

FALL 2025

TUALATIN

ARCH 484/584: TIMBER TECTONICS IN THE DIGITAL AGE

SCHOOL OF ARCHITECTURE AND ENVIRONMENT

OSU: WSE 425/525

COLLEGE OF FORESTRY

Timber Tectonics in the Digital Age: Temporary Structures for Tualatin's Future Riverfront Park

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Acknowledgments

The authors of this report would like to thank the City of Tualatin, Oregon State University (OSU), and the University of Oregon (UO) for making this project possible. OSU's Wood Science and Engineering Department and the UO's Department of Architecture supported this project. Specifically, we would also like to thank the following university and City personnel for their support during the course:

Kira Hein, Project Manager, Tualatin Parks Planning & Development

Dustin Schull, Director, Tualatin Parks & Recreation

Aquilla Hurd-Ravich, Community Development Director

Sidaro Sin, Tualatin Urban Renewal / Economic Development Manager

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Chris Brune, Downtown Revitalization Community Advisory Committee Member

Nastaran Hasani, Teaching Assistant, OSU

Tom Coates, Fabrication Lab Technician, UO College of Design

Phillip Mann, Tallwood Design Institute

BRING Recycling

Tallwood Design Institute (TDI), for providing space, expert personnel, and equipment

Arxada, for their donation of the LotusPro™ fluid-applied water-resistive barrier used to coat the project

And the following reviewers, who donated their time to help improve student work:

Namhyuck Ahn, Redbuilt

Modupe Akinnuoye, Andersen Construction

Esther Baas, Western Wood Structures

Andre Barbosa, OSU School of Civil and Construction Engineering

Dylan Chavez, CBTWO Architects

Nathan Corser, Burns McDonnell

Uli Dangel, UO School of Architecture & Environment

Kaley Fought, FORWARD Architecture

Jonathan Heppner, Lever Architects

Kevin Houser, OSU Architectural Engineering

Rebecca Littman-Smith, Scott Edwards Architects

Lech Muszynski, OSU Wood Science and Engineering Department

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Disha Sharman, ZGF Architects

Judith Sheine, Tallwood Design Institute, UO Architecture

Lori Stephens, Broadleaf Architecture

Quang Truong, Urbanform

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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 Tualatin. 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 Tualatin

The City of Tualatin is a thriving, welcoming community of nearly 28,000 residents known for its exceptional quality of life, strong community involvement, and attractive location. Tualatin offers a balance of small-town charm and big-city access. Its strategic location 12 miles south of Portland and 30 miles north of Salem, at the crossroads of Interstates 5 and 205, combined with commuter rail access via the Westside Express Service (WES), makes Tualatin a vital hub for both residents and businesses in the Portland metropolitan area.

The city's history dates back to the mid-1800s and is rooted in entrepreneurship and transportation. From its early days as a ferry crossing and rail depot, Tualatin has grown into a forward-thinking city with a strong economic base. Today, its economy is anchored by key industry clusters in advanced manufacturing, software and technology, health and wellness, transportation and logistics, and corporate services.

Tualatin's residents enjoy over 200 acres of public parks and riverfront spaces, top-rated schools through the Tigard-Tualatin School District, and one of

Oregon's premier shopping destinations—Bridgeport Village. The city is also rich in recreational and cultural offerings, including the famed Giant Pumpkin Regatta.

Downtown Tualatin, anchored by the Lake at the Commons, serves as a central gathering place for residents and visitors alike. With its blend of residential, retail, and office space surrounding a small manmade lake and public plaza, the Commons exemplifies the city's emphasis on livability and smart design.



Course Participants

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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 community needs. 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

Timber Tectonics in the Digital Age is an inter-disciplinary, inter-institutional course offered by Oregon State University's Wood Science and Engineering department and the University of Oregon Architecture department. The collaborative class brings together students enrolled in Wood Science, Civil and Construction Engineering, and Architecture to form integrated design teams.

The students designed, prototyped, and fabricated a kit-of-parts modular structure for the City of Tualatin's Riverfront Park. Students were tasked with reclaiming material from the previous year's project and using digital modeling and communication to maximize the efficiency of their creative efforts. A kit-of-parts building system is a set of standardized and repeated components which can be used to create a variety of structures from one set of building blocks, making them cost effective. Kit-of-parts systems can be designed for easy deconstruction, making these systems ideal for temporary structures such as park pavilions. By approaching architectural design through the concept of a kit-of-parts, students explore both the opportunities and constraints of prefabrication and modularization.

Students drew inspiration for their designs by studying a series of modular wood construction case studies. Students worked in small groups to model case study examples and then progressively developed their own kit-of-parts design proposals until the midterm review, which also included analyzing the Tualatin Community Park site conditions and creating proposals for the park's redesign. After the midterm review,

students converged to work on one collective design informed by feedback of earlier ideas, with students divided into specialized roles.

A constructability review informed final changes before the class design was pre-fabricated through Computer Numerical Controlled (CNC) routing and wood lamination at Oregon State University (OSU)'s Emerson Lab and the University of Oregon (UO)'s Millrace woodshop. Students successfully combined the components fabricated in Eugene and Corvallis to safely build a demonstration pavilion in OSU's Hatfield courtyard ahead of schedule.

The partnership between architectural designers, structural engineers, and wood specialists exposed students to the demands of collaborative design and construction. Students gained experience in digital workflows, designing with reclaimed timber materials, and construction project management. Lessons learned from the Timber Tectonics course point towards a promising future in reusable and recyclable wood architecture.

Introduction

Timber Tectonics in the Digital Age is a continuing collaboration between the UO's Architecture department and OSU's Wood Science and Engineering department. The studio specifically emphasizes the role of digital design and fabrication in timber innovation and seeks to provide a pre-professional opportunity for students to practice multidisciplinary collaboration. The studio focuses on exploring new opportunities in architecture that use parametric design tools, structural simulation, and engineered wood.

The City of Tualatin tasked students with a kit-of-parts building system design for a riverfront extension of Tualatin Community Park. Students focused on minimizing waste material and maximizing the flexible uses of the resulting kit-of-parts. Students were also

tasked with maximizing reuse of material reclaimed from the previous year's studio.

As part of the City of Tualatin's initiative to improve its downtown, students analyzed the Community Park area and designed a new preliminary master site plan. This included extending the Tualatin River Greenway Trail that passes through the park and examining the park's connection to the Lake at the Commons, a key area central to downtown Tualatin. Because of the studio's tie-in to site design and parks planning, the modular building system could be used to create a series of structures that would help make downtown Tualatin more pedestrian friendly. The City identified that wood architecture was a core part of Tualatin's heritage, and that efforts in the studio were part of Tualatin's effort to celebrate its history of place.

Design Constraints

Prior to starting the project, students were provided with design constraints as guardrails to ensure the final product is practical and compliant with real-world requirements.

The modular building system must be used to create:

- A canopy or gathering space for 50+ people
- Boat and equipment rentals
- Restrooms (1-3 gender neutral and ADA accessible spaces)

The design's kit-of-parts must:

- Use only ½ inch plywood sheets and 2x6 dimensional lumber
- Reuse wood from 2024's Timber Tectonics modular cabin project
- Minimize component variety
- Account for the limitations of Computer Numerical Controlled (CNC) machining
- Use wood to wood joints (no screws, nails, or glue) for the primary structure
- Prioritize easy assembly and disassembly
- Meet structural requirements and comply with design guidelines for weather protection as required by climate zone

Site Planning and Site Analysis

A major component of the studio was the emphasis on site planning as a key final deliverable. The City of Tualatin asked students to share their thoughts on the revitalization and restoration of the future Riverfront Park. An initial site visit introduced students to the complex ecology of the park renovation and the relationship of the park to the Lake at the Commons. Structures created for the park site were intended to be attractive to nearby pedestrians as welcoming beacons.

The City provided an initial site survey, Environmental Site Assessments, and the current Parks and Recreation Master Plan. Most useful were diagrams and ideas from a Tualatin Riverkeepers design charrette that helped inform students of preexisting conditions and potential opportunities.

The City asked students to prioritize the following in planning:

- Two separate vehicle access routes into the park in addition to the preexisting road
- Primary entry-exit from the concrete bridge
- Wider sidewalks between Boone's Ferry Road and the nearby Juanita Pohl Senior Center
- Exploration of extending the Greenway trail under the highway
- A new accessible boat launch
- River and creek restoration
- Primary parking out of major FEMA flood zones

Flood and restoration zones onsite informed students' initial park designs.

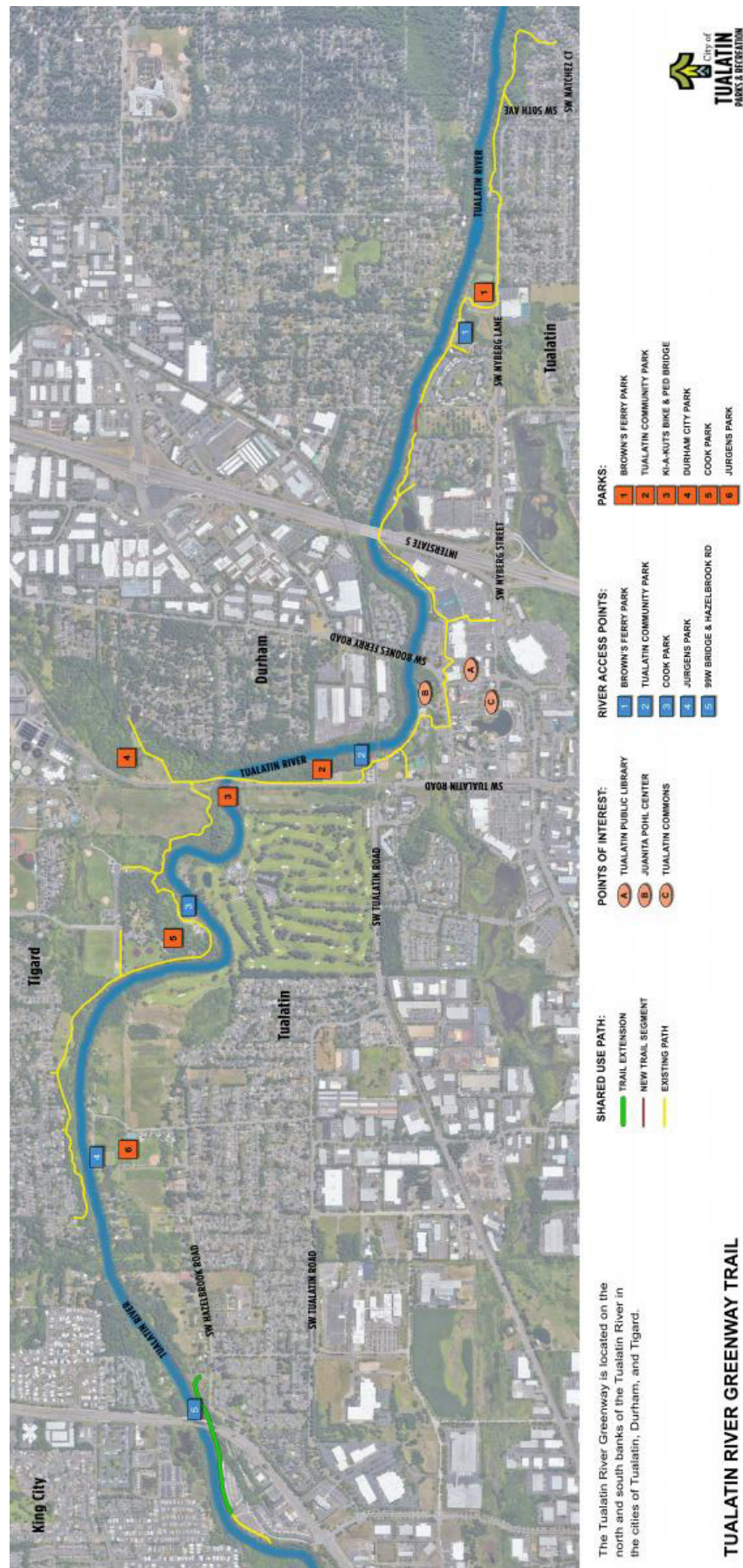


FIG. 1

Map of Tualatin River Greenway Trail.

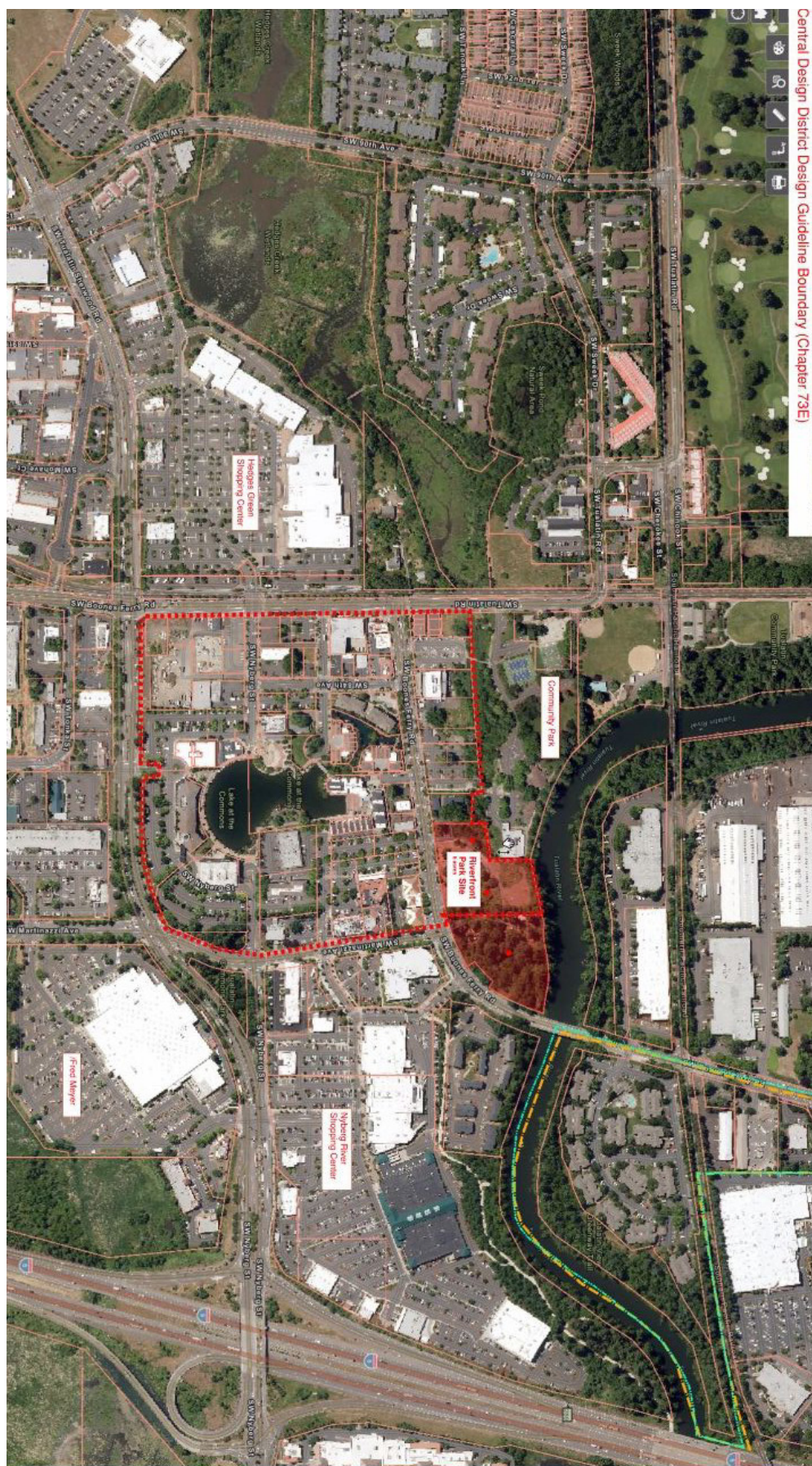


FIG. 2
Aerial view of the
Tualatin Riverfront Park
site.

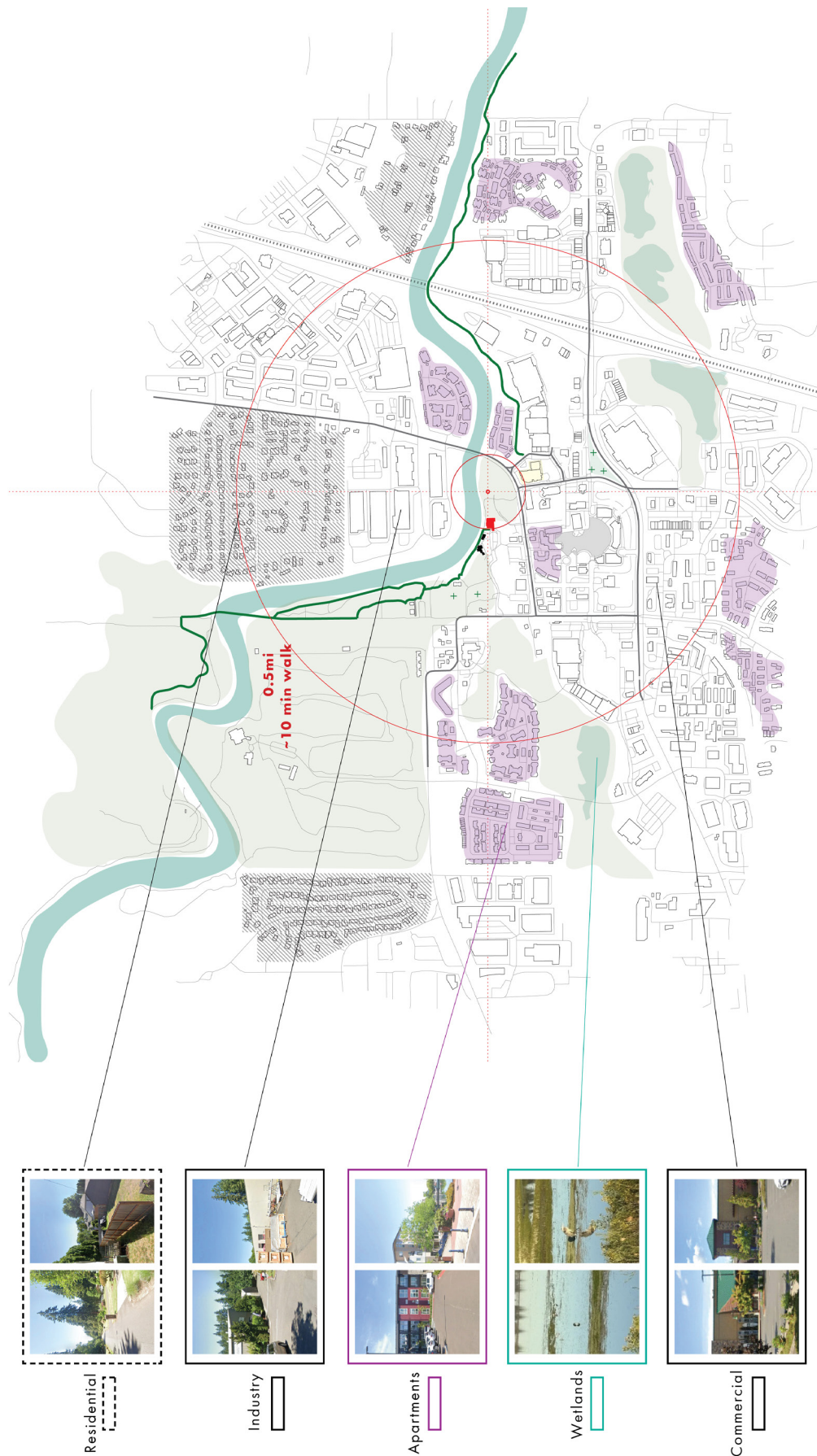


FIG. 3

Student site analysis of surrounding area.

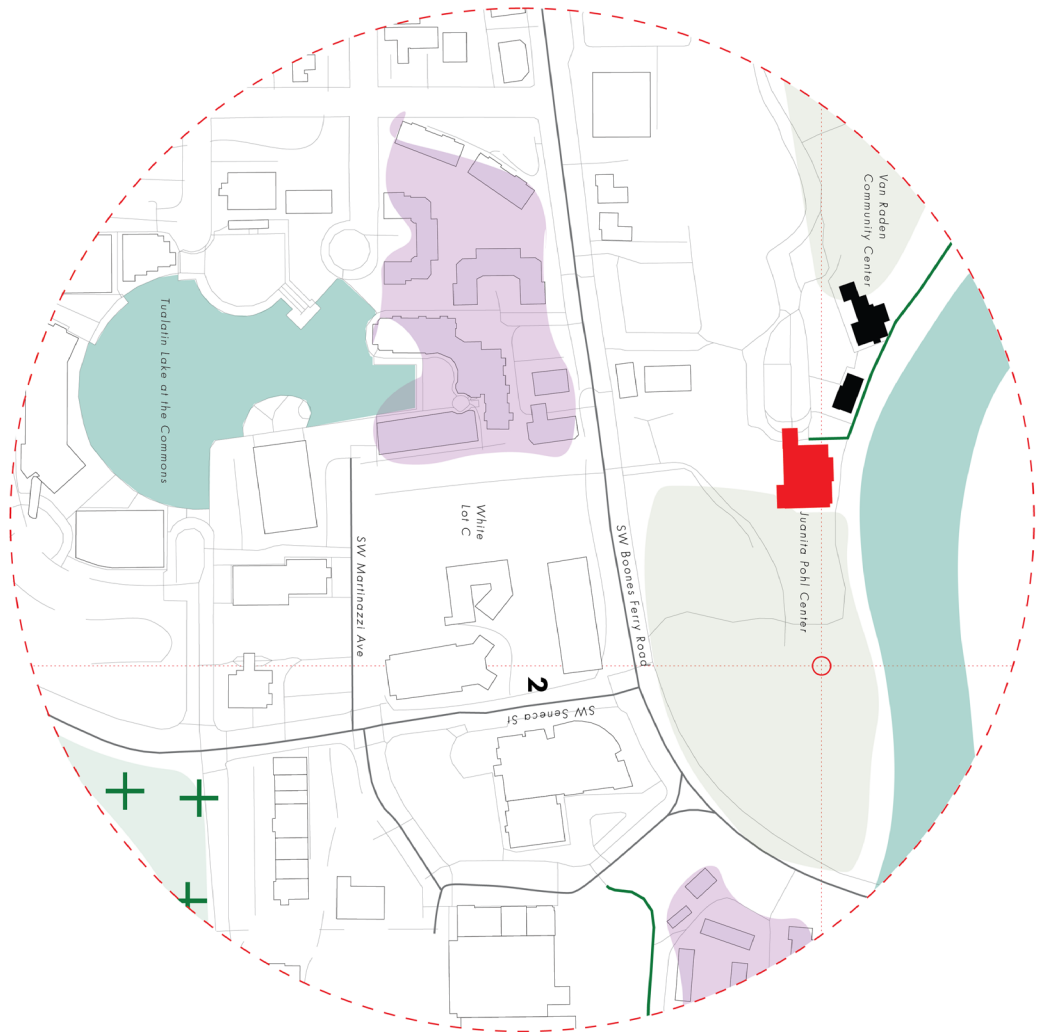
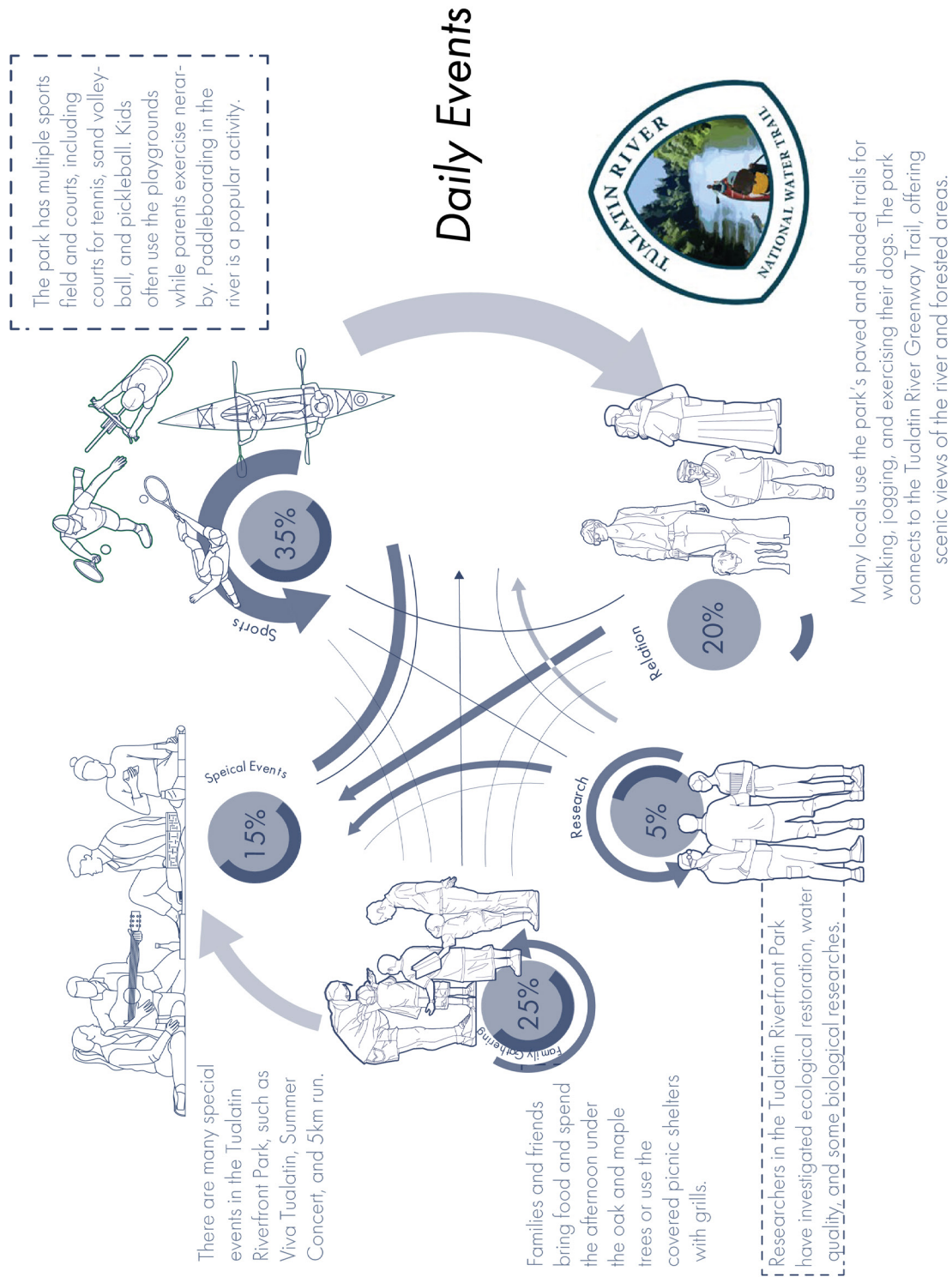


FIG. 4
Student site analysis of
existing conditions.

