

**Massachusetts Institute of Technology
Department of Architecture**

**Master of Science in Architecture Studies
Building Technology
(SMArchS BT)**

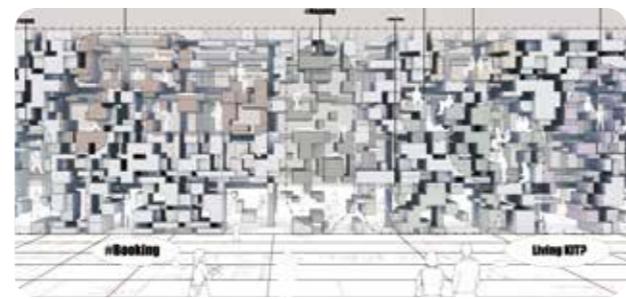
**Application Portfolio
Chili Shao**

C O N T E N T

Academic Projects

THE FABLE OF THE COMMUNITY

Personal(Graduation Design)/Academy/2020/Accommodation



Project: Post Pompidou

Personal/Academy/2019/Spatial Installation



Rapid City

Personal/Academy/2019/Accommodation



Working Palace

Personal / Academy / 2018 / Education



A Line Of Running Memories

Personal / Academy / 2019 / Community Infrastructure



Professional Projects

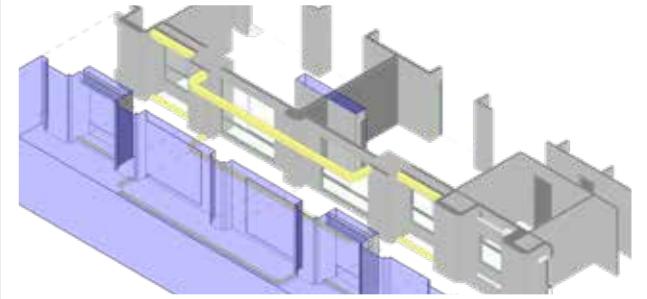
IN-BETWEEN READING

Personal/Academy/2018/Special Library



SparkGen-CostGen

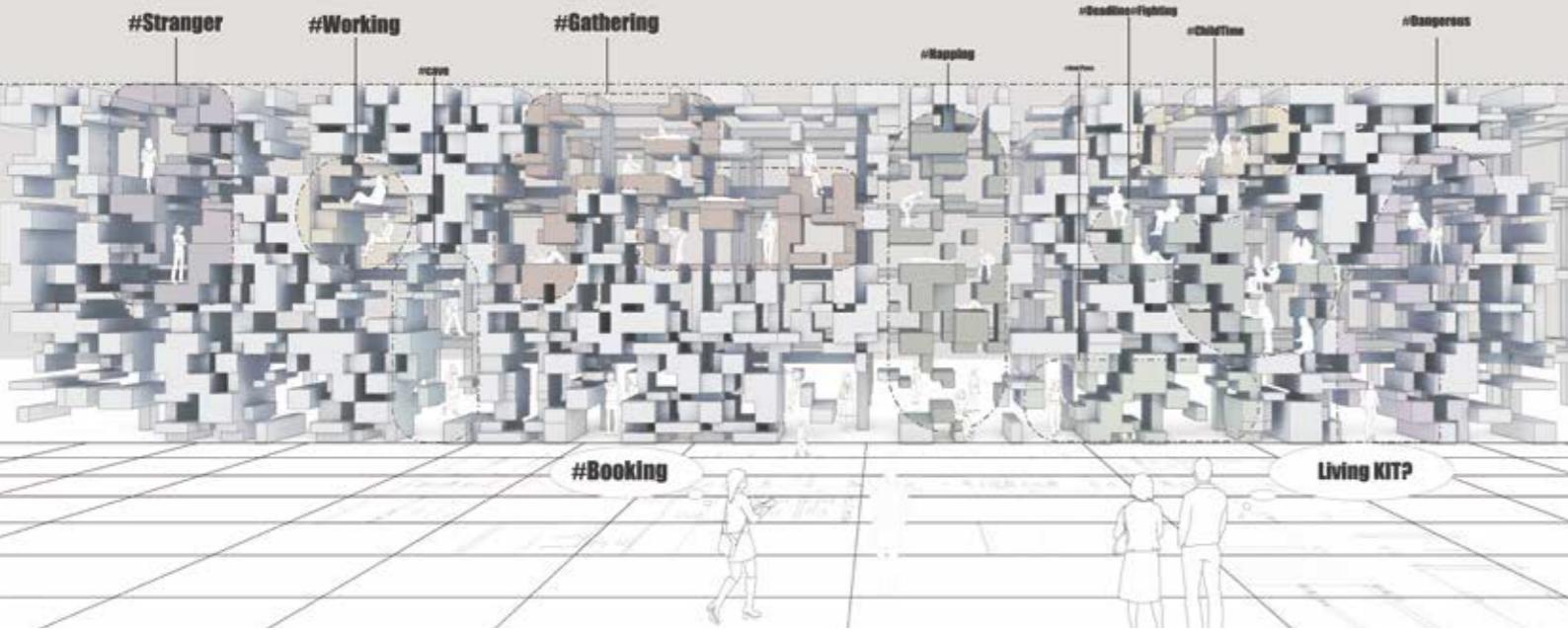
Personal/Professional Experience /2025/Programing



THE FABLE OF THE COMMUNITY

Personal(Graduation Desing)/Academy/2020/Accommodation

Residential	:	X m ²
Commercial	:	Y m ²
Office	:	Z m ²
Total	:	11360m ²



Urban Context

Taipei City, the capital of Taiwan, faces a critical housing challenge: high rental costs driven by rapid urbanization, high population density, and a shortage of affordable units. Over 2.5 million working-class individuals struggle to secure housing within the city, leaving them vulnerable to the rising cost of living. This project proposes a solution deeply rooted in the city's existing residential landscape.



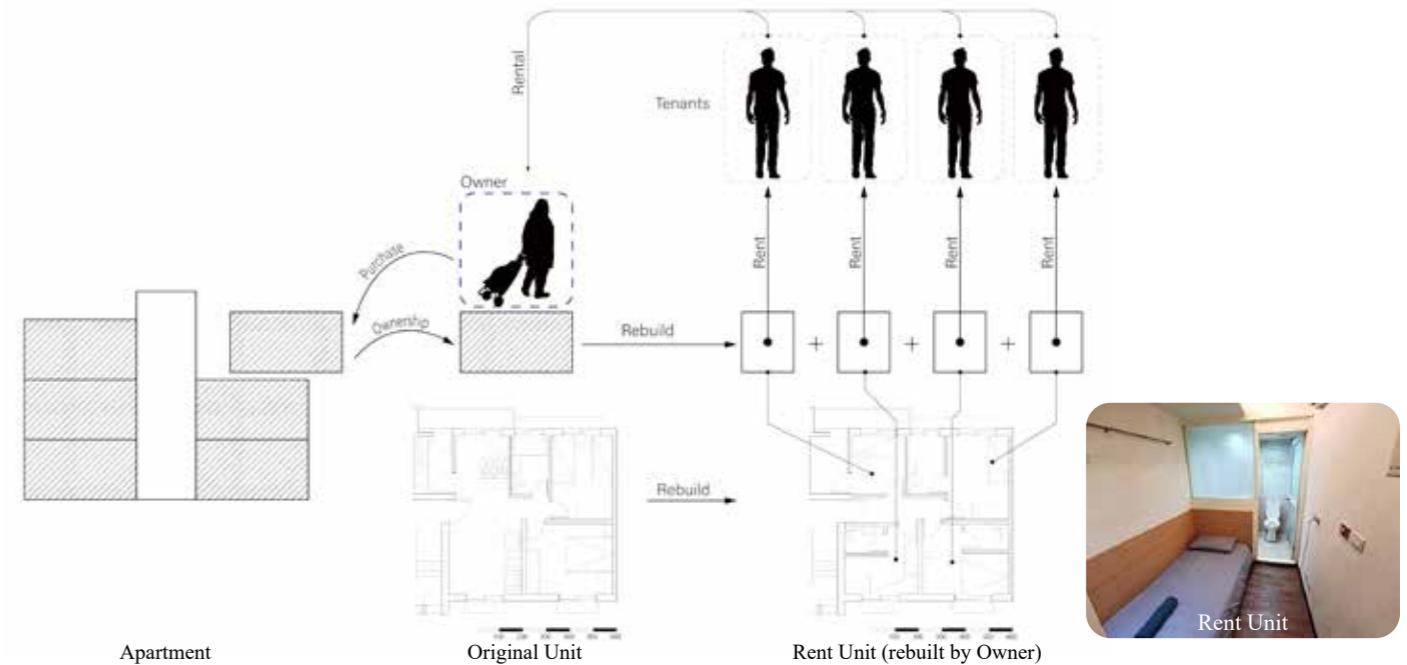
The photo of the old Taipei apartment illustrates how the space has been utilized after the residents moved in. The outward projection of window grilles and air conditioning units reflects changes in the building's usage.



The ground floor of the apartment usually fills with local markets and street food, which connect the activities of adjacent communities.

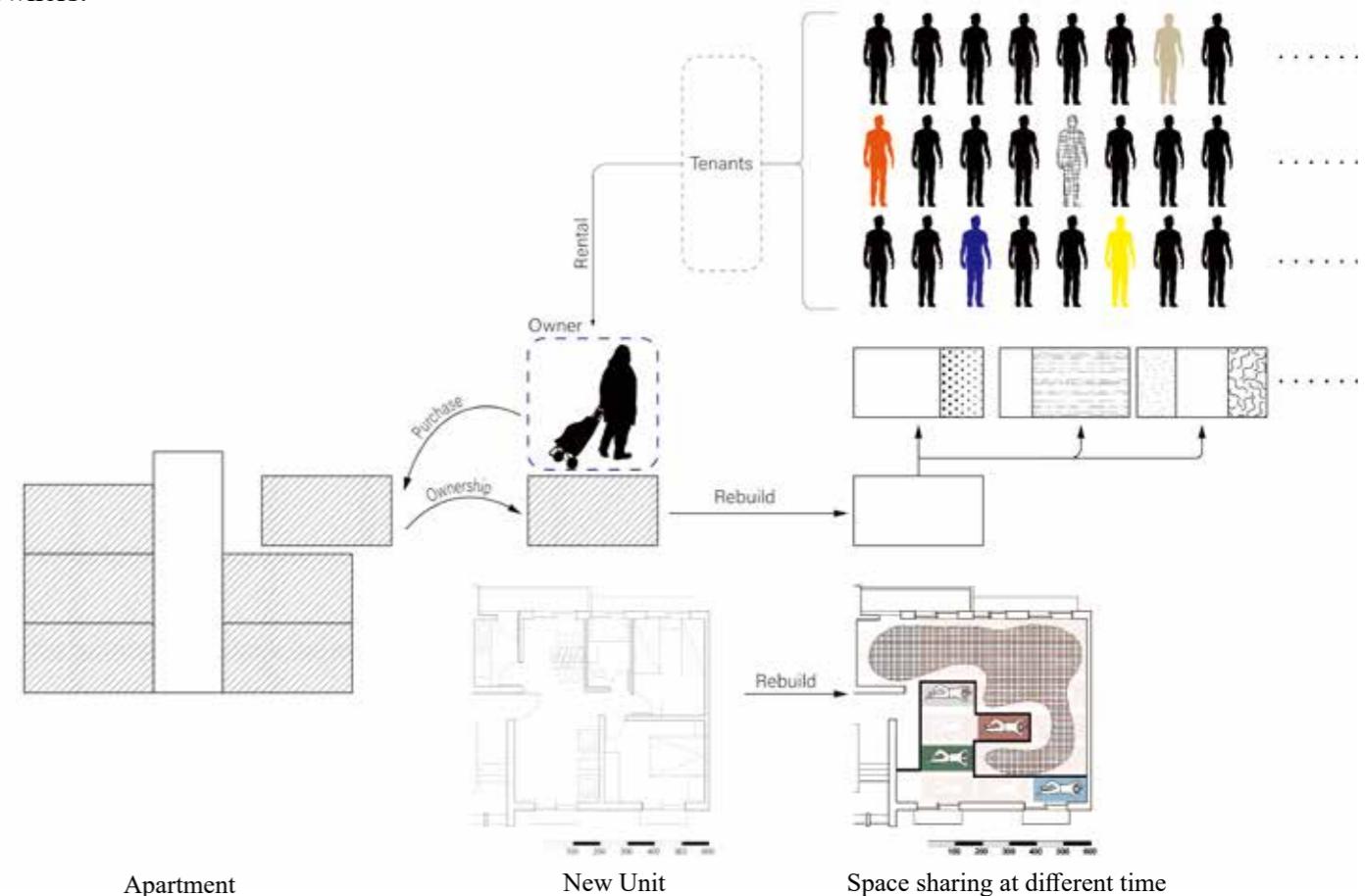
Current Critical Issues

In Taiwan, property owners commonly partition single apartment units into multiple smaller subdivisions to maximize rental yield. However, these modifications often lack holistic spatial planning, prioritizing unit quantity over spatial quality. Consequently, essential elements such as circulation, natural ventilation, and daylighting are compromised, leading to a significant decline in living standards.



Strategy: Dynamic Rental System

Diverging from conventional monthly rental models, this project introduces a flexible hourly pricing system. To facilitate this high-turnover usage, interior spaces are reimaged using a standardized "Living Kit." This approach ensures consistent spatial quality for users while maintaining economic viability for property owners.



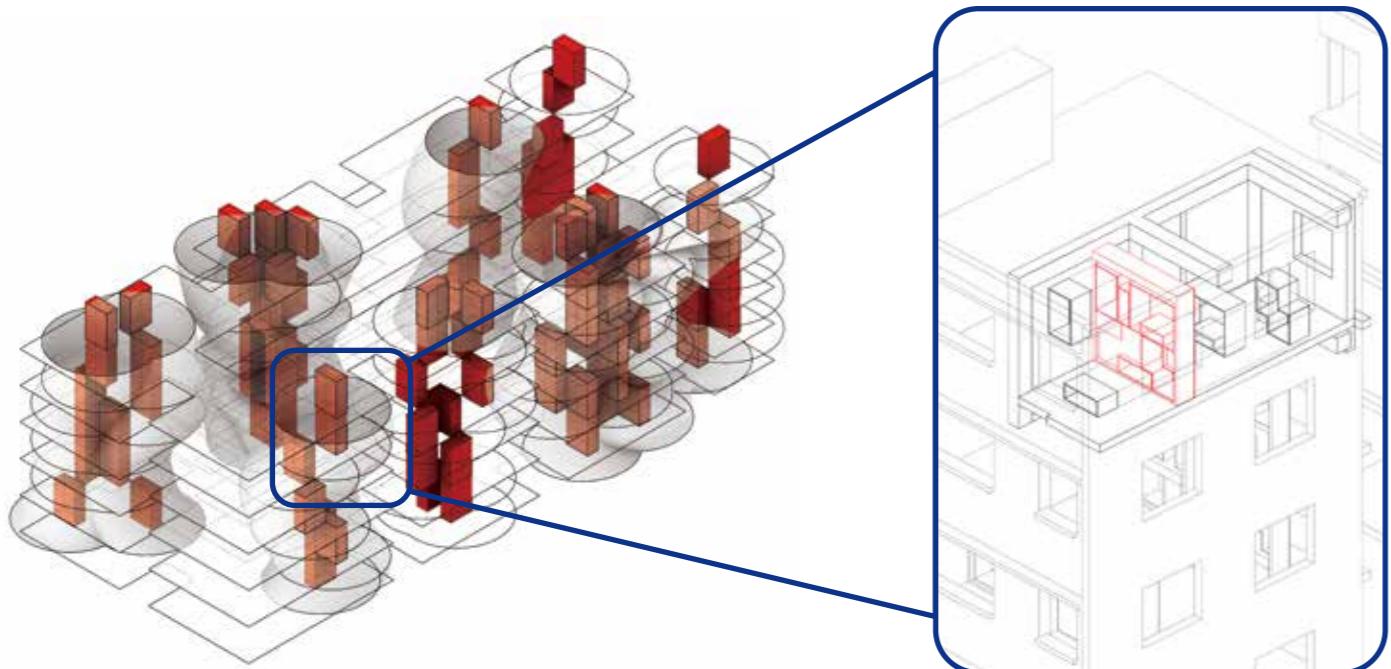
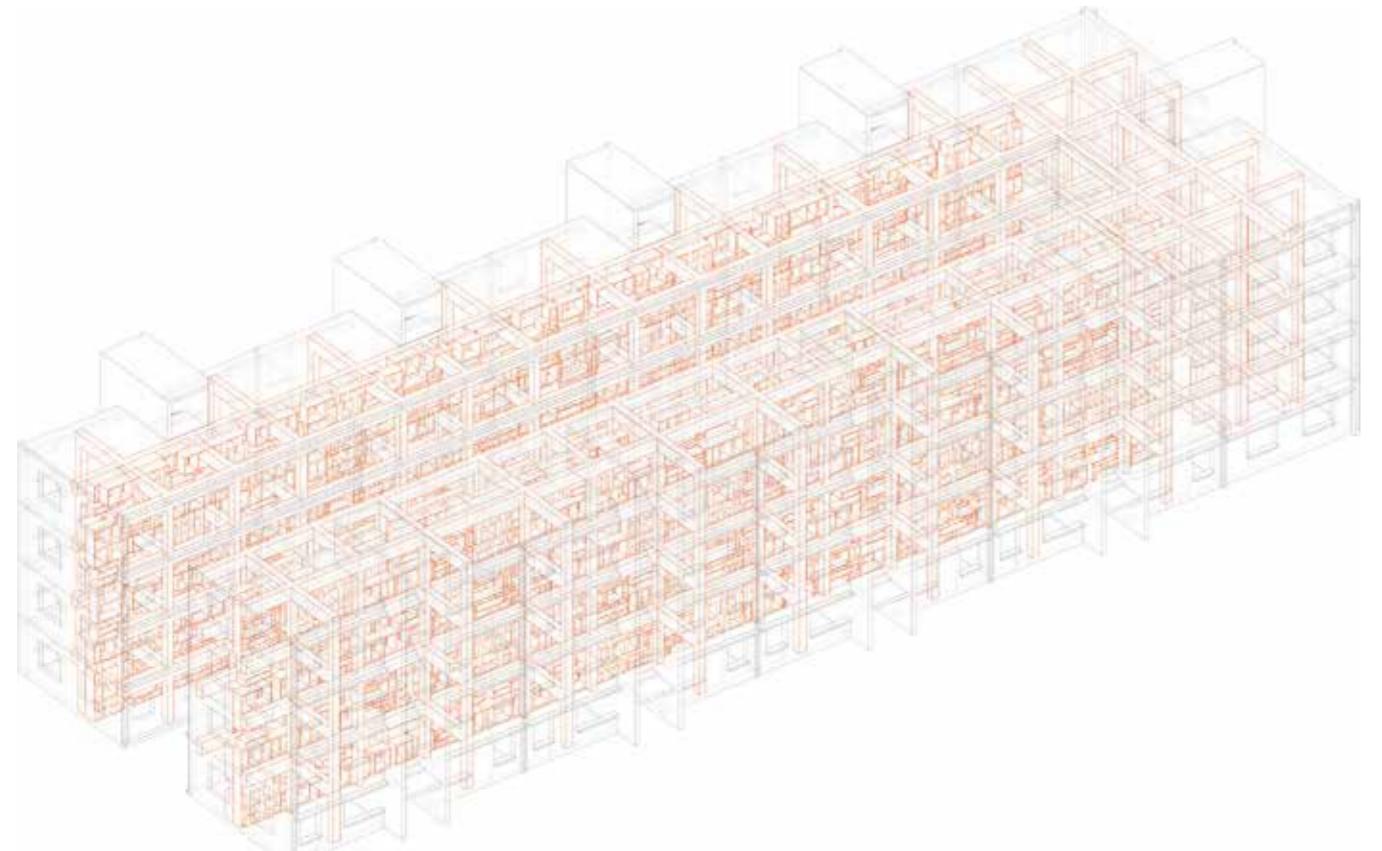


DIAGRAM : THE INTERVENTION OF THE RENEWAL MECHANISM INSIDE OLD APARTMENT

Intervention: The Renewal Mechanism

Walk-up apartments constitute at least 80% of Taipei's housing stock. Rather than demolishing and rebuilding, this project advocates for an interior intervention—installing a new spatial mechanism within the existing structures. This is particularly effective for ground-floor units adjacent to local markets, where the boundary between private dwelling and public street is already blurred. To succeed, this new mechanism—the Living Kit—must be highly mobile, lightweight, and integrated. It needs to accommodate diverse functions (from office to bedroom) without imposing structural loads on aging buildings, effectively functioning as a “move-in-ready” infrastructure.



THE INTERVENTION OF THE RENEWAL MECHANISM INSIDE OLD APARTMENT AND STRUCTURE

Generative Prototyping

Exploratory spatial studies generated via Grasshopper to test how varying unit dimensions influence volumetric aggregation and spatial density for the development of “Living Kit”.

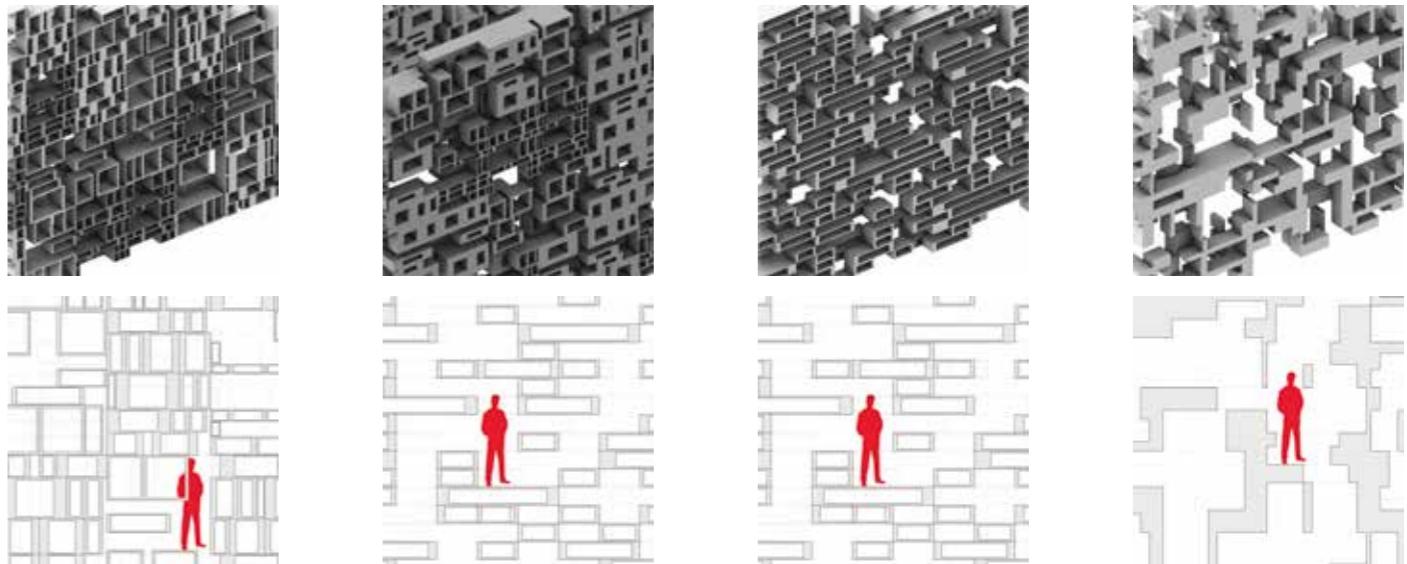


DIAGRAM : DIFFERENT GEOMETRICAL TESTING FOR LIVING KIT PROTOTYPE

Living Kit

The Living Kit establishes a dynamic living environment tailored to the diverse lifestyles of metropolitan residents. While the building's existing structural shell remains intact, the interior partition walls are reimagined as a flexible, responsive interface. Composed of modular geometric elements, the system is precisely scaled to function as integrated furniture. These volumetric units operate as a mobile partition system, allowing the space to transform seamlessly according to shifting patterns of use.



A SYSTEM OF SCALES: ADAPTING FURNITURE METRICS TO MODULAR LIVING

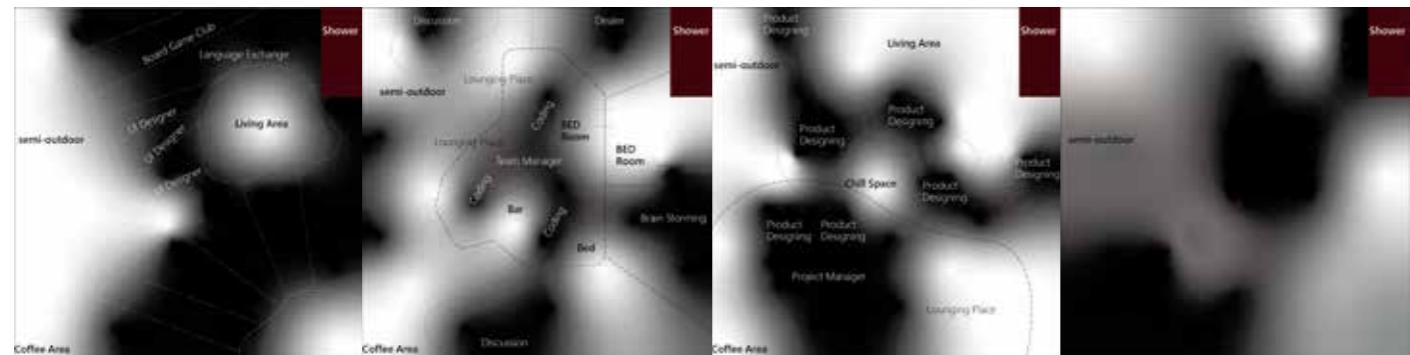


DIAGRAM: DISSOLVING SPATIAL BOUNDARIES

User Scenario: Time-Sharing

The mobility of the Living Kit redefines spatial boundaries, enabling extreme flexibility. A single unit can transform seamlessly: an office by day, a living room by night; a co-working space on weekdays, and a hostel on weekends. These configurations are achieved by rearranging modular wooden geometric elements which act as tables, beds, or seating, allowing the architecture to adapt to the inhabitant.



