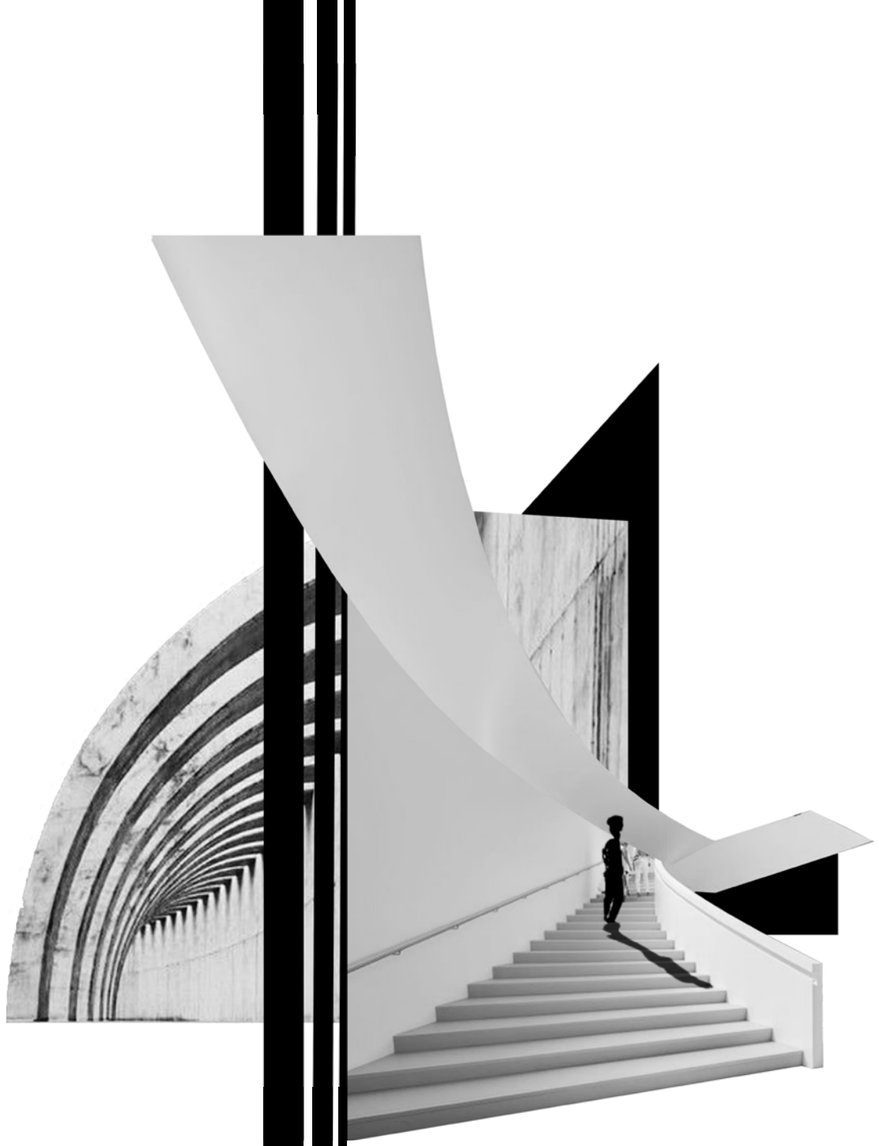

Kaiwen Sun

ARCHITECTURE PORTFOLIO

2025

Kaiwen Sun

Architect/ Designer

Education

Carnegie Mellon University, Pittsburgh, PA MAY 2026

Bachelor of Architecture (BAC) NAAB-accredited 5-year program

Major: Architectural and Building Sciences/Technology

Minor: Intelligent Environment, Human-Computer Interation

Overall GPA: 3.90/4.00, Dean's List

Relevant Courses: Architecture Design Studios, Advanced Structure Design, Intro to Architectural Robotics, Detailing Architectures, Fundamental of Computational Design

Skill

Skills: Adobe Suite, Rhino, Revit, AutoCAD, Grasshopper, Karamba3D, Ameba, Goat, RhinoVault, Robot Studio, V-ray, Python

Languages: English (Bilingual Proficiency), Chinese (Native)

Preject Experience

Robotics Fabrication Compression Only Bench **Pittsburgh, 2024.10 – Now**

- Collaborated in a team of four, integrating skills from advanced structural design and robotics to explore the potential of technologies in a real-scale project.
- Designed and fabricated a compression-only, dry-fit wooden bench with RhinoVault, optimizing the structure to determine ideal form.
- Developed a custom Grasshospper script for ABB 4400 robots, enabling precise 5-axis milling workflow.

Work Experience

Architectural Intern, Studio Zhu-Pei **Beijing, 2024 summer**

- Edited proposals and prepared renderings for client presentations
- Created architectural models using foam, cast concrete, and 3D printing.
- Collaborated on structural details and edit construction drawing in CAD.
- Developed concepts and preliminary designs for projects, including structural details and project-specific furniture using Rhino and Grasshopper.

Architectural Intern, IPPR International Engineering **Beijing, 2023 summer**

- Drew construction plans and sections in AutoCAD for ongoing projects.
- Facilitated in the early stage of bidding projects and produced diagrams.
- Operated professional building energy consumption software, calculated building performance, and generated reports on possible improvements.

Teaching Assistant, Carnegie Mellon University **Pittsburgh, 2022.08 - Now**

- Assisted in class: Digital Media, Material and Assembly, Structure Design II
- Held recitations with 70 students in attendance, did technical demos, graded homework, and addressed individual student's problems or concerns.

Contact Info

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Phone: 412.482.2780
LinkedIn: www.linkedin.com/in/kaiwen-sun

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Public Library

Studio Project, 2024/05

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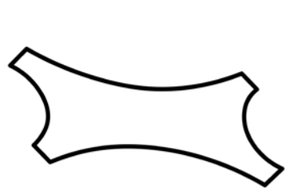
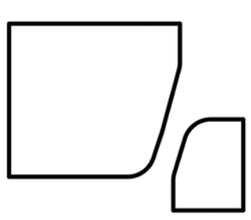


Compression Bench

Structure & Robotic Project, 2025/01

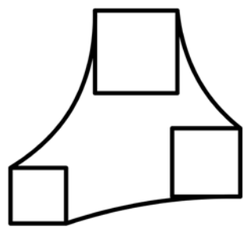
03.



Fire Station

Studio Project, 2024/12

04.



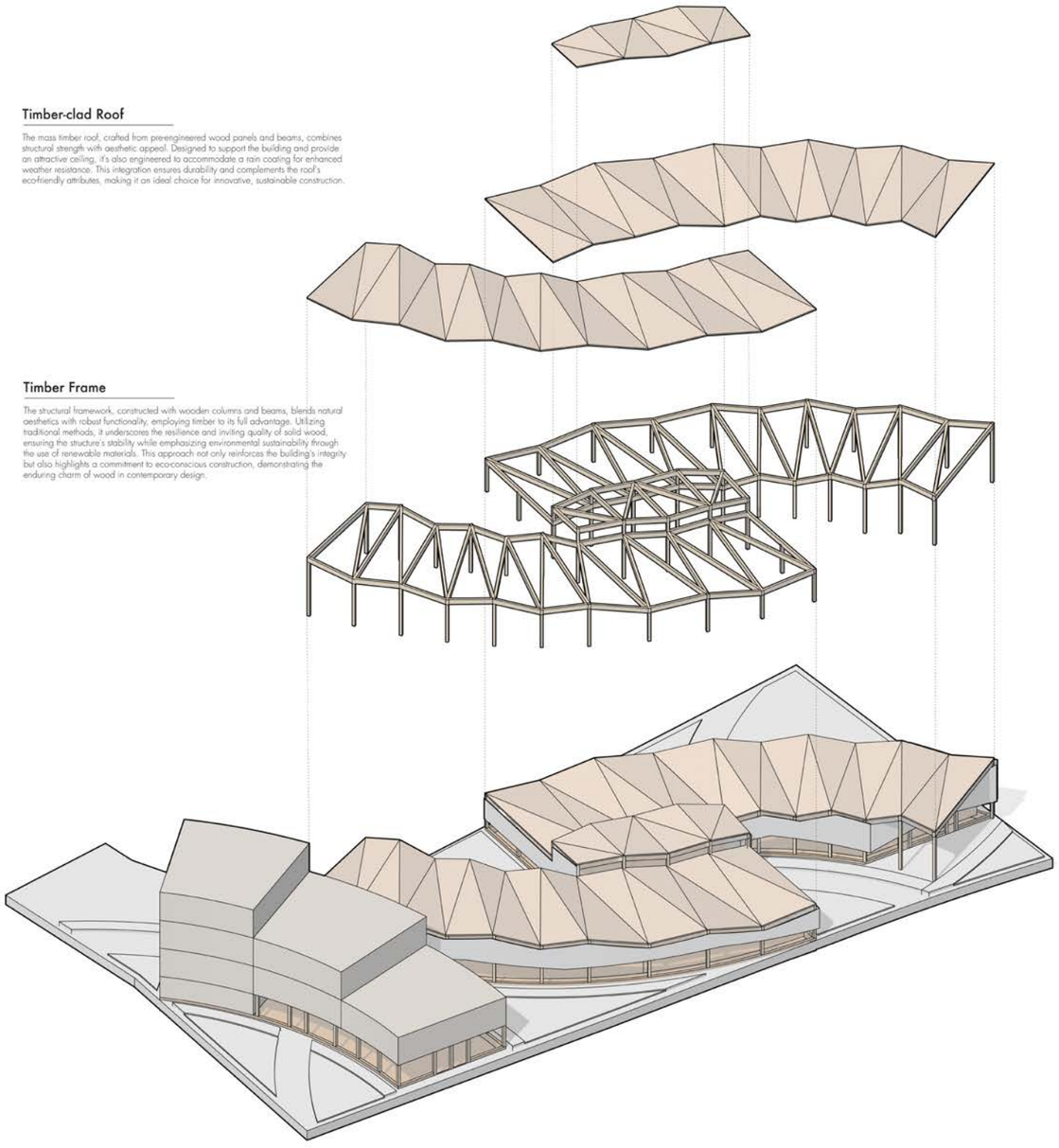
Housing Event Hybrid

Studio Project, 2023/12

05.