**FIG. 5**

Student site analysis of activities onsite.

Activity Map

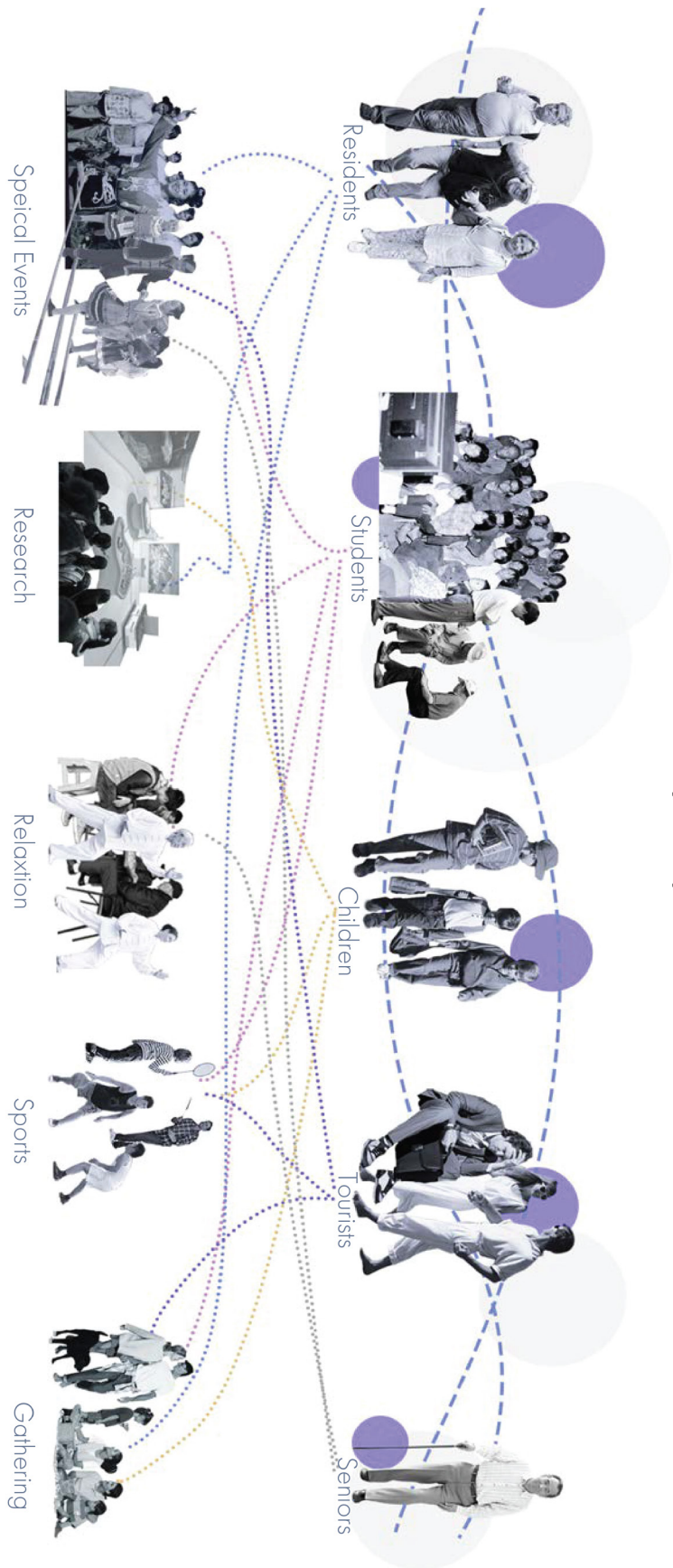


FIG. 6
Activity map.

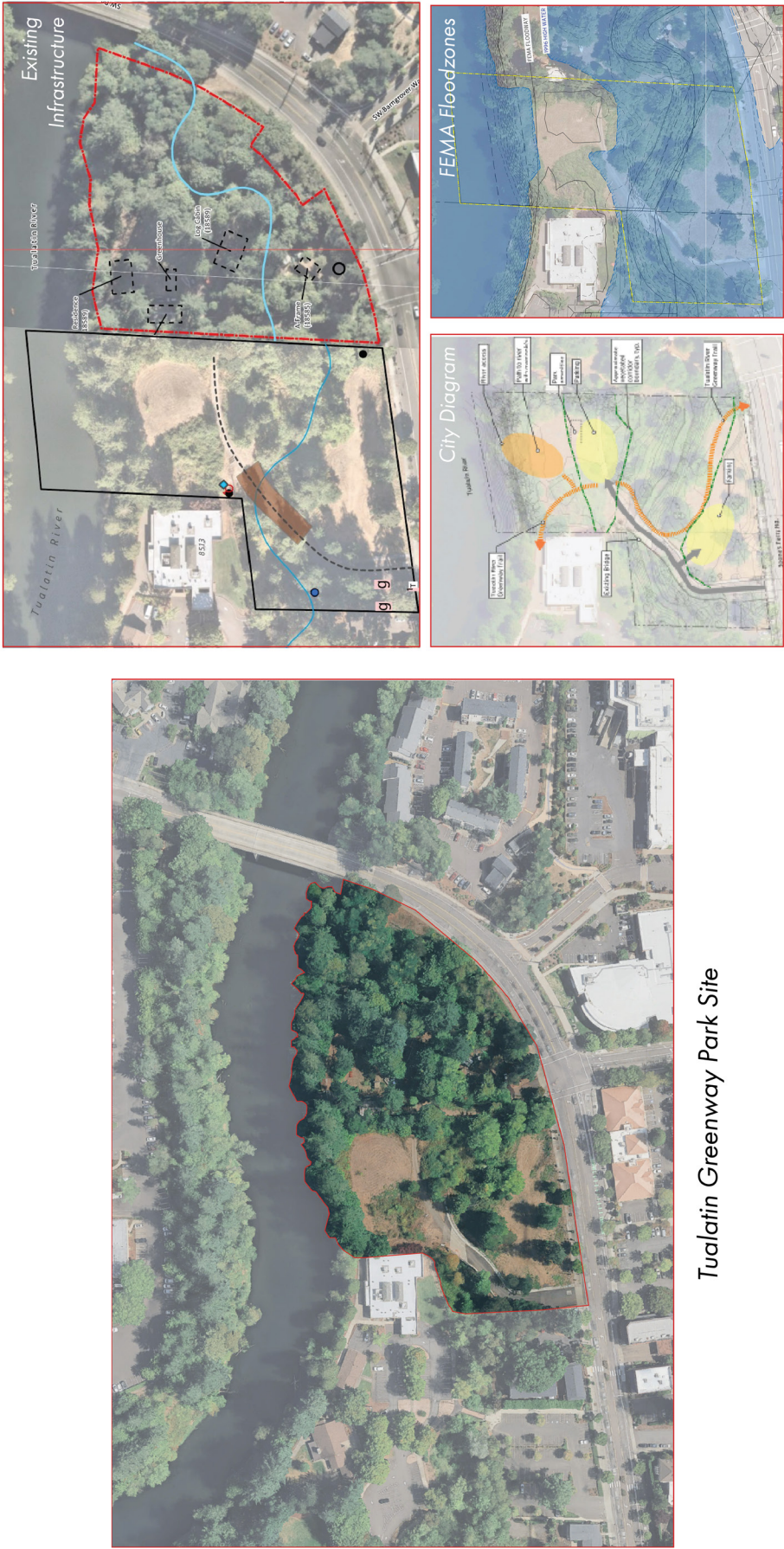


FIG. 7
Floodzones and boundaries at the site.

Modular Wood Case Studies

Before beginning any independent design work, students split into groups to study eight precedents of modular wood designs. Each group recreated the kit-of-parts used in each precedent to create a physical model and construction manual. Students also analyzed the rationale behind each project's strategy for enclosure, connections, constructability, and material choice. The deliverables for each case study mirrored the final product students were tasked with creating for the duration of the ten-week studio. The case studies also informed major decisions for the studio regarding chosen structural system and form.

MASS PLY PAVILION/LEVER ARCHITECTS - PARKER LEMME, MATTHEW SPARR, AKIRA TAMAOKI

FIG. 8

The Mass Ply Pavilion at the Portland Museum of Art.

Courtesy of LEVER Architecture.



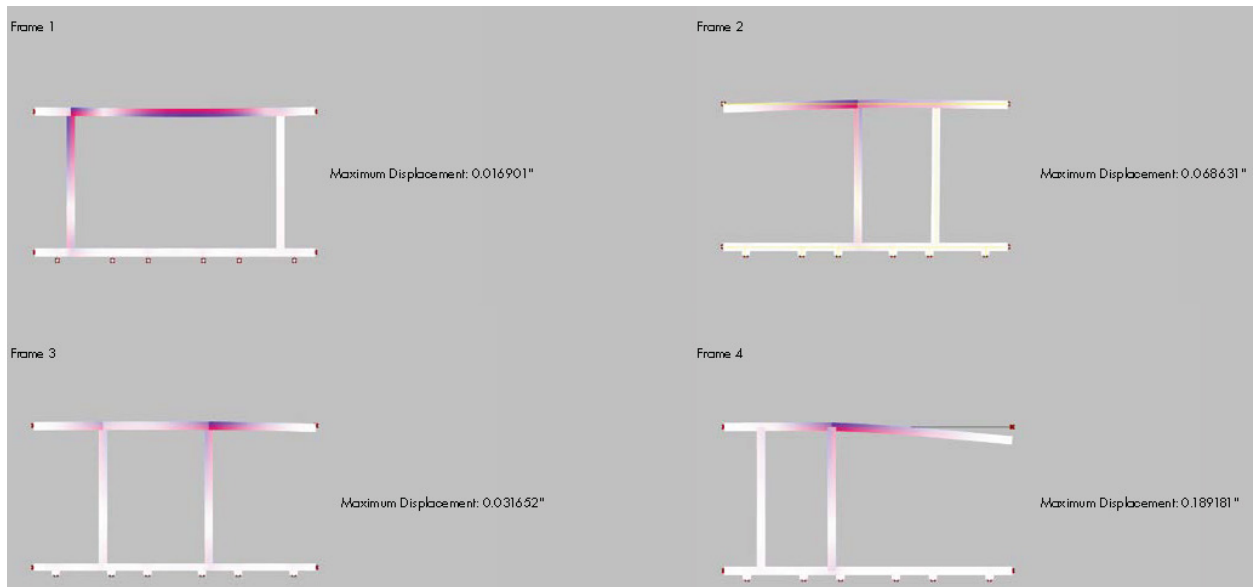
The Mass Ply Pavilion (MPP) was a 2017 installation at the Portland Art Museum, characterized by its use of giant planes of engineered plywood. The pavilion is constructed of fifteen 4'x17'x6' panels, with wall spacing between planes of plywood designed to test cantilevering capability of the wood product. All panels were designed to fit within a single truck and are exclusively fastened together using 10 1/4" and 11 7/8" screws.

The pavilion was designed to show off the functionality of Freres Lumber's Mass Ply Panel product, patented in 2018.

The engineered wood panels all begin as 4'x8' plywood before pressing and are currently manufactured locally in Lyons, Oregon. The final portal that the studio ultimately built also used MPP previously used for the Tallwood Design Institute research, as a temporary foundation for the structure. Students studied the pavilion by modeling it digitally and physically.

**FIG. 9**

Student model of the MPP Pavilion.

**FIG. 10**

Karamba analysis of the MPP pavilion.

**BUBBLE PAVILION/UNIVERSITY OF SEVILLE - EDWARD BOYKO, LUCA MITCHELL,
LIAM OGZEWALLA**

FIG. 11

Interior of the Bubble Pavilion.

Courtesy of the Higher Technical School of Construction Engineering at the University of Seville.

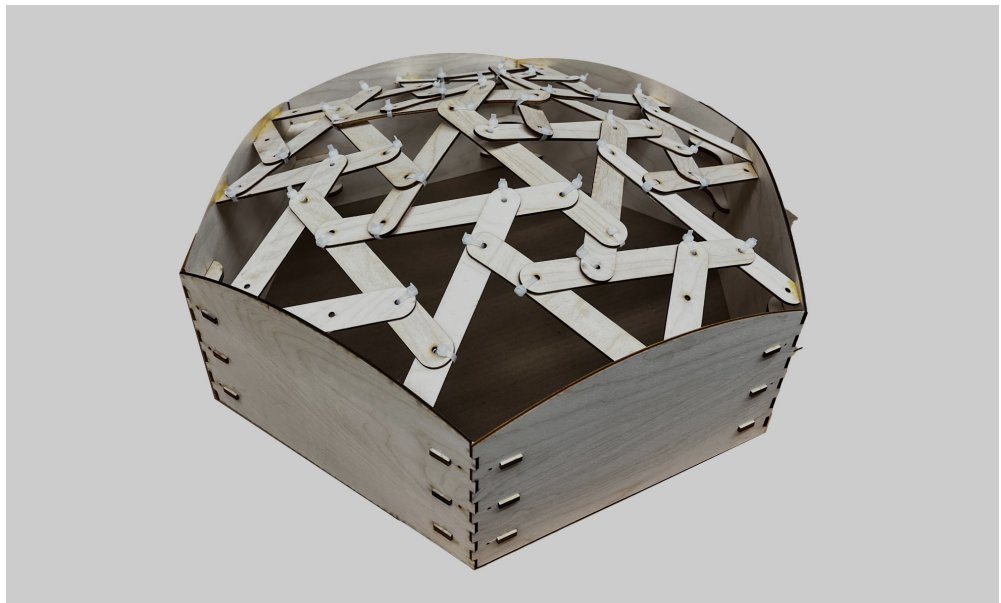


The Bubble Pavilion was an effort by the Higher Technical School of Construction Engineering at the University of Seville. The project aimed to construct an experimental parametric pavilion made solely out of wood “bubbles.” Thin eucalyptus plywood panels were cut via CNC router and carefully assembled into

the individual modules. Every cell-like module in the pavilion used an interior reciprocal frame to brace its outer hexagonal shell. This precedent was ultimately not used in the studio’s design, as the fabrication involved too many small pieces and was dependent on screws and bolts for module-to-module connections.

FIG. 12

Student model of a Bubble Pavilion module.



**BUGA PAVILION/ICD AND ITKE UNIVERSITY OF STUTTGART- PHILIP BASSETT,
DYUOGO DELFINO, TREVOR TORRES**



FIG. 14

Rendering of the completed Buga Pavilion..

Courtesy of Midjourney AI / Fabian Dejtiar.

The Buga Pavilion sought to recreate the plate skeleton structure of sea urchins using 376 shell cassettes made of Laminated Veneer Lumber (LVL). Finger joints cut into the sides of the hexagonal cassettes allowed each bespoke piece to slot into its neighbor, like the teeth on a gear. An LVL substructure of three arched

beams created the frame for the pieces to be craned into place. Each cassette acts as a stressed-skin panel, which allows the small pieces to span a large arch. The bespoke nature and complex curves of the Buga's final construction meant that it was ultimately not an inspiration for the studio's design.



FIG. 13

Student model of a Buga Pavilion cassette.

**KYUSHU GEIBUNKAN/ KENGO KUMA AND ASSOCIATES – ELIZABETH FOLPE,
JORDAN HULETT-QUINONES, DIEGO RAMIREZ**



FIG. 15

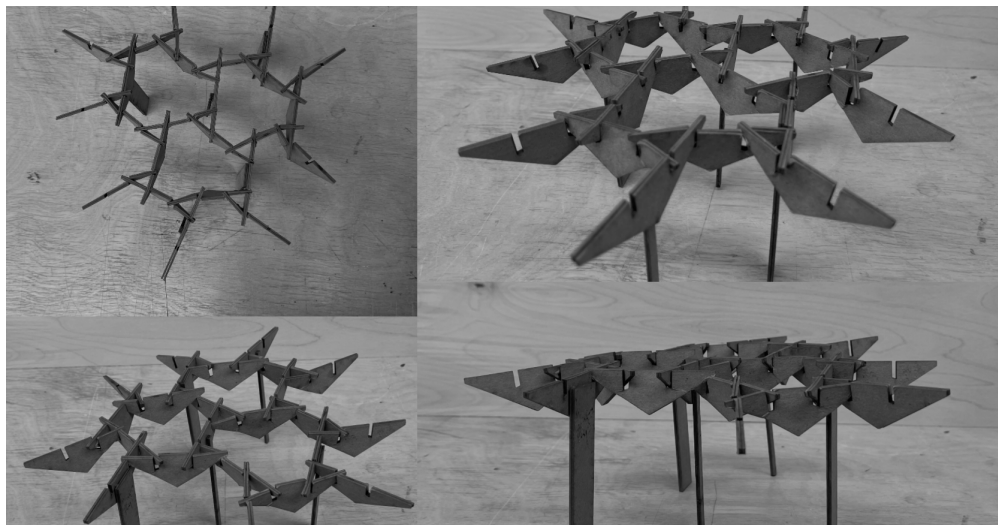
The plywood reciprocal frame of the exterior pavilion Kengo Kuma and Associates.

Kyushu Geibunkan is a park structure designed to create space for ceramics and artwork. Located in Fukuoka, Japan, the pergola is part of a larger museum complex on the same site. The structure uses a reciprocal frame made from cedar boards on a hexagonal grid to create a massive roof. Coverings over sections of the roof are made from exposed plywood panels. Planar pieces of Cross-Laminated

Timber (CLT) branch down from the roof to act as columns and serve as shear walls. The isosceles triangles that make up the reciprocal frame lent themselves as major inspiration to the Timber Tectonics class that occurred in 2023. Students still had access to the physical models from 2023's barrel vault portal, which inspired many of the chosen forms at the midterm.

FIG. 16

Student model of Kyushu Geibunkan Pavilion.



WIKIHOUSE/WHOME - ELI ELLISON, CALEB GALAS, CAITLYN RENK**FIG. 17**

Wikihouse on display at a United Kingdom building exposition.

Courtesy of Andy Roberts

Wikihouse is a modular building system that uses plywood panels, dovetail connections, and slots to create a variety of low-cost housing solutions. Anyone can download and create their own plywood home with minimal expertise. The system can create a variety of rectangular floor plans and sloped roofs. Homes are

composed of hollow box elements, filled with cellulose insulation, and constructed using rubber mallets. Each home is flat-packed and shipped to the owner by truck. Students used dovetail connections and box forms. An adaptation of the system's slot connections was a takeaway from the study of the Wikihouse approach.

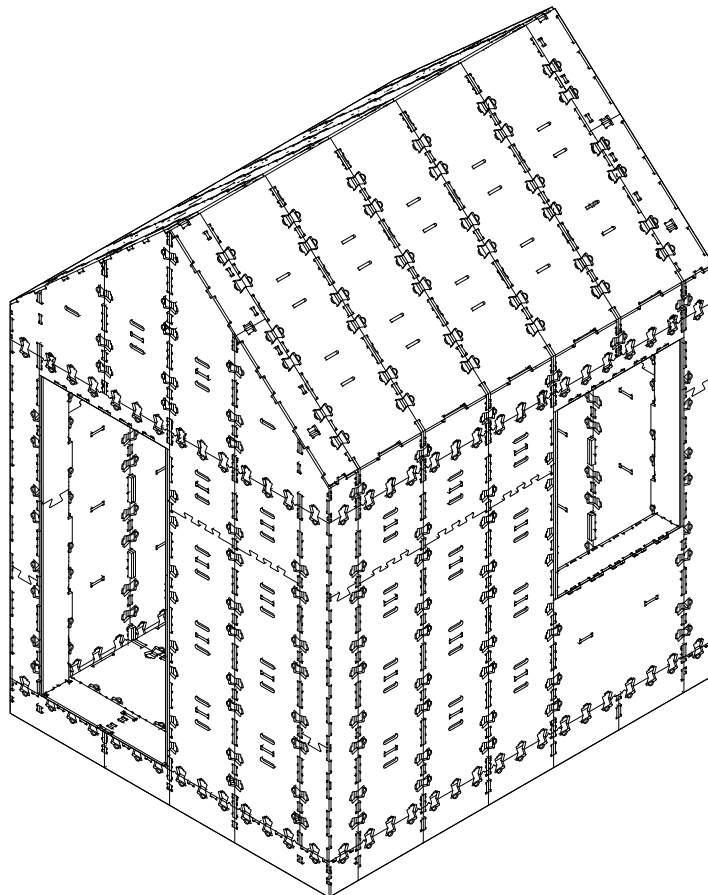
FIG. 18

Student model of
Wikihouse building
system.



FIG. 19

Students' cabin design
using Wikihouse
components.



LIINA TRANSITIONAL SHELTER/AALTO UNIVERSITY WOOD PROGRAM – SAMUEL DONKOR, OLIVIA NORD, YUHE HUANG



FIG. 21

Liina shelter fully constructed.

Courtesy of aalto university wood program.

The Liina transitional shelter was a prototype temporary building designed for use in response to a predicted growth in the number of worldwide refugees by 2050. The wooden shelters can be assembled by two adults in six hours, using prefabricated wood panels tightened into frames using nylon straps (called “liina” in Finnish). The panels are made from Finnish laminated-veneer

lumber (LVL), plywood, and wood fiber insulation, making the resulting structures fully recyclable. Liina was originally designed for refugees from earthquake-prone Ararat, Turkey, and is seismically resilient. Liina’s panelized construction and portal frame inspired students to experiment with creating plywood box members.



FIG. 20

Student model of Liina shelter.

**KUMAMOTO VENEER HOUSE/KEIO UNIVERSITY SFC HIROTO KOBAYASHI
LABORATORY (DESIGN, ASSEMBLY), AKIRA SUZUKI (STRUCTURAL ENGINEERING)-
LEXI MCNUTT, NATHAN SCHUTT**



FIG. 23

Students using the Veneer House as a market stall.

Courtesy of Veneer House Inc.

Veneer House Kumamoto (VHK) is part of a larger series of Veneer Houses, plywood homes which use temporary wood-to-wood connections. Veneer homes are named for their use of plywood in their primary construction; a plywood panel is composed of many thin layers of wood “veneers,” or wood shavings. Many Veneer Homes are meant to be rapidly constructable for use in disaster relief

after an earthquake or tsunami. VHK was the smallest of the Veneer Homes and was a multipurpose design that could be used as an emergency housing unit, a vendor stall, and an office meeting booth. The home uses a flat pack system that assembles using cut-outs and a standardized set of I, T, and L shaped connectors.