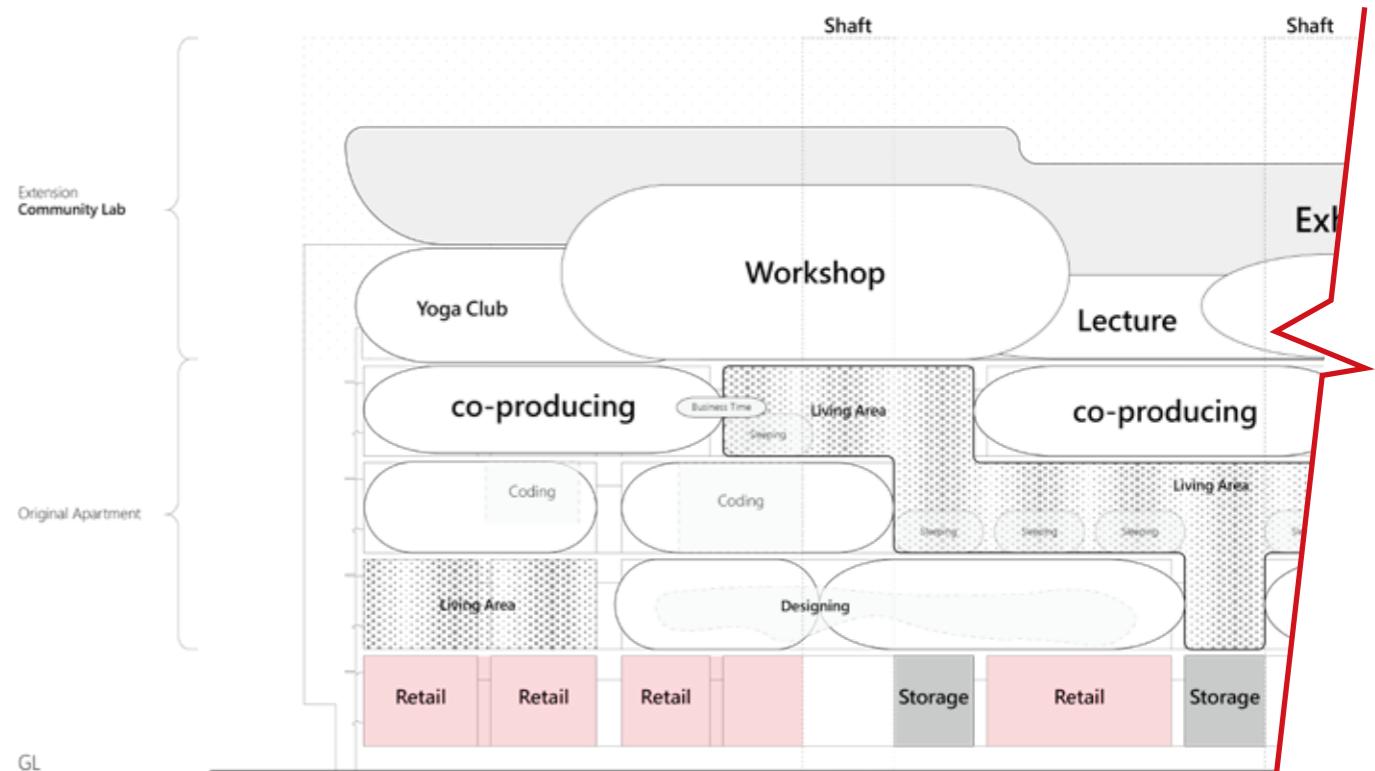
Office Spcae
10:00-18:00

Public Space
18:00-21:00

Living Space
21:00-9:30



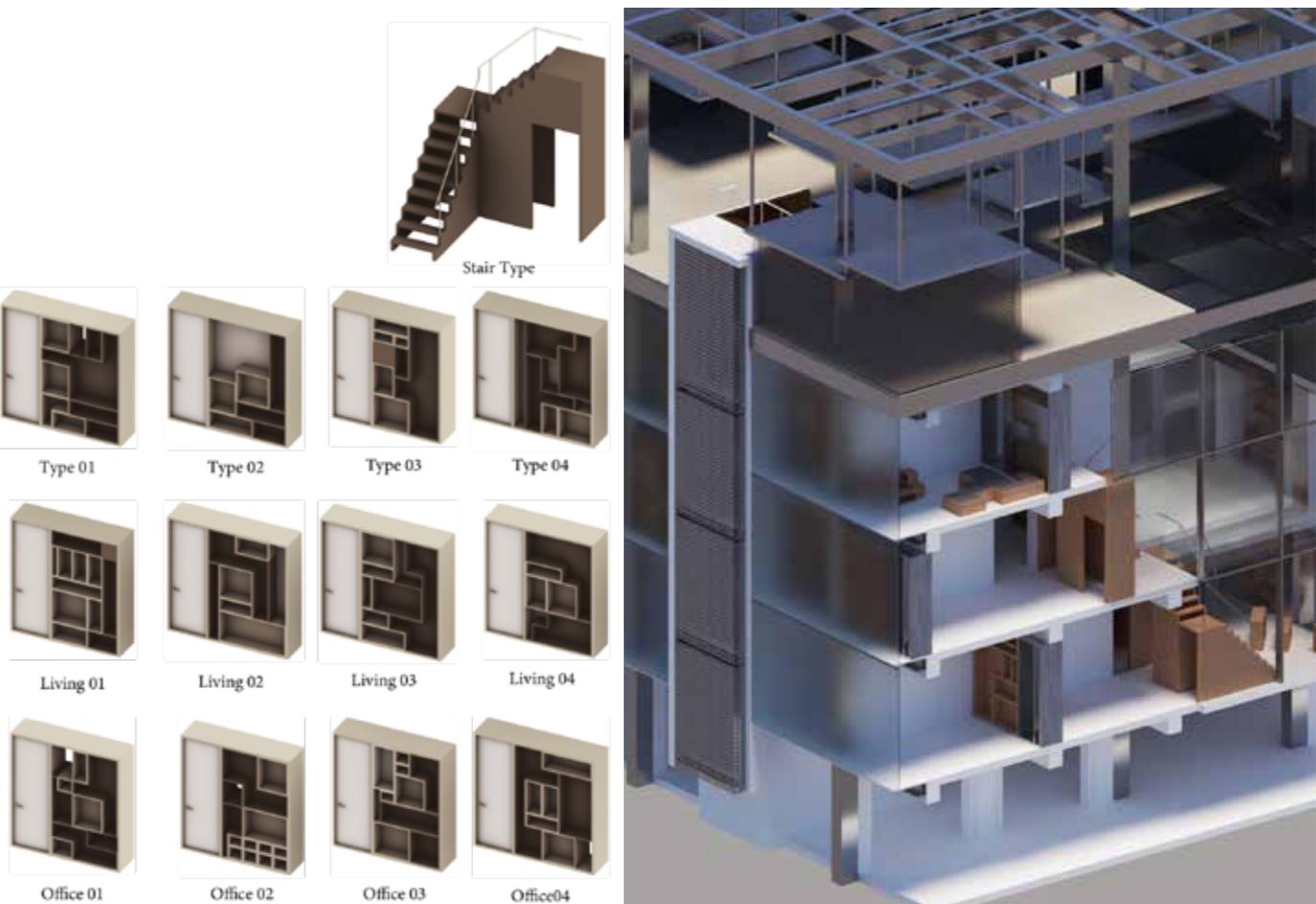
DIAGRAM: FLUIDITY OF WORK AND LIFE

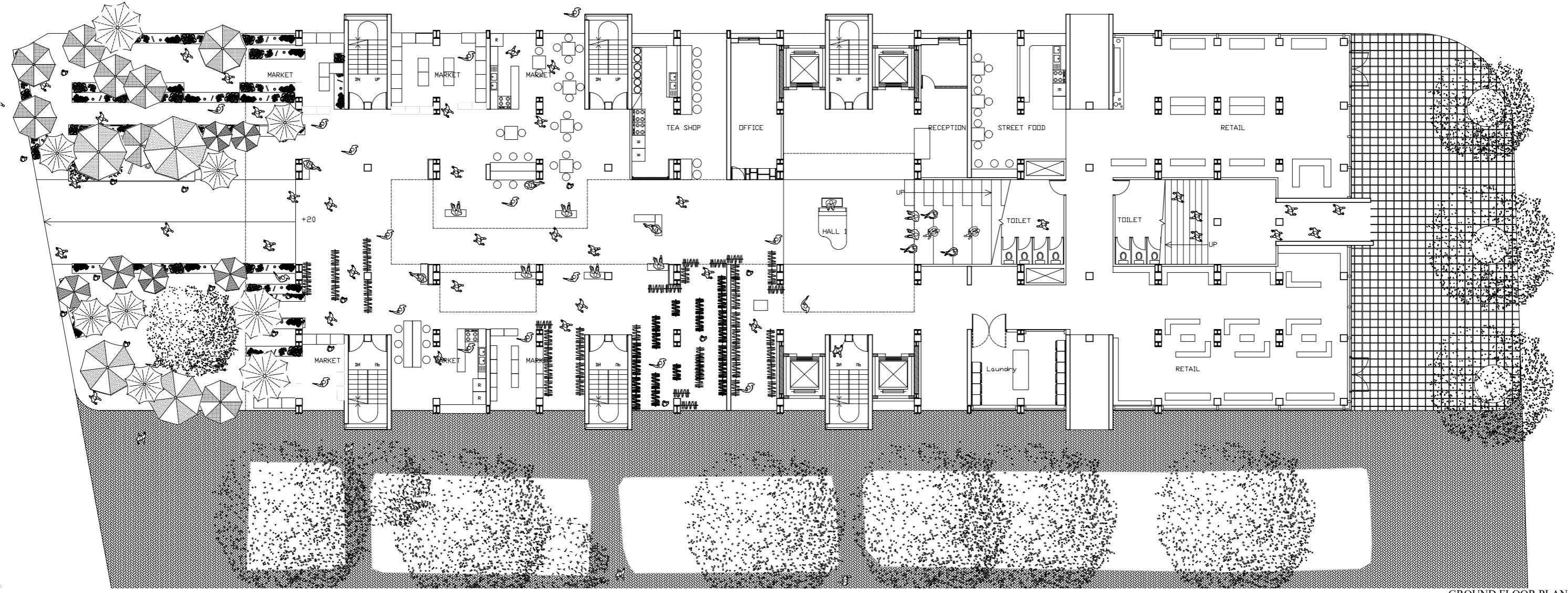


LIVING KIT OPTIMIZATION: From Geometry to Habitation

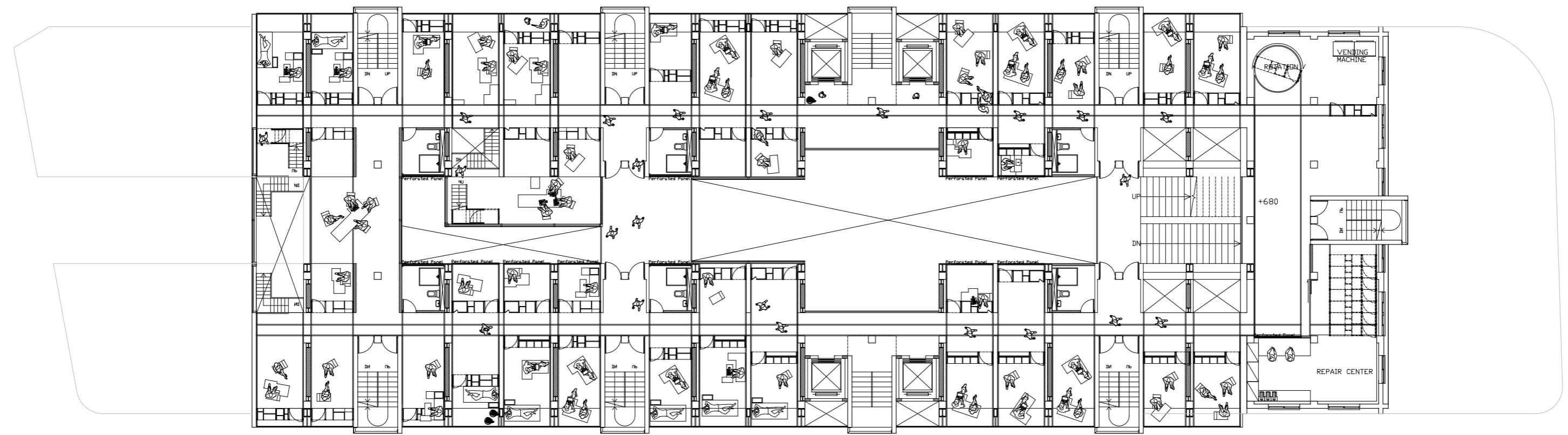
To integrate with the existing structural shell, the Living Kit incorporates essential architectural elements—such as doors, staircases, and timber finishes—to fully realize human habitability.

The system offers various typologies composed of scalable “cubic” modules, allowing users to select configurations that best suit their needs. These diverse user implementations generate a dynamic environment within the old structure, revealing a hybrid scenario for a new era of living.





GROUND FLOOR PLAN



SECOND FLOOR PLAN

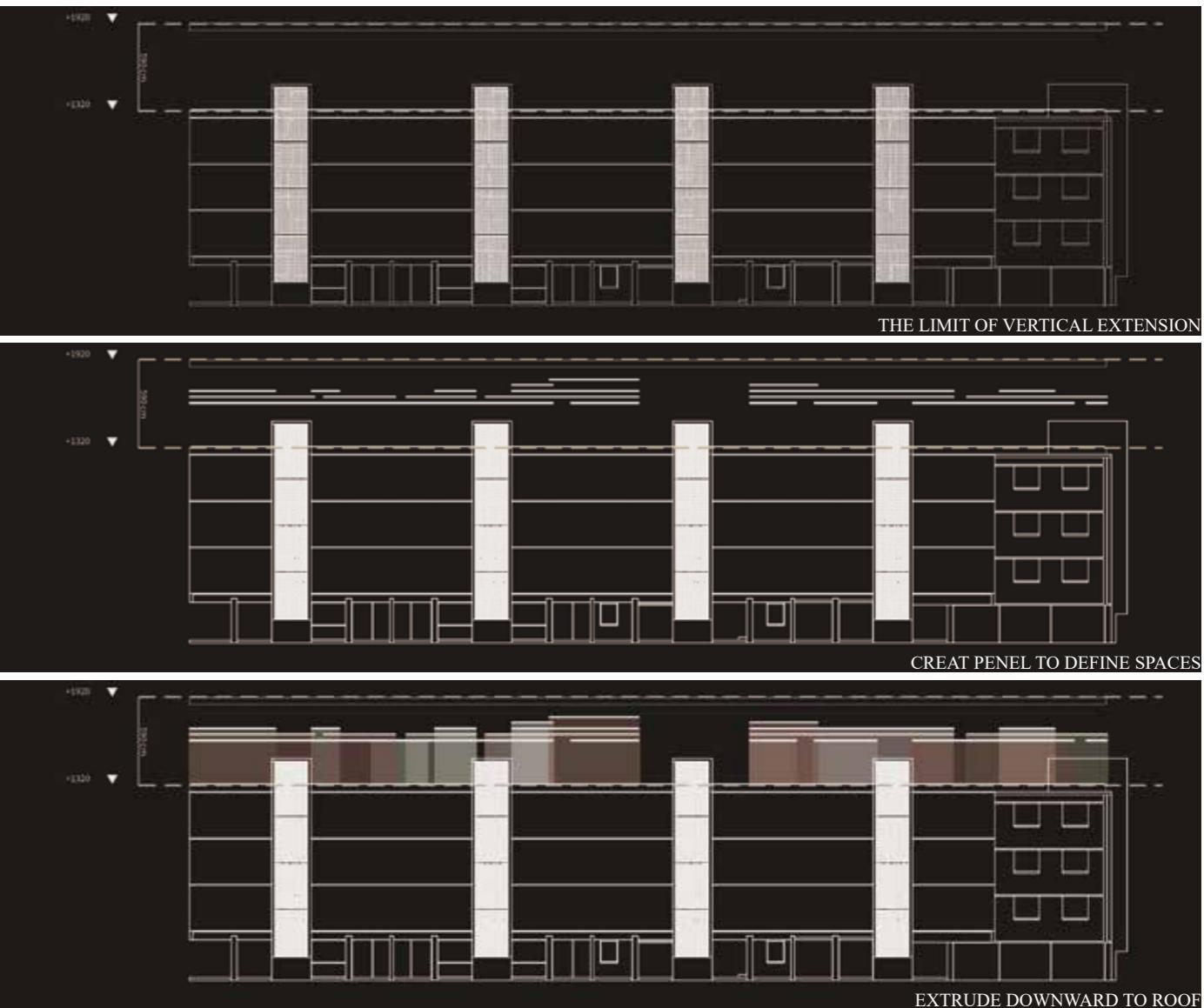


ROOF PLAN

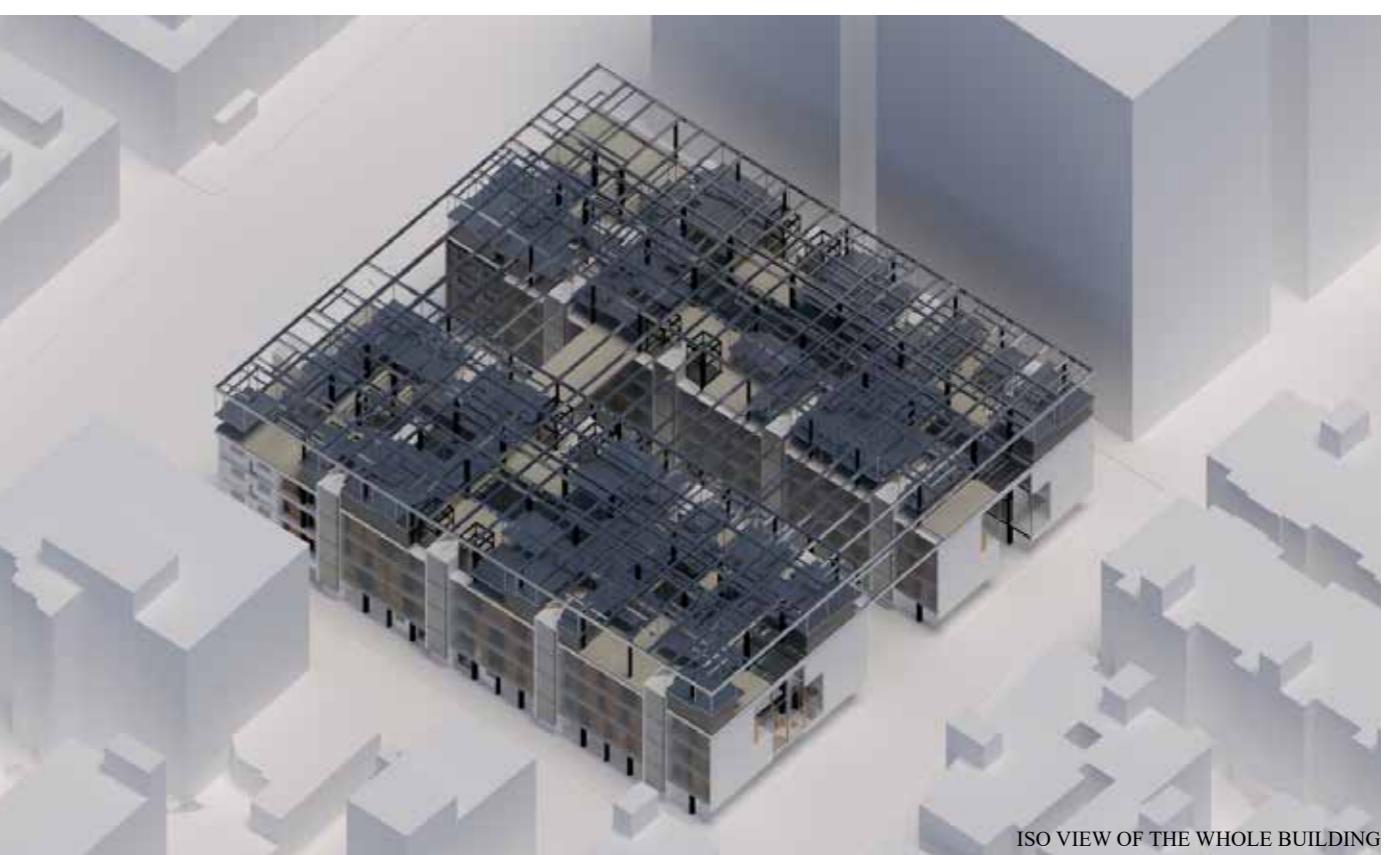
Roof Top

The rooftop serves as the primary hub for public activities and events, accommodating versatile programs such as rental classrooms and lecture halls. This level is designed as a second “ground,” where the rigid boundaries of traditional education are dissolved through a flexible architectural system.

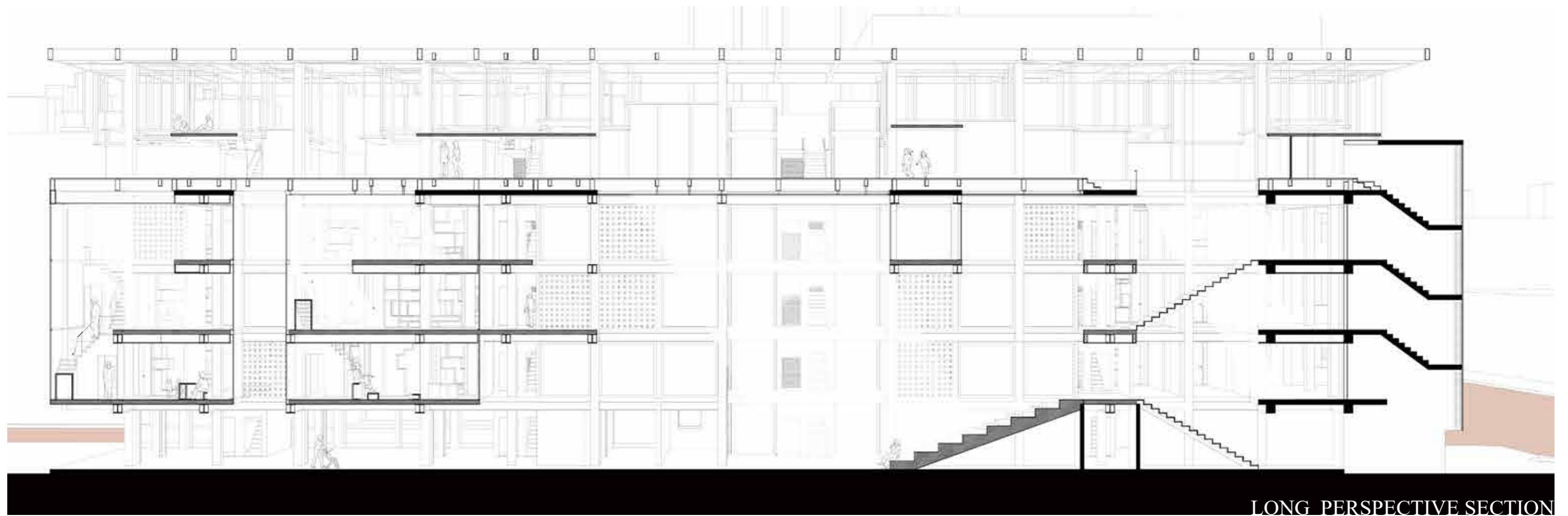
A series of roof panels at varying heights indicates the diverse functional requirements and spatial volumes beneath. Supported by a 5.5m structural limit, these height variations create a rhythmic skyline while providing specific atmospheric qualities for different activities.



PERSPECTIVEVIEW ON ROOFTOP



ISO VIEW OF THE WHOLE BUILDING



LONG PERSPECTIVE SECTION

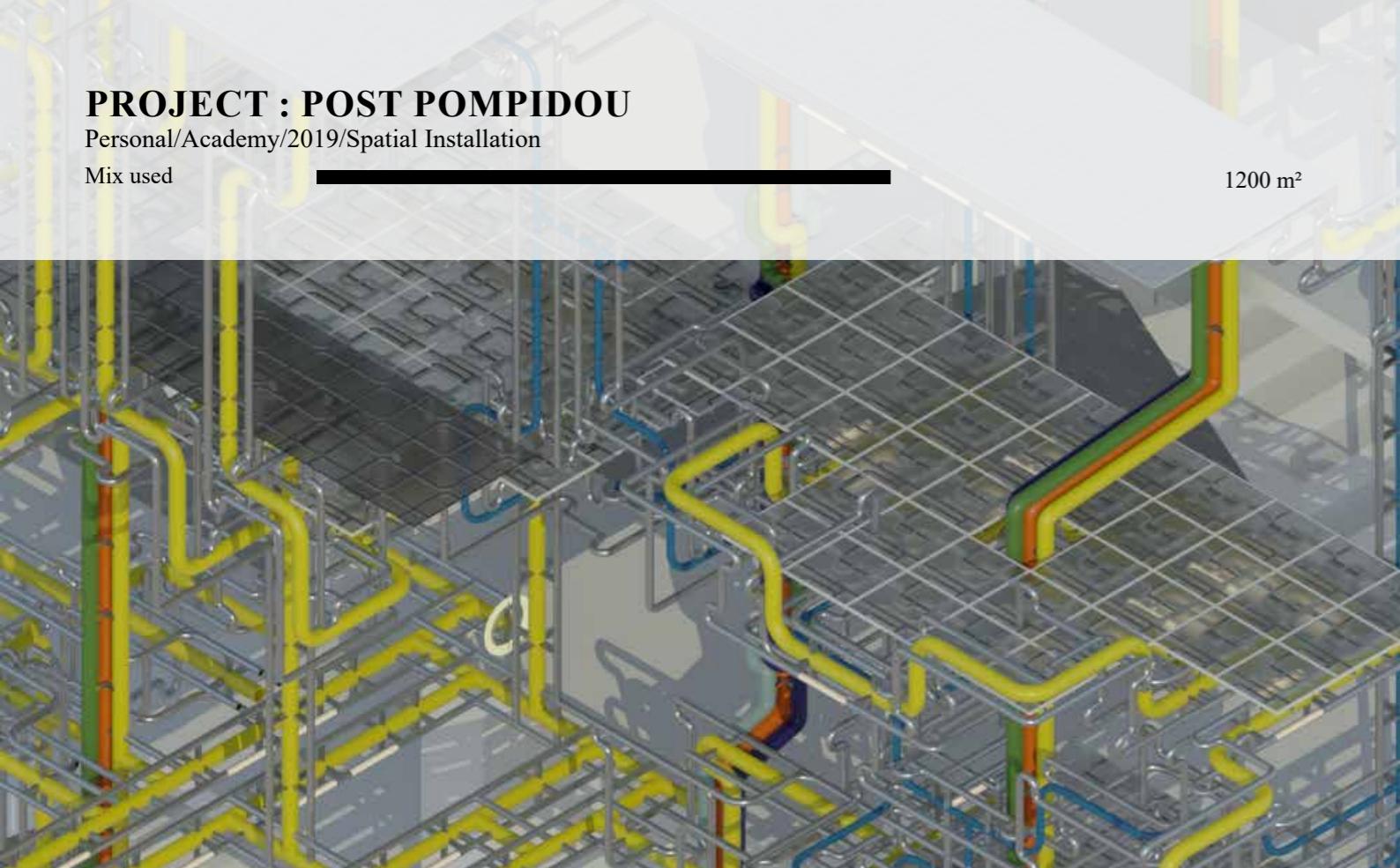


SHORT PERSPECTIVE SECTION

PROJECT : POST POMPIDOU

Personal/Academy/2019/Spatial Installation

Mix used



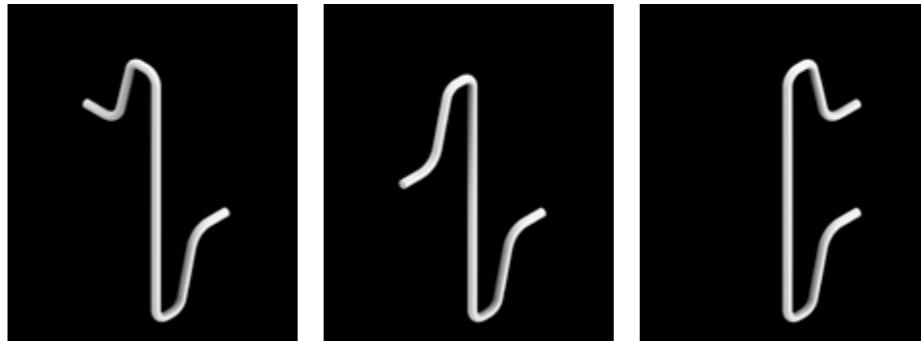
Concept and Inspiration

Project Post-Pompidou examines pipeline systems as an architectural framework for spatial organization. Informed by the conceptual approach of the Centre Pompidou, the project engages with the notion of “inside-out” architecture by situating mechanical and infrastructural elements within the spatial logic of the building. The study focuses on the spatial implications of deploying pipeline systems as three-dimensional organizational structures, investigating how such systems can contribute to spatial configuration, circulation, and architectural articulation.

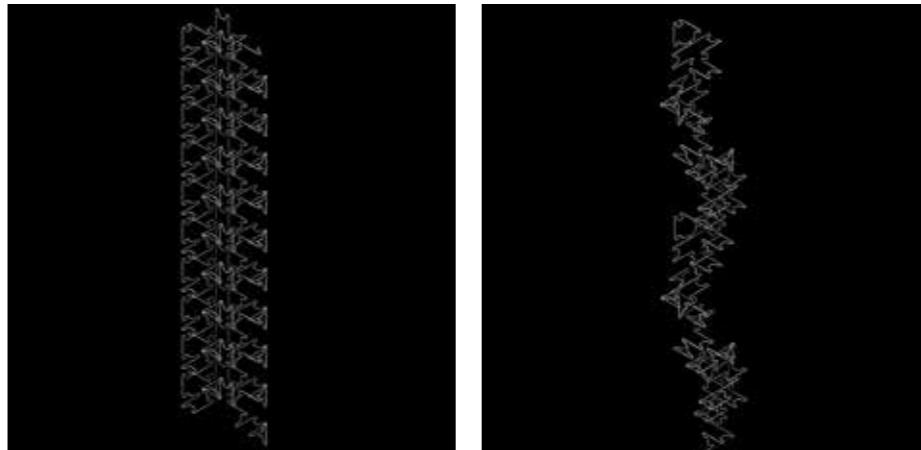


3D Printing Testing

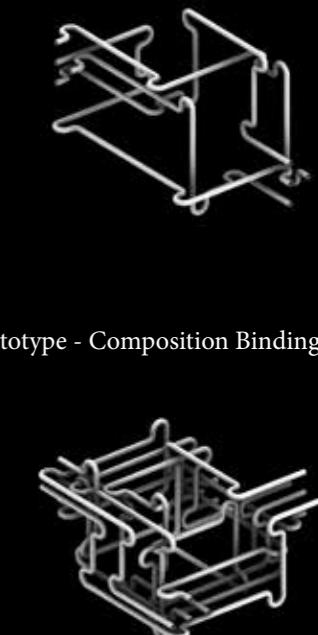
To verify the conceptual model, a 3D printer was used to create a test model for evaluating the stability and structure of the prototype.



Prototype - Composition



Prototype - Composition Binding

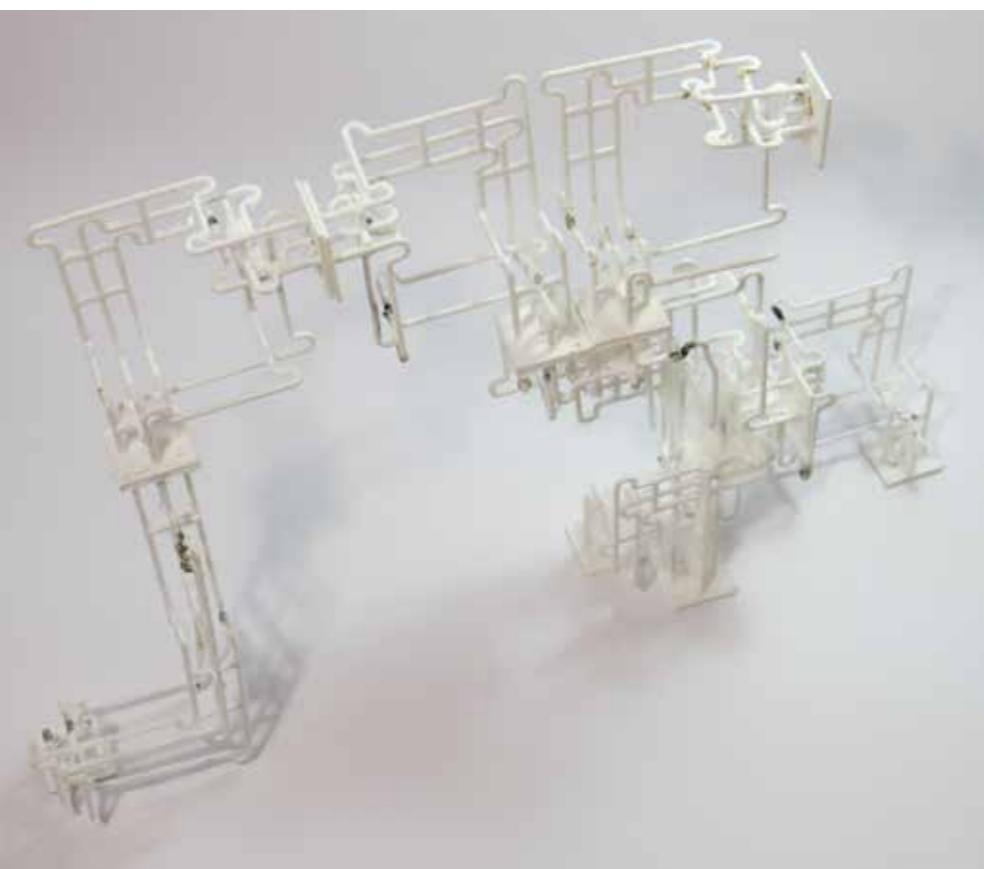


Prototype - Composition Binding

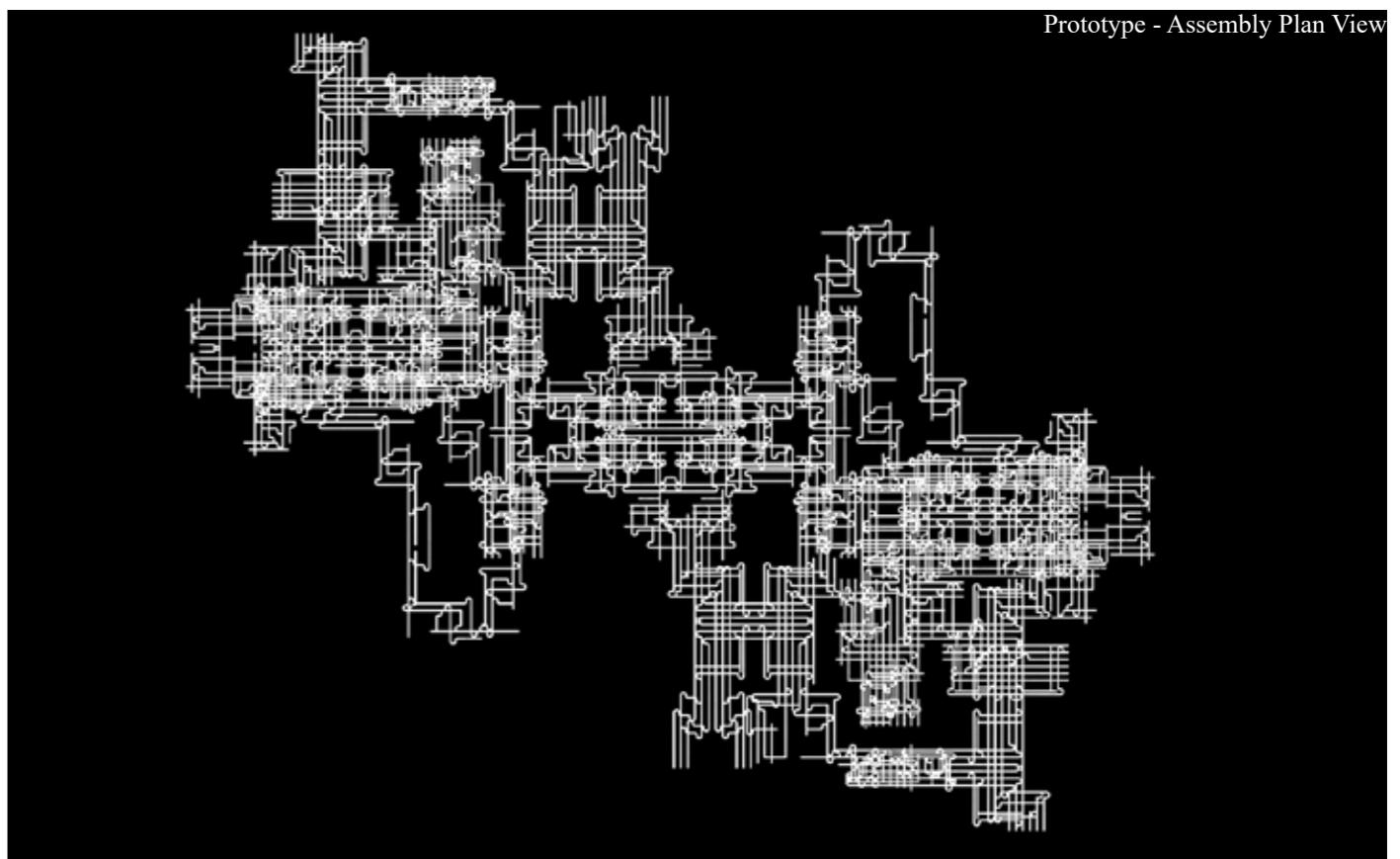
Prototype - Expanded Version

Prototype and Geometry

The prototype of this system is a hook-shaped metal tube with a diameter of 10 cm. Its geometry provides a connection between two dimensions: the 90-degree difference between its endpoints allows each unit to rotate and interlock with another. The curved portion of the hook creates additional surface area, enabling stronger attachment between components.



