking, dining, and working. Privacy, comfort, and flexibility are central to the design, ensuring that each resident feels secure and dignified.

This modular system goes beyond individual shelters. Using the same kit of parts, it can be scaled to create essential community spaces such as a dining hall or retail kiosk. These additional structures support communal dining and resource distribution contributing to a thriving, interconnected community.

Community engagement is further encouraged through shared porches that connect the shelters. These spaces create opportunities for neighbors to interact, share resources, and build a sense of belonging, all while respecting individual privacy.

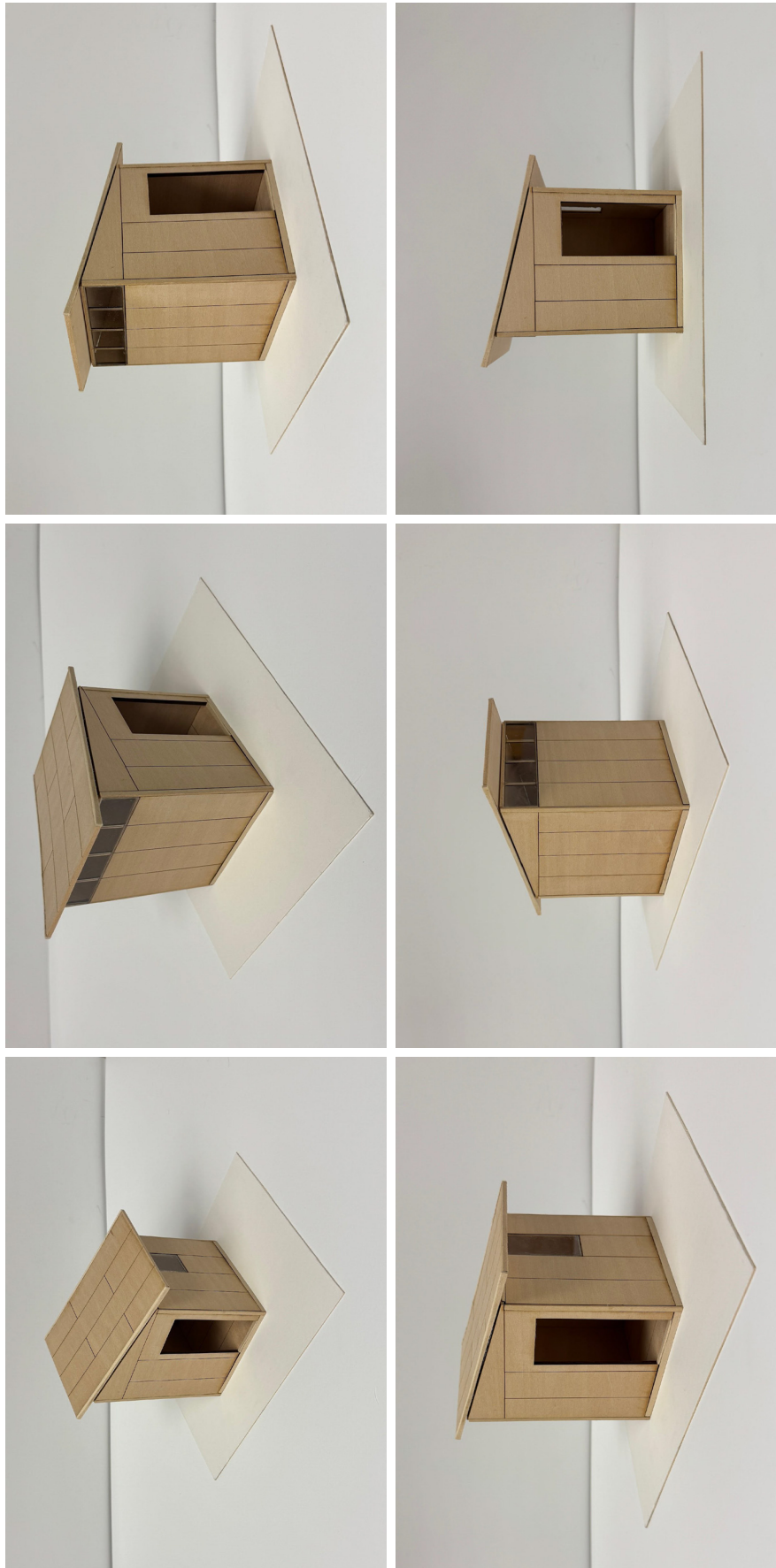
This project leverages the warmth and sustainability of wood construction to provide a humane and scalable approach to emergency housing. By combining adaptable private spaces with functional community buildings, it offers stability for individuals and a foundation for resilient, self-sustaining communities.

8 Panel Modular System

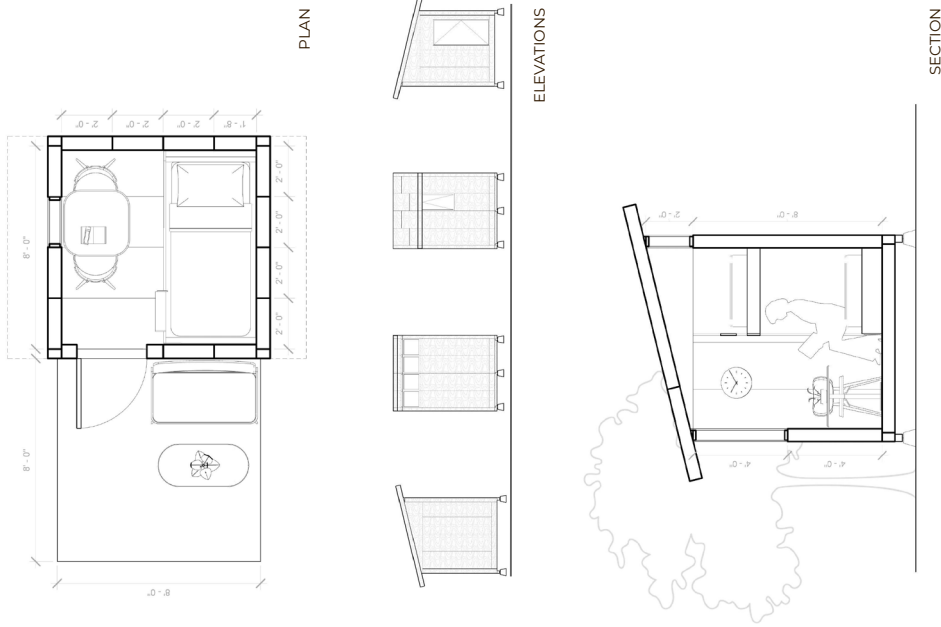


8' x 8' (Basic Shelter)

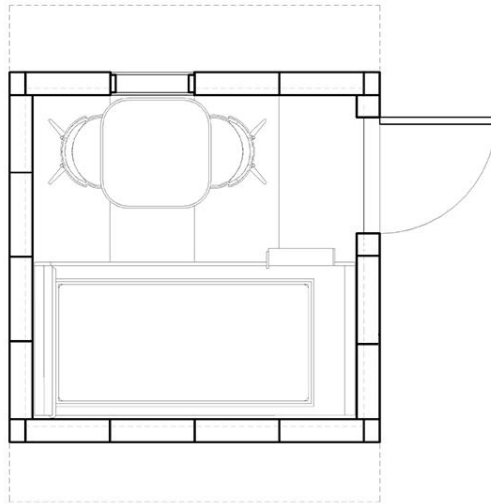
1/2" = 1'-0" Scale Model



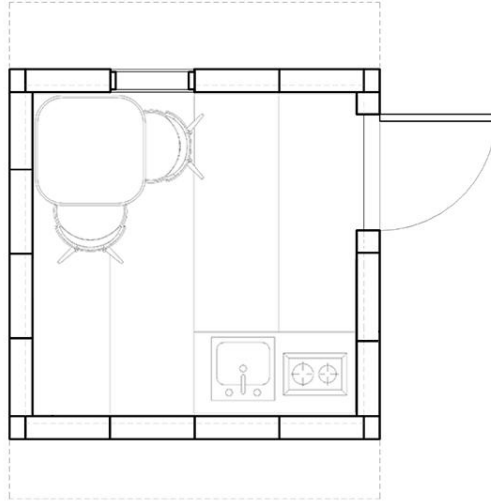
8' x 8' (Basic Shelter)



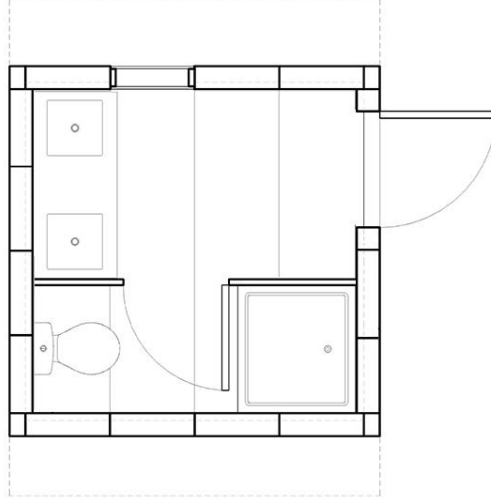
8' x 8' Program Options



BEDROOM

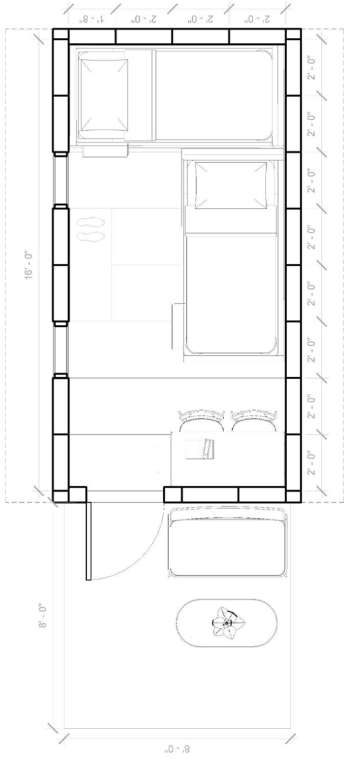


KITCHEN

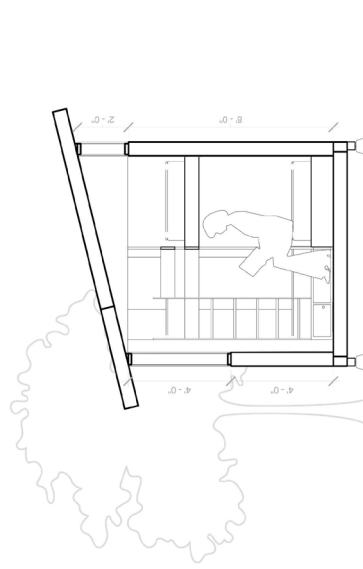


BATHROOM

8' x 16' Unit (Expanded Shelter)

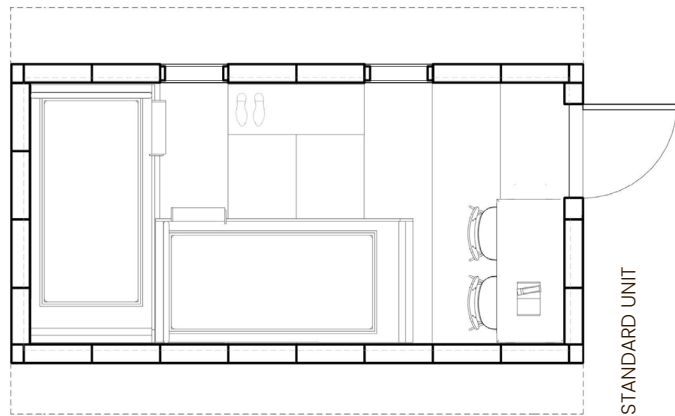
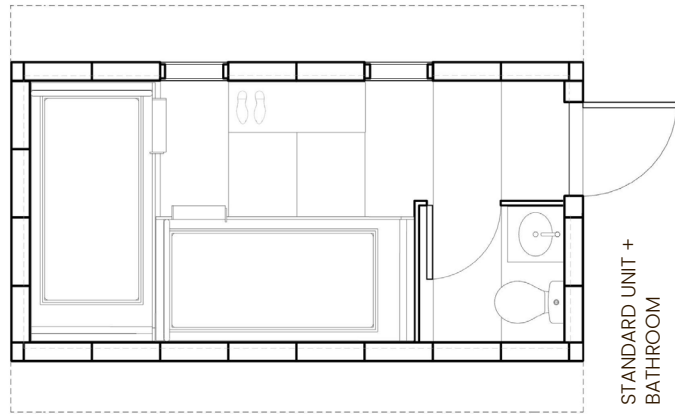
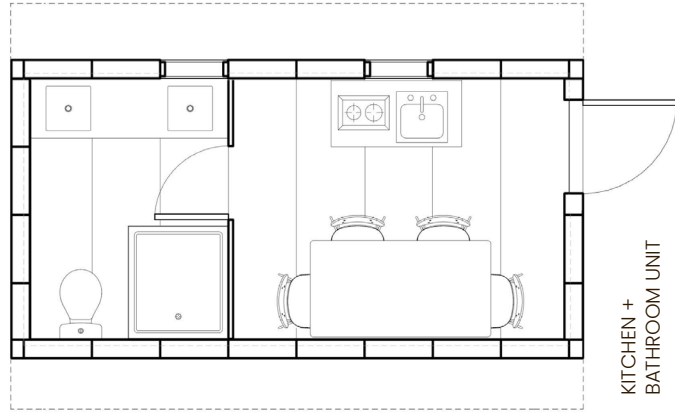


PLAN

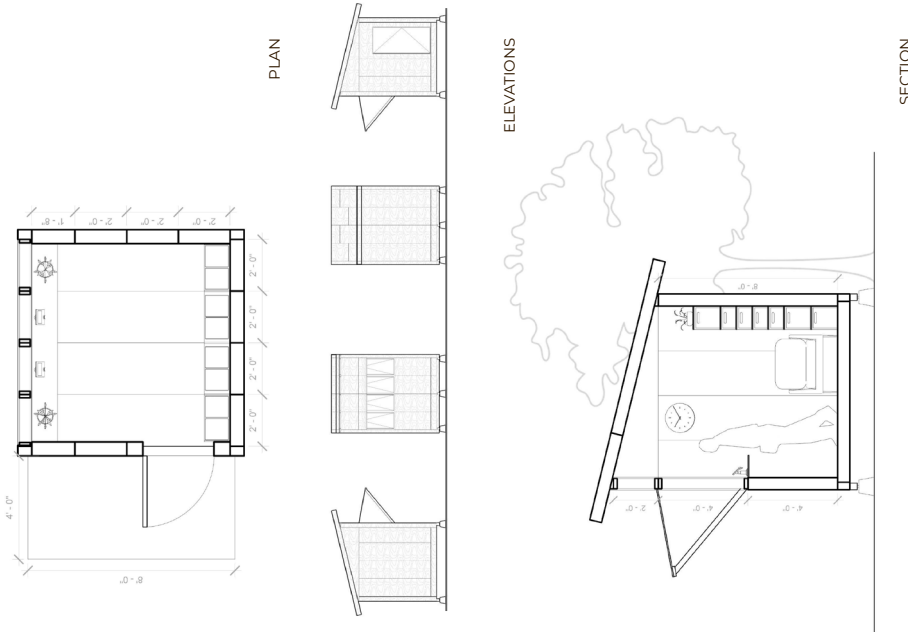


SECTION

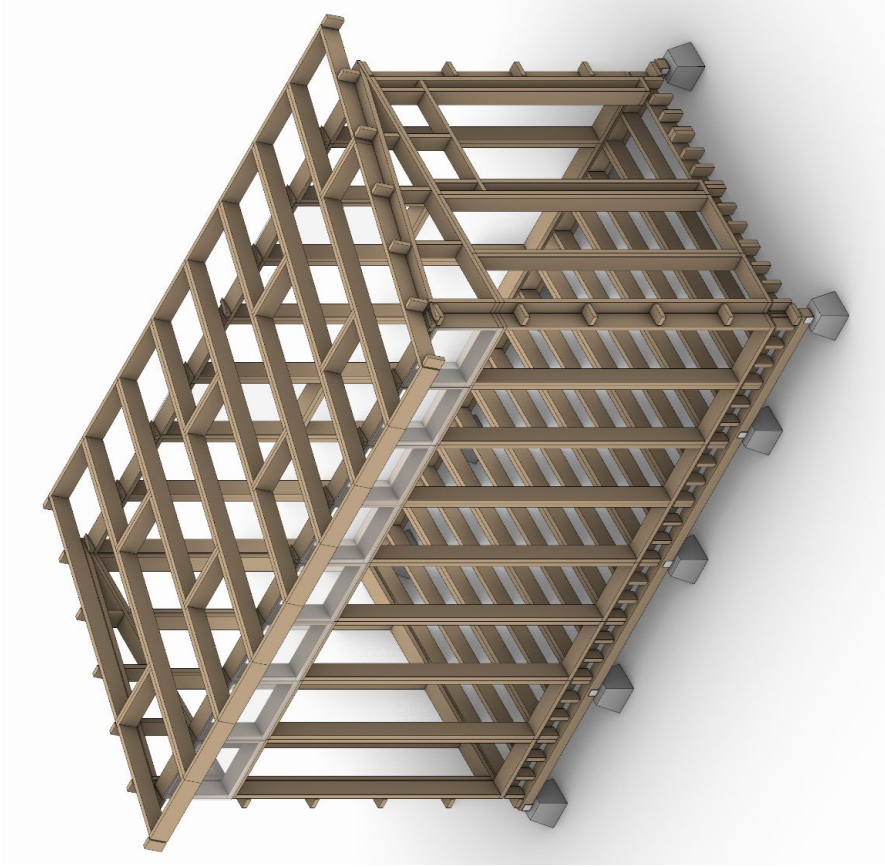
8' x 16' Program Options



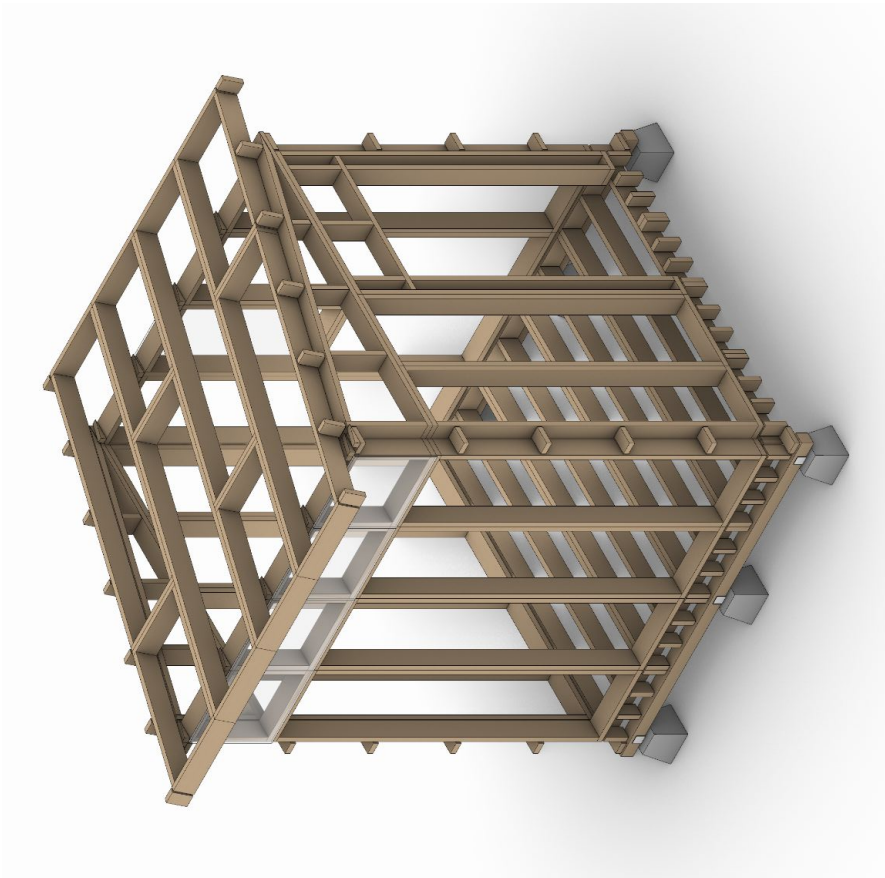
8' x 8' (Retail Kiosk)

