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At the conclusion of three years of active questioning, this work emerges as a bridge between the qualitative and quantitative realms of design.

Once an engineer who scribbled in black and white equations, I am now a designer who builds logics in color.

RED IS NOT ~~A COLOR,~~

Barnard Tuchmi

BUT MY THOUGHTS ARE

NO-ONE IS HELD TO BAIL

ACCOMMODATION

POLEMIC

NEXT SCISSORER. RIGHT?

ACCIDENTALLY POLEMIC

CORE 1

HALFWAY HOUSE

CORE 2

ADOPTIVE SCHOOL

CORE 3

WATER-RISE MANHATTAN HOUSING, APPENDIX

ADV. 4

THE BATH HOUSE: RECLAIMING ASHOKAN

ADV. 5

GREEN REVIVAL: KINGSBRIDGE ARMORY'S URBAN FARMING TRANSFORMATION

ADV. 6

HUSK TO HOME: BIOMASS TO CARBON-SEQUESTRATION CITY

ADR

HAN OAK, KOREAN TRADITIONAL ARCHITECTURE

VISUAL STUDIES

NERO ARCHITECTURE: SPATIAL DATA NARRATIVE

SCHOLARSHIP

NATURAL MATERIAL LAB

MEMBERSHIP & LEADERSHIP

AIAS

PARTNERSHIP

COMPETITIONS

OWNERSHIP

TITAVIO



HALFWAY HOUSE

Conceived amidst the entwined narratives of incarceration and marginalization, "Halfway House" is an architectural intervention deeply rooted in the critical examination of systemic cycles. This project is a theoretical exploration, weaving through the complexities of justice, rehabilitation, and urban dynamics. Positioned strategically at the Port Authority Bus Terminal, it serves as both a physical and symbolic gateway, mediating the transition from confinement to the community.

The design articulates a vision of reintegration, characterized by its striking facade—manifested in vibrant orange hues that drip symbolically, echoing the pressures faced by those emerging from the prison system. This visual intensity is not merely aesthetic but a deliberate act of making the invisible struggles of re-entry visible and poignant.

Internally, the building bifurcates functionally into distinct yet interconnected realms. The south side harnesses voids between structures to create sanctuaries that offer addresses and stability to those who have none. To the north, spaces open up to the public, providing communal gardens, atop the Urban Hustle, and places of interaction that bridge daily commuters with the city's visitors. Here, the once-marginalized can find employment and dignity, serving as bartenders, cooks, or guides, narrating new stories within the urban fabric.

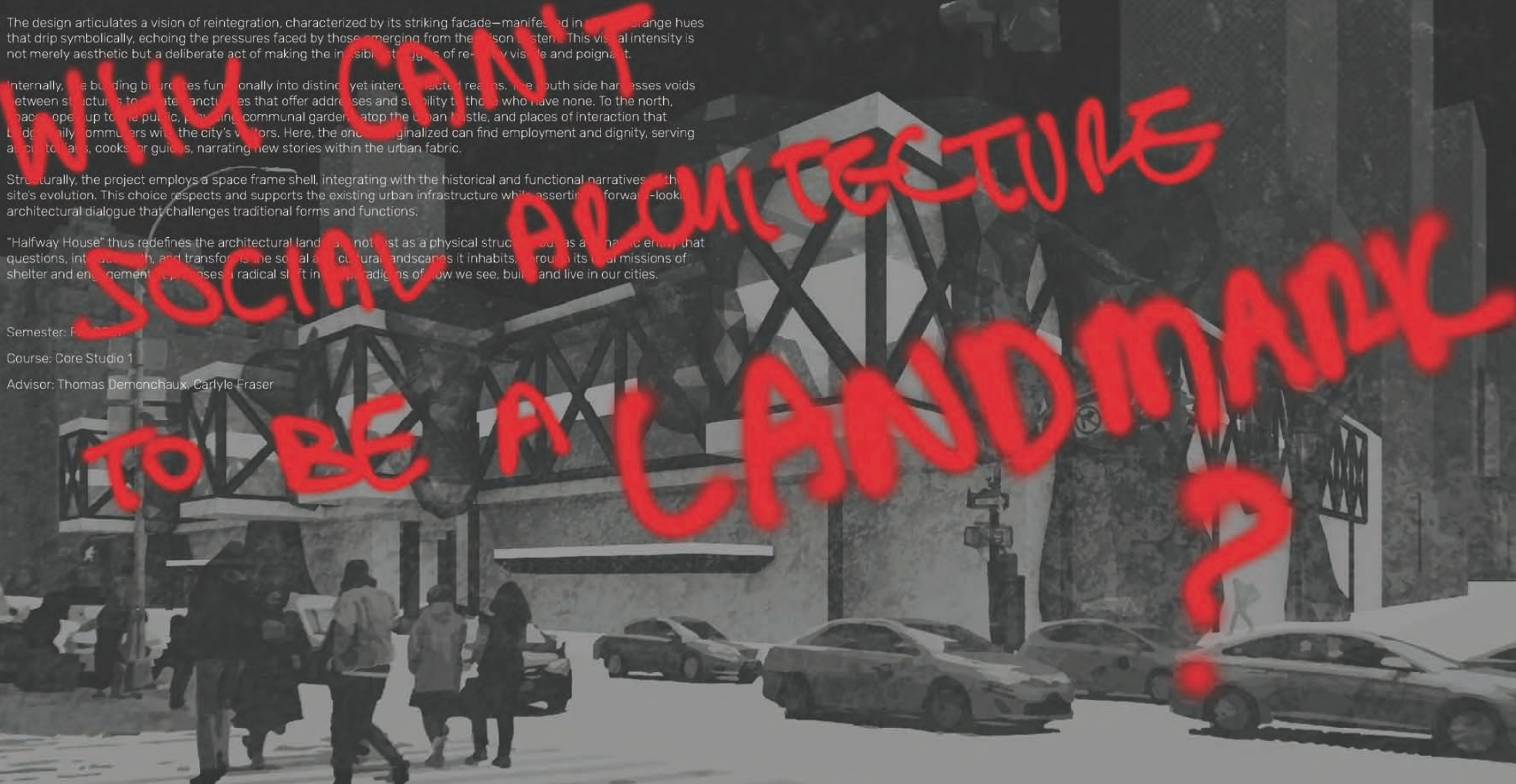
Structurally, the project employs a space frame shell, integrating with the historical and functional narratives of the site's evolution. This choice respects and supports the existing urban infrastructure while asserting a forward-looking architectural dialogue that challenges traditional forms and functions.

"Halfway House" thus redefines the architectural landscape, not just as a physical structure but as a dynamic entity that questions, interrogates, and transforms the social and cultural landscapes it inhabits. Through its dual missions of shelter and engagement, it proposes a radical shift in paradigms of how we see, build, and live in our cities.

Semester: Fall 2021

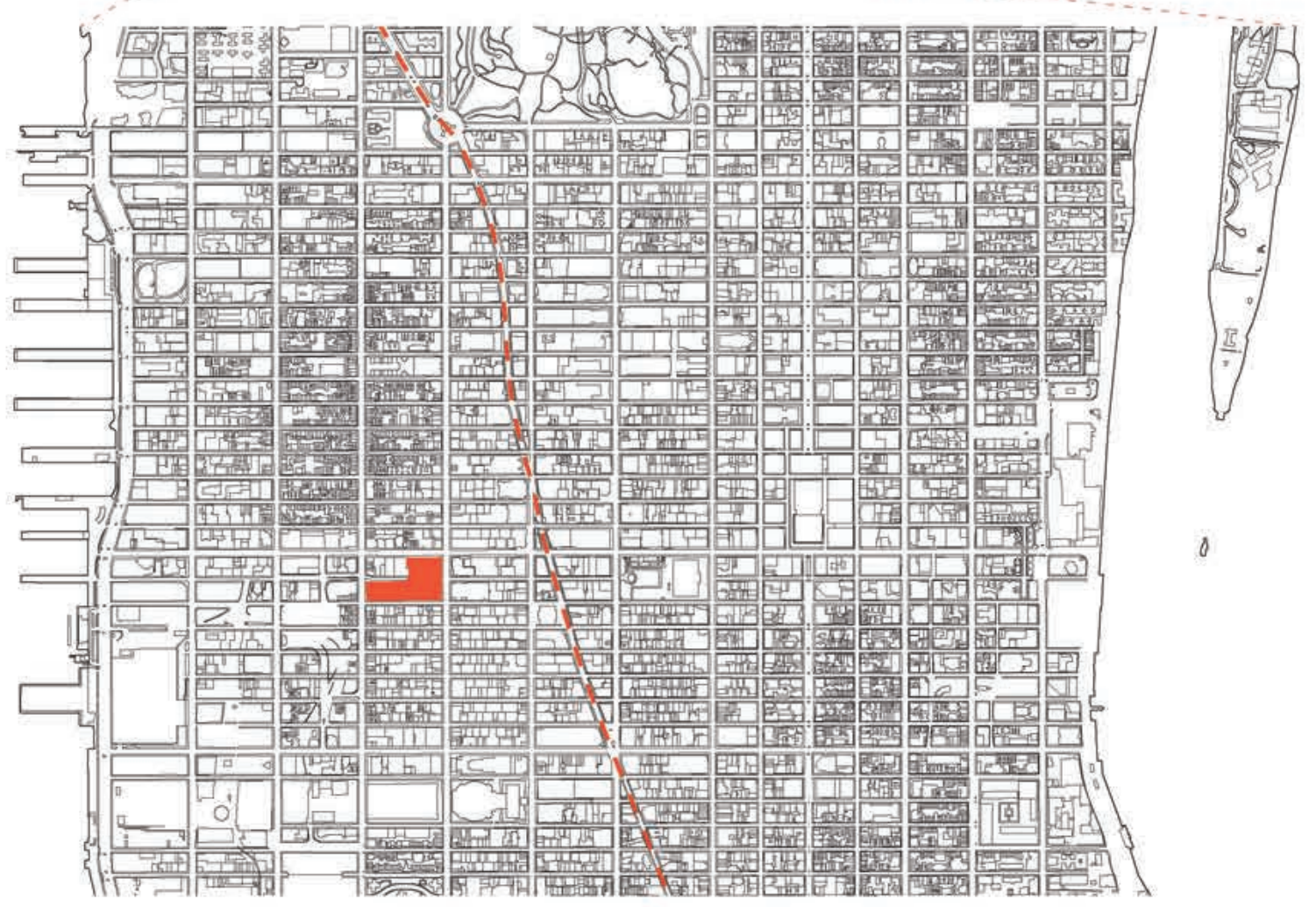
Course: Core Studio 1

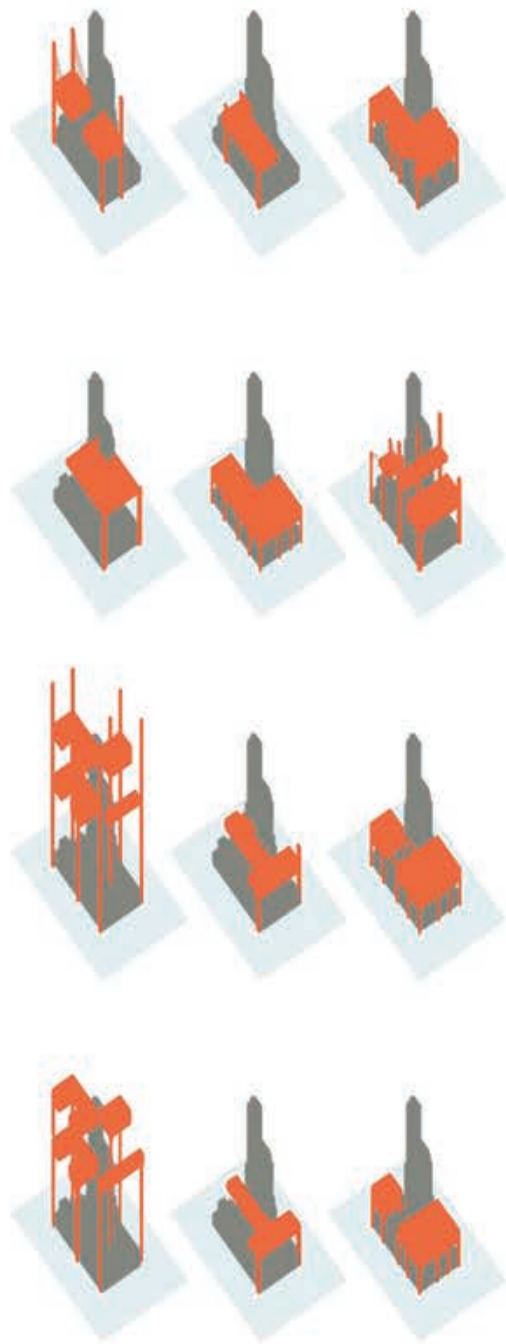
Advisor: Thomas Demonchaux, Carlyle Fraser



ACCIDENTALLY POLEMIC





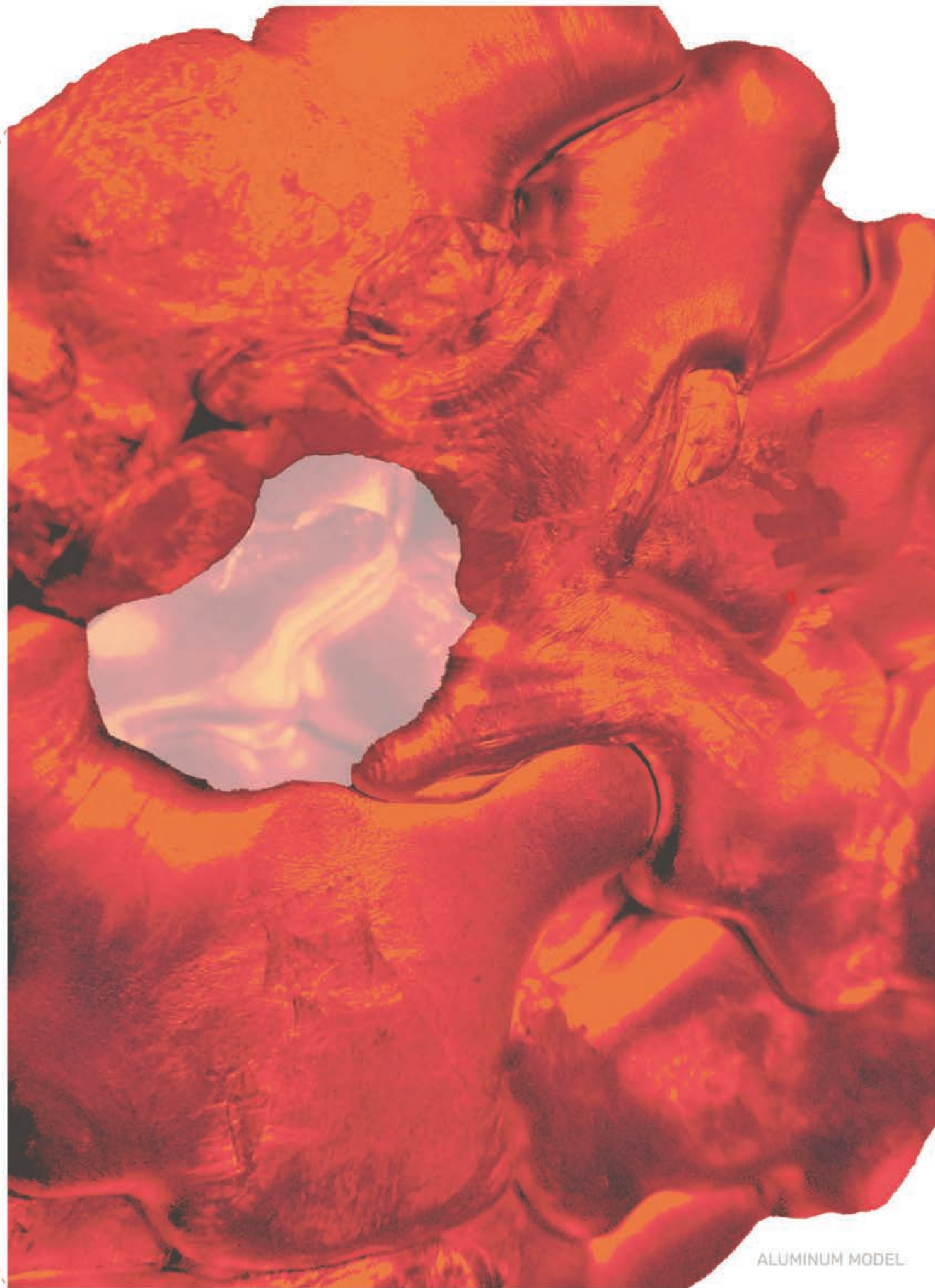


FORM FINDING

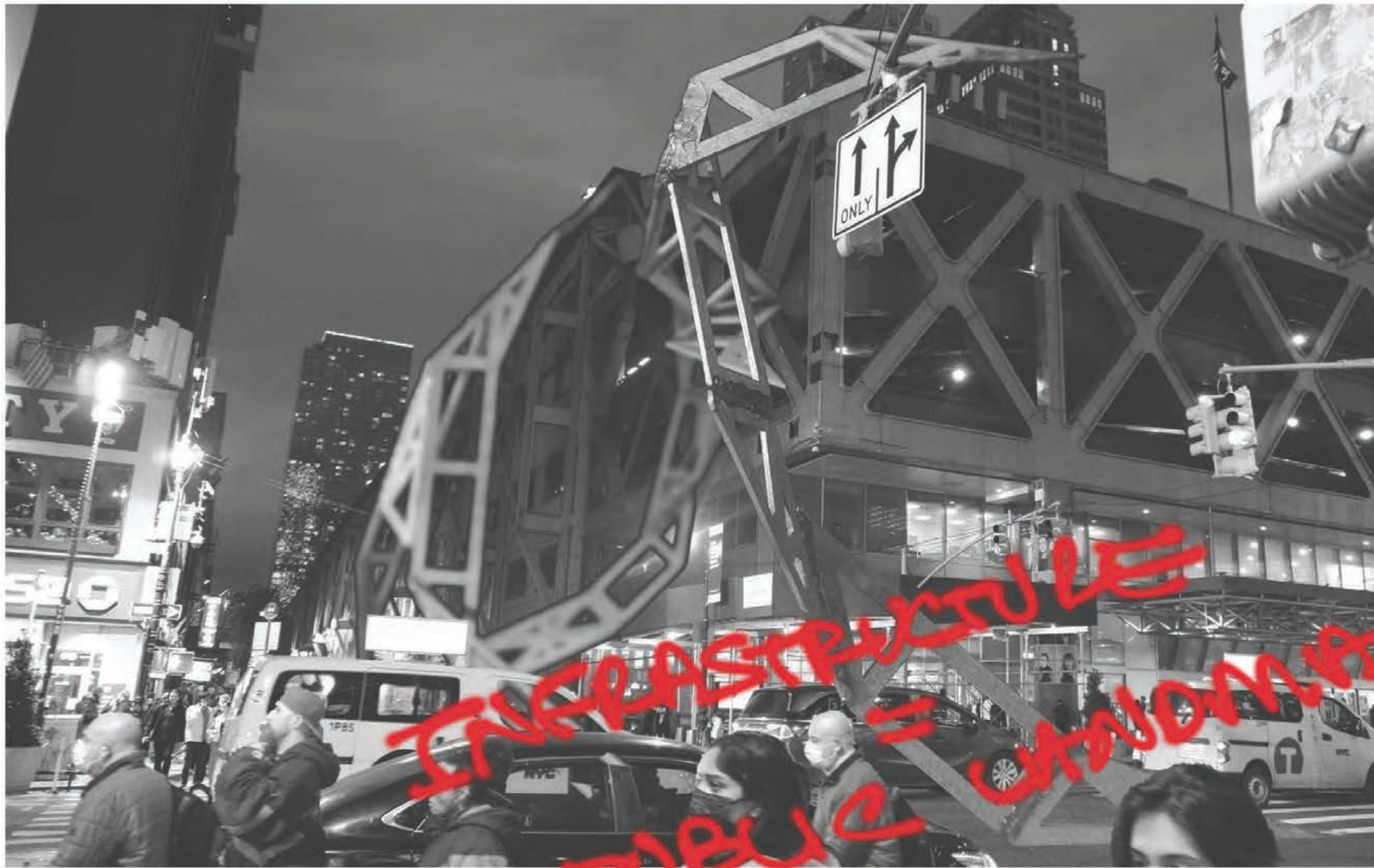
DOING RIGHT
 THING IN THE
WRONG PLACE



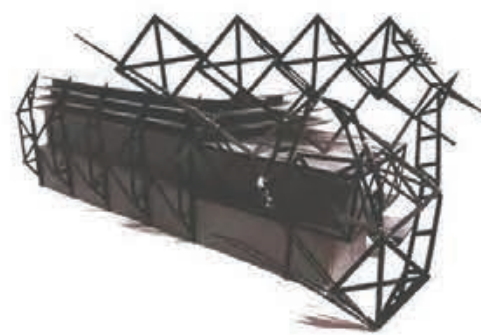
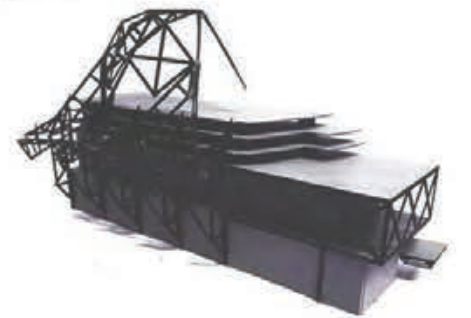
DOING WRONG
 THINK RIGHT
 IN THE RIGHT

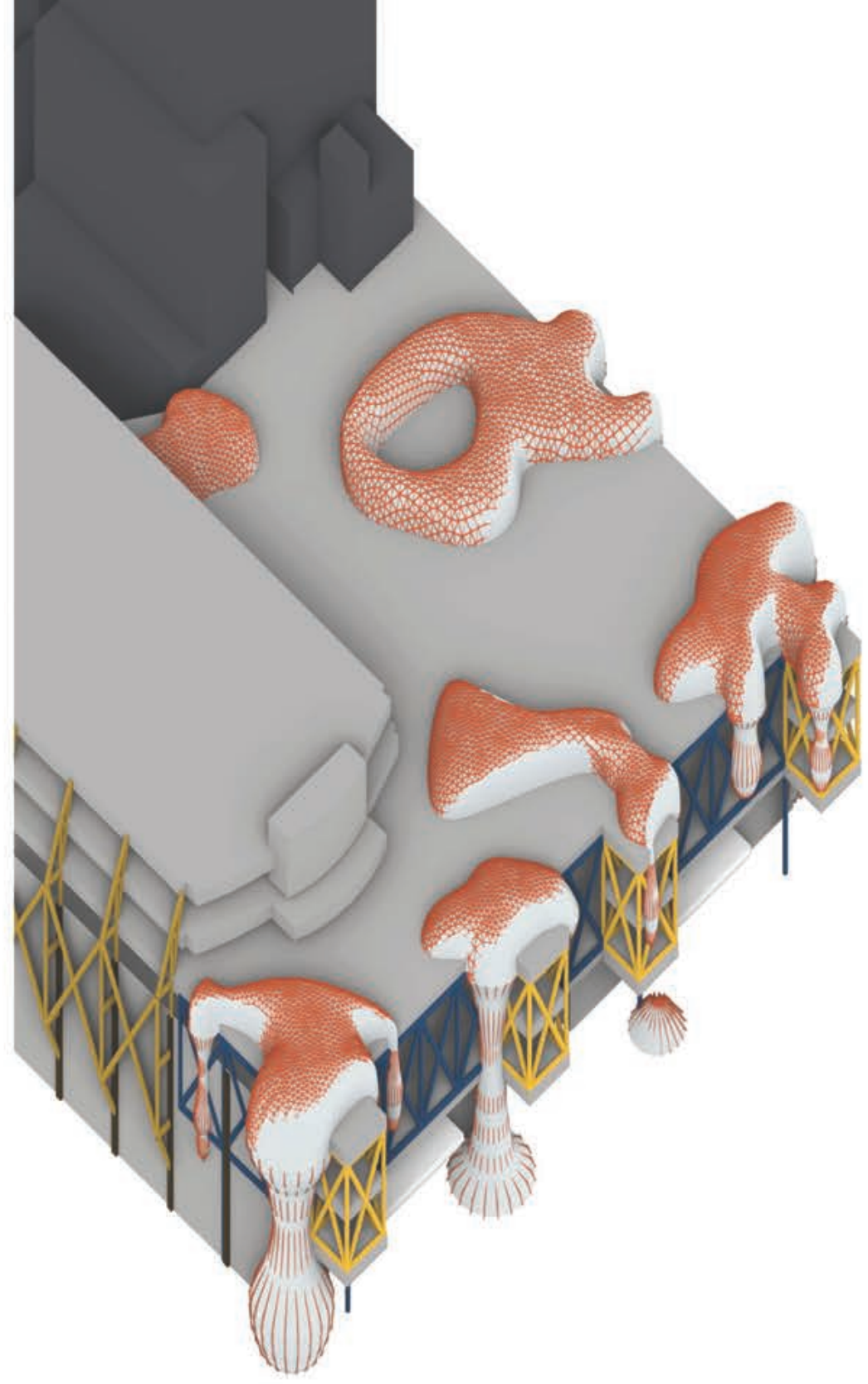
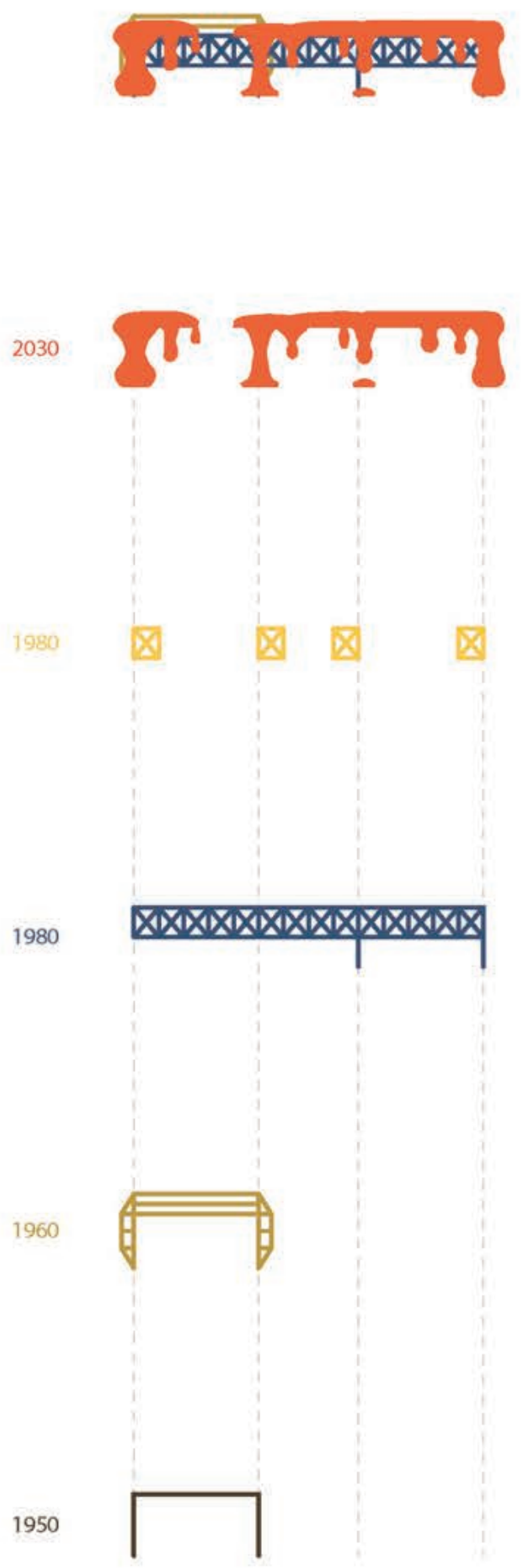
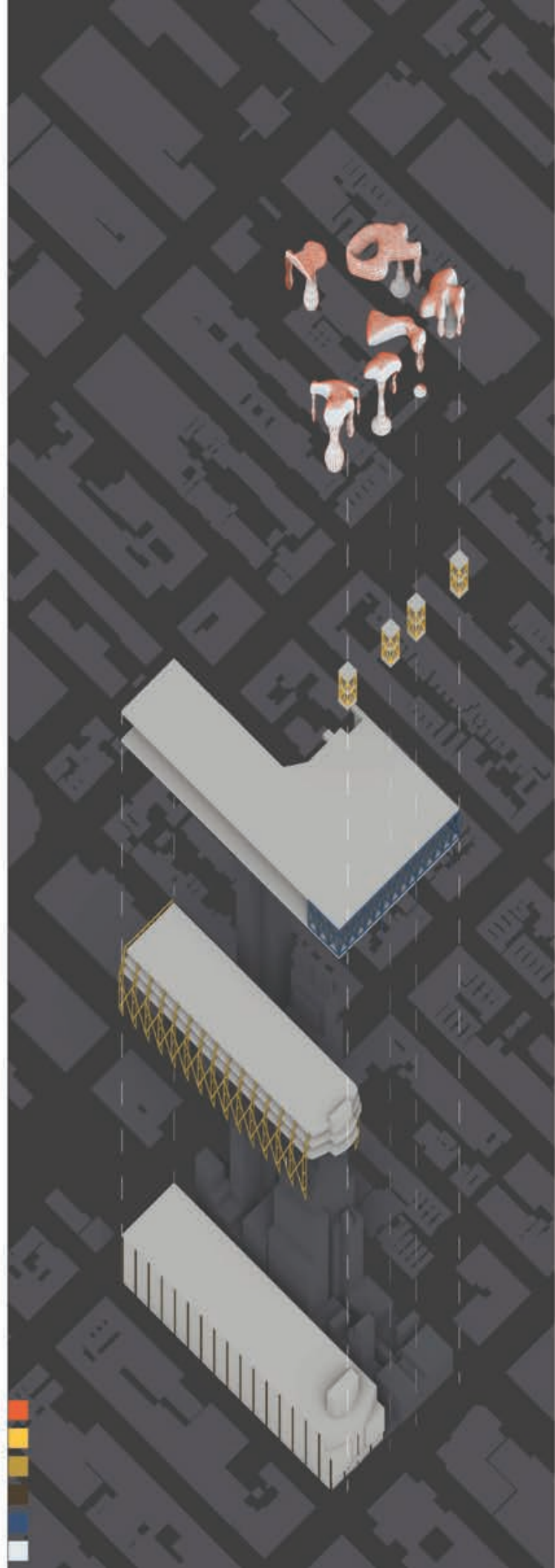