Prototype - Assembly Plan View

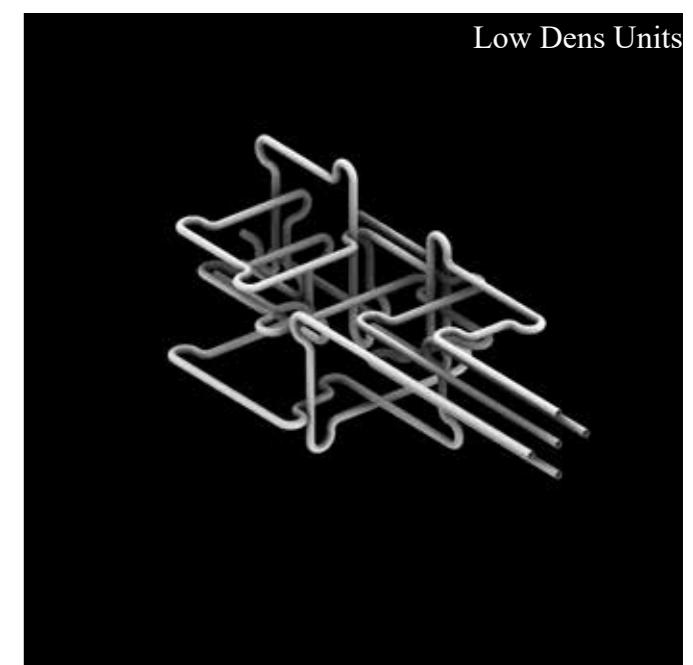
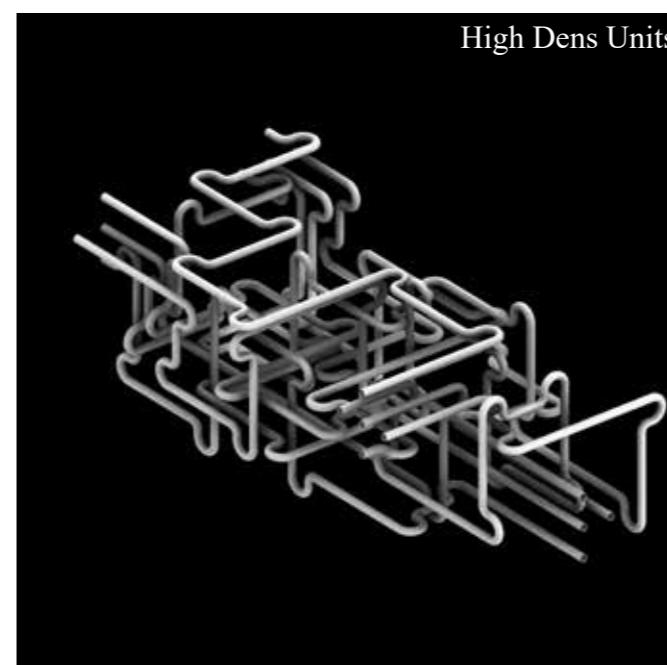
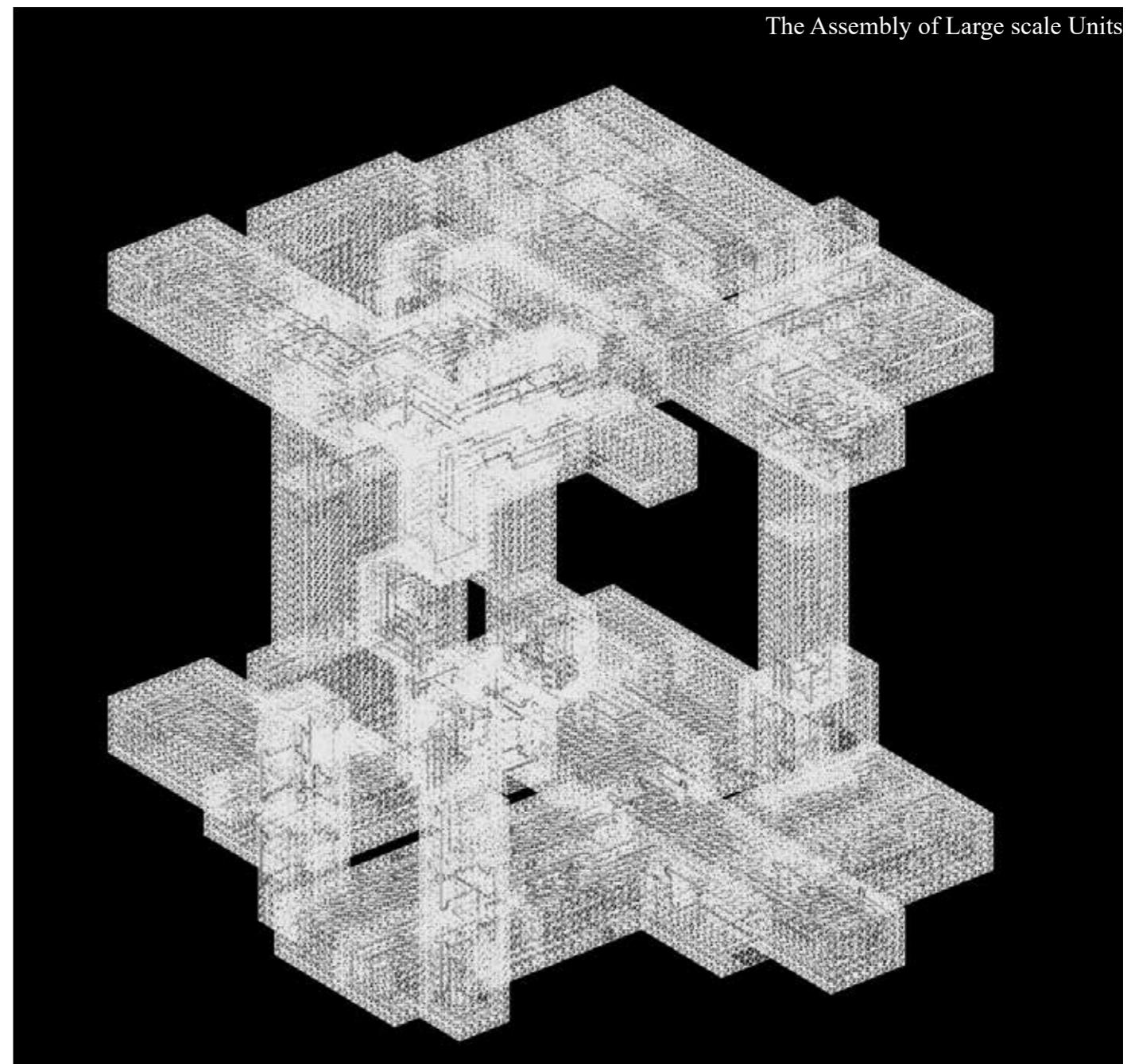
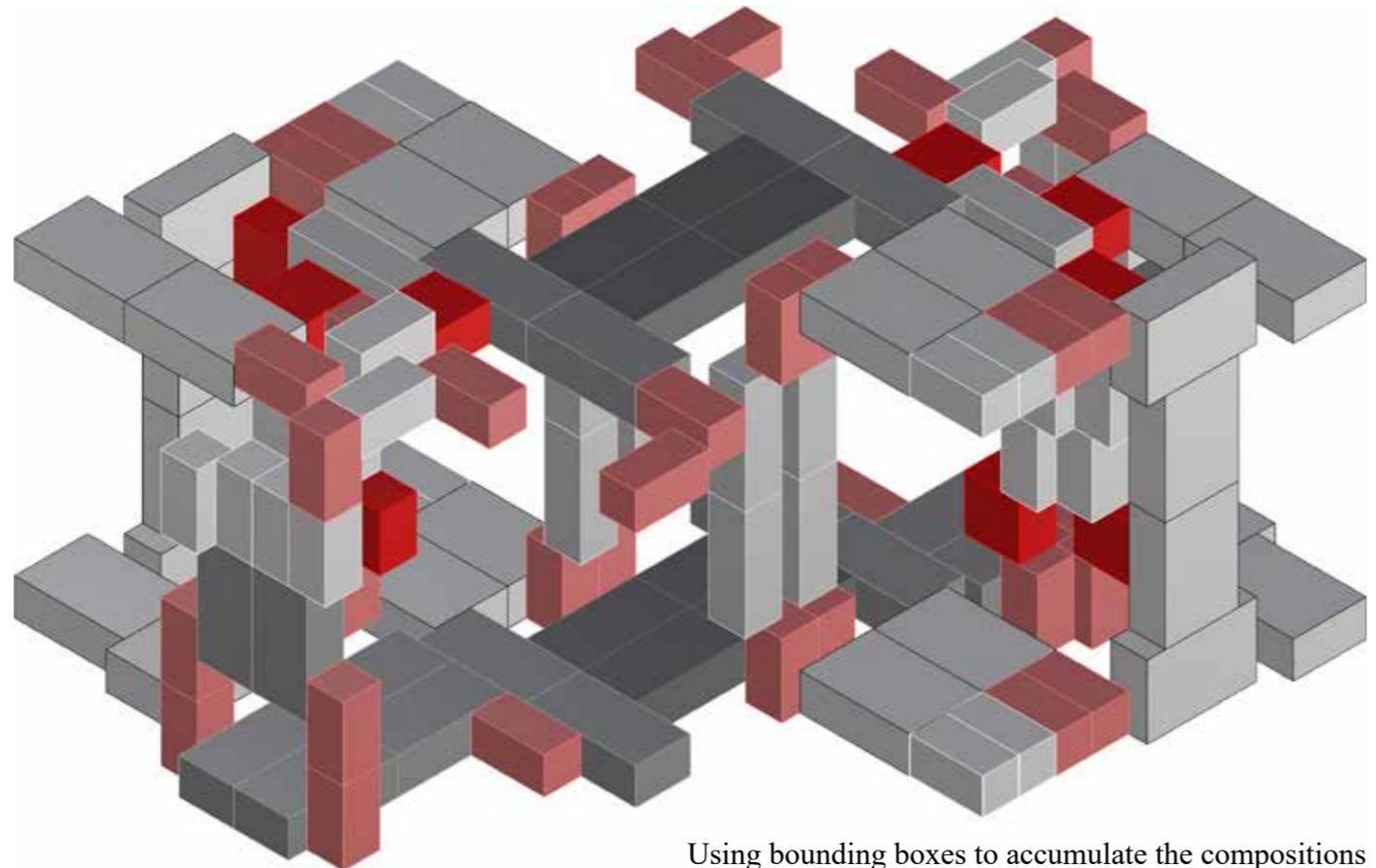
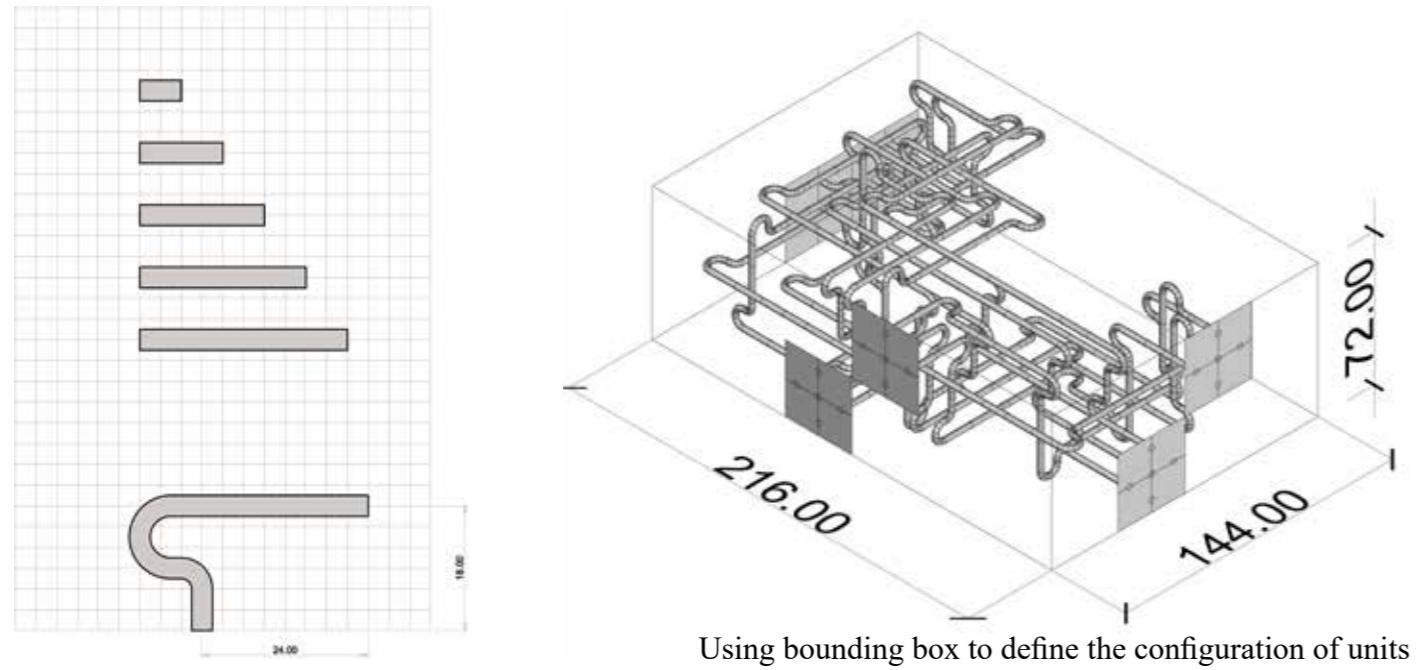


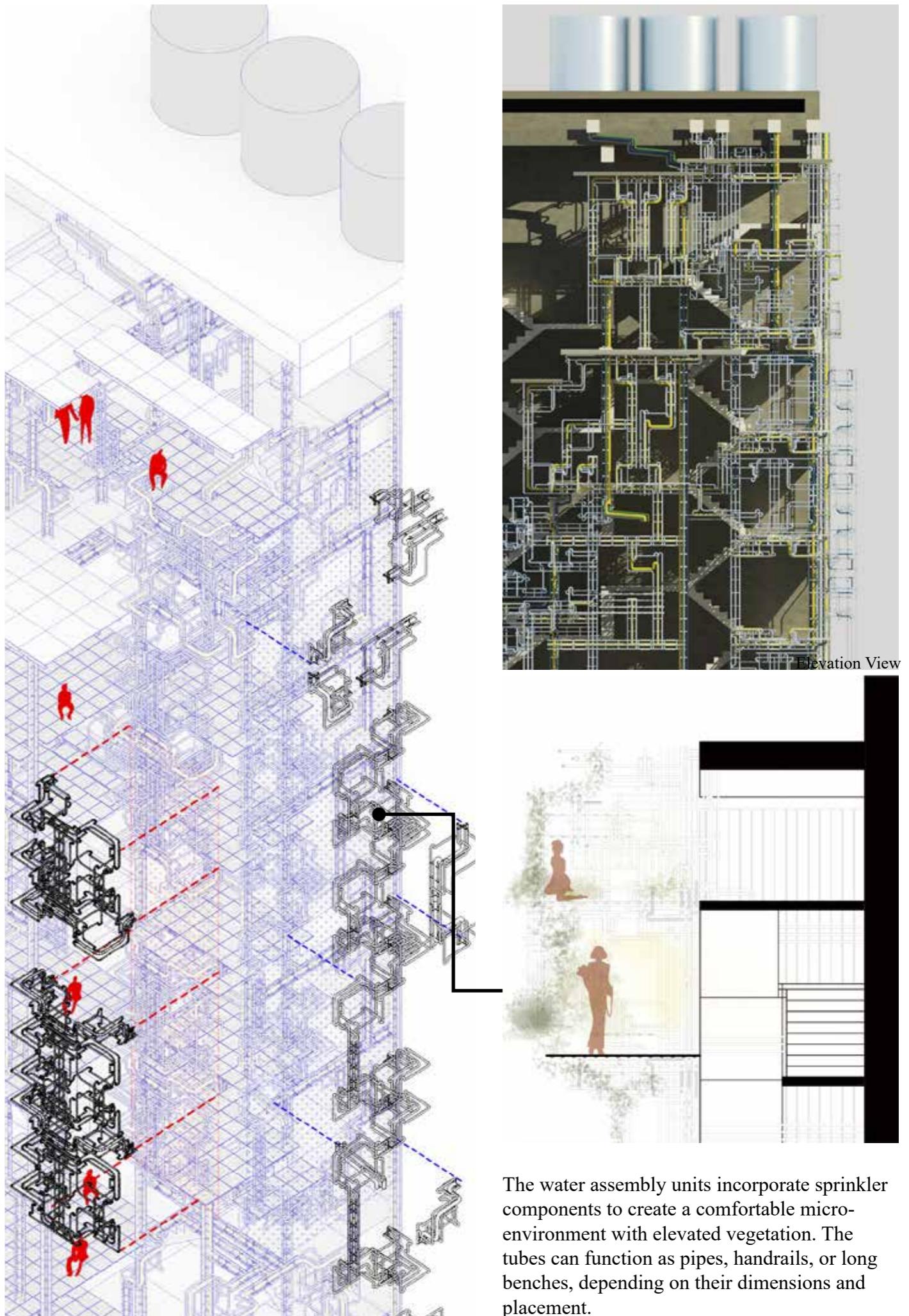
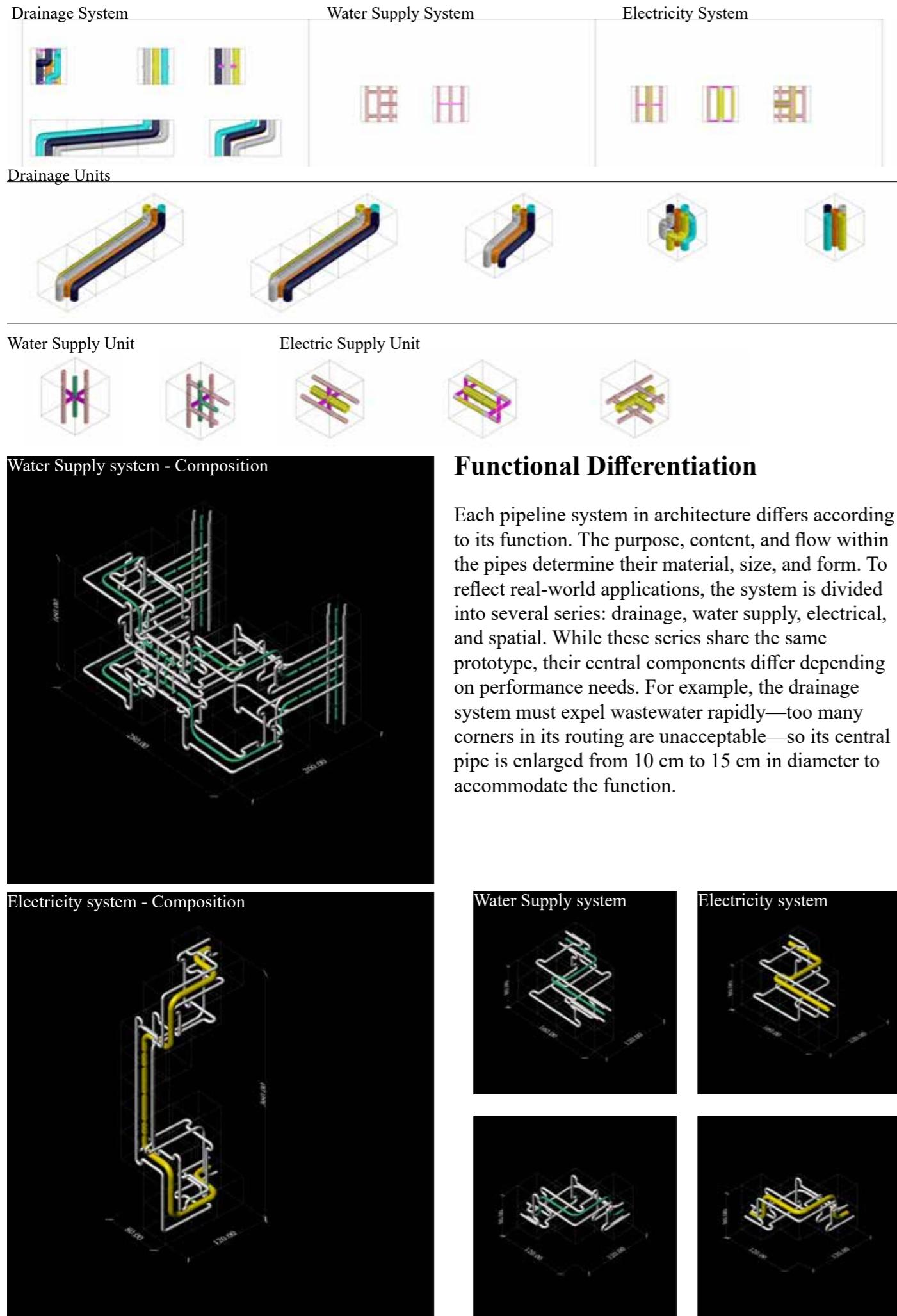
The Bounding Box

To manage the complexity of large-scale components, the project employs the “Bounding Box” as a fundamental strategy for spatial discretization. By encapsulating intricate sub-systems—such as structural framing and internal circulation—within defined volumetric boundaries, we establish a system that is replicable, computable, and reusable.

The Assembly of Large scale Units

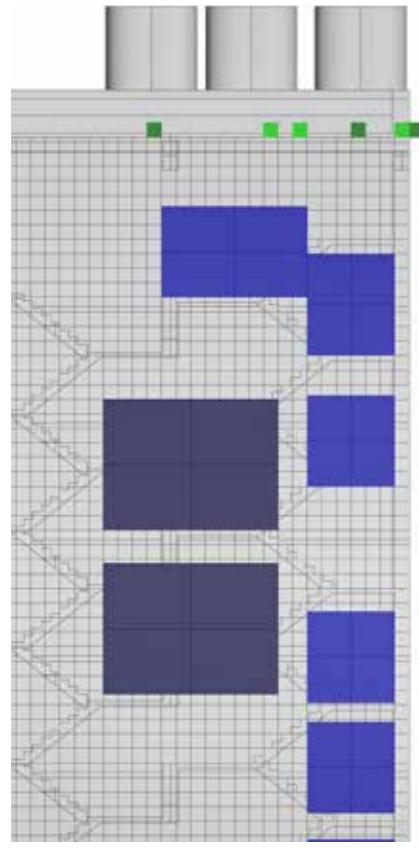
This method allows for the translation of complex geometries into a standardized language of assembly. Each bounding box acts as a basic unit of computation, enabling the systematic accumulation of compositions to form larger architectural aggregates. This modular logic ensures that whether the design requires a high-density cluster or a low-density arrangement, the components can be efficiently organized and reconfigured to meet varying functional demands.



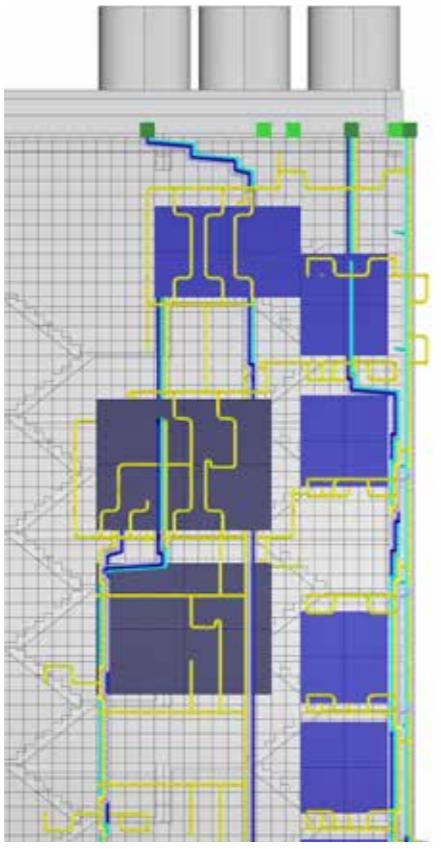


Construction Hierarchy and Spatial Logic

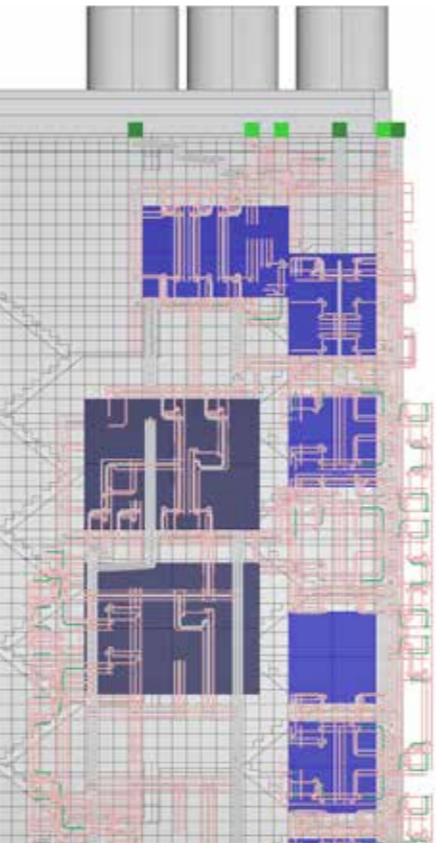
The scale and function of each pipe type define the sequence of spatial construction: drainage and water supply systems come first, followed by the electrical system, and finally the spatial system. This hierarchy establishes not only the order of construction but also the structural logic for developing a self-supporting pipeline architecture.



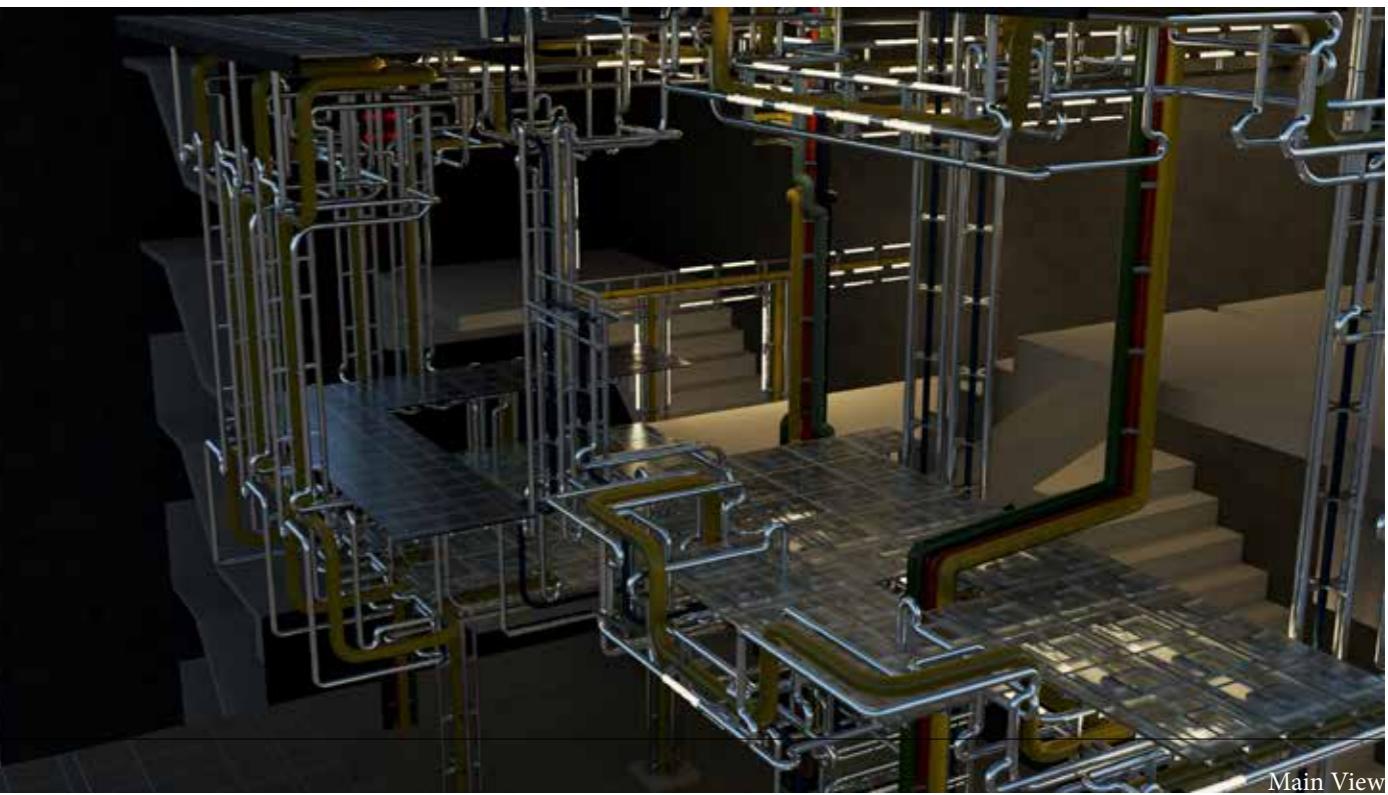
Defining the space(Blue blocks)



Generate drainage system



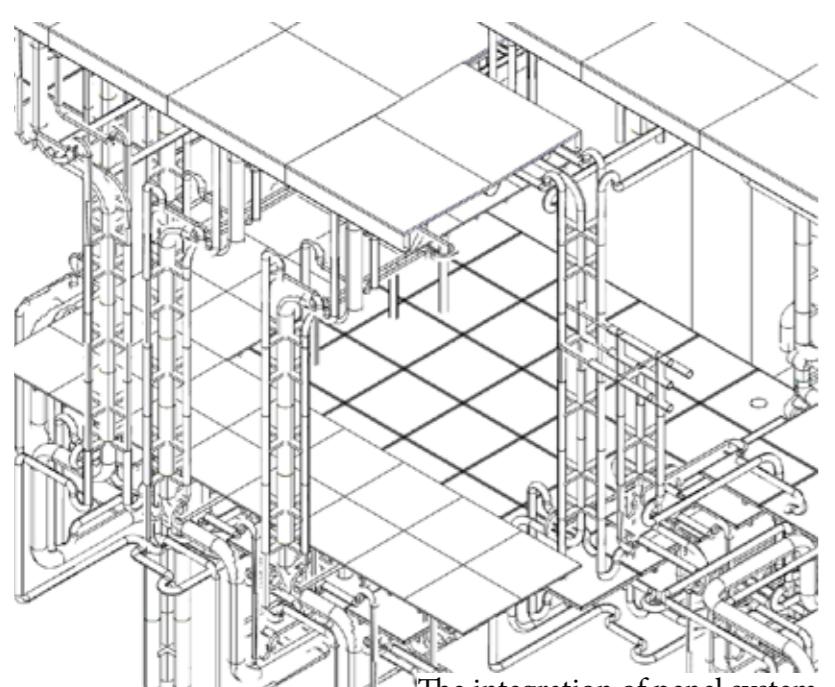
Generate other systems



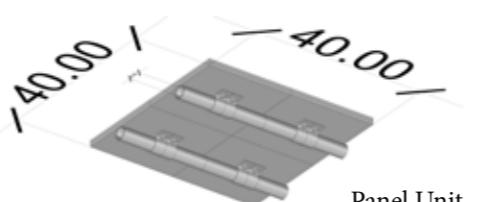
Main View



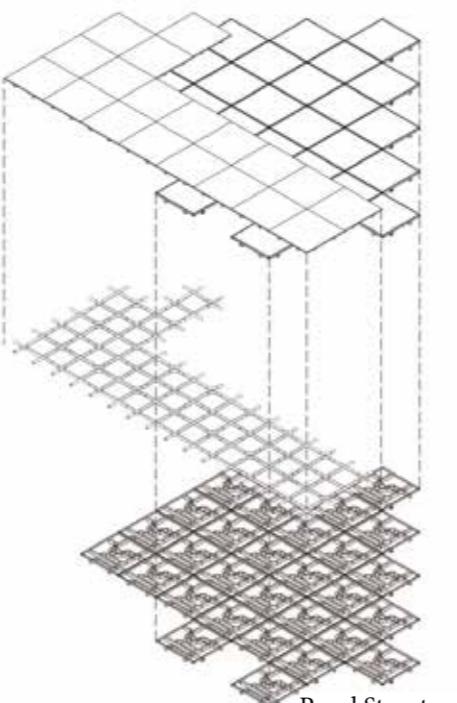
Main Iso View



The integration of panel system



Panel Unit



Panel Structure

RAPID CITY

Personal/Academy/2019/Accommodation

Hostel	[REDACTED]	6000 m ²
Shop	[REDACTED]	3000m ²
Park	[REDACTED]	5000m ²
Total	[REDACTED]	14000m ²

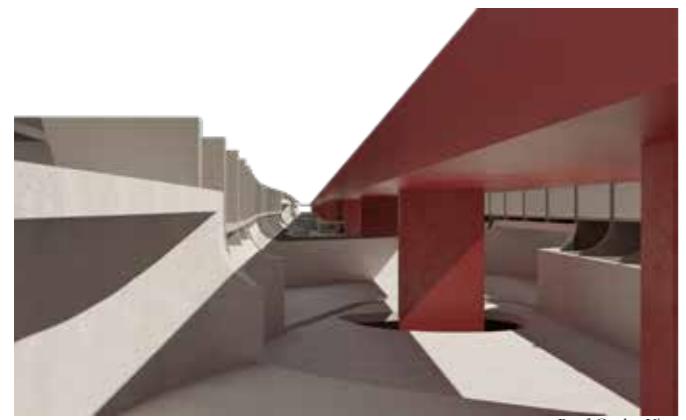
Rapid City is an algorithmic experiment that uses parametric conditions to support spatial-configuration development. The site lies beneath the viaduct of the Taichung Railway Line, forming a public void that serves local citizens. The project aims to build a multi-store park that offers renovated public spaces and reconnects the neighborhoods separated by the viaduct.