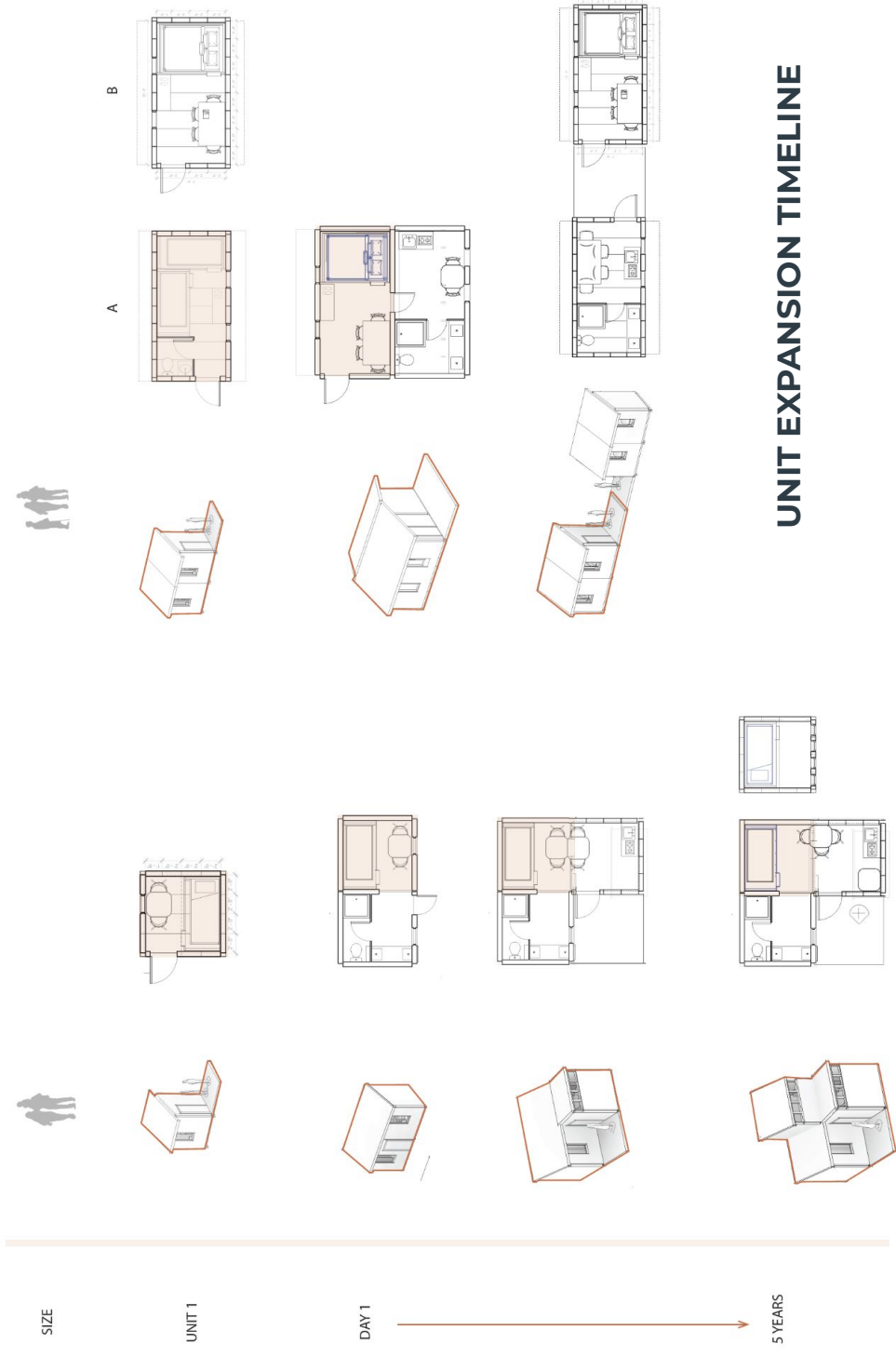


8' x 16' Structural Axonometric



8' x 8' Structural Axonometric

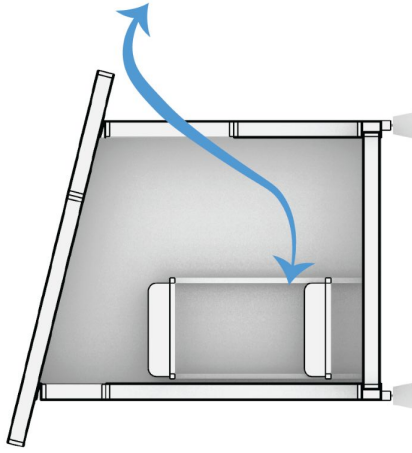
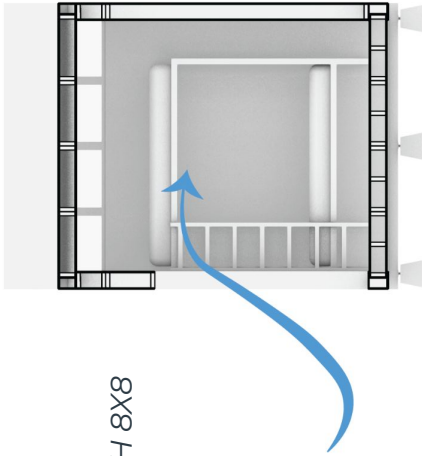




UNIT EXPANSION TIMELINE

VENTILATION

|| OPERABLE WINDOWS FOR BOTH 8X8
AND 8X16 MODULE



DAYLIGHT STUDIES

|| INTERIOR 8X8
|| INTERIOR 8X16

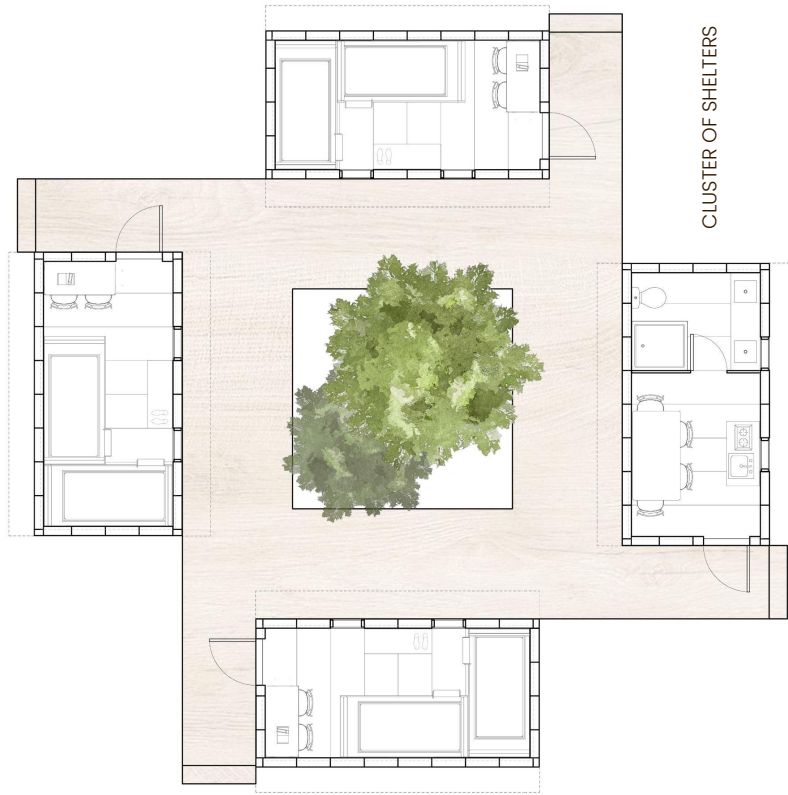


INTERIOR 8X8

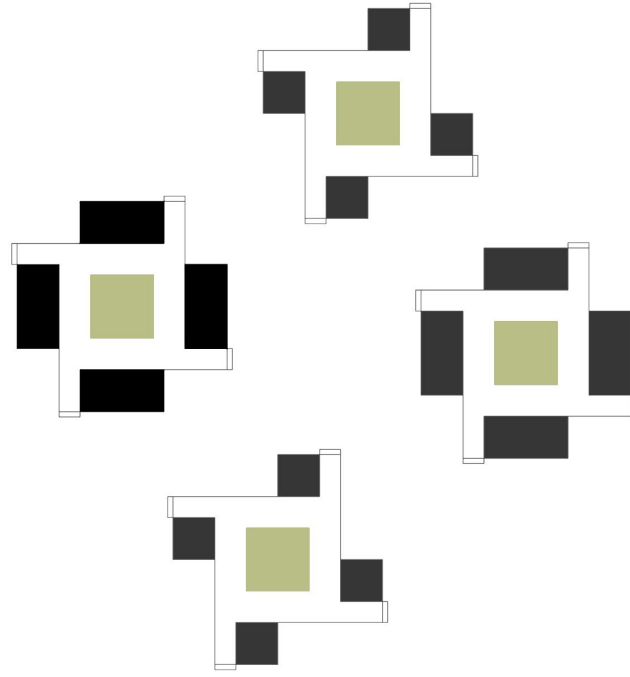


INTERIOR 8X16

SITE PLAN



CLUSTER OF SHELTERS

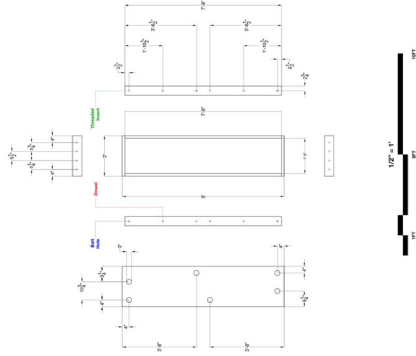


ARRANGEMENT OF CLUSTERS

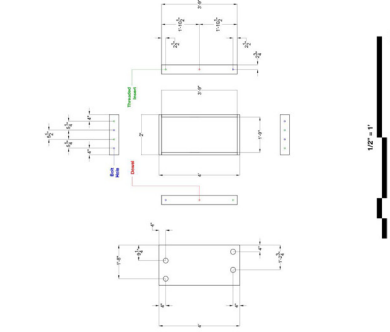


SSP DESIGN

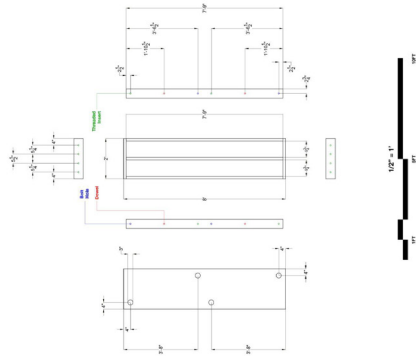
Panel Type B



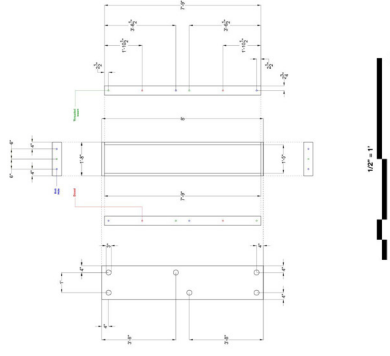
Panel Type C



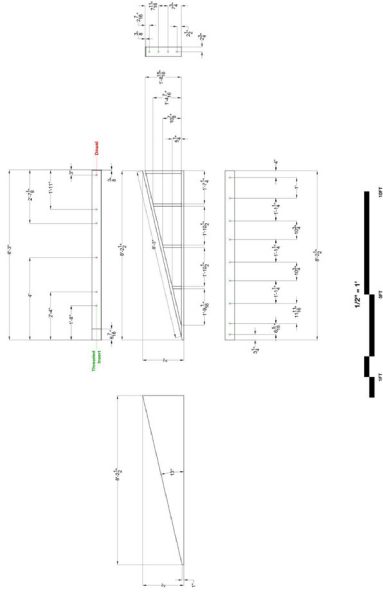
Panel Type A



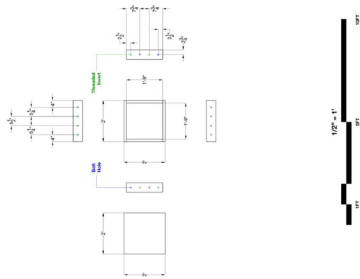
Panel Type B.S



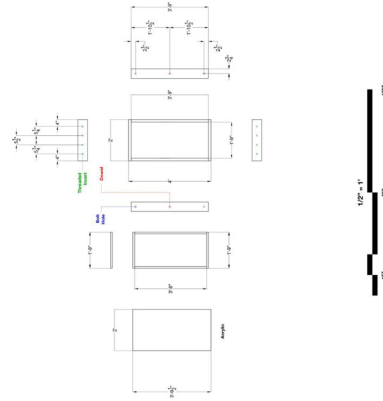
Panel Type E



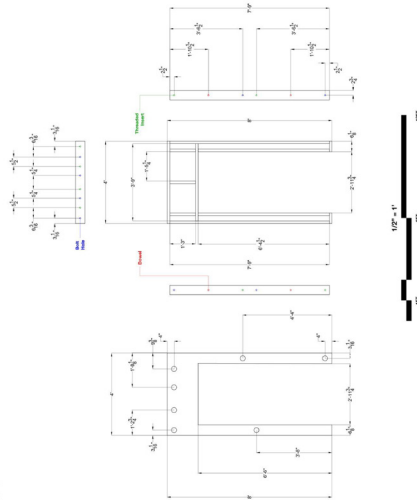
Panel Type D



Panel Type G



Panel Type F





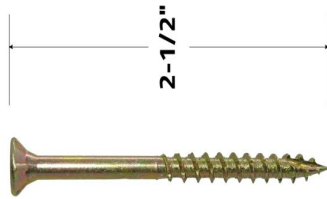
CONNECTIONS

DANIEL, JUMANAH, AND ALEJANDRO

Material



Exterior screws/
construction screws



Wood glue



Bolts
Size: $\frac{3}{8}$ " diameter, 2.5" length.

$\frac{3}{8}$ " Washers

$\frac{3}{8}$ " E-Z LOK threads

Tools



Socket and Ratchet



Drill



Star "torx" drive



Brad point Drill Bit

6ABC

1ABC

2AB

3ABC

4A

5ABC+

Flanges - Vertical Axis

On Friday we agreed to keep the connections how they are as the final design is due Monday. We also will not be moving forward with a new design.

-Arch Design Team

2' prototype of 6B w/ bolts

Link to digital model: [https://www.thingiverse.com/thing:3232630](#)

Thank you to the community for their support and feedback!