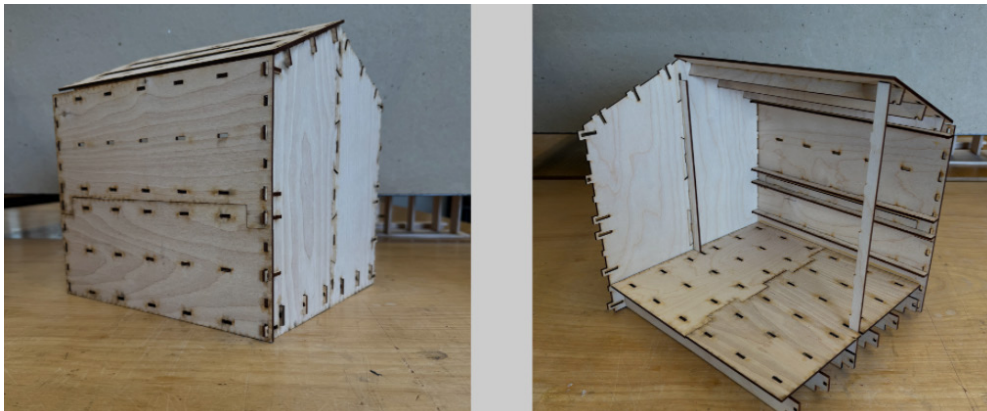


FIG. 22

Student model of the Kumamoto Veneer House.

**PALU COMMUNITY CENTER/ KEIO UNIVERSITY SFC HIROTO KOBAYASHI
LABORATORY (DESIGN, CONSTRUCTION), IAI PALU, AKIRA SUZUKI (STRUCTURAL
ENGINEERING), BANDUNG INSTITUTE OF TECHNOLOGY (CONSTRUCTION),
TADULAKO UNIVERSITY (CONSTRUCTION) -
TORAJA AMES, GEORGIA MANNING, MARYCLAIRE LANE**



FIG. 24

Palu Community Center on site in Palu, Indonesia.

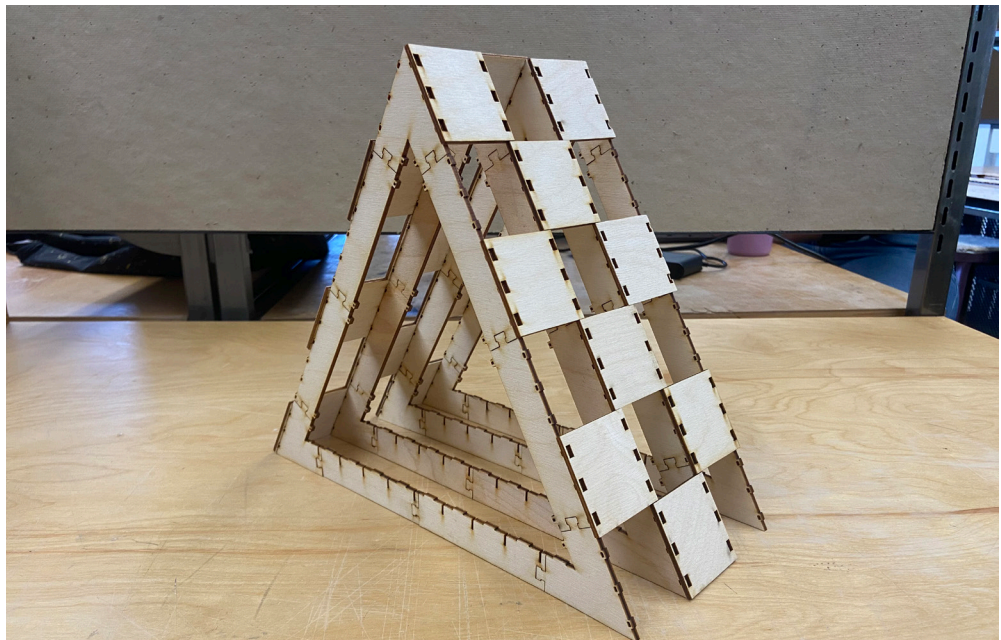
Courtesy of Veneer House Inc.

Another Veneer House project, the Palu Community Center was a project for the City of Palu, located in central Sulawesi, Indonesia. The people of Palu had been devastated by a 7.5 magnitude earthquake and subsequent tsunami. This event destroyed all structures along the Palu coast, with landslides following the earthquake affecting an additional 68,000 homes. The community center was built near a refugee camp for use as a gathering space. The triangle portal shape was inspired by local traditional homes. The community center used a

Veneer House pin connection to secure a checkerboard of bracing plywood boards over a triangular portal frame. The frame itself was constructed out of dovetailed plywood members and held in place by hand until braced. Students found the Palu Community Center to be the most influential and useful case study, recreating its pin connections with a series of study models. Midterm proposals heavily reused its alternating “checkerboard” bracing and portal frame approach.

FIG. 25

Student model of
the Palu Community
Center.



MODULAR WOOD CASE STUDIES SUMMARY

The most influential designs for initial midterm proposals were Kyushu Geibunkan and the Palu Community Center. After midterm review, renewed focus on the Wikihouse and Kumamoto Veneer House, as well as revisiting the larger Veneer House movement, steered design forward. Students continued to return to the Palu Community Center's connection type throughout the studio.

Midterm Proposals

After completing the case studies in week three of the course, students began work on midterm designs. In week five, teams consolidated into four distinct groups. Midterm proposals centered around possible uses of re-laminated 1.5" plywood, as students began preliminary structural analysis and determined that ½" plywood would not be sufficient to create planar portals of adequate span.

TEAM 1

Samuel Donkor, Yuhe Huang, Parker Lemme, Olivia Nord, Nate Schutt, Matt Sparr, Akira Tamaoki



FIG. 26

Rendering of Team 1's Proposal

Team 1 proposed a repeating portal frame created from planar elements united with a dovetail connection. The design drew inspiration from Tualatin's trestle bridge and the Maggie's Manchester Cancer Centre truss. Plywood elements were layered three times within each piece from the proposed kit-of-parts to form a truss. Strengths of this design included the kit's modularity, as the module could infinitely repeat in two dimensions,

and its flexible application to many forms. Reviewers also liked the gable form and truss idea. Weaknesses of the design included the cut-edge moisture vulnerability of the truss cutouts and the material and time wastage associated with cutting out the truss shapes. Cutting truss members from plywood means that the wood fiber is not aligned to the members for strength.

FIG. 27

Axon of Team 1's
Proposal

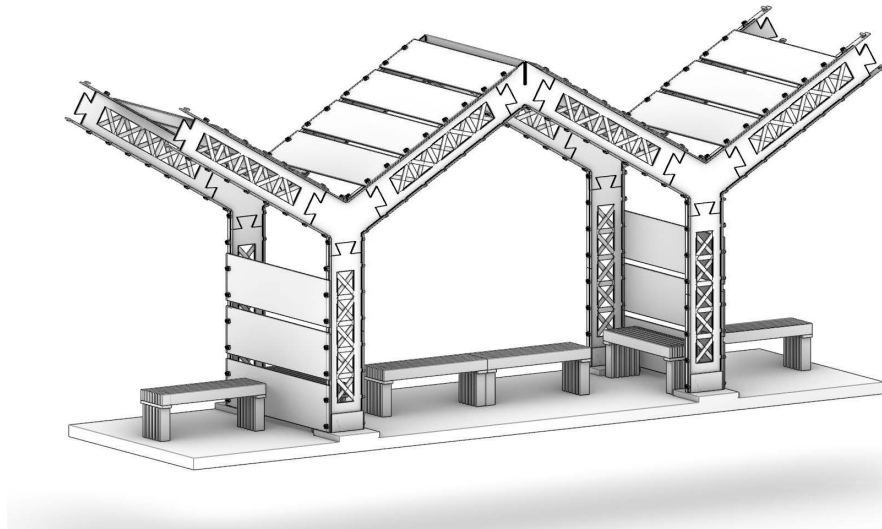


FIG. 28

Model of Team 1's
Proposal



TEAM 2

Philipp Bassett, Edward Boyko, Dhyogo Delfino, Luca Mitchell, Liam Ogzewalla, Trevor Torres

**FIG. 29**

Rendering of Team 2's Proposal

Teams 2 and 3 proposed a barrel-vaulted portal frame braced by interlocking plywood sheets. Kit-of-parts pieces proposed used dovetail joints to create larger structural members, similar to Team 1. Decorative patterns from traditional Kalapuyan weavings were cut into each bracing sheet. In this system, many keyholes were cut into the site of each piece of the kit-of-parts to allow use of

temporary T-shaped connectors for easy deconstruction. Strengths of the design included the use of Indigenous patterns as well as the strength of the pinned panels. Weaknesses of the design included the potential for the structure to be climbed, possible wind uplift, and concern over dovetail connections buckling to lateral force.

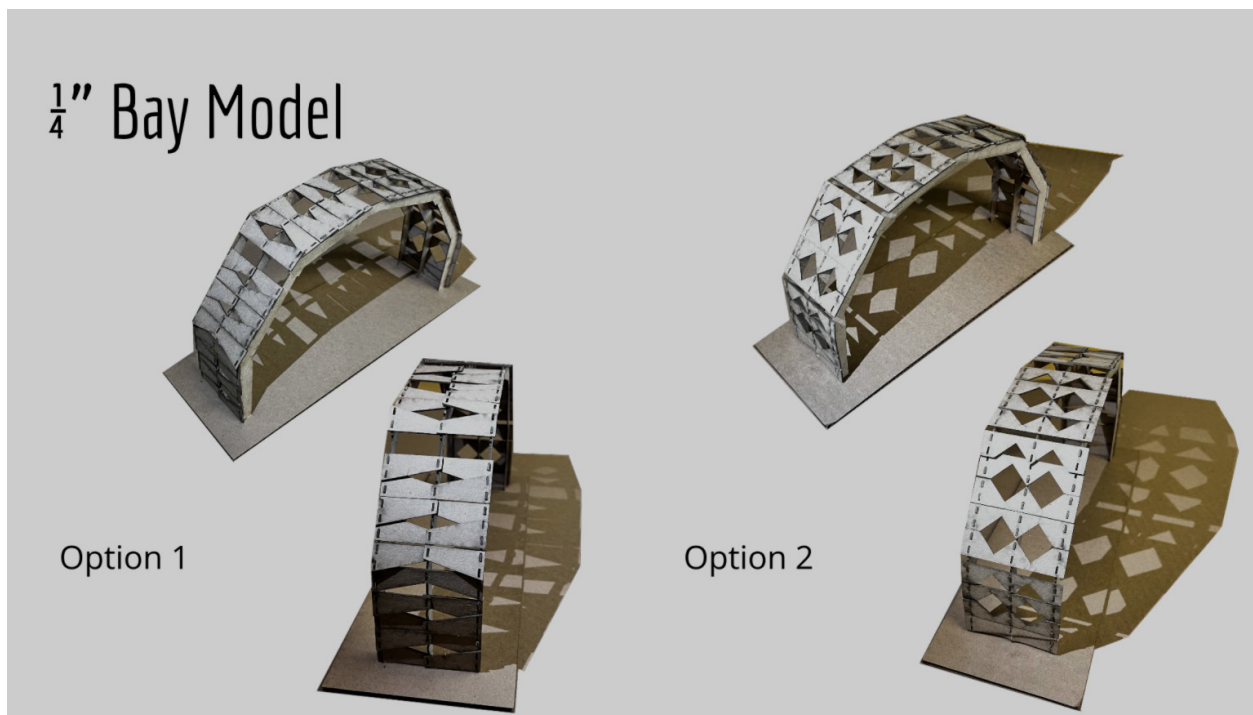


FIG. 30
Model of Team 2's Proposal



FIG. 31
The team's Kalapuya inspired bracing patterns.

TEAM 3**Elizabeth Folpe, Jordan Hulett Quinones, Diego Ramirez****FIG. 32**

Rendering of Team 3's Proposal

Team 3 proposed creating box beams out of a number of small plywood pieces. Box beams and columns made from the $\frac{1}{2}$ " plywood would be combined with 2"x6" rafters to create a traditional gable roof form. Students in this group cited the Minamisanriku Veneer House and Tualatin's existing "Rustic Shelter" as design influences. This kit of parts used only friction-fit slots, relying on vertical loading and two-way corner pieces to resist disconnection. Outer panels were proposed as nailed or key

fitted to interior columns. Strengths of this design included the bold contrast between the heavy frames and the filigree rafters. It featured easily fabricated and disassembled slot connections. Weaknesses of this design included the similarity of the many small pieces of the kit of parts and possible material waste from a smaller and more repetitive kit.

FIG. 33

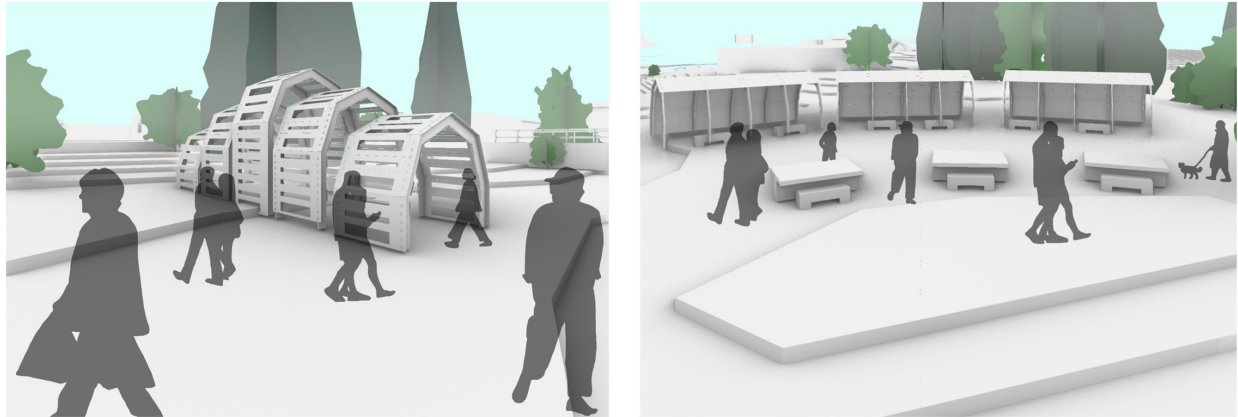
Model of Team 3's Proposal, scaled model of a boxed beam approach, and zoomed in view of boxed beam construction model.



TEAM 4

Toraja Ames, Eli Ellison, Caleb Galas, Alexander Garcia, MaryClaire Lane, Georgia Manning, Lexi McNutt, Caitlyn Renk

Site Renders

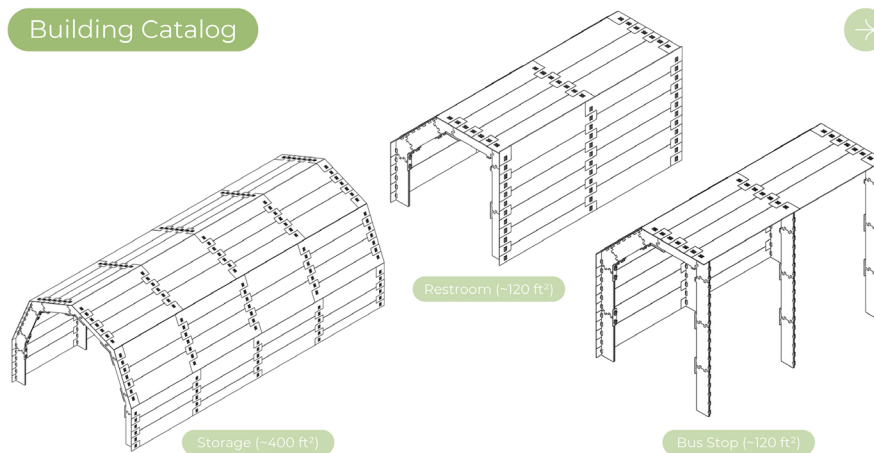
**FIG. 34**

Model of Team 4's Proposal

Team 4 proposed a barrel vault design with a series of small parts creating a portal via cut connections. Strap and flush joints joined slim plywood bracing elements tiled over the vault to the frame via T-pin connectors. The team proposed a series of rectangular cutouts in bracing for daylighting purposes. A “puzzle piece” dovetail connection was used between planar elements to create the connected

frames. Strengths of the design included the adaptability of the proposed structure for use as a storage shed, a restroom, and a bus stop, as well as the strength of the T-pin connections. Weaknesses of the design included the cutting time necessary for the connection and its potential out-of-plane instability.

Building Catalog

**FIG. 35**

Line drawing of
Team 4's Proposal

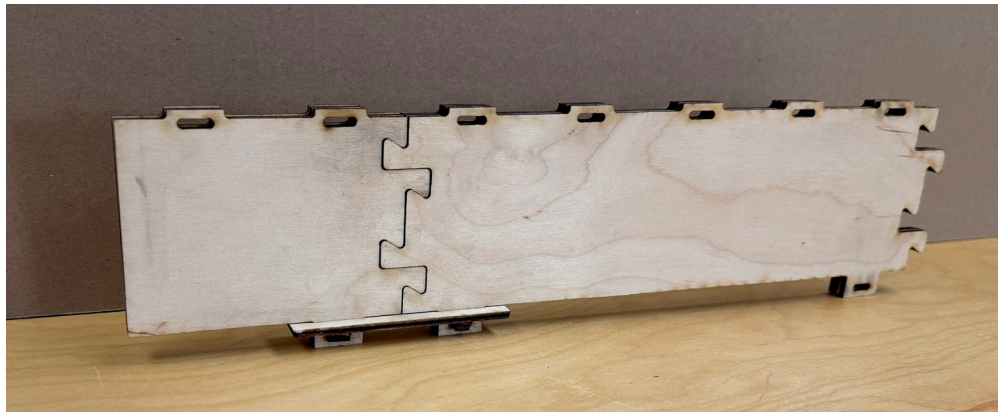
FIG. 36

Model of Team 4's
Proposal



FIG. 37

Model of Team 4's
Proposal



Initial Whole Class Design



FIG. 38

Rendered visual of proposed kit of parts.

After the midterm review, the class discussed how strengths of each proposal could be combined. Students continued towards their final design as one group split into the following subgroups: Architectural Design, Structural Analysis, Module Development, Connections, Moisture Protection, and Construction Planning. Subdivided into these groups, the class progressed towards a marriage of the differing midterm proposals. A gable-roof form was chosen due to concerns about water protection in Tualatin's climate. City of Tualatin reviewers had also responded positively to the gable form's similarity to classic wooden structures already existing in the Community Park.

Continued iteration on the Veneer House slot connections along with a spin-off of the checkerboard bracing of the Palu Community Center led to the use of a bracing wall panel that resembled a large "shingle." Students proposed the resulting structure in a constructability review during Week seven. Feedback during the review informed students to revise the slope of the gable roof, increase the overhang of the portal frame, and choose L-brackets for the ground connection. To give a more human scale and improve constructability, the structure's total height was reduced from 17 feet to 12 feet.

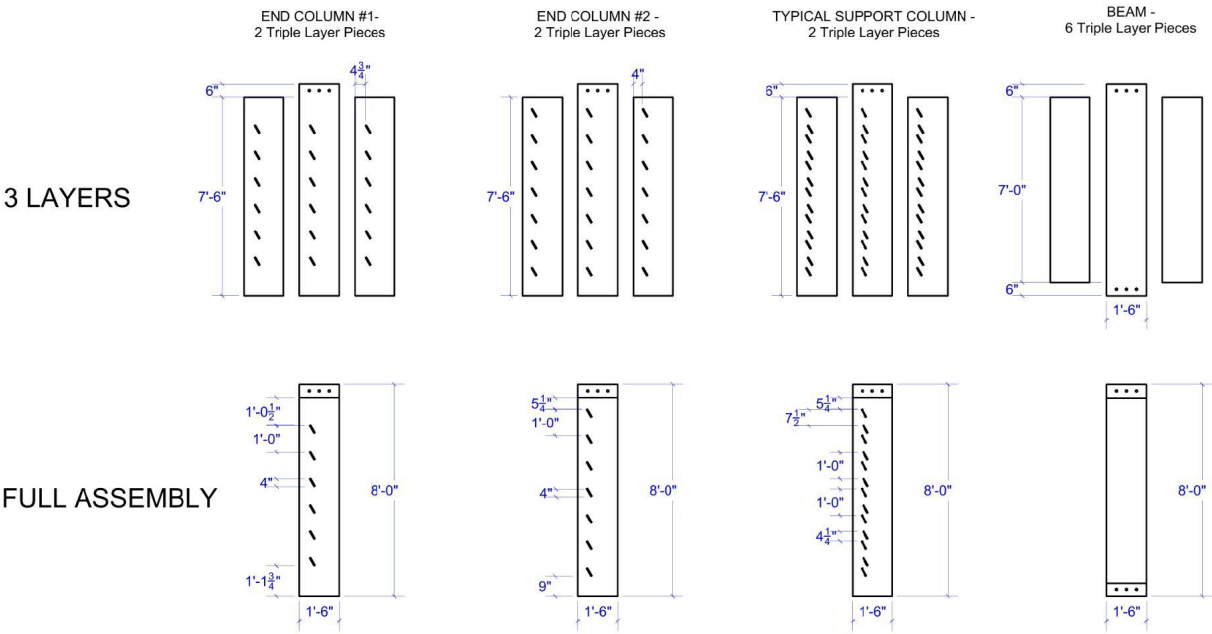


FIG. 40
Initial kit of parts proposed as a combined class.

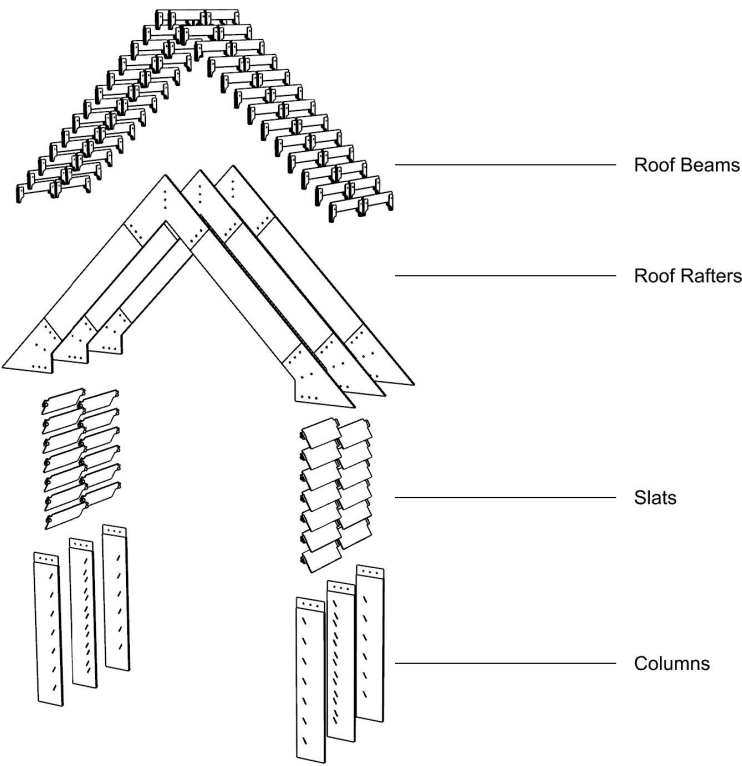


FIG. 39
Axon of the initial class design.

**FIG. 41**

Students pressing wood sheets on OSU's Minda Press.

The construction of the primary structural frame was revised several times. Students explored the dovetail connection at midterm and determined that a dovetail connection of $\frac{1}{2}$ " plywood was unreliable and difficult to manufacture to an acceptable tolerance using the available equipment. OSU students' structural estimates also determined that a $\frac{1}{2}$ " plywood section would not be thick enough to create a stable frame at the span specified in the class outline. To account for this weakness, the plywood

frame section changed twice. Originally, a Veneer House box beam frame was considered to create a stable portal shape out of the original plywood. Instead, the $\frac{1}{2}$ " plywood was ultimately glued together three layers thick to create 1.5" ply. This new section remedied the structural instability while creating the least number of individual kit pieces. The OSU team laminated the plywood using the Minda TimberPress at the TallWood Design Institute's Emmerson Lab.

FIG. 42

Student drilling dowel holes.