InteriorView



First Floor View



Roof Garden View

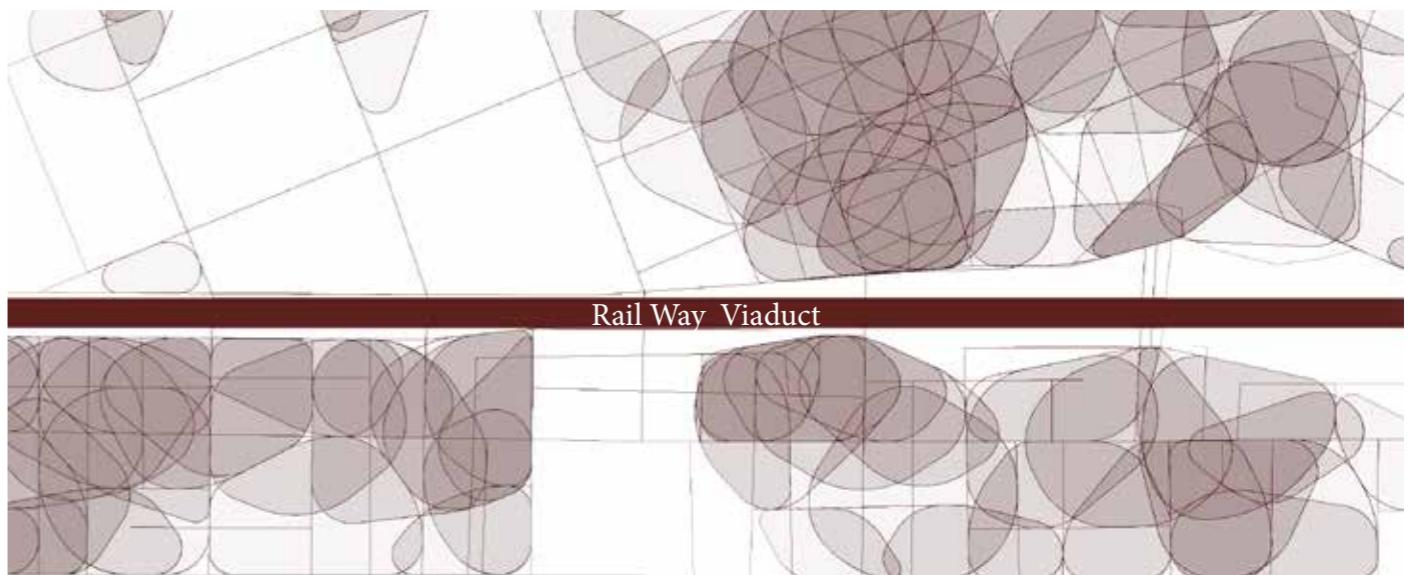


First Floor View

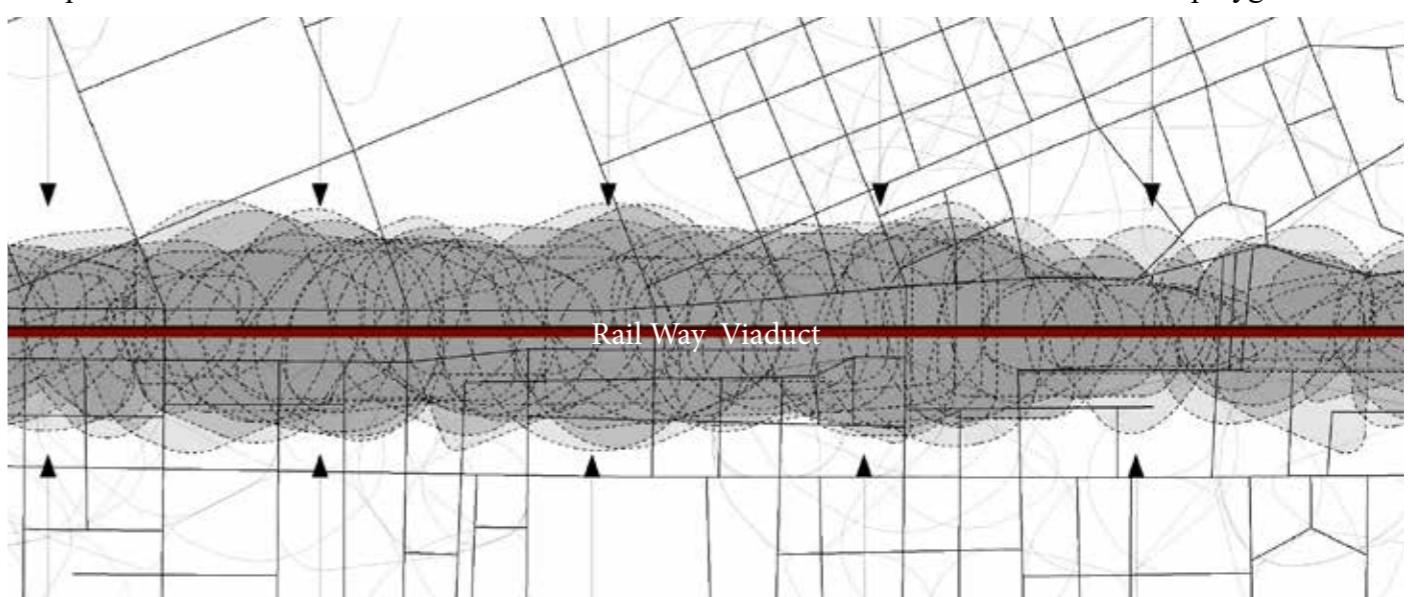
PHASE 1 PARAMETRIC STRATEGY



In Phase 1, the primary goal is to define the value of connectivity. In Taichung City, the street network was established in the early 20th century. The number of intersections reflects the scale and density of surrounding neighborhoods. Therefore, this project adopts a methodology that collects intersection counts within zoning areas along the main streets to evaluate the degree of connectivity.



A 300-meter-radius circle was drawn around each intersection in the road network. Intersections located within this radius were recorded as having a degree of connectivity with the central node. Consequently, intersections surrounded by a greater number of nearby nodes indicate a higher level of connectivity density. The points of intersection from the zone near the main street are visualized into series of fillet polygons.

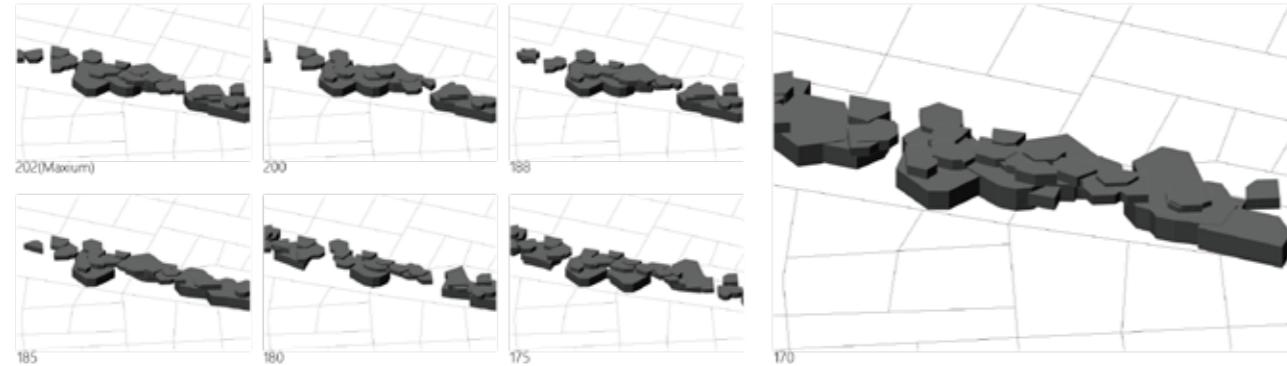


These polygons serve as prototypes for spatial formation. After being rescaled from the urban dimension to the living scale, the shapes are aligned along the viaduct, generating a sequence of interconnected curved plate spaces that reflect the underlying connectivity density of the street network.

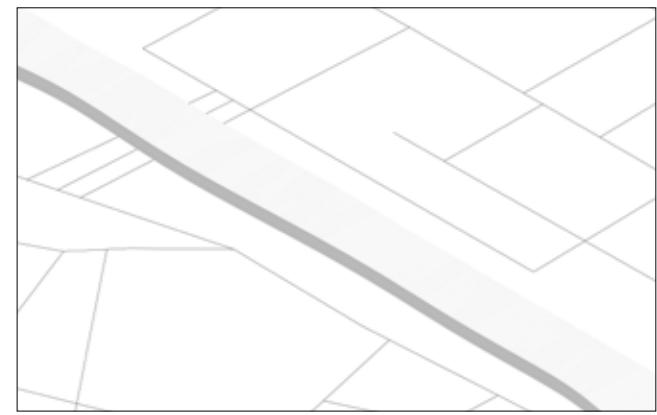
PHASE 2 SPATIALIZATION

In phase two, the main goal is to optimize the results from phase one and transform the geometric objects into architectural elements.

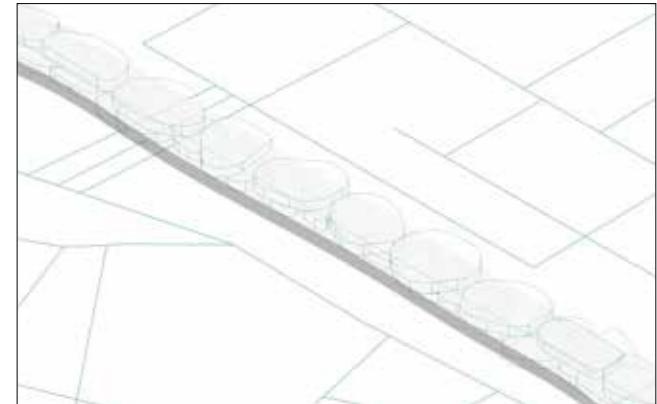
Different Results from the Algorithm



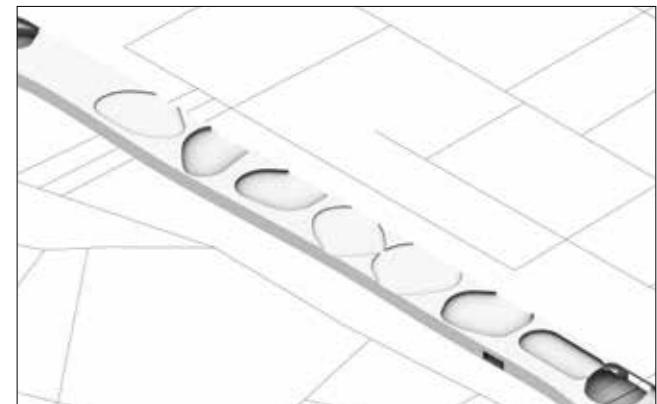
The Combination of Void Spaces



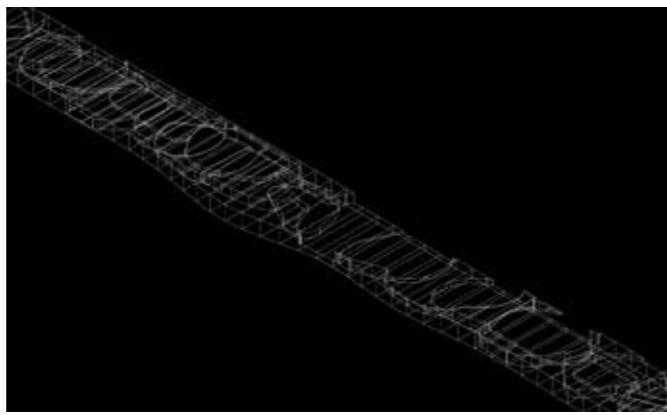
Create Curve Boundary



Create Space Volum



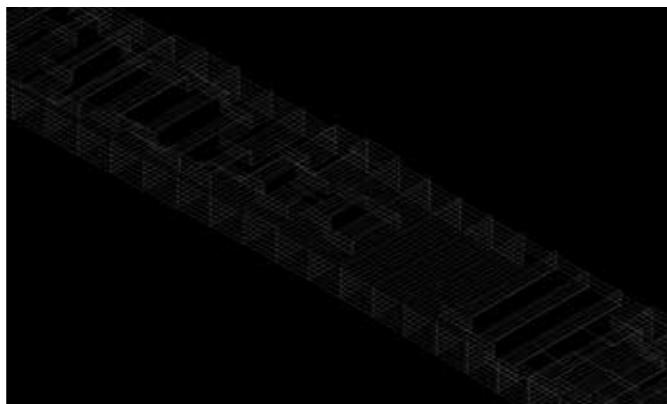
Boolean Difference two object



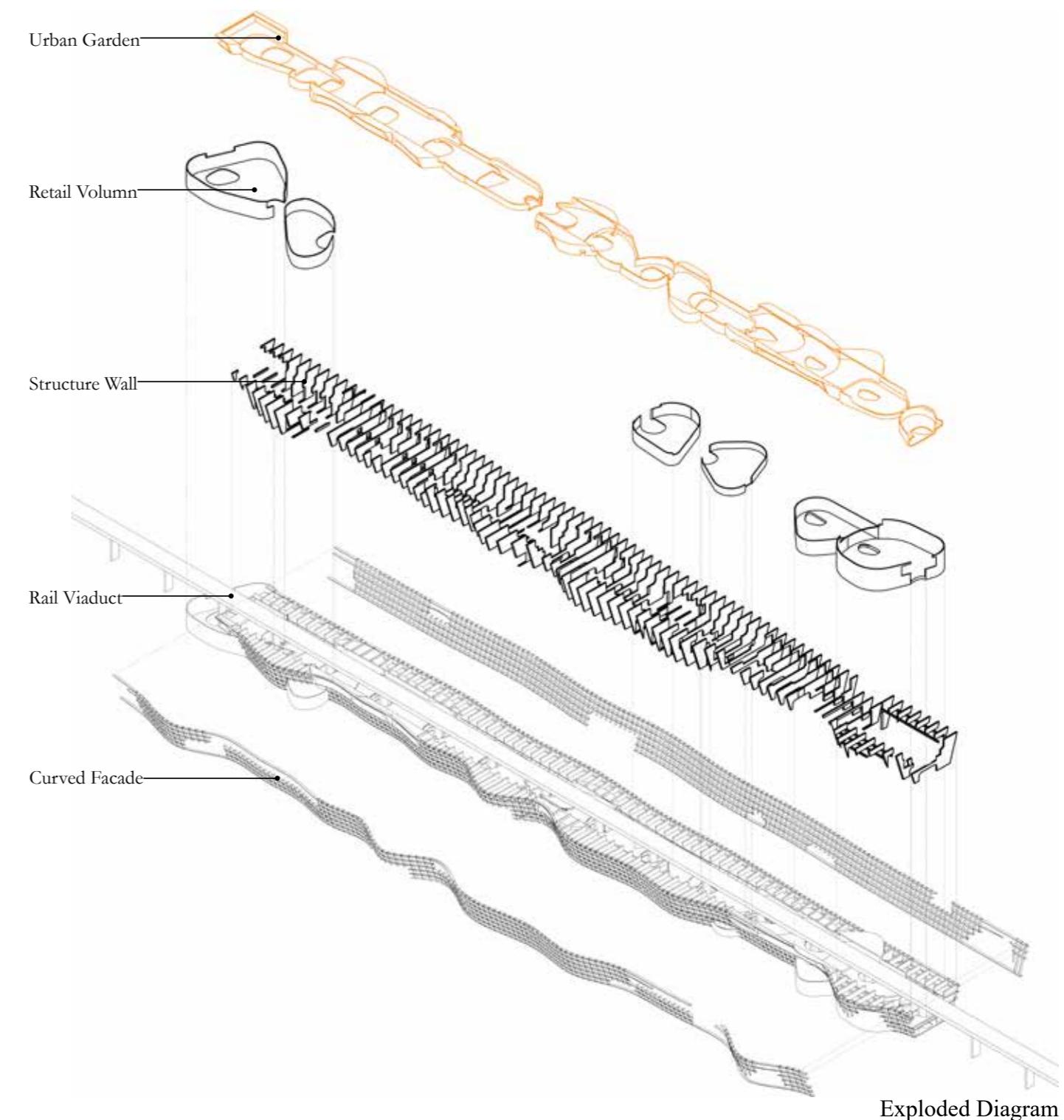
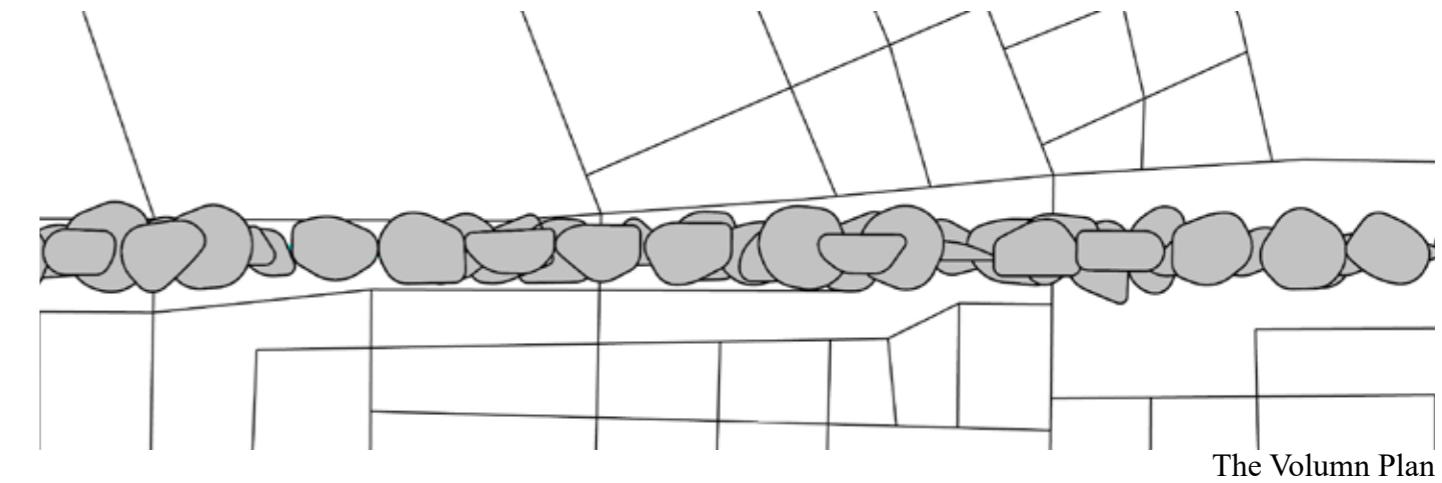
Create Structural Grid

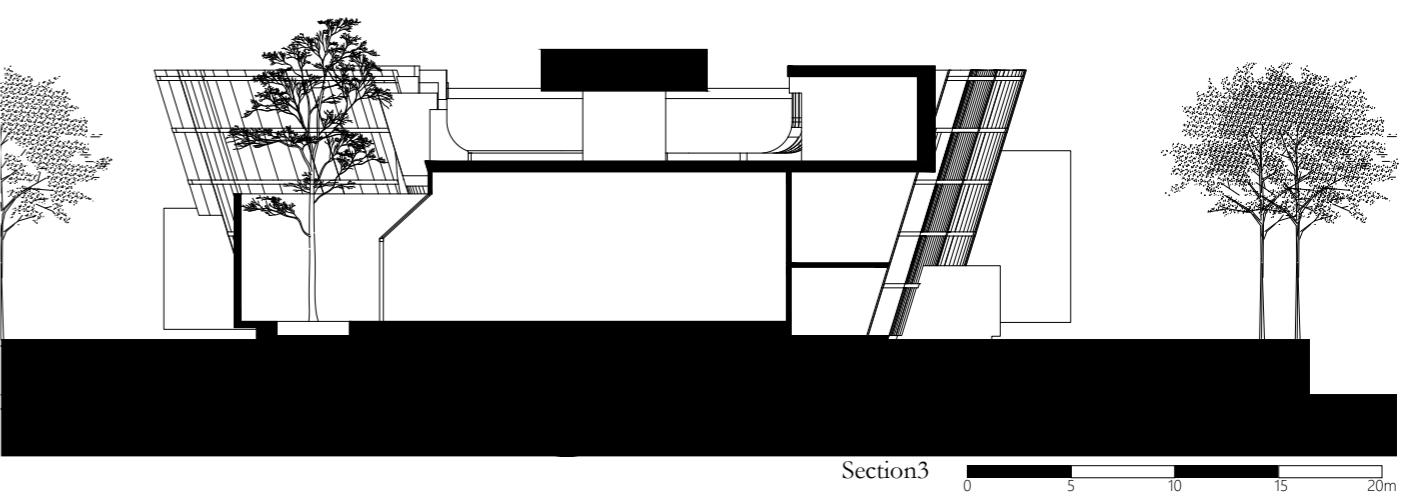
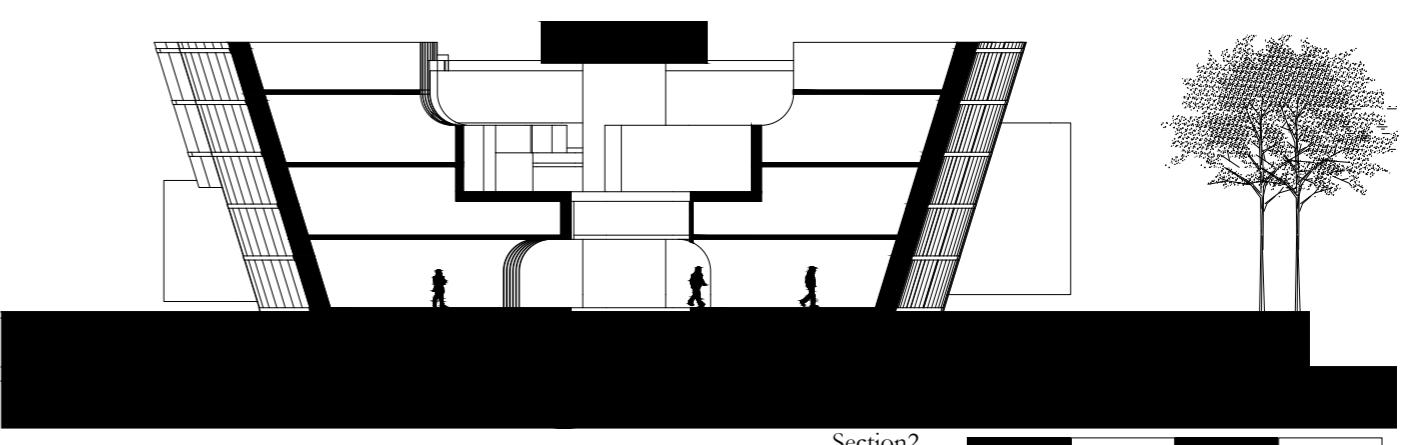
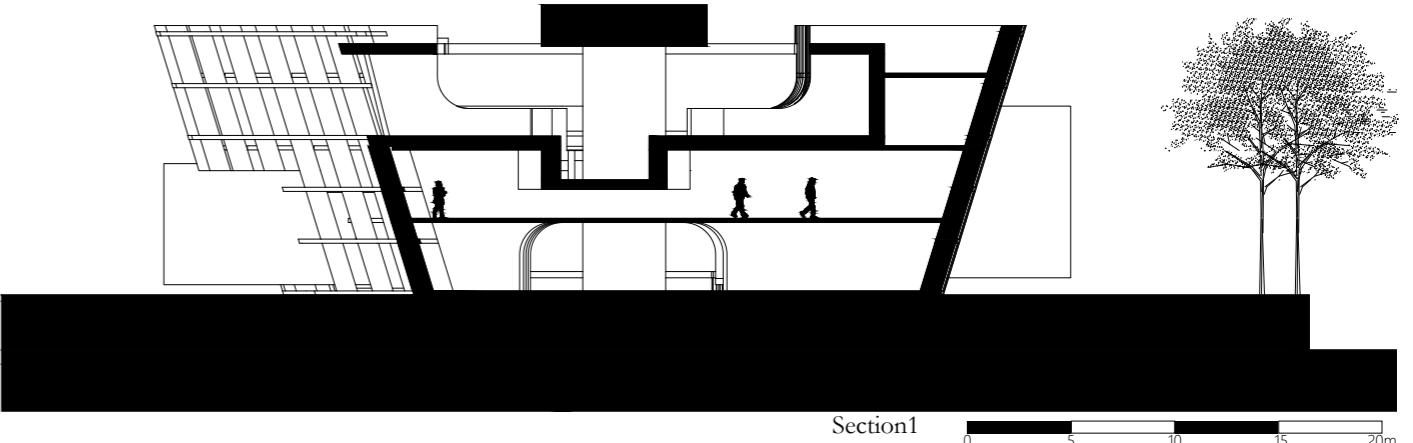
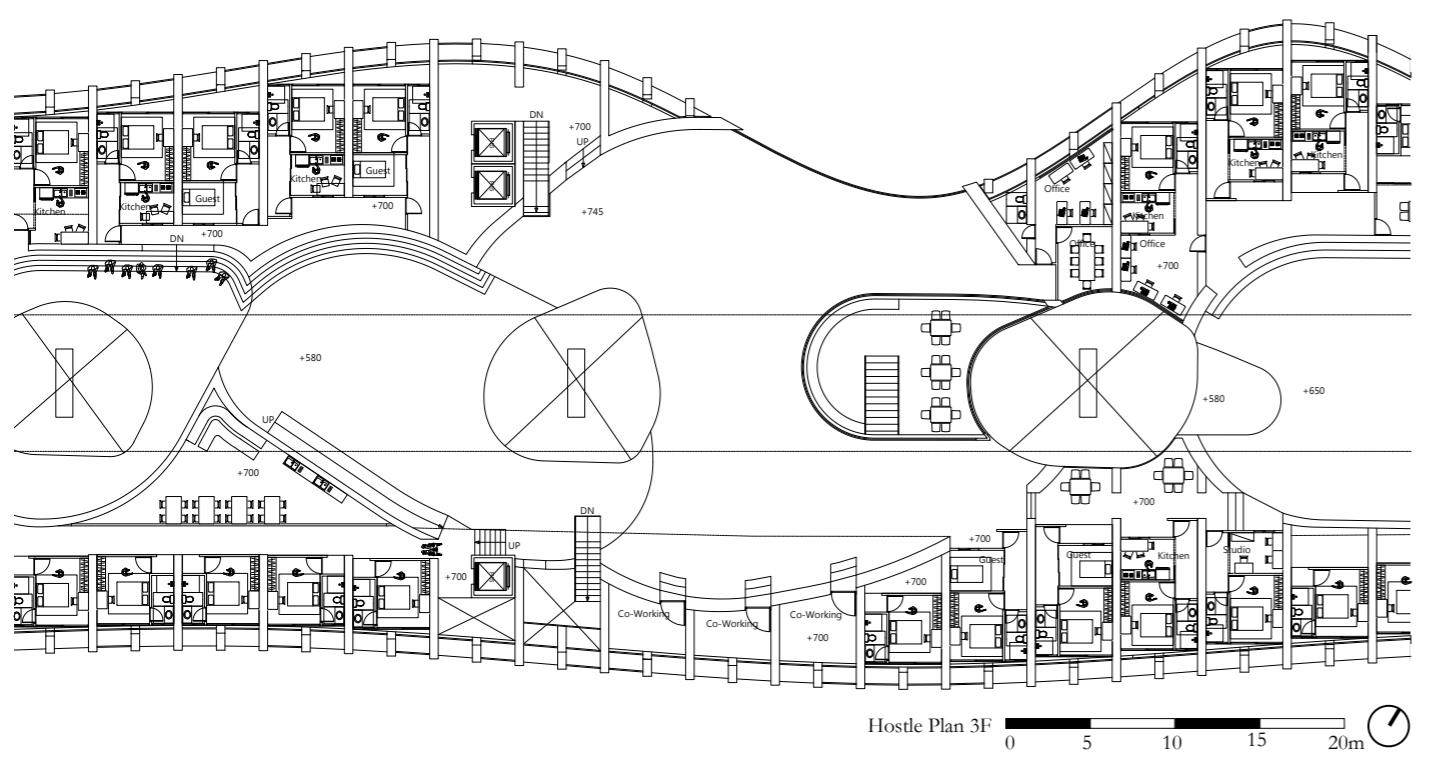
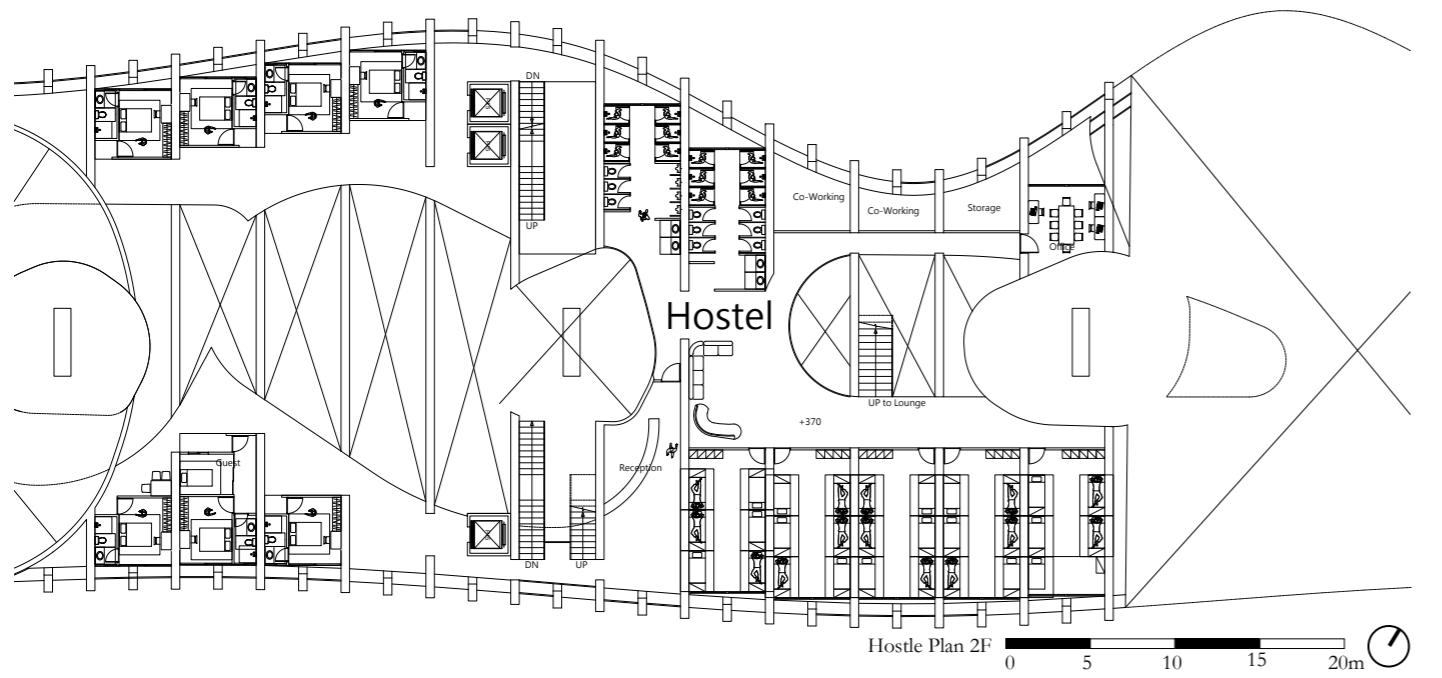
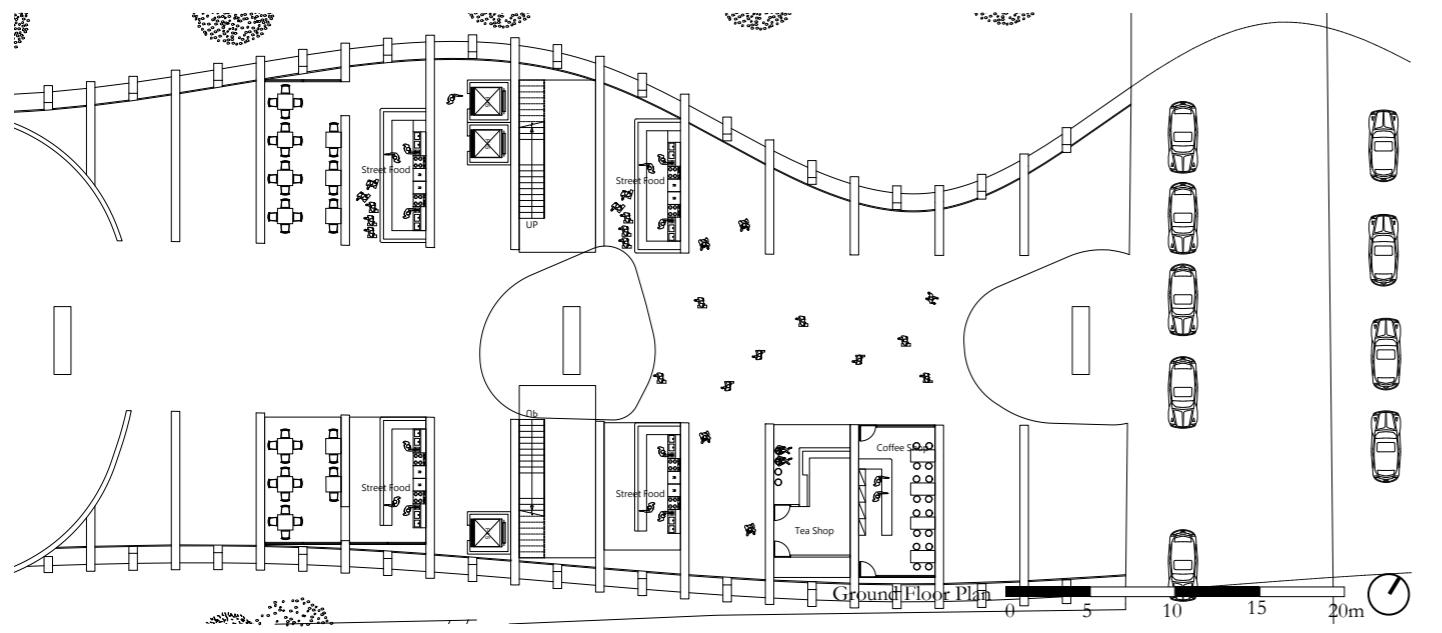