Gateway Pavilion

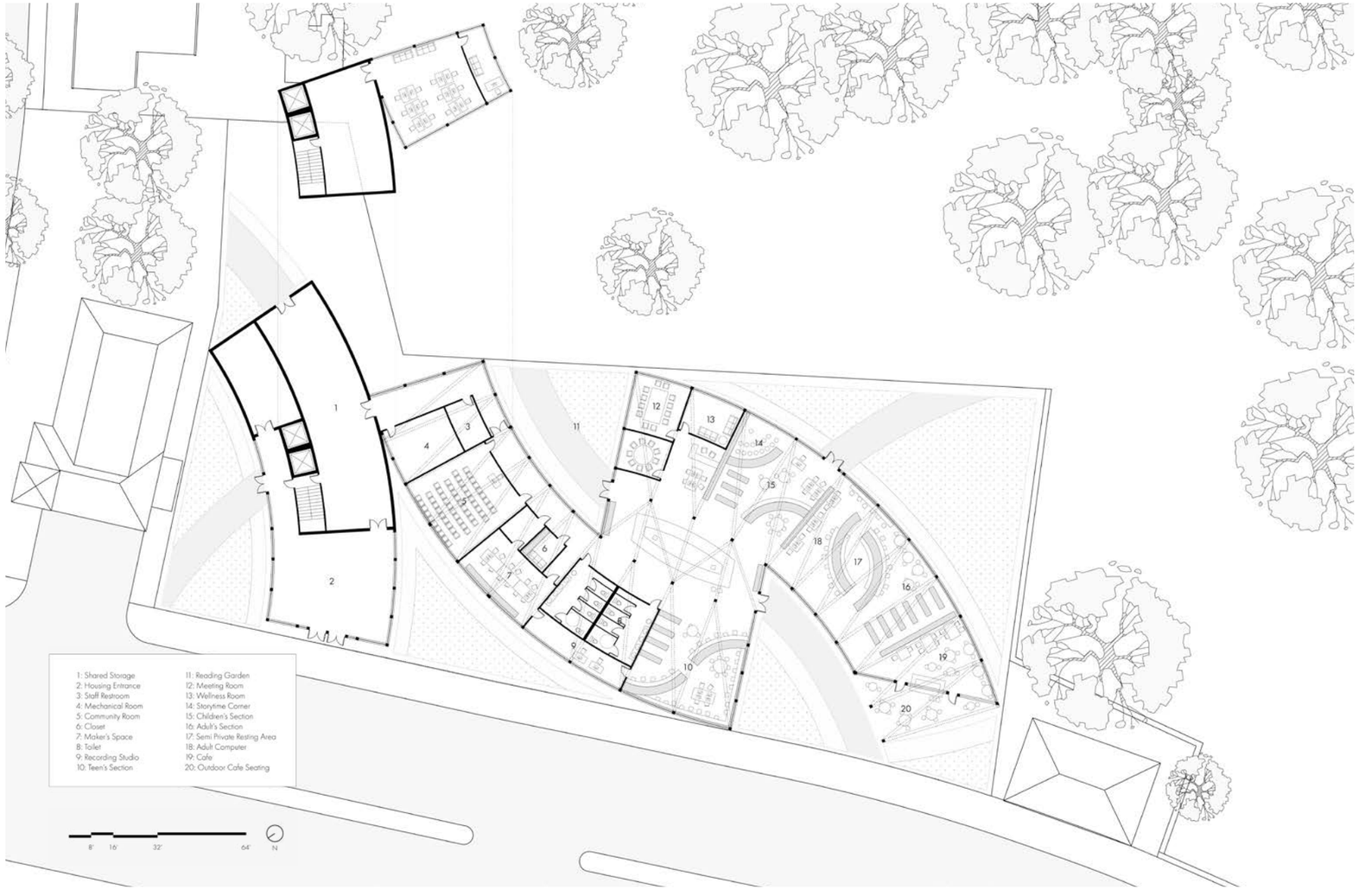
Design Build Project, 2024/06



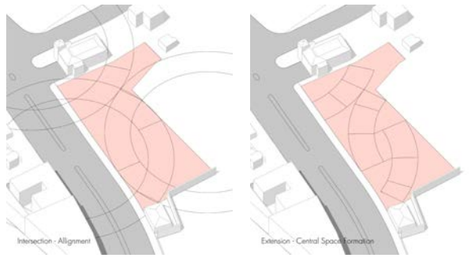
01.
Boston Public Library

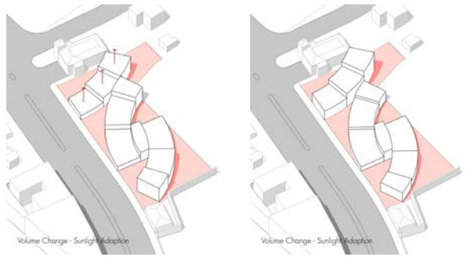
Individual Project
Instructor: Erica Cochran, Jeremy Ficca
Date of Completion: 2024.05
Site: Upham's Corner, Boston

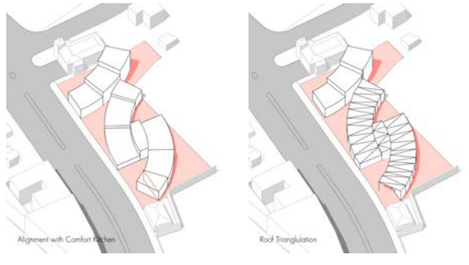
Key Words: : Bright, Welcoming, Open, Iconic, Conveniency, Relax
In my vision for a new public library in Boston's Upham Corner, I aspire to create a space where light, flexibility, and community converge. I imagine a building awash with natural light, featuring high ceilings and expansive open social areas, designed to feel bright, warm, and welcoming. Flexibility is a cornerstone of this vision, with spaces that are customizable and movable to adapt to various needs. I dream of integrating greenery through an enclosed private garden and ensuring outdoor access on ev- ery floor, perhaps through terraces. With a layout that emphasizes ease of circulation and accessibility for all users, my goal is to make logical design decisions that respond to the conditions, needs, and restrictions of the site. More than just a place for books, I want this library to be a compelling destination, giving people a reason to visit even without a specific purpose in mind. Ultimate- ly, my ambition is to create an iconic library that not only serves its functional purpose but also becomes a representative and cherished part of the community.



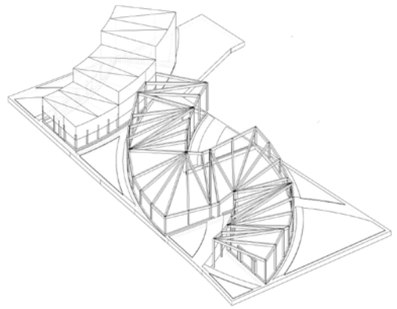
Building Floor Plan





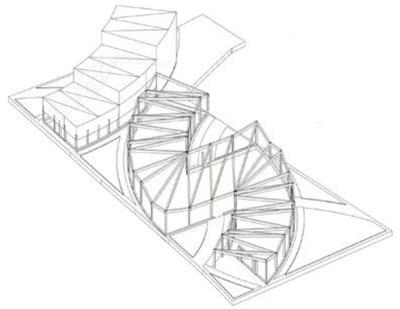


Form Generation



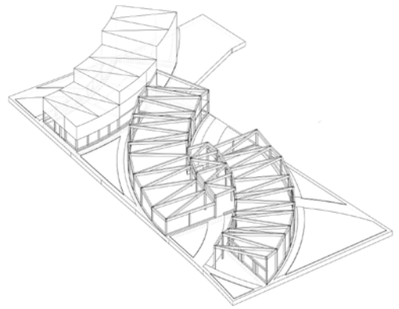
Option 1

original intended version
structure expressive
structure as space divide



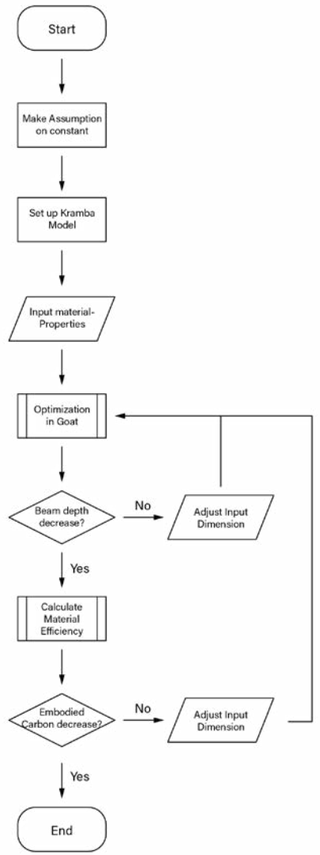
Option 2

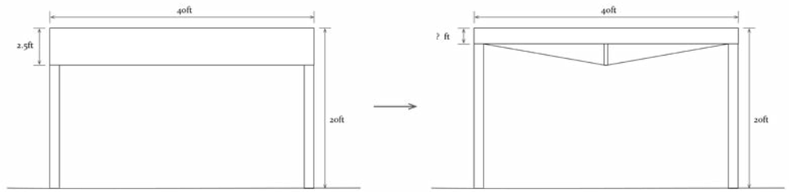
structure modified in the center
avoid multiple beams rest on single column

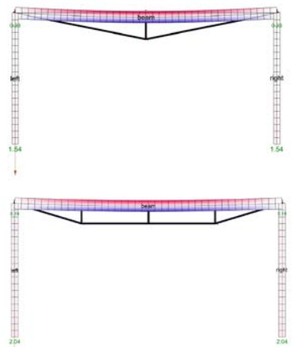


Option 3

final version of structure
decrease the space of beam in the middle
add two more rows of column to break the span







Key Assumptions:

Structure Type: Mass timber structure for a public library.
Span: 40 feet.
Beam and Column Cross-sections: Trapezoidal for both beam and columns; circular cross-section for steel cables.
Materials:
Beam and Column: Timber.
Cables: Steel.

Support Conditions: Pin supports at the base of columns, no translation or rotation allowed

Optimization Settings:

Optimization Algorithm: COBYLA

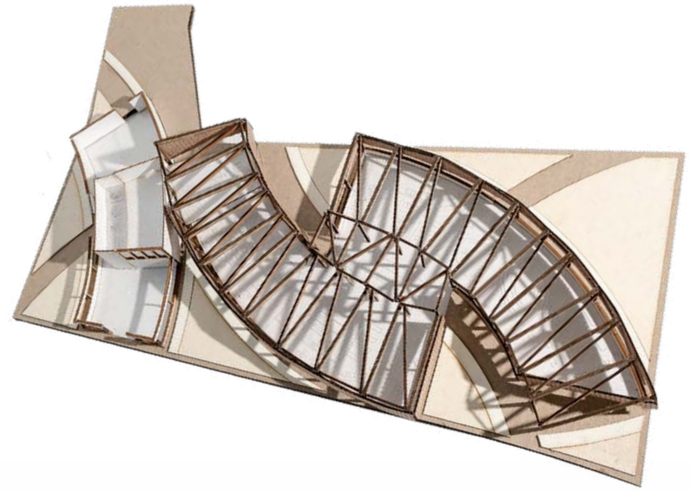
Variables:
Beam Depth: The primary variable being minimized.
Number of Cable Supports: Adjustable to optimize load distribution and deflection control.

Stopping Criteria:
Relative change in objective or variables falls below 0.001.
Maximum runtime of 30 seconds.

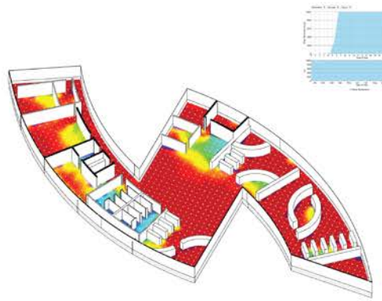
Before

After

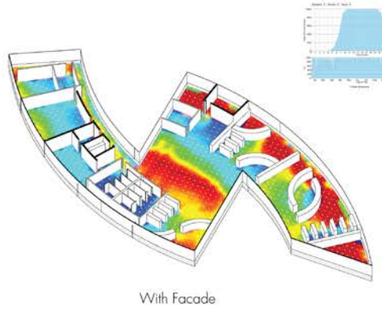
Goat Optimization - Reduce Beam Depth



building structure model, 1/16" = 1'



Without Facade



With Facade

	Spring	Summer	Fall	Winter
9am				
12pm				
3pm				
6pm				

Building Envelope Performance Matrix

02.