The layering of multiple sheets of plywood allowed students to design doweled tongue-and-groove joints to connect the major frame elements. These joints

created a sturdy planar frame with minimal CNC cutting time. The final approach saw more efficient use of reclaimed material than a box frame.

Final Design

The final design uses modular gable portal frames, created with three layers of plywood and braced with slanted plywood wall panels. The wall panels are connected to the thicker portal frames with pegged mortise and tenon joints. These joints used removable T-pins inserted into slots.

Each piece of the frame adheres to strict material restrictions. The available plywood sheets were 4'x8' or less, which steered students to size and space the structural frames to maximize the number of pieces that could be cut from one sheet. Frame pieces were sized to be 18" to allow for maximum depth of the portal frames while allowing tolerance for machining and space to fit other kit pieces. To conserve plywood for the columns and walls of the structure, reclaimed 2"x6" dimensional lumber pieces were used for the purlins of the final design. The purlins were connected to the plywood frames with half-laps.

Non-wood materials were minimized. Corrugated fiberglass roofing was chosen for its stiffness and transparency and was secured to the roof purlins with screws. Angle brackets were used to screw the flat sides of the columns into a mass plywood panel (MPP) base.

The pavilion's design approach and forms set the stage for the final adaptation of the class design as theoretical full-size buildings on the Tualatin site. The building system was adapted to create two possible 25' wide pavilions, that would use heavier MPP in the place of plywood and LVL for the roof purlins.



FIG. 43

T-Pin connection mockup.

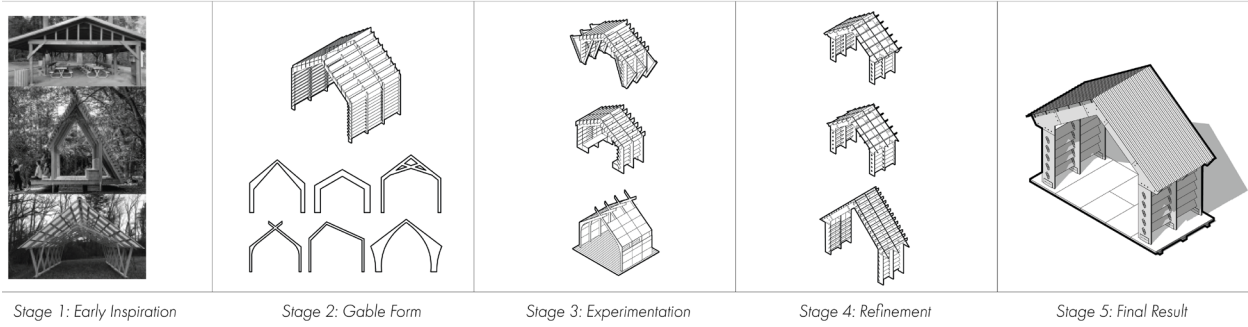


FIG. 45

Student diagram of the class's design process.



FIG. 44

Final render of the class design.



FIG. 46
Site render.

Construction

Most of the final design was prefabricated several days before the on-site building activity. Pre-fabrication (CNC cutting, piece refinement and finishing) took place in equal parts at UO and OSU with final assembly taking place in the OSU Richardson Hall's Hatfield Courtyard.



FIG. 47

Students carrying a frame to Hatfield Courtyard.

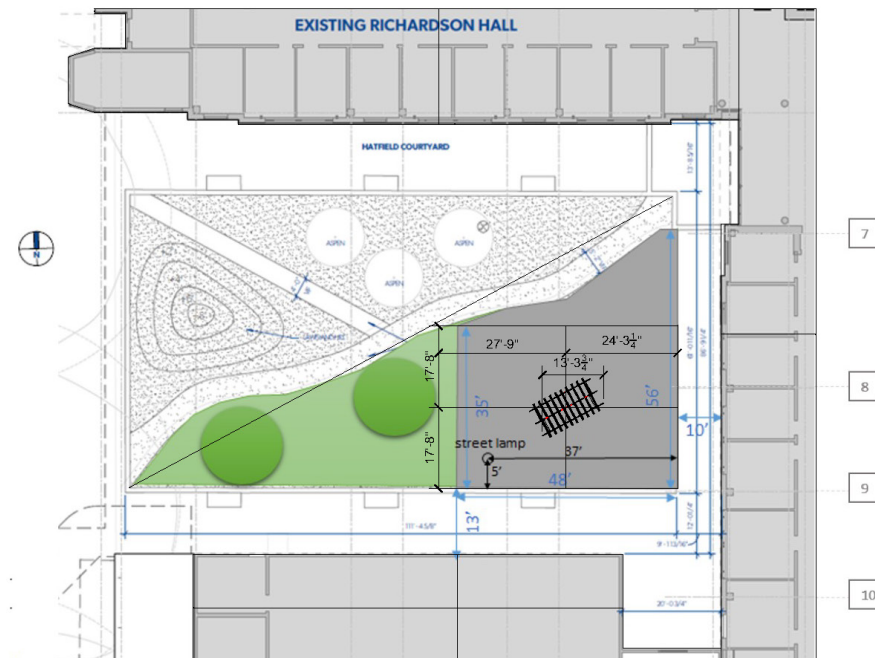
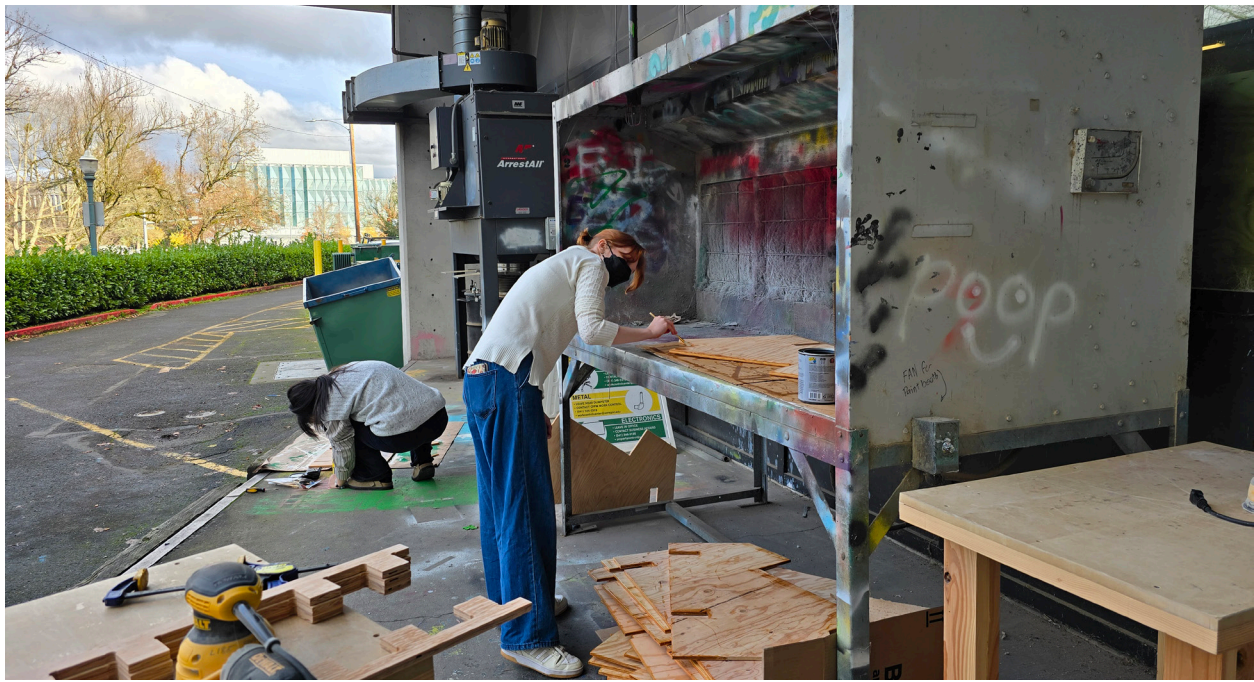


FIG. 48

The model pavilion's proposed location at OSU's Hatfield Courtyard.

**FIG. 49**

Students prepare and finish kit pieces at the University of Oregon woodshop.

**FIG. 50**

Student cutting connection dowels.

Students first began by disassembling the previous year's project and recycling available plywood. Reclaimed pieces were then driven to UO for CNC cutting. The previous team's design had many large access holes cut into the panels, which made some plywood panels less usable, but were fine for smaller pieces such as the T-pins.

Those pieces requiring lamination for the portal frame were cut and laminated at OSU. As the new portal corner pieces

were too large to be cut from the 2'x8' reclaimed plywood, new 4'x8' plywood sheets were purchased.

After cutting, students sanded the pieces for easier handling and then applied the fluid water-resistive barrier on the pieces. LotusPro finish was painted onto the faces of the panels, and the more impermeable Flexseal rubber sealant was used on the plywood end grain.

FIG. 51

Full set of parts for the design's frame.



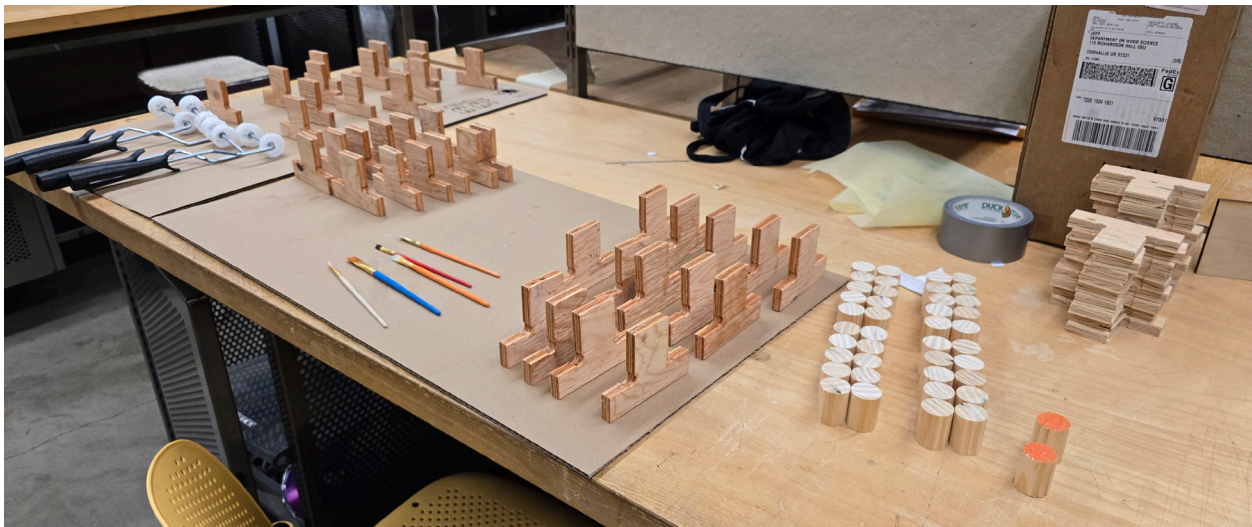


FIG. 52

Connection pieces being organized and packed for transport.



FIG. 53

Kit pieces being laminated at Oregon State University.

FIG. 54

MPP being lifted into place onsite.



The temporary foundation for the prototype was created out of recycled MPP from the Emmerson Lab at Oregon State University. The MPP was placed on solid-sawn lumber to elevate them from the imperfectly leveled site. Four 3'-0" by 6'-11.25" panels and two 3'-0" by 3'-5.625" panels created the final base.

For the construction, students first collected construction tools, including rubber mallets, straps, and Personal Protective Gear (PPE) as well as 12' ladders and drills. Students were divided into morning and afternoon shifts to have efficiently sized crews, beginning on December 3, 2025. Before beginning construction, all students were required to read a safety plan and complete safety modules for ladder and tool use through OSU.

Students first leveled the ground and laid the solid sawn lumber in OSU's Hatfield

courtyard. The MPP panels were then lifted by straps onto the lumber base.

Students then drilled the holes for the one-inch dowels on-site. After drilling, the frames were doweled together as top and bottom pieces. Students elected not to use tilt up construction due to concerns about dowels slipping out during transport from the Emmerson Lab to the courtyard. Frames were carried to the Hatfield Courtyard.

The columns were erected and attached to one another using angled wall panels and T-pins. The resulting walls were then screwed into the final position atop the MPP base. The top parts of the frames were hand-placed atop the columns and fitted with dowels.

**FIG. 55**

Students constructing angled walls on the ground.

**FIG. 56**

Students tilted each wall upright before securing the walls with angle brackets.



FIG. 57

A frame being lifted into position atop the assembled walls.



FIG. 58

Students placed frames while standing on ladders.

**FIG. 60**

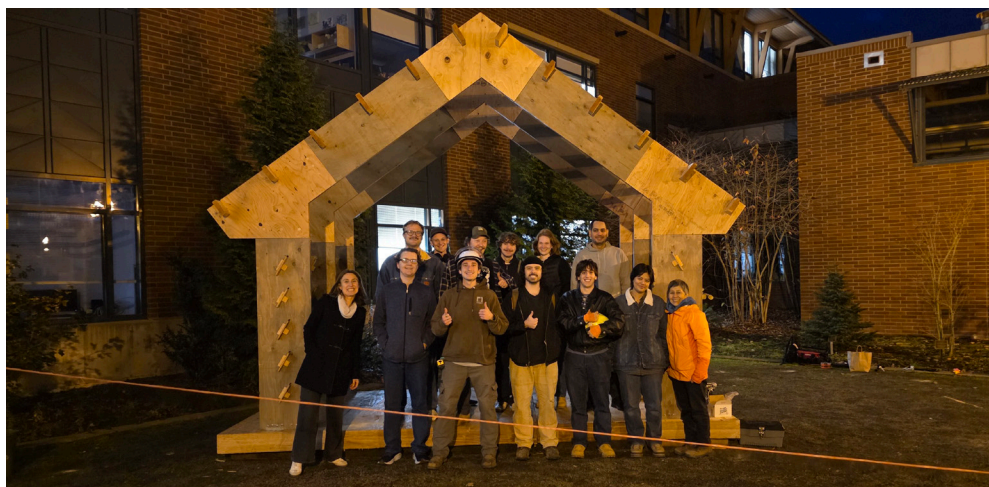
Students finishing the build.

Students then lifted the purlins into place and screwed on the fiberglass roofing panels. Construction was completed in just two days, where students had allotted for three.

Final construction costs were \$2,316.73 out of a \$2,400 budget, without compensating for student driving costs. Students were able to reclaim 59% of all wood used in the previous year's project.

Given water damage and holes in the reclaimed plywood, students felt satisfied with their reclamation efforts.

A final construction review invited the possibility of redesigning so as not to use dowels. Students also theorized that a boom lift would have cut the number of people needed onsite by reducing the number of ladders.

**FIG. 61**

Students posing after building the frame in one day.



FIG. 62

The final course review at Oregon State University

Final Site Design



FIG. 63

Final overview shot of possible proposed buildings.

The final site design created a large parking lot and boat launch immediately adjacent to the Juanita Pohl Center's east side. Pedestrian footpaths across the river and creek lead over small footbridges and out into the Lake at the

Commons and near the highway crossing. Two large gable structures contain boat rentals, restrooms, and community space surrounding a new community garden facing the Juanita Pohl Center.



FIG. 64

The final site design as compiled from all studio work.

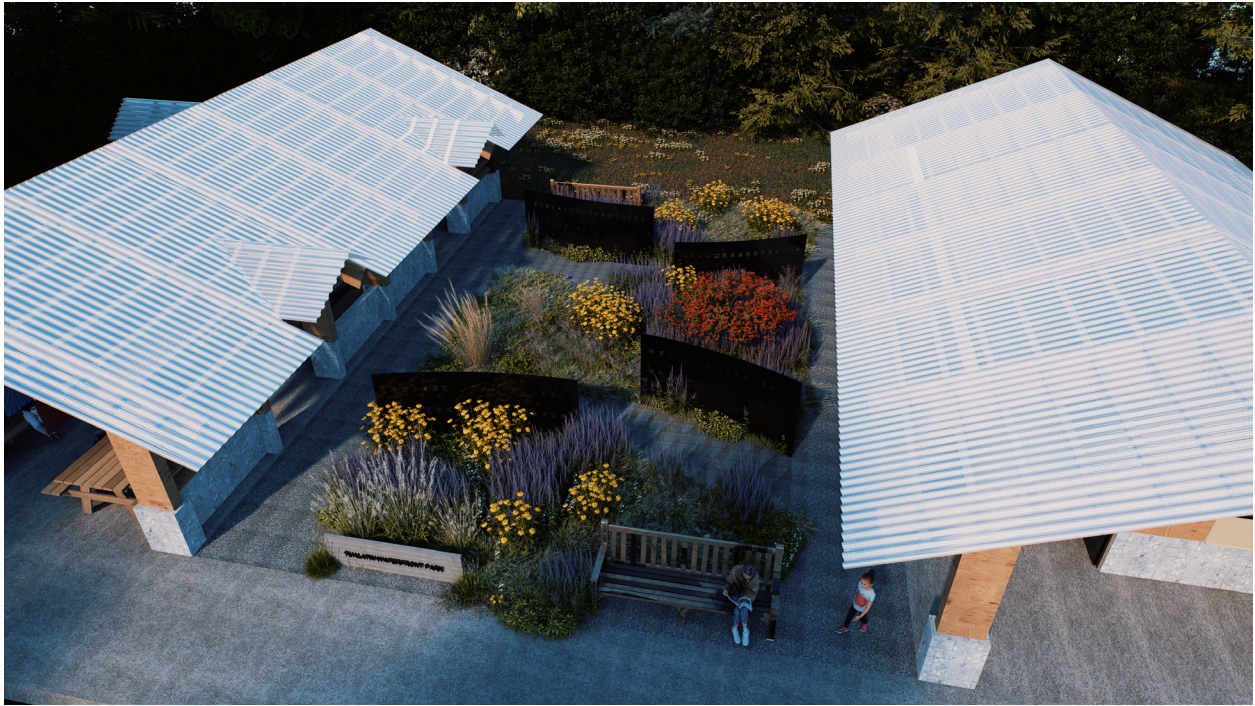


FIG. 65
Proposed community garden.



FIG. 66
Performance space contained under a proposed pavilion.



FIG. 67

The proposed boat rental area.

Conclusion

The final product created by the Timber Tectonics team was a combined lesson in architectural design, structural analysis, fabrication, construction, and effective collaboration and coordination.

Students collectively agreed that the project introduced a side of design previously unknown to them in 1) interfacing with the City of Tualatin's site planning and 2) in fabrication and tooling. Takeaways from the final review encouraged students to explore a maintenance plan to ensure the continued tightness of the dowel fittings and effectiveness of the waterproof

coating. Ideas for future improvement included pre-drying the dowel fasteners to provide a more reliable connection. Metal bolts instead of dowels would be more consistently reusable in future iterations. Reviewers also expressed a desire to see the design revised for a larger and more extensive overhang either by adding sacrificial members to the edges or by using a more rigid metal roof

FIG. 68

The frame of the structure before roofing was placed.



to cantilever over the structure's edges. Alterations on the quality and thickness of plywood veneer selected could also see future use of plywood in the purlins of the structure or in an increase in the number of diagonal wall panels. The structure could be mobile if mounted on a more continuous platform.

Overall, the project was received very positively for its on-time, on-budget delivery of a modular, reusable building created with reclaimed wood. Further experimentation into kit-of-parts buildings holds great promise for innovation in engineered wood structures.

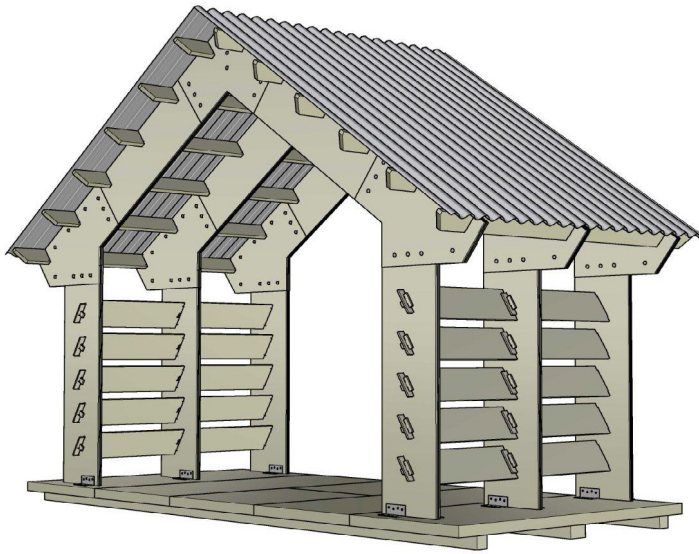


FIG. 69

Axonometric view of class design model.



FIG. 70

Axonometric view of class design as built.

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Appendix A

Final Report Introduction

INTRODUCTION



Our class proposal for the Tualatin Riverfront park is a kit-of-parts system designed using key connections and laminated plywood. To reinforce the reusability of the structure, students were restricted to the use of only wooden connections; metal fasteners were not allowed. Students also used plywood reclaimed from the 2024 Timber Tectonics studio. We have built one of a set of small portals, designed to be placed at entries and exits to the park. We also propose two sibling structures as a complement to the Juanita Pohl center and future boat launch, which will provide 2000 square feet of gathering space in the language of the smaller structure.

The community favored a design which was true to the origins of place, celebrating the nearby trestle bridge's structure and Oregon's natural habitats. A new boat launch, ADA accessible parking, and a vehicle access loop were key desires. The proposed structures will revitalize Tualatin's Riverfront Park. The structures will also aid in the effort to connect visitors from the Tualatin Lake at the Commons to the Tualatin Greenway, Juanita Pohl Center, and Van Raden Community Center. The larger proposed spaces, as well as individual portals, will enforce wayfinding features and delineate clear entrances and exits to the park. These structures will include spaces for retreat, venues for entertainment and events, and storage and rental services.



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Appendix B

Final Design Concept and Process



DESIGN CONCEPT & PROCESS

Class Design Objectives

- To create a community-appropriate structure with echoes to vernacular architecture
- To provide shelters that compliment and connect to nearby park amenities To create a reusable, classic structure which can be easily relocated or removed
- To take advantage the unique opportunity to place a major community gathering space in the outdoor setting of the local park

Design Steps

- Key precedents were found in Tualatin's Trestle bridge, the rustic structure already present on the Tualatin Riverfront, and

Future Steps

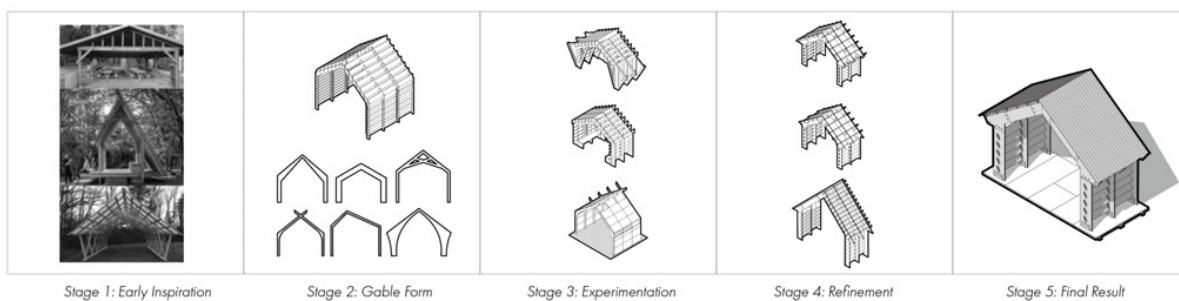
- Based on review, the design should be revised to create a stronger experience of a "transformative" portal
- The kit of parts portal should differ in language from the proposed buildings
- Larger building setback from the curb and increased path size around the boathouse, as well as garage doors or better ventilation on the boathouse, would be improvements



Design Process Precedents

Based on the midterm's encouragement of a classic form which exposed the wood connections at play, we leaned towards a simple structure that would accomplish architectural and enclosure needs at once.

Curved profiles of the portals, as well as an enhanced overhang created by sacrificial 2 by 6 wood pieces, were proposed. Ultimately, material restrictions saw a clean and small portal emerge out of an idea of lateral bracing as a "shingle."