Create Structural Walls



Create Structural Floor





Working Palace

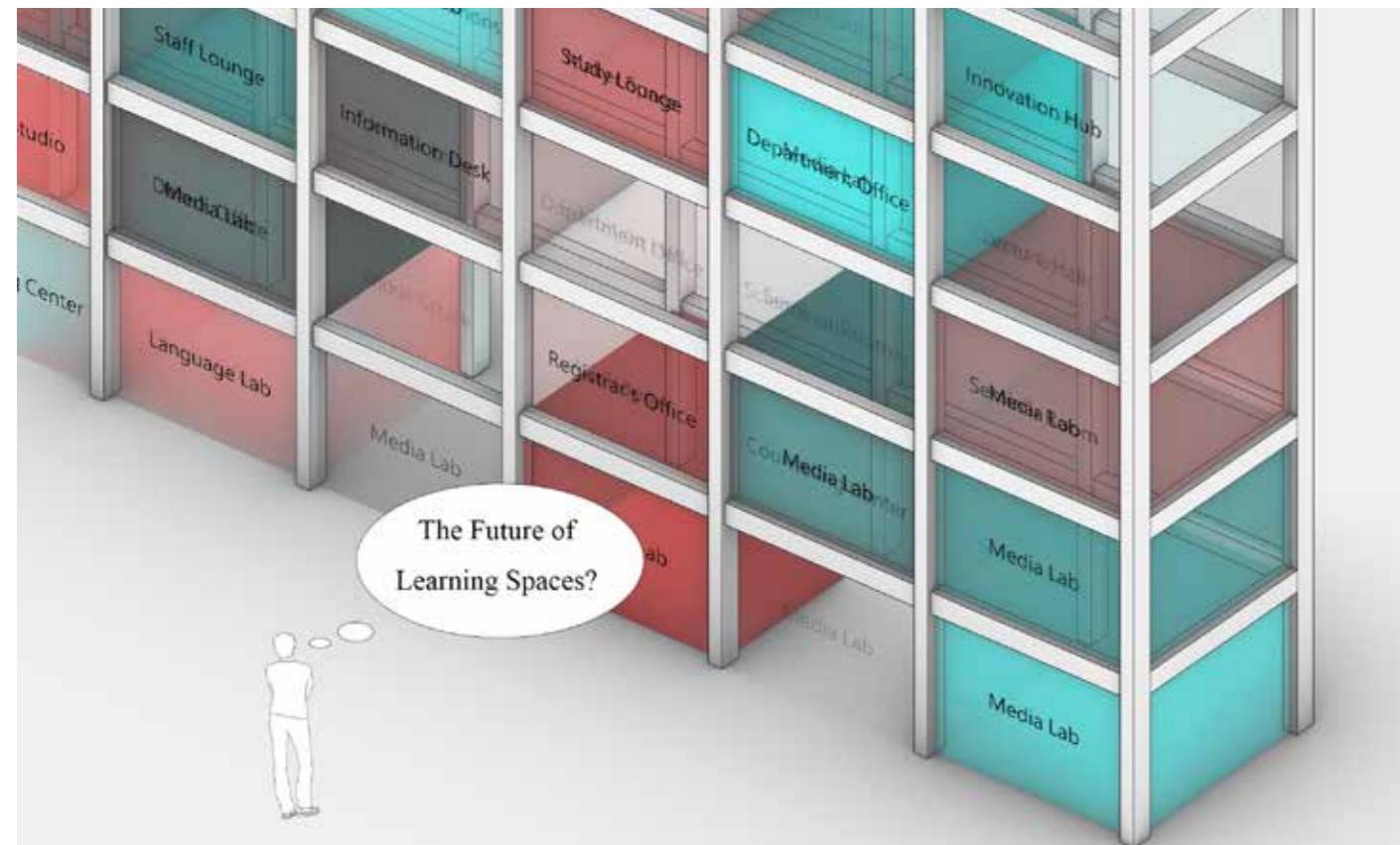
Personal / Academy / 2018 / Education

Education
Hotel
Commercial
Student Space
Office



A Flexible Educational Prototype for a Shrinking Society

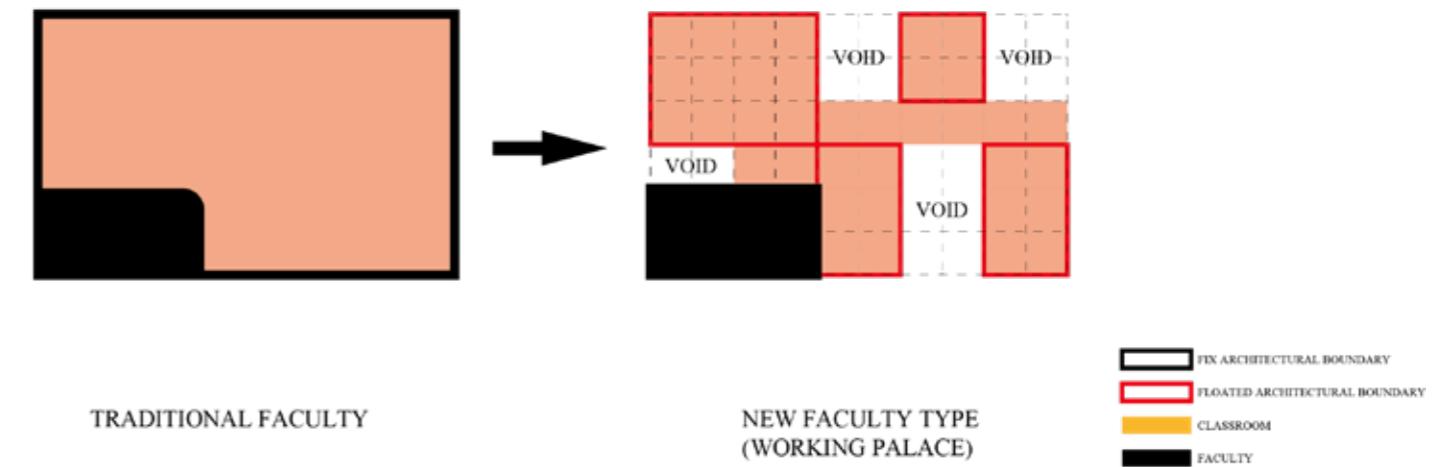
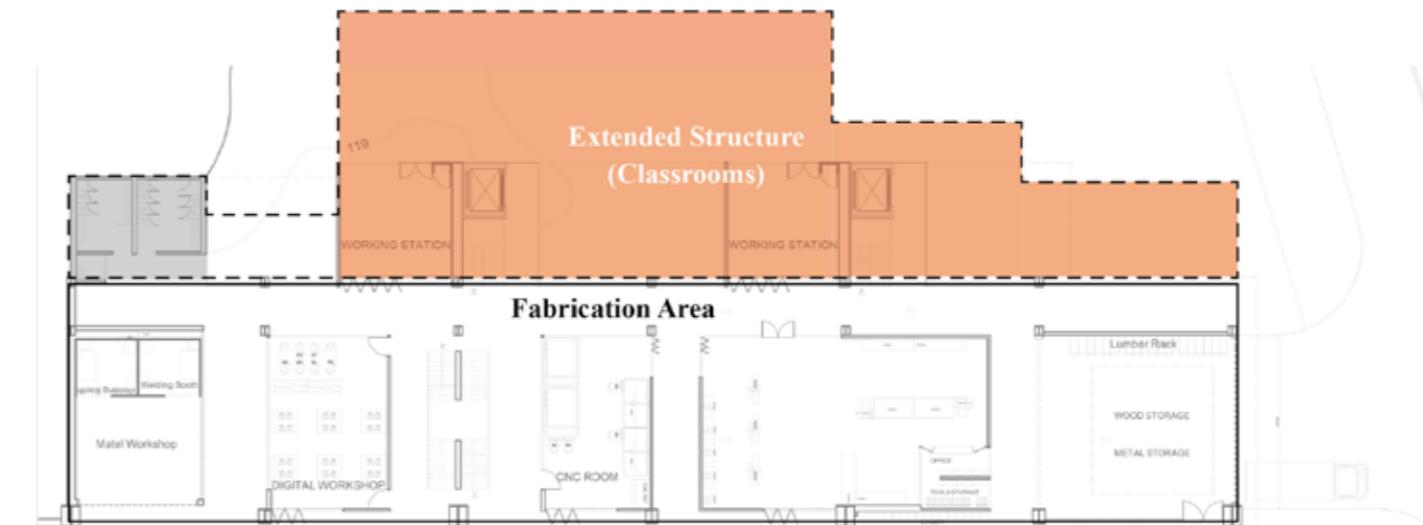
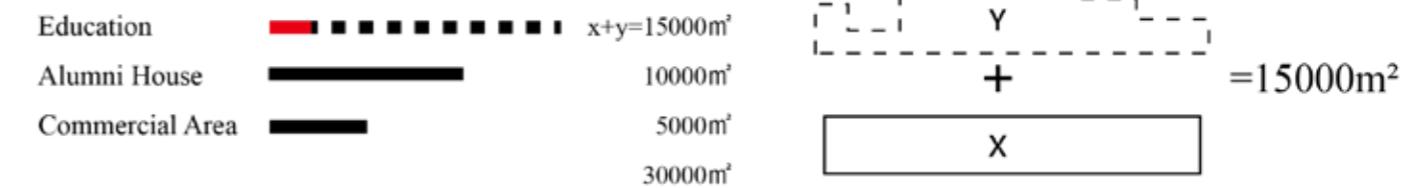
"Working Palace" is a speculative architectural intervention designed to address the paradox of Taiwan's declining student population and the persistent need for institutional growth. Located at the intersection of Tunghai University and Taichung's busiest urban artery, the project proposes a new educational typology that moves away from rigid, standardized spaces. By integrating a permanent technical "infrastructure" with a flexible "active facade," the design creates a resilient framework that can fluctuate in scale, mediating the relationship between industry-academia collaboration and the evolving needs of the modern campus.



Redefining the Educational Typology

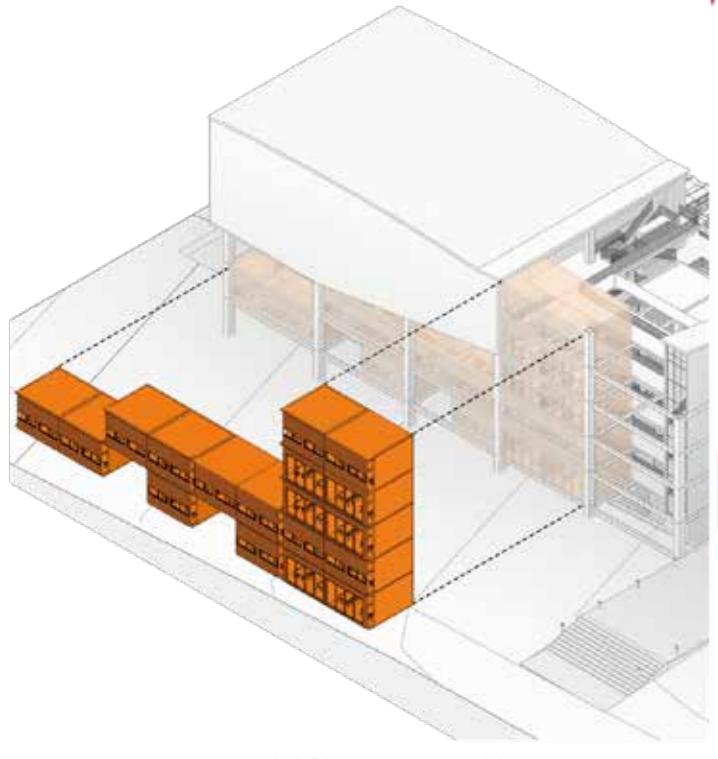
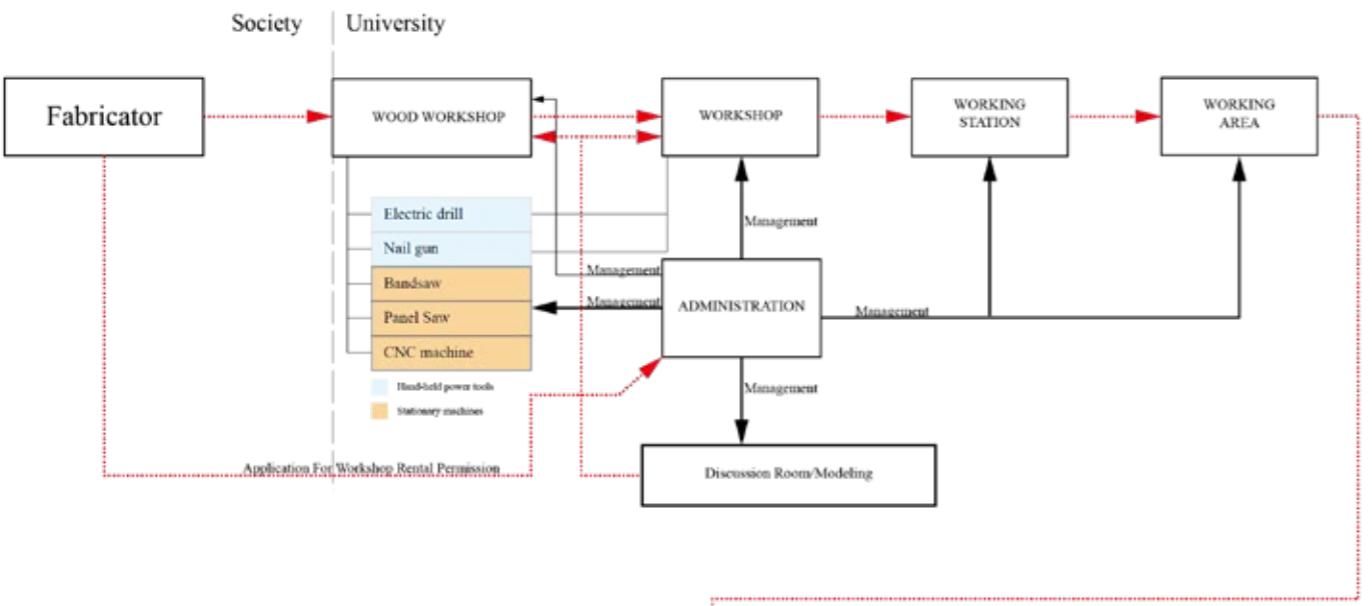
The project responds to the standardization of education and Taiwan's demographic crisis, marked by an annual 2-3% decline in the student population. This crisis prompts a radical spatial experiment: what if a building only retains its "survival spaces"—the essential circulation, shafts, and service cores—while leaving the living spaces as an adaptive variable?

"Working Palace" implements this concept by treating the faculty building as a permanent framework for floating requirements. When the student population fluctuates, the architecture reacts accordingly. In times of decline, further construction is paused to avoid underutilization; conversely, when new demands arise, the system facilitates the rapid insertion of prefabricated units within the primary structure. This approach transforms the traditional, static campus into a resilient environment that evolves in real-time.

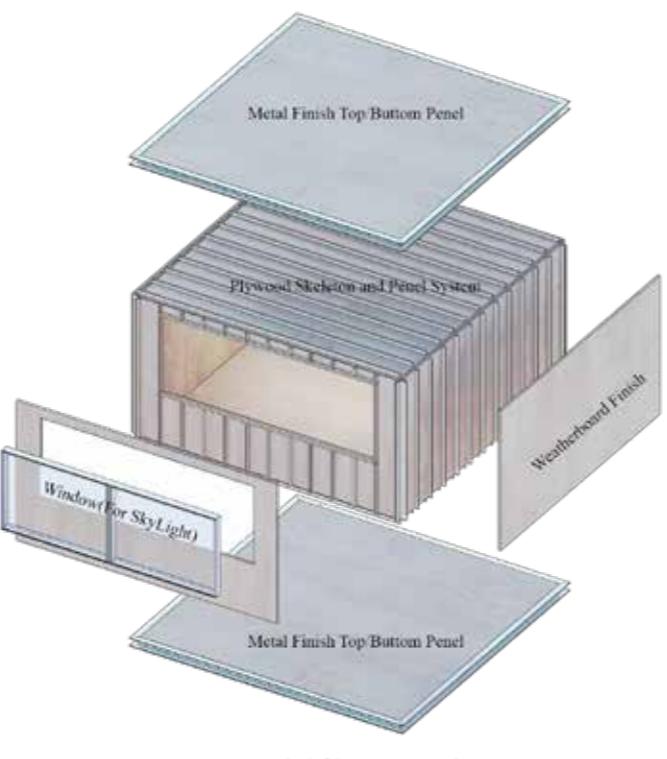


From Fabrication to Assembly

The implementation of the adaptive units follows a rigorous fabrication pipeline. External fabricators enter the system by applying for workshop rental permissions through the administration. They utilize the "Infrastructure Area"—equipped with wood and metal workshops, CNC machines, and digital labs—to manufacture modular "Extended Classroom Units." These units, featuring a plywood skeleton and metal-finish panels, are then transported and assembled onto the primary structural frame facing Taiwan Boulevard. This mechanism ensures that the building's volume remains in constant alignment with the real-time demands of its users.

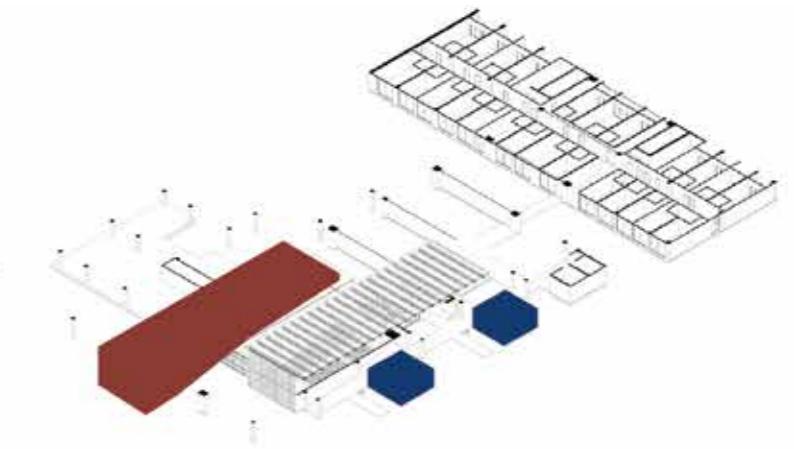


Extended Classrooms Assembly

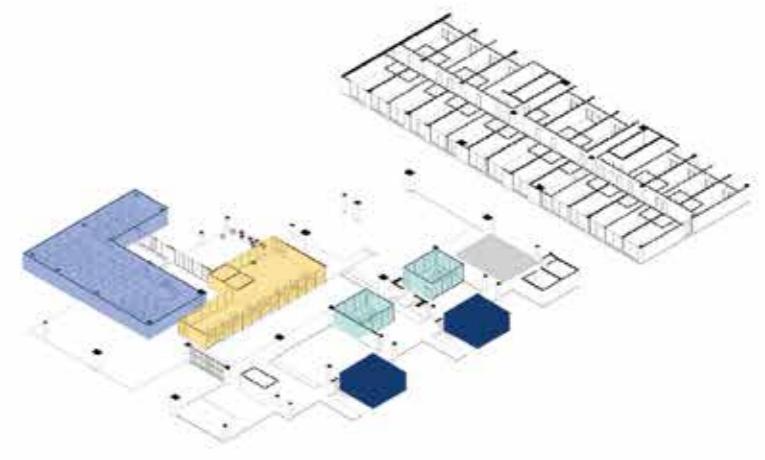


Extended Classroom Unit

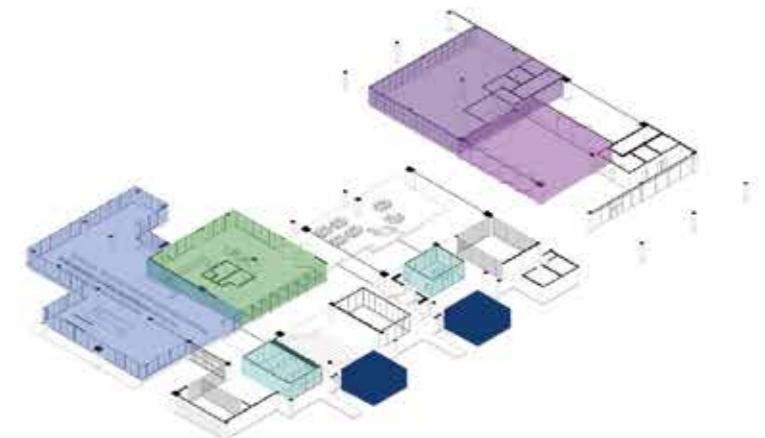
+1080
■ Auditorium
■ Working Station
■ Alumni House



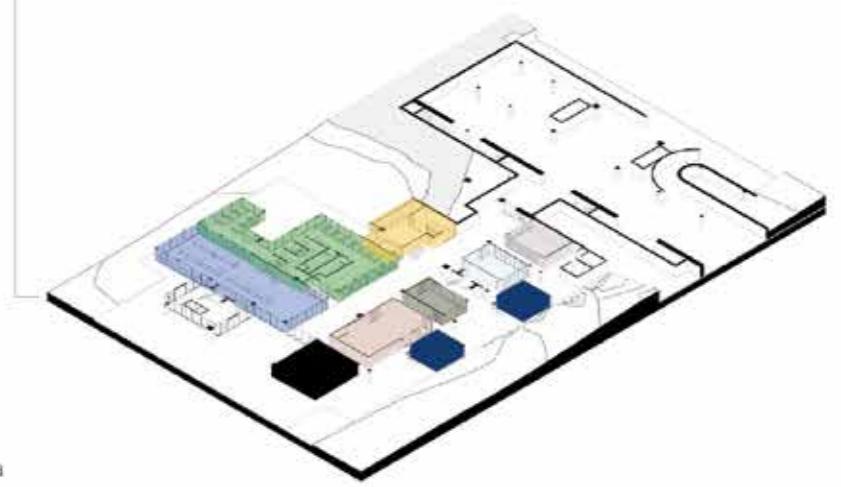
+720
■ Modeling Room
■ Discussion Room
■ Student IKEA Office
■ Student IKEA Storage
■ Working Station
■ Alumni House

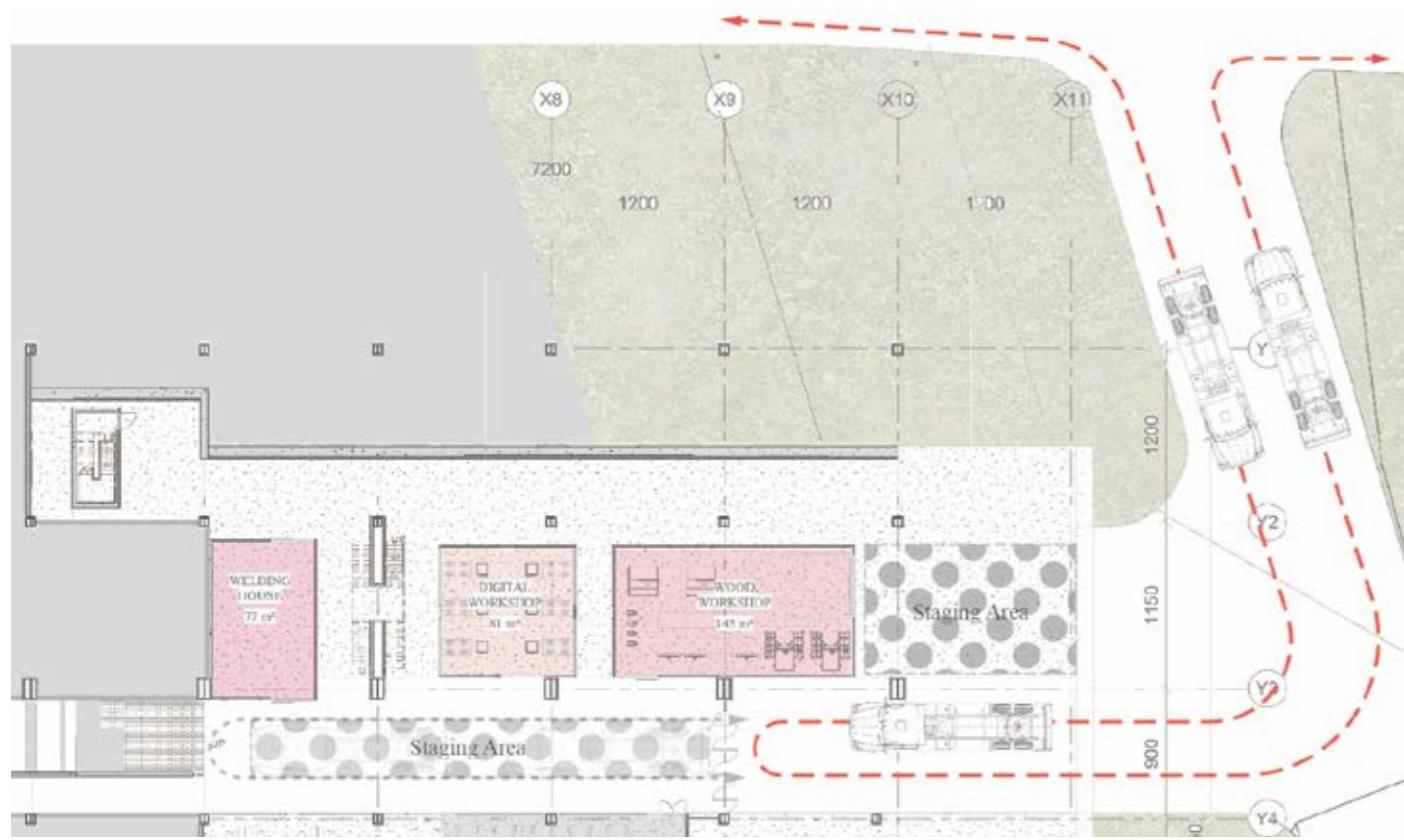


+360
■ Modeling Room
■ Discussion Room
■ Student IKEA Restaurant
■ Student IKEA Working Area
■ Working Station
■ Alumni House - Lobby
■ Convenience Stores



+0
■ Wood WorkShop
■ Metal WorkShop
■ CNC Room
■ 3D Printing Room
■ Storage
■ Student Restaurant
■ Student IKEA Working Area
■ Parking

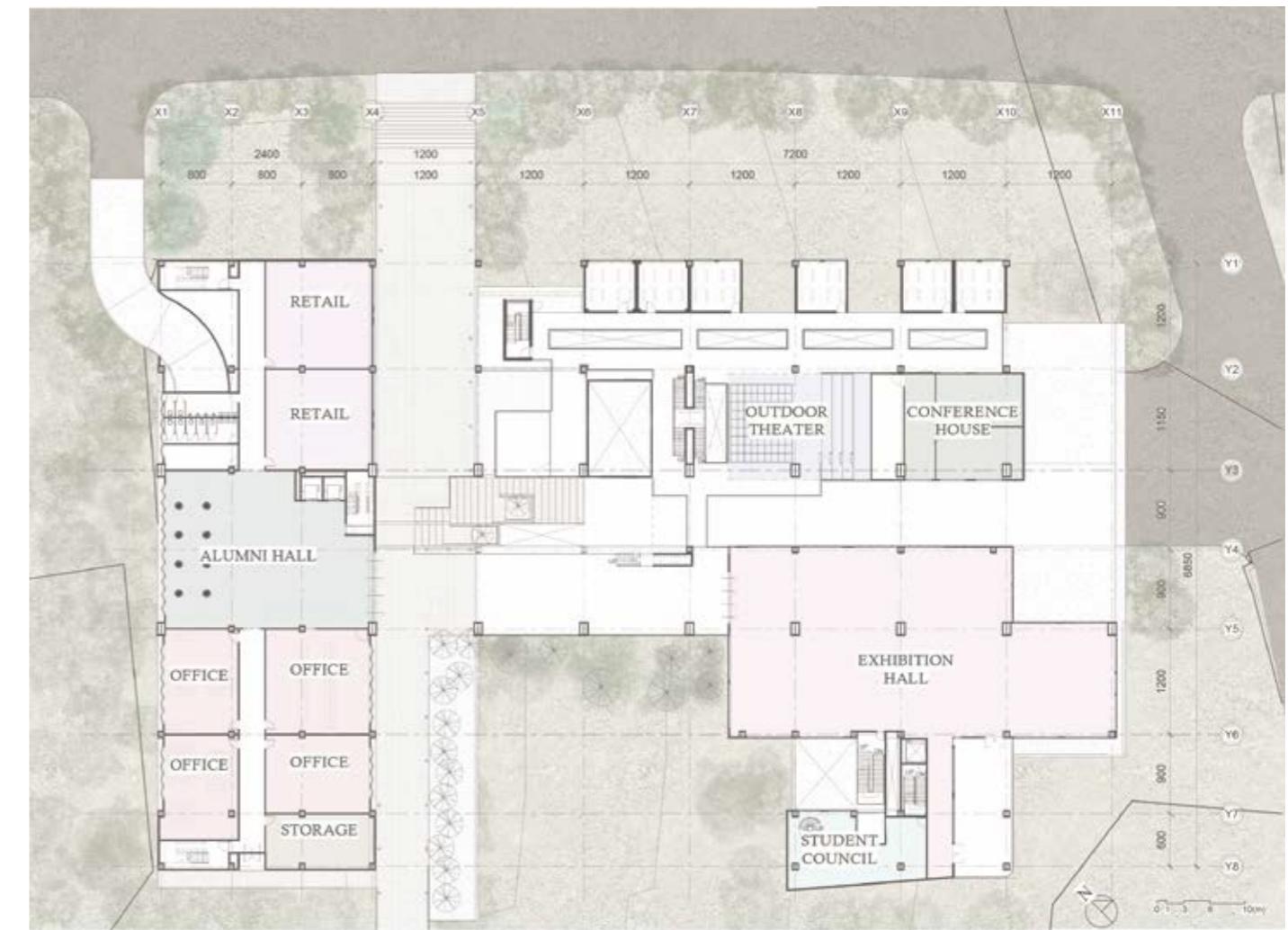
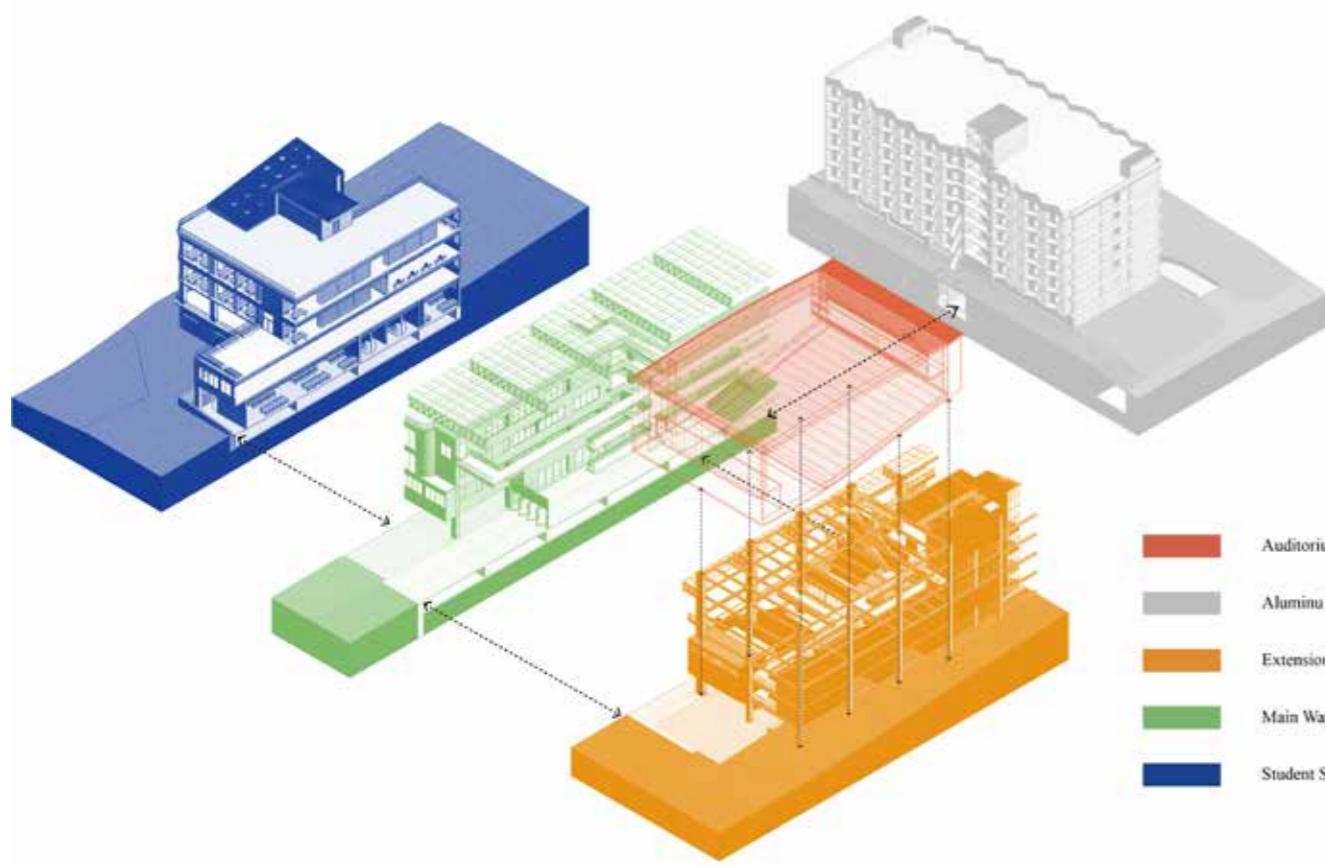