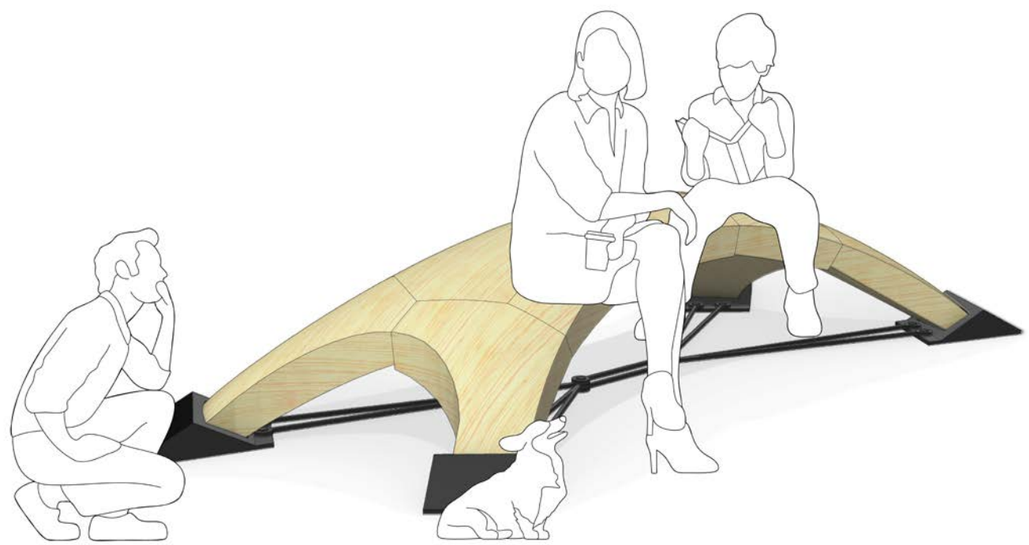
Compression Only Furnicular Bench

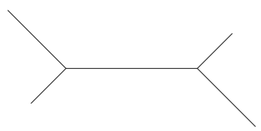
Team Project: collaborated with Darin Kim, Eric Yu, Hazel Froling
Instructor: Juney Lee, Joshua Bard, Vina Wei
Start Date: 2024.10, Expected Date of Completion: 2025.03
Joint Project of elective Advanced Structure Design and Architectural Robotics

This project explores the use of architectural robotics to mill a wooden bench structure designed to be assembled using a compression-only, dry-fit technique. Leveraging RhinoVault's structural optimization capabilities, we aim to create a stable, durable bench that relies solely on the compression of its parts for structural integrity, eliminating the need for adhesives or fasteners.

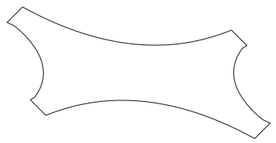
A key focus of the project is developing custom toolpaths in Grasshopper, tailored to the specific geometries of each component in the bench. By creating precise toolpaths, we aim to ensure each part is milled accurately to meet the project's exacting structural requirements. This workflow will allow us to produce unique, complex shapes that fit together seamlessly, supporting the bench's dry-fit design.

Through this project, we seek to build practical skills in creating advanced toolpaths, which are highly relevant to the evolving field of robotic architectural fabrication. The ability to customize and optimize toolpaths for unique, structurally demanding designs is increasingly important in architecture and construction, as the industry embraces automation and precision manufacturing. This project not only results in a functional, aesthetically pleasing bench but also enhances our understanding of robotic milling techniques and digital-to-physical workflows, contributing to our broader skillset in advanced fabrication technologies.

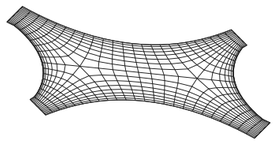




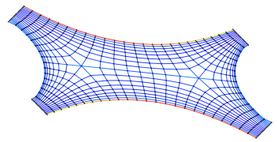
Skeleton



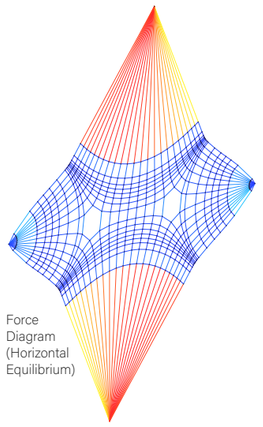
Boundary



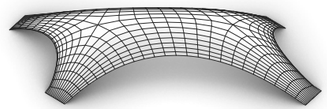
Mesh



Form
Diagram
(Horizontal
Equilibrium)

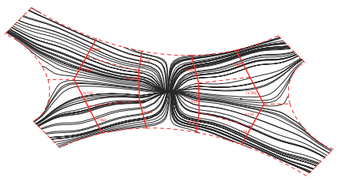


Force
Diagram
(Horizontal
Equilibrium)



3d Mesh
(Vertical Equilibrium)

Form Finding Process Using RhinoVAULT



Computational Tessellation of Freeform, Cut-Stone Vaults
Matthias Rippmann and Philippe Block

Simple rules that have dictated the panelization of historic masonry shell structures:

1. Voussoirs should be aligned such that the load-transferring contact faces are as perpendicular as possible to the local force flow to prevent sliding failure.
2. The tessellation pattern should be staggered or similarly laid out to ensure an interlocking voussoir arrangement.
3. The size of voussoirs should be as uniform as possible over the entirety of the surface.

$$\tan\theta = \mu_s$$

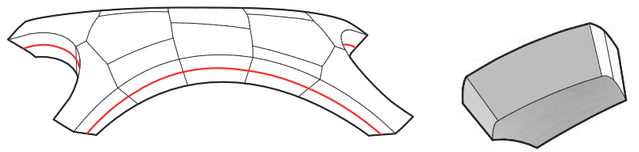
This equation is provided by Rippman and Block, in which the static coefficient of friction between elements, **μs**, is used to determine the friction angle **θ**, which is the angle between the normal of the load-transferring face and the local force vector.

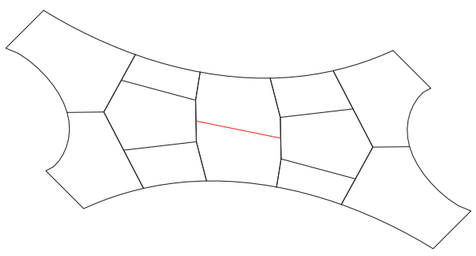
The static coefficient of friction for pine-on-pine is 0.55, resulting in a friction angle of 28.26.

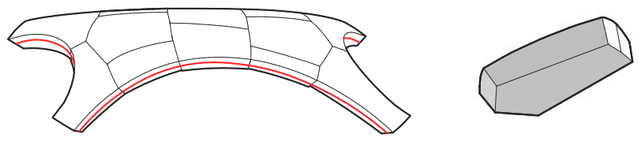
With this equation, it was discovered that the friction angle between load-transferring faces must be lower than 28.26 degrees.

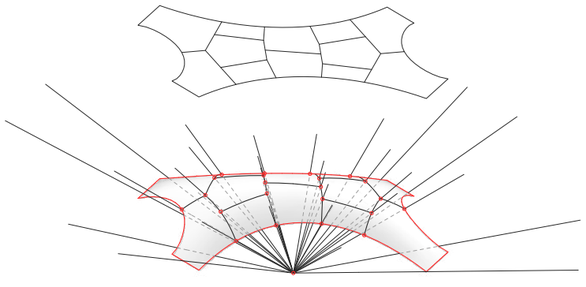
A force flow simulation was conducted using Karamba with a point load of 287.2 lbs, the 95th percentile of weight for adult males aged 20 and over in the US. The force flows were used to determine the optimal location of connective faces between the panels, which act as load-transferring faces.

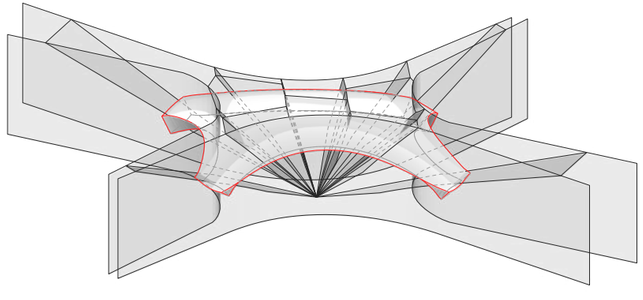
After measuring the size of every panel, it was determined that the middle panel (the keystone) was too big to be cut out from our stock material. Therefore, it was divided into two, making sure to follow the force flows at the apex of the structure in order to avoid the new division becoming a load-transferring face.







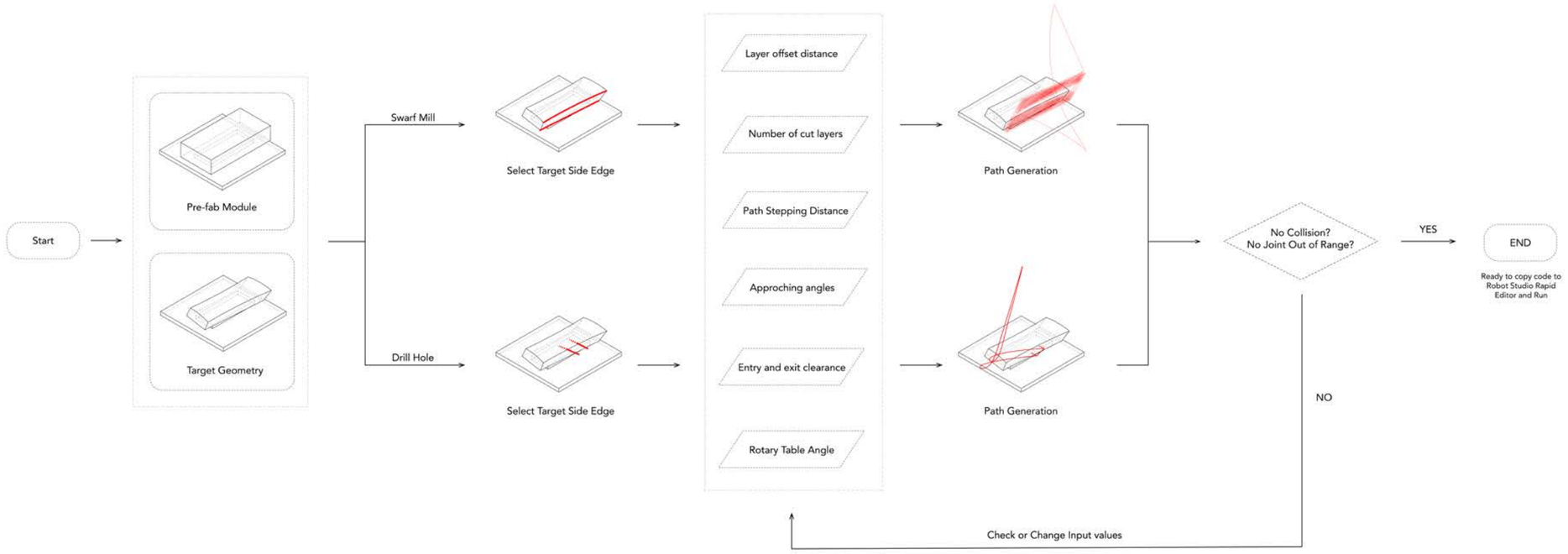




Left: To ensure all the panels would have a flat face for the compression tranfer surfaces, we devised a technique to draw the splitting surfaces fro a single point.