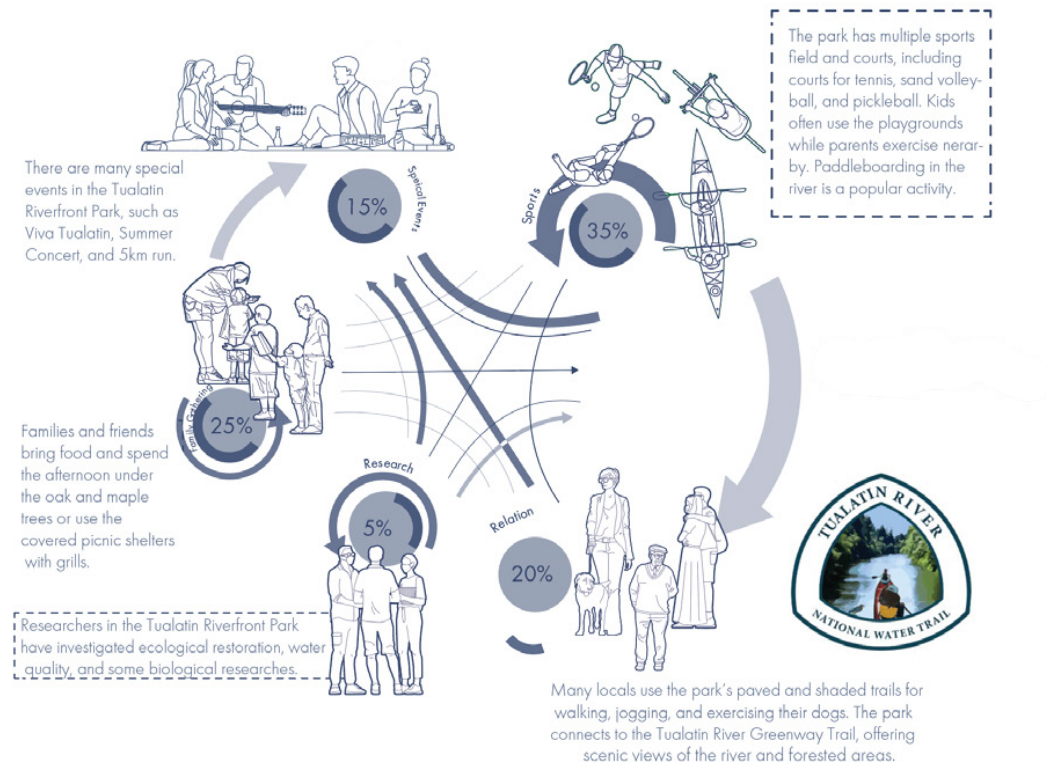
Design Process Diagram



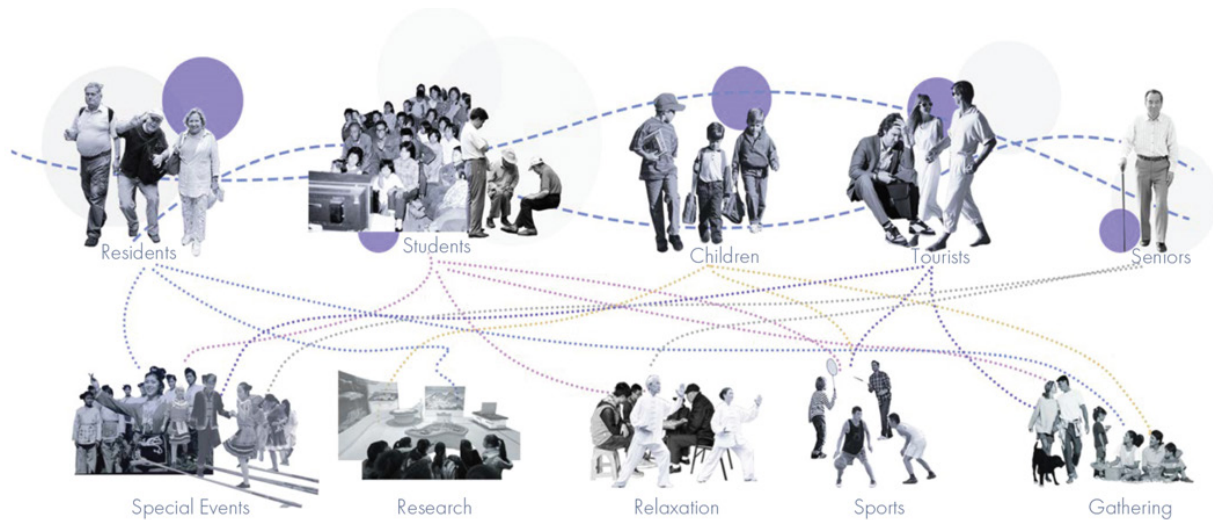
Adjacencies



Roads and Views



Daily Events



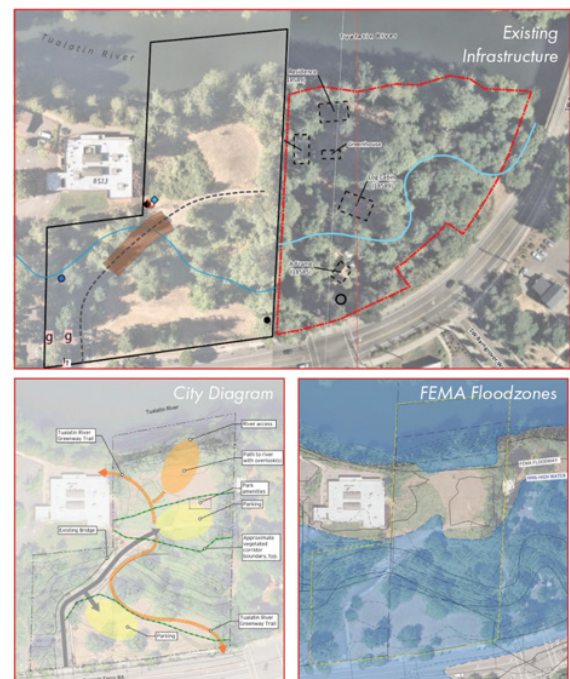


Tualatin Riverfront Park Proposed Site Plan

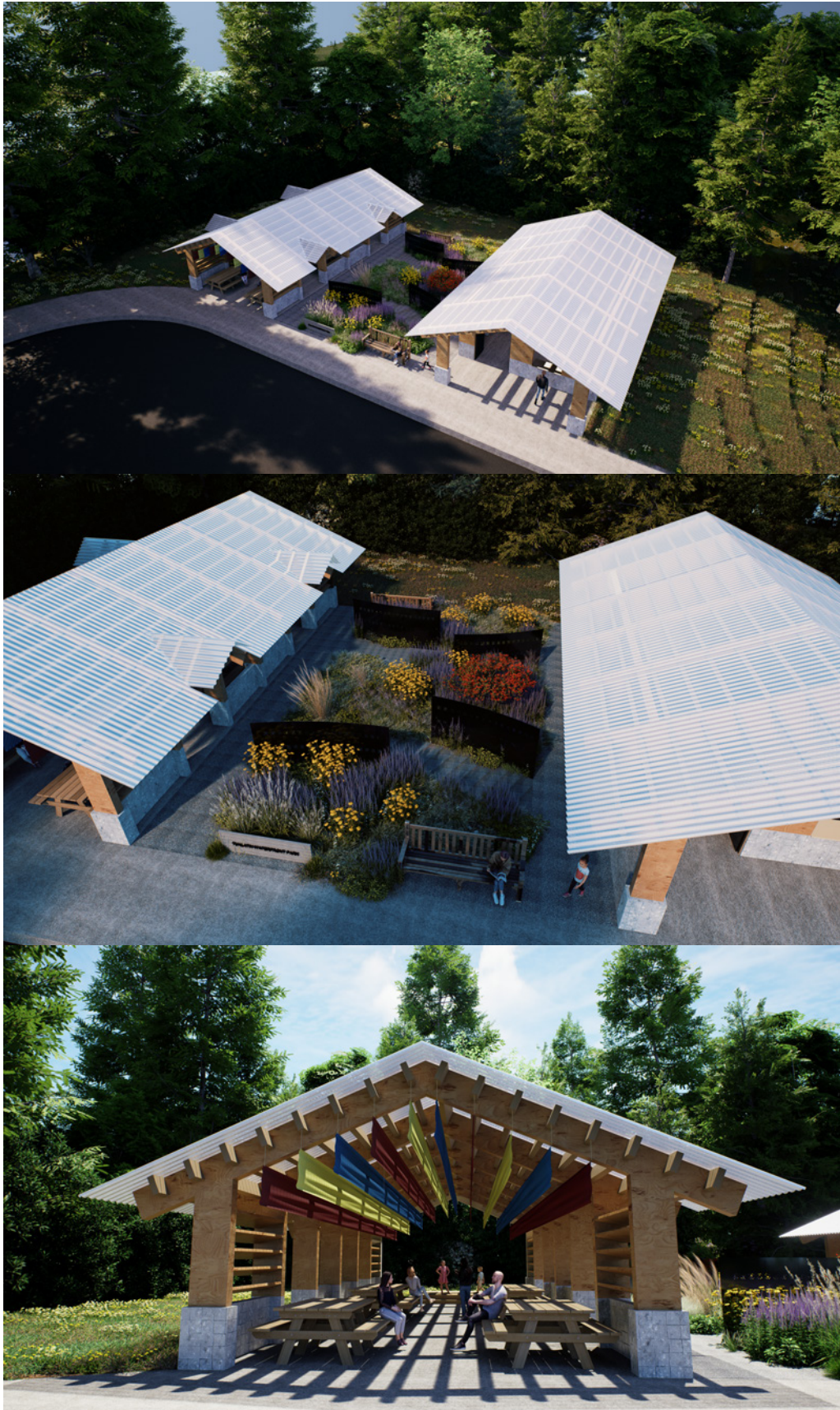
The chosen Riverfront park site is located in downtown Tualatin, critically adjacent to the Tualatin Lake at the Commons as well as future housing developments in the area and a potential new farmer's market located in the current parking lot south of the park.

The site has key restrictions in its placement near a riparian zone in need of restoration. A potential pathway under the bridge as well as the extension and new openings of currently dammed creeks introduces new ways for visitors to interact with water.

The community specifically wanted all proposed plans to include ADA accessible parking spots and safety from flood zones. A new boat launch for non-motorized boats needed to accommodate the safe transport and storage of kayaks.

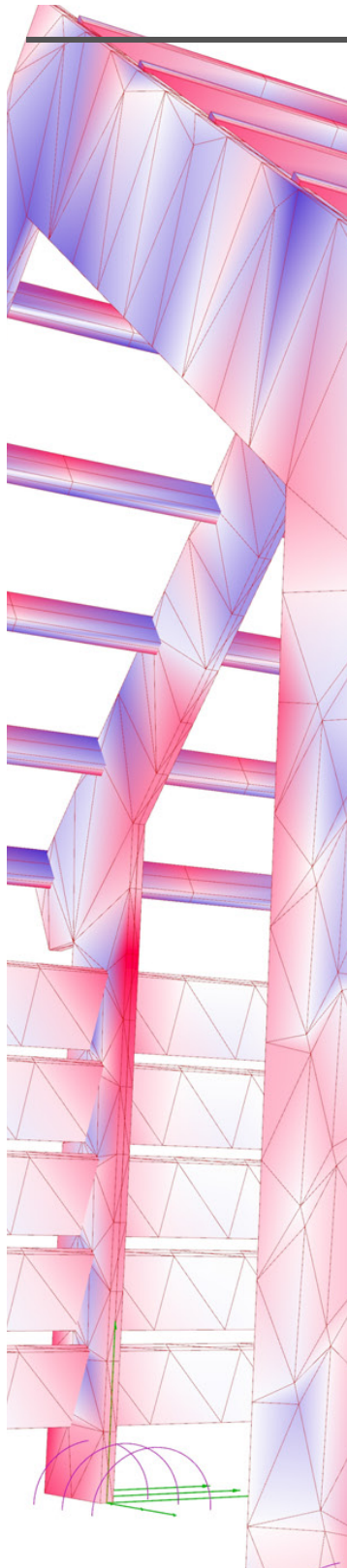


Site Features



Appendix C

Final Structural Design and Analysis



STRUCTURAL DESIGN & ANALYSIS

in our structural system, the laminated plywood frame handles the primary loading and is stabilized by secondary systems made from wood, which are the purlins and angled slats.

The team as a whole faced challenges due to the innovative design of the structural members, which evolved over time.

- It evolved from a dovetail design to dowel connection
- We considered a reciprocal frame before settling on a traditional frame structure
- The reclaimed material faces uncertainties regarding the quality of the member materials
- Lateral bracing design helps to resist some lateral forces

NDS 2024 sets the standards to follow for the dowel-type connections, but not very much for wooden dowels. Most dowel types used in timber are metal. We chose to implement a dowel size of 1-inch diameter, based on several methods used in larger scale timber connections. Consequently, a 3-inch minimum spacing, both from the element edge and center-to-center between dowels, was incorporated, according to NDS provisions. Our team adopted an unconventional and innovative design in the overall structure, due to lack of research with wooden dowel connections, as discussed previously.

The metal base connections were recommended by researchers at the Tallwood Design Institute, and after various tests for both structural integrity and constructability, we elected to use two (2) steel angle brackets per column.

KARAMBA 3D ANALYSIS

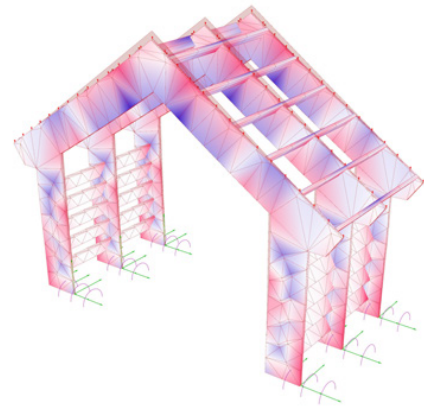
Karamba 3D allowed the ability to simulate and analyze simple 3D models of various design iterations throughout the term. We were able to accurately define material properties and dimensions in order to analyze load applications in different scenarios throughout the design process.

The analyses from Karamba 3D throughout the design process output displacement values which then influenced critical design choices like member depth, connection placement, and more structural roofing system considerations for the final build.

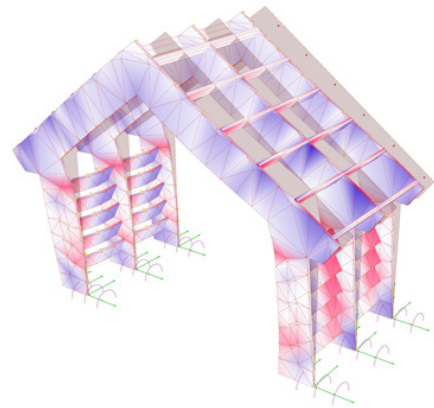
The Karamba analysis was able to prove that structural stability is achievable amongst a roofing system dead load and potential wind loads for the final design proposal. The bracing panels between the frames were also proven to provide enough lateral stability within the frame even with a smaller cross section of 1/2".

Potential modifications and adjustments to the structure:

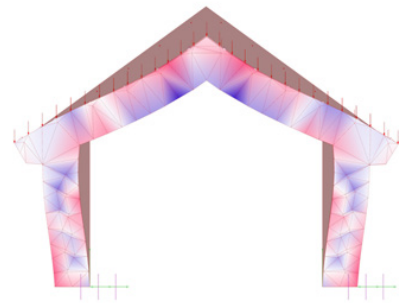
- Modular roofing system following rest of structure
- Thicker members, columns and panels
- Ground connection thrust force counter design
- More even dowel spacing, for better distribution of loads.



Karamba 3D Model



Deflection from force or wind load perpendicular to frame depth



Deformation from a much heavier roof system or snow load

Appendix D

Final Materials



MATERIALS

For this project, both the UO and OSU instructors pushed for two key restraints in our design: We had to focus on mainly using wood-to-wood connections, unless otherwise approved, and the materials had to be recycled wood from the previous project made by our counterparts from last year

Our team had planned to use reclaimed material consisting of what was originally 1/2-inch plywood, but testing concluded that it not sturdy enough for the conceptual designs at the time. Opportunities were found in laminating three layers of the 1/2-inch material together, creating a thicker material as well as customizing pieces for a tongue-and-groove system for our dowel connections and 2x6 boards.

Our approach for re-laminating and CNC machining the plywood frame elements has similarities to the process for Mass Plywood Panels (MPP), and we collaborated with the Tallwood Design Institute, using a high strength wood glue, a wood lamination press, and CNC cuts for the designs in the Emmerson Lab at Oregon State University.

The material quality was somewhat lowered due to the fact that our material was reclaimed wood from past projects. Reused wood faces several issues that could affect the design, and so layering the plywood gave the best structural strength we could achieve without wasting materials.



TALLWOOD
DESIGN INSTITUTE

Appendix E

Final Connections

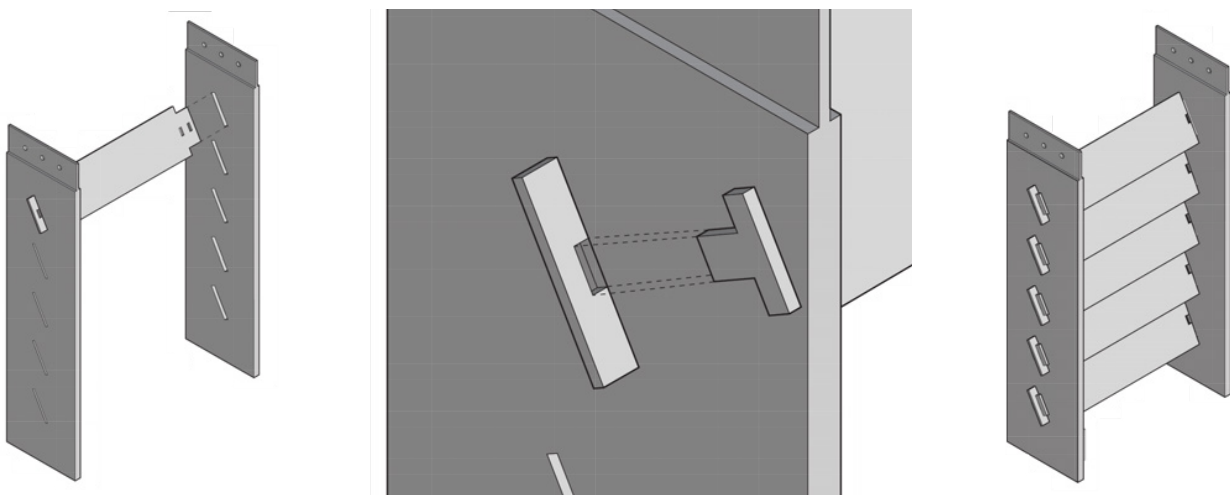


CONNECTIONS

The final connections underwent several iterative phases as we balanced various aspects of design, fabrication, and assembly. Initial concepts were more focused on finding a universal connection type that could work for all types of enclosures and purposes, but this approach was soon discarded in favor of more specialized pieces that were easier to manufacture and assemble. Other connection iterations were disregarded for being too complex to assemble, structurally unstable, or difficult to manufacture using the CNC. The culmination of our iterations were the slats with t-pin, purlin slots, dowel joints, and angle brackets. These connections were chosen for their balance of matching design intent, highlighting wood-to-wood connections, and their ease of assembly and manufacturing.

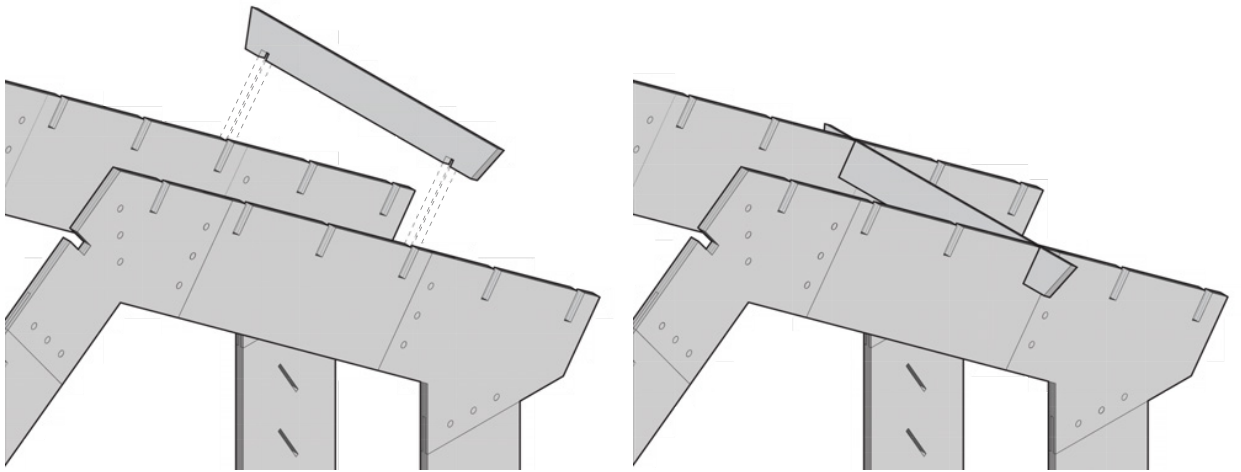


Various scrapped connections developed by connections team and studio

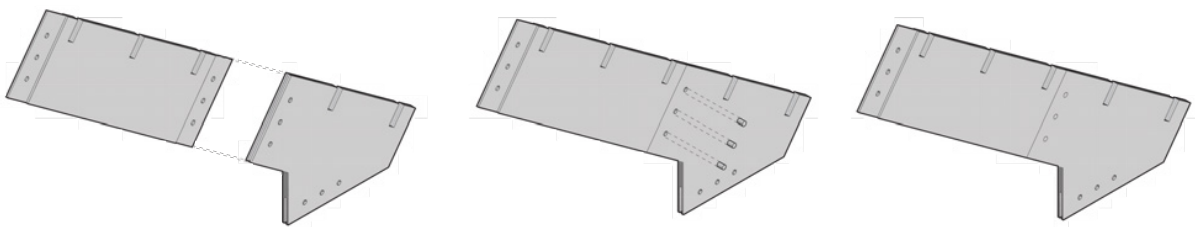


Final slat-column with t-pin connection

FINAL CONNECTIONS

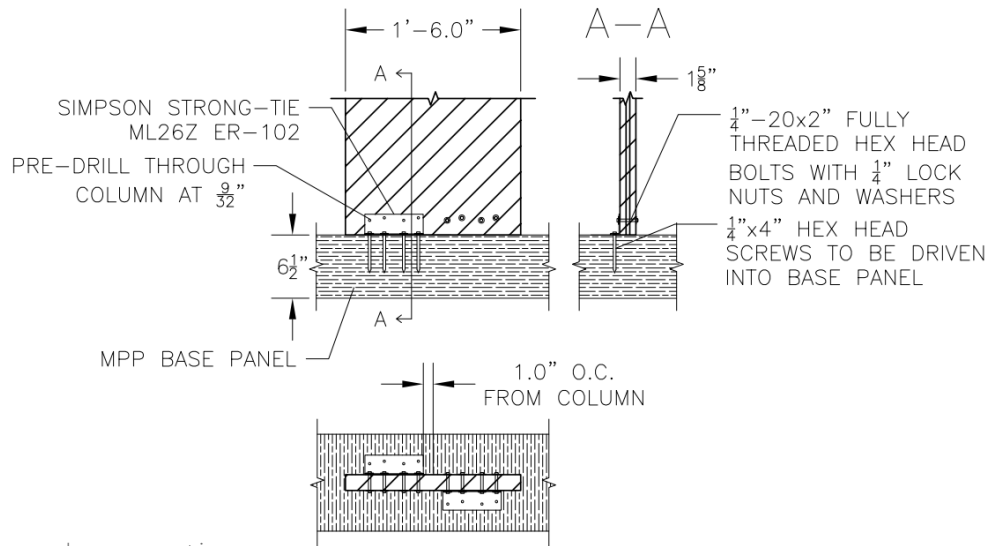


Final rafter-purlin slot connection



Final dowel connection

FINAL CONNECTIONS

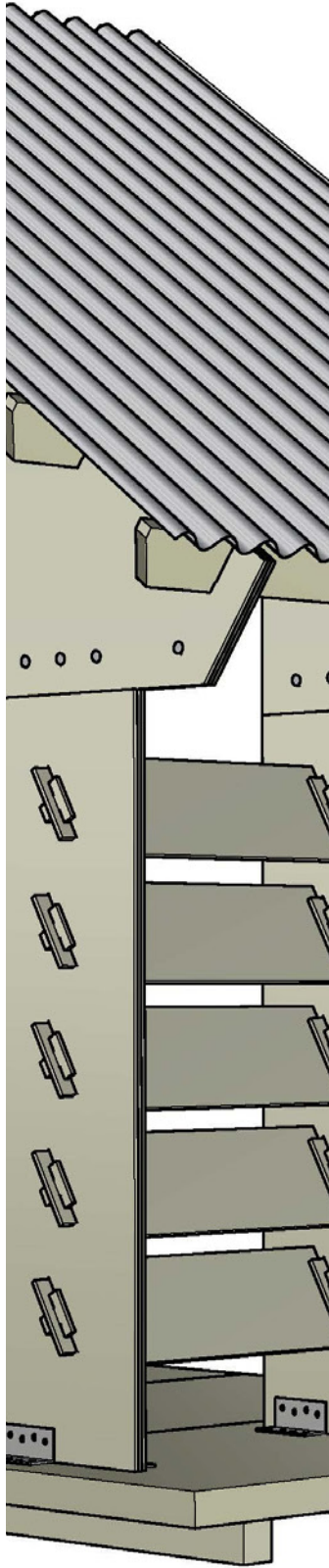


Final ground connection

The dowel connection and slat connection received the most feedback during the final review. Regarding the dowel connection, most comments were concerned about why a dowel was chosen instead of a screw and how a dowel may withstand long-term exposure to the elements. This was further supported during the final assembly when screws were still required to secure the connections together. Future projects may want to consider entirely replacing the dowels with screws instead, which provide a quicker assembly that is more secure. Comments over the slat connection largely revolved around the t-pin and its necessity. Upon building the structure, the t-pins were not as structurally significant since the tolerances for openings of the slats were larger, causing the connection to not be as rigid as expected. This caused the t-pins to be possibly entirely removed with little to no effort. Last, for the ground connection, there was a discussion about the accessibility of the structure due to the prototype being built on top of an MPP base panel. To ensure accessibility, investing in a wider concrete footing that remains above the ground instead can support the width of columns while individuals move through the structure.