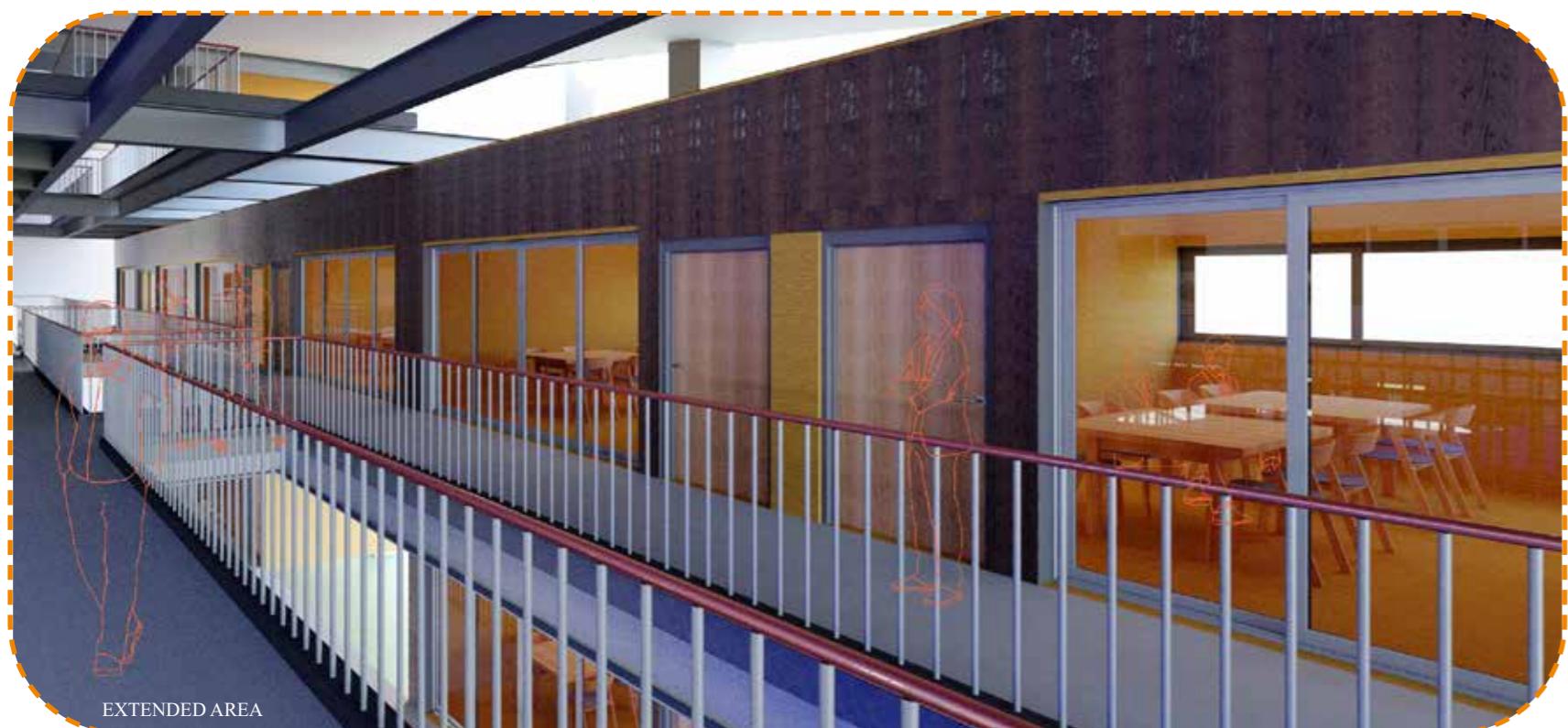
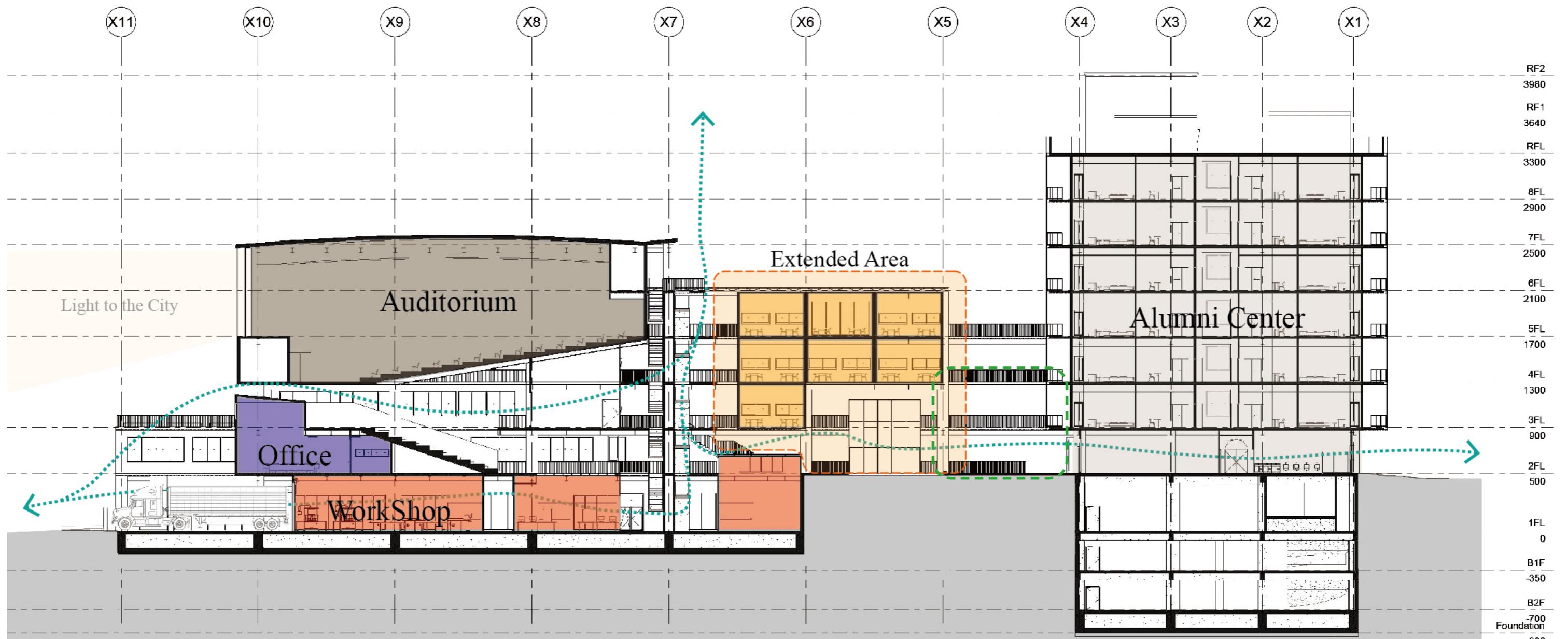


The Organization of Whole Building

"Working Palace" is organized into four programmatic zones designed for seamless industry-academia synergy. The Extension Area serves as the fabrication core, housing advanced workshops and automated warehouses for digital-to-physical translation. Acting as a spatial mediator, the Main Way connects production zones with the Student Service Area, which supports campus life through research hubs and communal spaces.

The Alumni Center functions as a structural backdrop, separating the student zone and undeveloped zone in the campus. The guest room partition system also uses pre-fabricated panel from workshops and factories.





A Line Of Running Memories

Personal / Academy / 2019 / Community Infrastructure

Cemetery
Pavilion

1800 m²
1200 m²
3000 m²

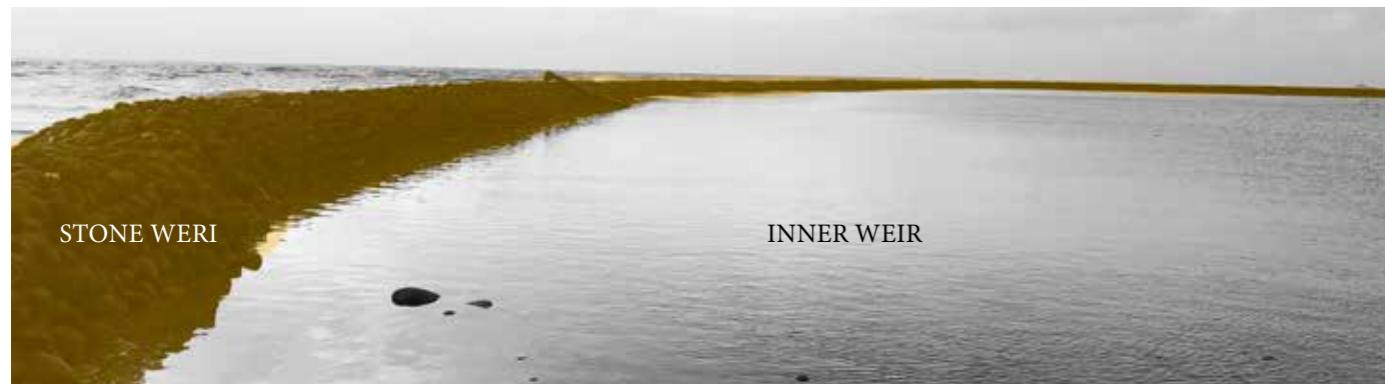
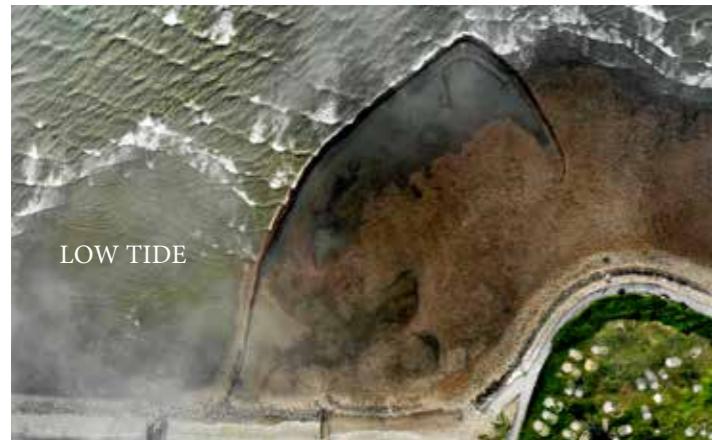


Linking the Stone Fish Weir with the Annual Marathon

The project focuses on using a historical structure—an ancient stone fish weir adjacent to an existing breakwater—as a means to link a community event, the annual marathon, with this inherited cultural landscape.

The annual marathon is a local community event intended to stimulate the regional economy by connecting fishing, tourism, and cultural activities. Its route links the coastal area, where the stone fish weir is located, with adjacent communities, promoting local food and culture to the public.

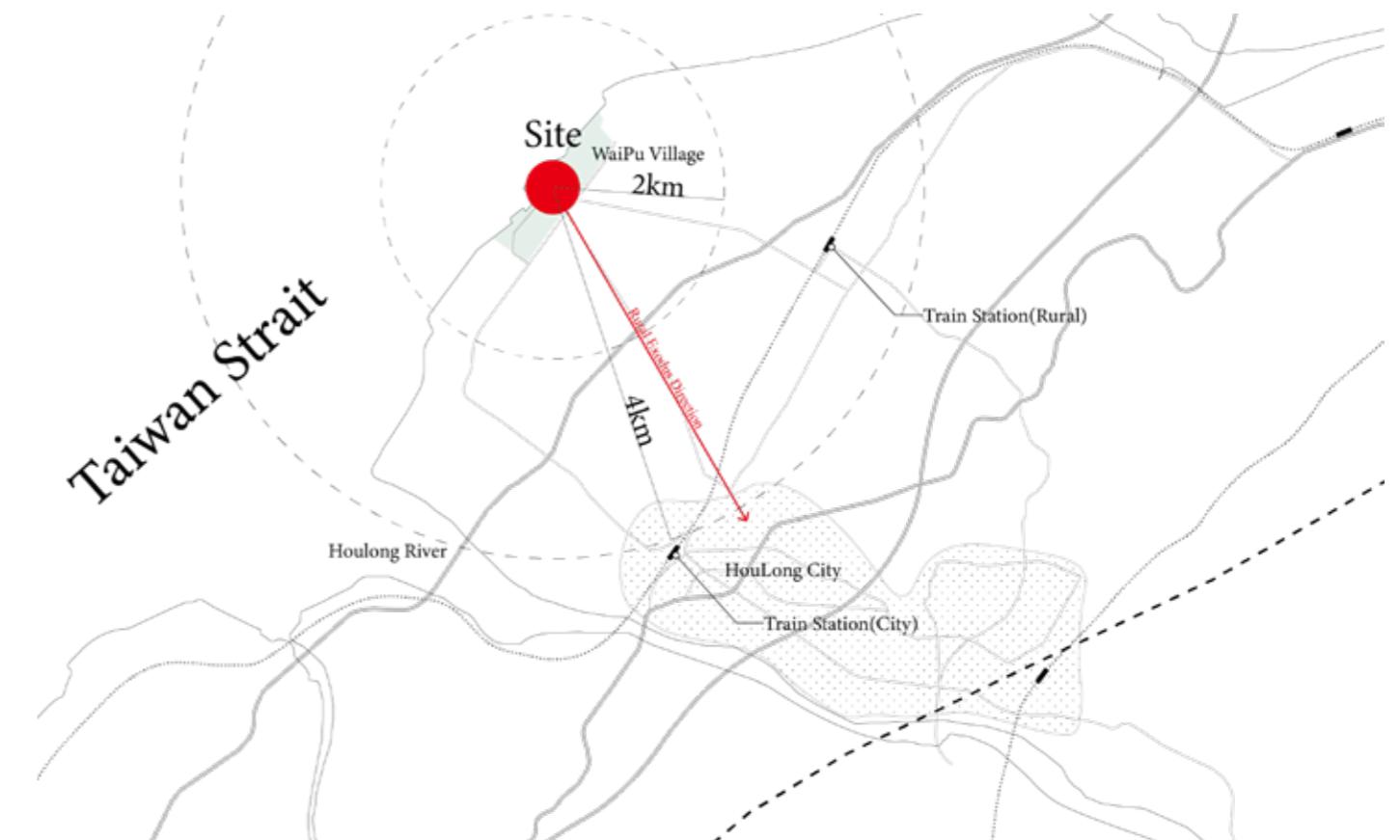
This design aims to transform the existing breakwater into a marathon pavilion that incorporates the local columbarium, addressing multiple community, cultural, and spatial issues within a single architectural intervention.

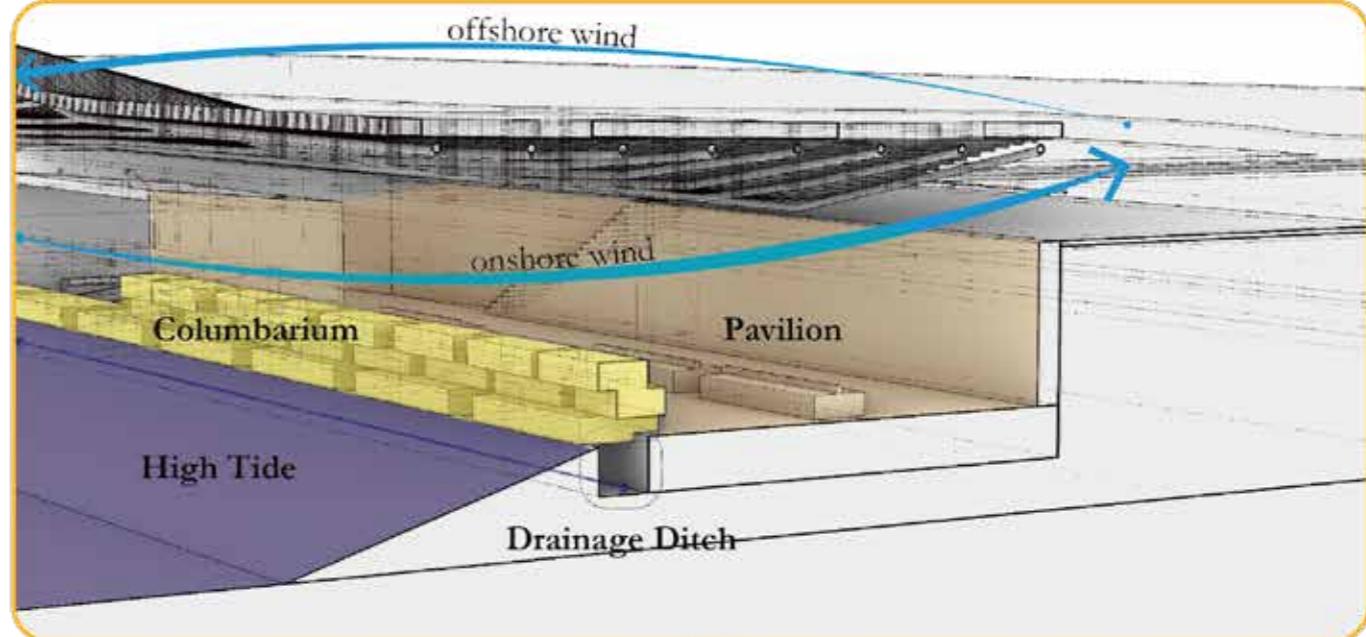
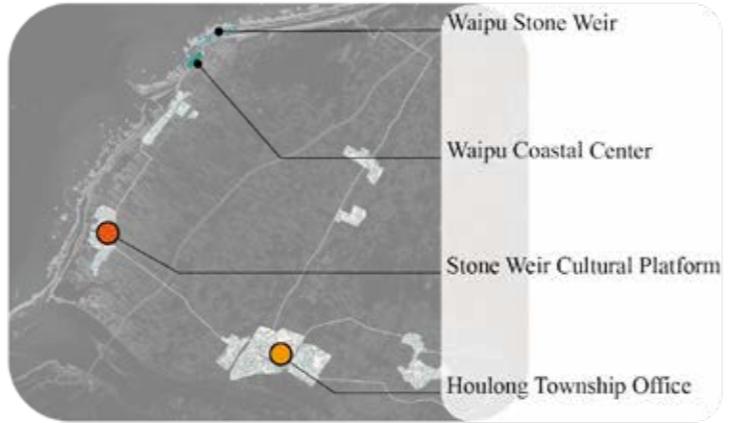
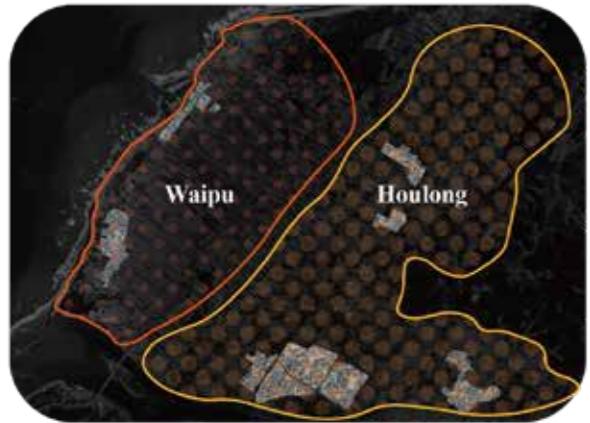


The Declined Fishing Village

The WaiPu area is defined by its traditional stone fish weir fishing practices, compact coastal settlements, and recurring religious festivals, creating a distinct cultural landscape deeply rooted in maritime livelihood and ritual. In contrast, the adjacent Houlong area serves as a regional infrastructural hub, accommodating high-capacity transportation networks, including railways and highways.

To revitalise the local economy, the government has integrated the maintenance of large-scale stone weirs with cultural marathon events to bolster WaiPu's public profile. This strategic synergy aims to empower local residents by generating supplementary income through the marathon and the subsequent surge in tourism-driven economic activity.

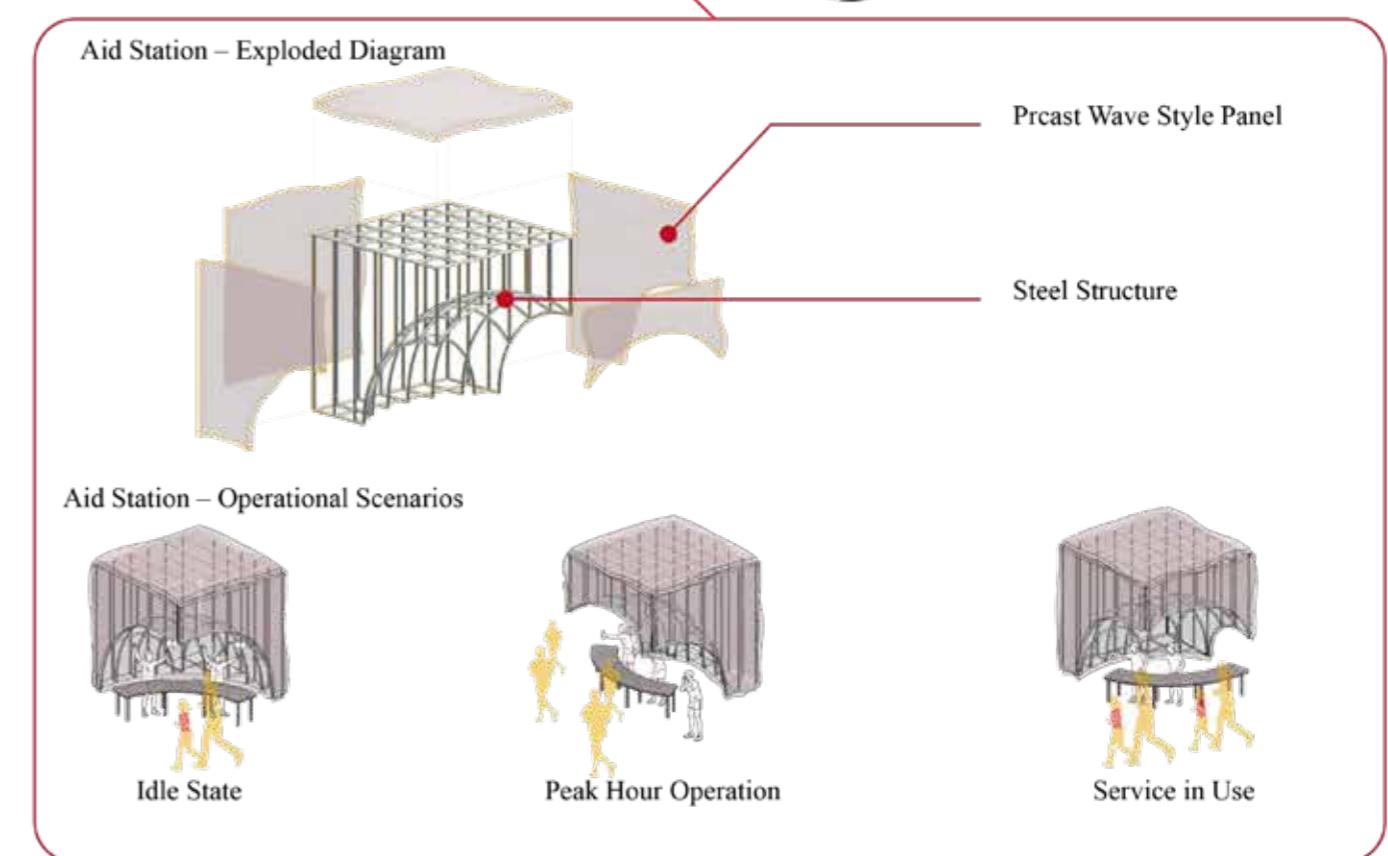
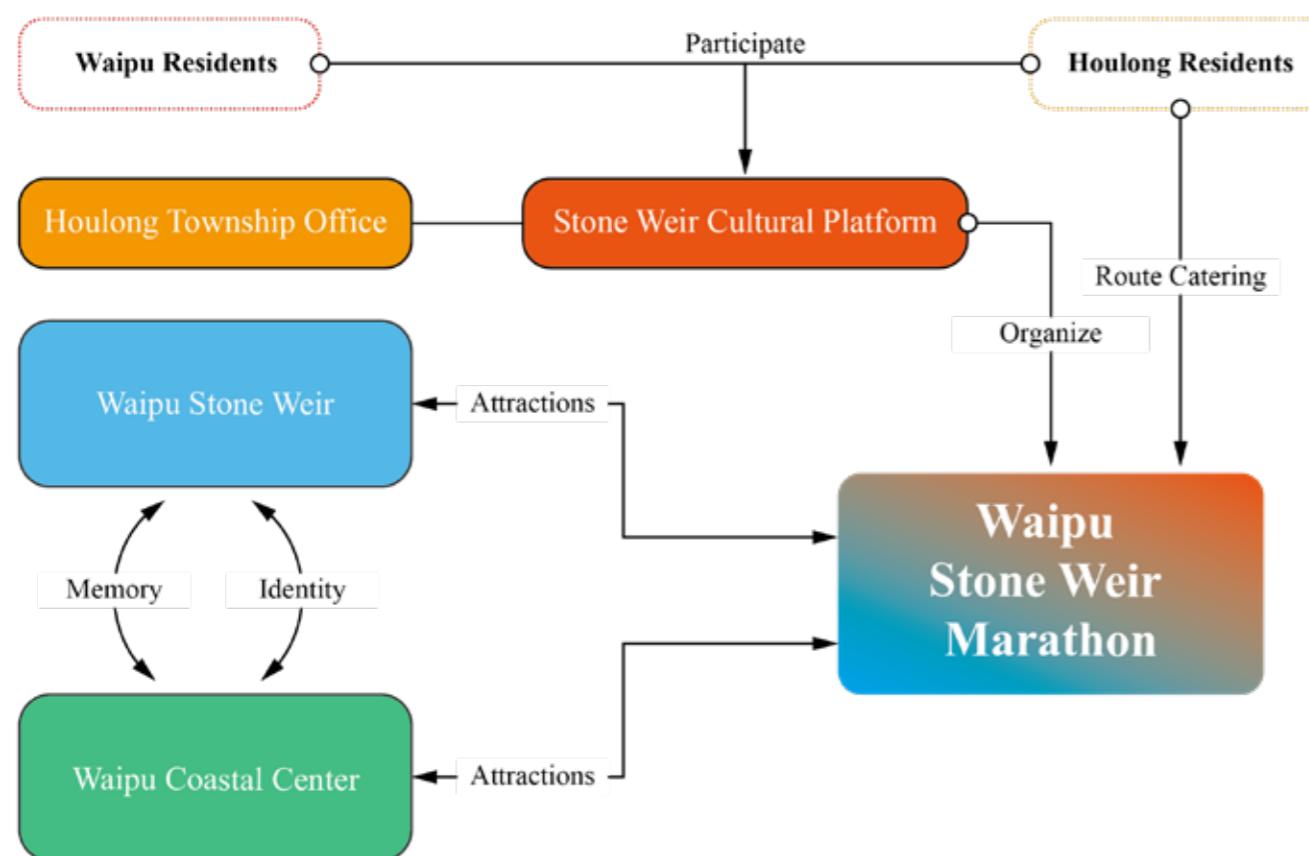
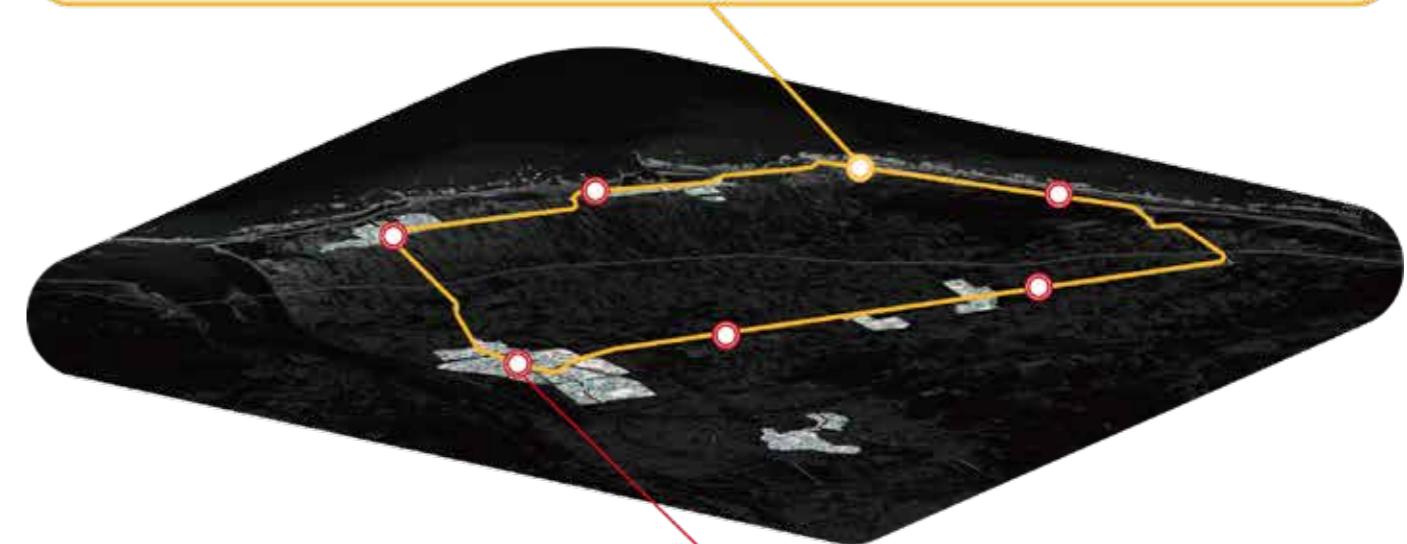