ALUMINUM MODEL



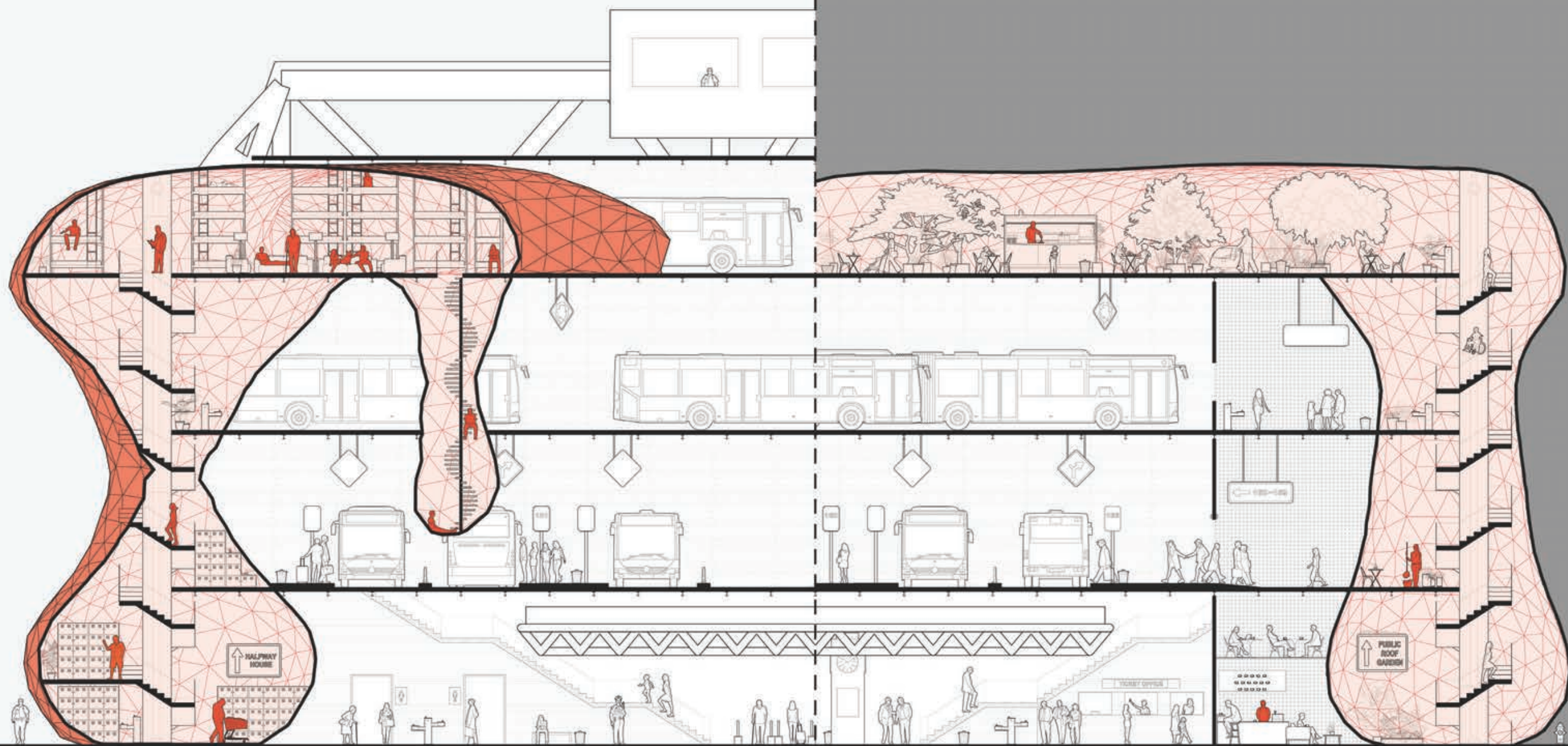
INTEGRATIVE
PUBLIC = UNKNOWN? \rightarrow





- GROUND CONNECTOIN TO ROOF**
 - ROOF GARDEN (NORTH)
 - HALFWAY HOUSE (SOUTH)
- ANNEX**
 - COMMUTER LOCKERS
 - RESTING NOOK
- EXISTING STRUCTURE**
 - FULLY SERVICING NY/NJ BUS TERMINAL

← SOUTH NORTH →



ADOPTIVE SCHOOL

In the post-pandemic world, the "Adaptive School" emerges as a transformative architectural concept that redefines the essence and functionality of educational spaces. This project, rooted in the fluid dynamics of societal needs, challenges the traditional static nature of schools, proposing a reimagined role in a digitally integrated society.

As the pandemic unveiled, schools extend beyond mere venues for knowledge dissemination. They serve crucial societal functions—daycare for working parents, nutritional hubs for the underserved, and emotional and social scaffolds in the form of teacher and peer support. The crisis highlighted the adaptability of education through digital means, while simultaneously underscoring the indispensable physical presence schools maintain in community support structures.

"Adaptive School" innovates with its physically transformative architecture, featuring mobile partitions that allow the building to flexibly alternate between individualized learning environments and large communal spaces. This adaptability not only reflects but actively supports the multifaceted roles of educational institutions in modern society. Here, a school is envisioned not as a series of classrooms but as a dynamic ecosystem capable of morphing in response to its occupants' immediate needs—be it a quiet study area, a lively debate hall, or a shelter in times of crisis.

Moreover, the school's operational model is reimagined to be more accessible and personalized. It embraces a student-centered approach where teachers act as guides in crafting tailor-made educational experiences, addressing various needs in the school environment. This model provides a space where students can seek specific help, engage in self-directed projects, or find a place and support beyond conventional school hours.

Through strategic openings and closures of its spaces, Adaptive School embodies the philosophical shift from a fixed educational domain to a fluid and open-ended dialogue with the community it serves. It is not just a building but a responsive organism that fabricates its form and function in response to significant community events.

In essence, "Adaptive School" stands as a beacon of modern educational philosophy, a testament to the resilience and adaptability required in a rapidly evolving world. It is a bold statement on the potential of architecture to catalyze and sustain societal transformation through the thoughtful reimagining of traditional spaces.

Semester: Spring 2022

Course: Architecture 2

Advisor: Anu Roy

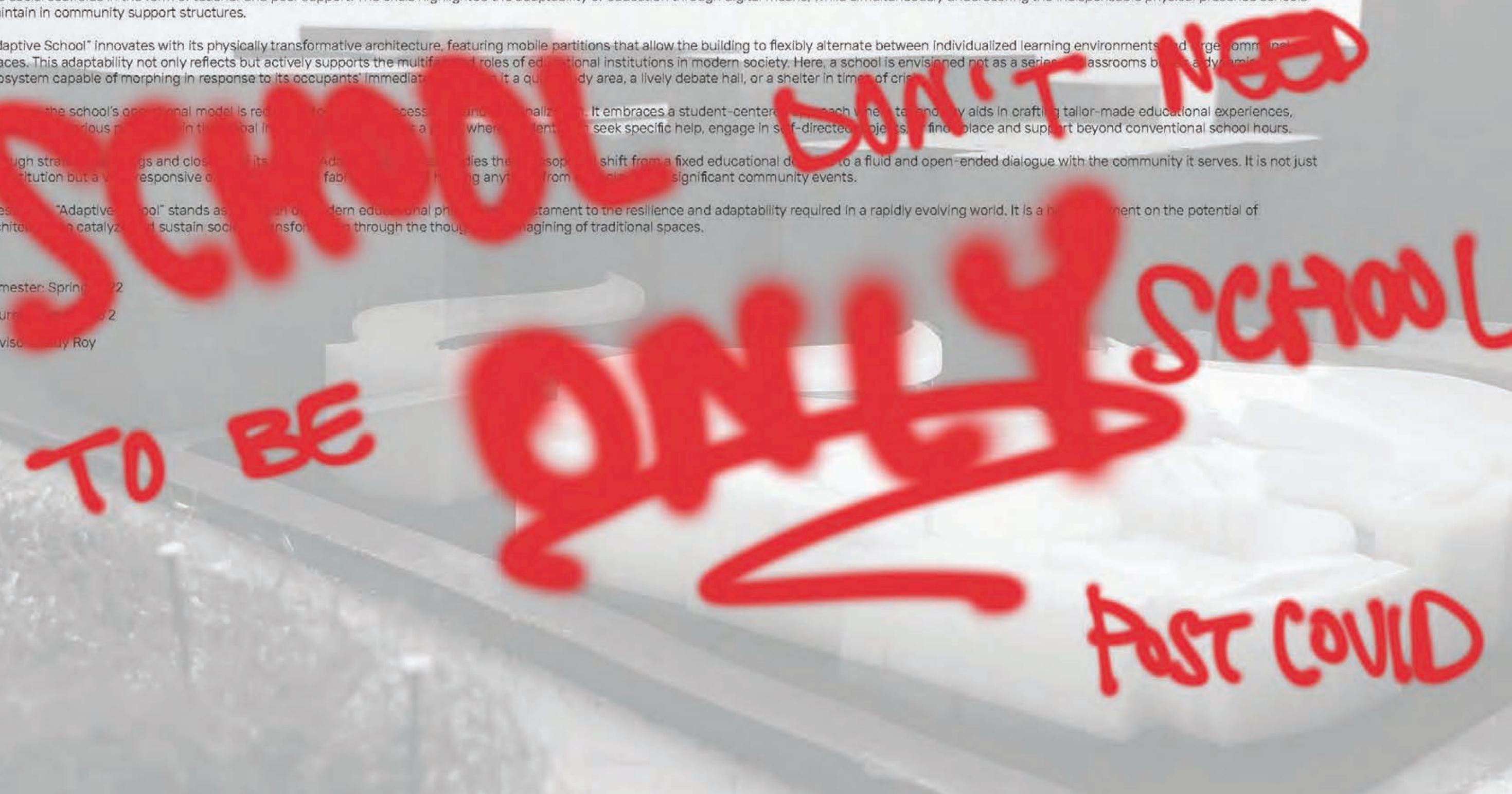
ACCIDENTALLY POLEMIC

TO BE

ONLY

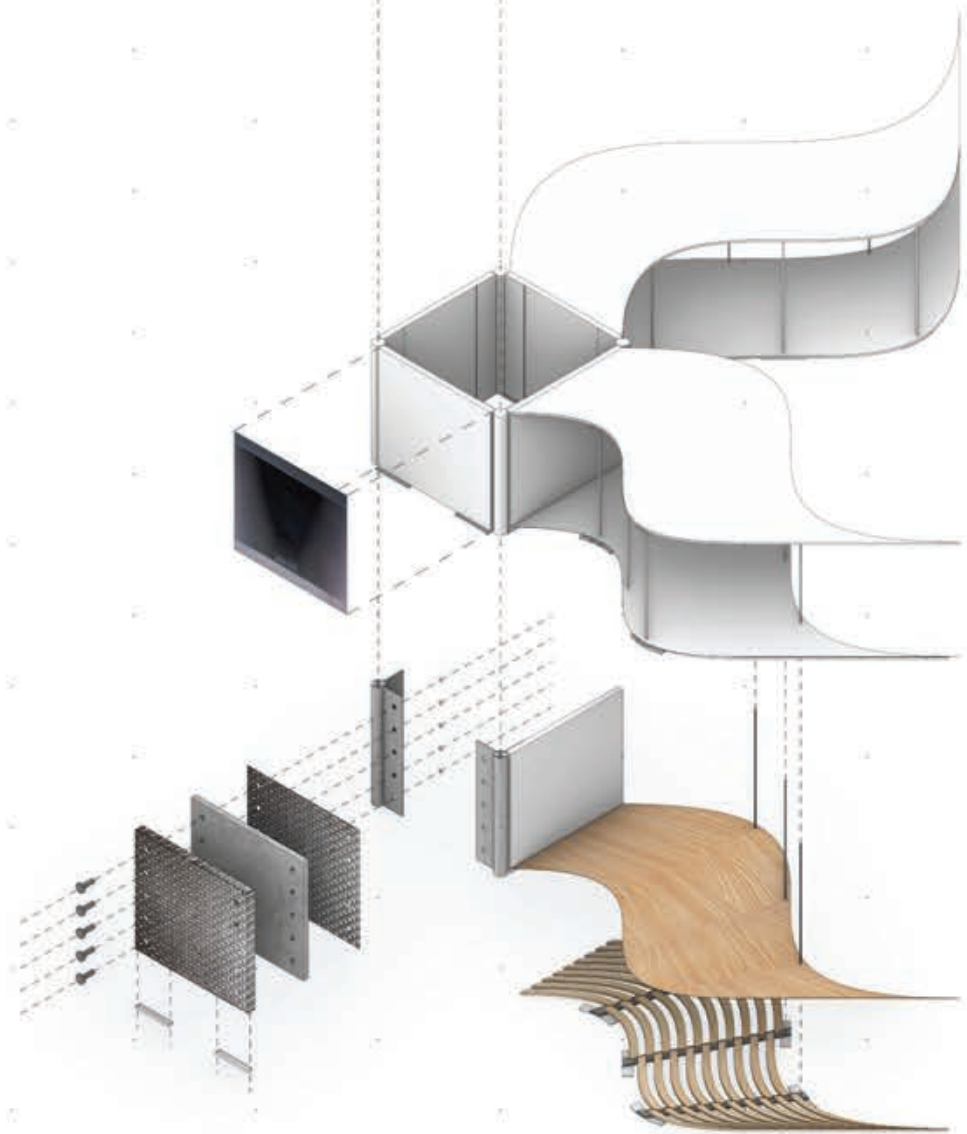
SCHOOL

POST COVID

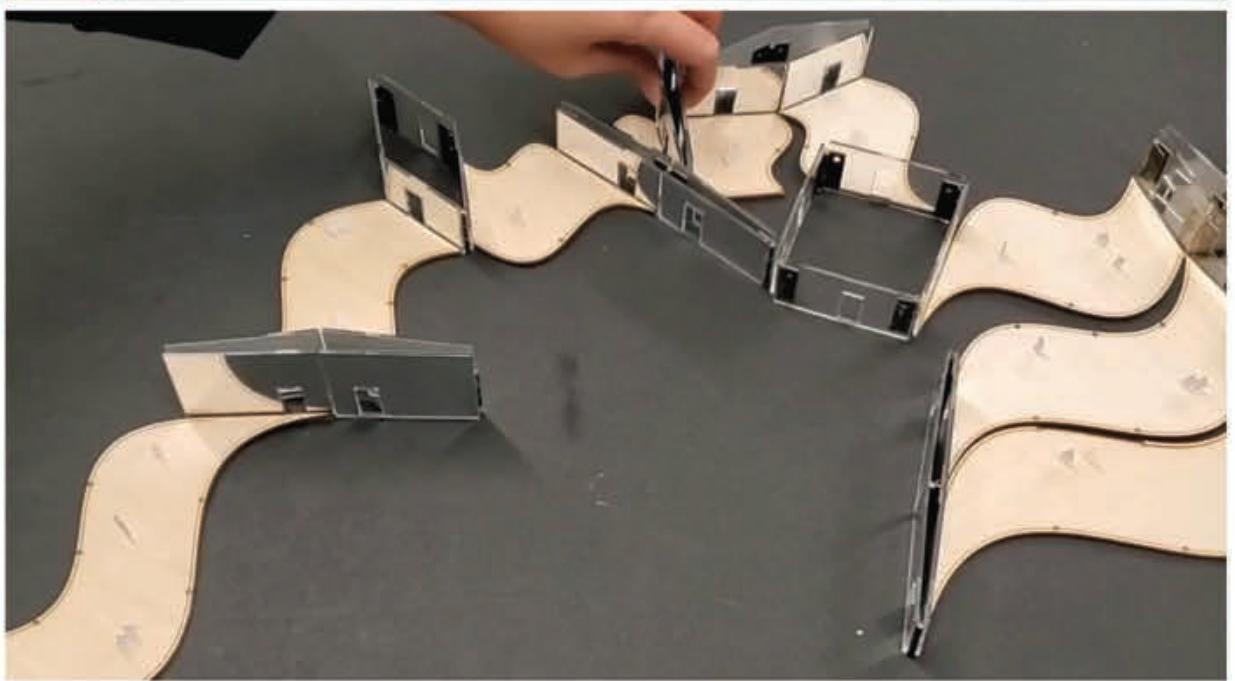
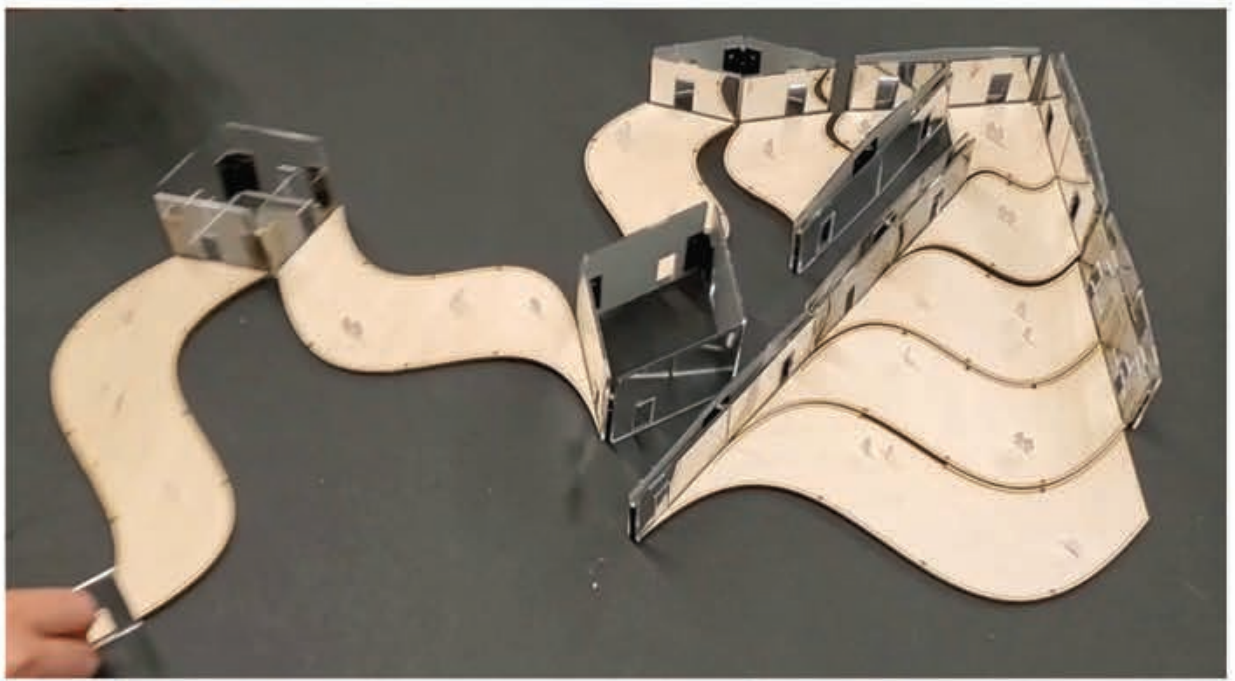
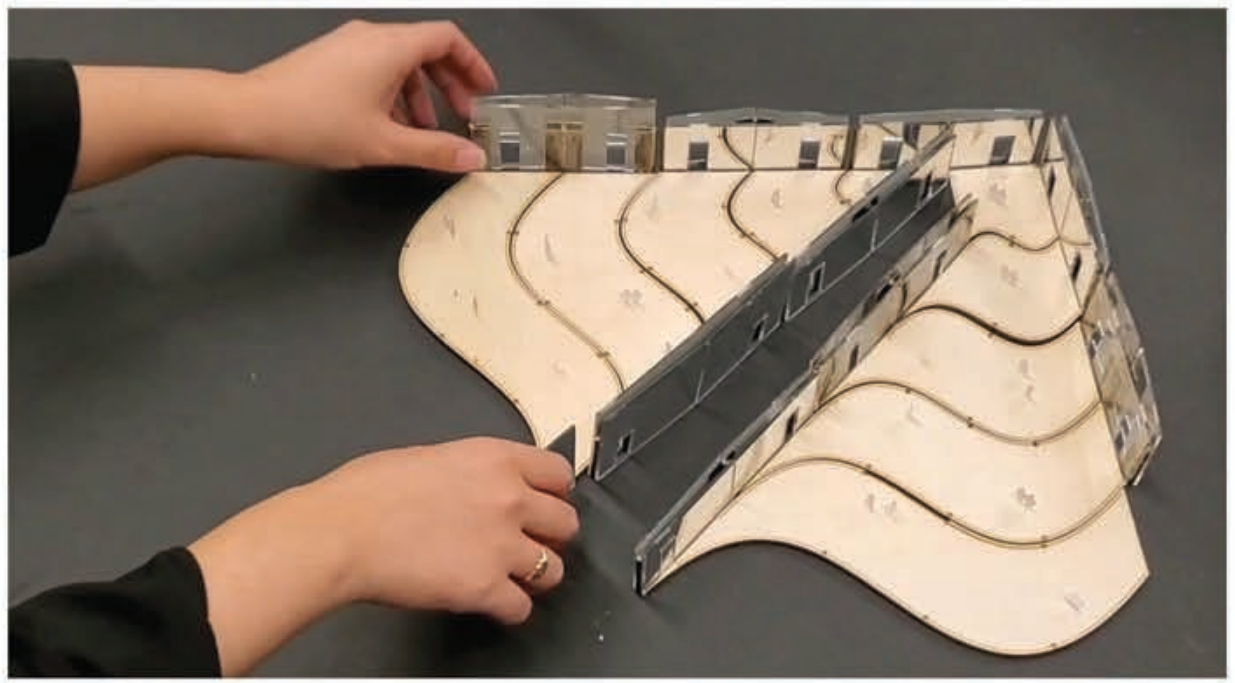