Above: After finalizing the panelization process for the compression-only bench structure, we shifted our focus to optimizing the panel thickness based on the applied forces and our selected material, which we decided would be wood. Through extensive testing in Karamba, we determined that the ideal thickness for each panel would be 2.75 inches. Additionally, we decided that the bottom of each panel should have a flat surface to ensure a strong connection during milling, while the top surface could retain its curved form.

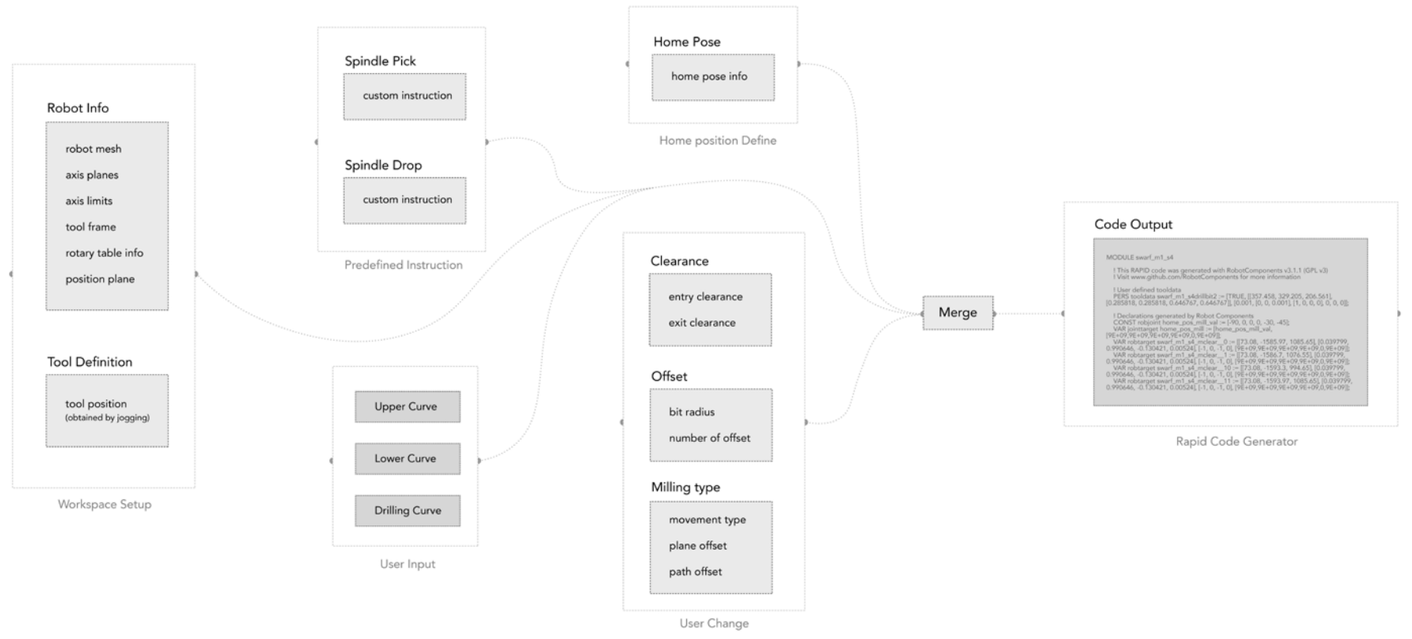
Finite Element Analysis Using Karamba and Panelization



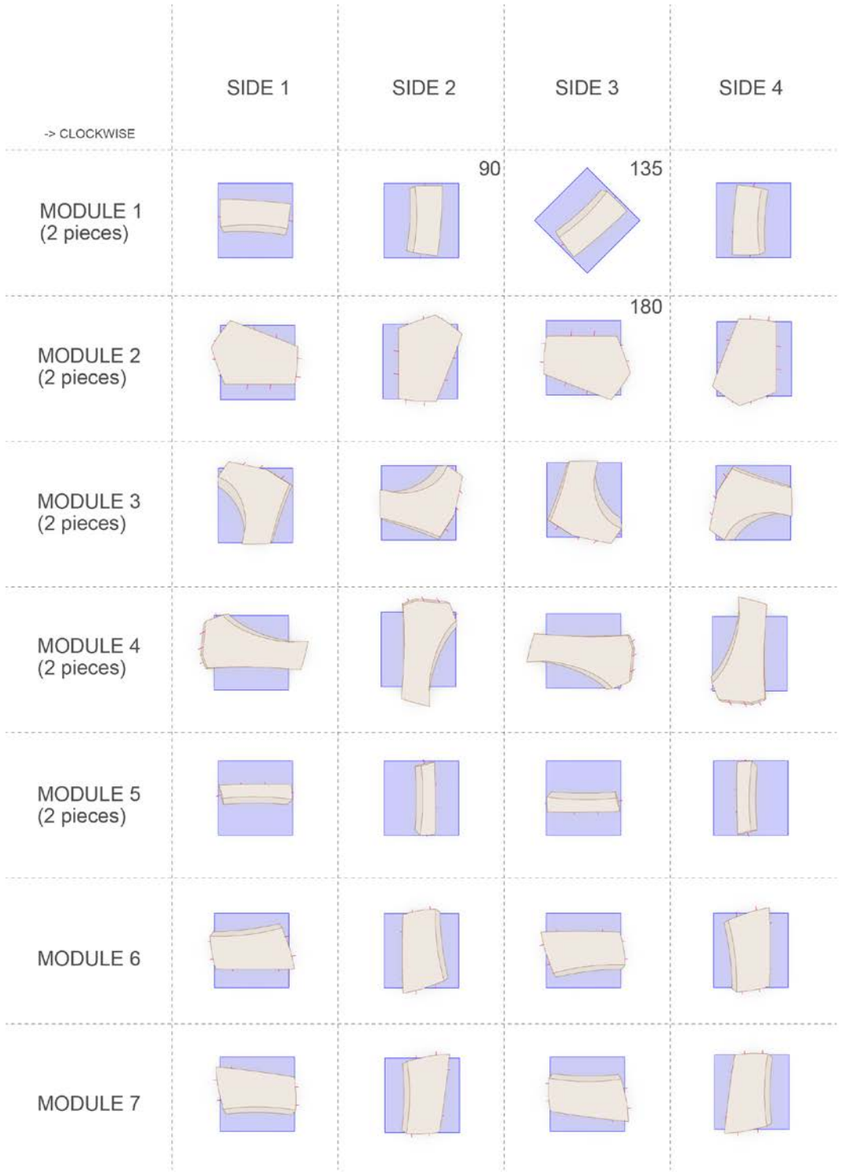
Robotics Fabrication Workflow


Swarf Milling

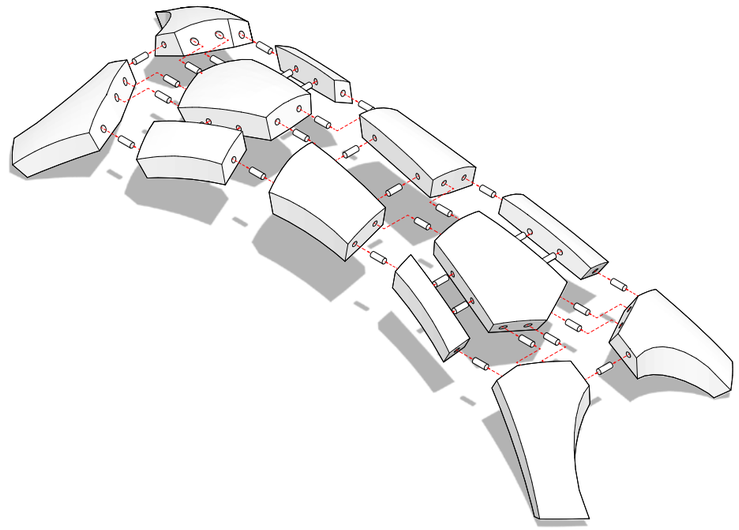

Drilling



Grasshopper Script Logic

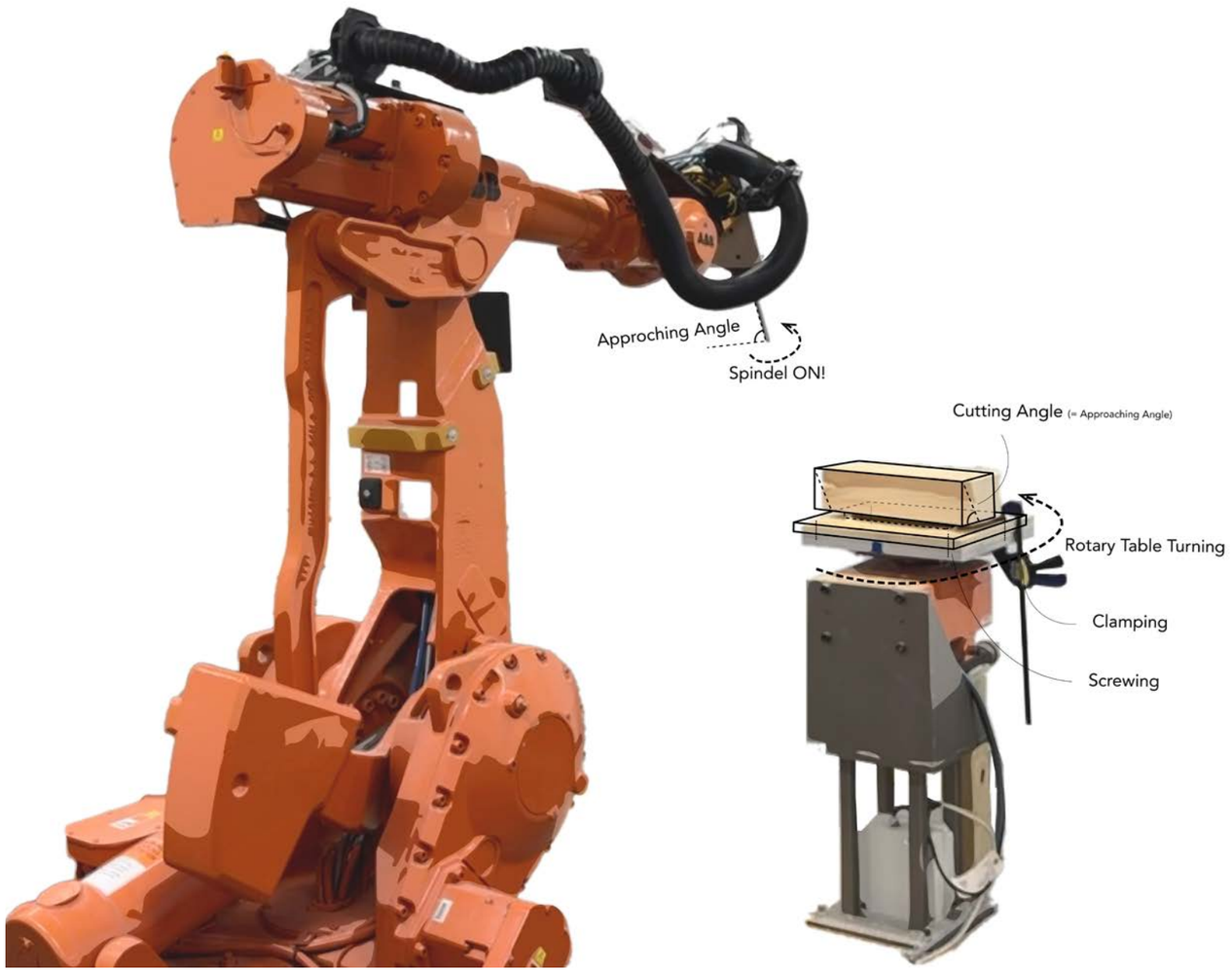


Pieces Matrix



Assembly Illustration

3D Printed Assembly Study Model



Workspace Setup

Real Scale Assembled Bench Leg

Whole Bench Expected to Finish by March, 2025

03.
Uptown Fire Station

Collaboration Project with Andrew Wang
Instructor: Kristina Fisher, Gerard Damiani
Consultant: Juney Lee, James Dudt, Studio NYL
Date of Completion: 2024.12
Site: Uptown, Pittsburgh