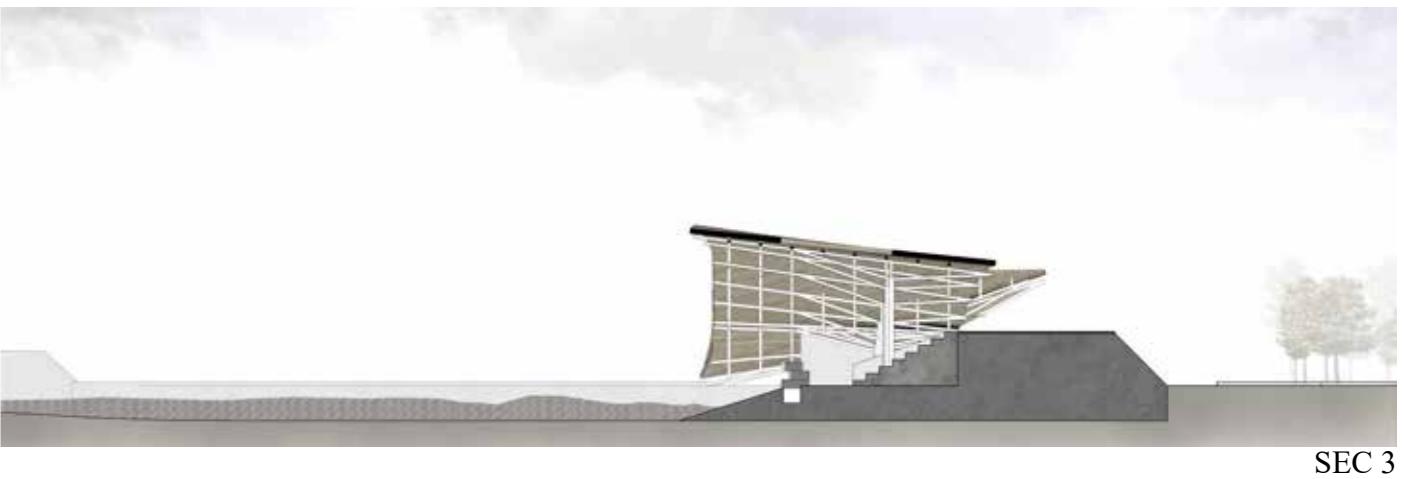
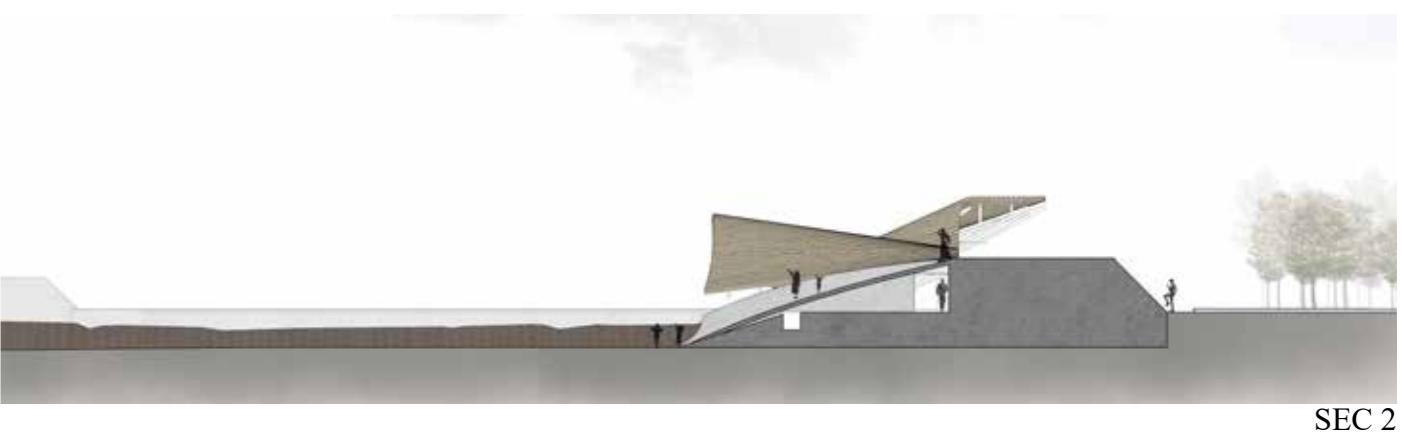
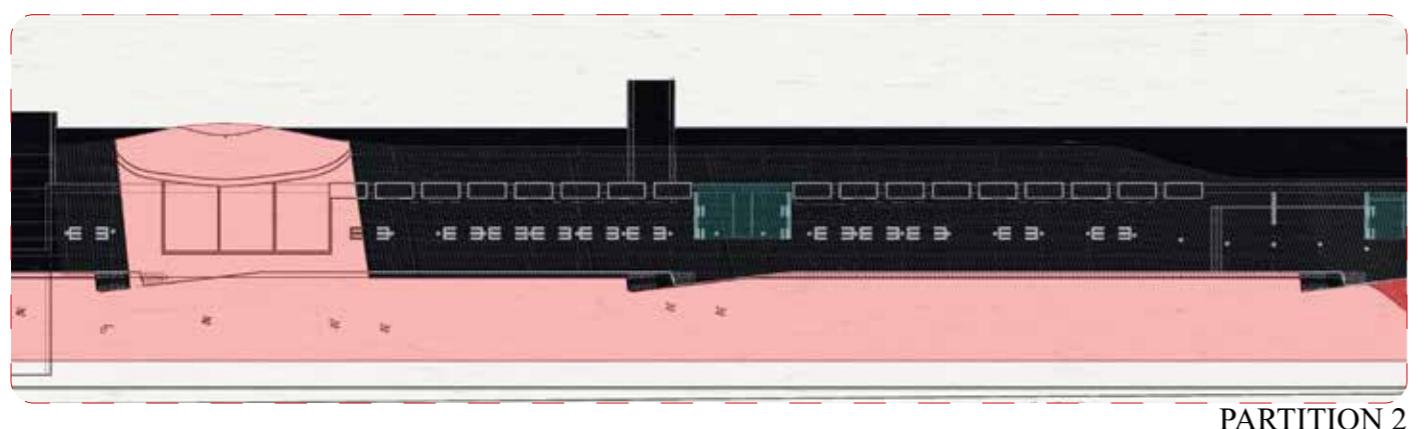
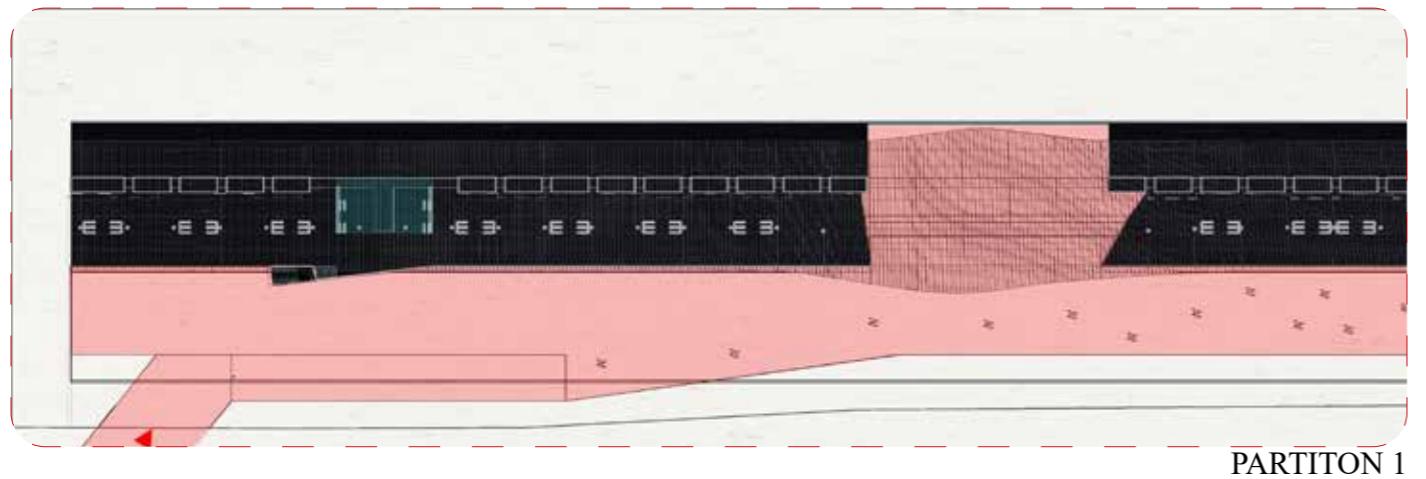
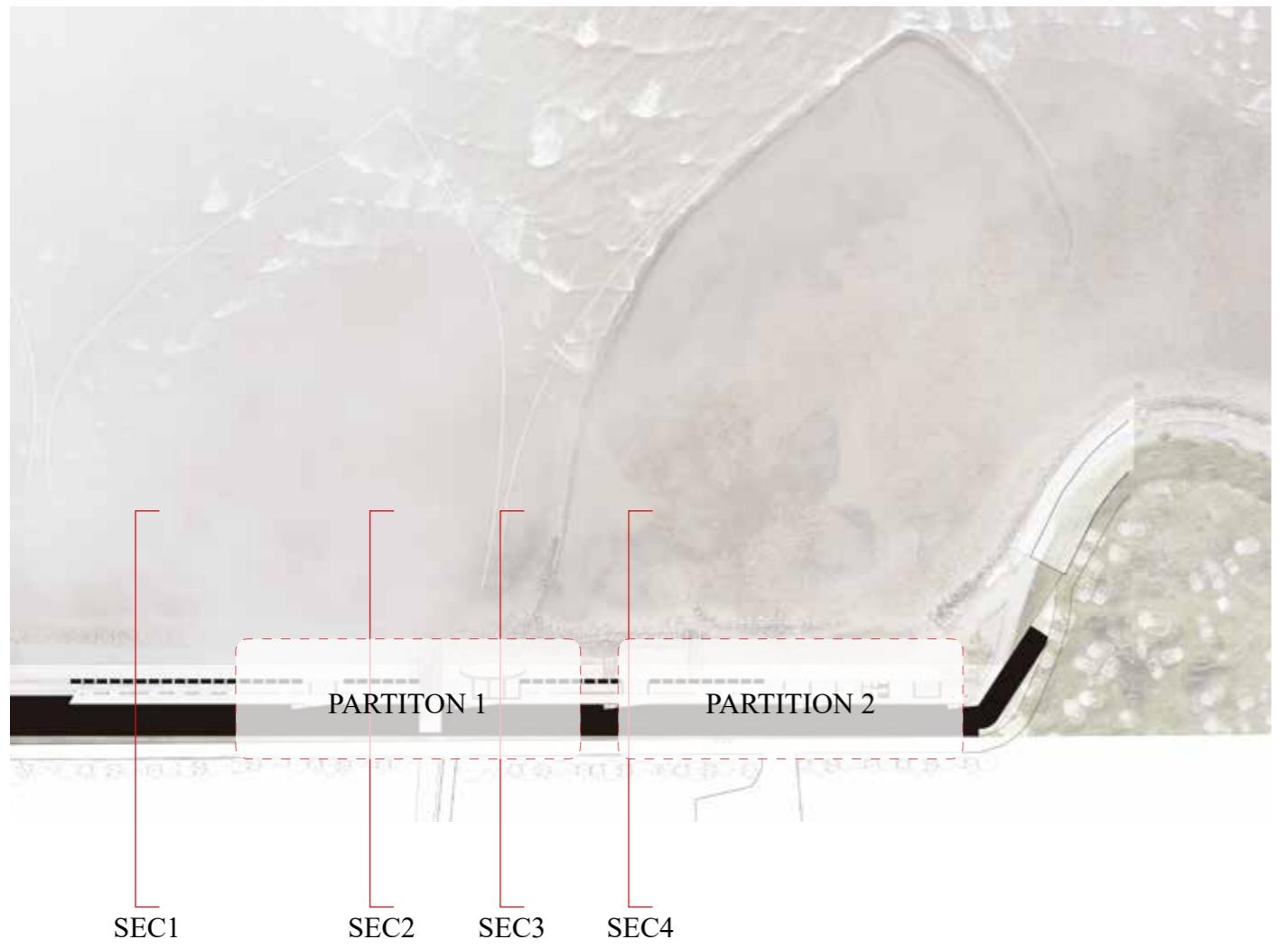


Local Policy Integration Strategies

The annual Stone Fish Weir Marathon serves as a mechanism to reconnect these two areas by mobilizing cultural heritage through a recurring public event. Building upon this event, the Waipu Stone Fish Weir Cultural Platform, hosted by the Houlong–Waipu Cultural Affairs Bureau, is proposed as an institutional framework dedicated to supporting local cultural practitioners in the research, preservation, and planning of stone fish weir-related heritage and activities. Through this platform, the marathon becomes not only a one-day event but part of a continuous cultural and policy-driven process.

As a recurring annual event, the marathon integrates the cultural landscapes of Waipu and Houlong directly into its race route. By traversing coastal infrastructure, fishing villages, and stone fish weir sites, the route enables participants to experience the region as a continuous cultural landscape at the pace of running. In this way, the marathon operates simultaneously at local, national, and international scales—presenting regional heritage through a format accessible to both local communities and visiting runners.

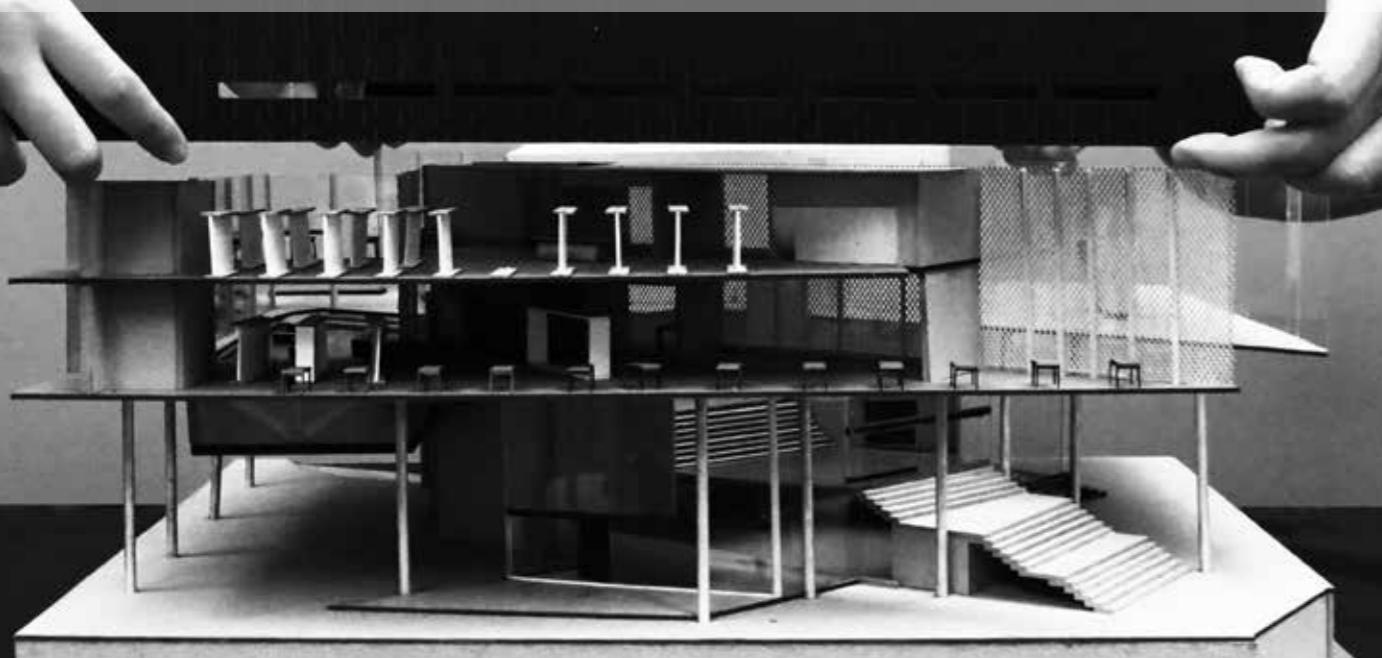




IN-BETWEEN READING

Personal/Academy/2018/Special Library

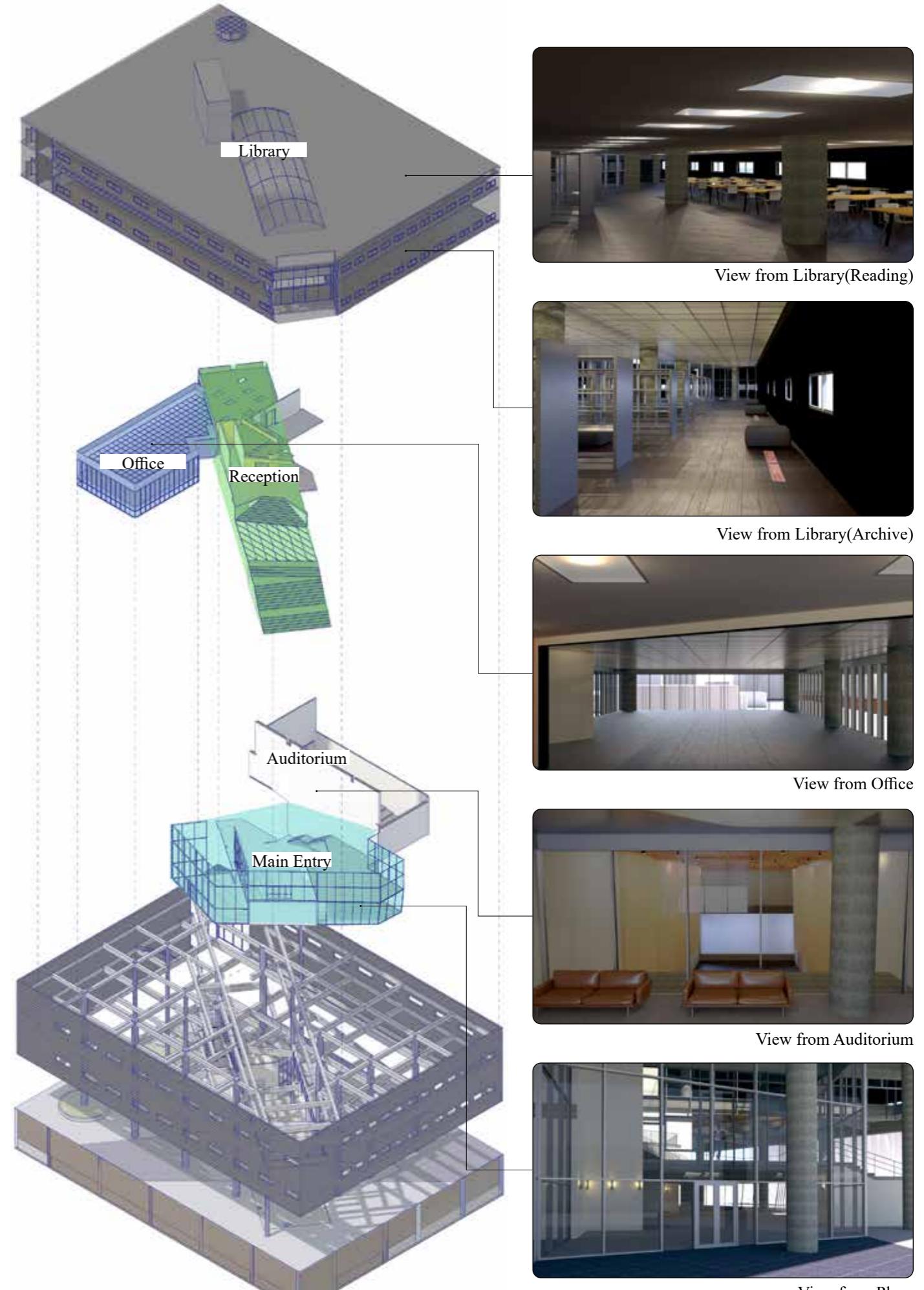
Library	4200 m ²
Play Ground	1200m ²
Auditorium	800m ²
Total	6200m ²



Design Concept

This project begins with an inquiry into the extreme condition of library space. A library, like a warehouse or data center, is a spatial system defined by storage and organization. Across time—from storing grain to storing information—such spaces share a logic of efficiency. Their architecture is determined not by people, but by the nature of what they contain.

The site is located in an old winery park that consists of public spaces and museums, renovated from abandoned winery factories and warehouses. The building stands at the forefront of the park, offering an opportunity to create a main diagonal axis that splits the library volume and connects the park with the city.

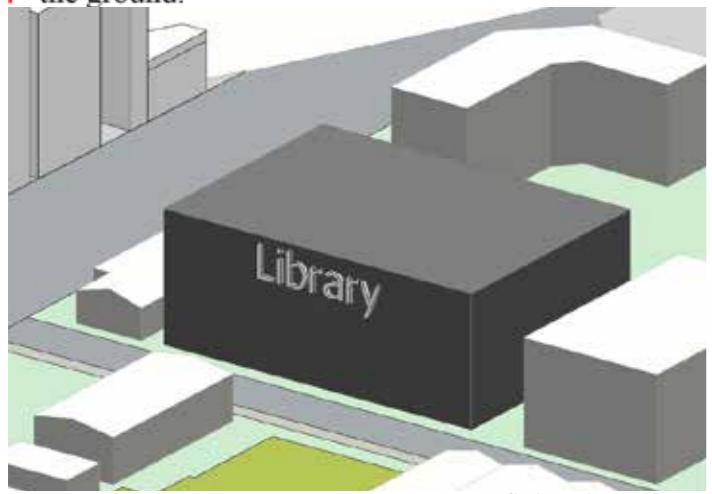




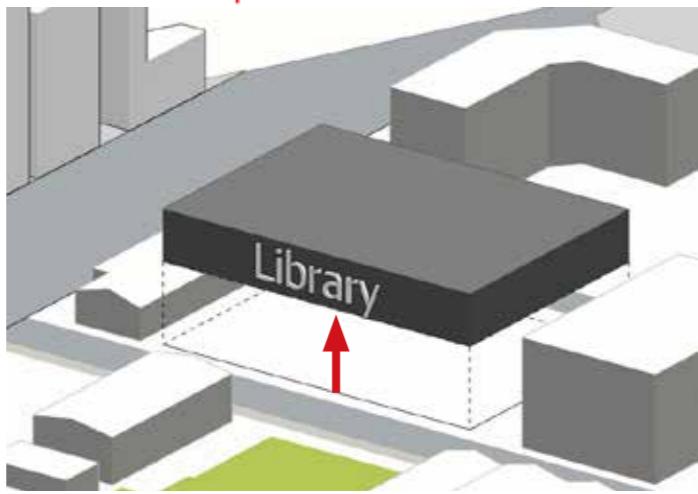
Specialized libraries are destination-oriented for their users. Therefore, in the context of public space, the stacks of a specialized library represent a relatively "secret" space for non-purposeful visitors (where "secret" implies privacy and infrequent use). While the specialized library is the ultimate goal for the purposeful visitor, a complete volume of space dedicated to the stacks can be extracted before reaching that final destination.

BOOK EARTH

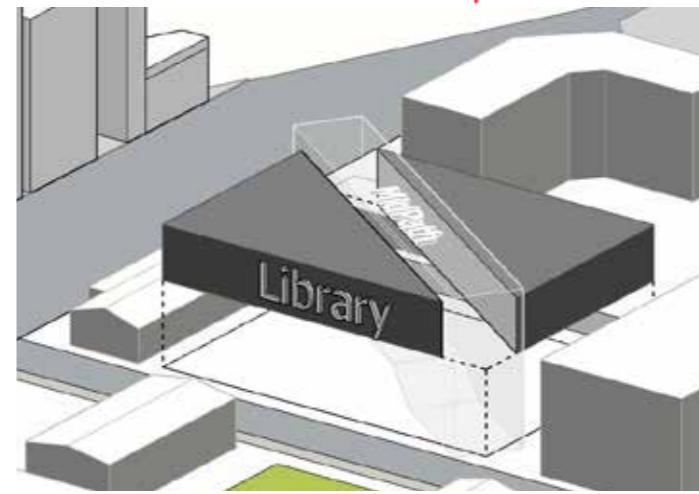
The library possesses an inherent objectivity; its existence is necessitated by the presence of books. Under this premise, the essence of a library—especially a specialized library resembling an archive—closely aligns with the form of a book stack. Digital information, books, and documents are first perceived as a holistic spatial volume situated on the ground.



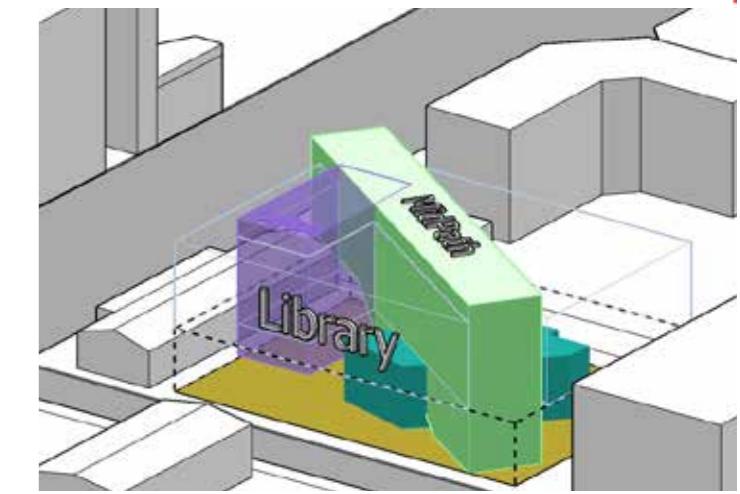
Defining the Volume



Lifting the Archive



Introducing the Mid-Path



Program Integration

Various spatial typologies can be embedded between the ground level and the stacks. By manipulating these typologies, a series of spatial relationships is created, categorized by the varying degrees of public accessibility and activity.

BOOK

EARTH

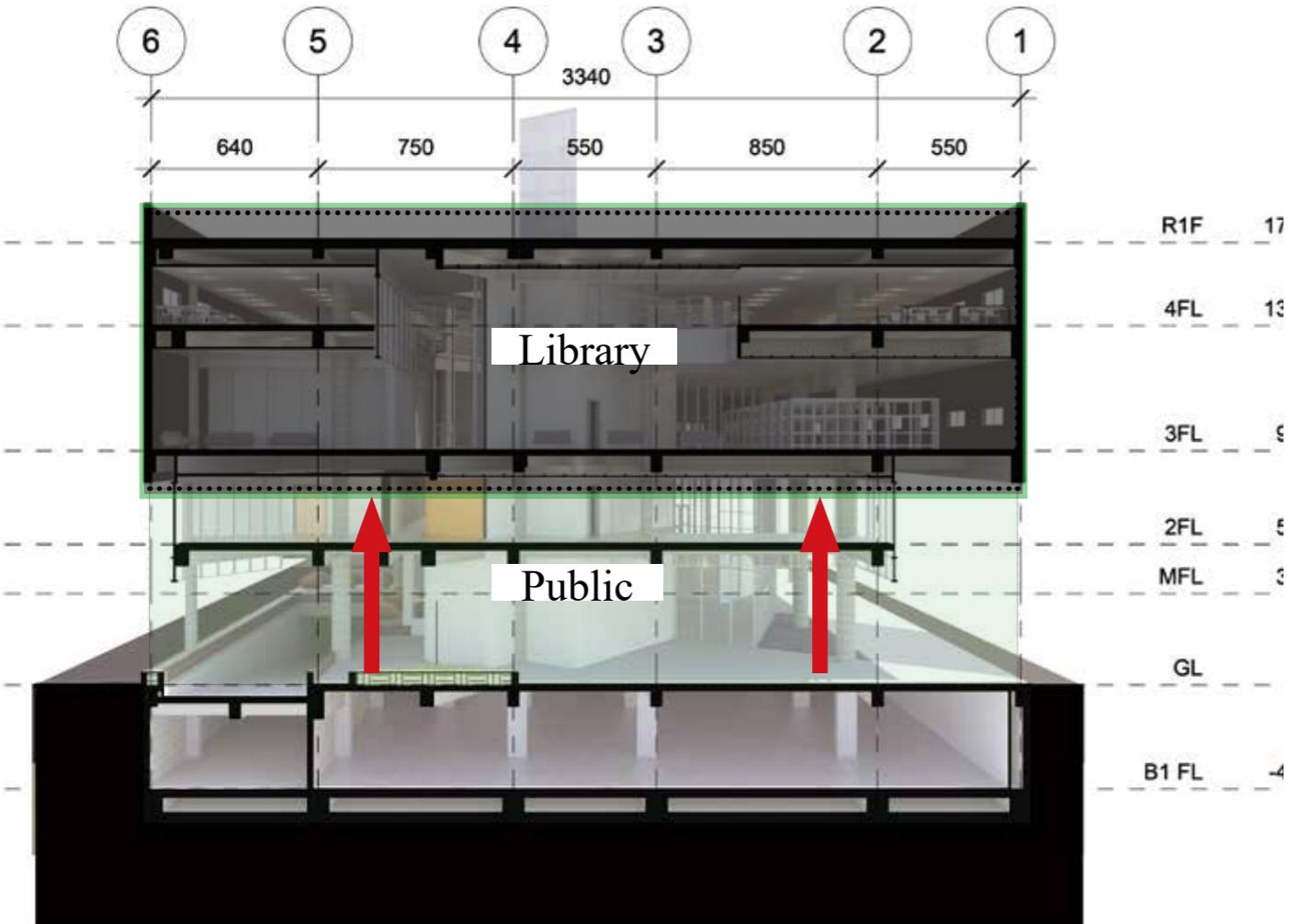
However, there is no space for human activity between the documents and the ground, so I pull them apart vertically. Consequently, a vast, ambiguous hybrid space begins to emerge between the ground (public) and the stacks (library).



BOOK

EARTH

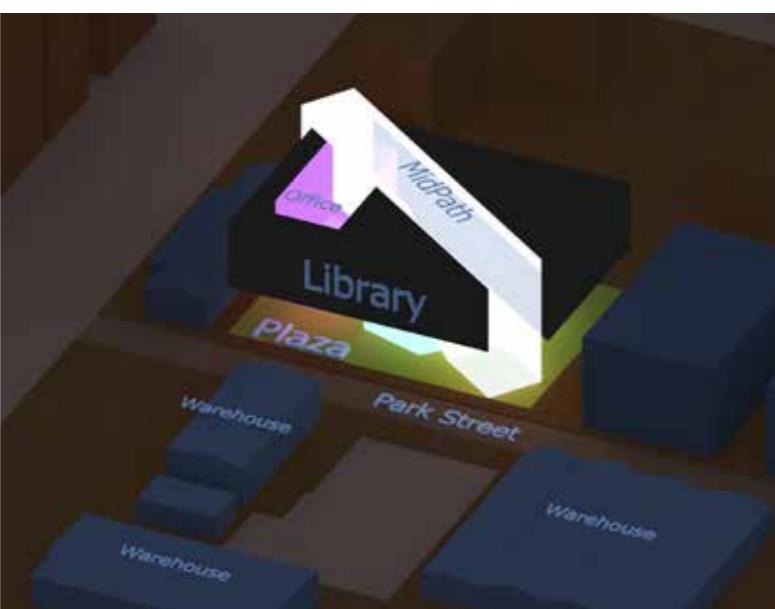
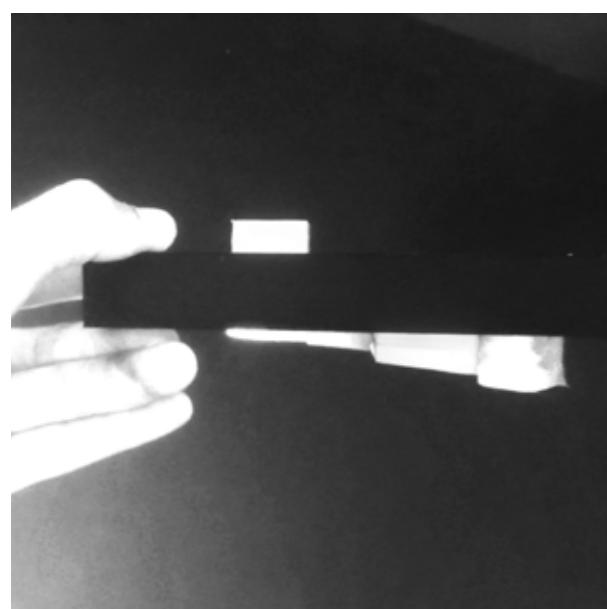
These spaces begin to host events such as people gathering, film/video, lectures, painting, magazine reading, and cultural industries. These events are layered and superimposed one by one between the stacks and the ground. This is the focus of this design: to analyze and organize the relationship between the stacks and the ground level.