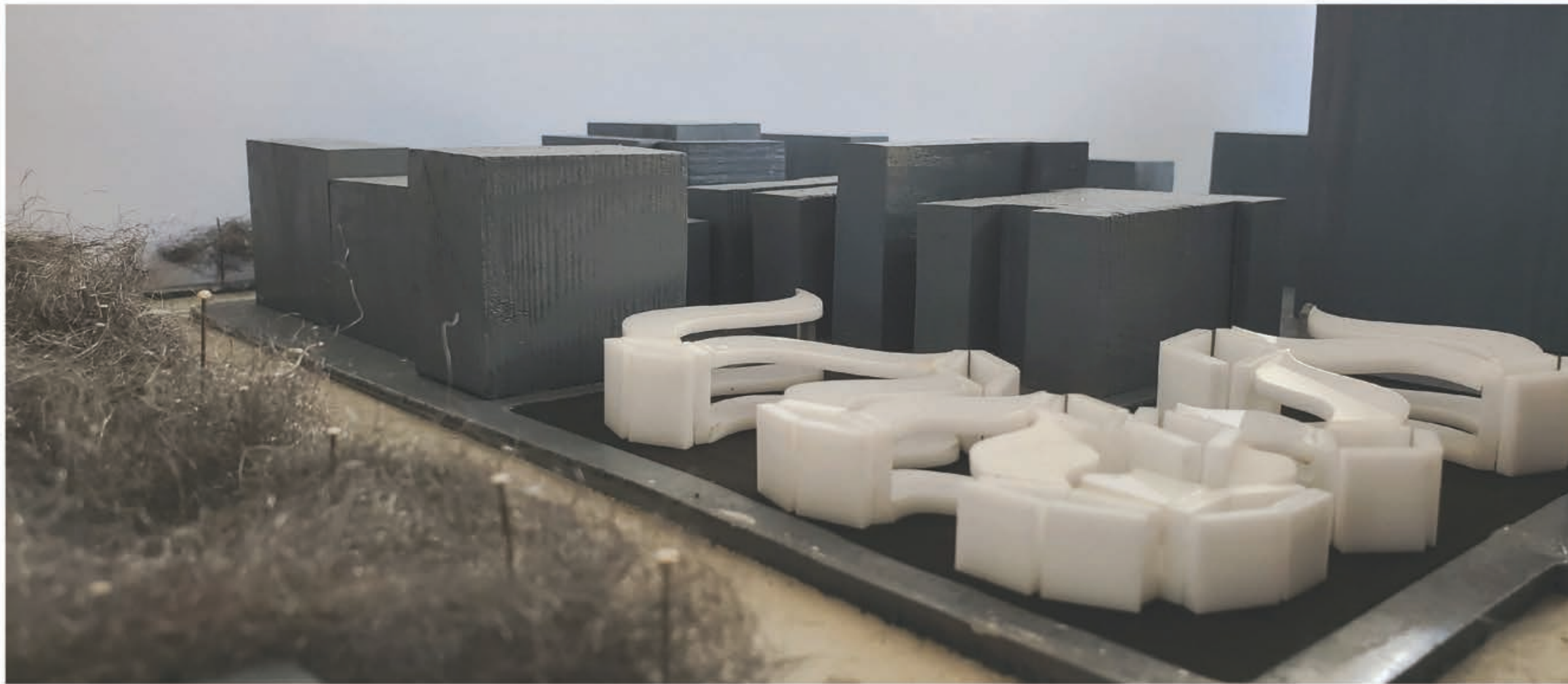


ADAPTIVE SCHOOL

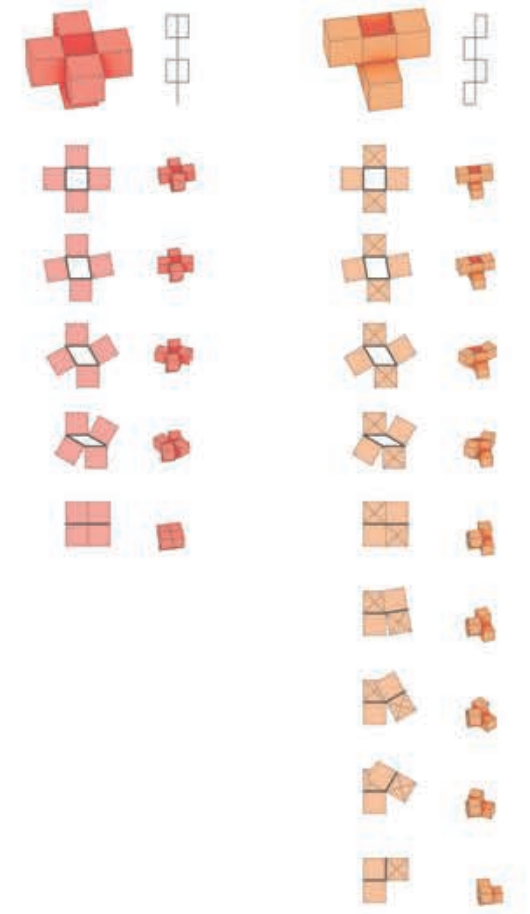


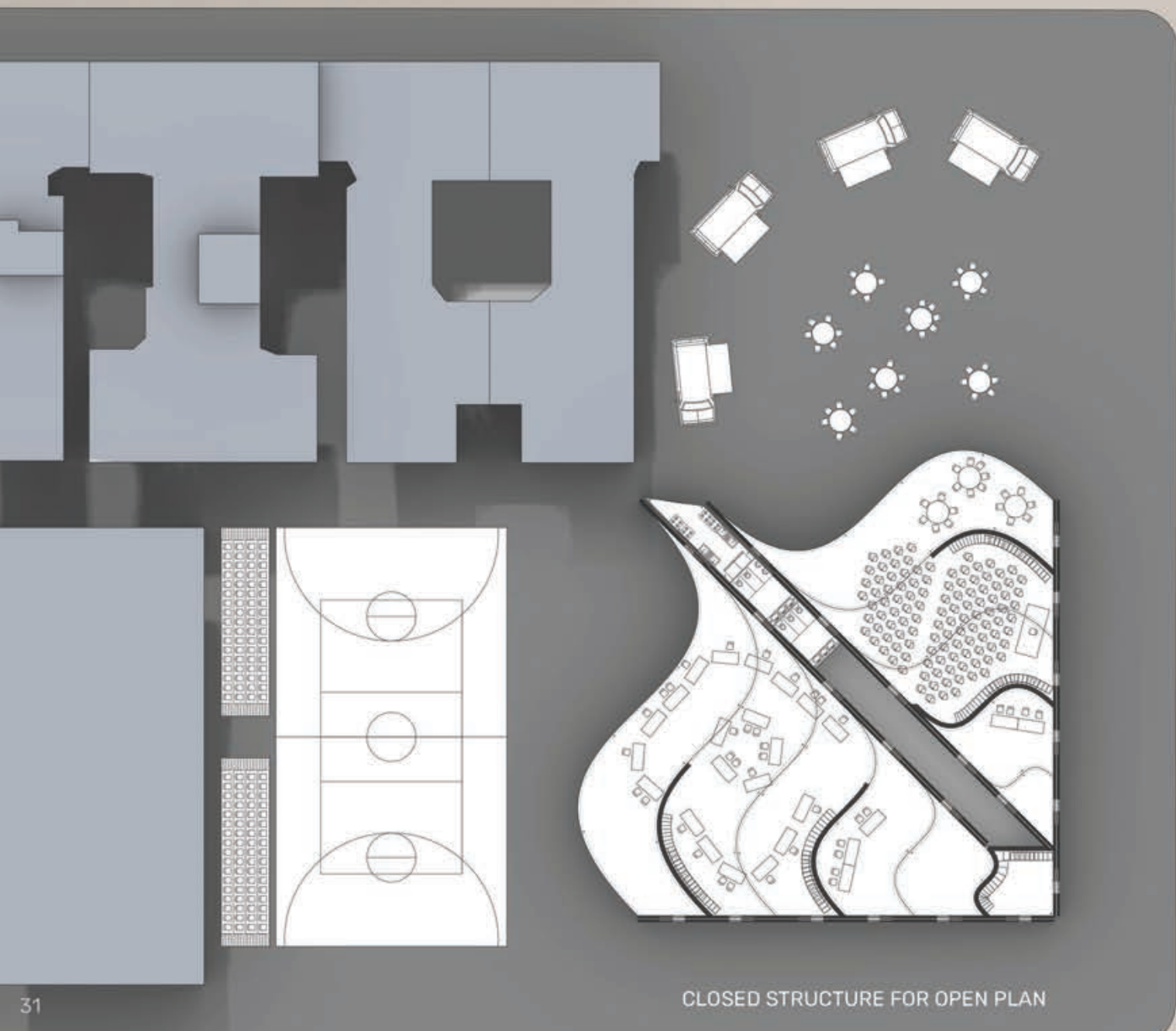
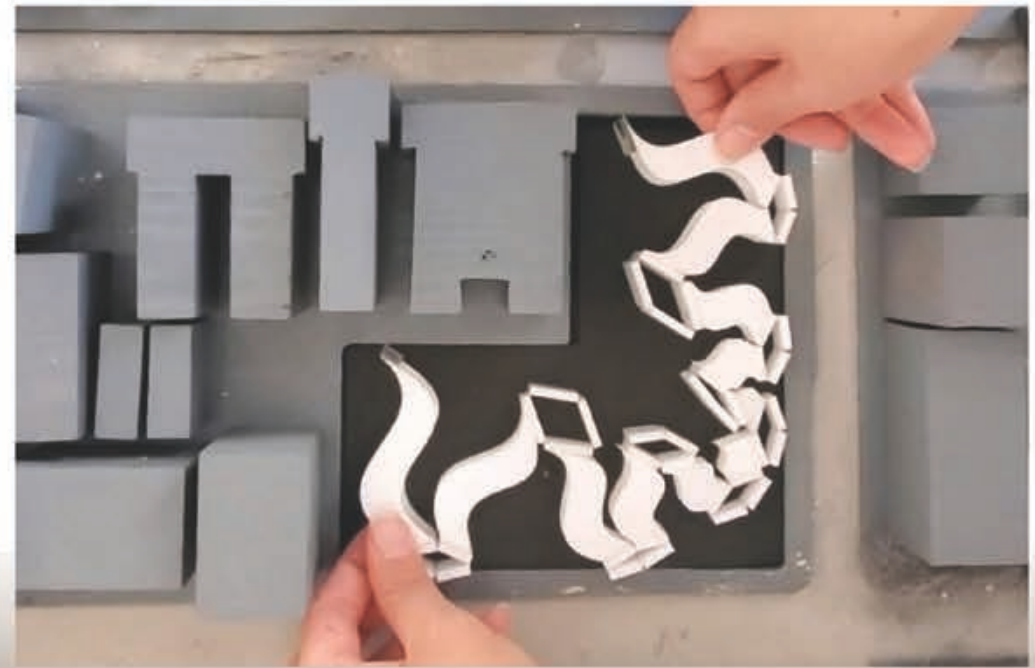
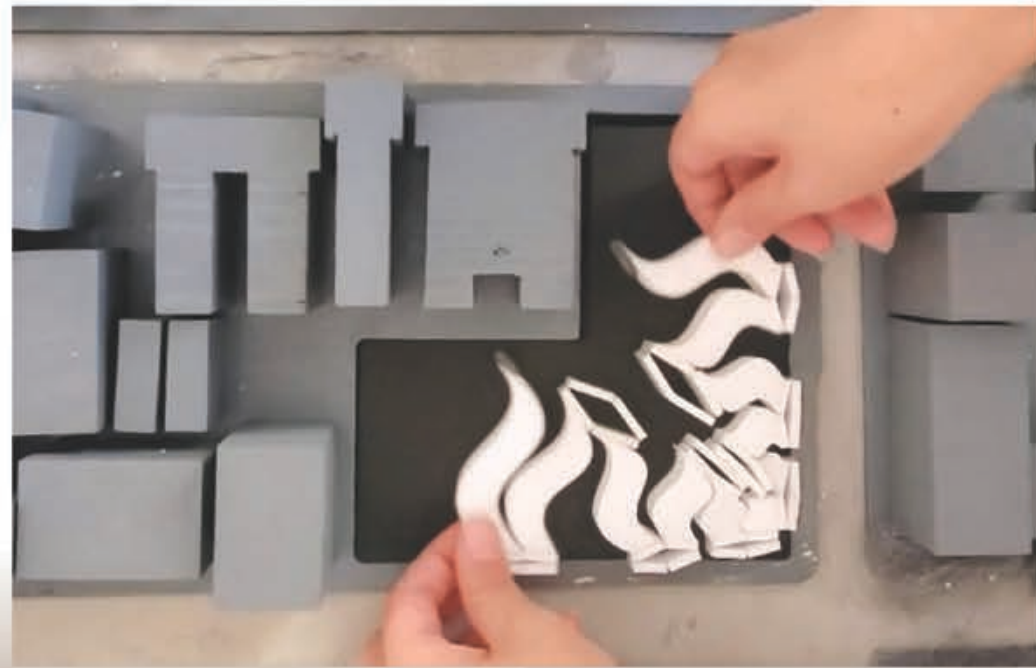
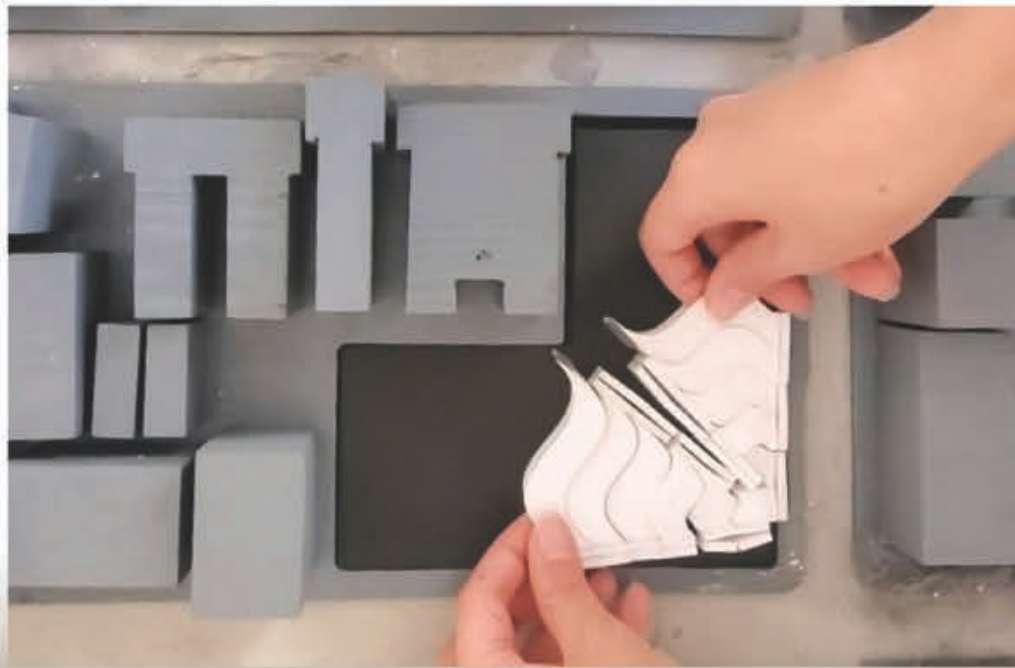
EXPLODED FOLDING MODULE DETAIL



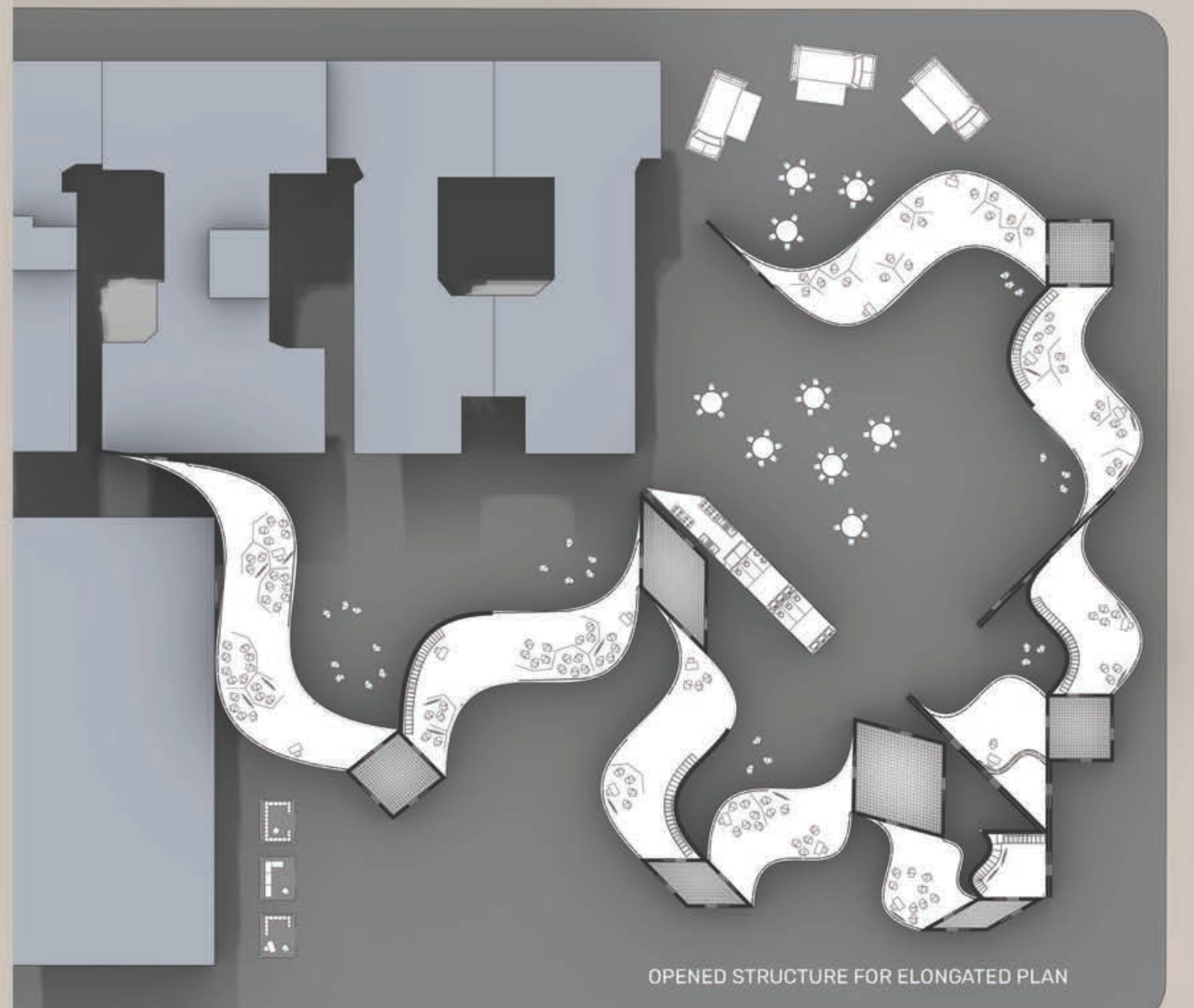


FOLDING MECHANISM STUDY





CLOSED STRUCTURE FOR OPEN PLAN



OPENED STRUCTURE FOR ELONGATED PLAN

THE BATH HOUSE: RECLAIMING ASHOKAN

Situated in the historical context of the Ashokan Reservoir—a man-made wonder designed to quench the thirst of New York City—"Reclaiming Ashokan: The Bath House" emerges as an architectural endeavor that addresses deep-seated socio-environmental scars. This project harnesses the power of architecture to mediate between the past and present conflicts derived from the reservoir's construction, which involved significant displacement and segregation of local populations.

As the reservoir was built, entire towns were submerged, and graveyards relocated, marking a violent reshaping of the landscape that benefited an urban populace at the expense of local communities. This upheaval was compounded by enforced segregation, affecting African Americans and Italian immigrants who labored under harsh conditions. Today, the legacy of exclusion persists, manifested in stringent security measures that sever the locals' connection to the water, symbolizing a broader disconnection from their environmental rights and heritage.

"Reclaiming Ashokan, The Bath House" proposes a healing design through the reintroduction of communal bathing facilities that utilize the very resource that has been a source of division—water. The project is deeply rooted in extensive historical research and spatial analysis, aiming to uncover and address the overlooked injustices. The design features innovative, ecologically sensitive water management systems that employ non-chemical sanitation and avoid microplastics, ensuring that the water used for bathing can safely return to the city's supply.

This architectural intervention is a bold statement against utilitarian policies that have historically prioritized metropolitan needs over local welfare. It reimagines the reservoir as a place of communal enrichment rather than mere resource extraction. The bath house is designed not only to provide a space for relaxation and social interaction but also to restore a sense of ownership and connection to the water among the local residents.

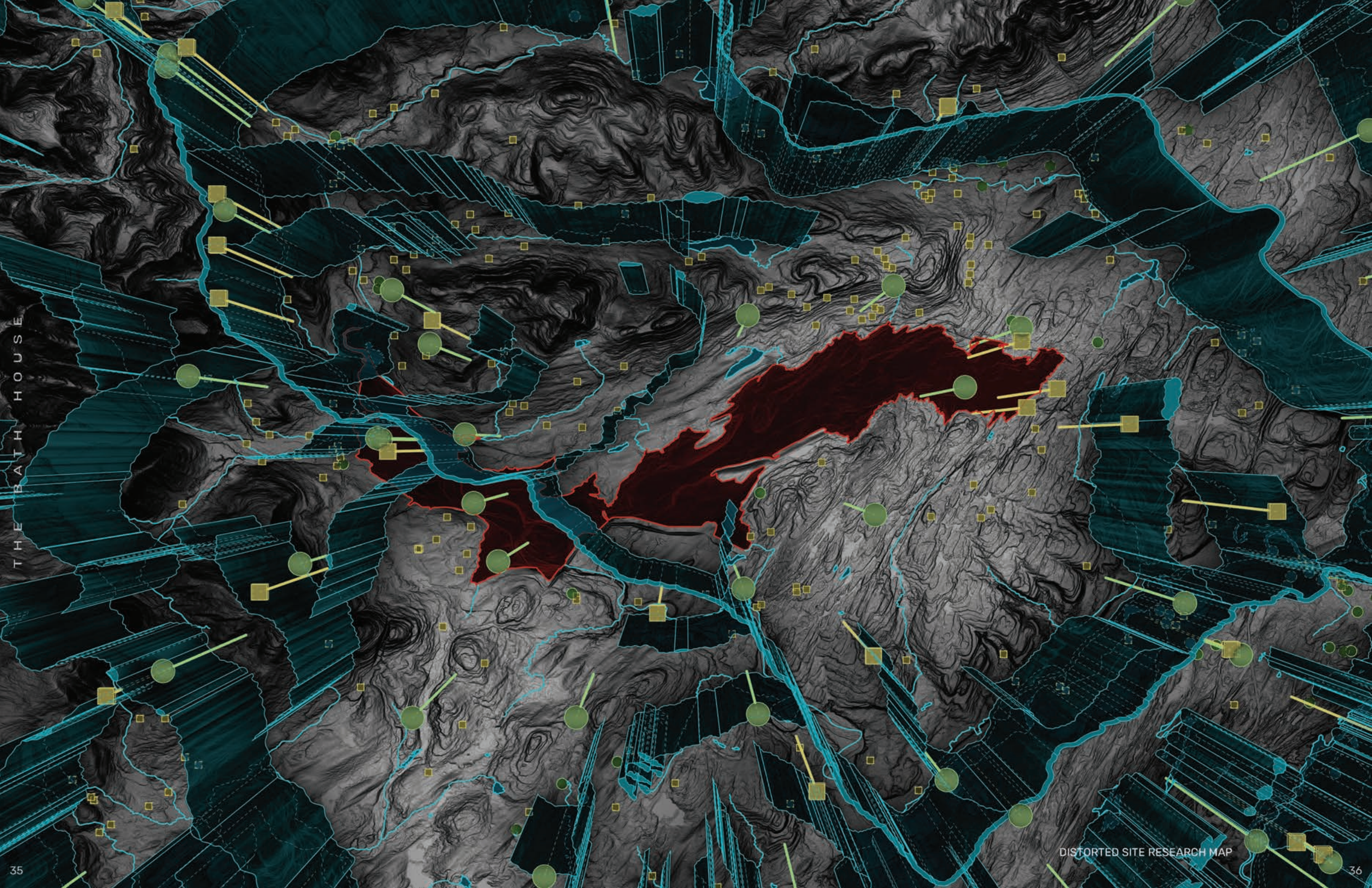
By transforming a site of historical division into a place of communal gathering and reconciliation, "Reclaiming Ashokan: The Bath House" embodies the principles of restorative justice through architecture. It serves as a catalyst for community healing, reconnecting the people with their water and the land, and reclaiming the landscape as a shared space of cultural and ecological significance. Through this project, water becomes a vessel for unity and healing, flowing through the community to mend the fissures of past conflicts and nurture a more inclusive and equitable future.