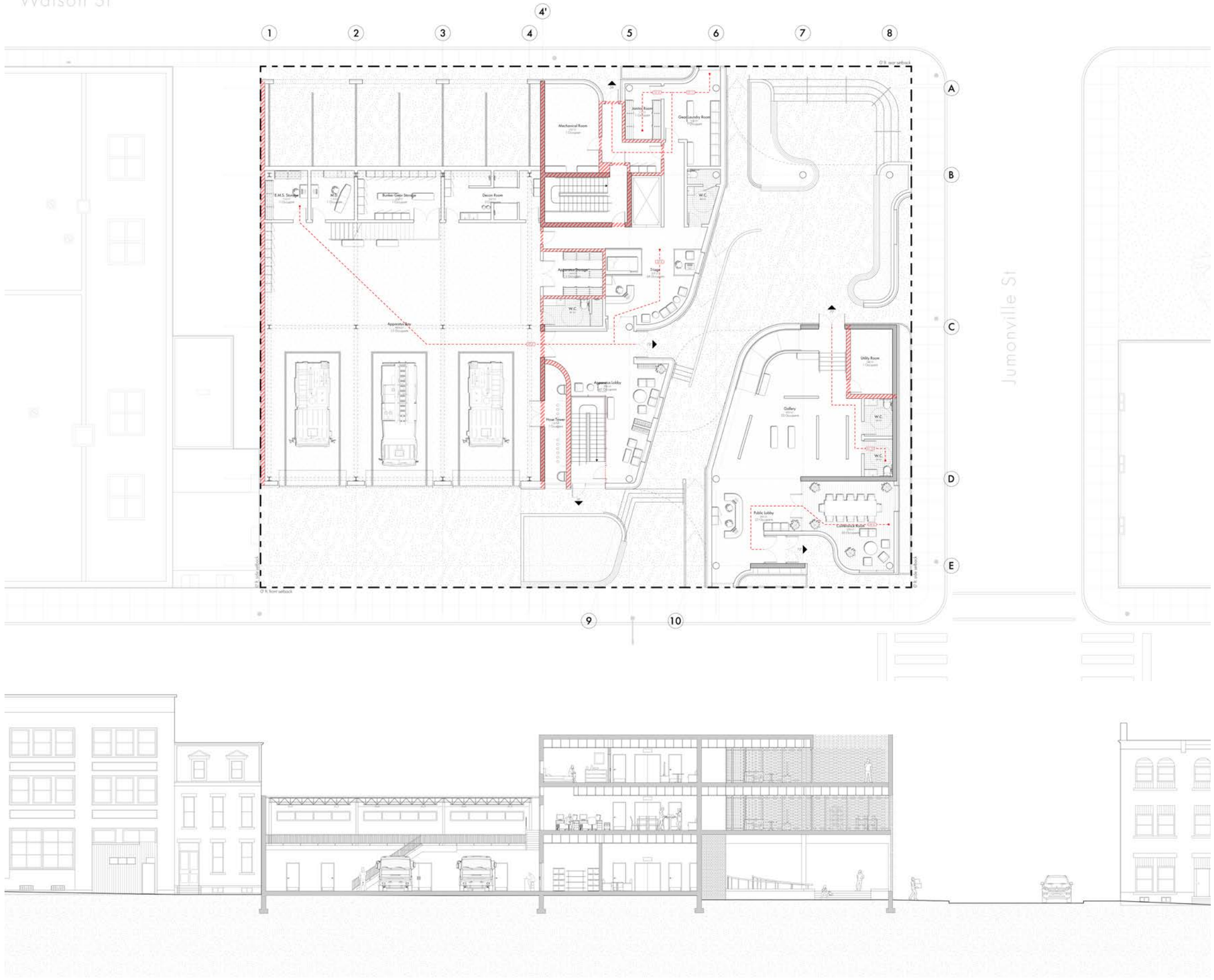
VISION
Our fire station transcends its function as an emergency service hub to become an integral part of the community—a space blending work, comfort, and experience. By fostering connections with its occupants, the neighborhood, and the environment, it sets a new standard for civic architecture, promoting inclusivity, transparency, and urban adaptability.

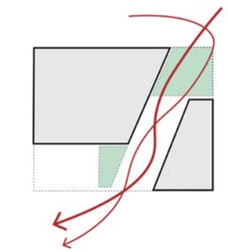
CONTEXT & COMMUNITY
Located between Forbes and Fifth Avenues, the station bridges the past and present, embracing the neighborhood's evolving character. Its approachable design, visible interiors, and inviting entrances foster pedestrian engagement and community pride, transforming it into an open, inclusive civic space.

FORM & MATERIALITY
Steel in the apparatus bay ensures expansive, column-free spans, while on-site cast concrete shapes the building's unique peels and transitions. Together, these materials balance functionality and architectural ambition, enhancing openness, flexibility, and connection.

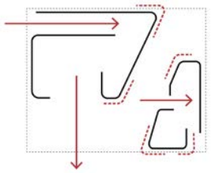
ENVIRONMENTAL RESPONSIBILITY
The design incorporates sustainability through a green roof water collection system and an efficient furnace-based HVAC system, reducing resource dependence and operational costs while supporting ecological well-being.

CONCLUSION
Through thoughtful design, material choices, and sustainable systems, the fire station uplifts its neighborhood, fosters engagement, and stands as a testament to shared civic values.

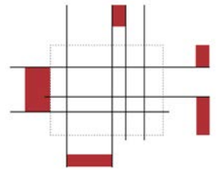




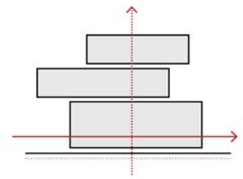
Neiborhood Passageway



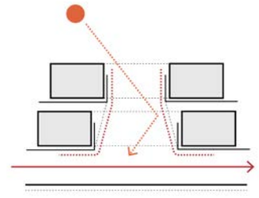
Peeling



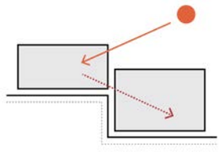
Urban Grid Allignment



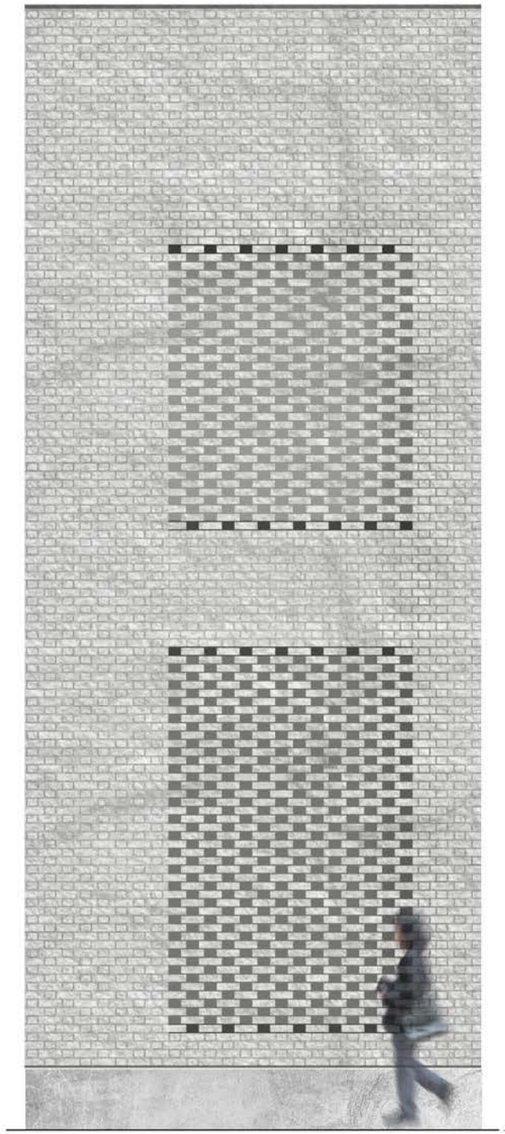
Public vs Private



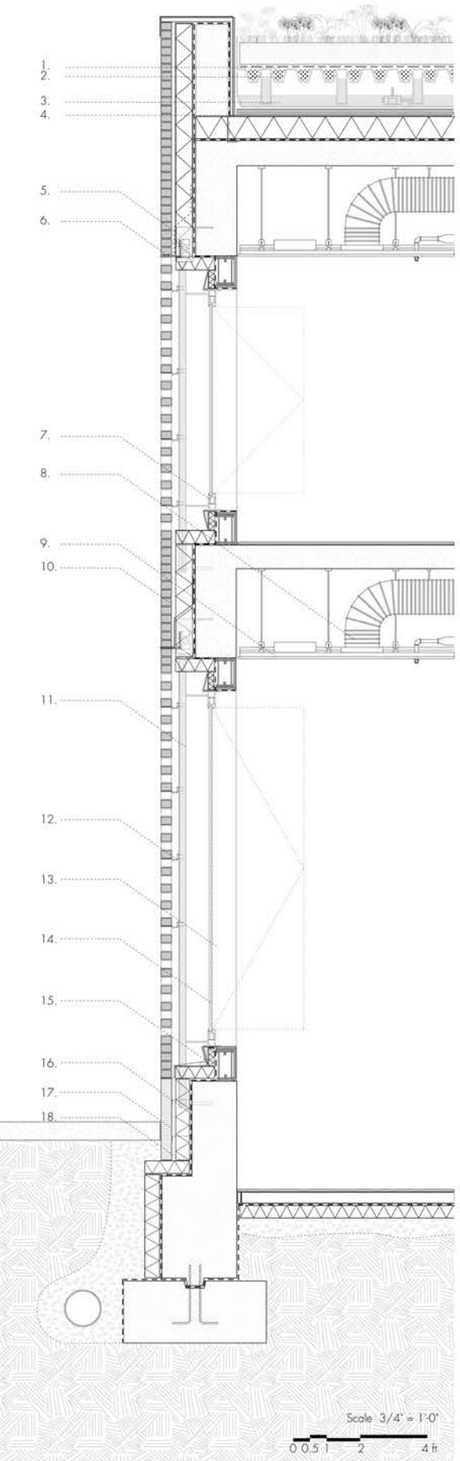
Experiential Lighting Atrium



Staggerd Floor

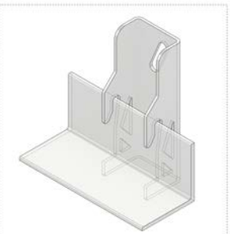


1. RAIN SYSTEM FILTER
2. GARDEN GR30 CUP
3. WATER RESERVIOR
4. HYDROFLEX 30
5. FERO C-SHAPE BRAKET
6. FERO LINTEL
7. WINDOW MOULIN
8. HVAC DUCTWORK
9. LIGHTING FIXTURE
10. EXTERIOR FACADE BRICK
11. ANGLED STEEL FRAME
12. HB213 BRICK ANCHOR
13. CONCRETE COLUMN
14. TRIPLE GALZED WINDOW
15. METAL SHEET FINISH
16. AWRB RESISTANCE LAYER
17. GRANITE
18. INSULTAION