Underfloor Girder Corner Detail

Right Scales Triangle

Side a = 1.2433
Side b = 7.2143
Side c = 7
Angle $\angle A = 14^\circ = 0.24435 \text{ rad}$

Grain

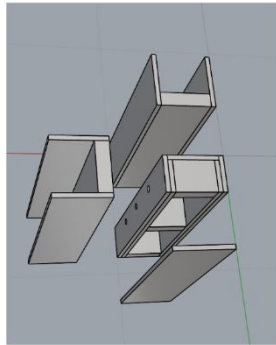
$\angle = 14^\circ$

7"

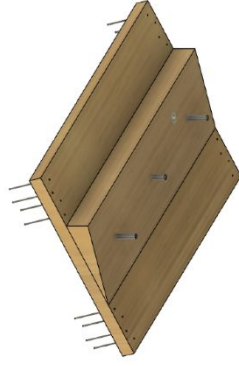
This structure would be more widely useful if it did not rely on a foundation, or other things that

Final Result

3C

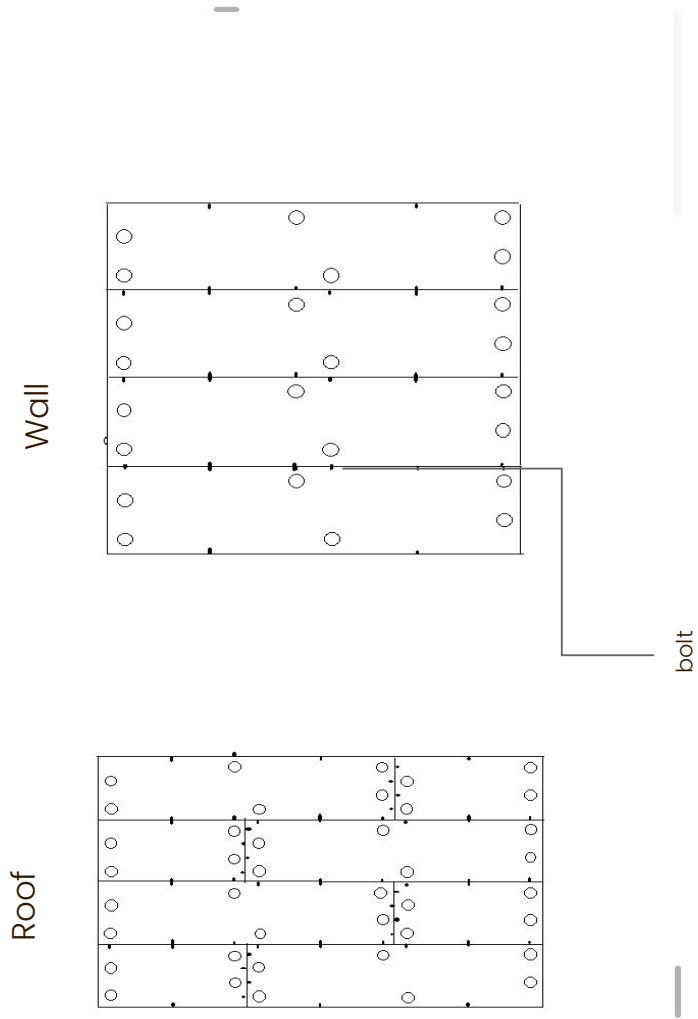


6B



Wall-to-wall- In plan

- Can access these bolts thru pre-cut holes on the panels
- Will need to use a socket and a ratchet

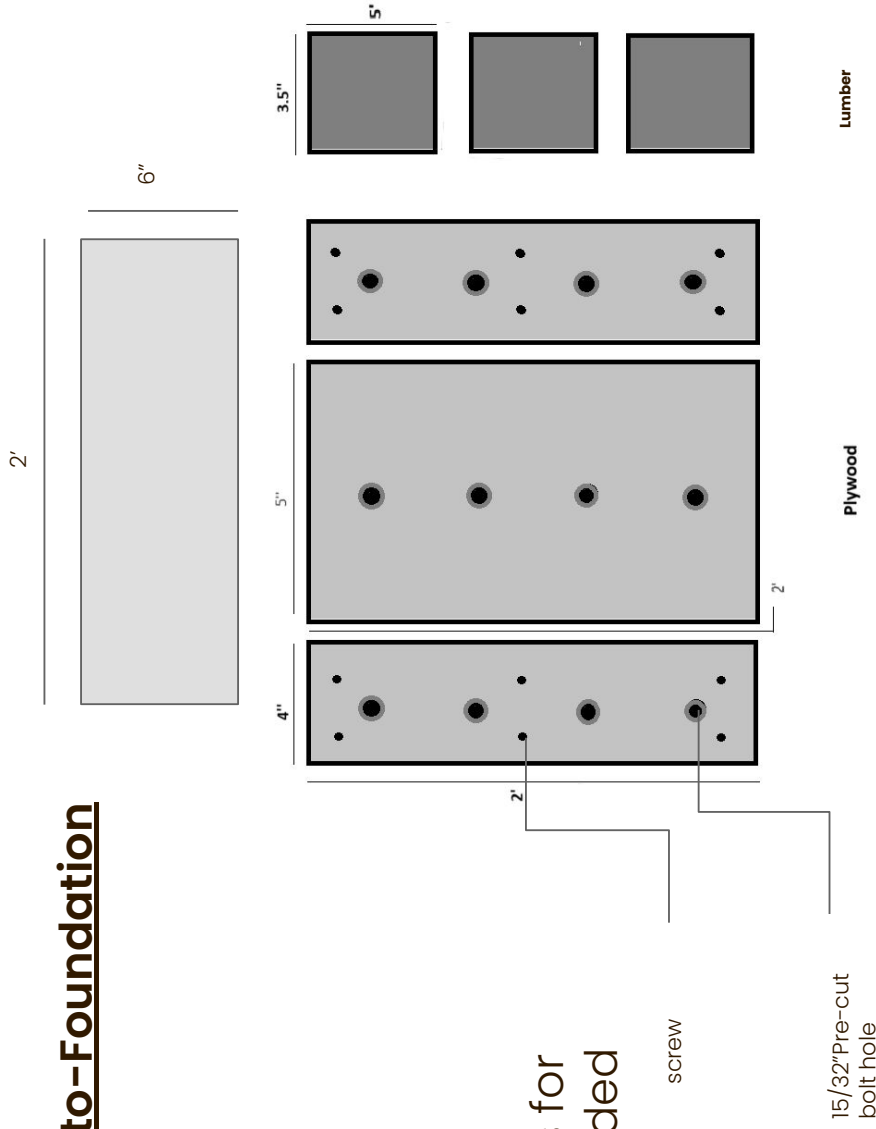


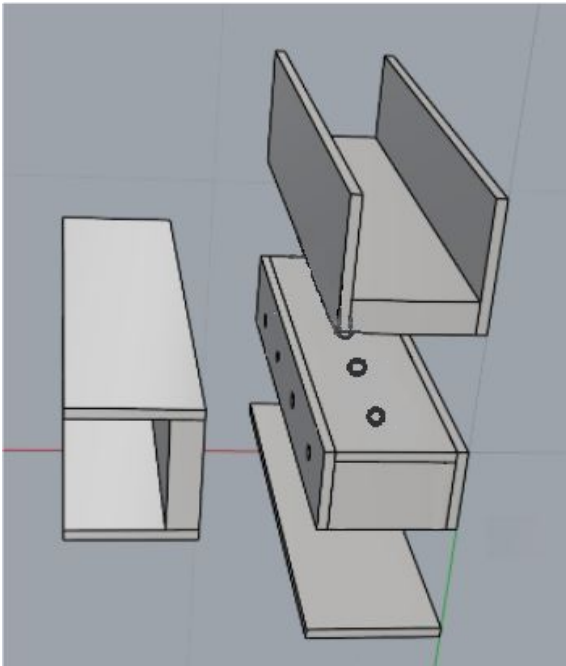
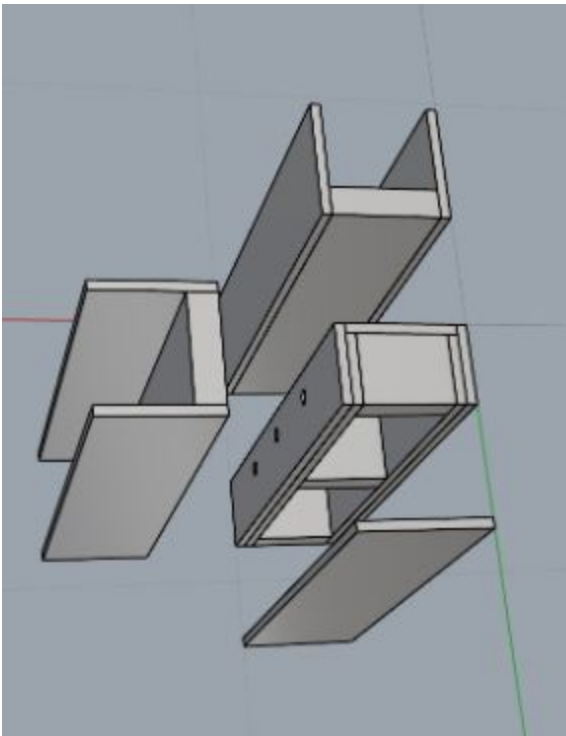


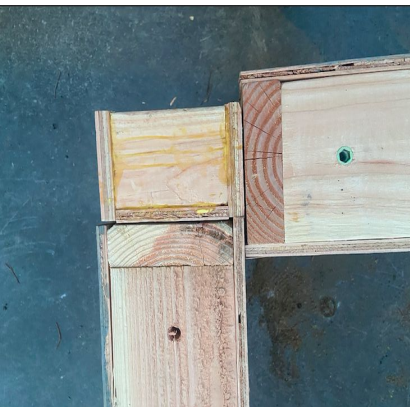
prototype

Wall-to-Floor & Floor-to-Foundation

- Quantity:
- 16 total - 2'
- 6 total - 8'
- 2 total - 20"
- 2 total - 4'
- Pre-cut 15/32" holes for the bolts and threaded fasteners.







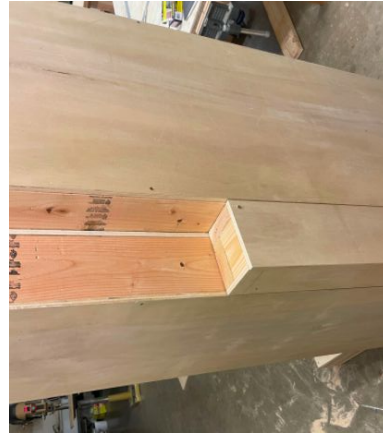
Wall-to-wall - corner

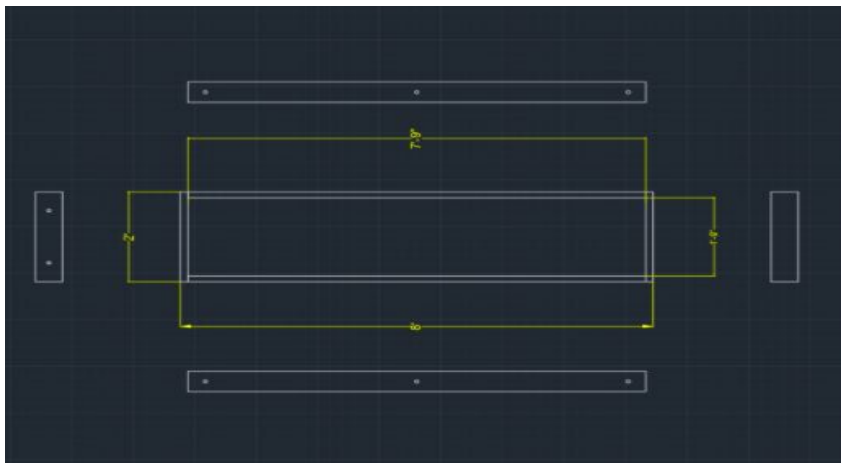
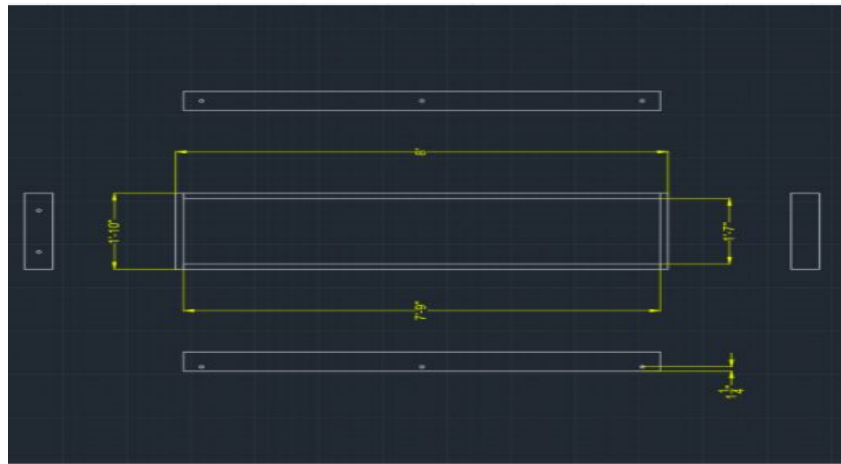
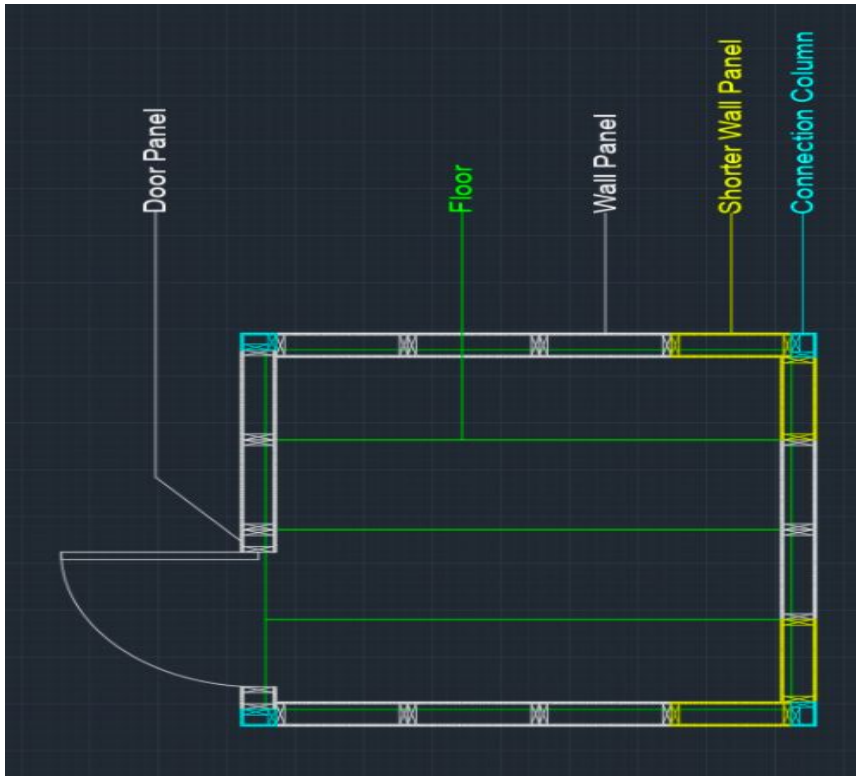
Material: Plywood

- Improve insulation performance
- Lighter than lumber

Quantity:

- 4 total-
 - 2 - 20"
 - 2 - 4'



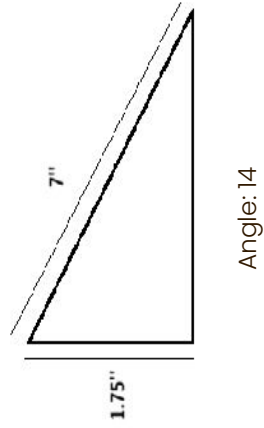
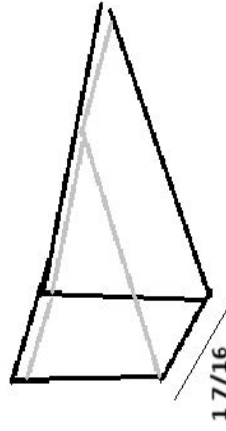
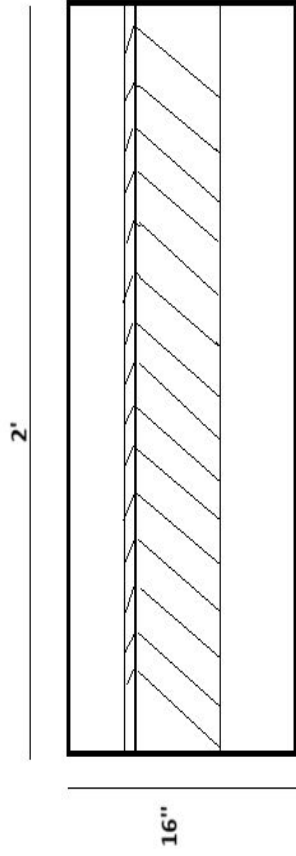


Short panel

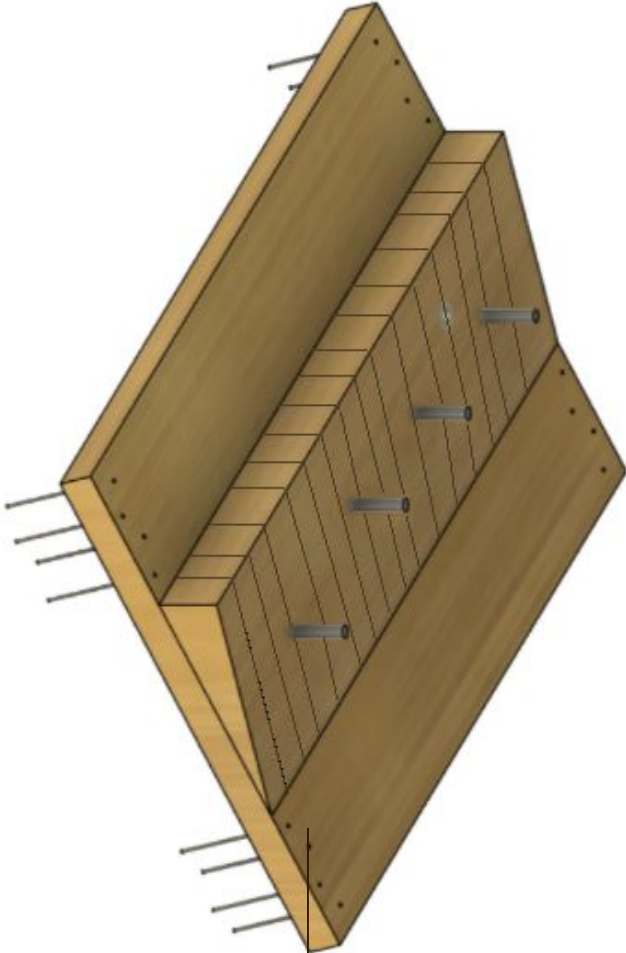
Typical panel

Roof-to-Wall

Quantity: 8 total







ENCLOSURE

JONAH, DONAVAN, AND ETHAN

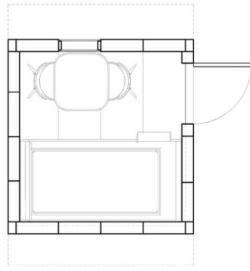
THERMAL PROTECTION STRATEGY

INSULATION USED



5.5" Hempitecture HempWool Batt Insulation - R20 from GoGreen Home Supply

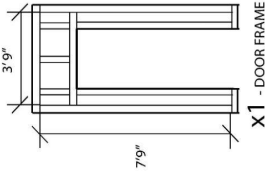
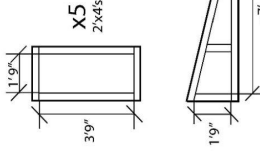
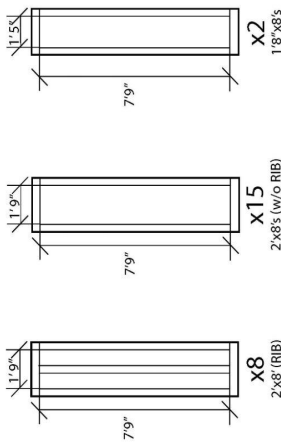
INSULATION - 24" WIDE, 5.5" THICK
 How many square feet do we need to fill with insulation?
 How many feet of 24" wide insulation do we need?



FLOOR PLAN

Each pallet has 64 panels of insulation with dimensions 24" x 5.5' x 5.5", so we would need to order one pallet from GoGreen Home Supply for one 8' x 8' structure. There will be waste from the panels as they are cut to fill the gaps in the framing, which can be repurposed for other panels and for additional shelters.