Semester: Spring 2023

Course: Advanced Studio 4

Advisor: Alessandro Orsini

WATER
TO
WATER





UNDERGROUND WATER SYSTEM

ARCHITECT
 BUILD BUILDING
 WE DRAW
 TO THEORY BE

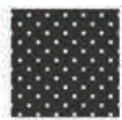


SURFACE WATER SYSTEM

DON'T BUILDINGS



Ashokan Reservoir



local community owned (public)



locally owned (private)



non locally owned (private)



NYC owned (public)



stream line



lot line



topo line

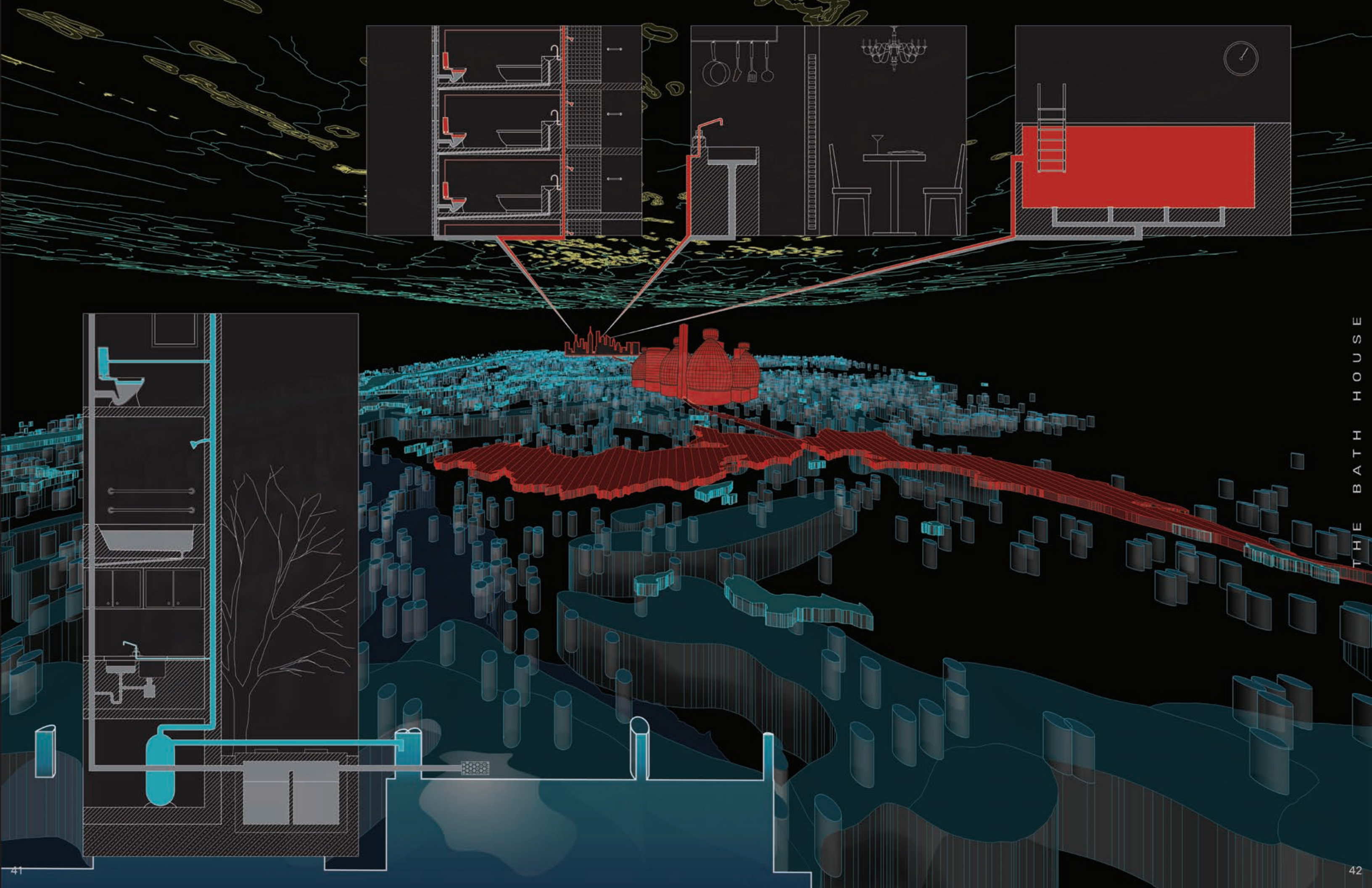


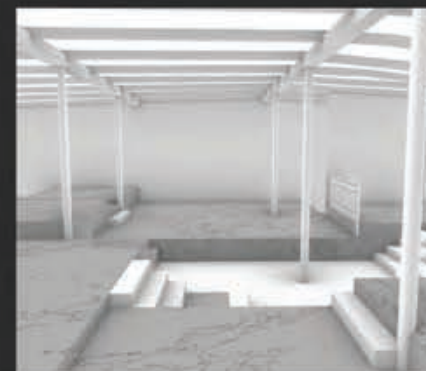
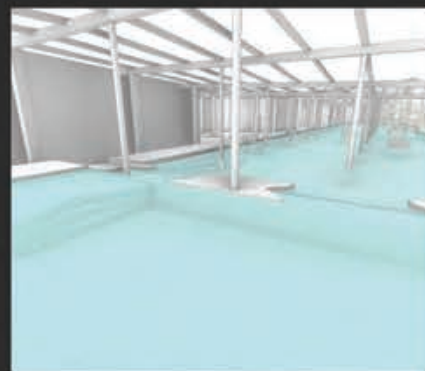
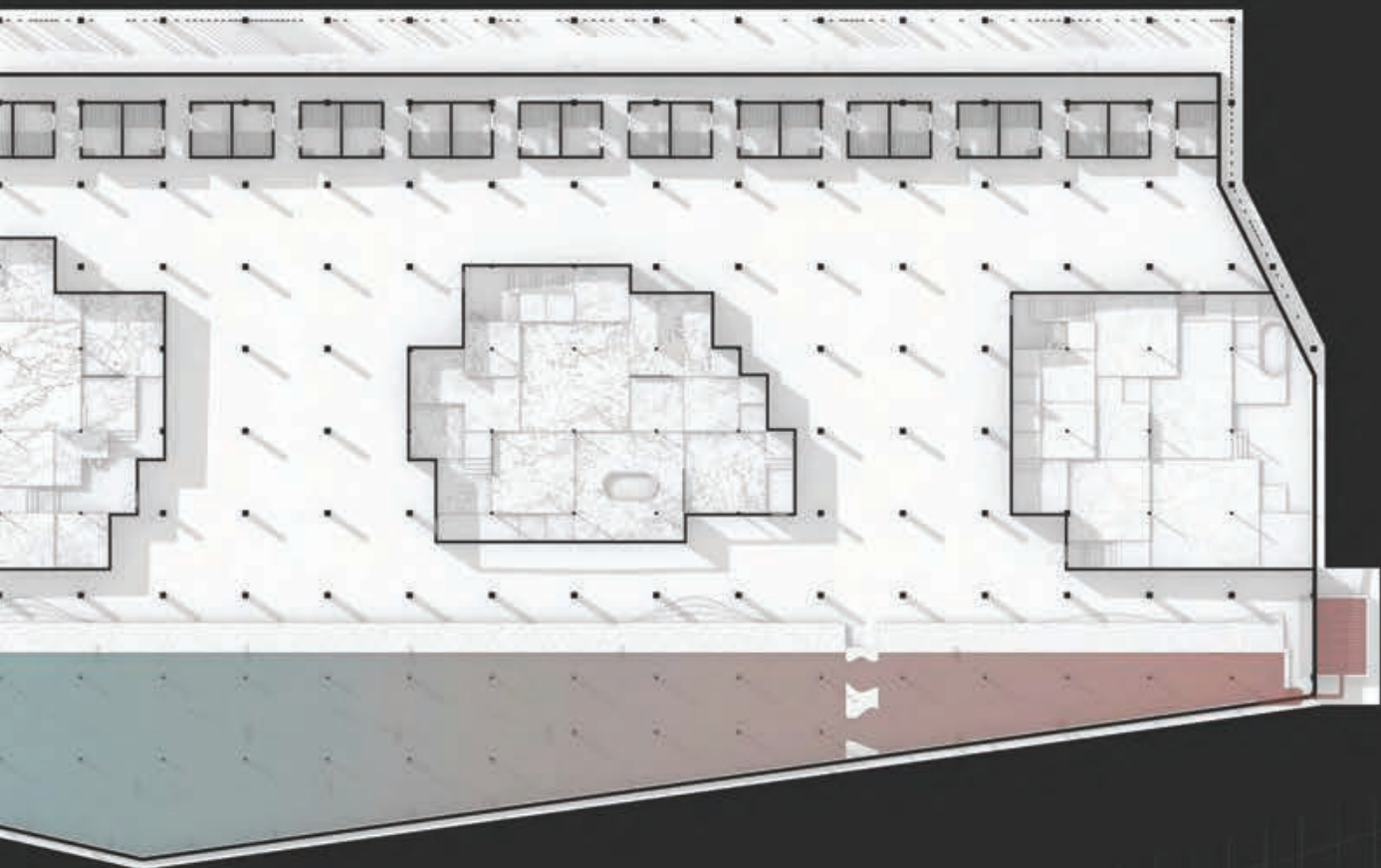
local building

THE BATH HOUSE



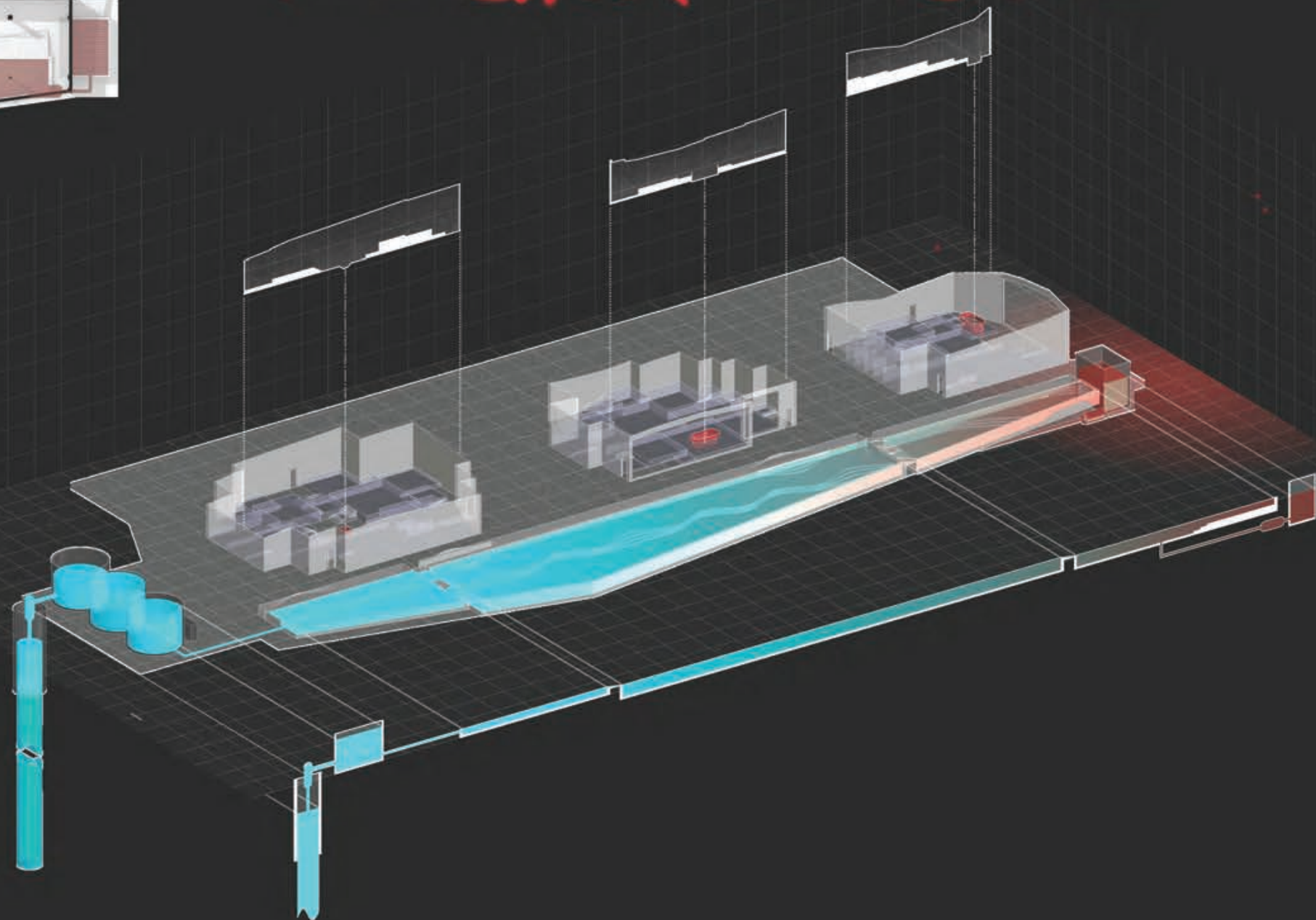
MAP CAN BE PROVOCATIVE
"DENVICE"





RADICALW SPECIFIC

"CRIP"
DESIGN
ON THE
LOOP HOLE



GREEN REVIVAL : KINGSBRIDGE ARMORY'S URBAN FARMING TRANSFORMATION

"Green Revival: Kingsbridge Armory's Urban Farming Transformation" is a visionary redevelopment of the historic Kingsbridge Armory, repurposed from a civil defense facility into a dynamic hub for urban agriculture and community engagement. This project embodies a strategic shift towards sustainability, integrating ecological systems with social space to rejuvenate the Kingsbridge neighborhood.

The expansive interior of the armory is ingeniously adapted to accommodate a large-scale greenhouse, optimized for year-round farming through advanced sunlight regulation and rainwater harvesting technologies. The focus on cultivating hydroponic crops like tomatoes and lettuce is complemented by an aquaponics system that uses tilapia fish, whose biological waste nourishes the plants, creating a closed-loop ecological cycle.

This transformation extends beyond agriculture, incorporating a comprehensive community center within the armory's structure. Facilities such as an athletics center, a community-run indoor farm market that showcases the farm's produce, and essential health services are integrated into the farming infrastructure. The programmatic elements are designed to foster social interaction and serve as a catalyst for community development.

Economically, the project is crafted to support the local economy by providing jobs in growing, packaging, and distribution, with the proceeds from sales being reinvested directly back into the community. This approach not only ensures local food security but also promotes economic resilience in the face of supply chain fluctuations and community challenges.

Architecturally, the armory undergoes significant renovations, with the ground floor partially open, creating a diagonal pathway that connects a new subterranean campus. Strategic modifications address the need for extensive air conditioning, creating a semi-outdoor space that utilizes the increased outdoor air flow effectively. This not only addresses the building's massive scale but also enhances accessibility and integration into the urban fabric.

"Green Revival" is a prime example of how architectural innovation can facilitate a more sustainable urban living. By transforming the Kingsbridge Armory into a hub for urban agriculture, community well-being, and economic sustainability, the project redefines the potential of historical sites and contributes to a greener and more connected urban future.

Semester: Fall 2023

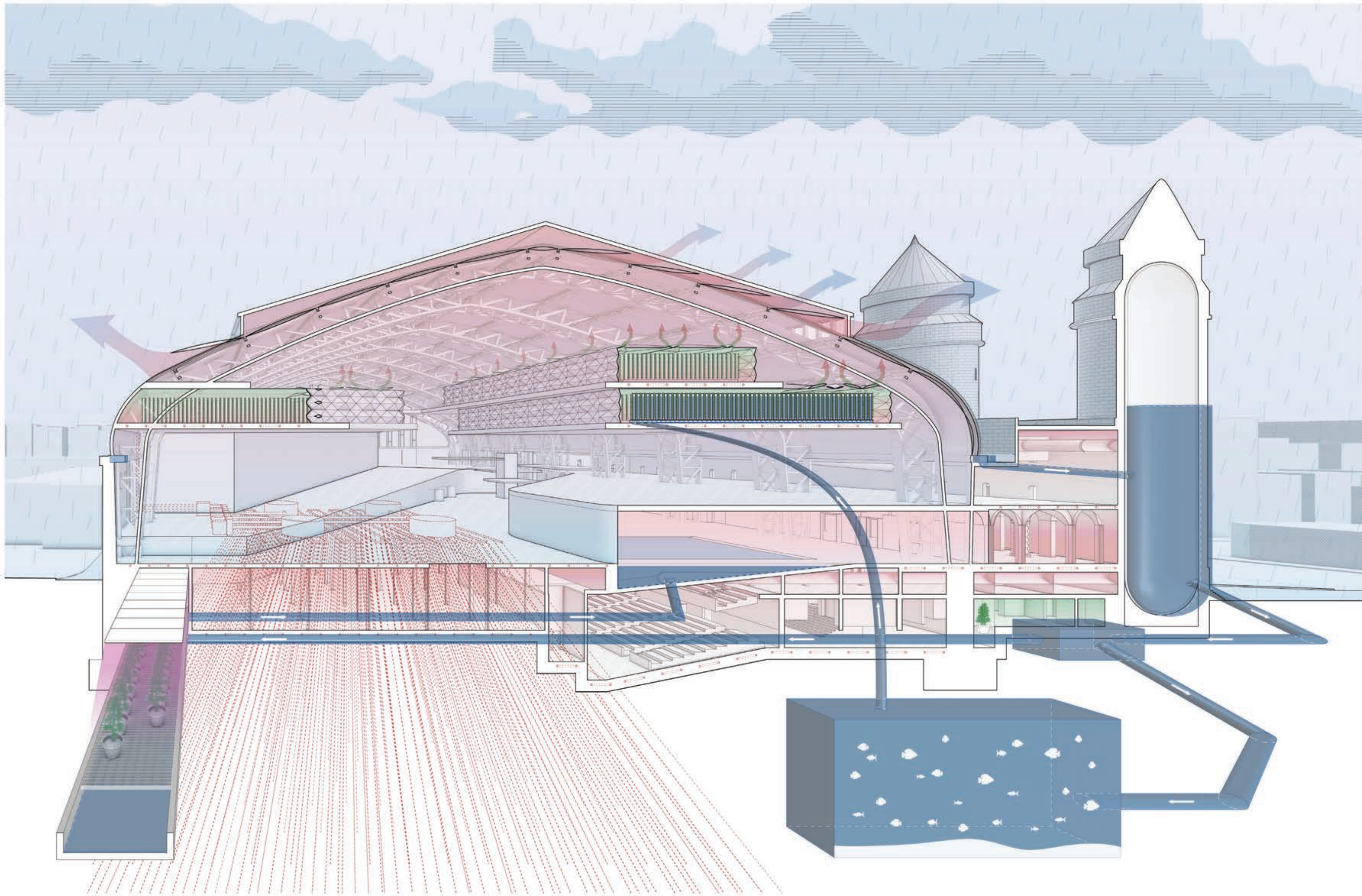
Course: Advanced Studio 5

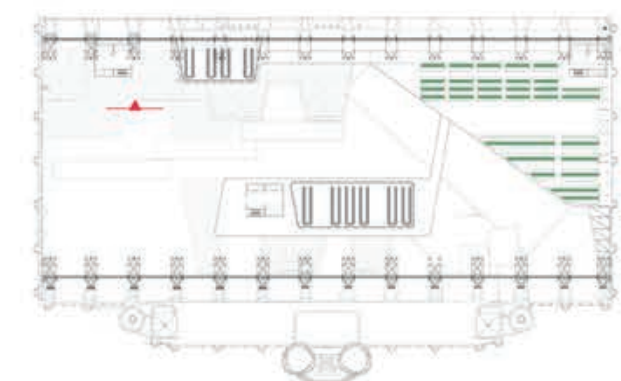
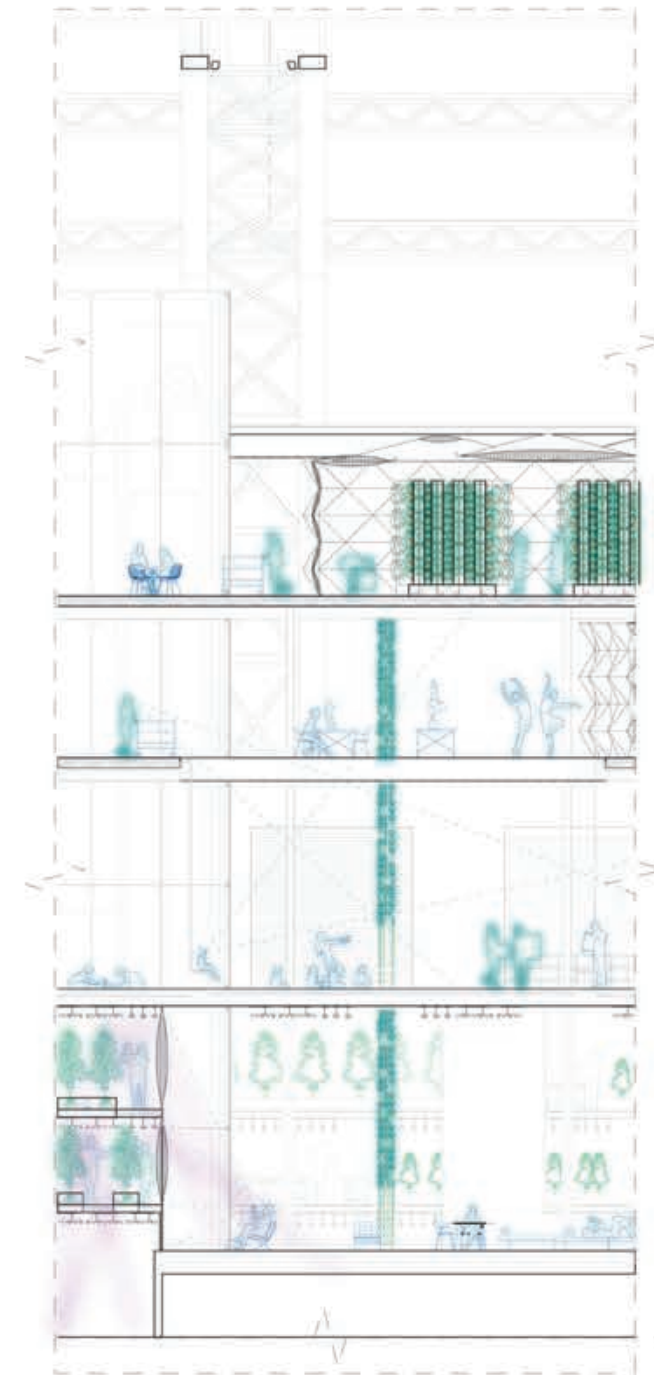
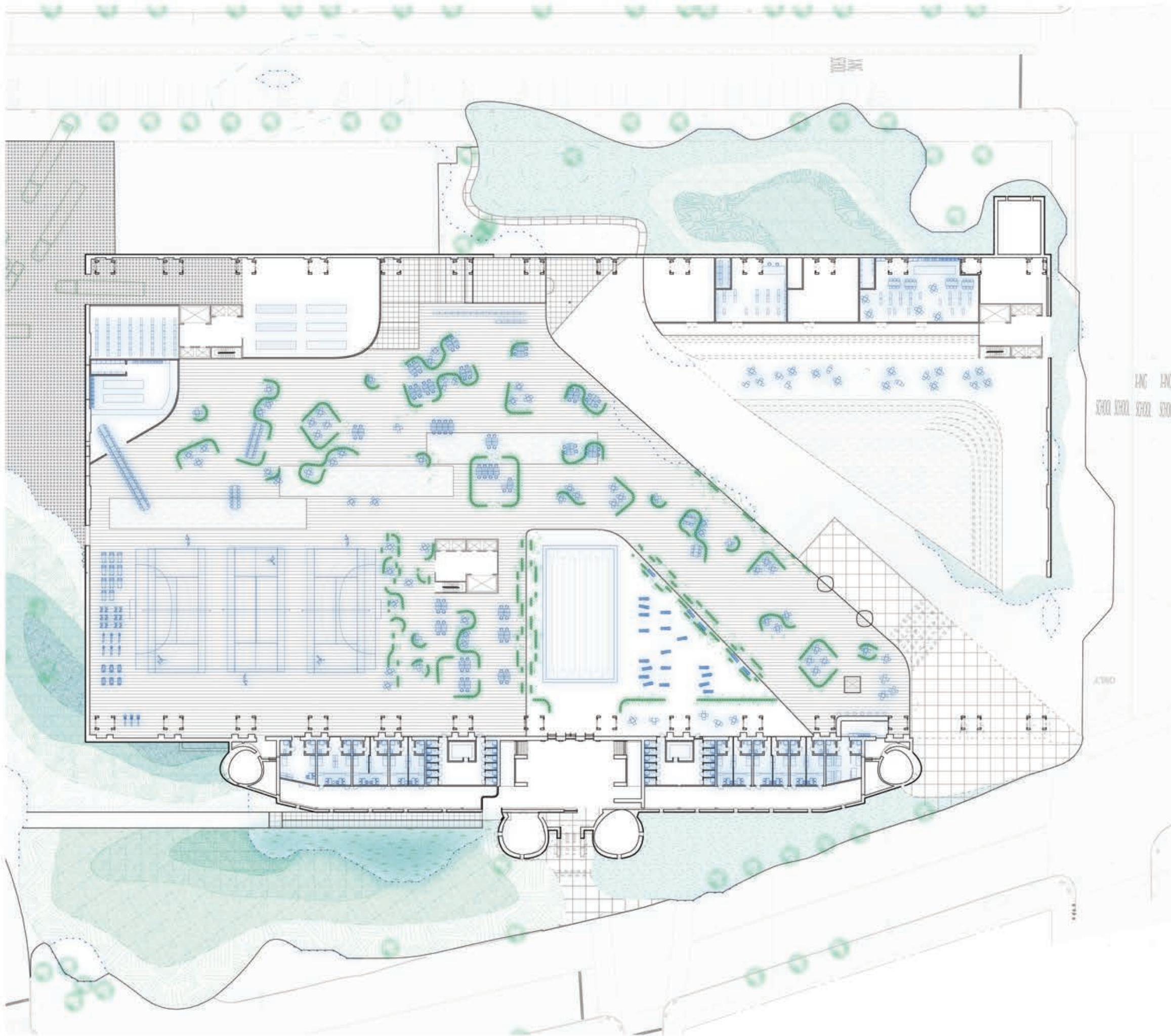
Advisor: Laurie Hawkinson

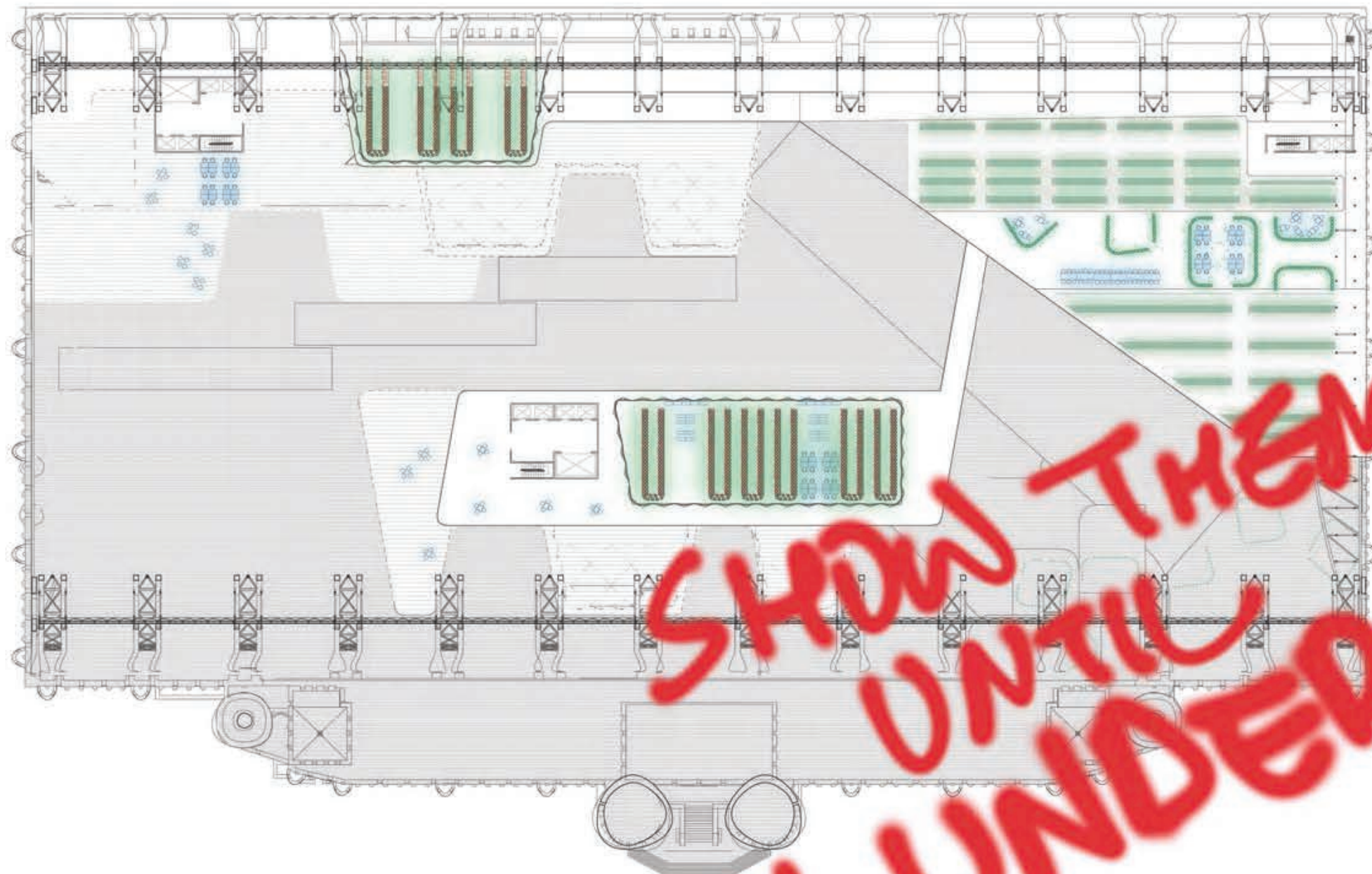
Teammates: Mikhail Kossir

NOBEL
TYPOLOGY

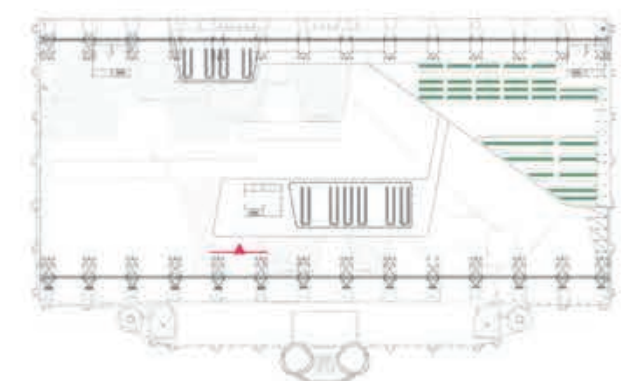
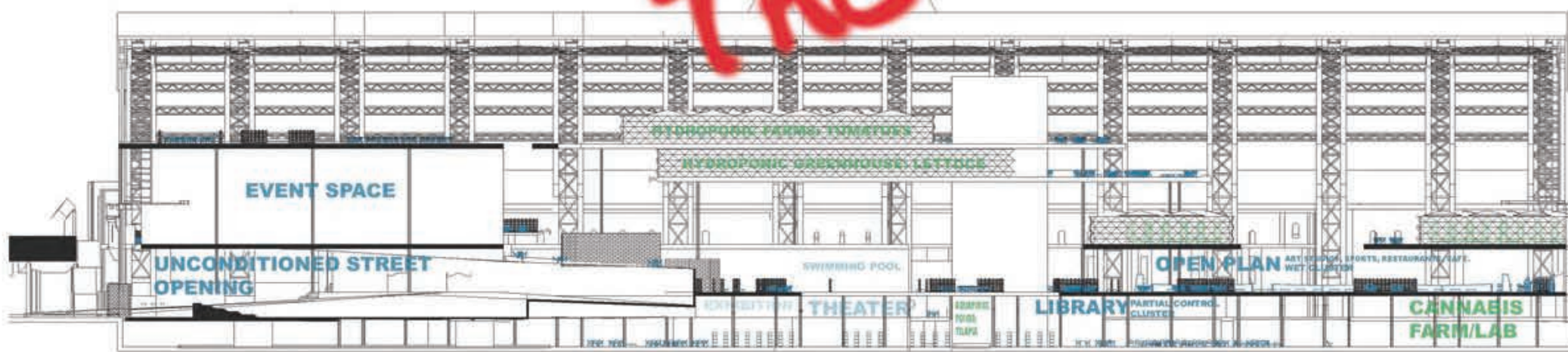