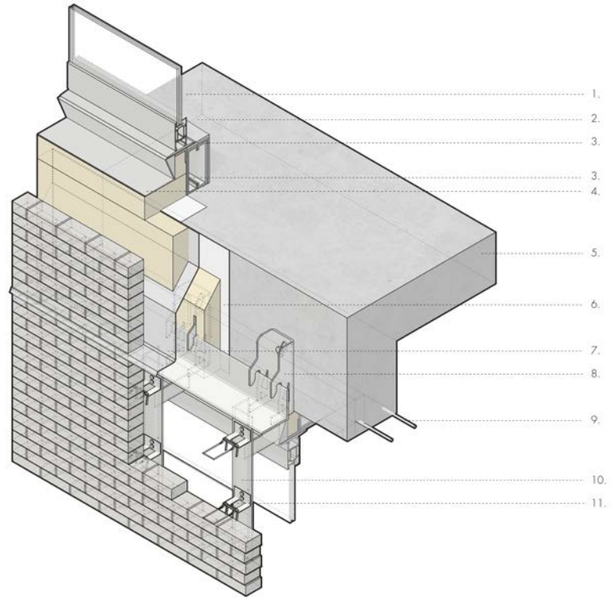
HB-213 Adjustable Veneer Anchor

Manufacturer Credit



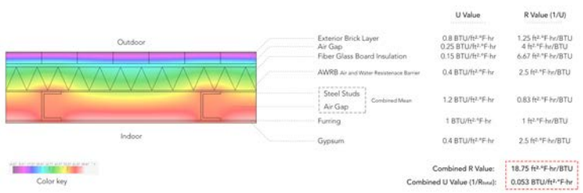
FERO FAST Thermal Bracket™ Offset Shelf Angle (with Lintel)

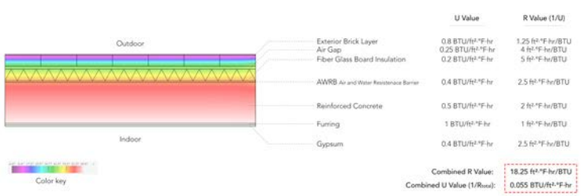
Manufacturer Credit



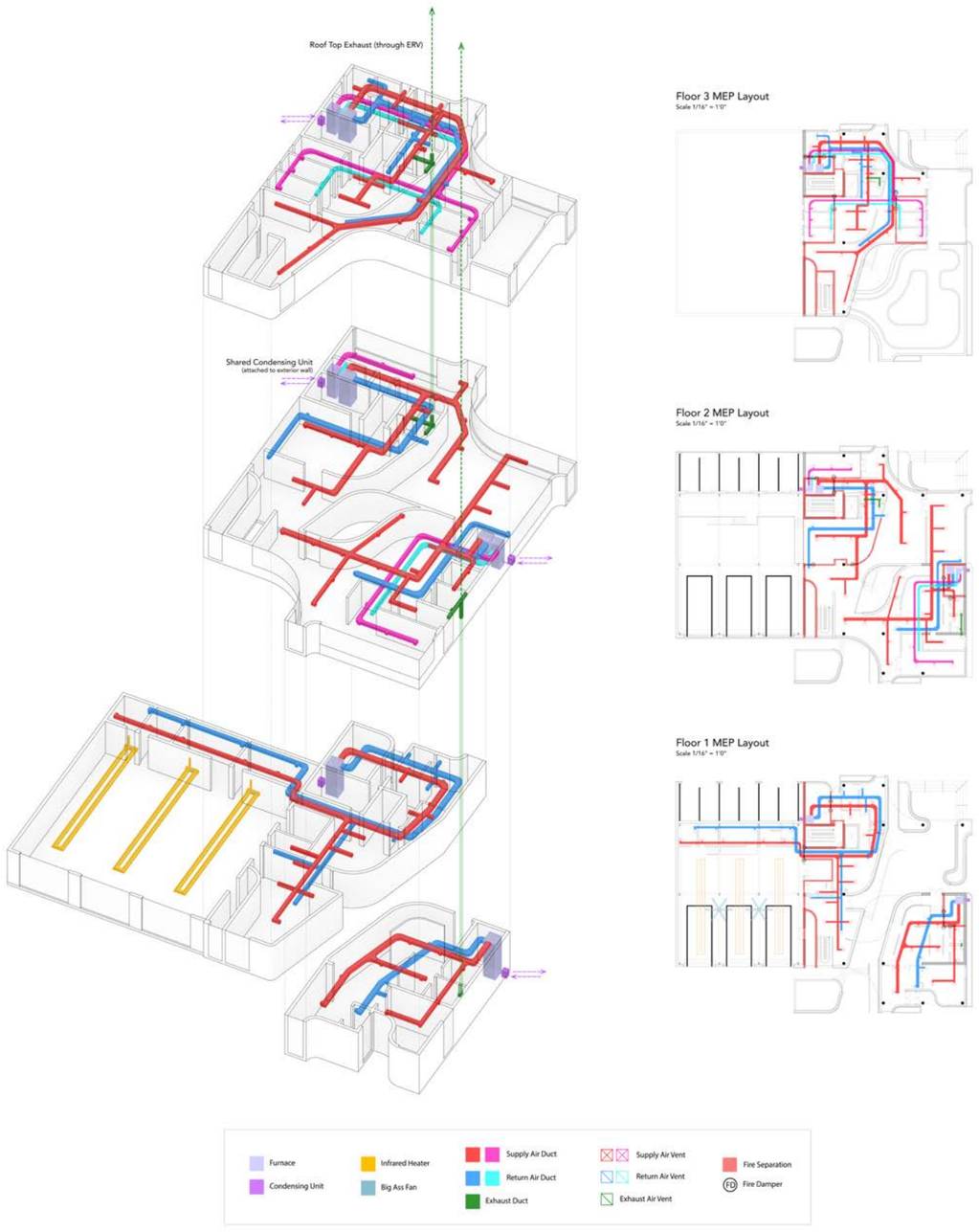
1. GLASS GLAZING
2. WINDOW MULLION
3. FIBER GLASS INSULATION
4. METAL FINISH
5. CONCRETE
6. AWRB MEMBRANE
7. STEEL FLASHING
8. FERO THERMAL BRACKET
9. STEEL REBARS
10. STEEL FRAMING
11. HB-213 VENEER ANCHOR

Exterior Enevelope Assembly Illustration





THERM wall analysis

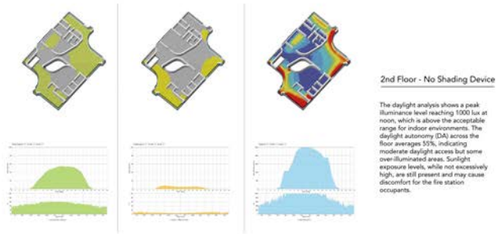


Building Mechanical System Integration

Exterior Building Render

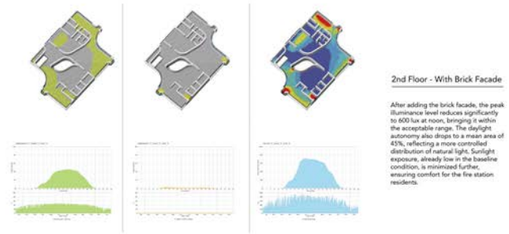
Apparatus Bay Render

Building Envelope Rendering



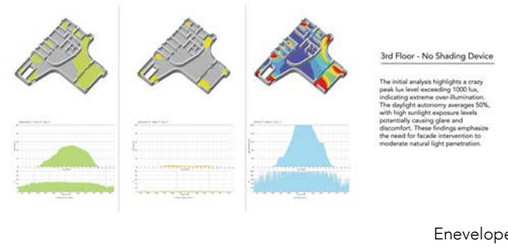
2nd Floor - No Shading Device

The daylight analysis shows a peak illuminance level reaching 1000 lux at noon, which is above the acceptable range for indoor environments. The daylight autonomy (DA) across the floor averages 55%, indicating moderate daylight access but some over-illuminated areas. Sunlight exposure levels, while not excessively high, are still present and may cause discomfort for the fire station occupants.



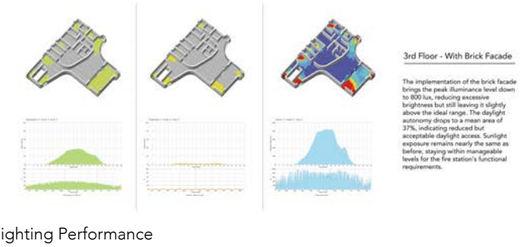
2nd Floor - With Brick Facade

After adding the brick facade, the peak illuminance level reduces significantly to 600 lux at noon, bringing it within the acceptable range. The daylight autonomy also drops to a mean area of 45%, reflecting a more controlled distribution of natural light. Sunlight exposure, already low in the baseline condition, is minimized further, ensuring comfort for the fire station residents.



3rd Floor - No Shading Device

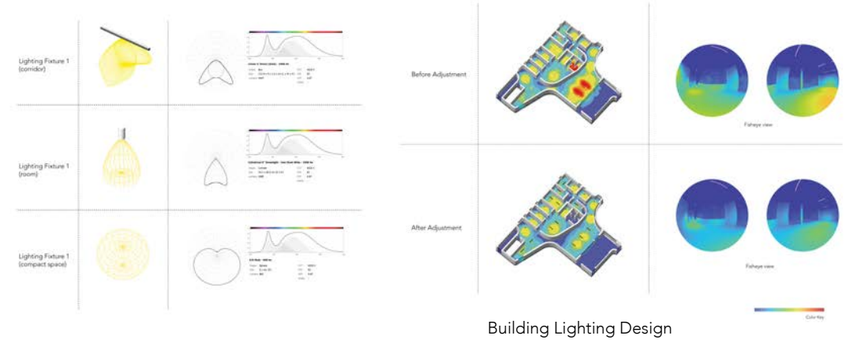
The initial analysis highlights a crazy peak lux level exceeding 1000 lux, indicating extreme over-illumination. The daylight autonomy averages 50%, with high sunlight exposure levels potentially causing glare and discomfort. These findings emphasize the need for facade intervention to moderate natural light penetration.