Appendix F

Final Kit of Parts



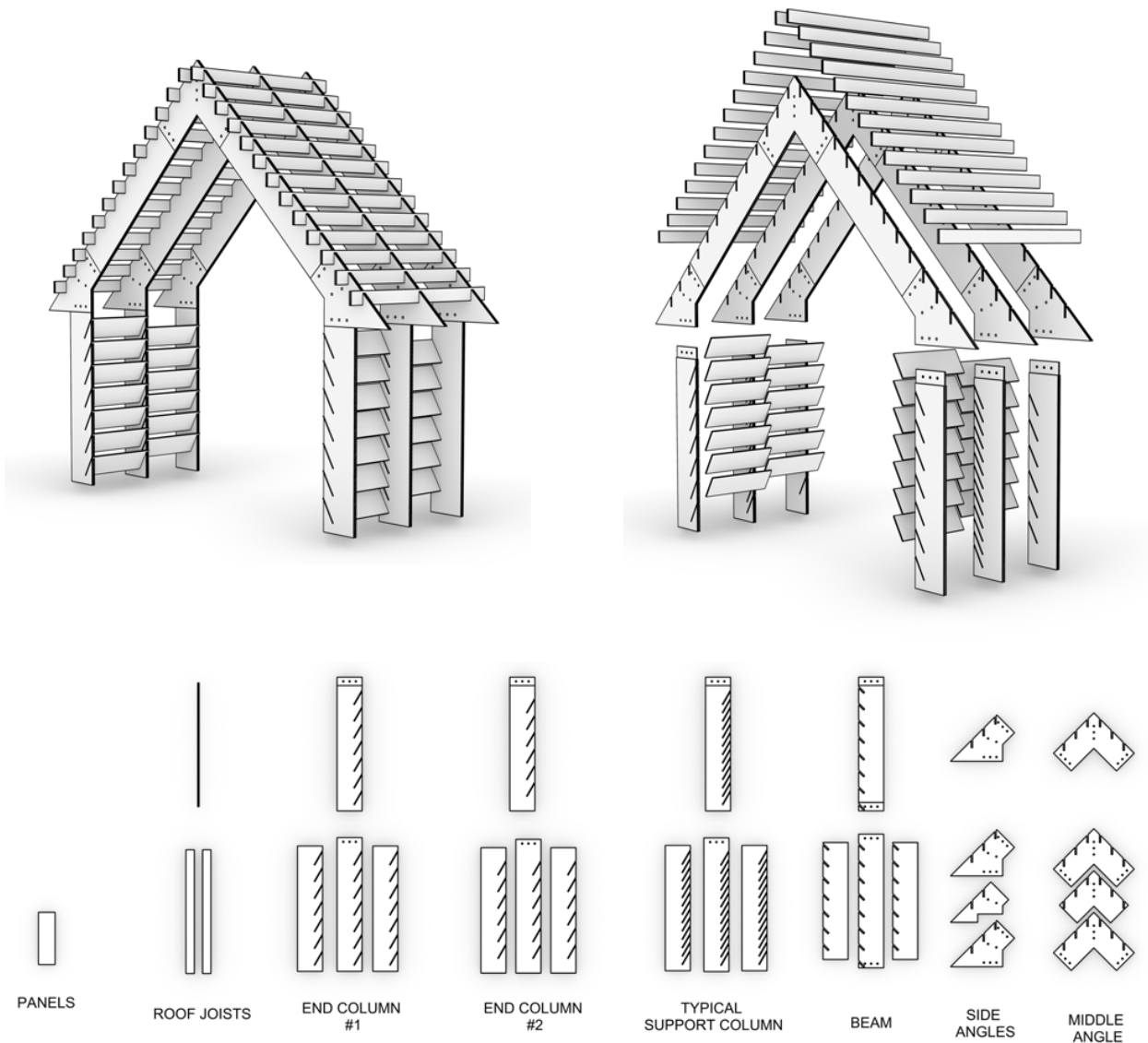
KIT OF PARTS

This kit of parts was developed based on the idea of a frame system with lateral stiffening panels seen in some of our precedents from both Veneer House and Wiki House. We aimed to create a modular system that could repeat and elongate with the addition of repeating frames and spanning panels with unique end conditions on either end so as to elegantly finish the system.

The design of this system was iterative mostly in the expression of the various connection types and the proportions of the system rather than in the aesthetic design. However there was some iteration in regards to the edge conditions of the frame corners and the look of the panels from the elevations. We wanted the system to be expressive of its construction, but in an elegant way.

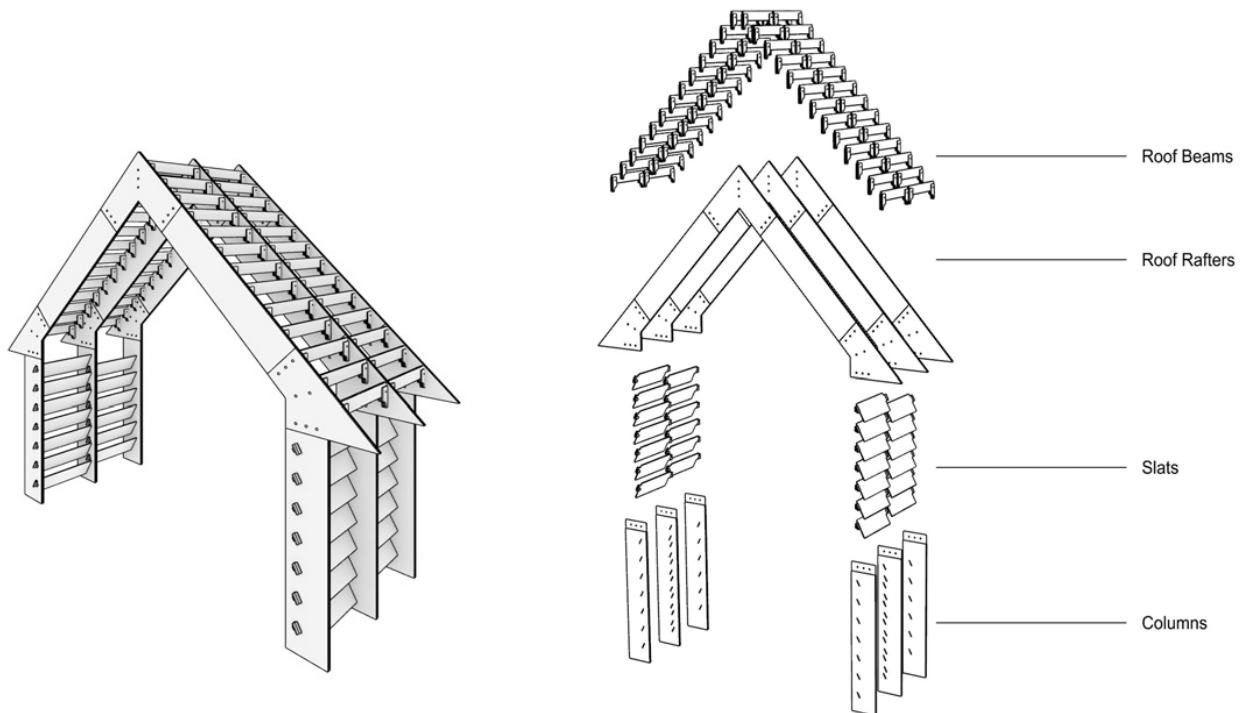
INITIAL KIT OF PARTS

Elements of this first proposal below stayed consisted in our design throughout the design process, including the dowel connections within the frame and the frame itself as the fundamental basis of design. In this first iteration however the slats would just slide in and out of the columns which was inevitably changed due to worries about public use, lateral stability, and stiffness.



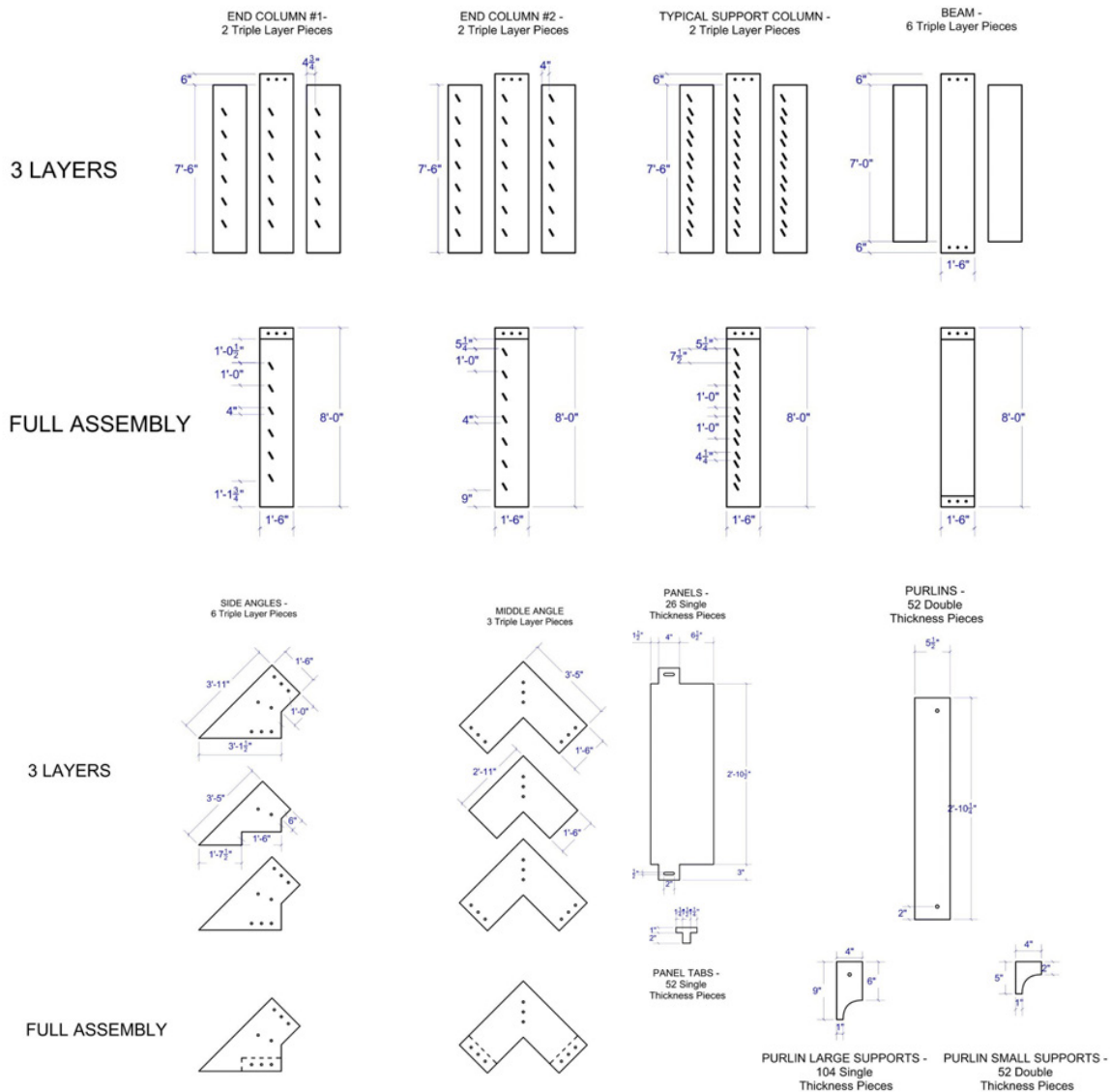
CONSTRUCTABILITY REVIEW KIT OF PARTS

For the constructability review we focused on a large system as we tried to maximize the size of each piece to make sure to use as much of the given 2'x8' panels as possible. This design was built and extended using alternating vertical slats and roof beams, secured to the column and roof frame. The biggest drawback was the initial height of the building being 17 feet. This height was too tall for us to realistically build in the time allowed and was not conducive to the human scale. There was also discussion of needing a simpler system for the roof rafters to allow for Polycarbonate attachments. We also needed to come up with a simpler connection point for the slats placed on the sides for ease of construction.



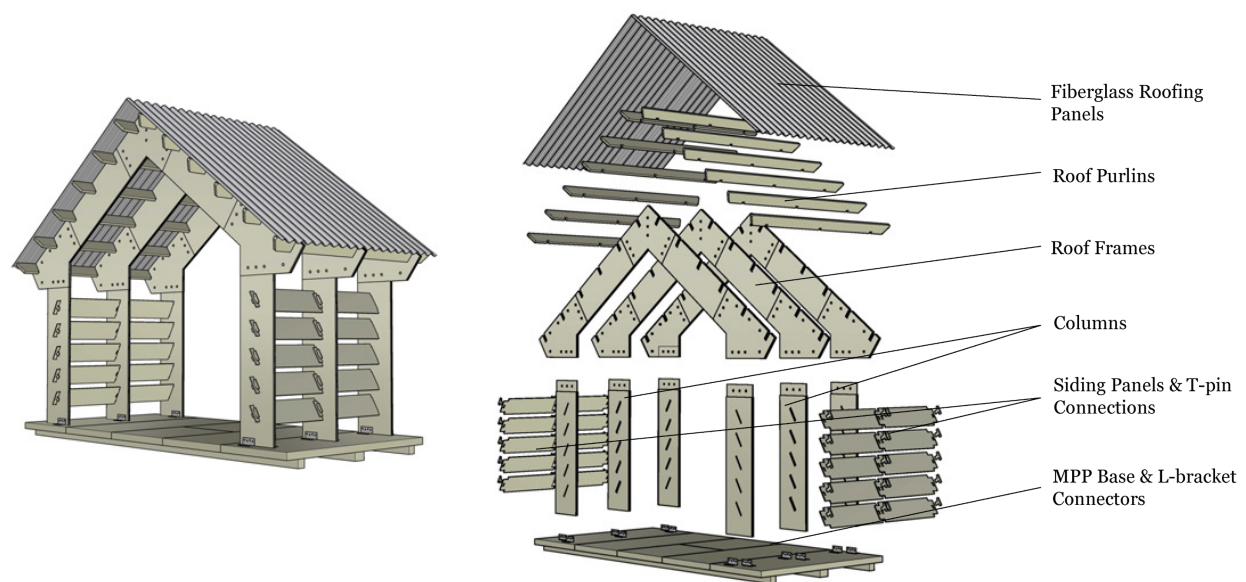
CONSTRUCTABILITY REVIEW KIT OF PARTS

In this kit, there were 23 pieces needed in total to create each of the 11 main components of this kit. This is due to the triple-layering of the beams, columns, and angle pieces. As seen in this kit, there are many small pieces that we realized would have been hard to CNC in order to make the connections in this design.



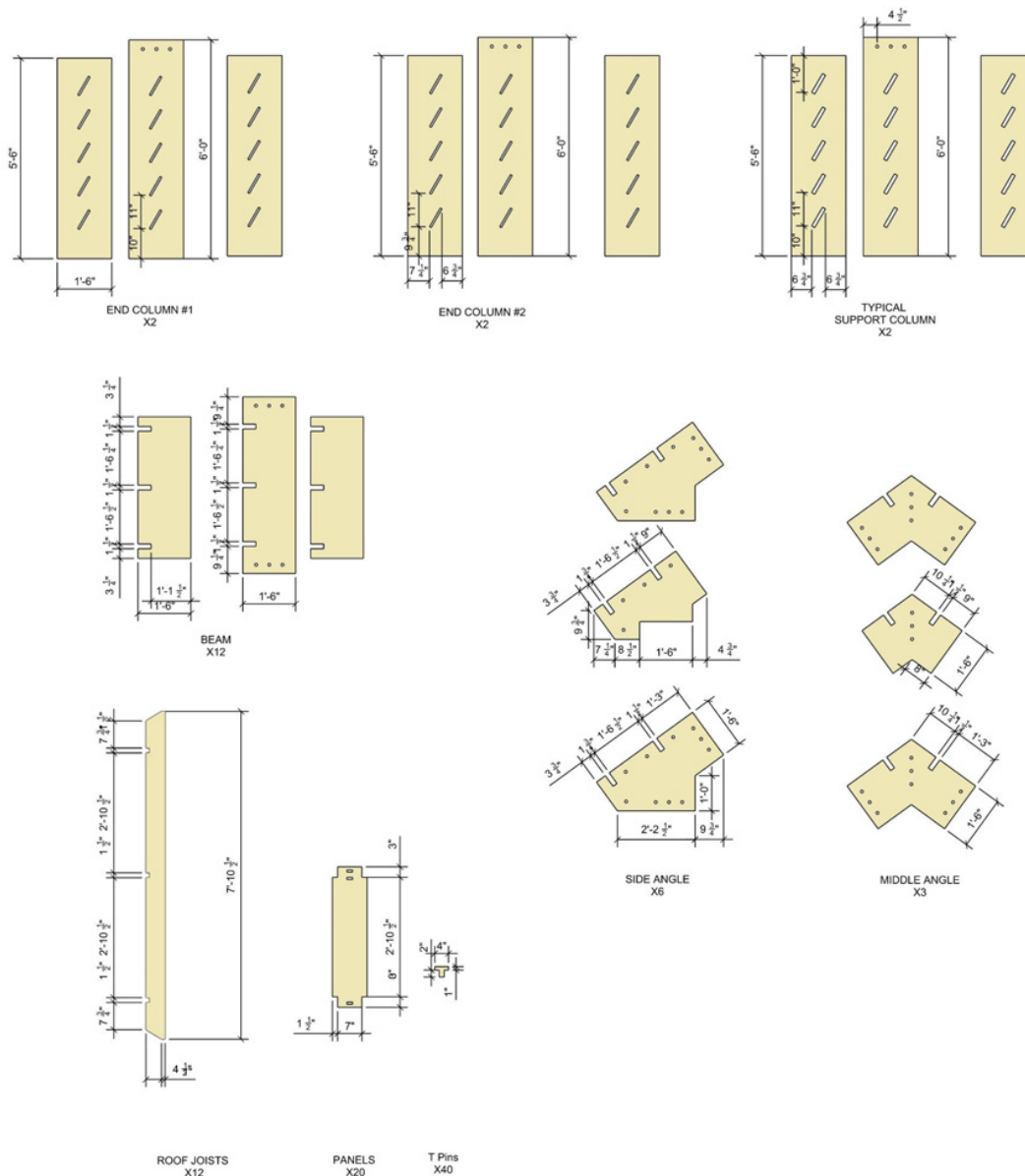
FINAL KIT OF PARTS

Our final kit of parts focused on the constructability of the structure and was limited to a 12ft. height. The slats were also placed in a way so that the pattern would not appear to alternate from bay to bay, although one layer does sit a $\frac{1}{2}$ inch deeper into the column than the other side so that the slat connections on the middle column could be doubled up. Finally we aimed to gain additional lateral stability with the use of continuous rafters on this prototype, each of them notched three times for stability in their connection to the frame. We also for the sake of constructing this prototype on an unlevel site, built it connected to a MPP base with alternating L-brackets. The fiberglass roofing also became as significant bracing element in this system which we did not anticipate upon designing.



FINAL KIT OF PARTS

In the kit of parts for our final prototype, there are 15 unique pieces and 23 total pieces needed to create one of each of the 9 main components of this kit. This is due to the triple-layering of the beams, columns, and angle pieces. The panels and T-pins consist of single layers of $\frac{1}{2}$ inch plywood and the rafters are made from reclaimed 2x6 lumbar. In comparison to the midterm kit of parts, this kit has less internal cuts, less unique pieces and no small roof purlin pieces to manufacture.

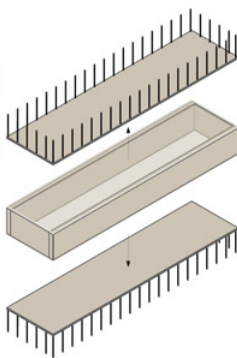


FABRICATION PLAN

Because of the unique challenges with the fabrication and cutting of our triple layer pieces we decided to create a re-manufacturing plan going from the pre-existing panel boxes to our finalized columns and beams. The first step of this process was to disassemble the previous years boxes. We kept the 2x8 side pieces to use as our purlins and took the face panels for CNC cutting. These panels were cut to their appropriate lengths (2 5.5' pieces and 1 6' piece for the columns) and then glued together. Once fully glued and pressed, the next step was to cut the parts using the CNC cut plans. Finally, the columns and beams would be set into the respective mortise joints of the connecting pieces and dowels would be drilled through both pieces. This helped insure that once the structure was assembled, the holes in the columns, beams, and connectors would all line up perfectly.

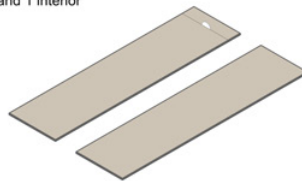
Step 1

Disassemble previous panels by removing nails and staples. Save the 2x6 side pieces to use for purlins and the 2x8' panels for CNC.



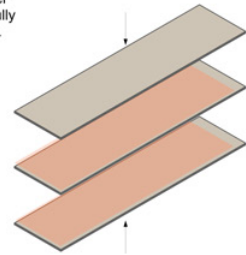
Step 2

Use table saw to cut the length 2 exterior pieces and 1 interior piece.



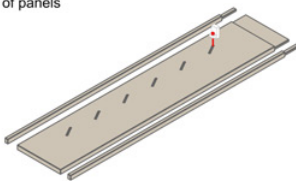
Step 3

Glue assembly together and press. Wait until fully dried to start next step.



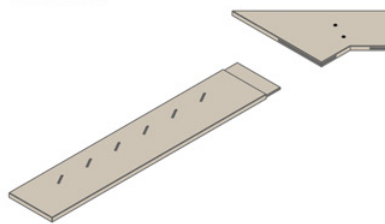
Step 4

CNC shear panel insets using 1/2" diameter drill bit. Cut width of panels



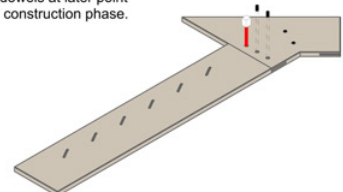
Step 5

Set within angle frame member.