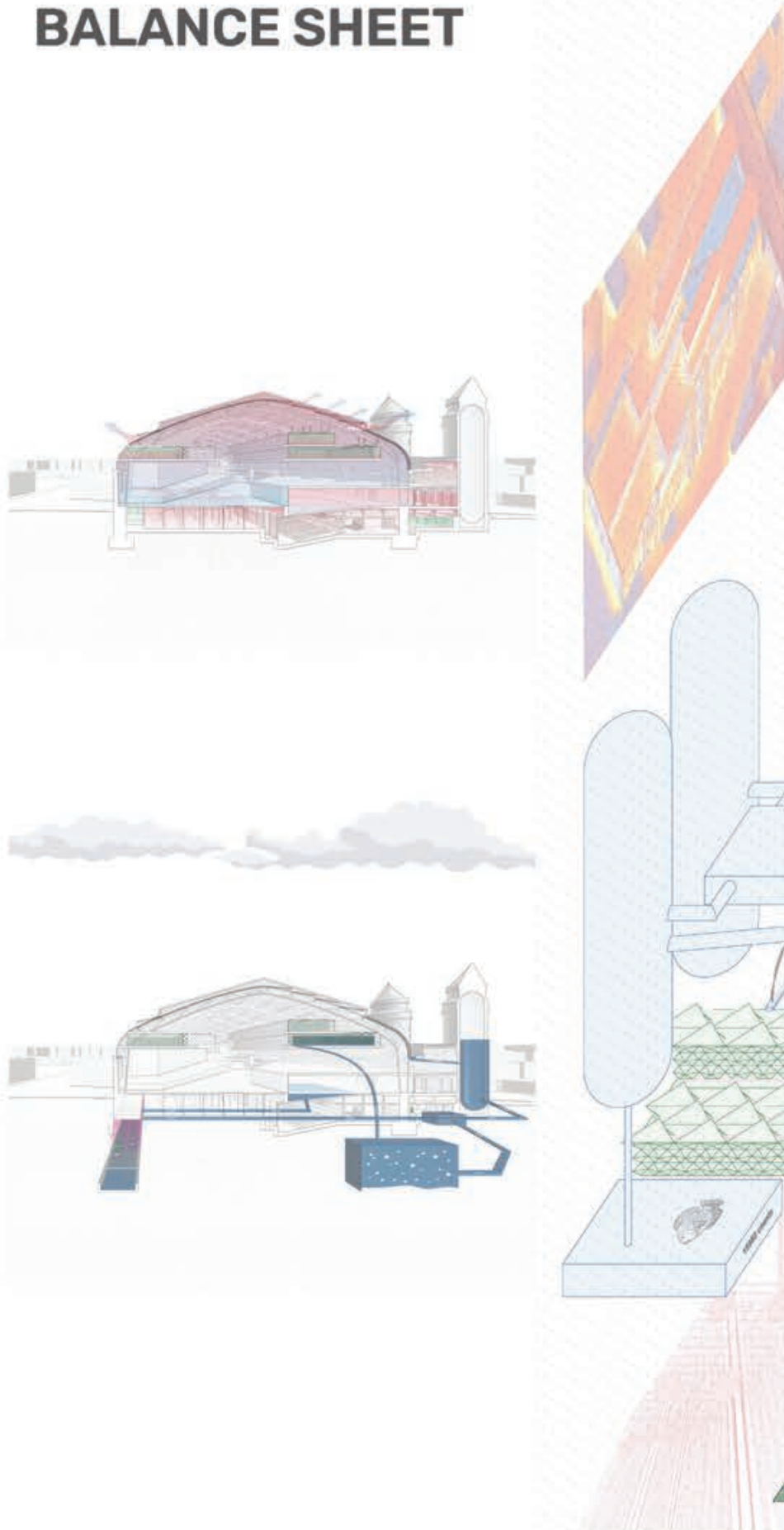




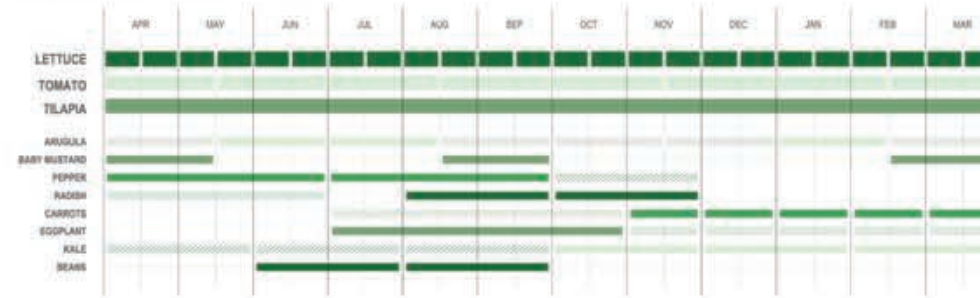
SHOW THEM
UNTIL
THEY UNDERSTAND



FARMING INPUT & OUTPUT BALANCE SHEET



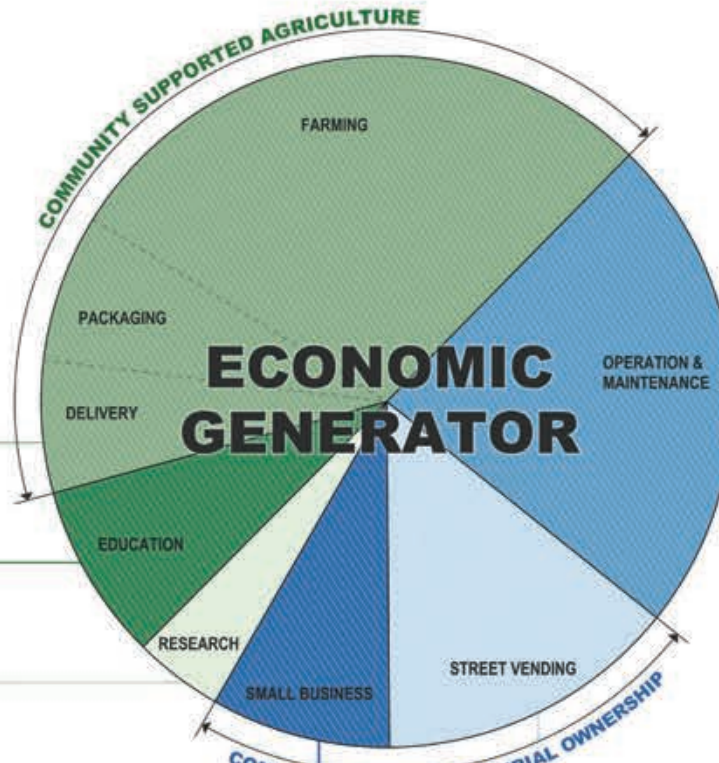
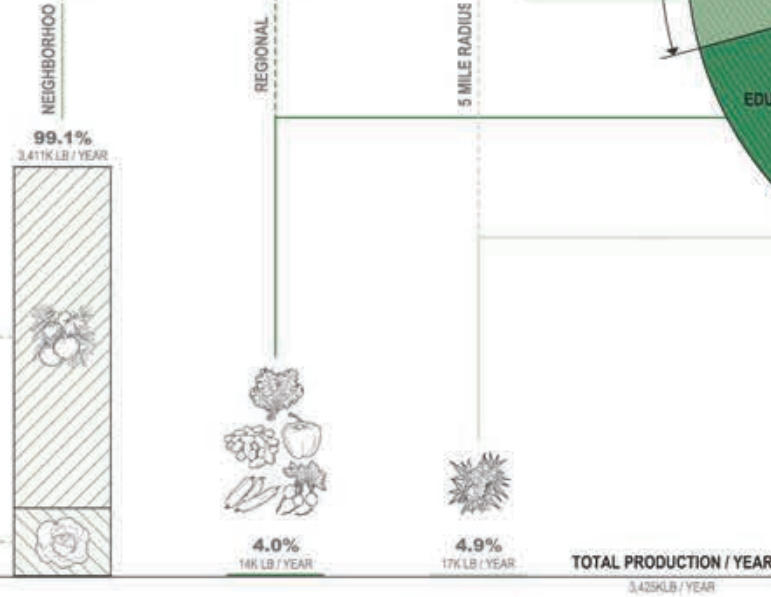
GROWING CYCLE



CANNABIS LABORATORY

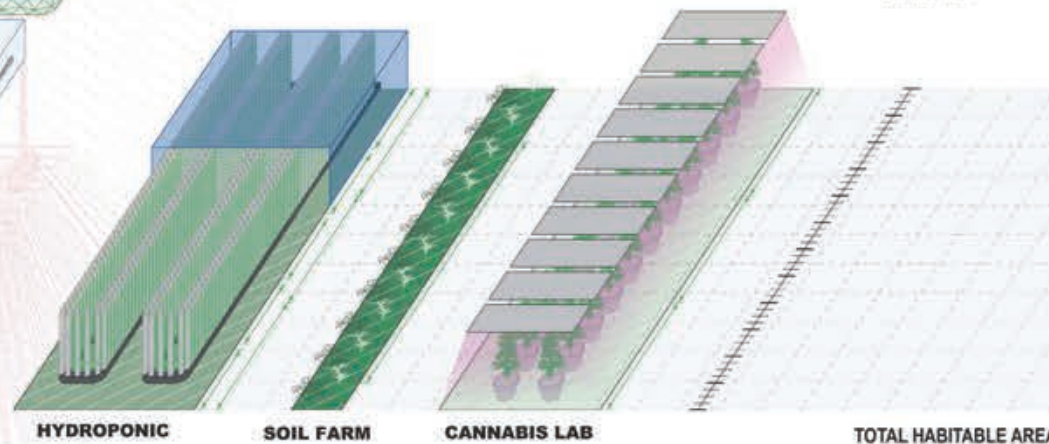


SUPPLY SCALE



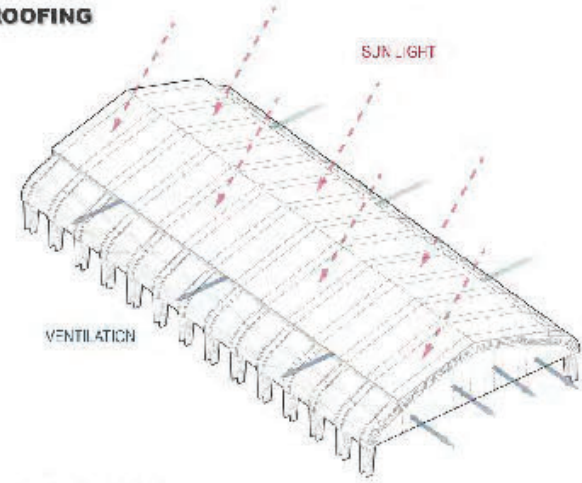
PROGRAM

- medical center
- locker rooms showers
- offices
- theatre
- exhibition
- library
- restaurant
- art studios
- sports
- swimming pool
- dancing
- large event space

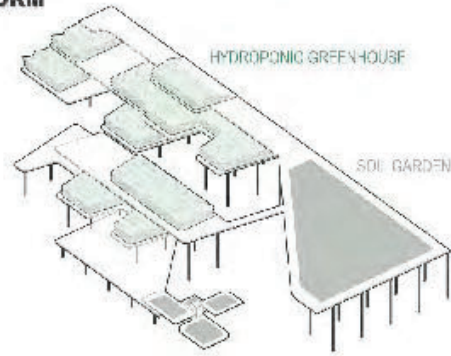


GREEN REVIVAL

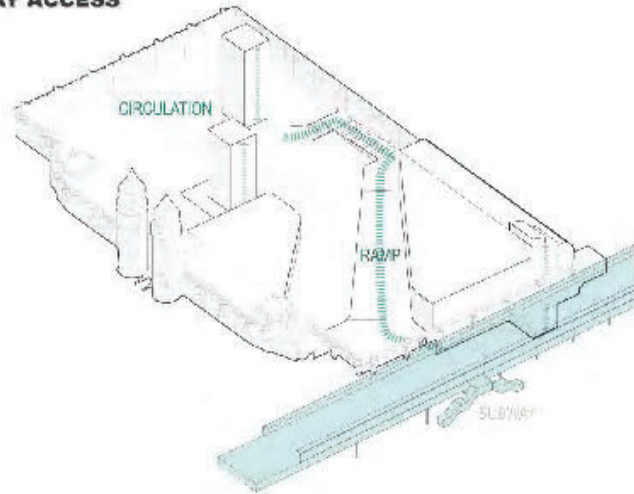
ETFE ROOFING



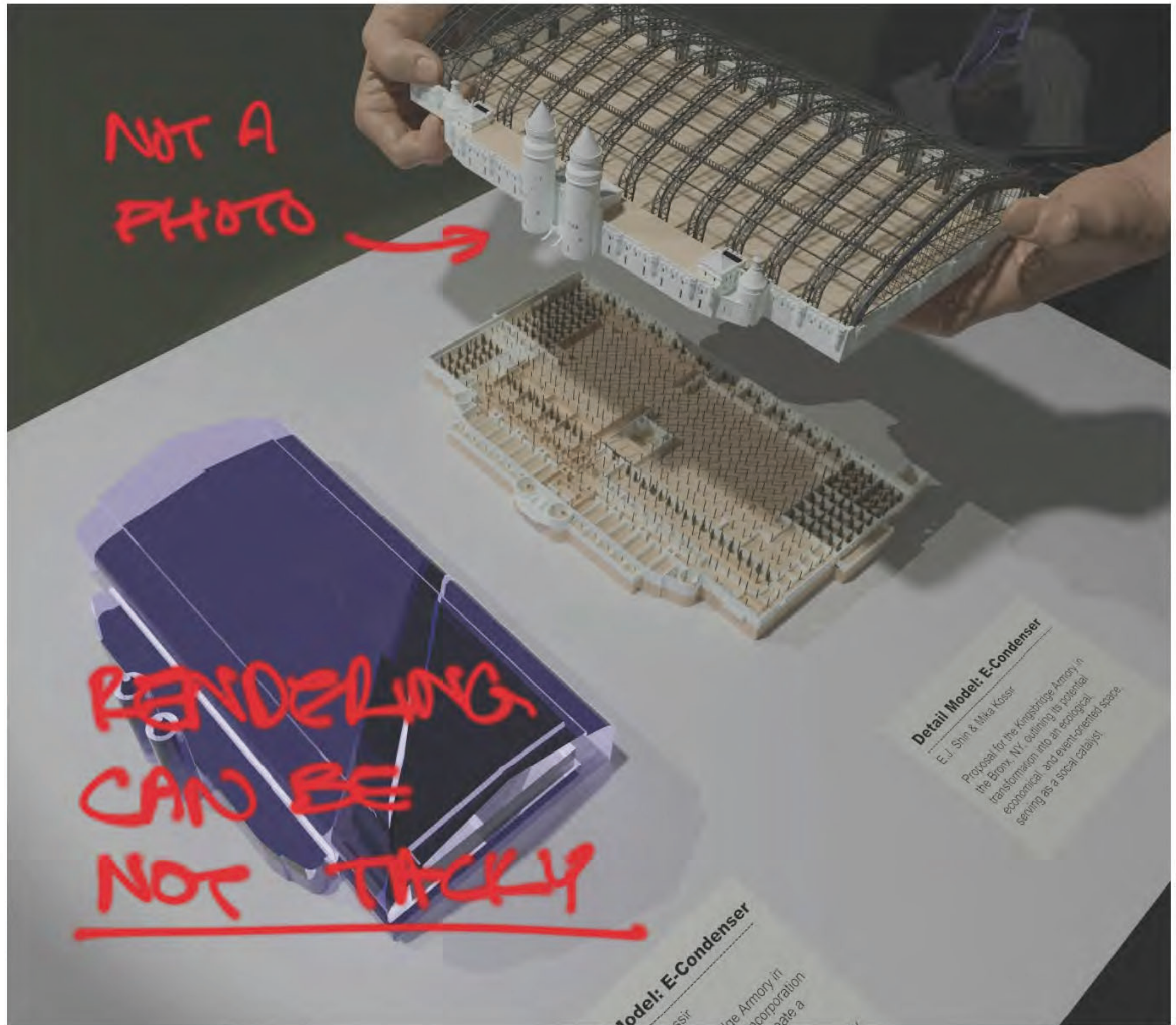
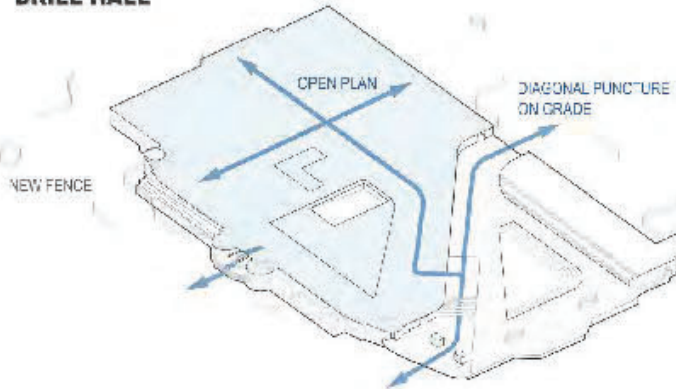
GROWING PLATFORM



SUBWAY ACCESS



DRILL HALL



NOT A PHOTO

RENDERING CAN BE NOT TRICKY

Detail Model: E-Condenser
E.J. Shin & Mika Kossir

Proposal for the Kingsbridge Armory in the Bronx, NY, outlining its potential transformation into an ecological, economical, and event-oriented space, serving as a social catalyst.

Model: E-Condenser
Kossir
the Armory in
incorporation
gate a

HUSK TO HOME : BIOMASS TO CARBON-SEQUESTRATION CITY

"Husk to Home: Biomass to Carbon-Sequestration City" emerges as a groundbreaking initiative aimed at redefining the role of architecture in the fight against climate change. By harnessing the untapped potential of agricultural byproducts, this project transforms construction practices, turning the built environment from a major emitter of greenhouse gases to an active participant in carbon sequestration.

The project is spearheaded by the development of an innovative building material that fuses natural elements like soil and rice husk with the structural strength of concrete and steel. This pioneering composite material forms the backbone of a new building typology that incorporates beams, columns, and bricks capable of absorbing carbon dioxide, thus reducing the overall carbon footprint of urban structures.

Situated in the northern regions of India, an area primed for solar energy utilization, the architecture draws inspiration from traditional Jali screens to provide passive cooling through natural wind tunnels, while also incorporating solar panels to harness the sun's energy efficiently. The design promotes not only environmental sustainability but also economic self-sufficiency, echoing the principles of traditional and modern design harmoniously.

Inside, the spaces are designed to be modular and adaptable, allowing for the dynamic use of carbon-sequestering materials in interior partitions. A unique aspect of the project is its community-oriented approach to manufacturing; residents can produce their own bricks from locally sourced rice husk, fostering a sense of ownership and participation in the building process. This empowers communities to adapt and evolve their living spaces as needed, enhancing the sustainability of the construction lifecycle.

"Husk to Home" not only proposes a significant reduction in the environmental impact of new buildings but also provides a scalable model for future urban development. The project envisions cities where every structure contributes to mitigating climate change, turning urban areas into vast networks of carbon-sequestering nodes. This ambitious vision repositions architectural practice at the forefront of environmental activism, demonstrating that sustainable building practices can profoundly impact both local communities and the global ecological balance.

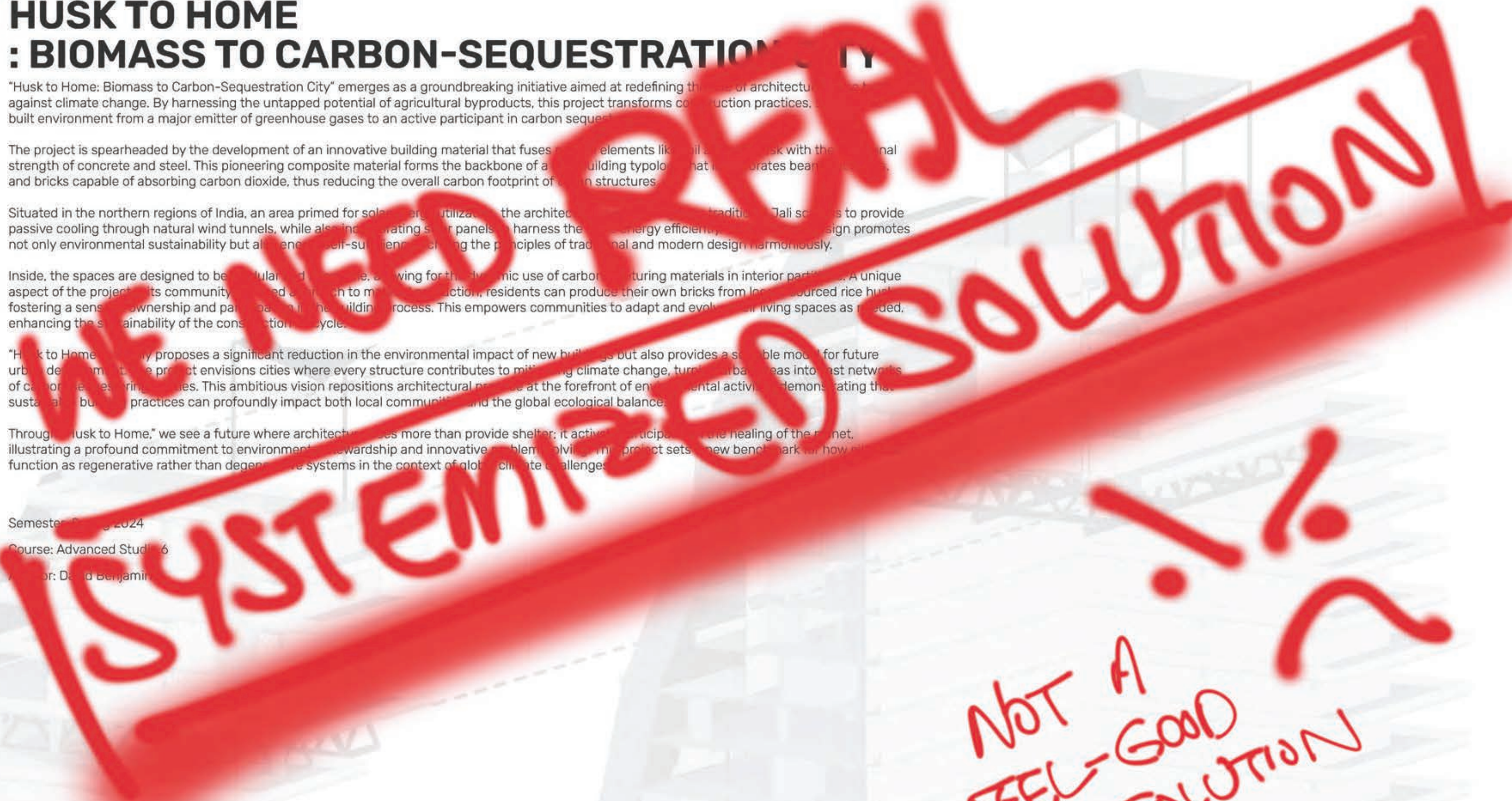
Through "Husk to Home," we see a future where architecture does more than provide shelter; it actively participates in the healing of the planet, illustrating a profound commitment to environmental stewardship and innovative problem-solving. The project sets a new benchmark for how buildings can function as regenerative rather than degenerative systems in the context of global climate challenges.