3rd Floor - With Brick Facade

The implementation of the brick facade brings the peak illuminance level down to 800 lux, reducing excessive brightness but still leaving it slightly above the ideal range. The daylight autonomy drops to a mean area of 37%, indicating reduced but acceptable daylight access. Sunlight exposure remains nearly the same as before, staying within manageable levels for the fire station's functional requirements.

Enevelope Daylighting Performance



Lighting Analysis for 3rd Floor - Fireman Resting Areas

Before Adjustment:

Over-illumination in bunker rooms and public reading areas caused lux levels to exceed 250 lux (~400 lux), as shown by the red zones in the simulation. This was due to the placement of three linear lights in a row, resulting in excessive brightness and discomfort.

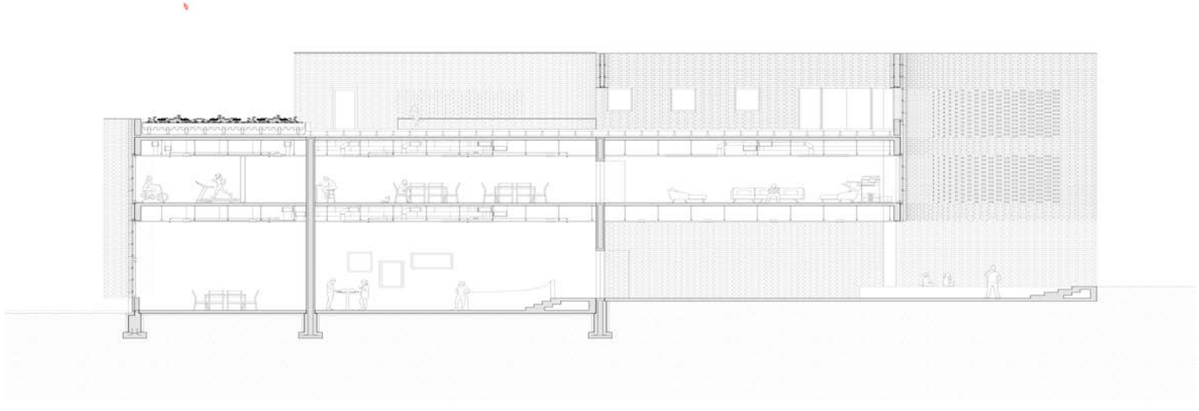
After Adjustment:

Reducing the number of linear lights brought lux levels to the required 250 lux for public reading areas, ensuring functionality without over-illumination. Cylindrical downlights were installed in compact spaces, achieving the required 50 lux for bedrooms while preventing glare and maintaining comfort.

Observation - Activity-Based Lux Levels:

Bunker Rooms: Optimized for rest at 50 lux.
Public Reading Area: Adjusted to 250 lux for focused activities.
Corridors: Linear lights set to 70-100 lux for safe movement.

Building Lighting Design



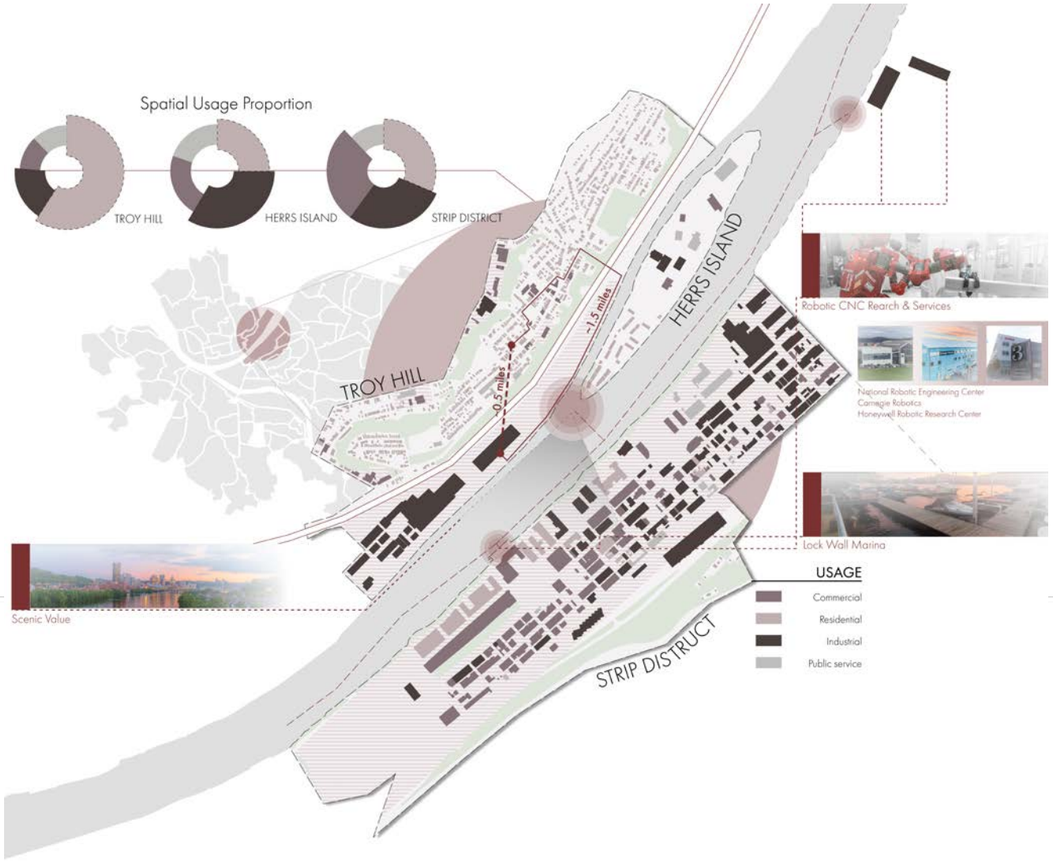
Building Detail Section

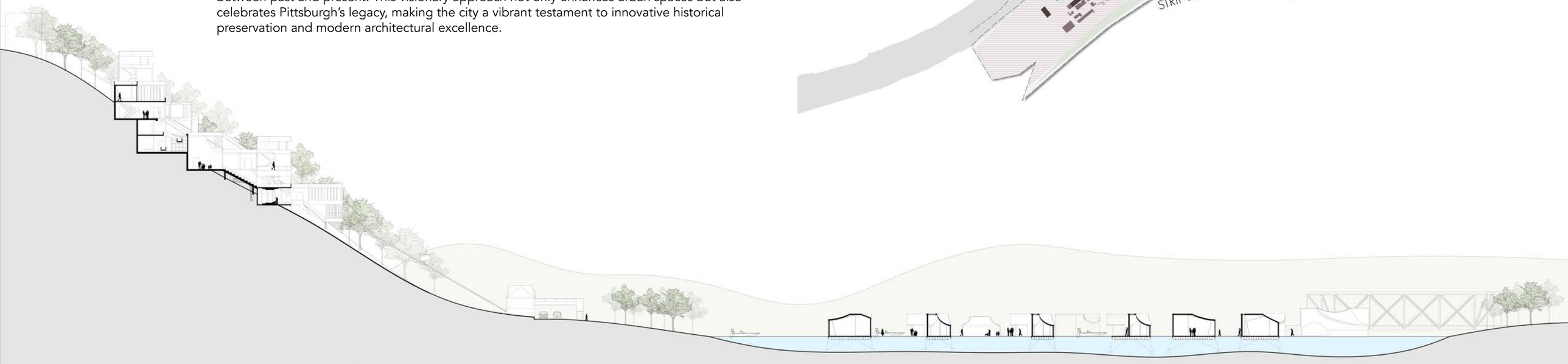
04.

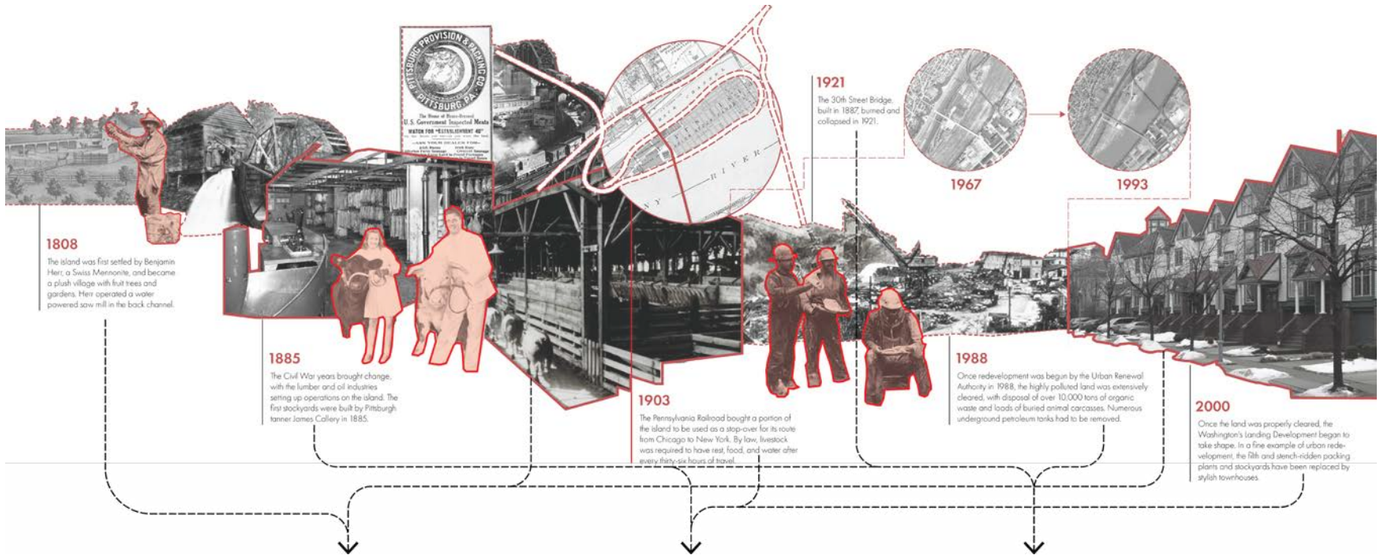
Pittsburgh Necklace

Collboration Project with Andrew Wang
Instructor: Vicky Achnani, Tuliza Sindi, Heather Bizon
Date of Completion: 2023.12
Site: Pittsburgh, PA