SPPs



CALCULATIONS

INSULATION BY SQUARE FEET

- 8 x 7'9" x 1'7.5" = 100.75sf for 2'x8' panels with ribs
- 15 x 7'9" x 1'9" = 203.44sf for 2'x8' panels without ribs
- 2 x 7'9" x 1'5" = 21.96sf for 1'8" x 8' panels
- 5 x 3'9" x 1'9" = 32.81sf for 2'x4' panels
- 2 x 0.5(1'9" x 7") = 12.25sf for 2'x8' triangular panels
- + 1 x (1'3" x 3'4.5") + 2(6'4.5" x 3") = 7.41sf for door panel

~378.61SF OF INSULATION

INSULATION OF 24" X 5.5' PANELS #

- 8 x (2 PER 2'x8") = 16 panels
- 15 x (2 PER 2'x8") = 30 panels
- 2 x (2 PER 1'8" x 8") = 4 panels
- 5 x (1 PER 2'x4") = 5 panels
- 2 x (0.5 PER Δ PANEL) = 1 panel
- + 1 x (1 PER DOOR PANEL) = 1 panel

57 PANELS

MOISTURE PROTECTION STRATEGY - KIT OF PARTS



1 Tarp + Overhang Roof
(Water shedding surface)

Re-using polyethylene tarp from tent purchased, 10'x20' punctured with grommets and tie down system



(Water shedding surface)

Reusable flashing, cut to meet 2' widths for panel size, applicable for door and window panels

MOISTURE PROTECTION STRATEGY - KIT OF PARTS



4 rolls of Waterproof UV Tape

Secondary system between slices

4 rolls (30') = 120'

Applied between joints between panels and connections pieces to prevent water infiltration.

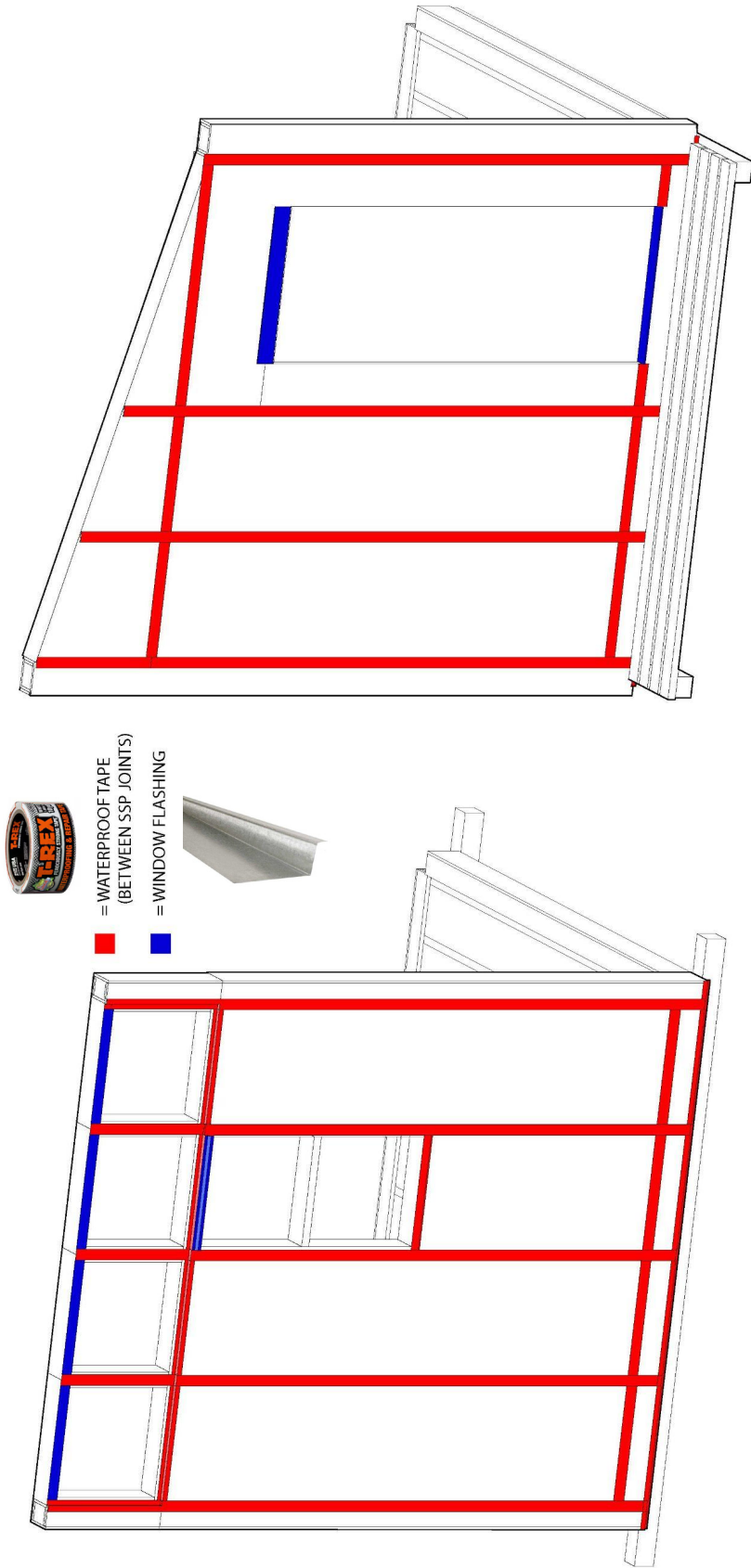


5 buckets of Timber Coating

Keeps the structure durable against moisture

2 Coats on plywood surfaces & connections, adding up to ~1200sf

WATERPROOFING STRATEGIES - TAPE & FLASHING APPLICATION



FOUNDATION STRATEGY - KIT OF PARTS



10 Cement Pier Blocks

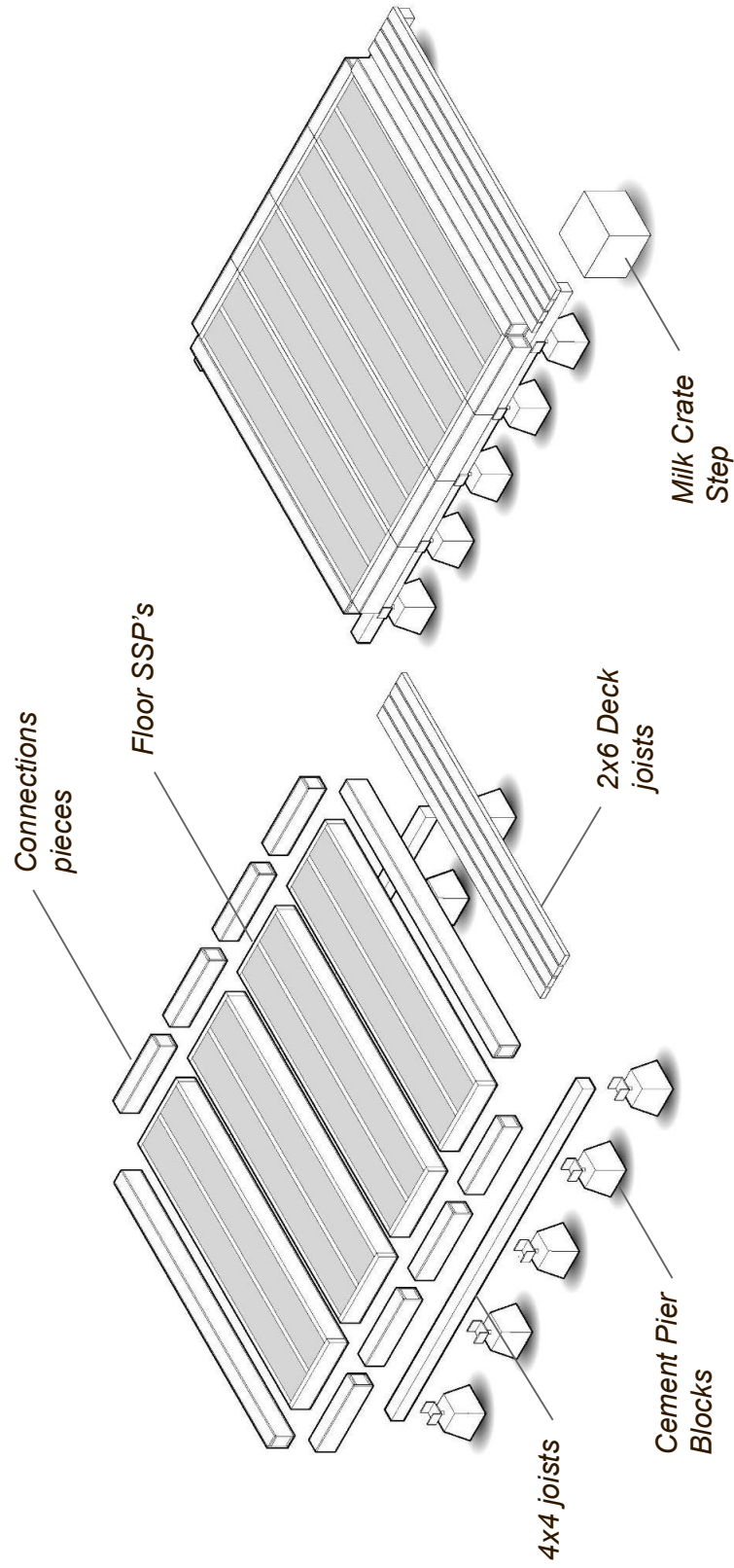
Foundational supports every 2 feet spaced at intersections between SSP's to support structure.



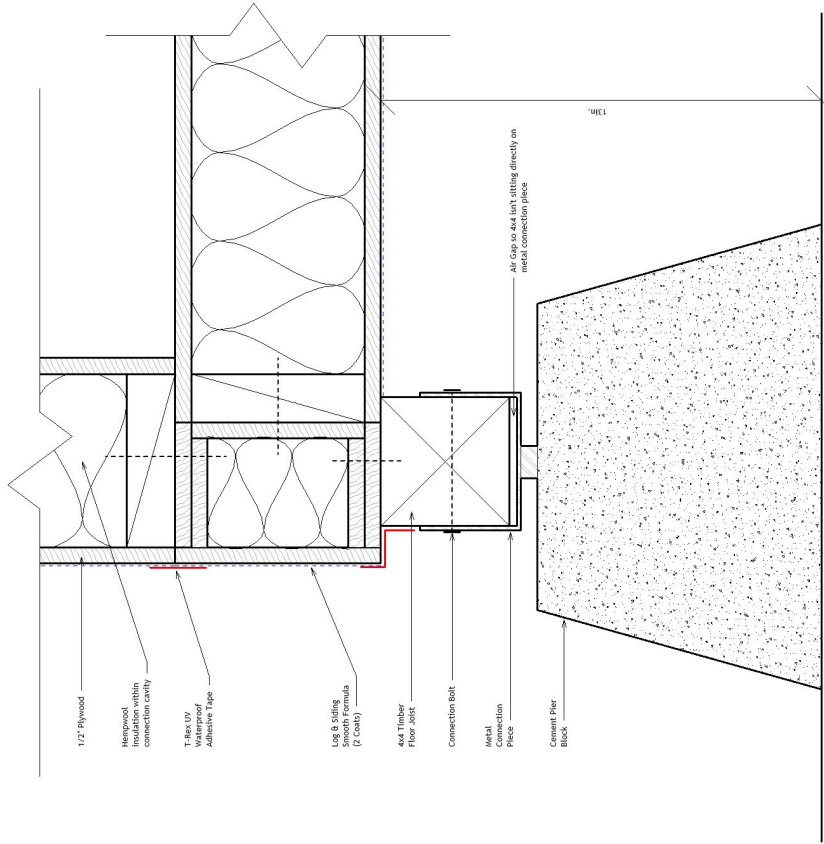
2 10' long 4x4 floor joists

Joists to support SSP's and porch floor joists.