Semester: Spring 2024

Course: Advanced Studio 6

Author: David Benjamin

ACCIDENTALLY POLEMIC



!!!
NOT A
FEEL-GOOD
SOLUTION

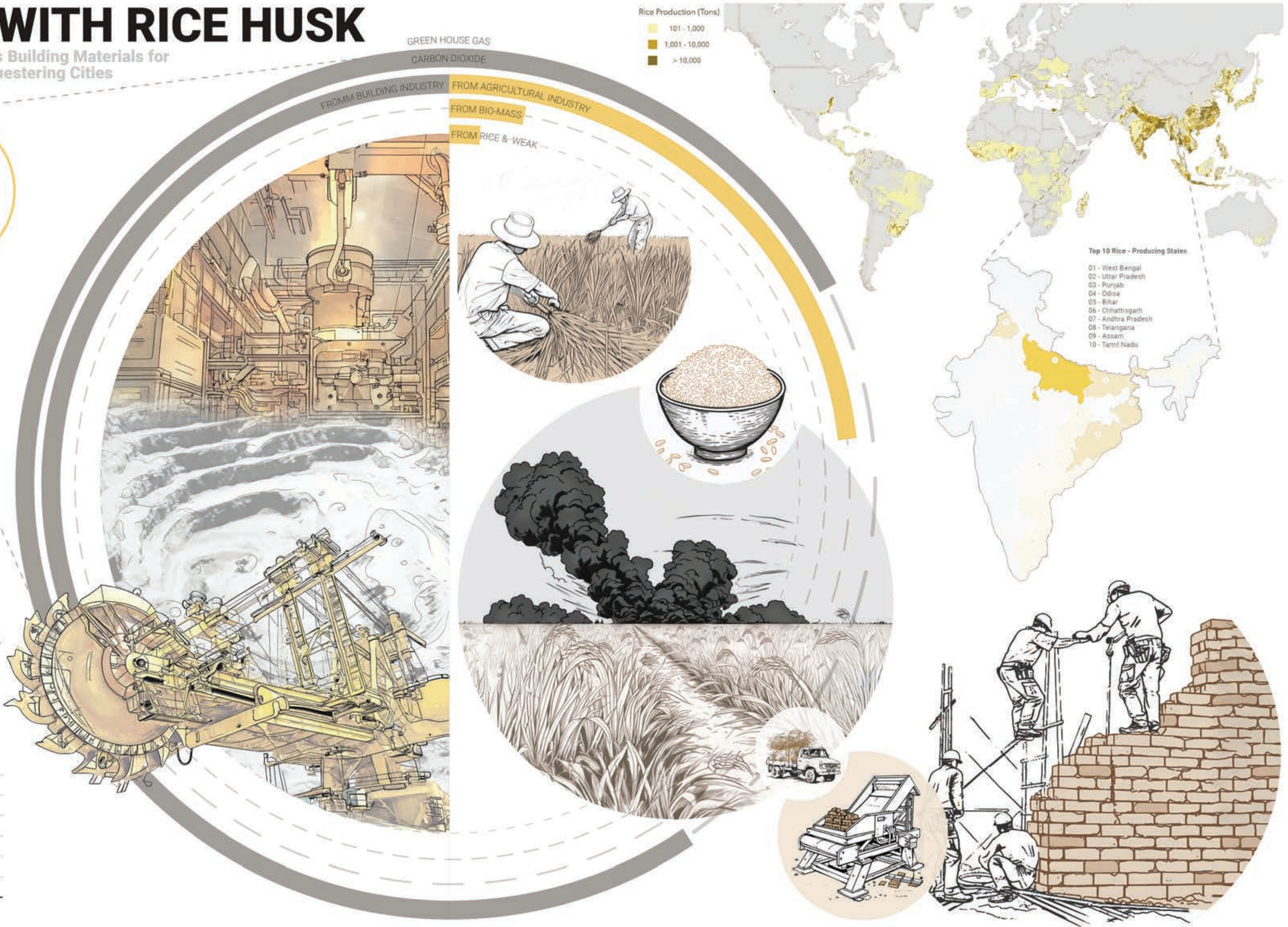
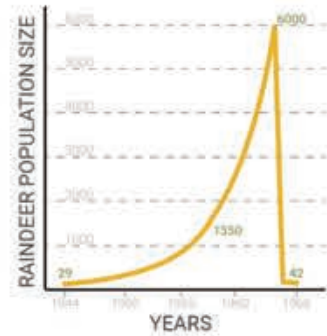
BUILD WITH RICE HUSK

Alternative Biomass Building Materials for Future Carbon-Sequestering Cities



The reindeer incident on St. Matthew Island, where a population boom led to near extinction from resource depletion, mirrors humanity's challenge with global population growth and resource consumption.

We must balance growth with Earth's finite resources to prevent ecological collapse and ensure sustainability.



Rice Production (Tons)

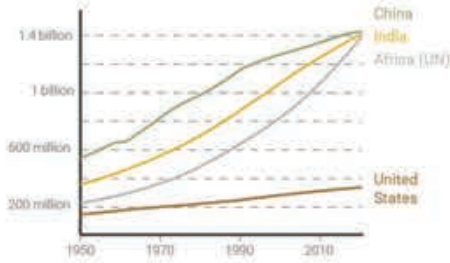
- 101 - 1,000
- 1,001 - 10,000
- > 10,000

Top 10 Rice - Producing States

- 01 - West Bengal
- 02 - Uttar Pradesh
- 03 - Punjab
- 04 - Odisha
- 05 - Bihar
- 06 - Chhattisgarh
- 07 - Andhra Pradesh
- 08 - Telangana
- 09 - Assam
- 10 - Tamil Nadu

HUSK TO HOME

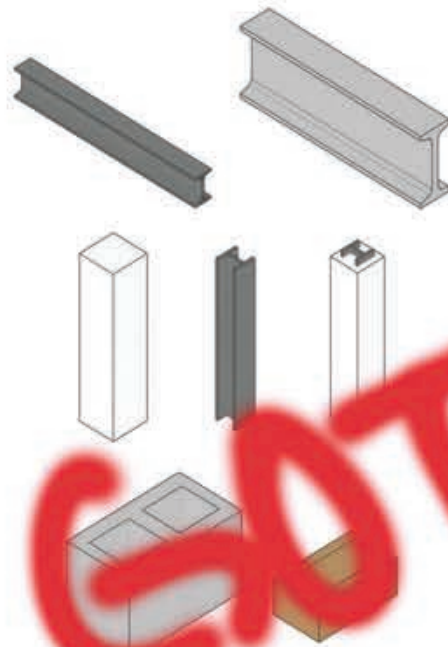
POPULATION, 1950 TO 2021



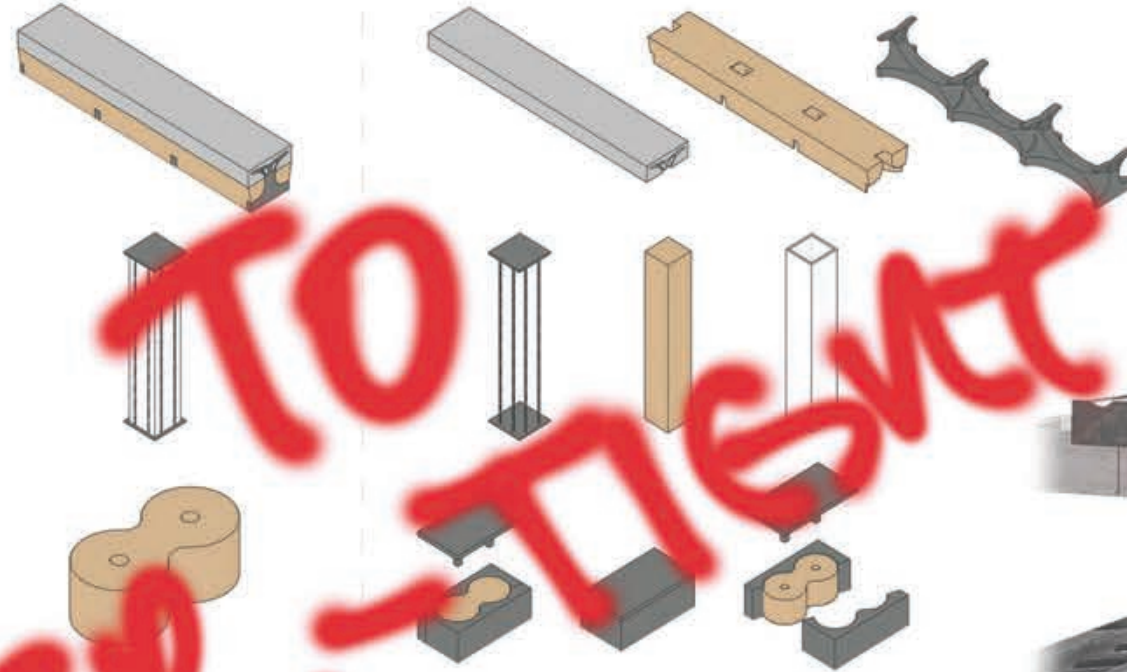
Considering the anticipated population growth in regions like China, India, and Africa, and the inevitable construction of new cities to meet housing demands, humanity faces a challenge: current resource statistics suggest the need to reduce carbon-intensive construction instead of building more. What if we could fundamentally change the elements of carbon-sequestering building materials? Cities built with these materials could function as carbon sinks, effectively contributing to combat this climate crisis!



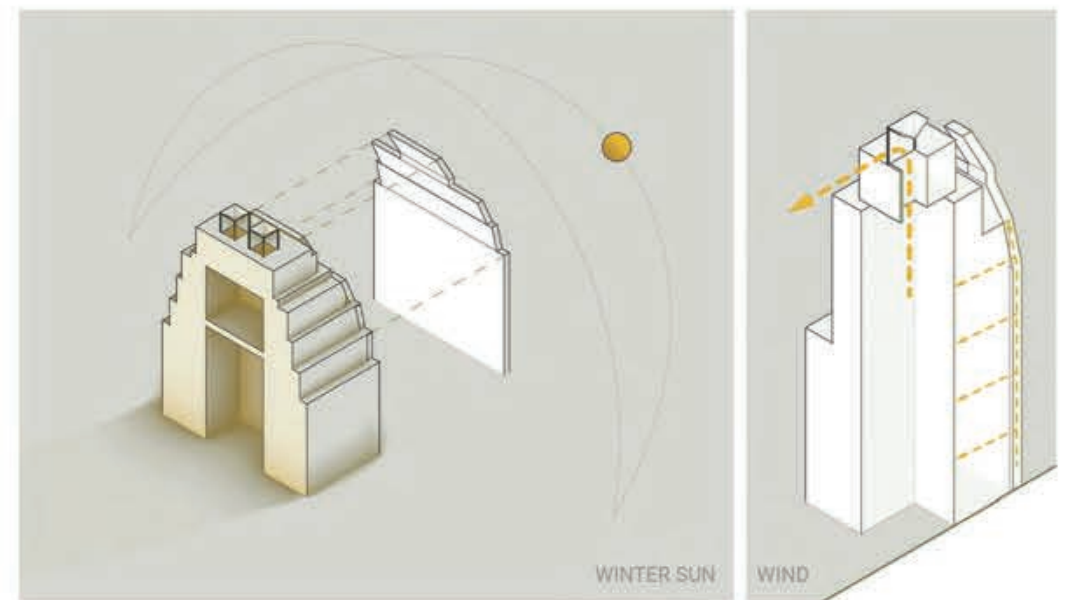
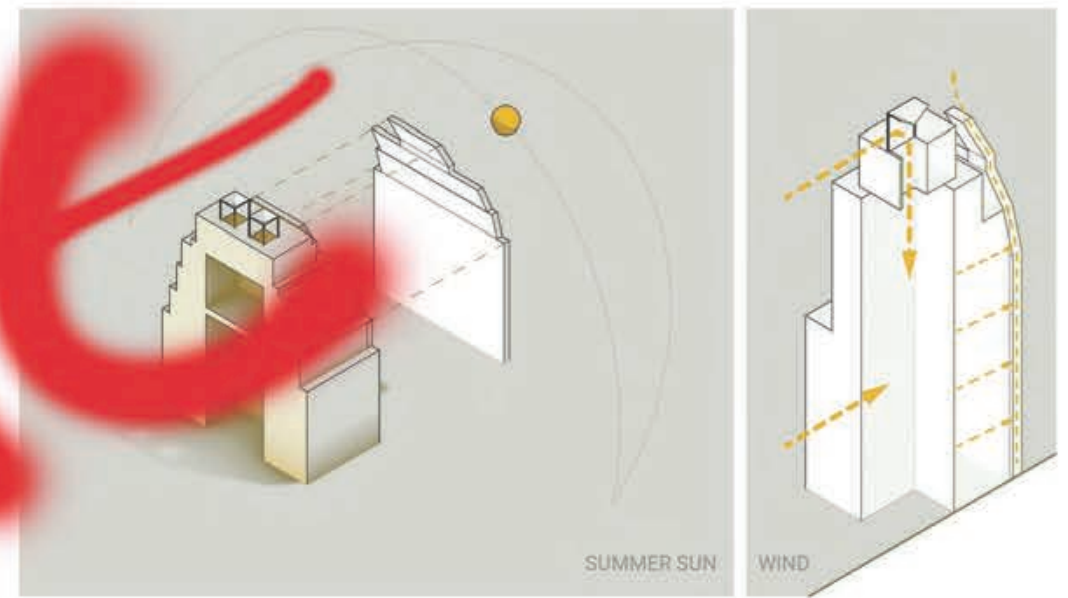
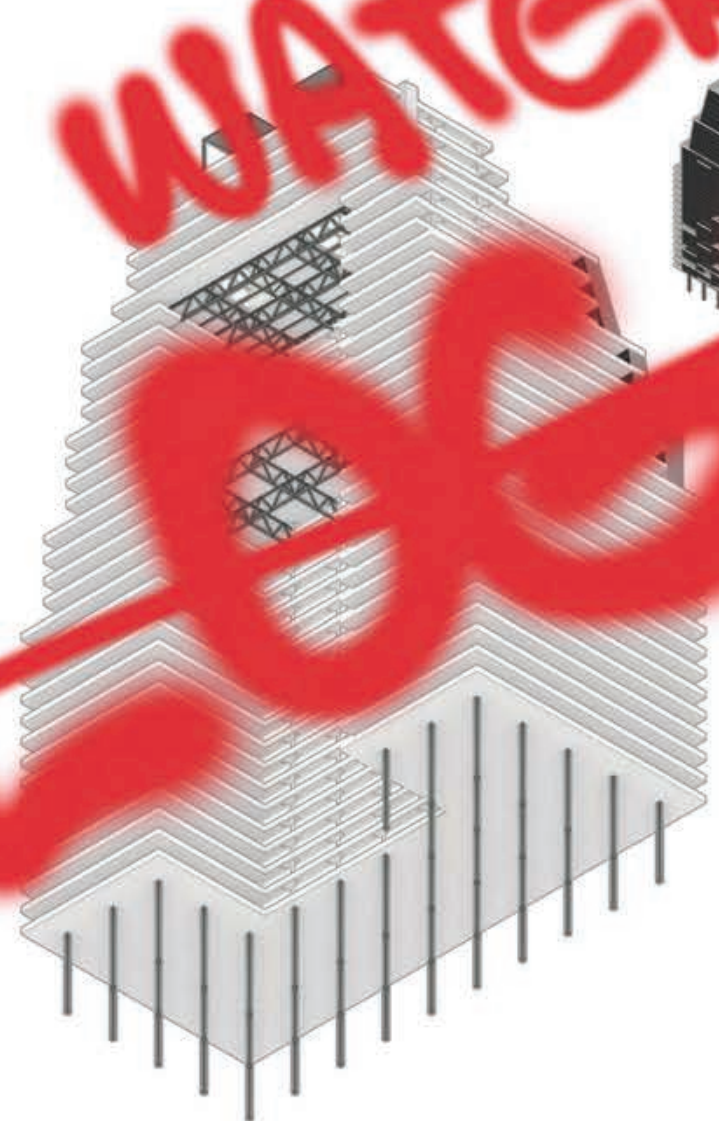
TRADITIONAL BUILDING MATERIAL



RICE HUSK (BLEND) BUILDING MATERIAL

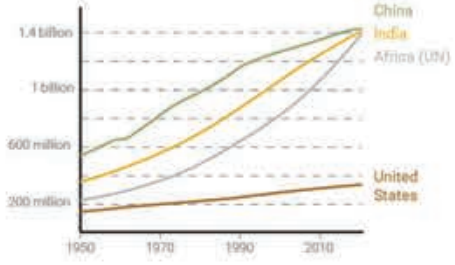


YOU GOT TO BUILD WITH WATER TO FIGHT CLIMATE CHANGE



HUSK TO HOME

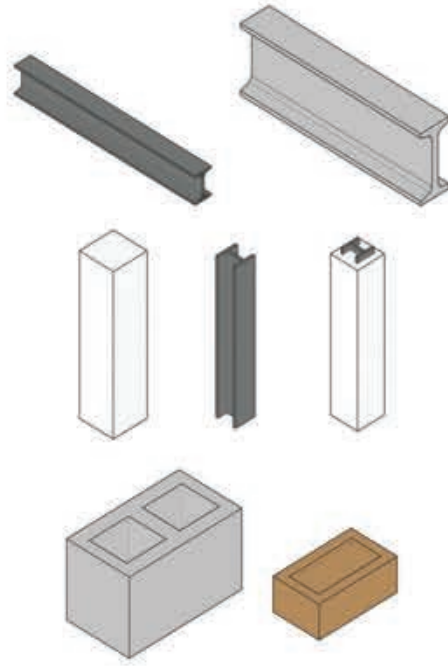
POPULATION, 1950 TO 2021



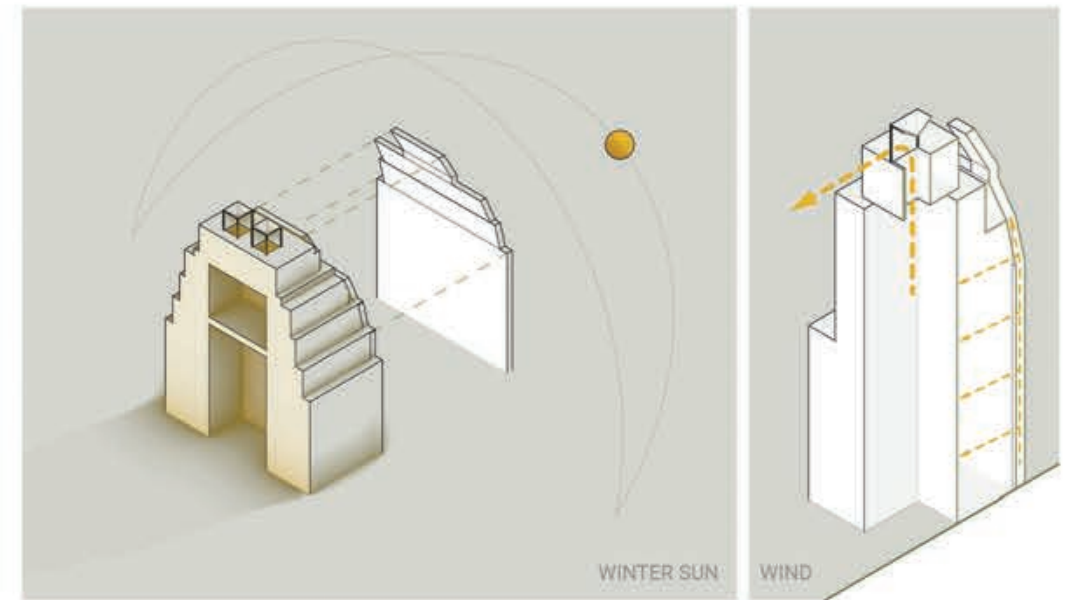
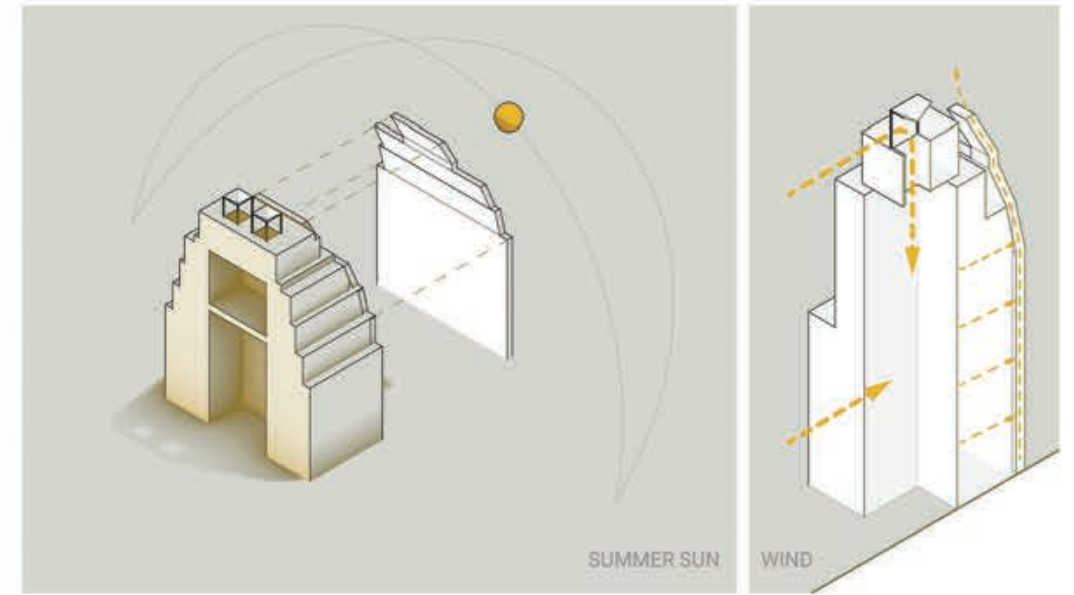
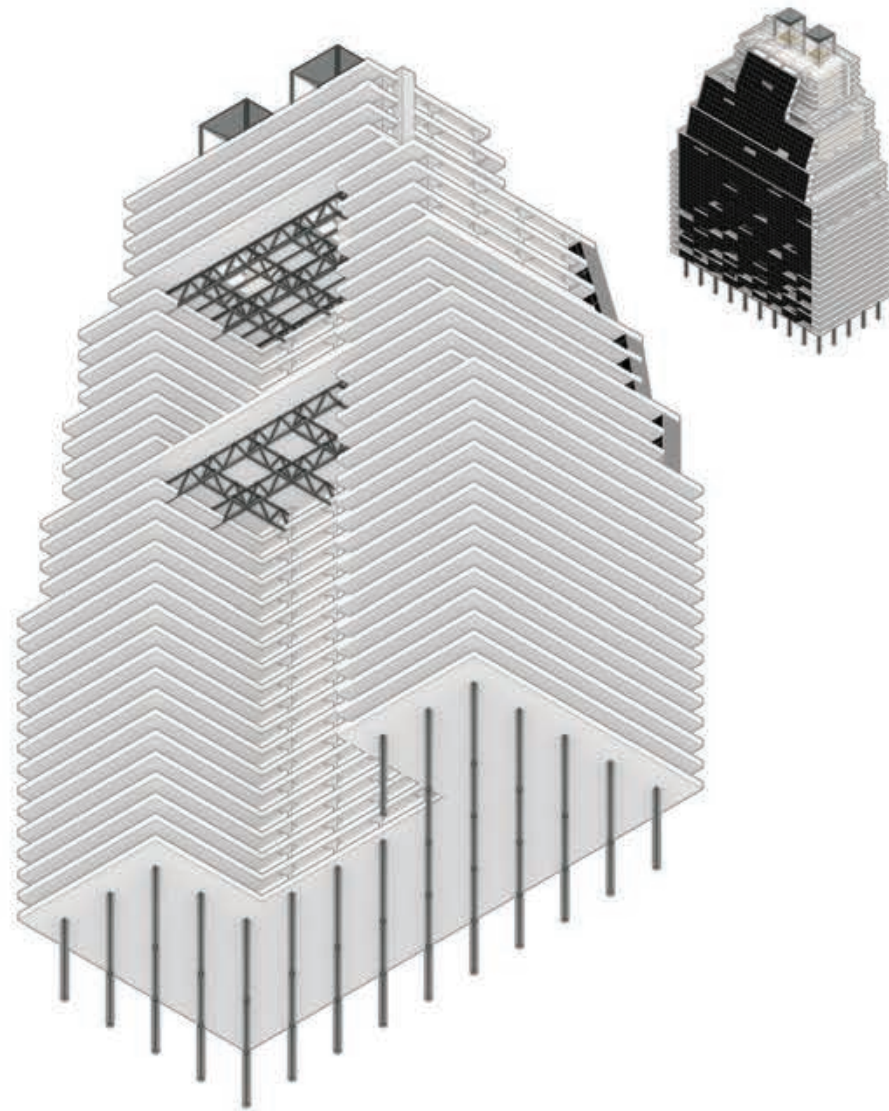
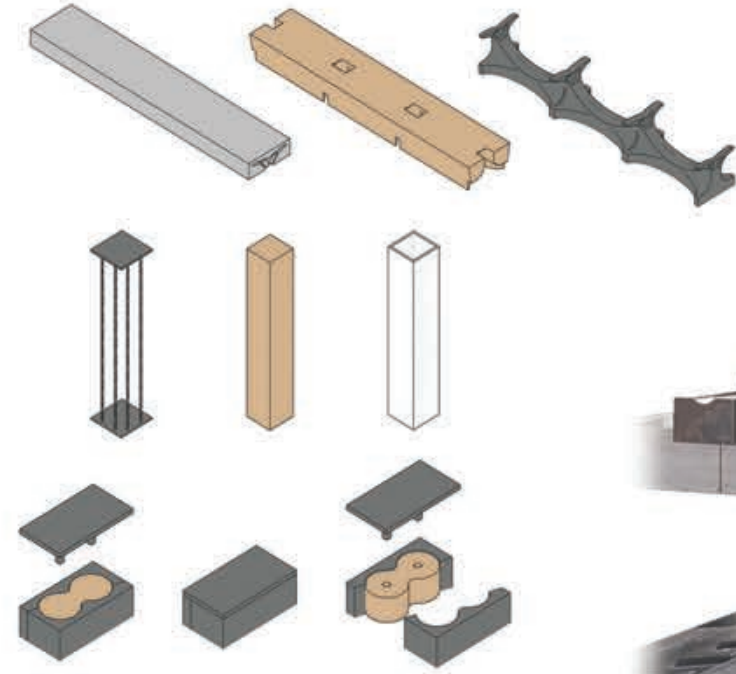
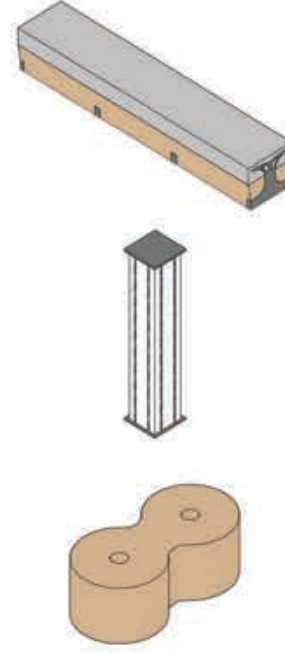
Considering the anticipated population growth in regions like China, India, and Africa, and the inevitable construction of new cities to meet housing demands, humanity faces a challenge: current resource statistics suggest the need to reduce carbon-intensive construction instead of building more. What if we could fundamentally change the elements of carbon-sequestering building materials? Cities built with these materials could function as carbon sinks, effectively contributing to combat this climate crisis!