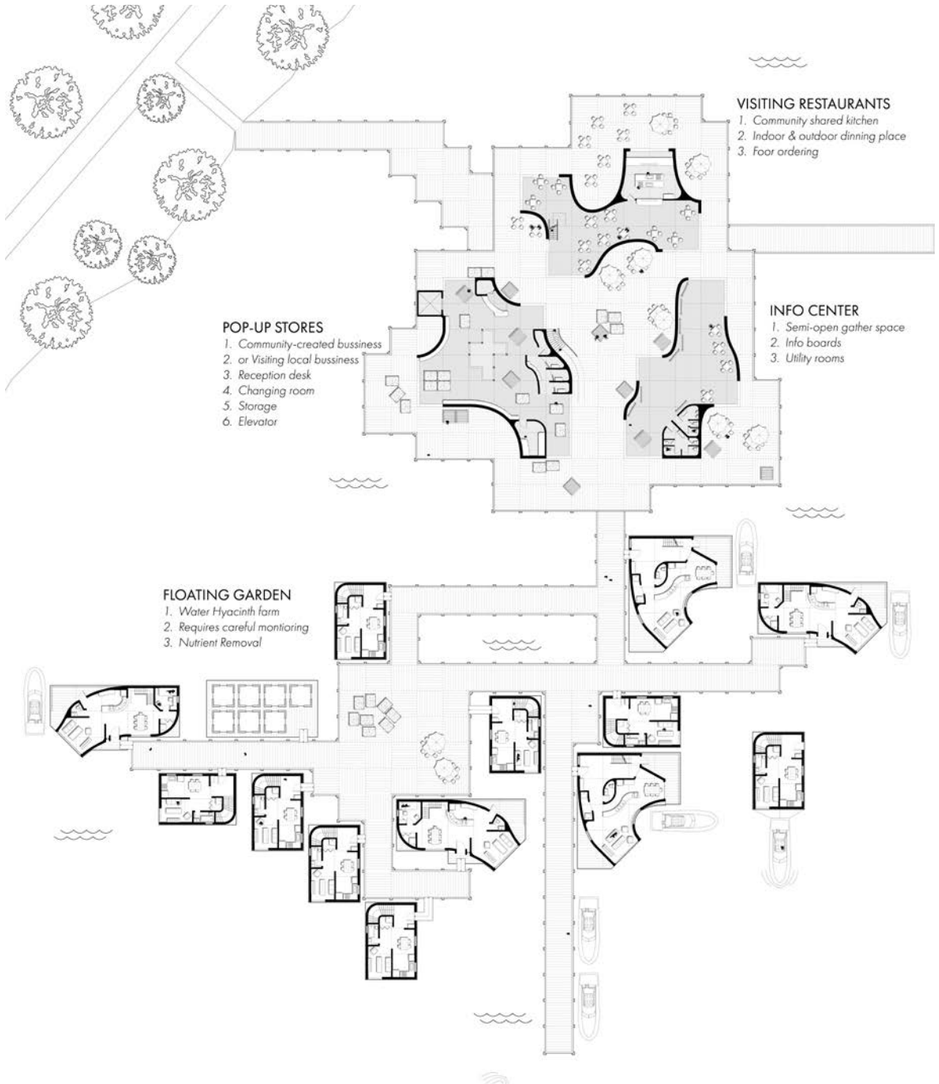
The Architectural Heritage Integration Project in Pittsburgh blends futuristic architecture with the city's rich historical essence. Encompassing landmarks such as a reimagined incline, a revitalized river island, and a reborn warehouse district in the Strip, the project marries contemporary design with historical narratives. Each site offers an immersive experience that underscores Pittsburgh's industrial and cultural heritage, fostering a deeper connection between past and present. This visionary approach not only enhances urban spaces but also celebrates Pittsburgh's legacy, making the city a vibrant testament to innovative historical preservation and modern architectural excellence.



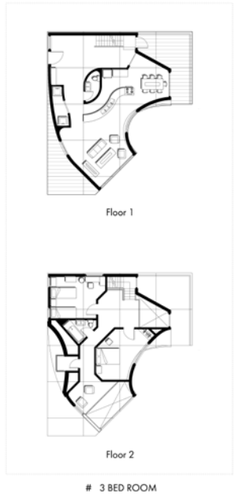




Form Genration Diagram



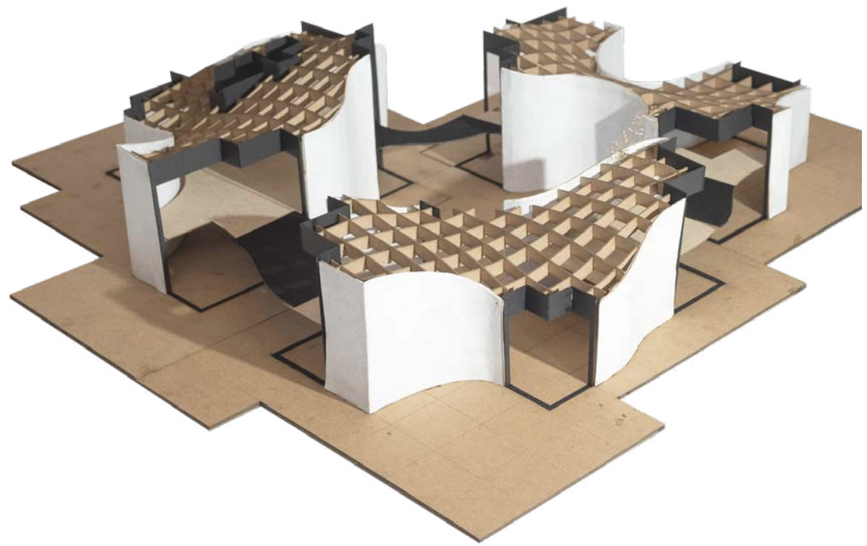
Herr's Island Housing Hybrid



3 BED ROOM

2 BED ROOM

1 BED ROOM



activity space structural model, 1' = 1/16"

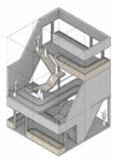
cafe

lounge

children center

restaurant 1

resturant 2



verticalgarden

Incline event Space Hybrid

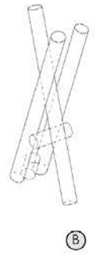
section model, 1′ = 1/32″

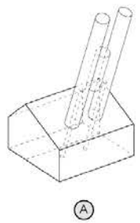
05.
All About Bamboo

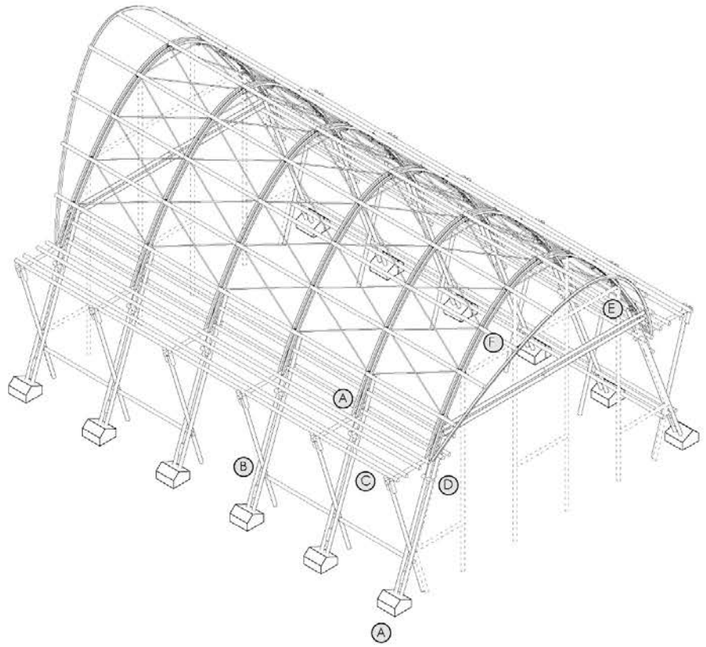
Design-Build Project organized by NOMAS
My Role: Design and Fabrication Team Lead
Advisor: Vicky Achnani
Date: 2022.09 - 2024.06
Site: Pittsburgh, PA

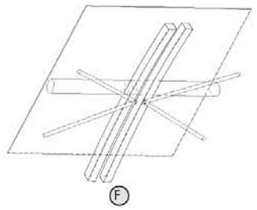
This year-long studio project is carefully curated with the aforementioned aspects in mind by utilizing bamboo that has been repurposed from the previous NOMAS Spring Carnival Pavilion installed on campus. The project aims to set a cogent case of low-carbon practices through a full-scale intervention in the neighborhood, thereby supporting an underserved community. Constructing a greenhouse for the locals, the project exposes students to the delicacies of participatory design. Establishing a new classroom that deviates from the conventions, the students are provided with a comprehensive understanding of the site's subtleties, the intrinsic properties of the materials, and the intricacies of the design-build process.

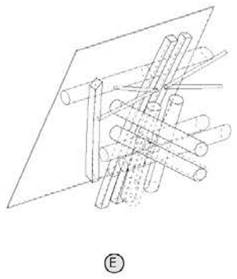
The project is a milieu that demonstrates the potential of the waste economy and low-carbon material while addressing the pressing issues of climate change and social justice and aims to serve as a catalyst. The process of designing, prototyping, participatory design, systems detailing and responding to a real brief on-site is a meticulous endeavor that extends the sphere of architectural education. Working with bamboo, repurposing materials, direct engagement with the community, and making architectural education more impactful, tacit and responsive to societal needs are important steps that align well with the new pedagogy of the School of Architecture.

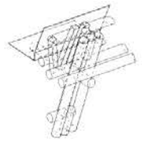


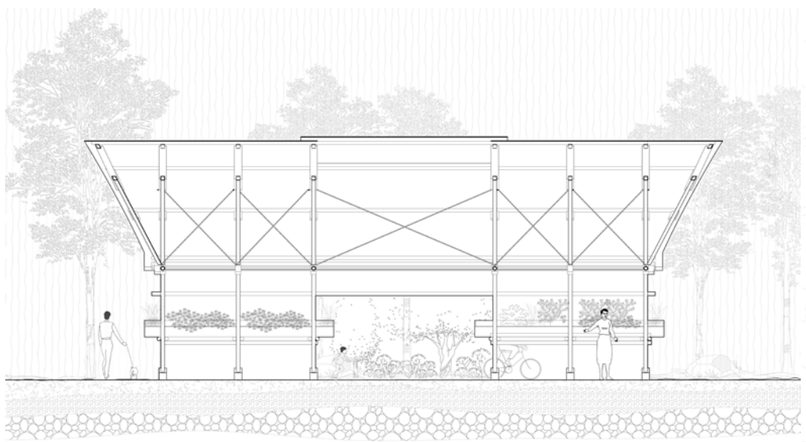


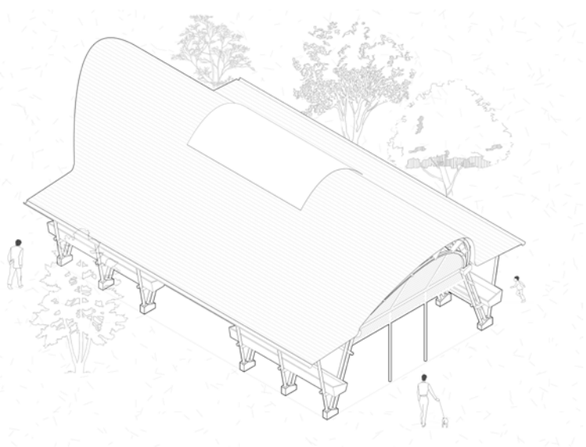












2023.02 - 2023.04

Prototyping phase in woodshop

2023.04 Carnival week (compeleted in 7 days)

Construction Phase on Site

2023.04 CMU Carnival

Pavilion Documentation

2023.05 taken down by the group in few hours

Disassembled and Transported to New Site

2023.05 until now

Bamboo Connection Prototype for Greenhouse