Step 6

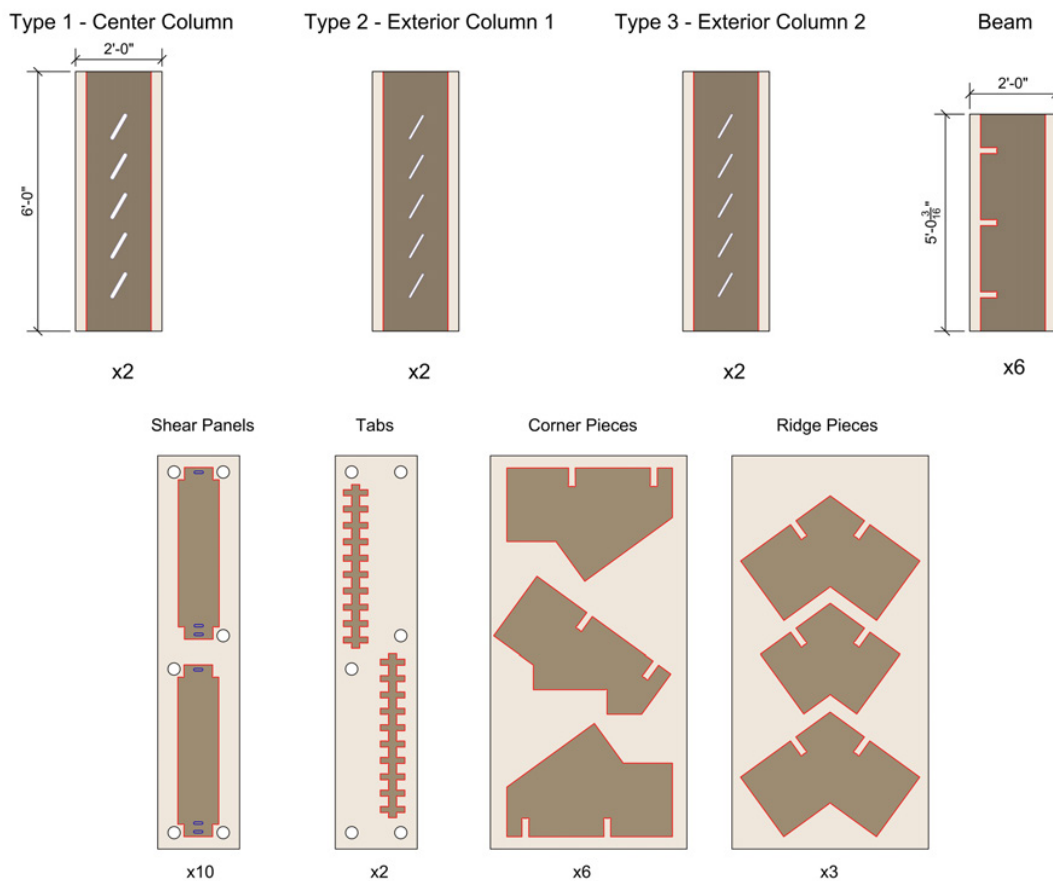
Use drill to create 1" diameter dowel opening. Insert dowels at later point during construction phase.



CUT PLANS

The cut plans for the kit of part we're divided up between pieces that had to be cut at OSU and at UO. The pieces that were cut at OSU were developed using our re-manufacturing plan (columns and beams). Because of this, the pieces were already at the correct length and just had to be CNC cut to trim the edges and add slots for the panel insertions. The original design had to be slightly modified during this step to create curved edges to the inserts for the columns in order to make CNC cutting possible. Additionally, for the beams dog bone cuts were added to interior right angles for the purlin cavities.

At UO the panels, T-pins, ridge connections, and corner connections were fabricated. Unlike at OSU, the triple layer ridge connections and corner connections could not be creating using our re-manufacturing plan because of the angled nature of the pieces. Because of this, the individual layers were CNC cut then the triple layers were glued and screwed together. These pieces were very simple to layout and the only modification was to create dog bone cuts at interior corners. The single ply T-pins and panels were cut from existing 2'x8' sheets that had pre-existing holes in them. To account for this a master plan for the sheets was developed that accounted for all possible hole locations. After this was done, the pieces were cut out as normal with dog bones added and rounded interior edges in the panels.



Appendix G

Final Moisture Protection



MOISTURE PROTECTION

Building Enclosure

Key Functions of the Enclosure

- Protect structure from precipitation, wind, and moisture intrusion
- Support ventilation and drying of wood components
- Maintain durability while preserving the lightweight kit-of-parts logic

Primary Strategies

- Layered fiberglass roof assembly for rapid shedding of water
- Vertical siding configuration promoting drainage and airflow
- Material protection coatings to limit water absorption

Foundation Separation

- Elevated Base: MPP panels rest on a 15 x 7 ft panel bottom and foundation MPP surface

Roof Geometry

- A sloped roof encourages rapid runoff away from structural joints
- Overhangs reduce exposure of columns and wall panels

Siding Orientation

- Vertical panel layout promotes downward water movement.
- Open-joint design allows drainage and airflow behind panels

Moisture Protection

- Flex-Seal applied to end-grain areas most vulnerable to capillary uptake
- Clear coatings protect without altering appearance or tolerances

Drying Pathways

- An air cavity behind siding prevents trapped moisture
- Panel spacing ensures evaporation and reduces long-term swelling



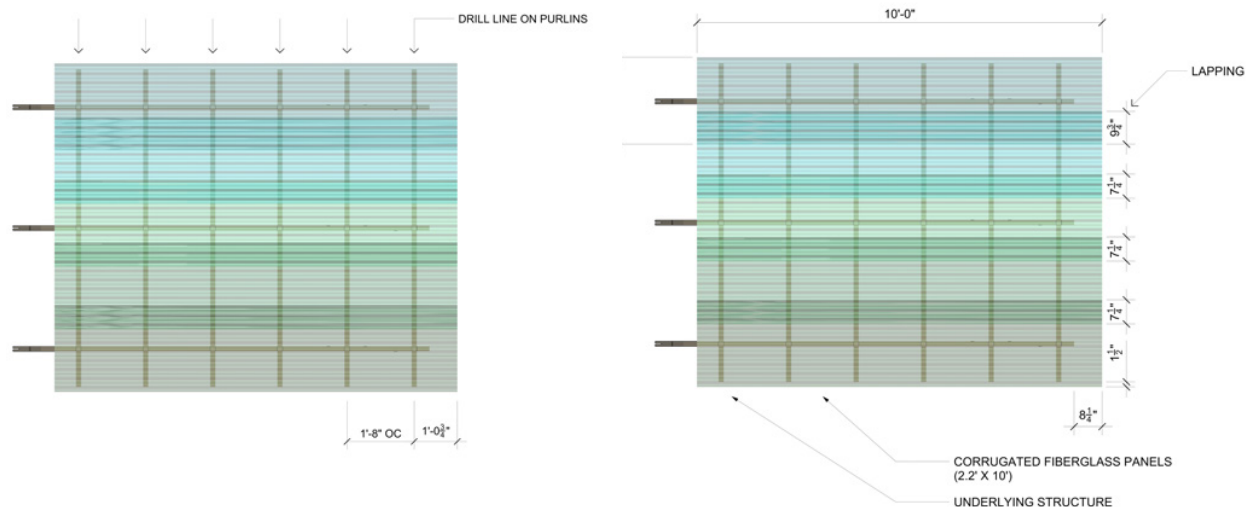
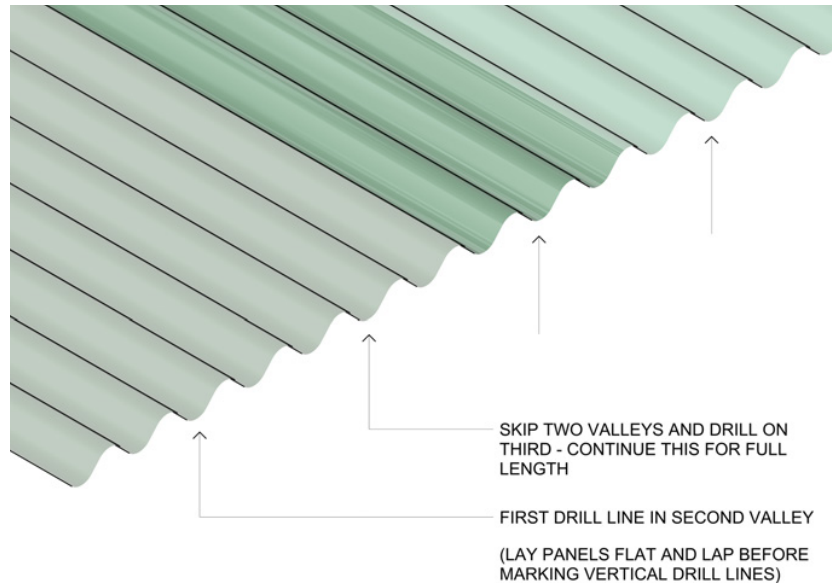
Corrugated Roofing System:

- 20 count 2 x 10" clear fiberglass corrugated roofing panels.
- 2 count ridge caps.
- 200 count washered roofing fasteners.
- Horizontal closure strips (optional).

(Graphics below show half of roof profile, colors differentiate individual panels)

Roof Design Considerations:

- Panelized system is lightweight and easy to assemble / disassemble.
- Fiberglass panels are highly resistant to weather.
- Corrugated roofing is readily available.
- Panels easily attach to roof structure.
- Translucent panels reveal wood connections and structure underneath.



1. Mechanisms of Water Transfer in Wood

Water moves through wood by four main mechanisms: **capillarity**, **gravity flow**, **diffusion**, and **convection**.

- Capillarity**: Liquid water drawn through microscopic pores and cell walls by surface tension.

- Gravity flow**: Downward movement of liquid water through cracks, checks, or lamination gaps under the influence of gravity.

- Diffusion**: Water vapor migration through pores, driven by differences in vapor concentration (humidity gradients).

- Convection**: Water vapor carried by moving air through larger openings or voids.

For the prototype, the most critical mechanisms are capillarity and gravity flow, since the MPP panels were exposed to standing water during testing. Moisture vulnerability was greatest at surface seams, panel edges, and end grain, where gaps and exposed fiber structure allowed faster absorption.

2. Prototype Moisture-Protection Strategies

The prototype utilized a dual-coating system to minimize both surface and end-grain water absorption:

- LotusPro (clear hydrophobic coating)**: Applied to panel faces. Forms a breathable water-repellent barrier that bonds with cellulose, repelling liquid water while allowing vapor exchange.

- Flex Seal (clear rubberized coating)**: Applied to end grain. Creates a flexible, waterproof seal that blocks capillary water uptake in high-absorption zones.

- Surface slope detailing**: Added to promote runoff and reduce prolonged water contact.

Together, these treatments significantly reduced capillary absorption and gravity-driven flow, improving overall moisture resistance and dimensional stability.

3. Material Properties and Selection Criteria

Both coatings were selected for their durability, low VOC content, adhesive compatibility, and transparent finish suitable for exposed wood applications.

- LotusPro:** Nano-silane formulation with high hydrophobicity, UV stability, and long-term adhesion to wood fibers.

- Flex Seal:** Elastomeric coating forming a continuous, flexible barrier that tolerates dimensional movement and prevents cracking.

Application: Apply to clean, dry surfaces at 15–25 °C, two coats with full drying between applications.

Maintenance: Reapply every 3–5 years or after visible wear, surface damage, or UV degradation.

4. Effects on Construction Tolerances

Both coatings form very thin layers (<0.1 mm) and do not impact construction tolerances or fit.

Edge treatments may require light sanding before gluing to maintain proper bonding.

Overall, the coatings enhance durability and moisture control without affecting structural precision or assembly.

5. Proposed Modifications to the Enclosure

Following prototype testing and final review feedback, several improvements were proposed to enhance performance and durability:

- Larger roof overhangs to minimize direct rainfall exposure and reduce the frequency of wetting-drying cycles.

- Using corrugated roofing material as siding to protect structure. Siding and roofing could be continuous profile.

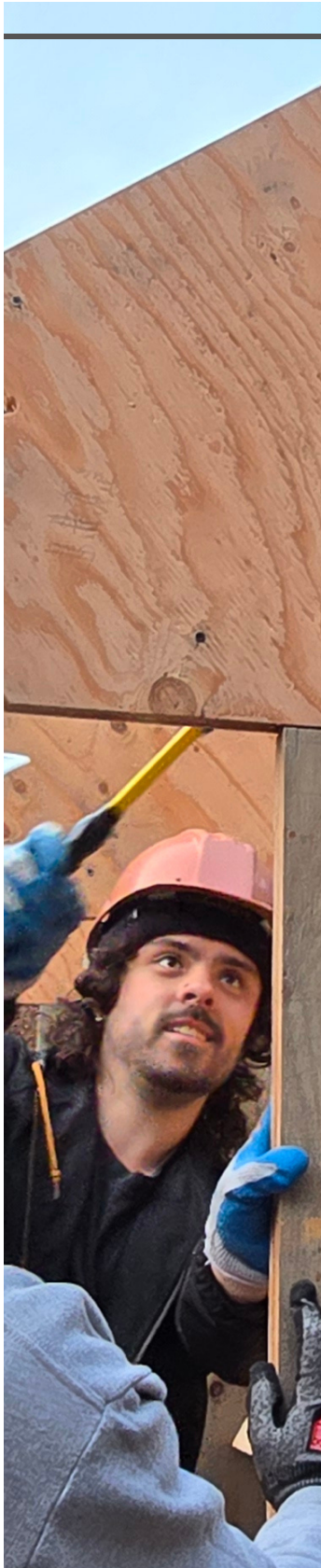
- Graffiti-resistant finishes or protective coatings on visible surfaces to improve maintainability and appearance.

- Increased clearance at column base connections to prevent water pooling and allow proper drainage and inspection access.

These modifications further strengthen the building's moisture protection strategy and improve long-term serviceability of the timber enclosure.

Appendix H

Final Construction Planning

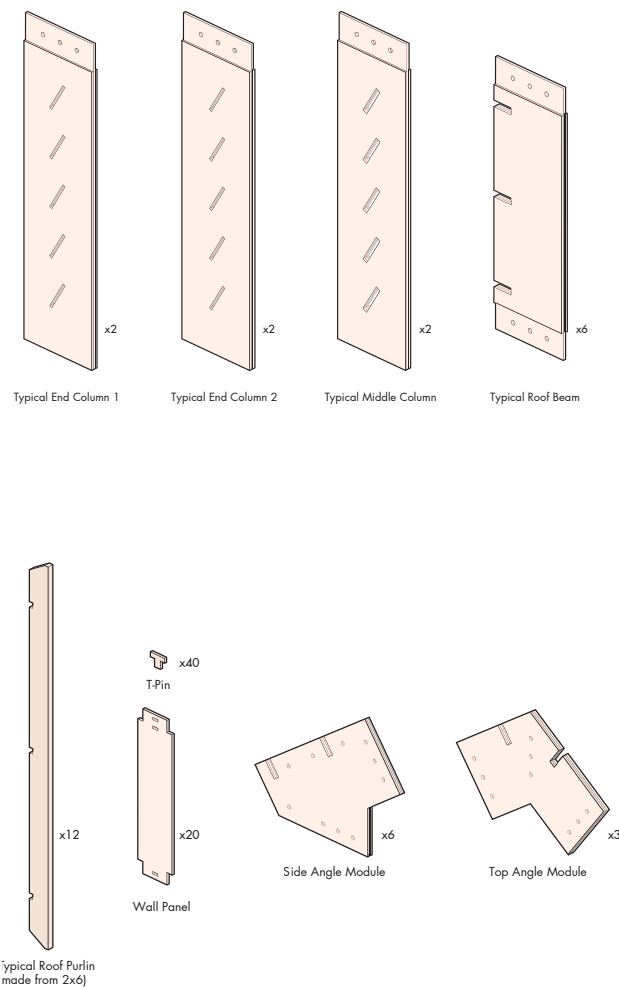


CONSTRUCTION PLANNING

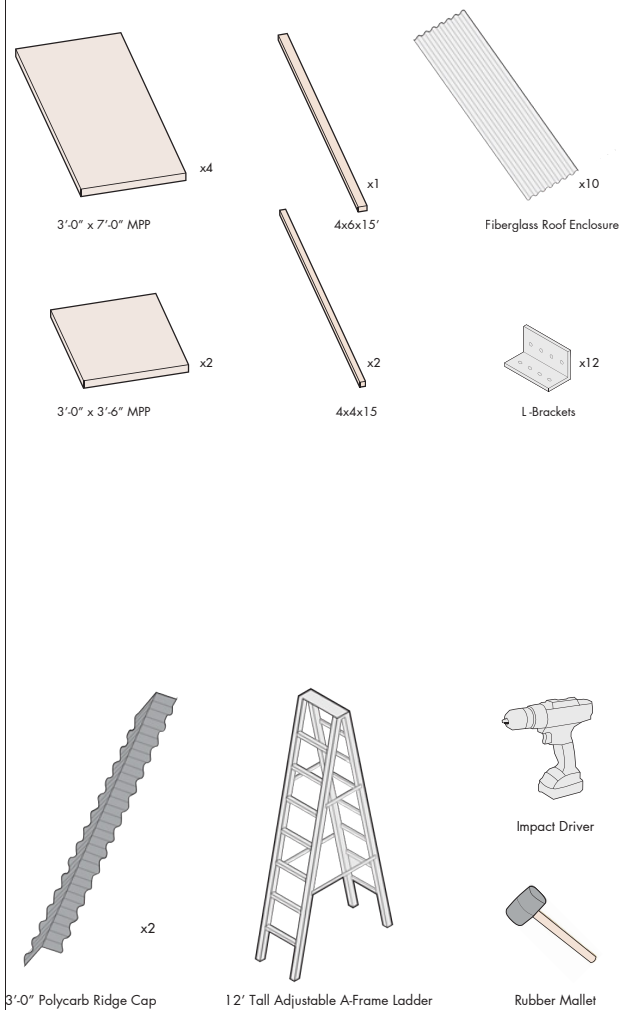
- To prepare the Hatfield Courtyard for our structure, we selected the most flat surface which was towards the southern end of the courtyard. We started by laying down four pieces of solid-sawn lumber (two 4x4x15' members and one 4x6x15' member). Next, we placed six total MPP on top of these members to create a platform for our structure. The sizing of the MPP came out to be four 3'-0"x7'-0" and two 3'-0"x3'-6" panels. We connected these panels together with 32 screws total, screwing diagonally to ensure a strong connection
- Our assembly process was split into four major categories, being **Prefabrication**, **Transportation**, **Site Preparation**, and **Construction**. We prefabricated the walls and frame tops of the structures, carrying them to site by hand using 3-4 people, assembled our foundation platform, then constructed the rest of the structure on site. Our process is further documented with diagrams.

CONSTRUCTION SEQUENCING - KIT OF PARTS

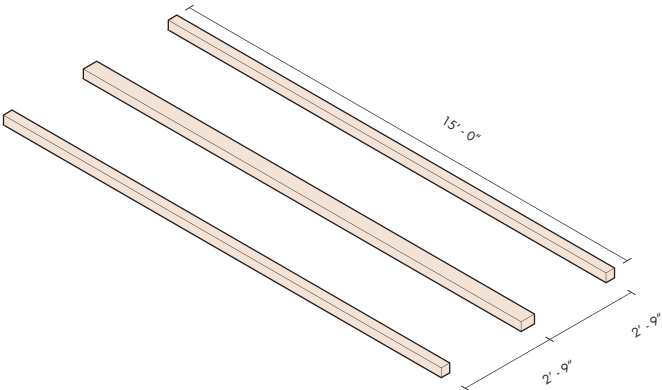
Fabricated Timber Elements



Site, Products, and Tools



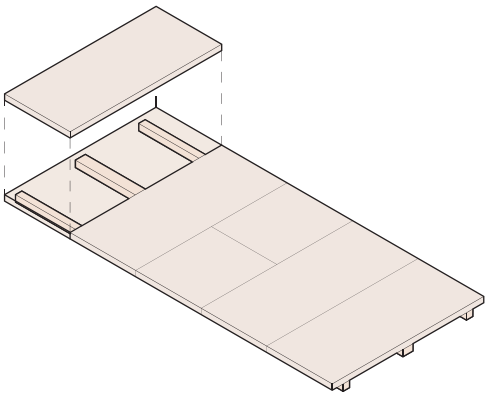
SITE SELECTION AND PREPARATION



2-4

Lay the two 4x4s on either end of the 4x6 by 2'-9"

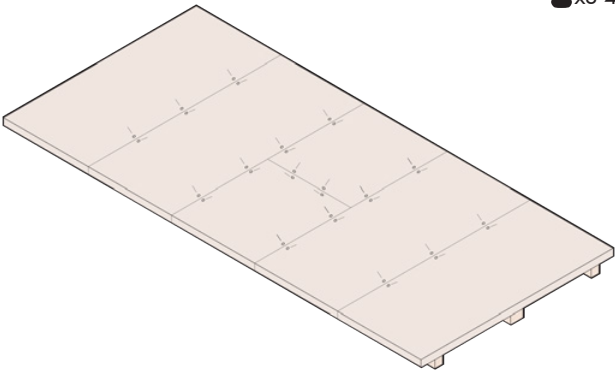
1.



3-4

Lay the four 3'x7' MPP on top of the 4xs with the two 3'x3.5' MPP in the center

2.

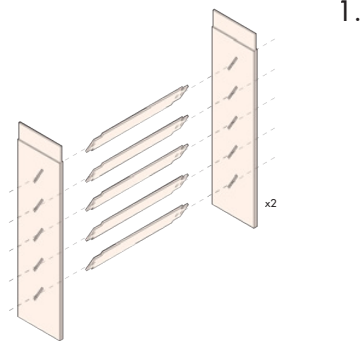


1-4

With 32 screws, screw diagonally into the MPP to secure each panel to one another. Additional people may participate in this step to speed up the process.

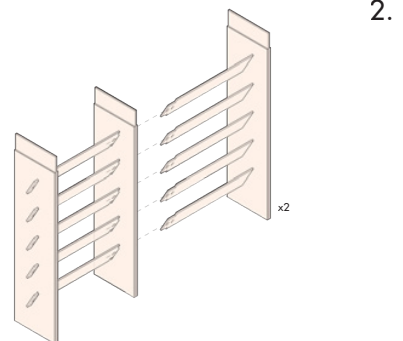
3.

PREFABRICATION



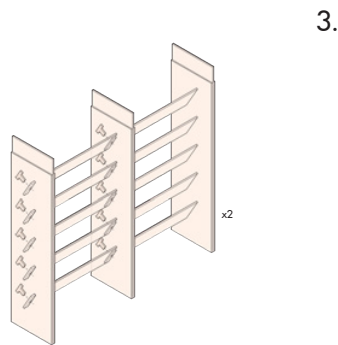
1.

 x3-4 Slide five wall panels into a typical edge column 1 and a typical middle column. Two people should hold the columns in place while another slides the panels into place



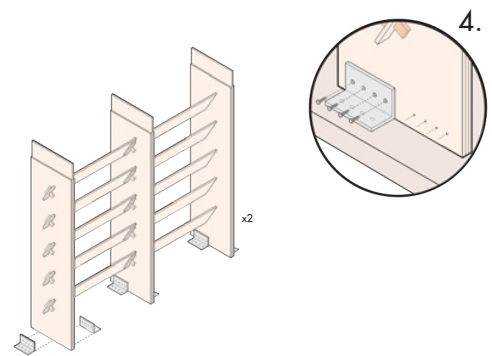
2.

 x3-4 Slide a wall panel connected to a typical edge column 2 into a completed partial wall from step 1



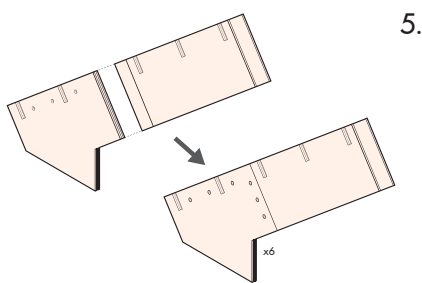
3.

 x1-2 Slide twenty T-pins into each of the wall panel holes to secure them in place



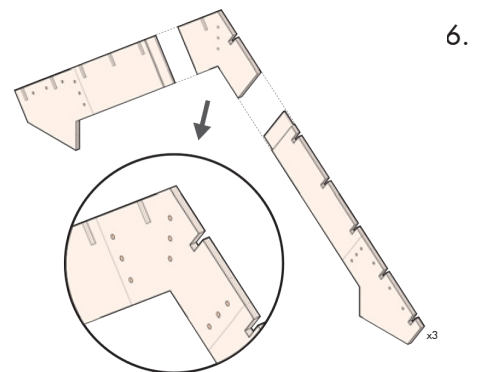
4.

 x2-3 Slide twenty T-pins into each of the wall panel holes to secure them in place. 1-2 People should hold the walls in place while a third bolts the brackets in



5.