TRADITIONAL BUILDING MATERIAL

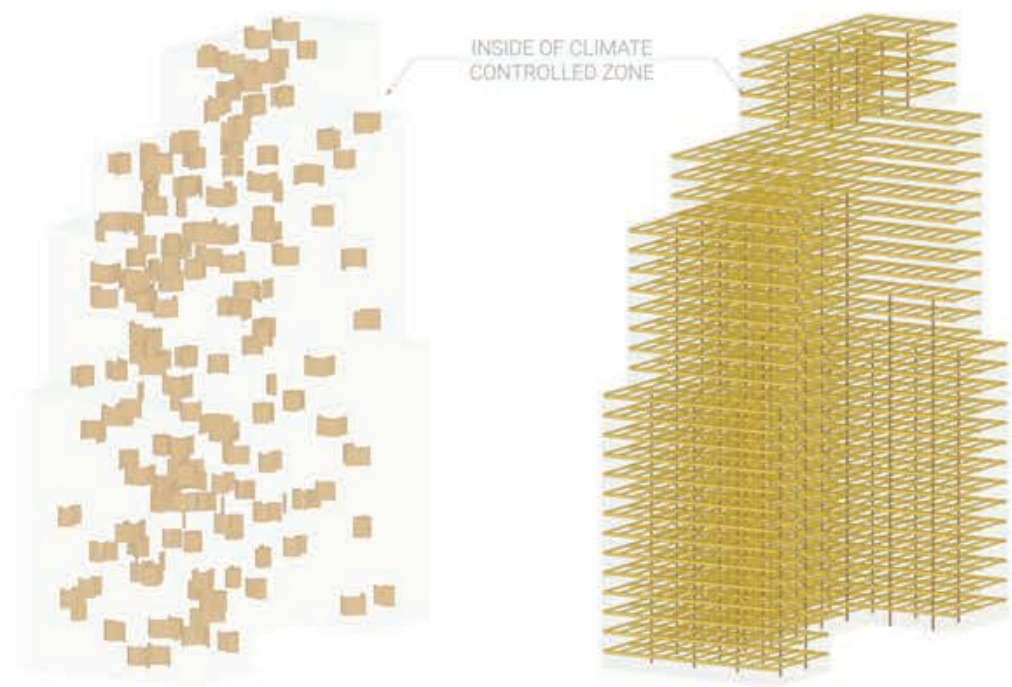


RICE HUSK (BLEND) BUILDING MATERIAL



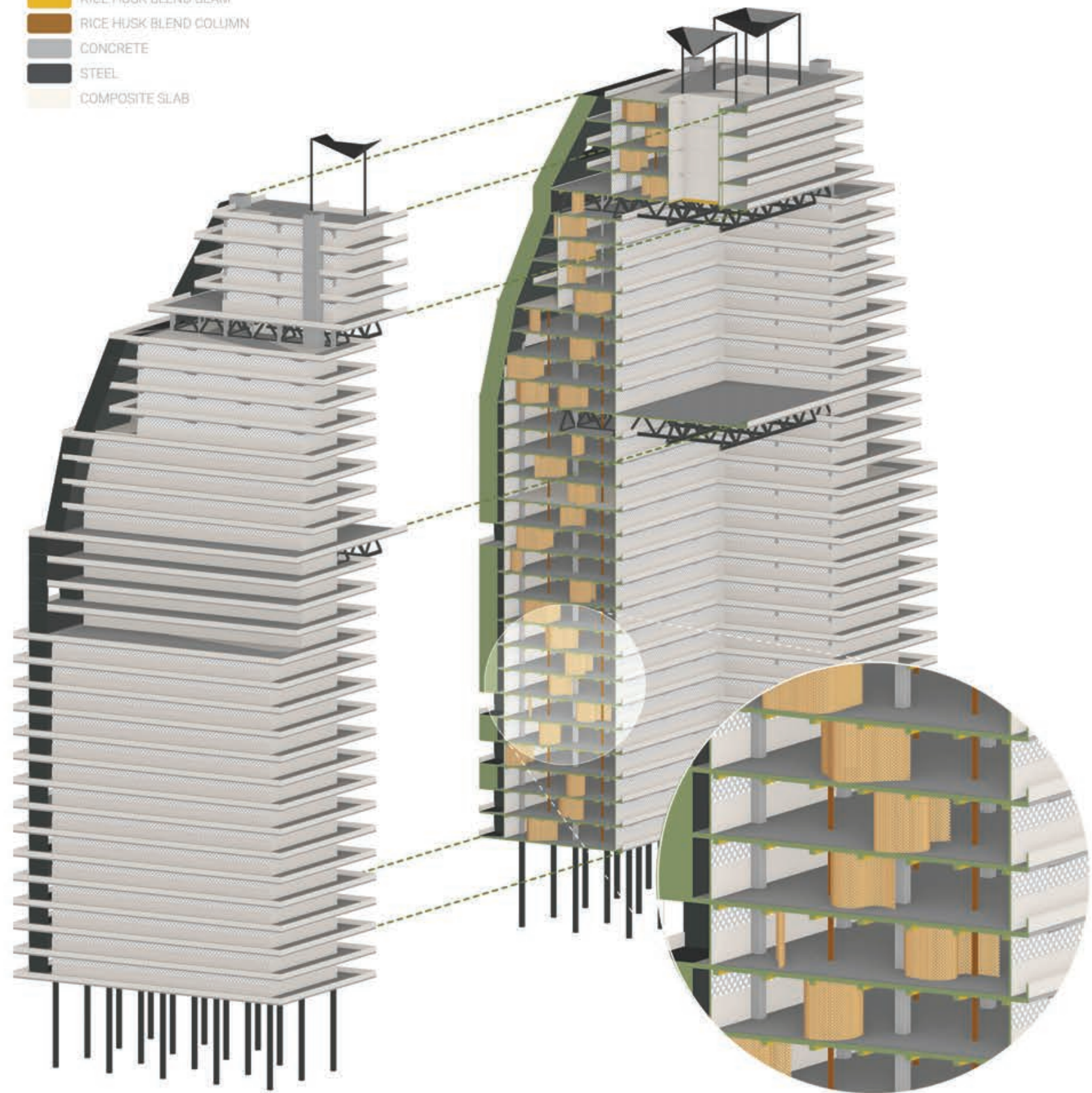
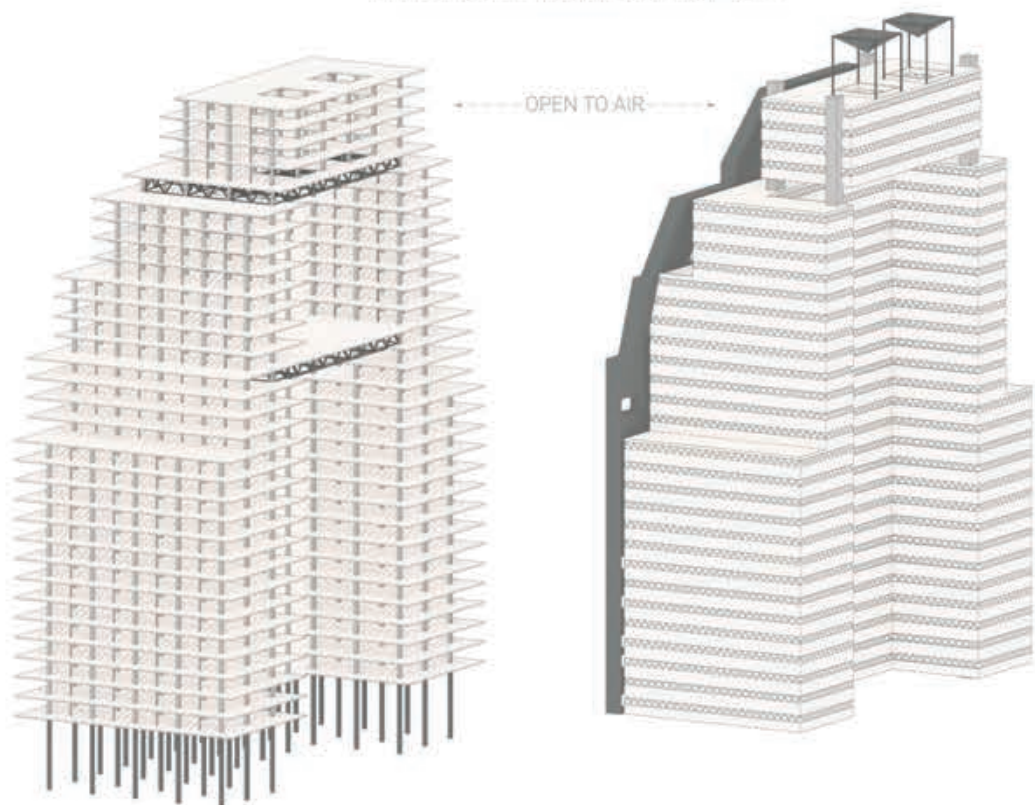
HUSK TO HOME

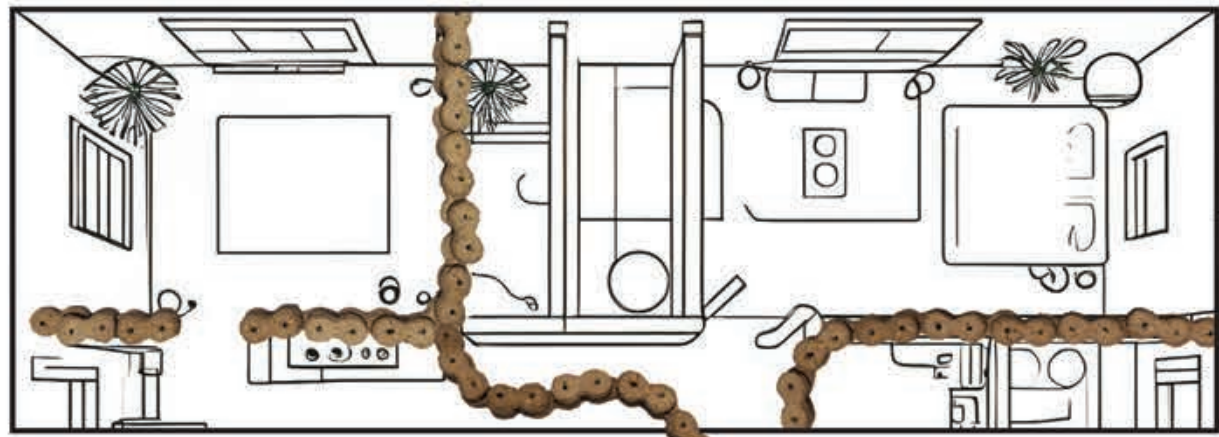
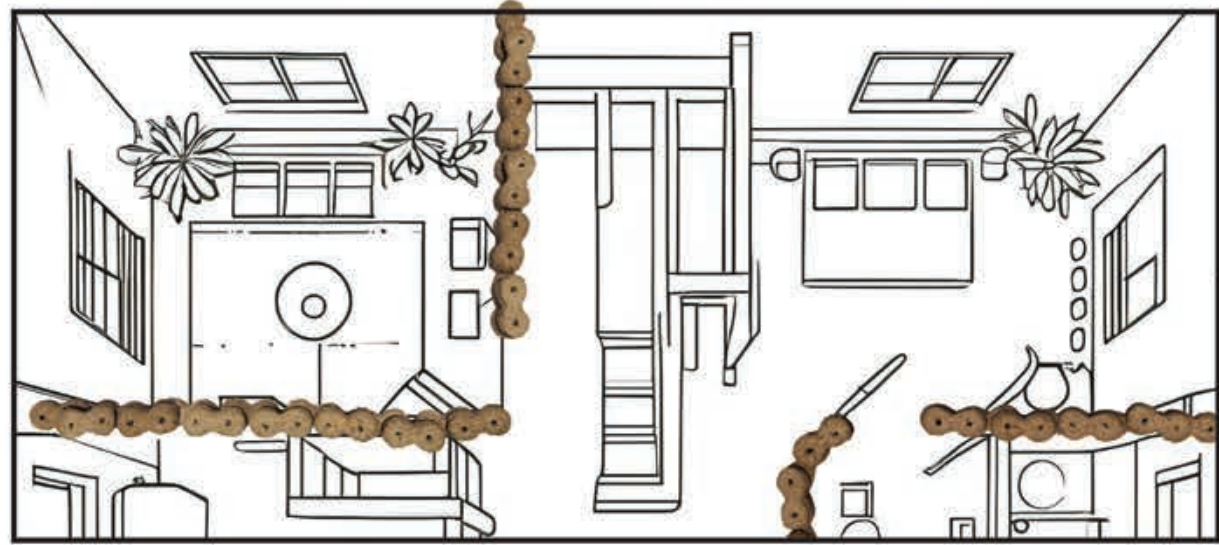
RICE HUSK (BLEND) BUILDING MATERIAL



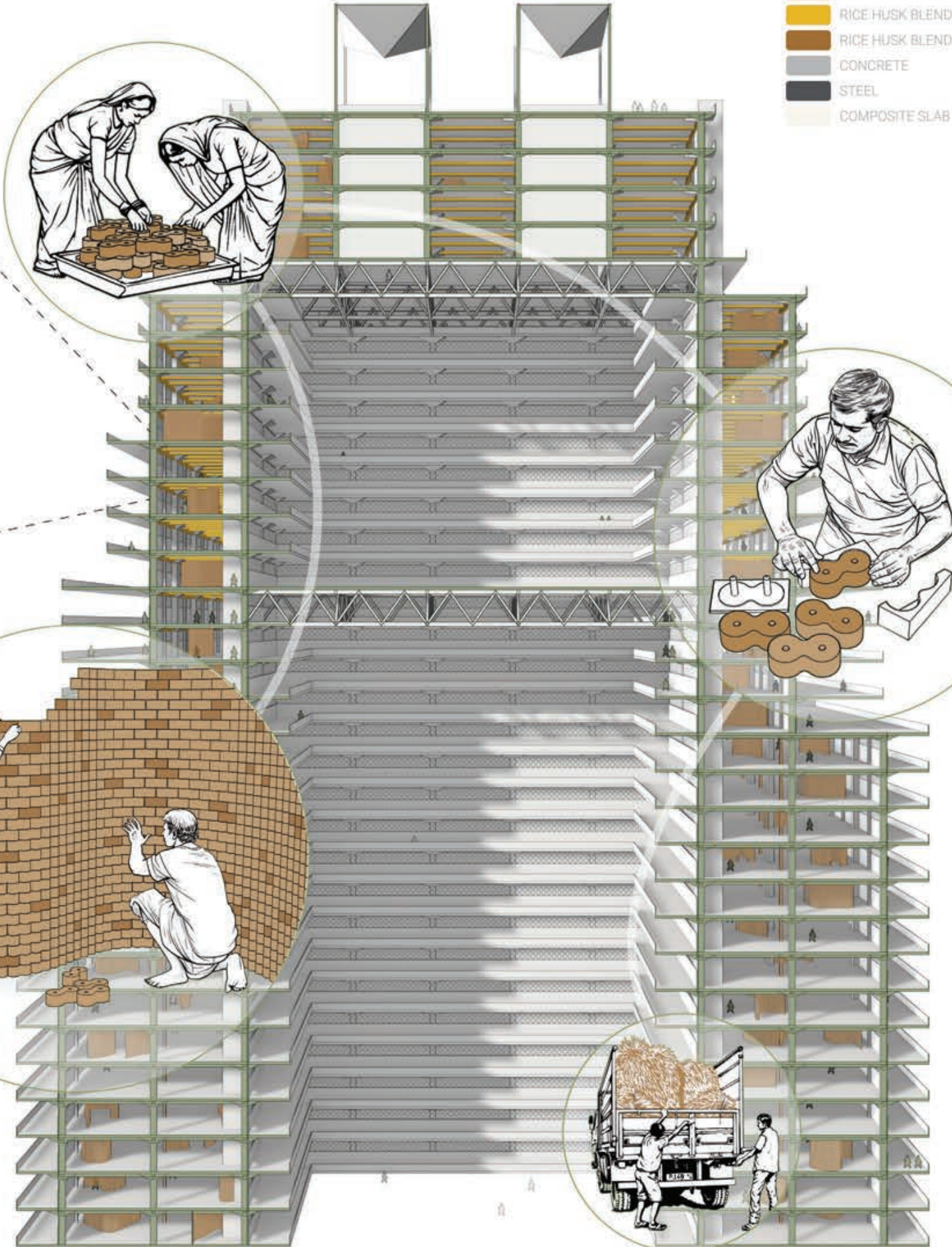
- RICE HUSK BRICK
- RICE HUSK BLEND BEAM
- RICE HUSK BLEND COLUMN
- CONCRETE
- STEEL
- COMPOSITE SLAB

TRADITIONAL BUILDING MATERIAL





- RICE HUSK BRICK
- RICE HUSK BLEND BEAM
- RICE HUSK BLEND COLUMN
- CONCRETE
- STEEL
- COMPOSITE SLAB



HAN OAK, KOREAN TRADITIONAL ARCHITECTURE

"Han Oak, Korean Traditional Architecture" embarks on a meticulous exploration of Korean heritage through the architectural lens, forming an integral component of the Architectural Drawing and Representation coursework sequence. This academic endeavor utilizes technical drawing and model-building as pivotal mediums, facilitating a profound understanding and appreciation of historical architecture.

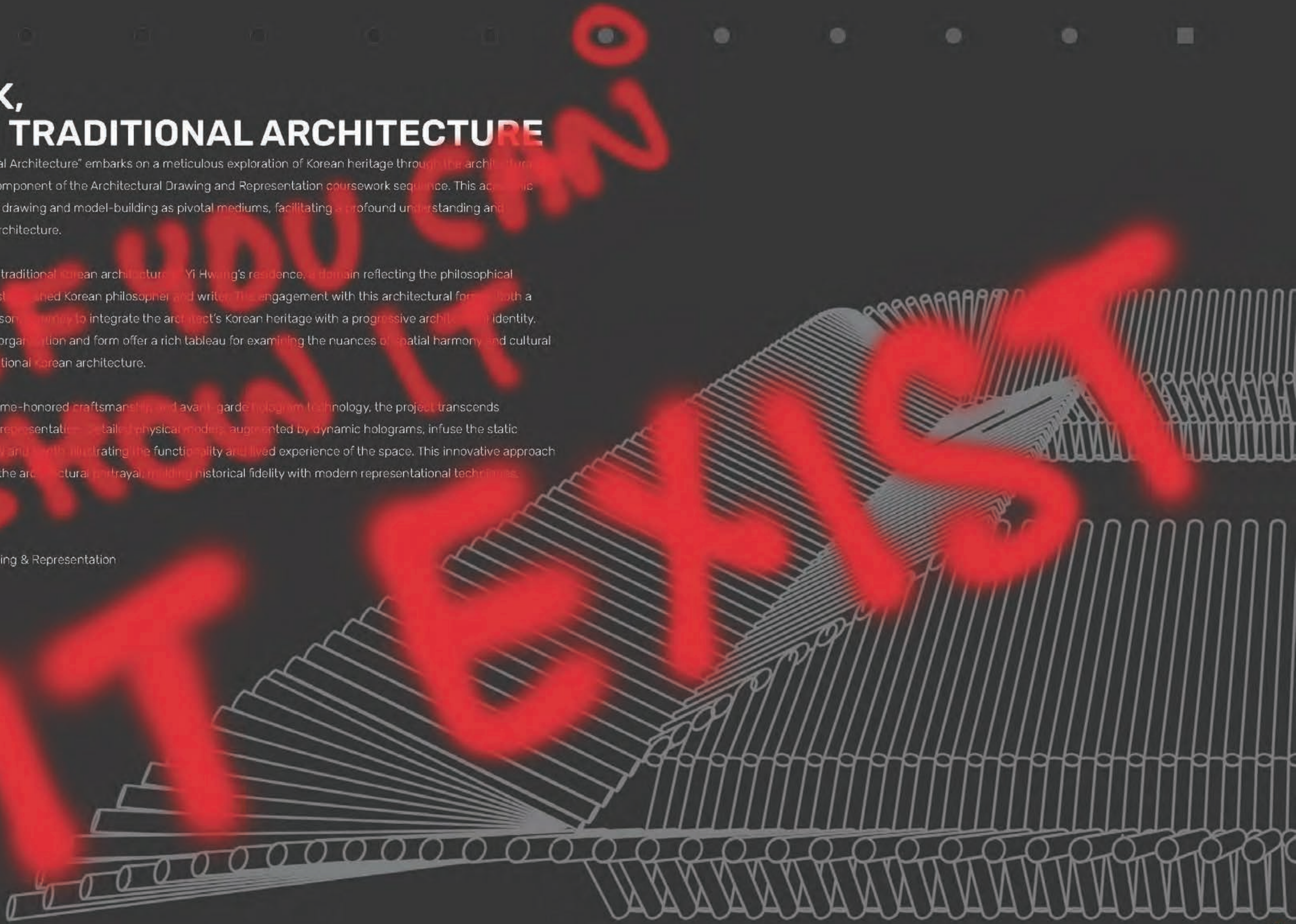
The project centers on the traditional Korean architecture of Yi Hwang's residence, a domain reflecting the philosophical depth of its occupant, a distinguished Korean philosopher and writer. The engagement with this architectural form is both a scholarly pursuit and a personal journey to integrate the architect's Korean heritage with a progressive architectural identity. The structure's distinctive organization and form offer a rich tableau for examining the nuances of spatial harmony and cultural resonance inherent in traditional Korean architecture.

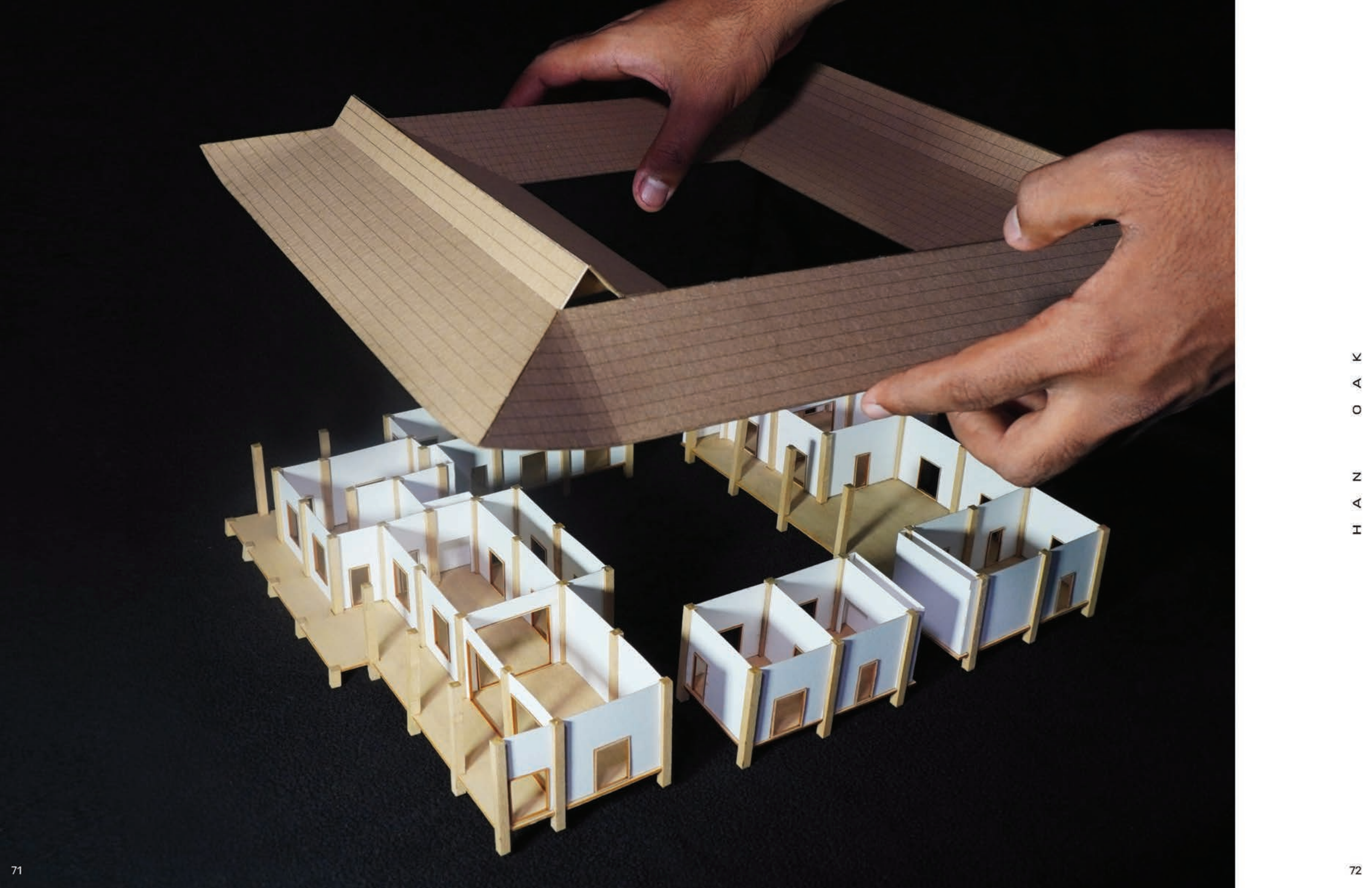
Employing a synthesis of time-honored craftsmanship and avant-garde hologram technology, the project transcends conventional architectural representation. Detailed physical models, augmented by dynamic holograms, infuse the static representations with vitality and depth, illustrating the functionality and lived experience of the space. This innovative approach enhances the precision of the architectural portrayal, melding historical fidelity with modern representational techniques.