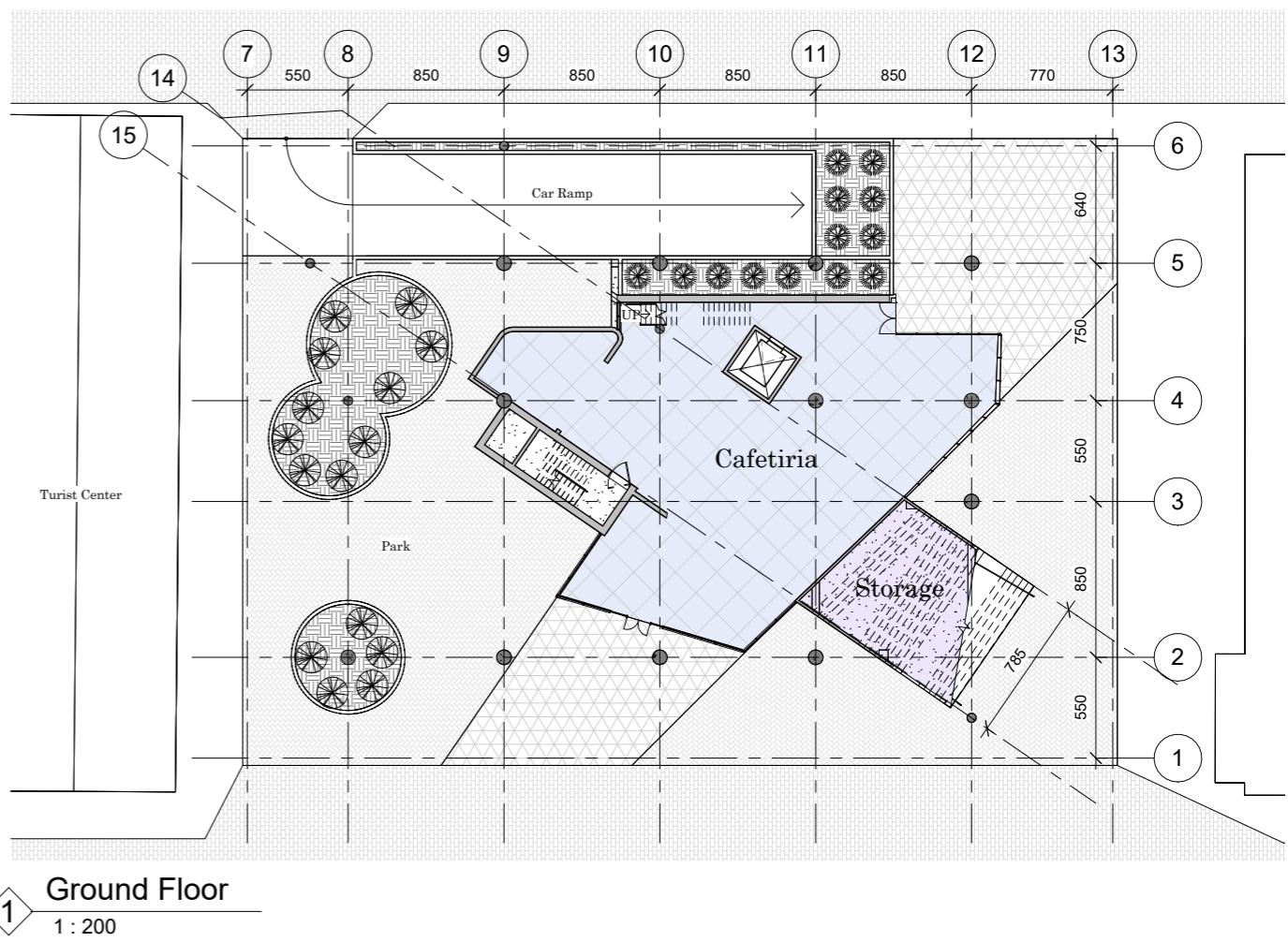
The Short section to imply the spatial relationship

Lifting the Library

The design strategy begins by separating the library's core programs according to their levels of public accessibility. The archive and reading areas, which require a controlled environment, are consolidated into a solid "black box" and elevated above the ground. This move liberates the ground plane to form an open plaza, extending the public flow from Park Street into the site.

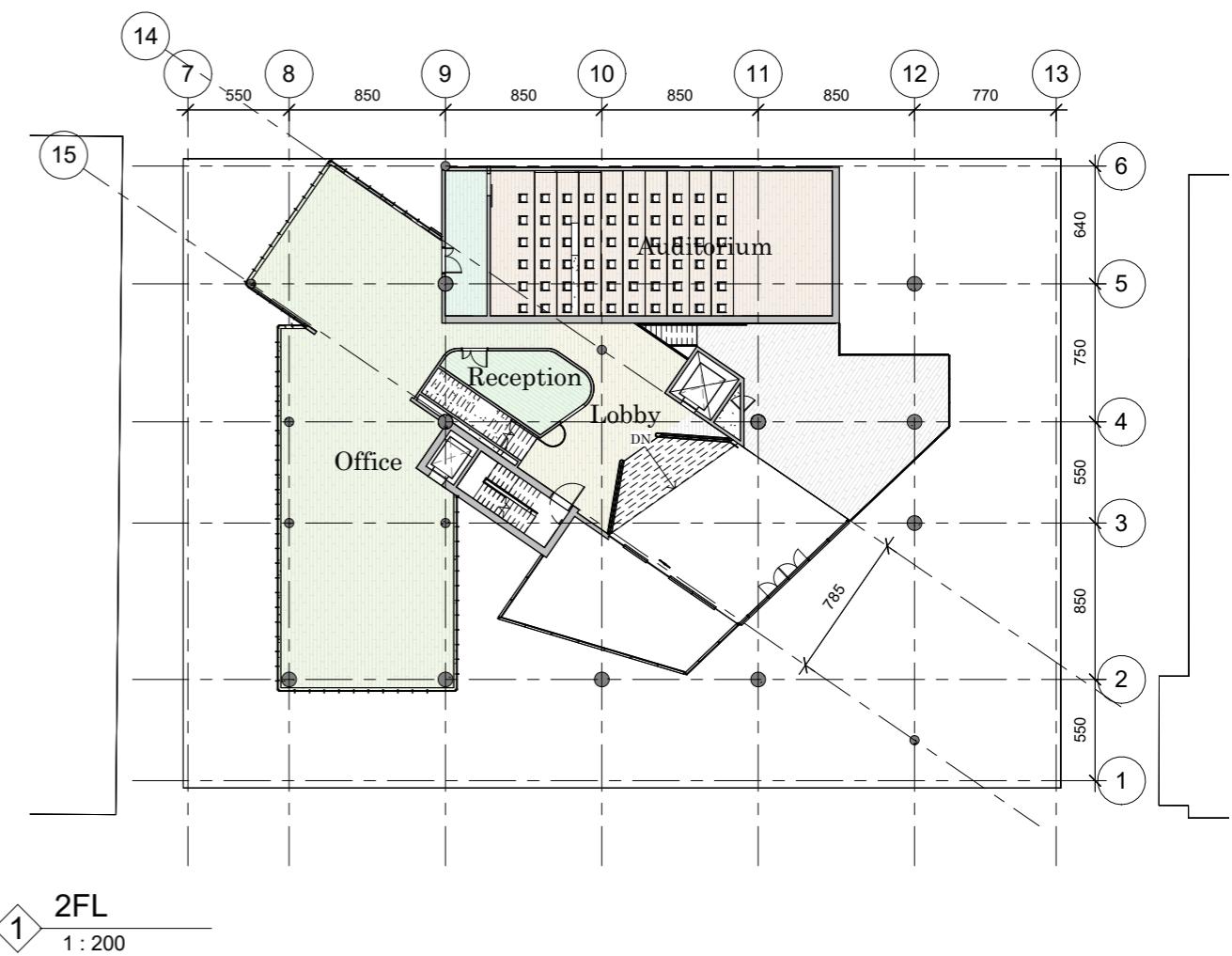


Concept model of In-Between Space



Ground Floor

1 : 200



2FL

1 : 200



Reception View



Cafeteria View



Lobby View

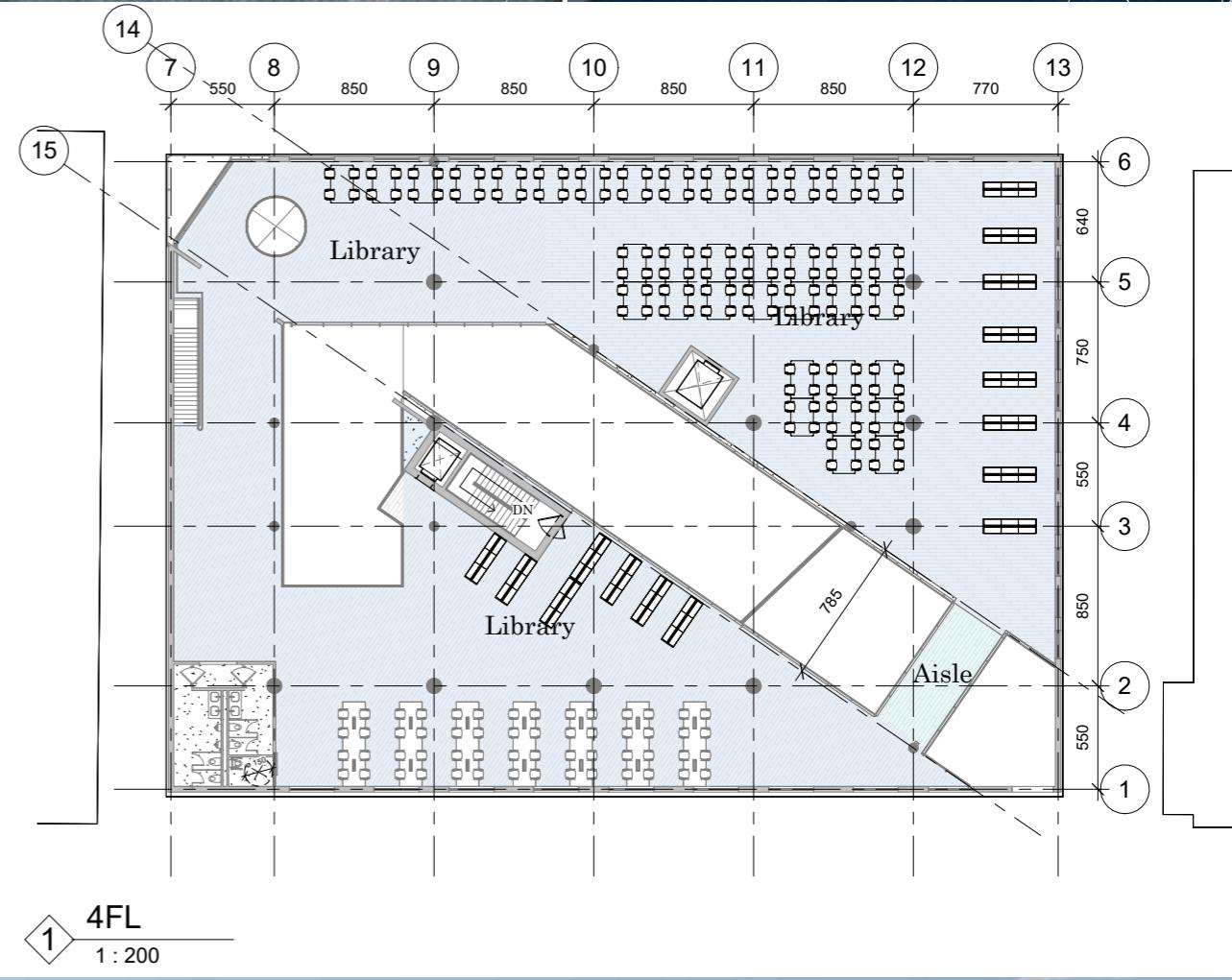


Lobby View (To the City)



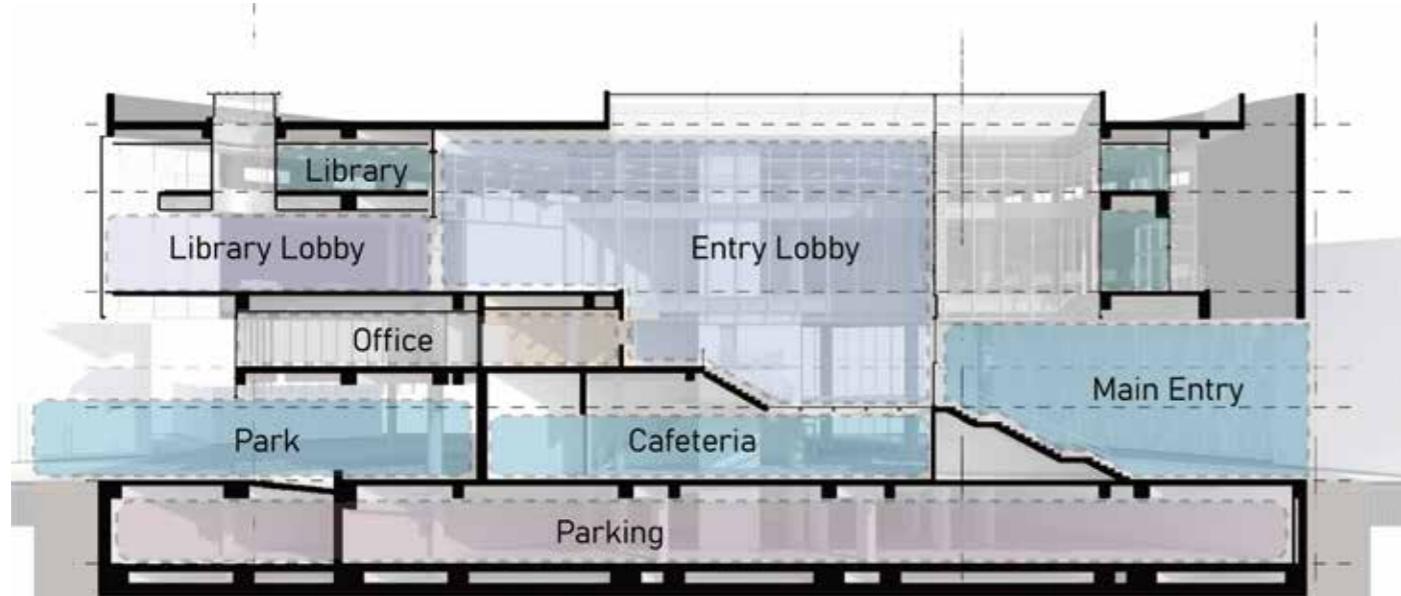
3FL

1 : 200



4FL

1 : 200



Exterior View



Key Inefficiencies in the Conventional Construction Cost Workflow

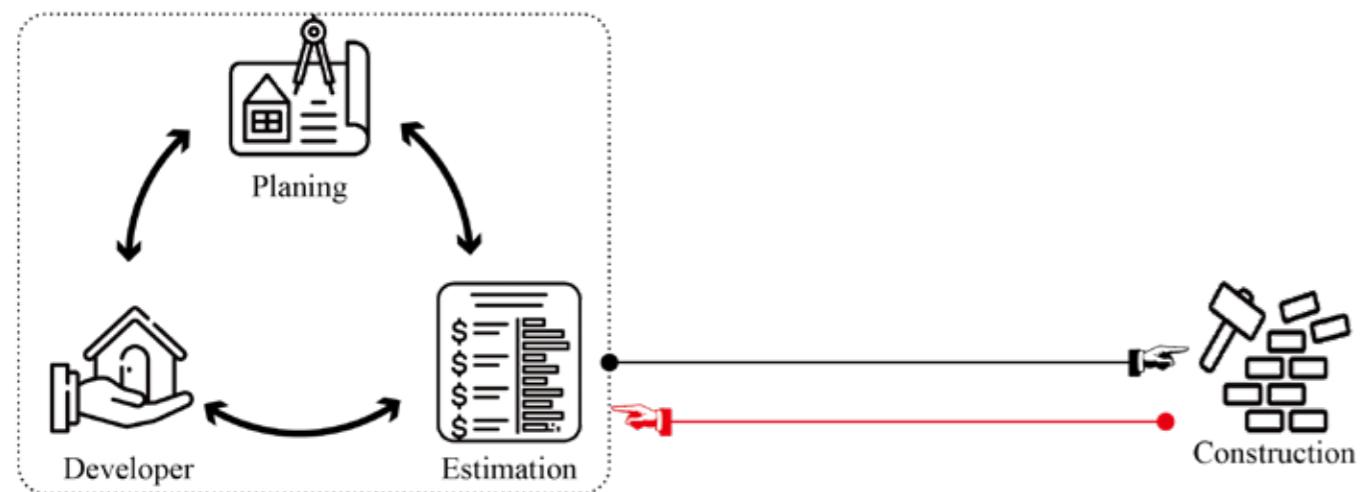
Conventional construction cost estimation workflows suffer from structural inefficiencies.

BIM-based processes require excessive modeling effort and become difficult to modify once finishing

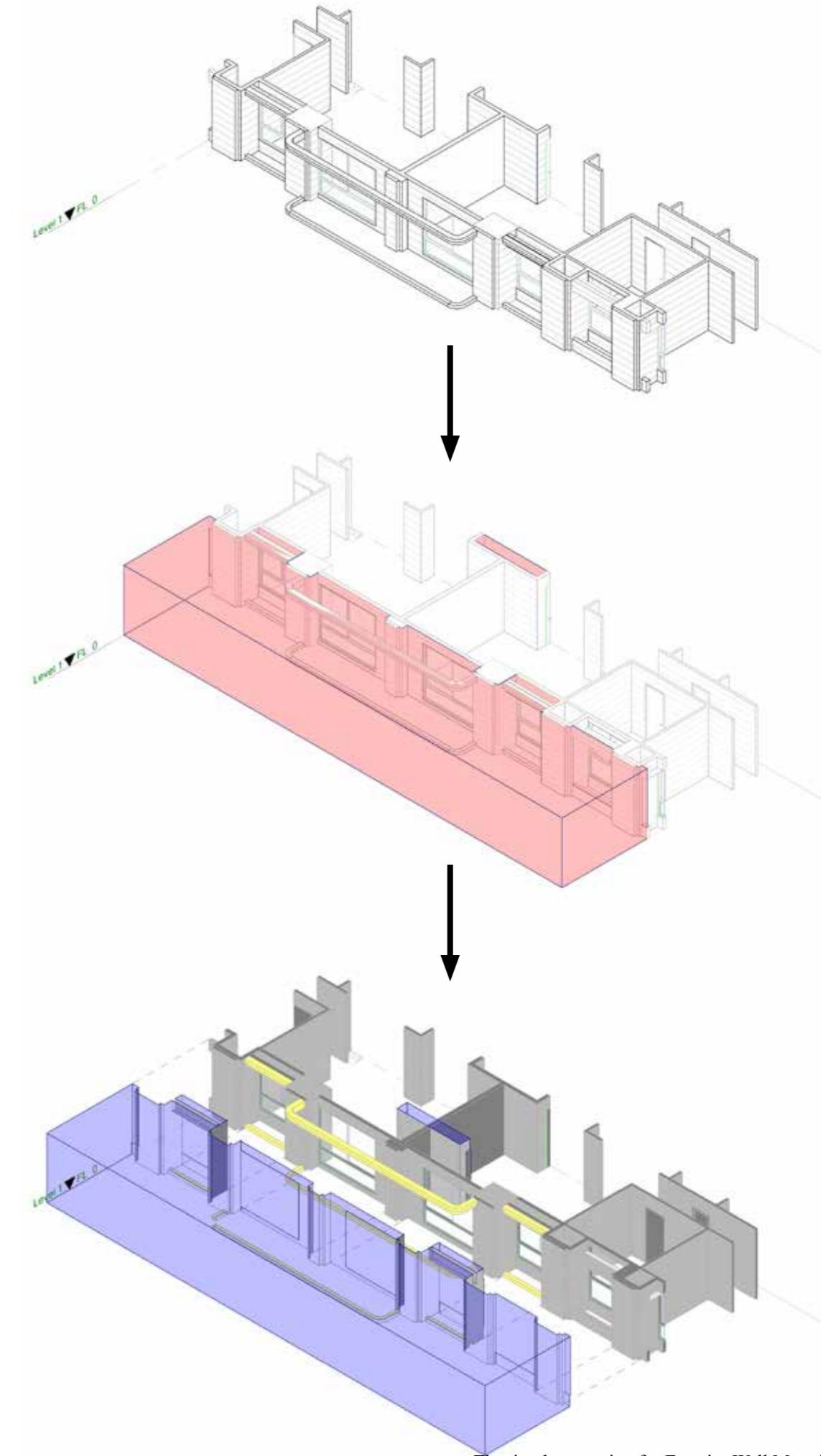
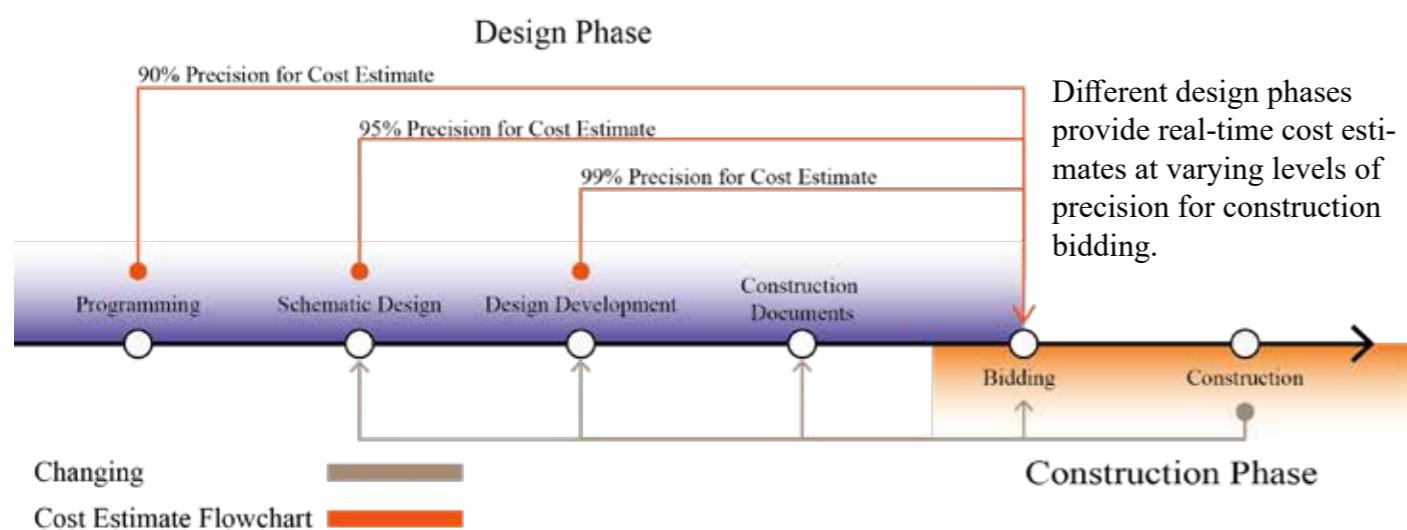
materials are defined.

Key Issues

- Inefficient decision-making due to delayed cost feedback
- Excessive back-and-forth between planning, estimation, and development
- High risk of rework caused by late integration of construction constraints



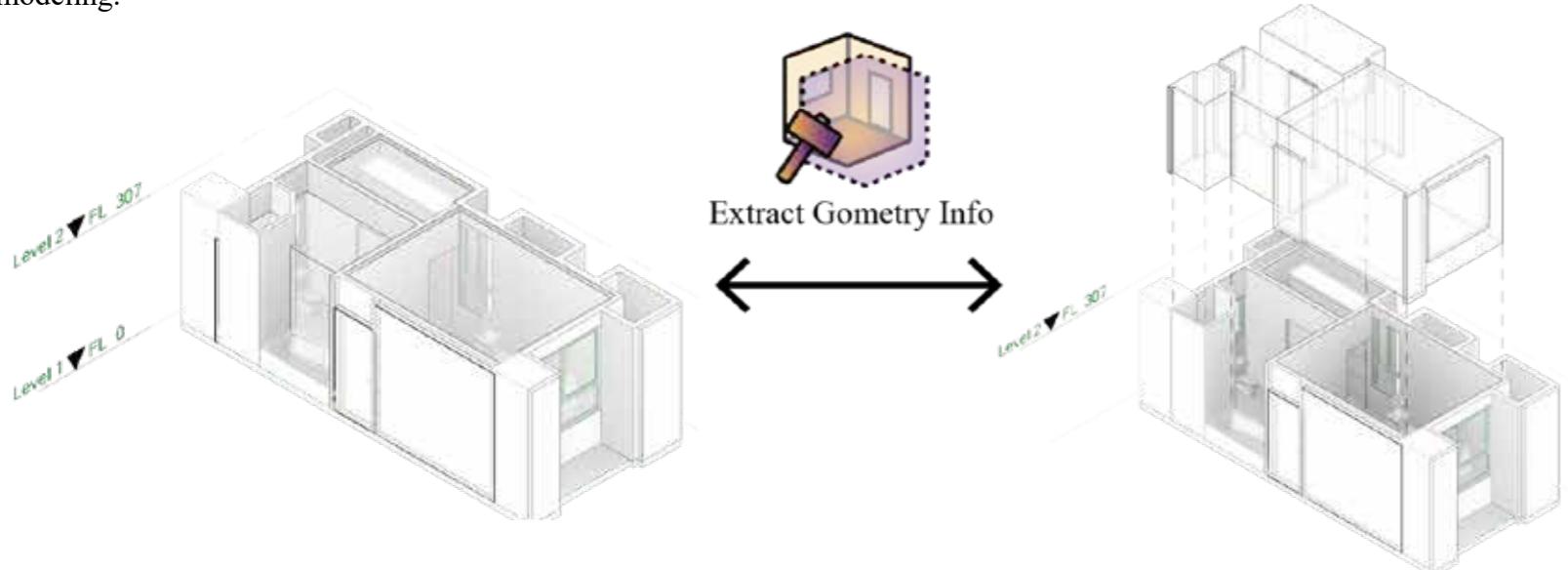
The system extracts geometric information directly from BIM surfaces using a geometry-driven approach and exports this data outside the BIM environment. This separation allows greater flexibility in cost analysis and adapts efficiently to frequent design changes.



Decoupling Geometry and Material Data for Cost-Driven Modeling

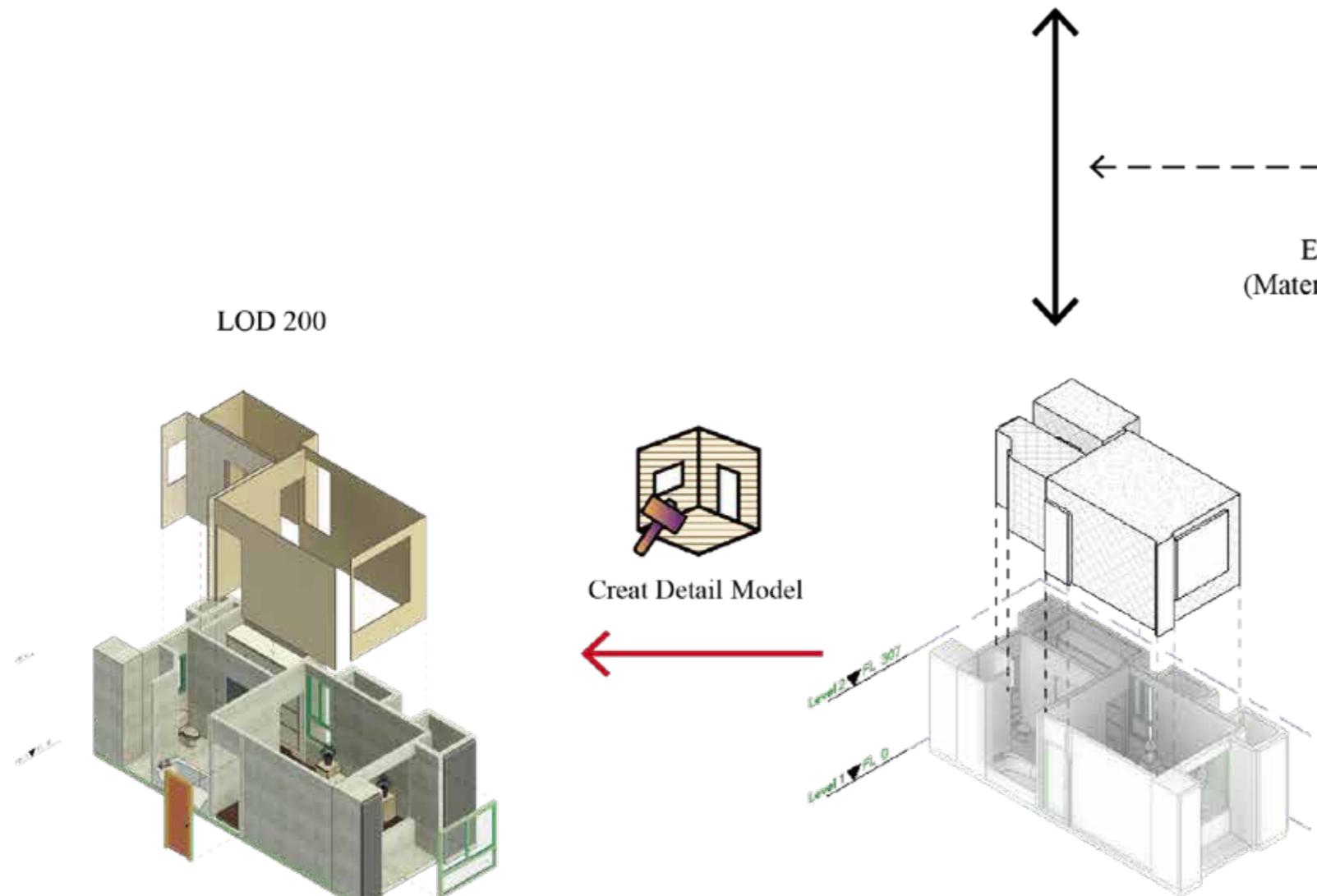
The kernel of this function is reducing modeling effort for cost estimation.

By decoupling geometry and material data, CostGen computes accurate building costs directly from a material database once the geometric model is defined, enabling real-time cost feedback without additional modeling.



Programming Model (LOD200)

Geometry-only Model (LOD200)

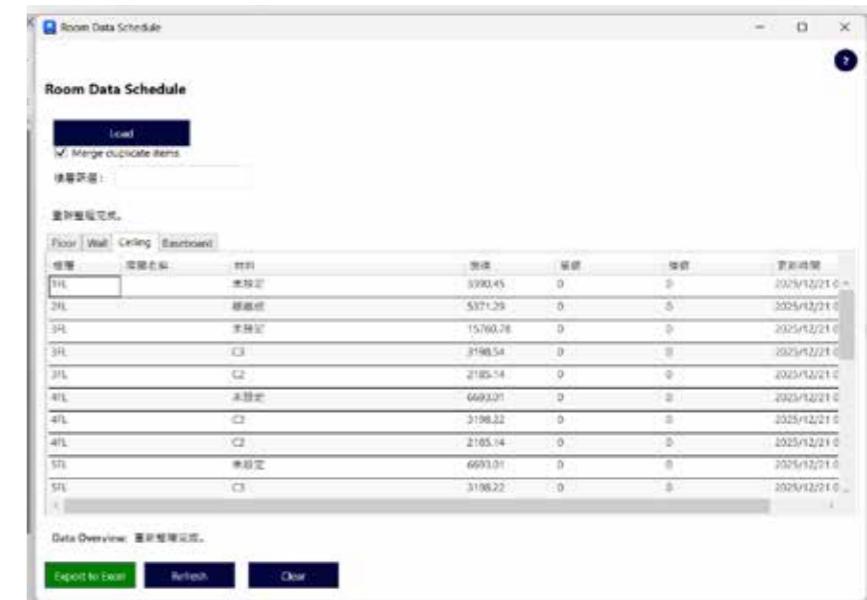


Detail Model (LOD400)

Geometry-only model with data-driven details

Demonstration Clip Link:

https://drive.google.com/file/d/10mHK9dVvwKq8o73LP_uMEpMfbdbUs8DQ/view?usp=sharing



Export to .csv or .xlsx

External Detail Database
(Materials, Assemblies, Cost Data)

	A	B	C	D	E	F	G	H
	樓層	房間編號	面積名稱	材料	面積 (m²)	單價	總價	更新時間
1	1	1FL-01	未命名房間	未設定	813.75	0	0	2025/12/19 16:12
2	2	1FL-02	未命名房間	未設定	388.79	0	0	2025/12/19 16:12
3	3	1FL-03	未命名房間	未設定	388.79	0	0	2025/12/19 16:12
4	4	1FL-04	未命名房間	未設定	244.13	0	0	2025/12/19 16:12
5	5	1FL-05	未命名房間	未設定	736.90	0	0	2025/12/19 16:12
6	6	1FL-06	未命名房間	未設定	1,979.40	0	0	2025/12/19 16:12
7	7	1FL-07	未命名房間	未設定	389.53	0	0	2025/12/19 16:12
8	8	1FL-08	未命名房間	文化石	701.81	0	0	2025/12/19 16:12
9	9	1FL-09	未命名房間	文化石	710.42	0	0	2025/12/19 16:12
10	10	1FL-10	未命名房間	文化石	370.28	0	0	2025/12/19 16:12
11	11	1FL-11	未命名房間	文化石	370.28	0	0	2025/12/19 16:12
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18	18	1FL-18	未命名房間	未設定	759.98	0	0	2025/12/19 16:12
19	19	1FL-19	未命名房間	未設定	343.58	0	0	2025/12/19 16:12
20	20	1FL-20	Kitchen	未設定	131.30	0	0	2025/12/19 16:12
21	21	1FL-21	未命名房間	未設定	337.45	0	0	2025/12/19 16:12
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24	24	1FL-24	Kitchen	未設定	759.57	0	0	2025/12/19 16:12
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47	47	3FL-26	未命名房間	未設定	131.30	0	0	2025/12/19 16:12
48	48	3FL-27	未命名房間	未設定	131.30	0	0	2025/12/19 16:12
49	49	3FL-28	未命名房間	未設定	131.30	0	0	2025/12/19 16:12
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51	51	3FL-30	未命名房間	未設定	131.30	0	0	2025/12/19 16:12
52	52	3FL-31	未命名房間	未設定	131.30	0	0	2025/12/19 16:12