FLOOR / FOUNDATION CONSTRUCTION

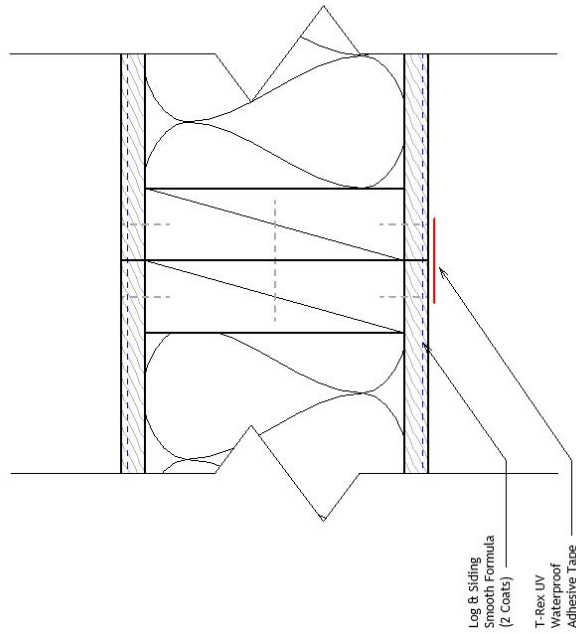


WALL TO FLOOR CORNER CONNECTION WITH 4x4 JOISTS

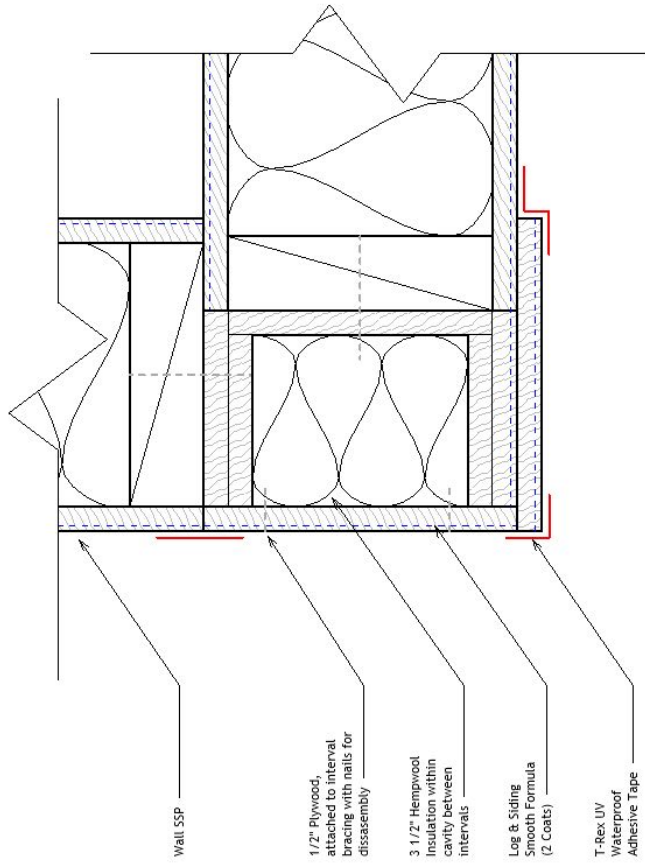


WALL TO WALL

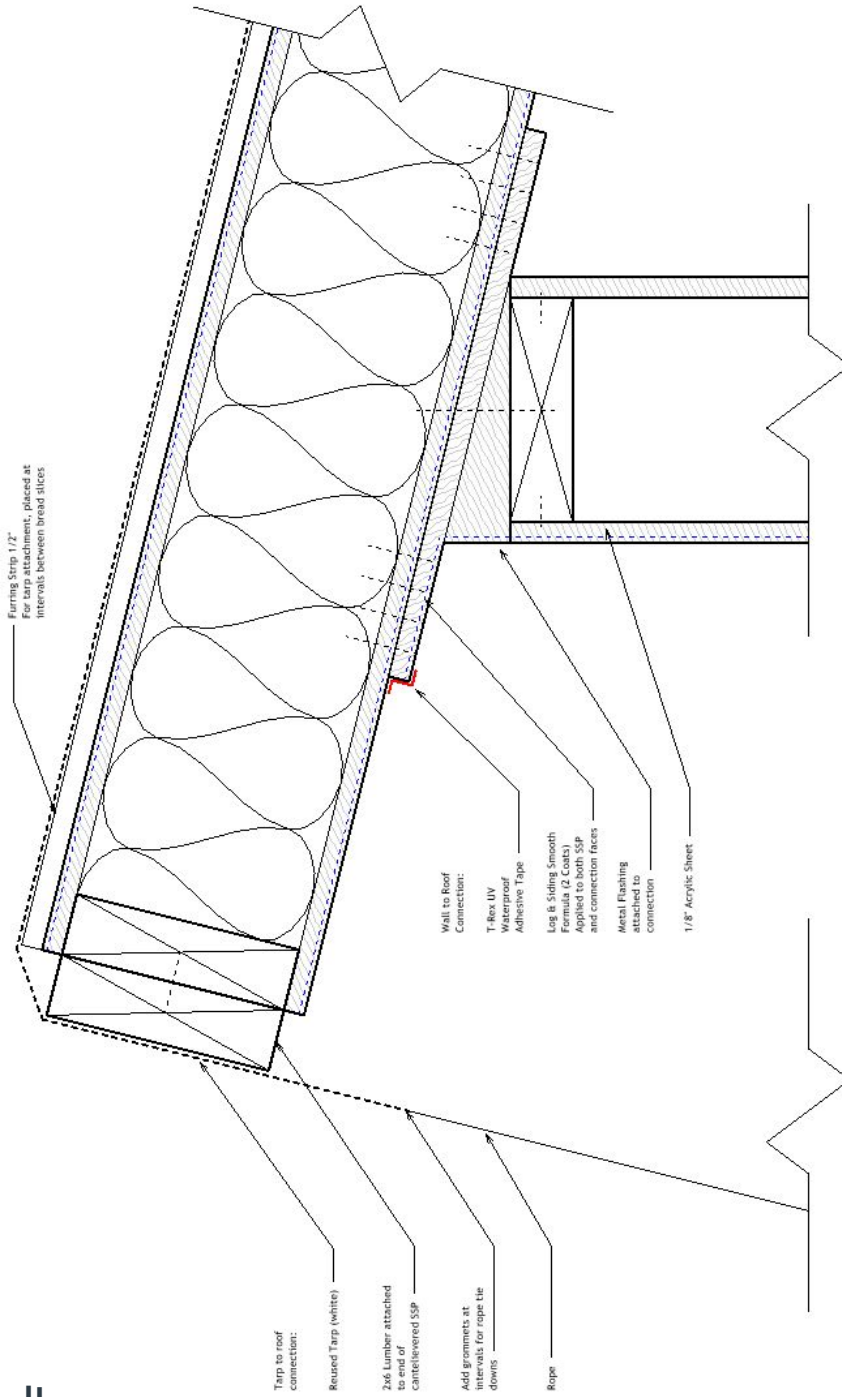
PLAN



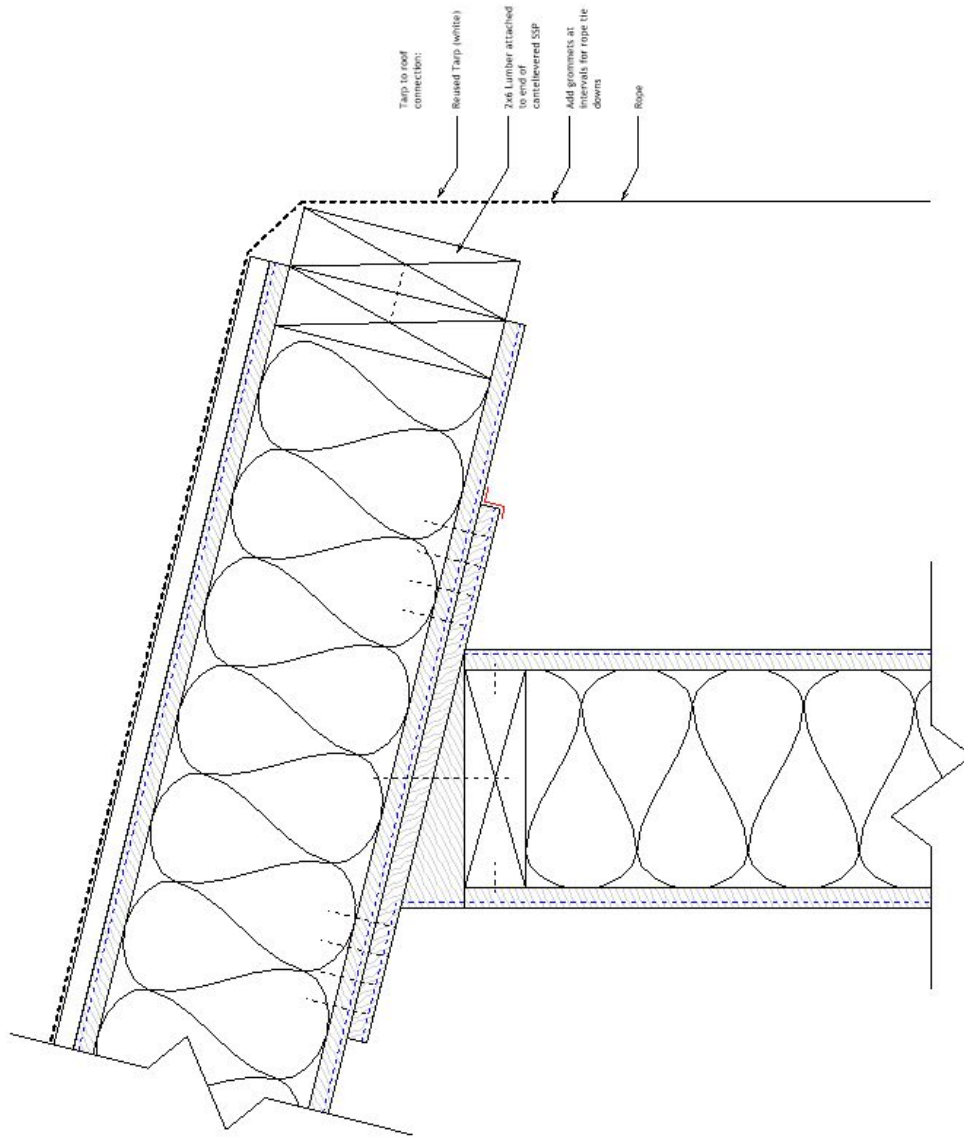
CORNER PLAN



WALL TO ROOF HIGH OVERHANG

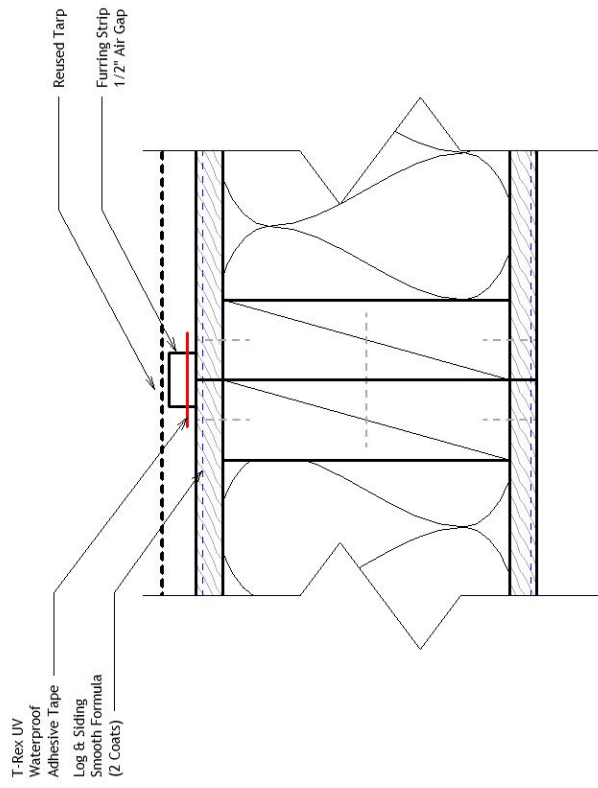


WALL TO ROOF LOW OVERHANG

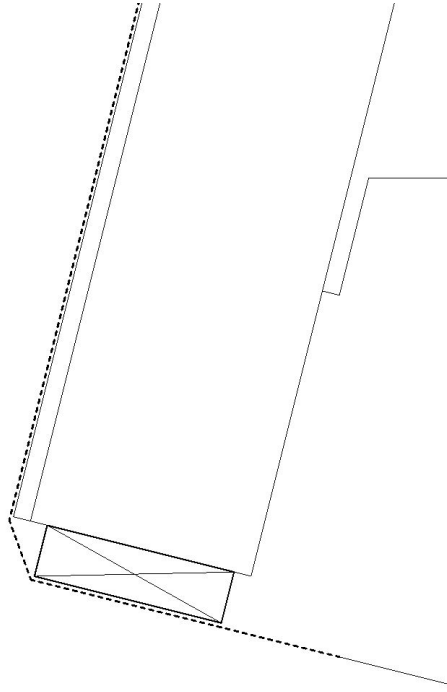


ROOF DETAILS

TARP TO ROOF PANELS



CANTILEVERED TARP OVER DECK



STRUCTURAL ANALYSIS

Location

City	State
Silverton	Oregon

Design Loads

Snow Load	Wind Load
33.2 psf	8.4 psf(wind) 5.2 psf(Lee)

Deflection Limits

Location of SSP	Deflection Limit (8ft lengths)(in)
Floor	0.267
Roof	0.4
4x4 Foundation beam	0.4

SSP Limitations

Allowable based on deflection	178.8 psf
Ultimate Bending Stress Limit	151.9 psf
Rolling Shear Limit	52.4 psf
Horizontal Shear Limit	133.6 psf

SSP Panels Karamba Analysis

Panel Type A

Framing: 2x6

Size: 2' x 8'

Weight: 119.6 lbs

Xmax(Floor): 0.000868

Panel Type B

Framing: 2x6

Size: 2' x 8'

Weight: 99 lbs

Xmax(Wall): 0.000023

Xmax(Roof): 0.0185

Panel Type B.S.

Framing: 2x6

Size: 1' 8" x 8'

Weight: 89 lbs

Xmax: 0.000004

Panel Type C

Framing: 2x6

Size: 2' x 4'

Weight: 54.6 lbs

Xmax(Roof): 0.017

Panel Type D

Framing: 2x6

Size: 2' x 2'

Weight: 20.5 lbs

Xmax(Window Frame): 0.00018

Panel Type E

Framing: 2x6

Size: 2' x 8' 3"

Weight: 56.5 lbs

Xmax(Window Frame): 0.000011

Panel Type F

Framing: 2x6

Size: 4' x 8'

Weight: 141 lbs

Xmax(Door): 0.000019

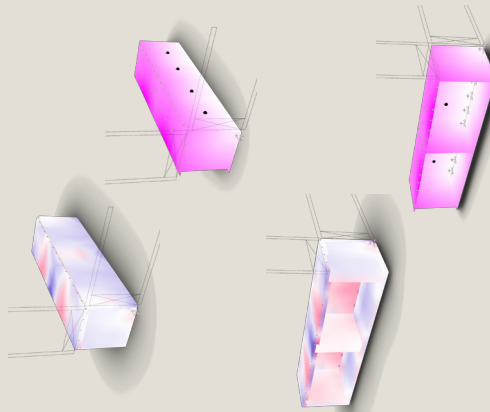
Connection: Floor to Wall

Framing: 2x6

Size: 2' x 6.5" x 6.5"

Weight: 10.3 lbs

Max. disp.: 0.00134



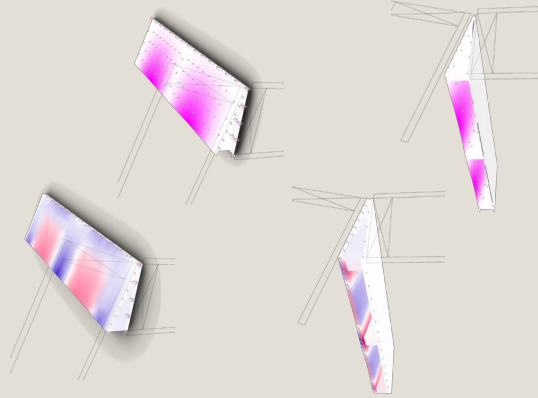
Connection: Wall to Roof

Framing: 2x6

Size: 2' x 6.5" x 2"

Weight: 5.6 lbs

Max. disp.: 0.000975



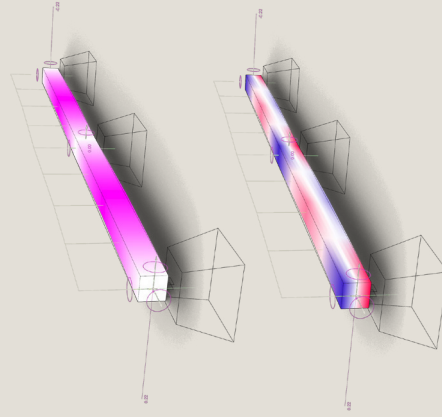
Foundation beams:

Ideal* support dist.: 4' o.c.

Size: 4" x 4" x 10'

Weight: 35.5 lbs

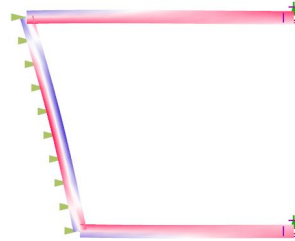
Max. disp.: 0.000165



*limit movement for comfort, aesthetics from exterior, and cost considerations

Section Karamba Analysis

The distribution of the LRFD loading on a two foot slice is shown below. The loading in question shows the tensile stress experienced on the lower half of each roof slice and the load pathing of the distribution. This expresses the importance of monitoring deflection as weight is added to a slice and potentially increasing thickness.

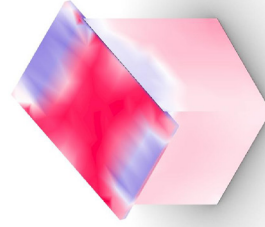


Shell Karamba Analysis

The analysis below shows the stress experienced by the whole shelter. The whole is experiencing compressive stress along the middle and tensile across the connections. The greatest deflection Xmax is found in the center of the shells and would need the most reinforcement there should the deflection increase past the limit of 0.4in for the roof.

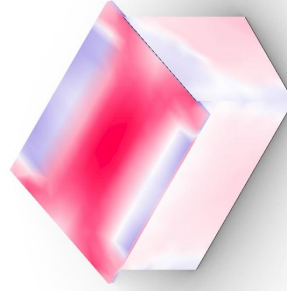
Plan: 8' x 8' (Basic Shelter)

Xmax: .006098



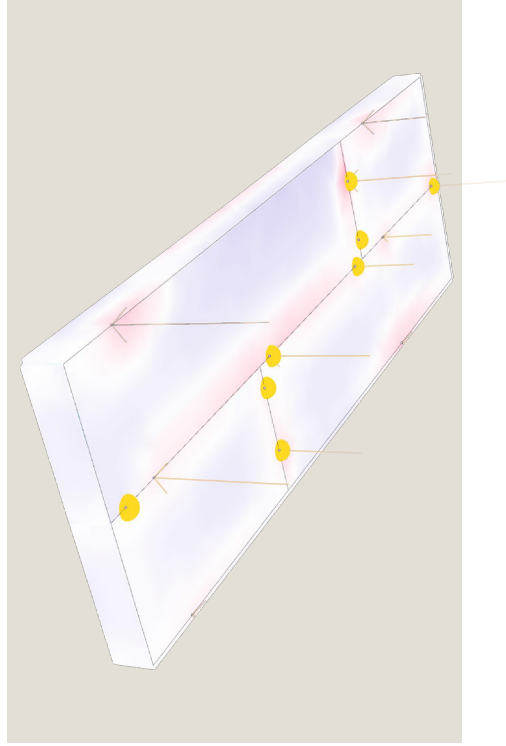
Plan: 8' x 16' (Expanded Shelter)

Xmax: .015306



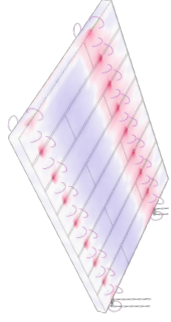
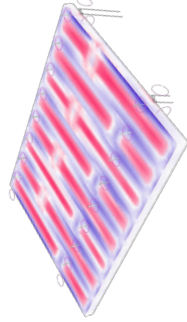
Roof Framing Analysis

These models show a more detailed example of the loading conditions on the roof plane. Internal framing provides more consistent support through the span, creating less discrepancy between the basic shelter and expanded iteration, and less strain at the center as would be expected on a single spanning surface. Deflection values show allowable strain under snow load conditions, assuming connections between panels have a similar rigidity to the SSPs.



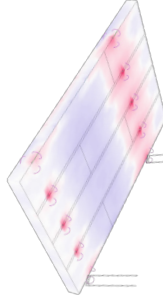
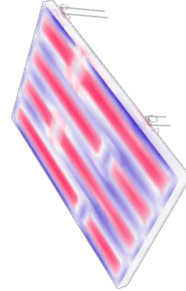
Plan: 8' x 16' (Expanded Shelter)

Xmax: 0.01115



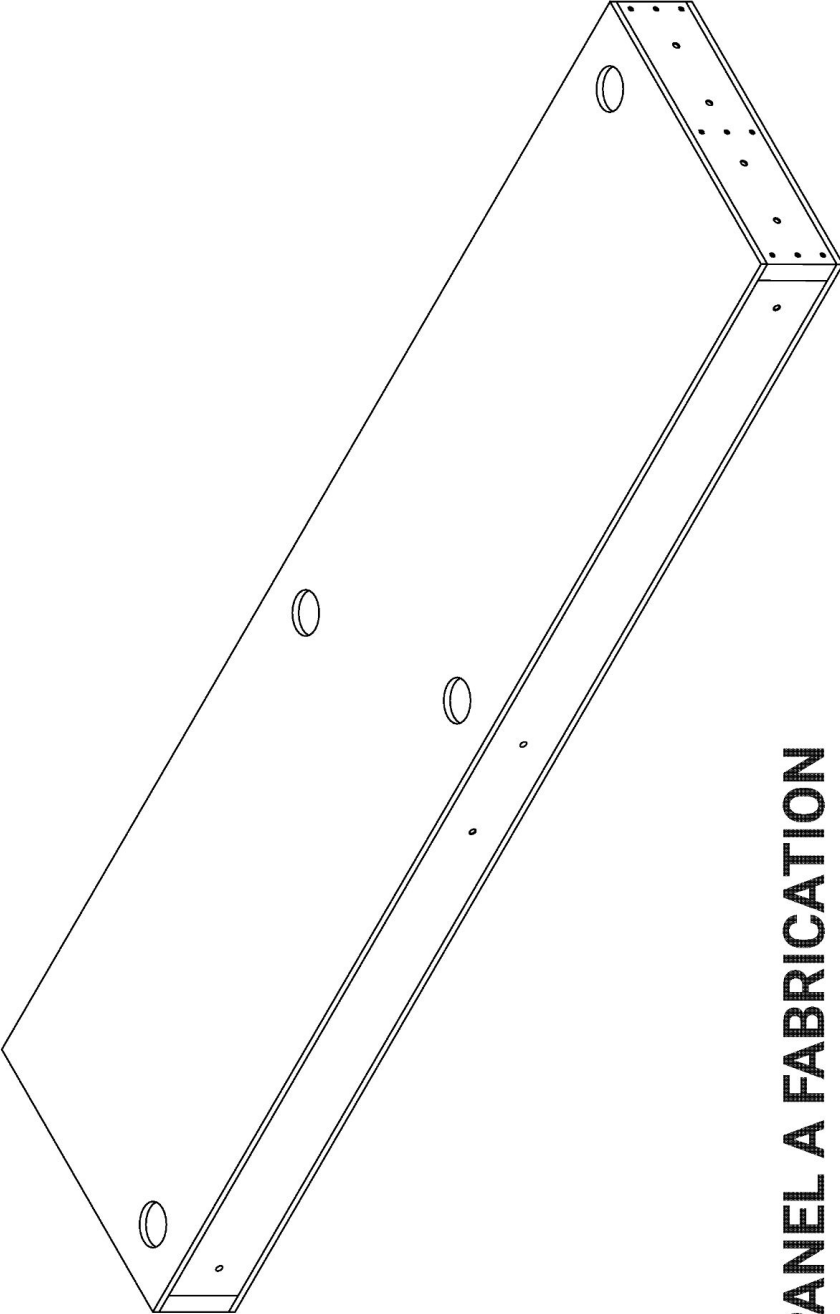
Plan: 8' x 8' (Basic Shelter)