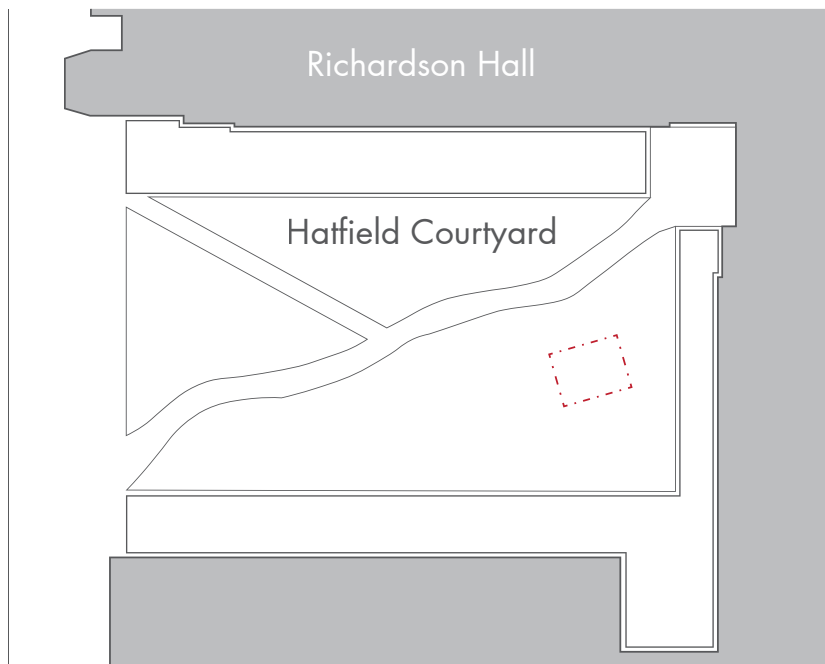
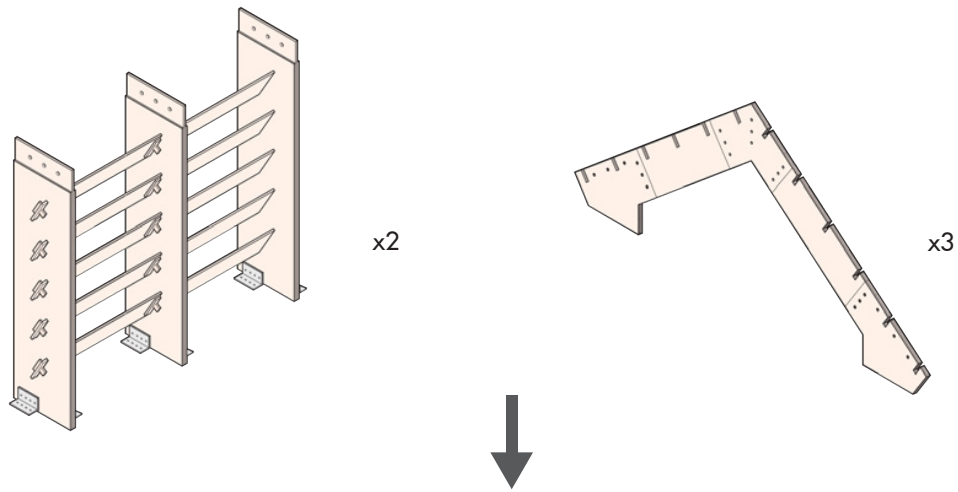
 x3-4 Slide a typical column into a side angle module. Drill 1" holes once connected and secure with dowels hammered into place



6.

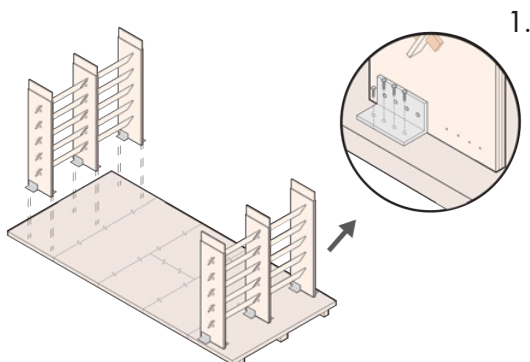
 x3-4 Slide two modules constructed from step 5 into a top angle module. Drill 1" holes once connected and secure with dowels hammered into place

TRANSPORTATION



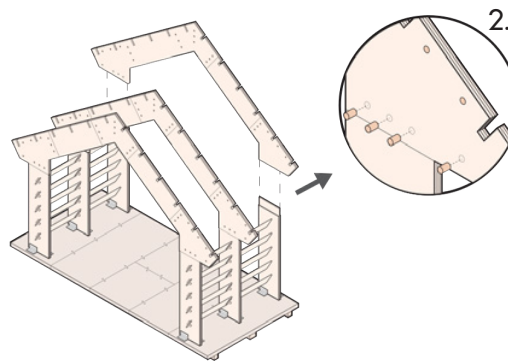
Transport the prefabricated walls and frame tops to site. Each prefabricated element can be carried by 3-4 people

ON-SITE CONSTRUCTION



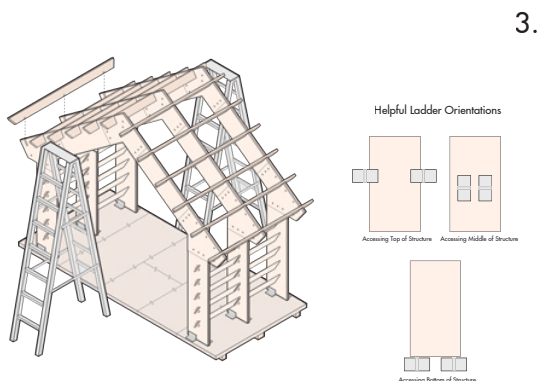
1. x3-4

Place the prefabricated wall modules centered on the MPP foundation. Secure each column with eight bolts through the L-Brackets



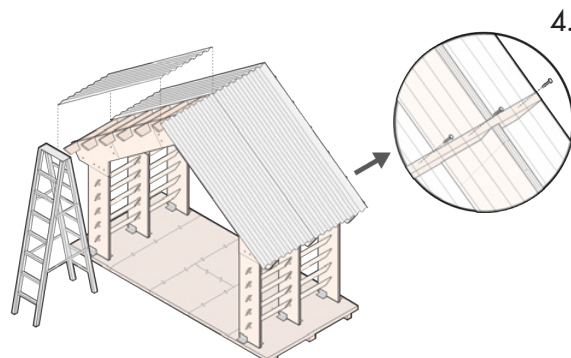
2. x4-5

Place each of the frame tops on the columns. Drill 1" holes once connected and secure with dowsels hammered into place



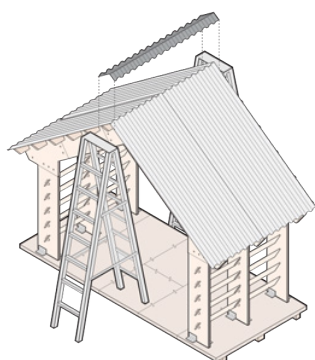
3. x3-4

Hammer in place the twelve 2x6 purlins into the gaps in the frames. Use A-Frame Ladders and locations highlighted to achieve the different heights of the structure



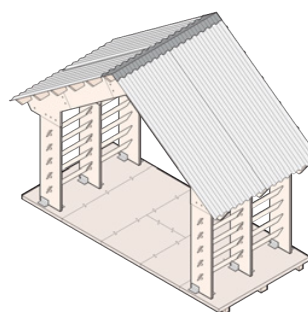
4. x3-4

Screw Fiberglass roof panels into the purlins at each "hill" of the fiberglass. Use A-Frame Ladders and locations highlighted in step 13 to achieve the different heights of the structure



5. x2-3

Screw ridge cap through the fiberglass into the tops of the frames. Use A-Frame Ladders and location highlighted in step 13 to access the top of the structure



6.

Appendix I

Final Risk Planning and Deconstruction

RISK MANAGEMENT PLAN

SAFETY IN DESIGN, CONSTRUCTION PLANNING, AND SITE

- **Design**

Informing design decisions based on safety and lowering the amount of risk was the start to the safety planning. The initial design was significantly taller and due to the risk of working from taller ladders, the design was changed to bring the height to 12' rather than 16'.

- **Construction Planning**

Creating a safe and viable construction plan was crucial in making the process safer for both the construction team and the OSU community who would pass by. All lifting and construction operations were planned to account for safe lifting procedures and keeping any danger contained within the building area. No parts above 25 lbs. were to be lifted by any individual and team lifting was implemented throughout the construction plan.

- **Site**

The entire construction area was roped off with signage attached to prevent unauthorized individuals from entering the construction space. This keeps the both the public safer during construction and the team safer from distractions.

CONSTRUCTION PHASES, HAZARDS, LIKELIHOOD, SEVERITY & MITIGATION

Phase 1 – Site Prep & Materials Handling

Hazard	Likelihood	Severity	Mitigation
Dropping material	Medium	Moderate	Wear gloves and boots, proper lifting technique, team lifting for heavy items
Trip hazards	Medium	Low	Material staging area, maintain clean work zone
Splinters & sharp edges	Medium	Low	Gloves, tool awareness

Phase 2 – Prefabrication and Drill Use

Hazard	Likelihood	Severity	Mitigation
Drill injury to wrist/fingers	Medium	Moderate	Training in tool handling & torque control
Wood chips to eyes	High	Low–Moderate	Mandatory eye protection
Incorrect fastening/ misalignment	Medium	Low	Work done at stable stance, verify alignment

Phase 3 – Ladder Use (Roof Installation & Upper Fastening)

Hazard	Likelihood	Severity	Mitigation
Dropping material	Medium	Moderate	Wear gloves and boots, proper lifting technique, team lifting for heavy items
Trip hazards	Medium	Low	Material staging area, maintain clean work zone
Splinters & sharp edges	Medium	Low	Gloves, tool awareness

Phase 4 – Fiberglass Roof Installation

Hazard	Likelihood	Severity	Mitigation
Sheet catching wind	Low	High	Install in low-wind conditions
Loss of footing	Low	Moderate	Stable ladder position, trained users only
Edge hazard handling	Medium	Low	Gloves to protect from sharp fiberglass edges
Inhalation of fiberglass dust	Low	High	N95 respirators for lung protection

TRAINING, PPE, INCIDENTS, COMPLIANCE

Training Requirements

- Ladder-safety training required for all individuals working above 6'
- Tool-use training for drill handling
- Fall hazard awareness training for ladder operators
- Only trained personnel permitted to perform roofing installation

PPE Requirements

- Safety glasses during all fastening operations
- Gloves during fiberglass and lumber handling
- Closed toe construction-grade footwear encouraged

Emergency and Incident Preparedness

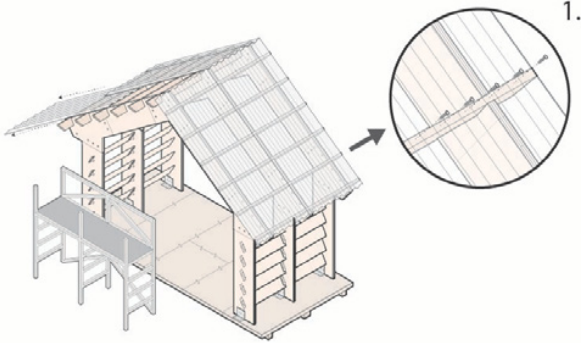
- First Aid kit available nearby
- One individual designated as Safety Coordinator
- Immediate reporting of near-miss and incidents

Compliance and Verification

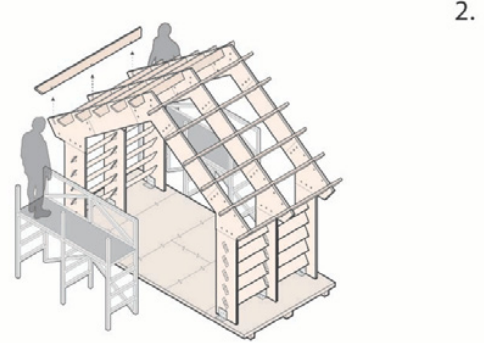
Daily checklist:

- Ladder inspection
- Drill condition and battery integrity
- Work-area housekeeping
- PPE verification

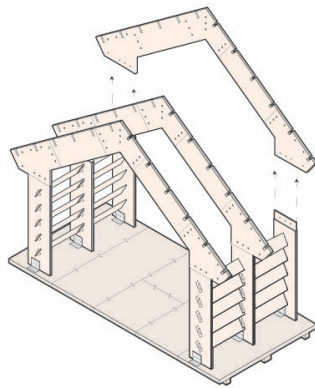
DECONSTRUCTION PLAN



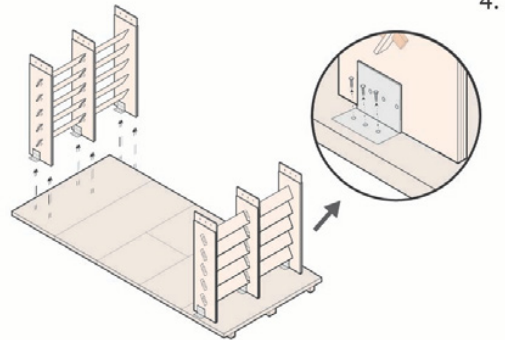
Unscrew fiberglass panels from the purlins
3 people per panel, 1 drill per panel, 1 scaffolding or ladder



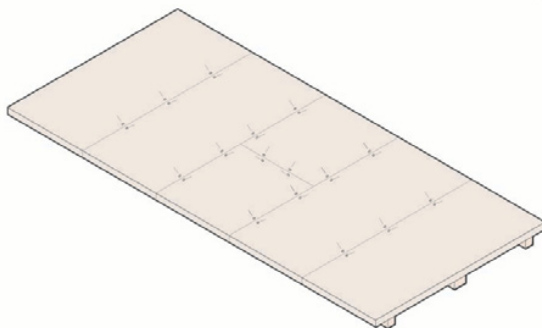
Hammer the purlins out of place, take them out and handoff to someone on the ground
3 people, 2 rubber mallets, 2 scaffolding or ladders



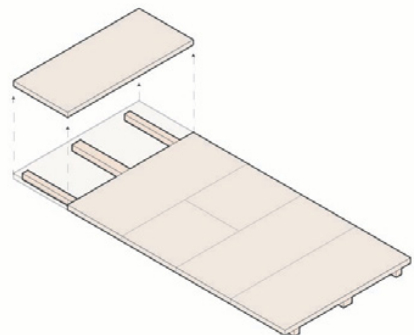
Remove the dowels from the corner joints and remove the top piece as a whole by tilting it down
4-8 people, 2 rubber mallets, 1 scaffolding or ladder per frame



Remove the screws from brackets and remove the walls from the foundation as a whole piece
3 people per wall, 1 drill per wall

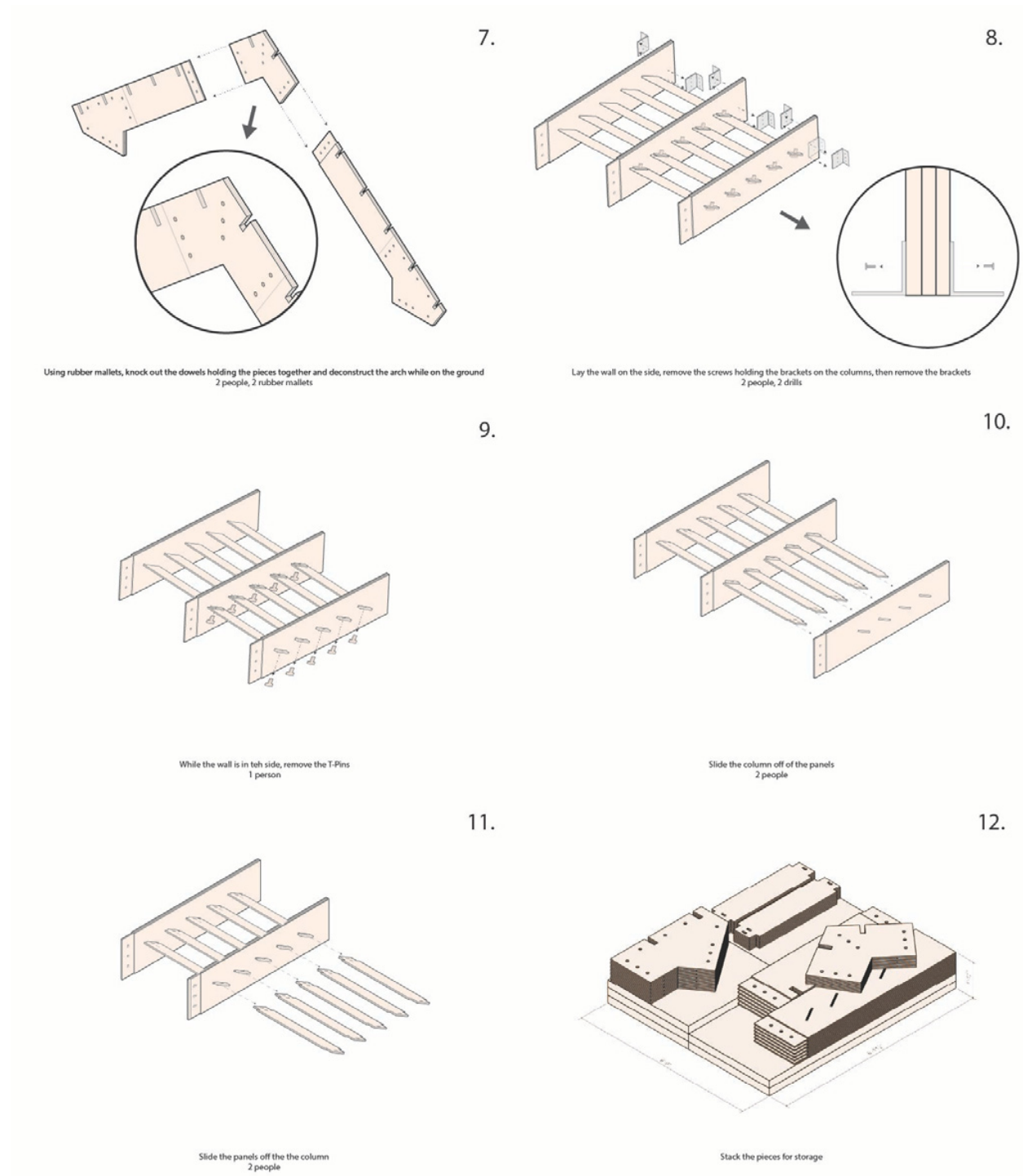


Remove the screws from the MPP panels, releasing them from the beams
2-3 people, 2-3 drills



Remove the MPP panels from the beams
4-6 people per panel

DECONSTRUCTION PLAN



Appendix J

Final Post Construction Reflection

POST CONSTRUCTION REFLECTION

SUCCESSSES:

- Getting the final projects fully built
- No injuries on site
- Production of pieces completed on time

IMPROVEMENTS:

- Find a more efficient fastener rather than dowels
 - Screwing the joints together would be quicker and safer for the construction
- Using a boom lift
 - Instead of having people on ladders holding up the top piece, using a boom lift to get people out of the way could improve safety
- Redesigning wall slats to allow for tilting up the frame as a whole

REFLECTION

Overall, the construction process was very efficient, constructing the whole structure in around 5 hours, and no injuries were sustained, which is a great accomplishment. During our construction, we may have had a couple of hiccups with pieces, but we quickly problem-solved a solution so we could get it done in time. We had the perfect number of people on site for the process. Around 12 people were the ideal amount for the full construction, with 6 people for the addition of the roofing.



MANAGEMENT

PROJECT TIMELINE

WEEK 8

11/17

Receive feedback on feasibility, finalize design

11/19

Iterate solutions based on feedback, start CNC

11/21

Finalize design, finish CNC (UO)

WEEK 9

11/28

Thanks giving Break

11/26

Continue sealing pieces

11/24

Seal CNCed pieces

WEEK 10

12/01

Finish sealing, preassemble parts and prepare for transport

12/03

Assemble structure on site & prepare for presentation

12/05

Final presentation



MATERIAL USAGE & WASTE



RECYCLED WOOD USAGE:

Recycled 2' x 8' plywood panels used: **48**

New 4' x 8' plywood panels used: **21**

Recycled 2" x 6" beams used: **12**

Total recycled material percentage: **59%**



WOOD WASTE:

Wasted plywood per panel: **9 ft²**

Total wasted plywood: **549 ft²**

Total plywood used: **1,440 ft²**

Total wasted material percentage: **38%**

FINANCIAL SUMMARY

Consumable Items							
Category	Item	Vendor	Item Cost	Quantity	Total Cost	Status:	For Who?
Materials	1/8" plywood x 18" x Duck Store		\$ 22.00	8	\$ 176.00	NYC paid	UO
Materials	MDF 3/4" x 48" x 96"	Crosscut Hardwoods	\$ 44.65	2	\$ 89.30	SCYP paid	UO
Materials	Assorted	Home Depot - Jordan	\$ 21.70	1	\$ 21.70	SCYP paid	UO
Materials	Plywood CDX	Jerry's Eugene	\$ 22.50	8	\$ 135.00	SCYP paid	UO
Materials	Shaper Tape	online	\$ 22.00	5	\$ 110.00	SCYP paid	UO
Materials	Plywood CDX 1/2" 4ft	https://www.homedepot.com/pep/	\$ 22.90	8	\$ 183.20	SCYP Paid	UO
Tools & Matr	Flex Seal Liquid Clear	https://www.homedepot.com/p/FLI	\$ 34.98	2	\$ 69.96	SCYP paid	UO
Materials	Corrugated Fiberglass	https://www.betterheadforjerrys.co	\$ 23.75	10	\$ 237.50		OSU
Tools & Matr	4in. Polycarbonate Ri	https://www.betterheadforjerrys.co	\$ 19.99	2	\$ 39.98		OSU
Tools & Matr	Wood dowels 1 inch*	https://www.homedepot.com/p/Pir	\$ 5.48	3	\$ 16.44	SCYP paid	OSU
Materials	Plywood CDX 1/2" 4ft	https://www.homedepot.com/pep/	\$ 22.90	12	\$ 323.76	SCYP Paid	OSU
Tools & Matr	Flex Seal Liquid Clear	https://www.homedepot.com/p/FLI	\$ 34.98	2	\$ 69.96	SCYP paid	OSU
Tools & Matr	Hex Head Wood Scre	https://www.homedepot.com/p/Wc	\$ 6.98	2	\$ 13.96	SCYP paid	OSU
Tools & Matr	Wood dowels 1/4" * Home Depot		\$ 2.08	1	\$ 2.08	Matt paid	OSU
Tools & Matr	Wood glue (one gallo Home Depot		\$ 38.98	1	\$ 38.98	Matt paid	OSU
Tools & Matr	Assorted Sandpaper	Home Depot	\$ 21.96	1	\$ 21.96	Matt paid	OSU
Tools & Matr	Clear Wood Sealer	Home Depot	\$ 92.98	1	\$ 92.98	SCYP paid	UO
			Total		\$1,642.76		
Reusable Item							
Category	Item	Vendor	Item Cost	Quantity	Total Cost	Status:	For Who?
Tools & Matr	Router bits 1/4" flat e	https://www.amazon.com/Spetool-	\$ 61.99	1	\$ 61.99	SCYP paid	UO
Tools & Matr	Router bits tapered b	https://www.amazon.com/Foos-Tag	\$ 39.99	1	\$ 39.99	SCYP paid	UO
Tools & Matr	Router bits asst'd bal	https://www.amazon.com/FOOS-Sj	\$ 29.99	1	\$ 29.99	SCYP paid	UO
Tools & Matr	Hex Head Screw Bolt	https://www.amazon.com/Stainless	\$ 10.48	3	\$ 31.44	Mariapaola	OSU
Tools & Matr	Nuts & Washers	ACE Hardware	\$ 16.25	1	\$ 16.25	Luca paid	OSU
Tools & Matr	Sample Nuts, Bolts & ACE Hardware		\$ 28.43	1	\$ 28.43	Toraja paid	UO
Tools & Matr	4 in. x 3/8 in. Shed Re Home Depot		\$ 5.77	4	\$ 23.08	SCYP paid	UO
Tools & Matr	Paint rollers	Home Depot	\$ 22.68	1	\$ 22.68	Matt paid	OSU
			Total		\$ 253.85		
Vehicle Rentals							
Category	Item	Vendor	Item Cost	Quantity	Total Cost	Status:	For Who?
Transportati	Minivan Rental Oct 3	UO Motorpool	73 + gas	1	\$ 172.52	SCYP paid	UO
Transportati	Sedan Rental Oct 3	UO Motorpool	39 + gas	1	\$ 115.75	SCYP paid	UO
Transportati	Home Depot Truck R	Home Depot	\$ 21.85	1	\$ 21.85		UO
			Total		\$310.12		

AMOUNT AVAILABLE
(SCYP +
STUDIO FEES):

\$2,400

AMOUNT SPENT::

\$2,206.73

ACKNOWLEDGEMENTS



Special thanks to Tom Coates, Phil Mann, Byrne Miyamoto, Art Myers, Sustainable City Year, the City of Tualatin, Arxada, and all the folks at UO and OSU who made this project possible.

REFERENCES:

- NDS 2024

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