Xmax: 0.01108



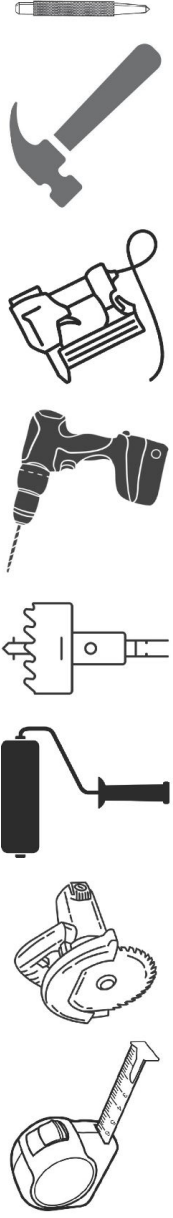


CONSTRUCTION PLAN

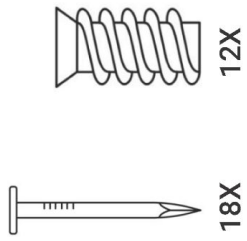


PANEL A FABRICATION

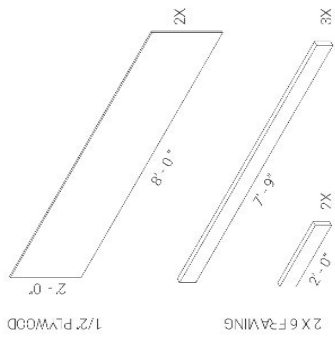
TOOLS NEEDED



FASTENERS NEEDED

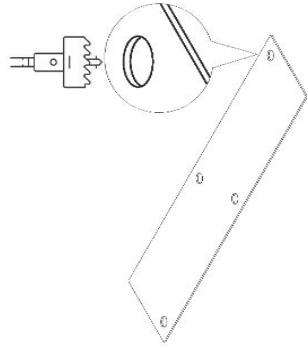
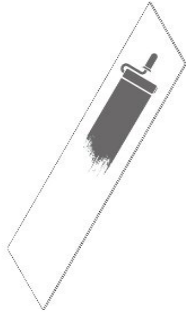


PANEL A

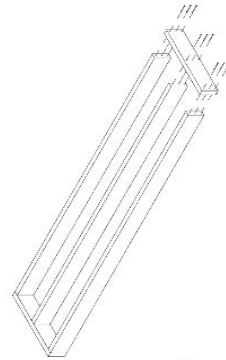


1 CUT ALL MATERIAL TO SIZE

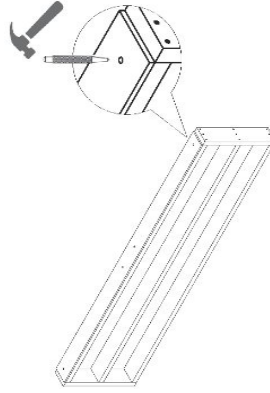
2 PREP EXTERIOR PLYWOOD SKIN WITH 2 COATS OF WRB PAINT ALLOWING TO DRY COMPLETELY BETWEEN COATS



3 PREP INTERIOR PLYWOOD SKIN WITH CONNECTION ACCESS HOLES

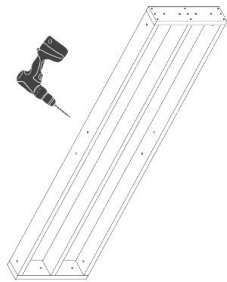


4 BUILD PANEL FRAME

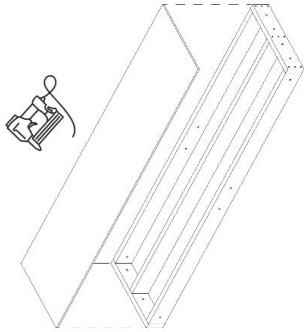


5 USE PRE MADE JIG & CENTER PUNCH TO MARK ALL BOLT HOLE LOCATIONS

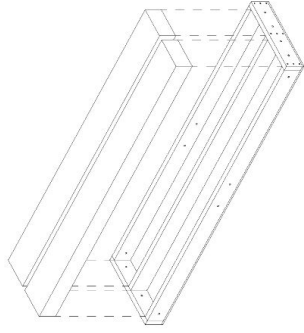
PANEL A



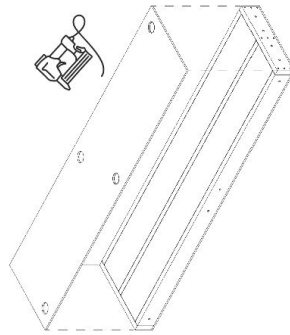
6 DRILL ALL BOLT HOLES (15/32")



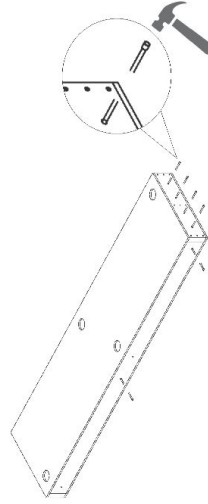
7 ATTACH EXTERIOR PLYWOOD SKIN



8 ADD INSULATION



9 ATTACH INTERIOR PLYWOOD SKIN



10 EMBED THREADED INSERTS

PANEL A

TOOLS USED

- Drill
- Miter Saw
- Tape measure
- Socket wrench
- 15/64" Drill bit
- 3/8" bolt
- Wood Glue

Roof to Wall Connection

Fabrication:

"Cut the following rectangle piece of plywood 1'-8" by 7'-8".

"Cut 1 1/2" of the following strip of lumber using a Miter Saw.

Construction:

1. "Using Wood glue, stick the 1 1/2" triangles in plywood strip you cut off of 1 1/2" from the top and bottom of step 1, on side of the triangles.
2. "Once the triangles are dry and placed in location you can move on to the next step."
3. "Now use a 15/64" drill bit and make 3 holes, 2 at 4" and one at 1" as shown above."
4. "Flip the Connection piece around and fit it into the wall. The 1 1/2" triangles will and use screws to fasten it to the roof."

PIECES NEEDED

x1

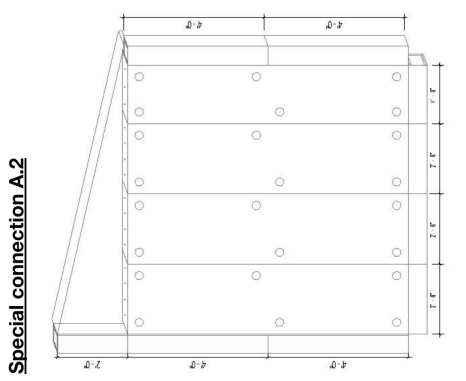
x1

x1

x1

1' - 8"

"Same concept as the 2' connection but shrink down to 1'-8" for the shorter esp panel. Hole layouts are 5" from one another."





CONSTRUCTION
PLAN

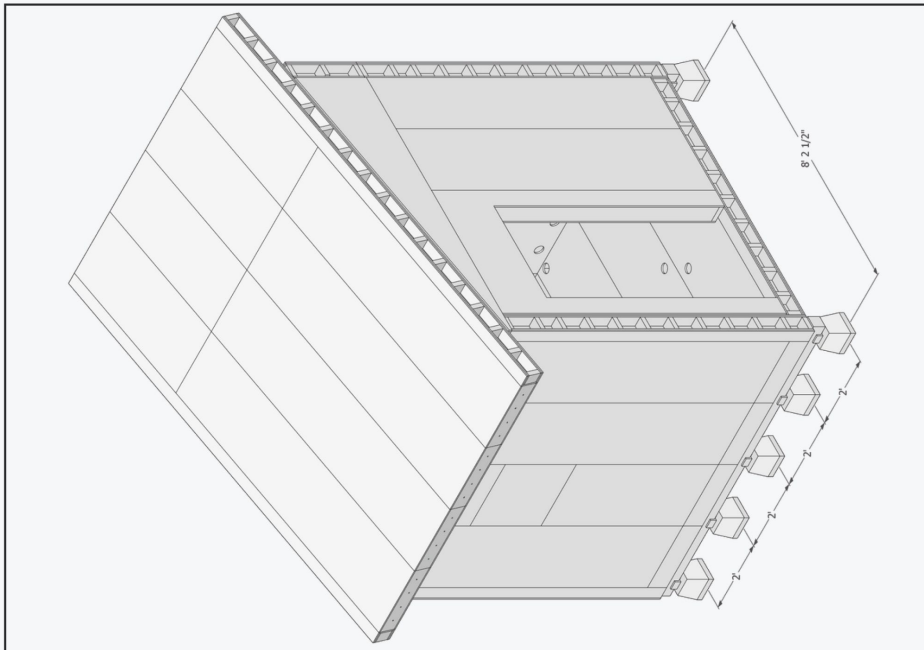
ARCH 484
TIMBER TECTONICS
PROFS. CHENG & RIGGIO

TABLE OF CONTENTS

- LIST OF PARTS (PRE-FAB)
- LIST OF PARTS (REPAIR / REPLACEMENT)
- LIST OF TOOLS
- LIST OF ROLES
- SITE SELECTION
- SITE PREPARATION
- MATERIAL STORAGE
- WEATHER COUNTERMEASURES
- LOGISTICS

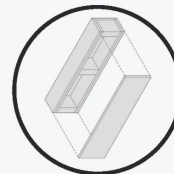
CONSTRUCTION

- A..... CONCRETE BLOCKS
- B..... GIRDERS
- C.....ASSEMBLING A SLICE
- D.....RAISING THE SLICE
- E.....SECURING THE SLICE
- F.....ASSEMBLING THE DOOR WALL
- G.....RAISING THE DOOR WALL
- H.....SECURING THE DOOR WALL
- I SECOND BASIC SLICE
- J ASSEMBLING THE WINDOW SLICE
- K.....ASSEMBLING THE BACK WALL
- L.....WATERPROOFING
- M..... ATTACHING THE TARP



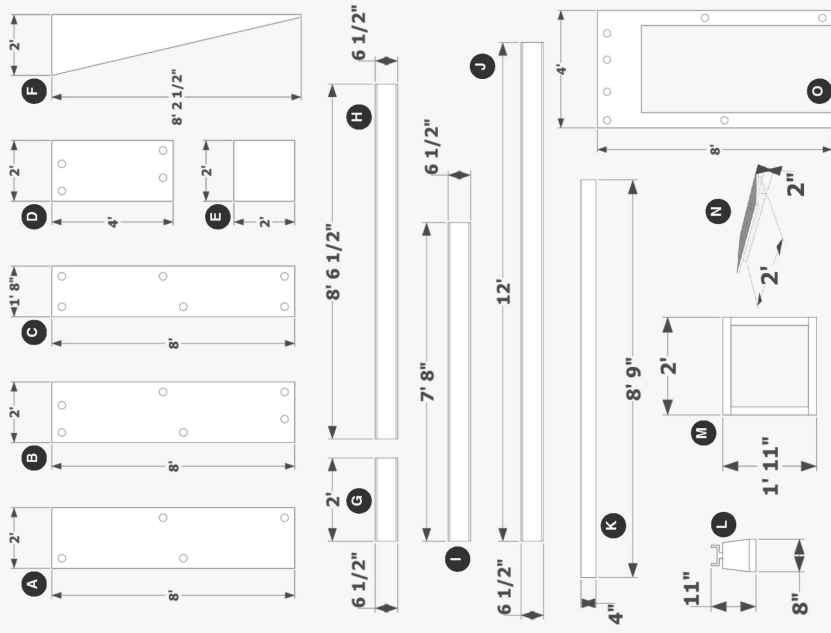
LIST OF PARTS (PRE-FAB)

- Panel **A1** (has center member) x 4
- Panel **A2** (no center member) x 16
- Panel **B** x 4
- Panel **C** x 2
- Panel **D** x 5
- Panel **E** x 2
- Panel **E** x 2
- or
- Operable Window **P** (not pictured) x 1
- Panel **F** x 1
- Connector **G** x 18
- Connector **H** x 4
- Connector **I** x 2
- Connector **J** x 2
- Girder **K** x 2
- Concrete Pier **L** x 14
- Clerestory Panel **M** x 4
- Roof Brackets **N** x 8
- Door Frame **O** x 1
- Door **P** (not pictured) x 1



All connectors (G-J) have a corresponding front panel that is detachable and should not be attached prior to construction

LIST OF PARTS (PRE-FAB)



LIST OF TOOLS / PARTS (BUILD / REPAIR)

- Chalk
- Masking Tape x 1 roll
- Measuring Tape x 1
- Hammer x 2
- Framing Nails x 2 boxes
- Cordless Drill x 1
- 3/8" Bolts x 1 box
- 3/8" Socket Wrench x 2
- 3/8" Threaded Inserts x 2 boxes
- Tarp x 5
- Screw-in Hooks x 24
- Level x 1
- Ladder x 2
- WRB Tape x 4 rolls

LIST OF ROLES

The majority of tasks necessary for the construction of this shelter are designed to be done by untrained laborers guided by one or a small number of individuals familiar with construction practices. Therefore, there are few roles that require specialized knowledge, physical ability or training.

Those that do are listed here:

Cordless Drill User
Heavy Lifting
Hammer User
Rope Tying

WEATHER COUNTERMEASURES

If possible, construction work should not be done during inclement weather that could pose any risk to the workers. Follow local guidelines to the best of your ability.

Kits made for areas with rain will include a tent that should be assembled during site preparation and placed over the construction area. When construction is complete, the tent can be repurposed for use by the occupants of the shelter. An assembly guide for the tent is included within its packaging.

For areas with heavy winds, extra care should be taken to secure the tarps used to protect the materials. Weighted tie-downs are included in kits for high-wind areas.

SITE PREPARATION

Before assembly, the site should be divided into two zones. Both zones are 16 feet wide.

Zone A (Assembly) should be 10 feet long.

Zone B (Build) should be 16 feet long.

Both zones are divided into a central working space and 4 feet of circulation.

These zones can be delineated by chalk, tape, rope, or paint. In areas with an excess of available space, these markings are not required.

The site must be

- Flat and solid
- A minimum of 16 feet wide
- A minimum of 26 feet long
- Without obstruction to a height of 12 feet

MATERIAL STORAGE

While shipped globally in 9' x 9' x 4.5' containers, the panels of the shelter are all sized to be able to be transported by pickup truck - a long bed pickup will be able to hold even the largest panels with a closed tailgate.

In storage, the panels should be kept in a dry environment away from the elements to ensure maximum lifespan upon deployment.

On site, the materials should be stored in between tarps when not in use. The tarp covering the panels can be secured by any heavy object - stones, for example, or the concrete piers used for the foundation.

Transport of panels should be done by the appropriate number of able-bodied individuals, as detailed on the next page.

Transport over longer distances or lifting to a height above waist level will require more workers.

MATERIAL STORAGE

PANEL	WEIGHT	WORKERS
A	130 lb	4
B	112 lb	3
C	60 lb	2
D	25 lb	1
E	82 lb	3

LOGISTICS

Some storage solutions will allow for the distribution of materials as they are needed. Others will demand that all materials be held on site. For ease of transport and use, all materials are labeled as denoted in the list of parts.

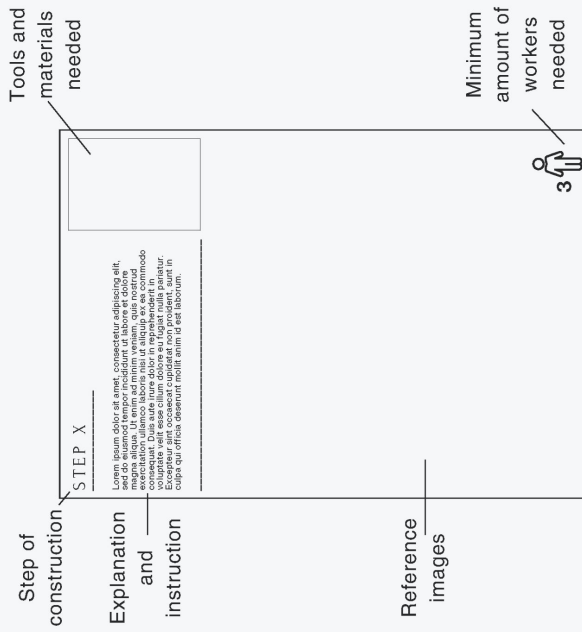
In the following construction steps, each portion of construction is listed as it becomes necessary. However, some of these steps could be completed ahead of time - or at a separate location, if robust transport options are available. Those steps are listed below.

- Step B - girders can be attached before placement of concrete piers.
- Step C - all slices can be assembled ahead of time to speed up construction.
- Step F - as with step C
- Step I - as with step C
- Step J - as with step C

Keep in mind that any assembly done off-site will significantly increase the weight and size of those parts - do not assemble any pieces off-site without a plan in place for their transport and safe placement.

CONSTRUCTION

Throughout this section, certain information will be listed on each page for quick reference. An explanation of this notation is found below.



STEP A - CONCRETE PIERS

Lay out the concrete blocks, spaced as below.

To aid in your placement, use a measuring tape alongside a non-permanent method of marking the ground (tape, chalk, paint, etc.).

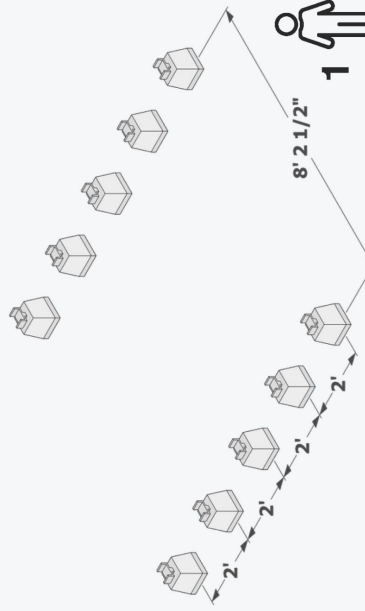
Orient the connectors along the long edge.

Tools

Measuring Tape
Tape, Chalk or
Paint

Roles

None



STEP B - GIRDERS

Place the 4" x 4" wooden girders into the metal connectors, centered along the long axis.

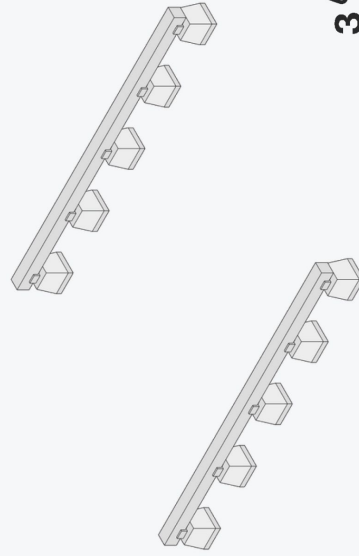
Drill them into place from the outside with bolts placed through the openings of the metal connectors, keeping the bottoms of the girders 1/2" above the flat surfaces of the connectors for air flow.

Tools

Measuring Tape
Level
Drill

Roles

Drill

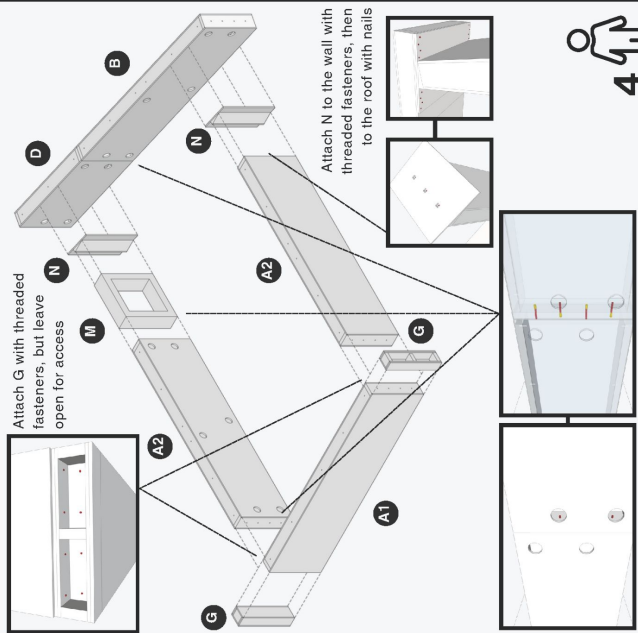


STEP C - ASSEMBLING A SLICE

Laying the panels on their sides over a tarp or on a solid man-made surface, construct a basic slice of the shelter, making sure all access holes are on the interior.

The wall panels should extend beyond the floor to be flush with the G connectors (including their 1/2" finish panel, which will not be attached at this stage.)

- Tools**
 Socket Wrench
 3/8" Fasteners
 Hammer
 Nails
- Roles**
 Heavy Lifting
 Hammer



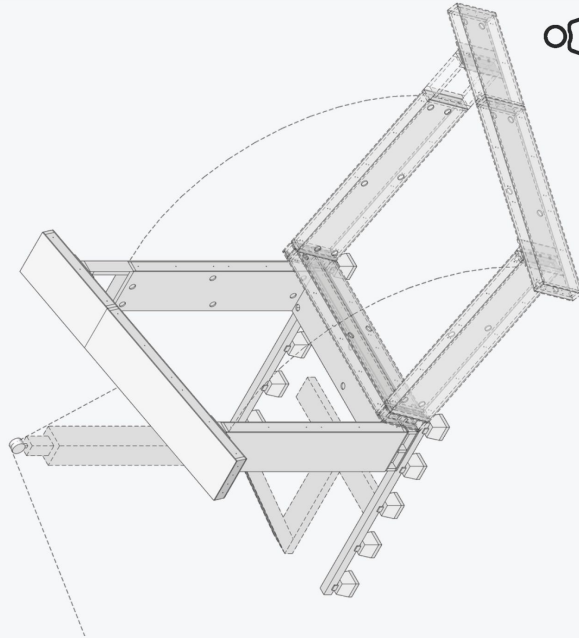
Use access holes and socket wrench to tighten threaded fasteners

STEP D - RAISING THE SLICE

As a team, push or carry the slice up to the edge of the foundation and lift its lower edge onto the girders.

With at least two workers guiding / supporting the slice, attach a rope to the pulley system (WIP) and pull it up to a vertical position, centered and resting perpendicular atop the girders.

- Tools**
 Ladder
 Pulley
 Rope
- Roles**
 Heavy Lifting



STEP E - SECURING THE SLICE

With the slice atop the girders, align it so that its edges align with the centers of the piers below on the long axis.

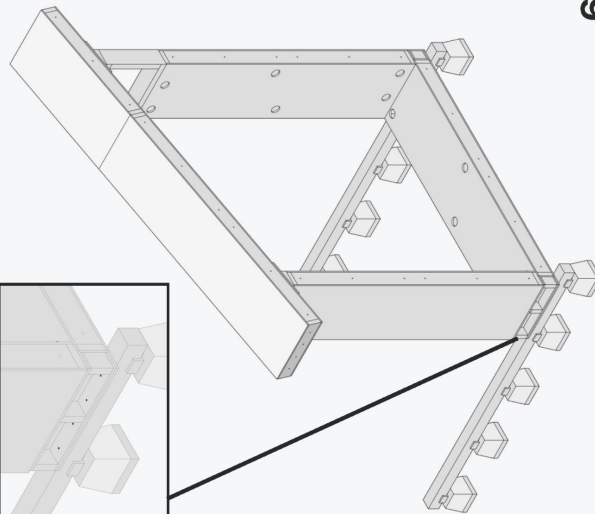
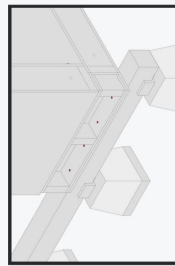
Then use a socket wrench to secure the slice to the girders with threaded inserts.

Tools

Socket Wrench
Fasteners

Roles

None



STEP F - DOOR WALL ASSEMBLY

Lay the main panels of the door wall flat with their access holes facing upward and connect them through threaded inserts inserted into pre-drilled holes.

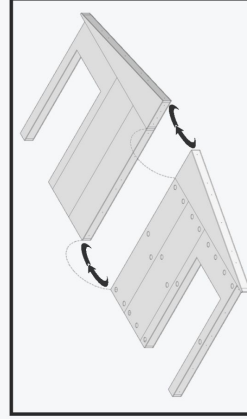
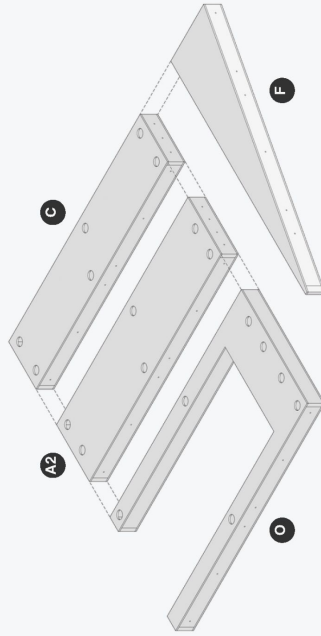
Then, flip the entire panel over.

Tools

Socket Wrench
Fasteners

Roles

Heavy Lifting



STEP F - DOOR WALL ASSEMBLY

Attach connectors to the door wall with threaded fasteners inserted into pre-drilled holes. Align connector J to these holes.

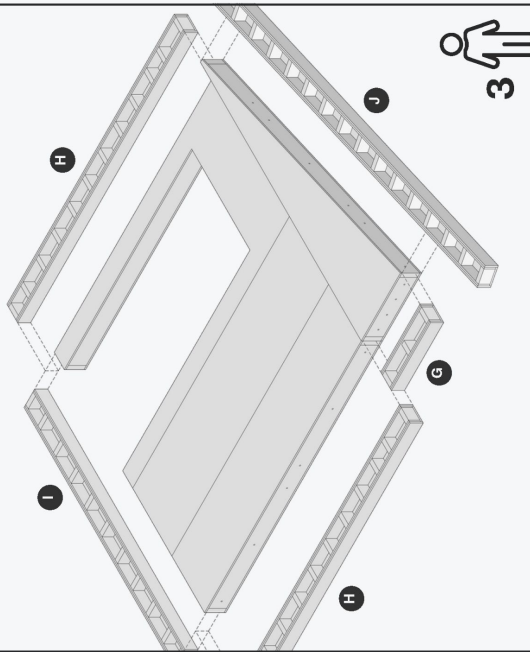
Make sure to keep these connectors 1/2" lower than the faces of the panels so as to ensure a flush surface when the outward-facing panels are attached.

Tools

Socket Wrench
Fasteners

Roles

None



STEP G - RAISING THE DOOR WALL

As a team, push or carry the slice up to the edge of the foundation and lift its lower edge onto the girders.

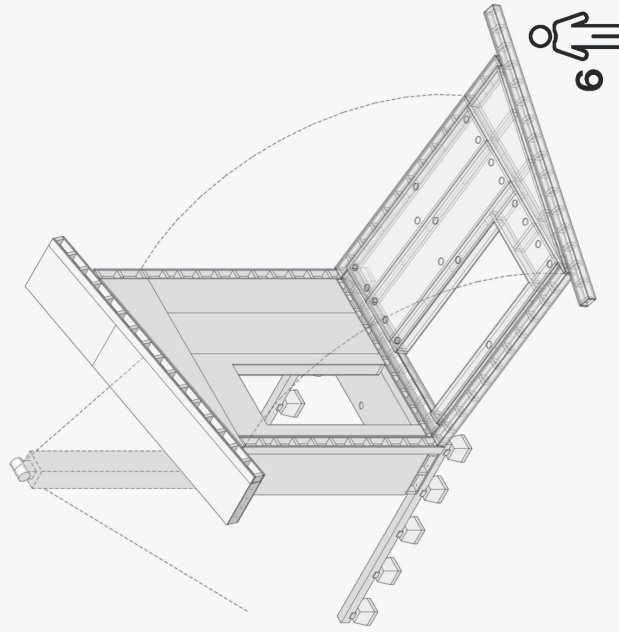
With at least two workers guiding / supporting the slice, attach a rope to the pulley system (WIP) and pull it up to a vertical position, centered and resting against the slice that has been secured.

Tools

Socket Wrench
Fasteners

Roles

Heavy Lifting



STEP H - SECURING THE DOOR WALL

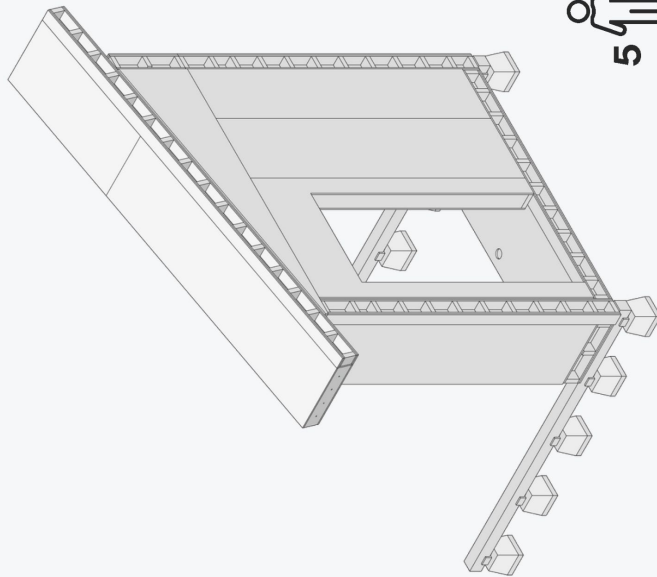
With the slice atop the girders and flat against the edge of the secured slice, use a socket wrench to secure the slice to the girders and slice with threaded inserts.

Tools

Socket Wrench
Fasteners

Roles

None



STEP I - SECOND BASIC SLICE

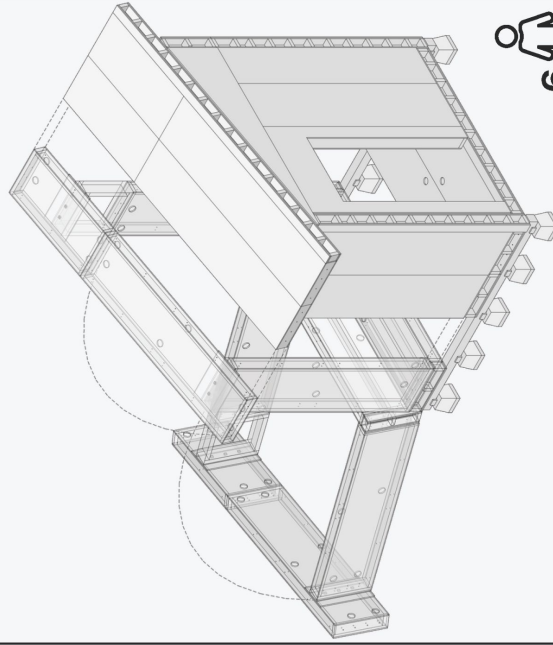
Repeat Steps C, D, and E, creating a second slice and lifting it onto the girders from the side opposite the door, sliding it into place, and securing it both to the girders and to the existing structure using threaded inserts.

Tools

Socket Wrench
Fasteners

Roles

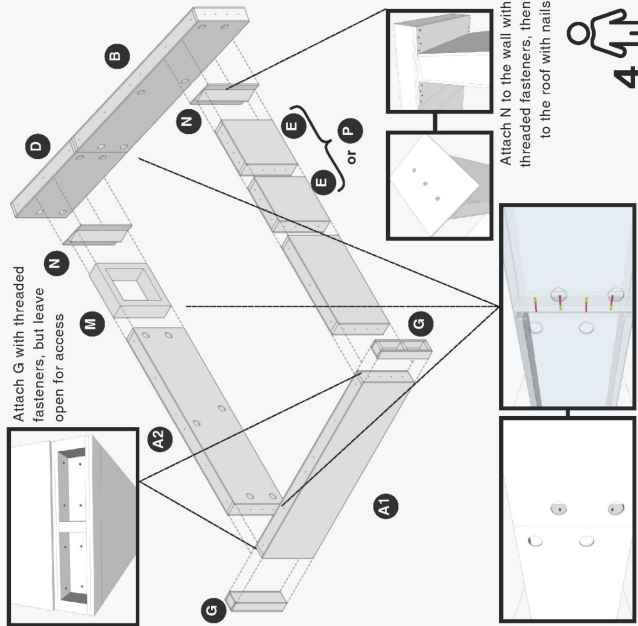
Heavy Lifting



STEP J - WINDOW SLICE

Repeat Step I (using the diagram below in place of the image for step C) to create a window slice. Then lift it onto the girders from the side opposite the door, slide it into place, and secure it both to the girders and to the existing structure using threaded inserts.

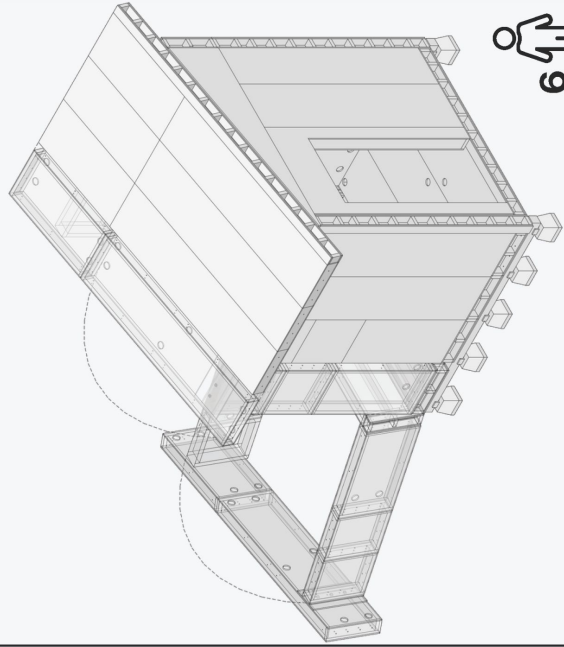
- Tools**
 Socket Wrench
 Fasteners
 Hammer
 Nails
- Roles**
 Heavy Lifting
 Hammer



STEP J - WINDOW SLICE

Repeat Step I (using the diagram below in place of the image for step C) to create a window slice. Then lift it onto the girders from the side opposite the door, slide it into place, and secure it both to the girders and to the existing structure using threaded inserts.

- Tools**
 Socket Wrench
 Fasteners
- Roles**
 Heavy Lifting



STEP K - BACK WALL

Repeat the first half of Step F (using the diagram below), laying the main panels with access holes facing upwards and attaching them by tightening fasteners into the pre-drilled holes located within the 3" access holes.

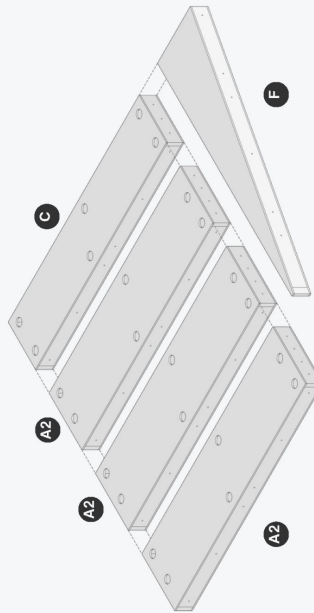
Then, flip the panel over.

Tools

Socket Wrench
Fasteners

Roles

Heavy Lifting



STEP K - BACK WALL

Attach connectors to the back wall with threaded fasteners inserted into pre-drilled holes. Align connector J to these holes.

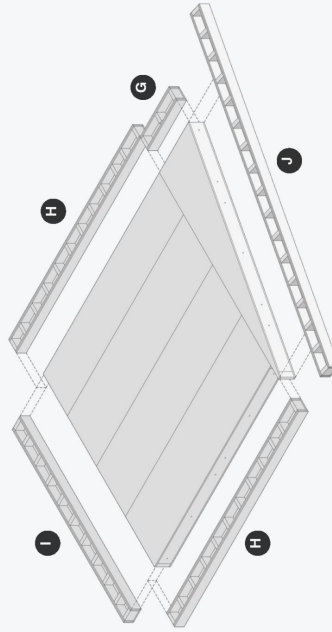
Make sure to keep these connectors 1/2" lower than the faces of the panels so as to ensure a flush surface when the outward-facing panels are attached.

Tools

Socket Wrench
Fasteners

Roles

None



STEP K - BACK WALL (CONT.)

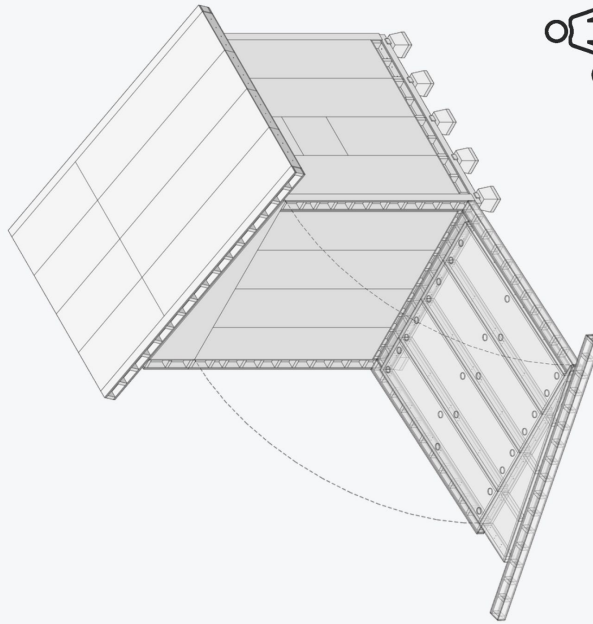
Repeat Steps G & H using the back wall, raising it into place and attaching it to the girders and existing structure.

Tools

- Socket Wrench
- Fasteners

Roles

- Heavy Lifting



STEP L - WATERPROOFING

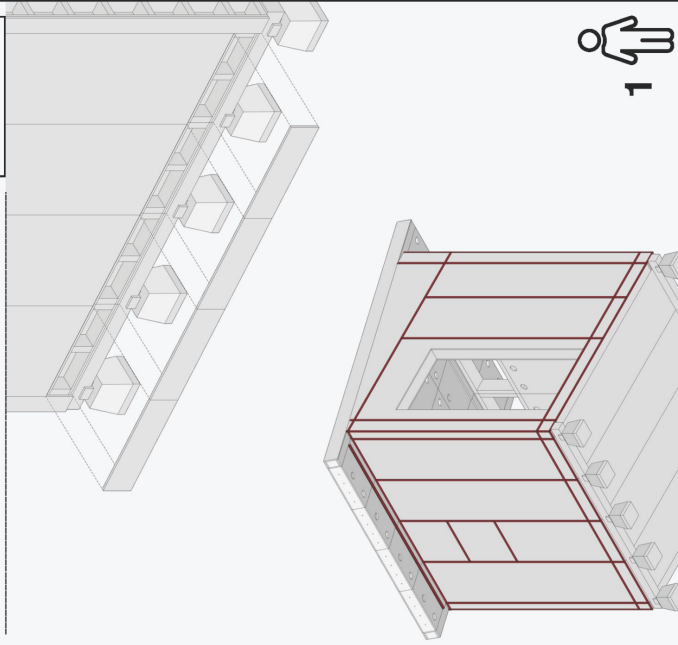
Attach the finishing panels to the connectors with nails.
Cover all external seams with WRB tape.
Attach the door to the door frame as indicated in the included door installation manual.

Tools

- Hammer
- Nails
- WRB Tape
- Ladder

Roles

- Hammer

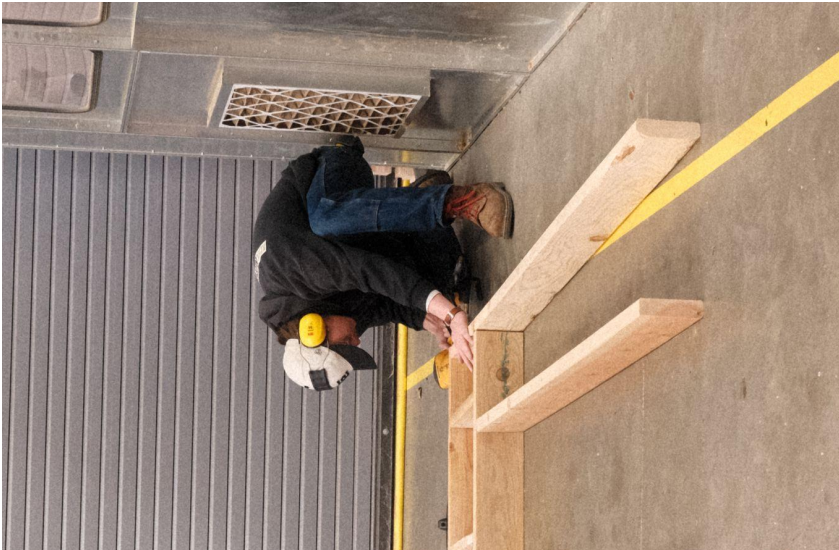




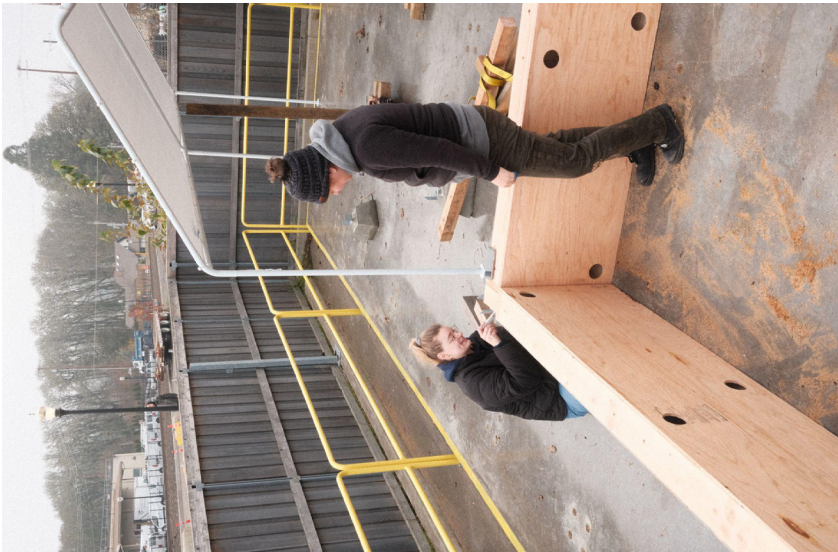
Drilling



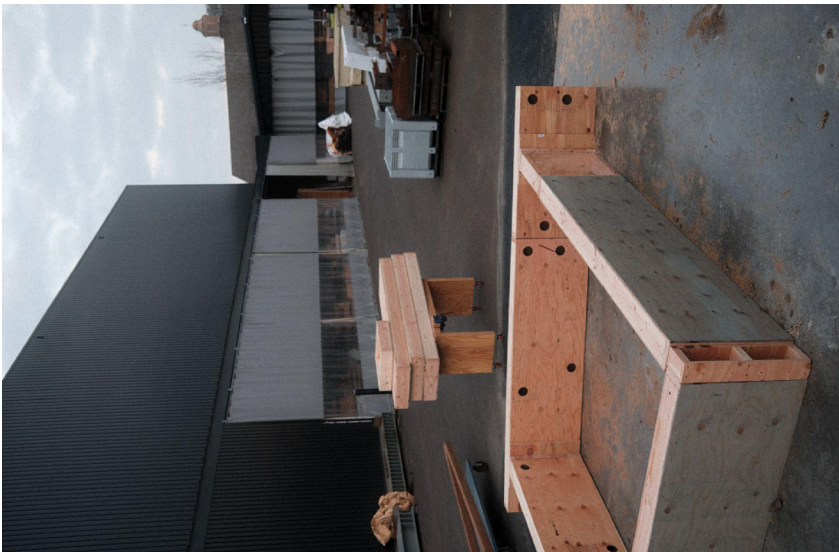
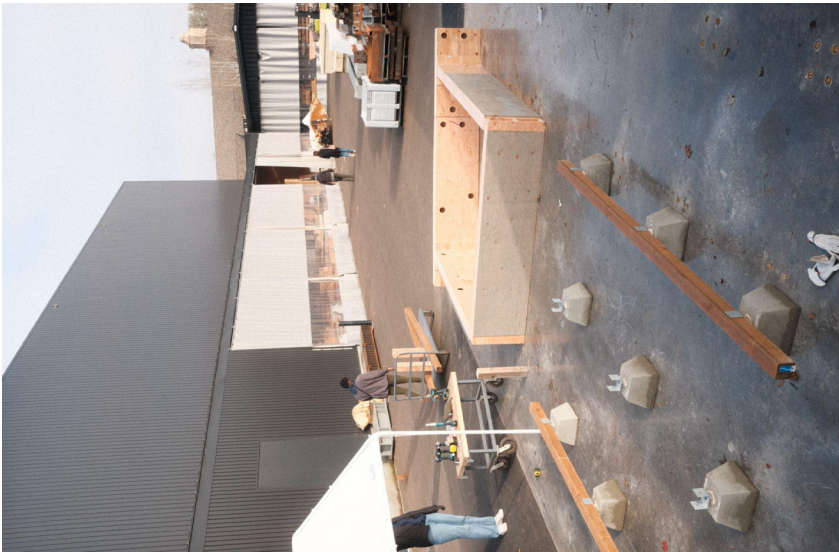
Marking



Frame Assembly



“Bread Slice” Assembly

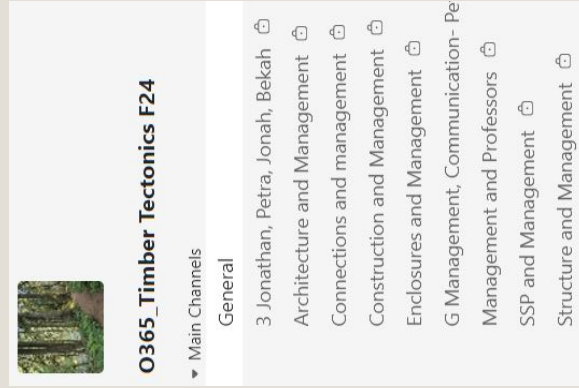


“Bread Slice” Assembly

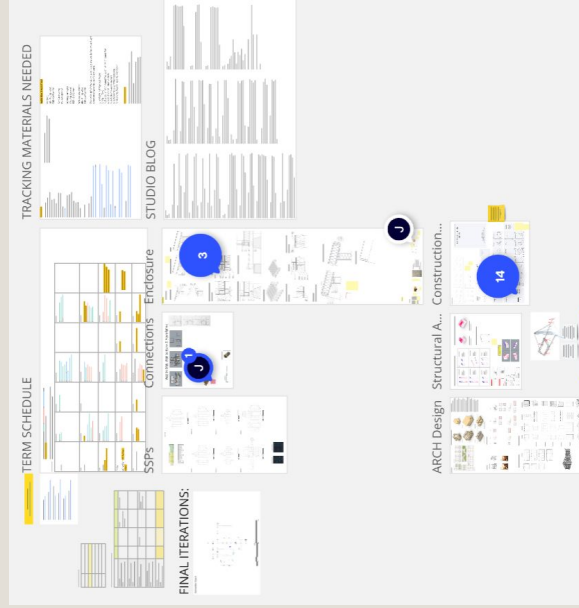
PROJECT MANAGEMENT

Scheduling, group communication, material procurement

Communication via
Microsoft Teams



Collaboration via Zoom meeting and
Miro boards



Timeline

First two weeks: initial designing

11/15 -> Construction review

11/18 -> All SSP types finalized

11/25 -> Prefab. SSP Panels

Finish construction documents

12/2 -> Build Week

Apply WRB/ stain to exterior

12/5 -> Start Assembly

12/6 -> Final Review

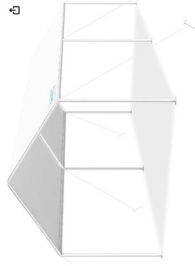
TERM SCHEDULE

This calendar will track when tasks are completed, need to be completed, meeting discussions and other important dates. Teams can be noted too with letters.
 Please feel free to add and edit, but try not to multiply move a deadline, instead just write a sticky note if something isn't going to be done in time or needs to be done earlier. Thanks everyone!

ALL GROUPS

11/10 LO WEEK 6	Monday 11/14 D Shop plans G Final details	Tuesday 11/15 G Create material tracking log	Wednesday 11/16 D Address all owned design changes E Finalize load distributions F Finalize floor joist framing G Finalize floor joist framing H Finalize floor joist framing I Finalize floor joist framing J Finalize floor joist framing K Finalize floor joist framing L Finalize floor joist framing M Finalize floor joist framing N Finalize floor joist framing O Finalize floor joist framing P Finalize floor joist framing	Thursday 11/17	Friday 11/18 C Calculate total moments per SSP GROUP NEED FLOOR AND LUMBER ESTIMATE	11/19
11/10 LO WEEK 7	Monday 11/11 HOLIDAY	Tuesday 11/12	Wednesday 11/13 E Check in on analysis and modeling F Do all deconstruction manual G Do all deconstruction manual H Do all deconstruction manual I Do all deconstruction manual J Do all deconstruction manual K Do all deconstruction manual L Do all deconstruction manual M Do all deconstruction manual N Do all deconstruction manual O Do all deconstruction manual P Do all deconstruction manual	Thursday 11/14	Friday 11/15 CONSTRUCTION MEETING - VIRTUAL 3PM D Inher materials used (J, K, L) E Included small scale trailer F Finalize floor joist framing G Finalize floor joist framing	11/16
11/17 LO WEEK 8 Final and water proofing at corner	Monday 11/18 A FINAL SSP design B Finalize floor joist framing C Finalize floor joist framing D Finalize floor joist framing E Finalize floor joist framing F Finalize floor joist framing G Finalize floor joist framing H Finalize floor joist framing I Finalize floor joist framing J Finalize floor joist framing K Finalize floor joist framing L Finalize floor joist framing M Finalize floor joist framing N Finalize floor joist framing O Finalize floor joist framing P Finalize floor joist framing	Tuesday 11/19	Wednesday 11/20 C FINAL envelope and foundation D Update materials with final SSP joint connections	Thursday 11/21	Friday 11/22 D Site design draft E Finalize floor joist framing F Update materials with final envelope and foundation decisions G FINAL construction material parts list	11/23 *Have final SSP connection, envelope and foundation decisions made this week so we can obtain materials
11/24 LO WEEK 9 PREFAB ALL PIECES	Monday 11/25 E Engineering and quality control F Utilization and deflection analysis revisions	Tuesday 11/26	Wednesday 11/27 LO class in virtual 3-3 D Finalize floor joist framing E Finalize floor joist framing F Finalize floor joist framing G Finalize floor joist framing H Finalize floor joist framing I Finalize floor joist framing J Finalize floor joist framing K Finalize floor joist framing L Finalize floor joist framing M Finalize floor joist framing N Finalize floor joist framing O Finalize floor joist framing P Finalize floor joist framing	Thursday 11/28 Thanksgiving break	Friday 11/29 Thanksgiving break	11/30 *Have final drawings done before Thanksgiving break
12/1 LO WEEK 10 - BUILD WEEK @ ODU	Monday 12/2 All components to ODU WATERPROOF DAY 1	Tuesday 12/3 WATERPROOF DAY 2	Wednesday 12/4 A SSP and foundation ready end of day B Submit final drawings C Submit final drawings D Submit final drawings E Submit final drawings F Submit final drawings G Submit final drawings H Submit final drawings I Submit final drawings J Submit final drawings K Submit final drawings L Submit final drawings M Submit final drawings N Submit final drawings O Submit final drawings P Submit final drawings	Thursday 12/5 FINAL BUILD AT ODU - ASSEMBLY STARTS	Friday 12/6 Final project close Review at 1pm Finalize floor joist framing	

Budgeting



\$170



\$23.40



\$118



\$7.99

PAST EXPENDITURES								
#	Date Requested	Date Acquired	Vendor	Item Description / Purpose	Unit Price	Qty	Amount	Details/Notes
1		10/4/2024	Oregon State Motor Pool	Vehicle Rental - Ford Fusion			76.23	
2		10/4/2024	Market of Choice	Field Trip food			40.00	
3		10/4/2024	for Bekah, Donovan, Wilka	Field Trip mileage for drivers	71.69	3	215.07	
4		10/11/2024	Duck Store	Modeling Supplies			137.90	
5		11/8/2024	Home Depot (Grant)	Prototype Modeling			85.80	
6		11/14/2024	Jerry's (Alejandro)	Prototype Bolts and T-Nuts			18.4	
7		11/20/2024	Lowe's	2"x4" acrylic, 1/8" thick	118.00	1	118	Delivering to UO
8		11/20/2024	Amazon	Construction Cover: 10' x 20' tarp with frame			170	Delivering to OSU
9		11/20/2024	Amazon	10' of 1/2" Wood Dowel (10 pk of 1')			6.99	
10				4x8 Plywood	23.40	30	702.00	
11				2x6 Lumber	5.39	70	377.30	
12				WRB Shipping			43.92	
13		11/29/2024	Home Depot (Jonah)	Weatherproofing Tape, 30'			50.12	160 needed
14		11/30/2024		3/8" Zinc Flat Washers (100 pack)	25.06	2	116.54	160 needed
15		12/1/2024		3" Zinc Exterior Bolts			116.54	160 needed
16		11/30/2024		1 gallon wood glue			25.98	
							2,184.25	Project Total
							1,104.95	UO Total
							895.05	REMAINDER OF UO BUDGET
PROPOSED PURCHASES								
	Date needed	Vendor (provide options)	Item Description / Purpose	Unit Price	Qty	Amount	Pickup or Delivery?	
		BRING?	Window hinges and flashing					
			2x4, 8' lumber	27.18	2	54.36		
			4x4, 10' Lumber					
		Amazon https://www.amazon.com/Plat	3/8" Threaded Inserts	7.99 (20 pcs)	160	63.92	Quantity: 8	
							1,223.23	UO Running Total
							776.77	Running Remainder
DONATIONS								
	Date Requested	Date Acquired	Vendor	Item Description / Purpose	Details			
	11/26/2024		TimberPro	5 gallons semi-transparent Blue Heron Paint-on WRB	In Portland, will need two days to be applied			
		11/22/2024	BRING	Reclaimed Door	At UO studio			
		11/22/2024	BRING	Door Hinges	At UO studio			
		11/25/2024	At OSU	Foundation cinder blocks	At OSU, 8 available with holder for foundation joists			
		12/1/2024	Bekah	Door Knob				

Project Cost

All Material Costs: \$ 1,667.78

Donations

Wood Products: \$ 1,079.30

Semi-Transparent paint-On WRB

Hardware: \$ 230.58

Reclaimed door and hardware

Modeling/ Prototyping: \$ 242.10

8 foundation cinder blocks

Other Studio Costs: \$ 331.30

Project Total: \$ 2,184.25

List of materials

56 4x8 plywood
 139 2x6 dimensional lumber
 6 4' x 8' x 1/2" Plywood Panels
 10 2 x 4 x 8'-dimensional lumber
 2 4"x4"x12' lumber
 8 cinder blocks
 (120) 2.5" x 3/8" Exterior Bolts
 (120) 3/8" Exterior Washers
 (120) 3/8" EZ-Lok Threaded Inserts
 1 gallon of Titebond Exterior Wood Glue
 4 rolls of waterproof UV tape
 1 timberpro coating
 Tarp
 Metal sheet flashing
 5.5" Hempitecture Hempwool

List of tools

Socket and Ratchet
 Drill
 Star "torx" drive
 Brad point Drill Bit
 Bandsaw
 Router
 Japanese hand saw
 Sandpaper
 Hammer
 Ladder



THANK YOU

FROM ALL OF US AT OREGON AND OREGON STATE!

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