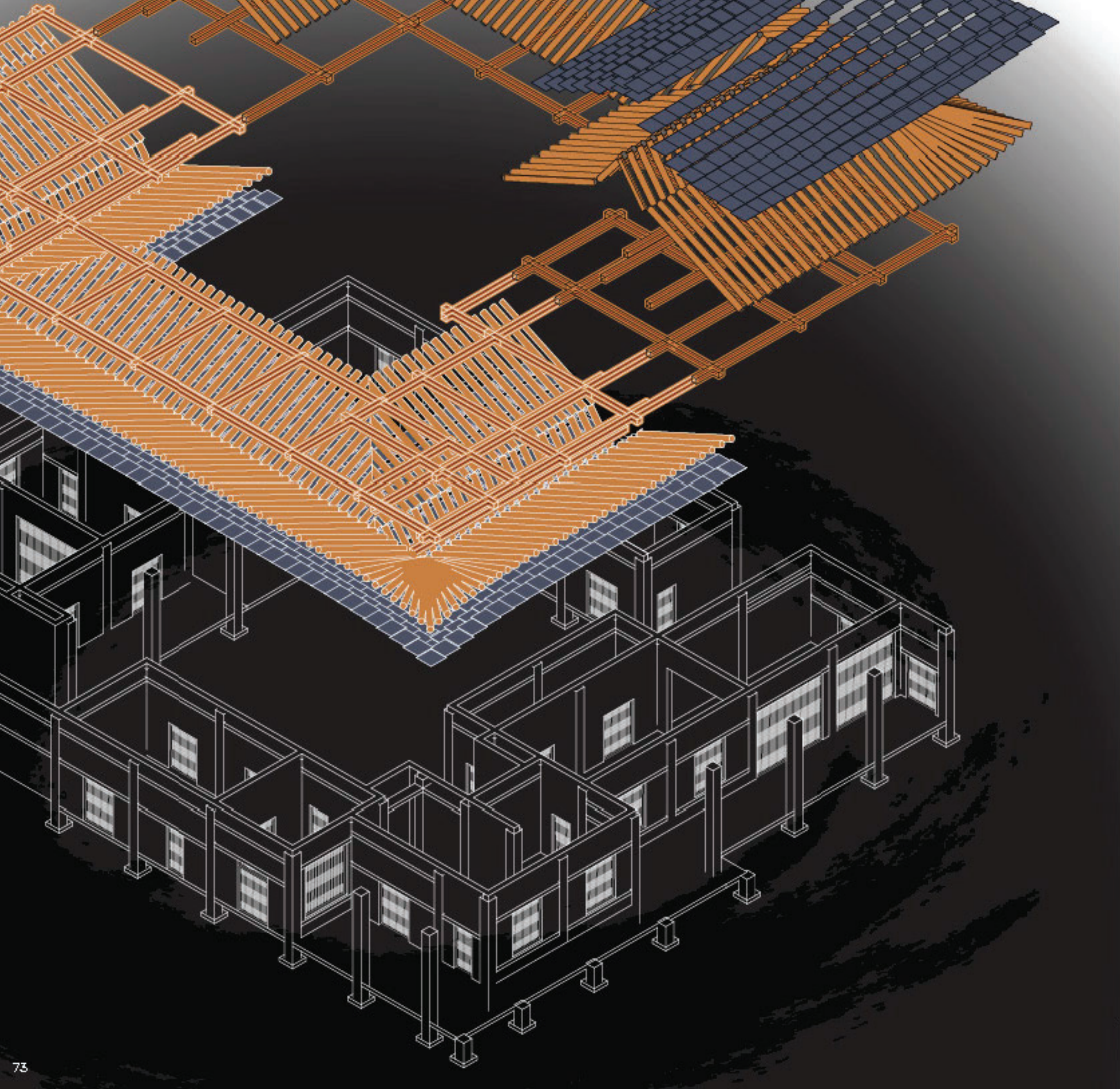
Semester: Fall 2021

Course: Architectural Drawing & Representation

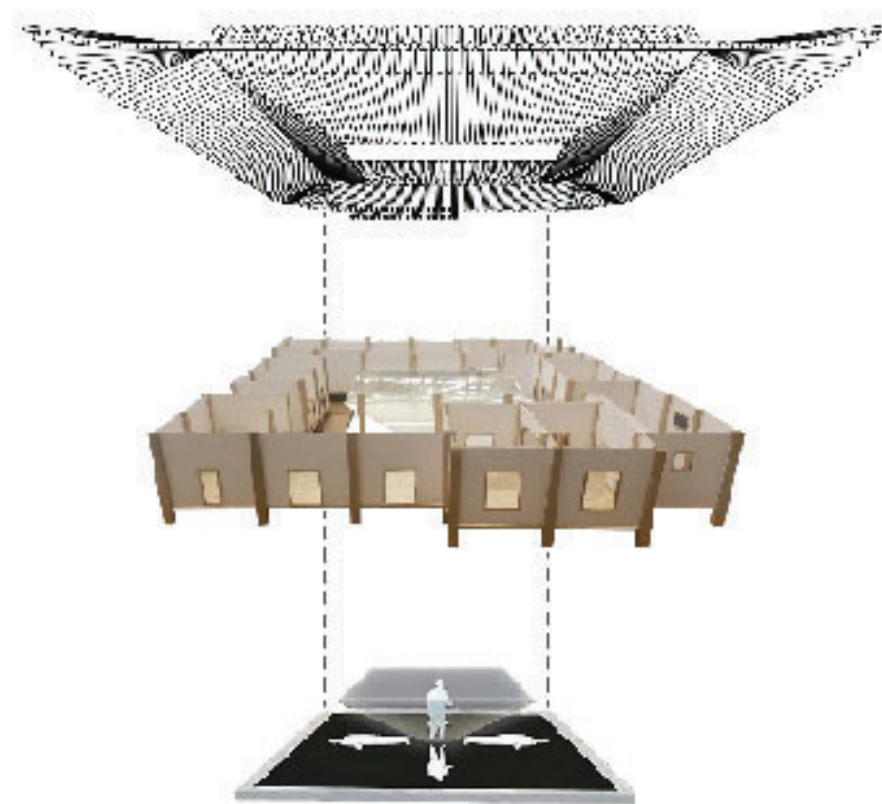
Advisor: Josh Uhl







HOLOGRAM SETUP





SUMMER SUN



WINTER SUN



MOON LIGHT



H A N O A K

SPATIAL DATA NARRATIVE: NERO ARCHITECTURE

In the exploration of neuroarchitecture, the intricacies of human cognition and environment are intertwined, creating a rich tapestry of understanding. This journey is deeply influenced by a compelling personal narrative shaped by dyslexia. This condition fosters a unique sensitivity to spatial and sensory details, enabling a profoundly intuitive engagement with architectural spaces.

The journey into neuroarchitecture was initiated by the seminal "Building Sense" seminar, facilitated by [Name] and Leah Kelly in spring 2024. Originally an engineering student, the seminar's focus on human spatial cognition resonated deeply, igniting a passion that seamlessly aligned with both academic pursuits and professional aspirations. A pivotal experience catalyzed a transition from engineering to architecture, marked by a deeper integration of interdisciplinary perspectives at GSAPP.

Navigating the complexities of this transition, the commitment to this new path has remained steadfast. Engaging in extensive projects, self-directed studies, and even procuring specialized equipment for independent research have been integral to this journey. The ultimate ambition is the pursuit of a PhD, aiming to synthesize architectural theory and practical design methodologies—a fusion that carries an engineering foundation with architectural innovation.

Through this academic and professional evolution, neuroarchitecture emerges not only as a field of study but as a profound medium for exploring the interaction between human cognitive processes and the built environment, paving forward a practice that is as theoretically rich as it is grounded in real-world application.

Semester: Spring 2024

Course: Visual Studies

Advisor: Josh Begley

I THOUGHT THIS WAS
WHAT I WILL LEARN
IN ARCHITECTURE SCHOOL

I CARE FOR THIS TOPIC SO
MUCH ENOUGH THAT I'LL
PURSUE THIS FORWARD
MY OWN

ACCIDENTALLY POLEMIC

Neuro Architecture

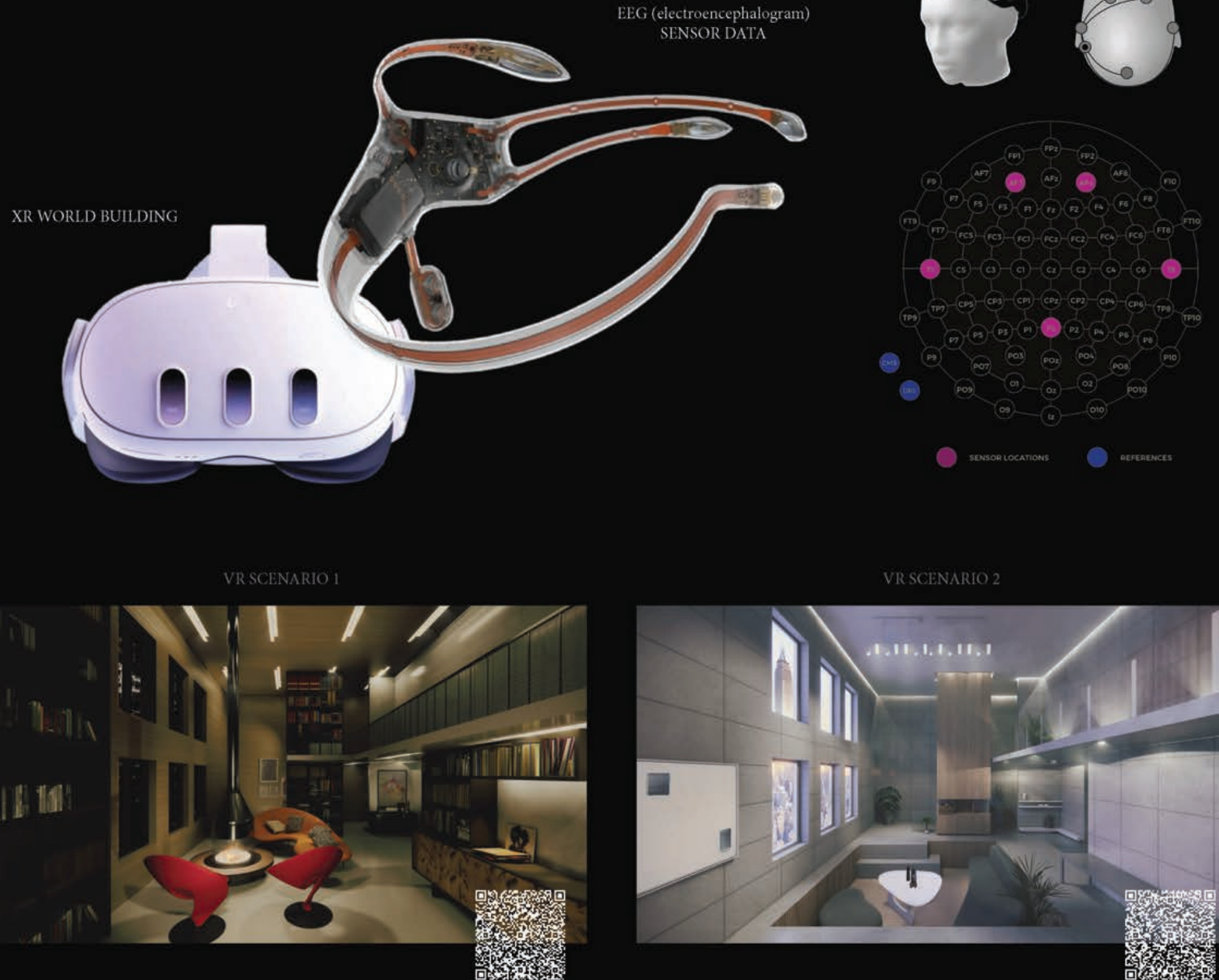
Quantifying Emotional Responses to Built Environments Using Advanced Technology

Abstract

The field of neuroarchitecture, emerging from recent advancements in neuroscience and technologies such as brain measurement tools, AI, and Extended Reality (XR), offers unprecedented opportunities to explore the interplay between architectural environments and human emotions. This research proposal seeks to investigate how spatial designs influence emotional responses by employing an interdisciplinary approach that merges the latest technology with neuroarchitecture studies. At the core of this study is the use of electroencephalogram (EEG) technology to measure emotional reactions to built environments, referred to as the “metabolizing” of space. The project proposes traveling to locations characterized by extreme sensorial designs to elicit pronounced emotional responses, which will be quantitatively analyzed to assess the emotional quality of these spaces. With the data gathered, we aim to reconstruct these environments within an XR setting, supported by AI, to further study human-environment interactions under controlled conditions. This innovative approach not only seeks to quantify the emotional impact of architectural spaces but also to validate the role of neuroarchitecture in enhancing our understanding of spatial quality. By integrating methodologies from architecture, neuroscience, and technology, this research endeavors to produce an initial framework that informs future studies in neuroarchitecture and enhances our understanding of emotional interactions between humans and the built environment through the quantification of the emotional qualities of spaces.

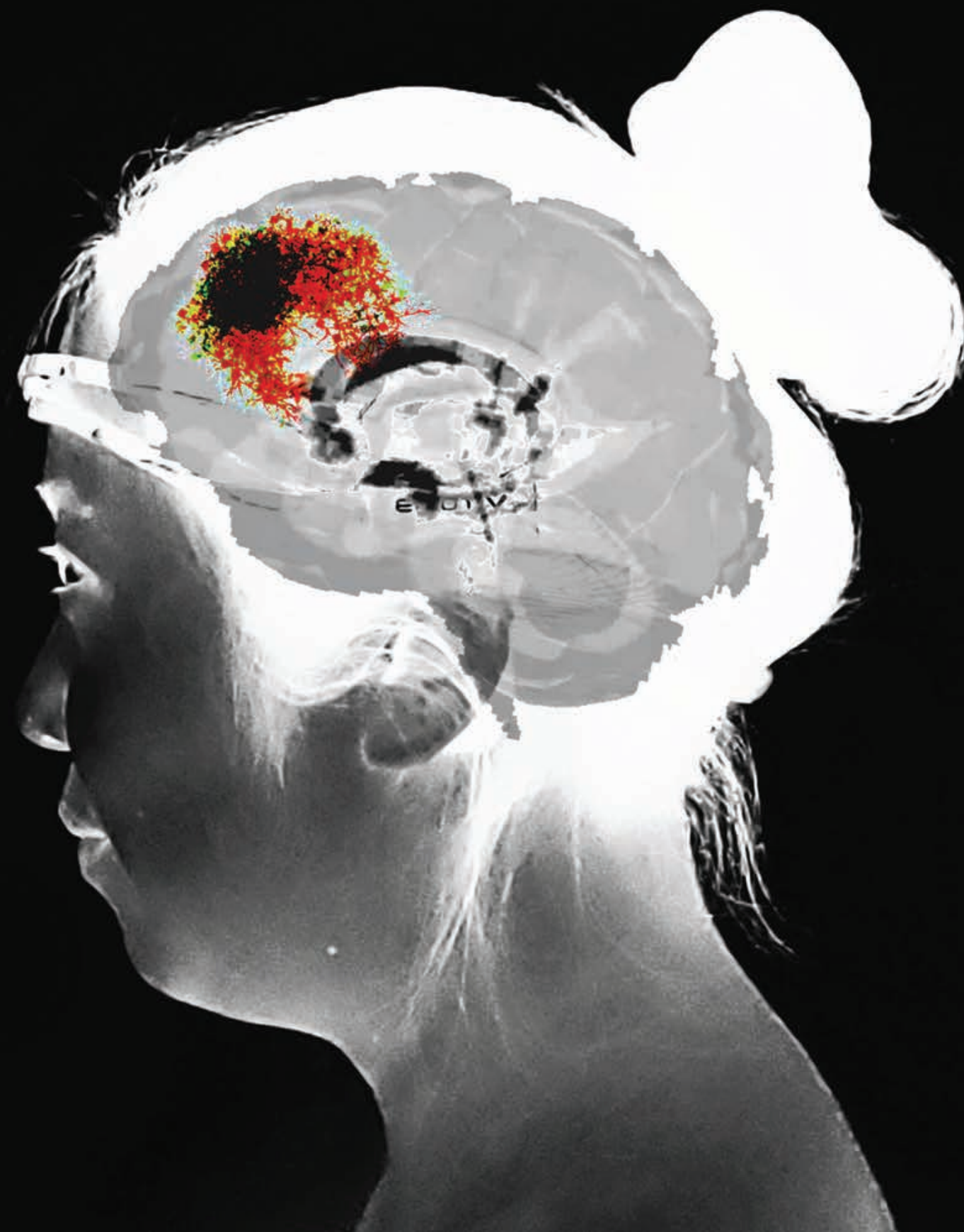
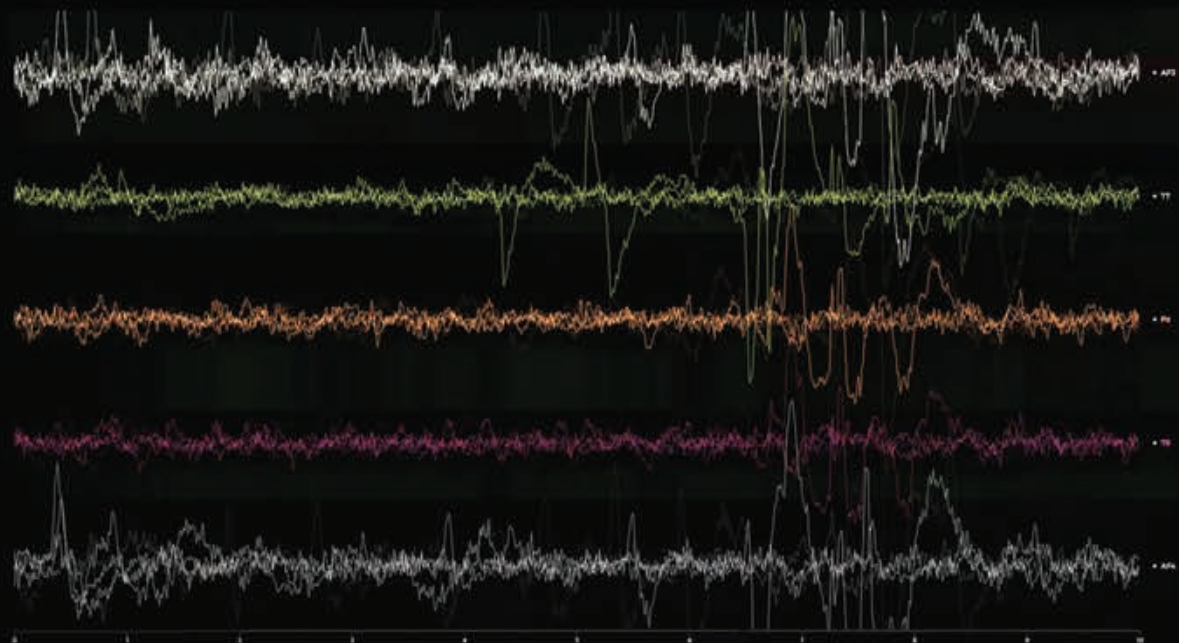
Keywords

Neuroarchitecture, Spatial Research, Emotional Responses, Spatial Design, EEG Technology, Built Environment, Sensory Design, Extended Reality (XR), Virtual Reality (VR), Human-Environment Interaction,



City spiders are larger, urban rivers salmon are smaller, city earthworms are more tolerant to metals... If such human-mediated ecosystem changes lead to rapid change in the course of the evolution of other species' behavior and anatomy is critical in order to make the urban ecosystem favorable to our well-being. (11, Proulx et al.)

Proulx, M. J., Todorov, O. S., Aiken, A. T., & de Sousa, A. A. (2015). Where am I? Who am I? The Relation Between Spatial Cognition, Social Cognition and Individual Differences in the Built Environment. *Frontiers in Psychology*, 7.



CORE 1

HALFWAY HOUSE

CORE 2

ADOPTIVE SCHOOL

CORE 3

WATER-RISE MANHATTAN HOUSING, APPENDIX

ADV. 4

THE BATH HOUSE: RECLAIMING ASHOKAN

ADV. 5

GREEN REVIVAL: KINGSBRIDGE ARMORY'S URBAN FARMING TRANSFORMATION

ADV. 6

HUSK TO HOME: BIOMASS TO CARBON-SEQUESTRATION CITY

ADR

HAN OAK, KOREAN TRADITIONAL ARCHITECTURE

VISUAL STUDIES

NERO ARCHITECTURE: SPATIAL DATA NARRATIVE

SCHOLARSHIP

NATURAL MATERIAL LAB

MEMBERSHIP & LEADERSHIP

AIAS

PARTNERSHIP

COMPETITIONS

OWNERSHIP

TITAVIO

Semester: Summer 2023 - Summer 2024

Role: Research

Advisor: Lola Ben-Alon

NATURAL
MATERIALS
LAB

HA! THIS
IS WHAT ACADEMIA

SCHOLARSHIP

I LOVE IT



ACCIDENTALLY POLEMIC



Developing 3D-Printed Natural Fiber-Rich Earth Materials in Construction

EunJin Shin¹, Olga Beatrice Carcassi^{1*}, Yierfan Maierdan², Shiho Kawashima² and Lola Ben-Alon¹

¹ Graduate School of Architecture, Planning and Preservation, Columbia University, New York, NY, 10027

² Civil Engineering and Engineering Mechanics, Columbia University, New York, NY, 10027
*To whom all correspondence should be addressed: obc2101@columbia.edu

Abstract. Advanced manufacturing and 3D printing of clay- and earth-based materials have been recently emerging, but have been limited to little or no fiber reinforcement. Enriching 3D printable earthen composites with natural fiber reinforcement may improve durability, thermal resistivity, carbon storage potential, mechanical performance, and ductility. This study continues a line of research by the authors for developing printable fiber-rich earth composites for mixtures, focusing on defining mix-designs. The continued investigation shown in this paper focuses, specifically, on the mechanical performance and ductile behavior through bending tests that comply with ASTM C67. Importantly, the mechanical behavior here aims to comparatively investigate processing parameters – manual vs. machine mixing apparatuses – for the earth-fiber-additive composites, considering a range of agro waste co-products: wheat straw, hemp, banana, and kenaf fibers. The results show the benefits of employing the machine mixing technique for fiber homogenization, resulting in improved performance (with bending strength increased by 29 to 78%) for the 3D printed components.

Keywords: 3D Printing; Earth Materials; Plant Fibers; Bending Strength; Ductile Behavior; Processing Parameters

1 Introduction

In recent years, there has been a growing interest in earth-fiber assemblies as a sustainable alternative to cement-based materials for 3D printing due to their low embodied carbon, affordability, health, and range of thermal characteristics^{1,2}. Notable examples of 3D printed earth construction include experimental pavilions produced by educational institutions³, and applied installation⁴. However, existing examples often lack sufficient fundamental or scientific characterization. Mix-designs are rarely recorded, and include earth materials with little to no fiber reinforcement, leading to limited thermal conductivity and ductility potential. To overcome these limitations, research efforts by the authors have focused on developing and characterizing 3D printable earth-fiber-additive composites with maximal natural plant-based fiber

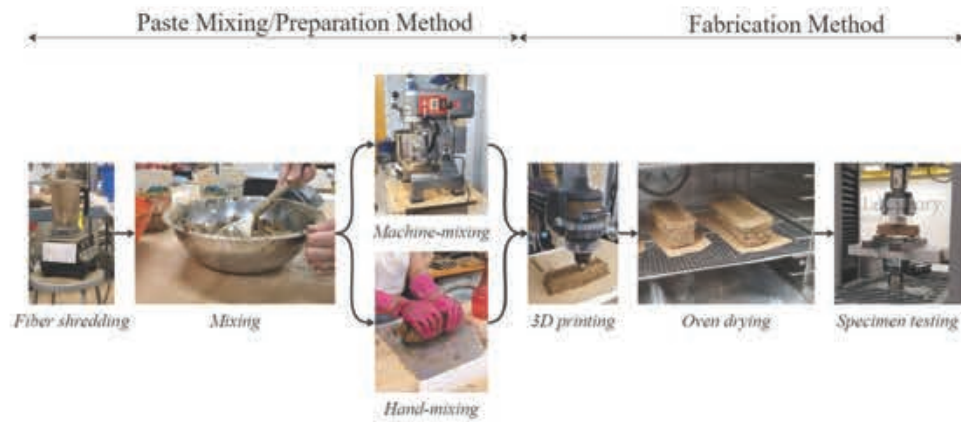


Fig. 2. Paste Mixing/Preparation Method and Fabrication Method

3D Printing. The 3D PotterBot 4 Pro (3D Potter, USA), equipped with a 6mm nozzle, was employed to evaluate the mix-design's efficacy. The specimen's geometry was a prism, measuring 40mm in height, 40mm in width, and 150mm in length (Fig. 3). Optimal printing parameters, including layer height, flow rate, and speed, were meticulously documented. The printing path was designed to alternate the extrusion direction with a 4mm layer height for enhanced structural integrity. The g-code script was generated using Rhinoceros 7 and Grasshopper (Robert McNeel & Associates, USA). After printing, the specimens were dried in a food dehydrator (NutriChef Electric Food Dehydrator Machine, USA) at 30 degrees Celsius for three days to guarantee complete drying in a controlled environment.

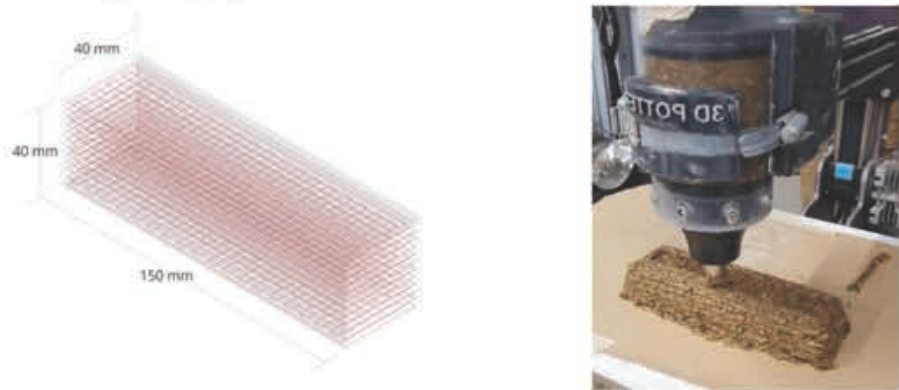


Fig. 3. Left: Printing path generation in Rhino/Grasshopper. Right: specimen printing session.

Bending Strength Analysis. To obtain the bending test results, the average of three specimens per mix design values was recorded by using the MTS Criterion 7k Universal Testing Machine controlled by a computer with 30 kN loading. The bending strength was assessed according to ASTM C67/C67M by applying a loading rate of 0.5 mm/min until failure. The specimens were parallelepiped with a squared base of 40x40

Clay	D2	111	388	36	53	150
	D3	115	484	34	46	152
Light Kenaf Clay	C1	113	590	30	42	152
	C2	129	591	32	44	155
	C3	107	466	31	49	151

3.2 Bending Strength Results

The results, summarized in Fig. 4, show the bending strength for the examined composites. The manual-mixed samples exhibited a significantly lower bending strength, ranging across an average of 1.78 MPa for straw, 2.47 MPa for hemp, 3.09 MPa for banana, and 3.57 for kenaf. The bending strength values of the machine-mixed mixtures are characterized by higher average values, namely 2.64 MPa for straw, 4.39 MPa for hemp, 3.98 MPa for banana, and 5.69 MPa for kenaf. The results therefore show a 29-78% improvement in bending strength for machine-mixed vs. manually-mixed preparation methods for the final printed elements. This improvement highlights the significance in the introduction of a controlled method of stir together the mix-design components in order to fully utilize the potential of fiber orientation in 3D-printed elements. These results are presumed to be related to the homogeneity of the mix design, as well as the mechanical and microstructural integration of the fibers with the paste.

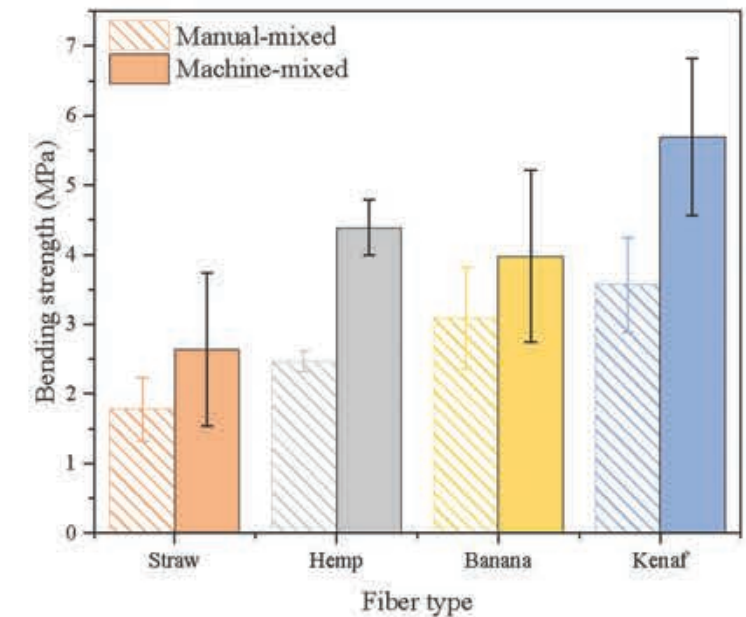
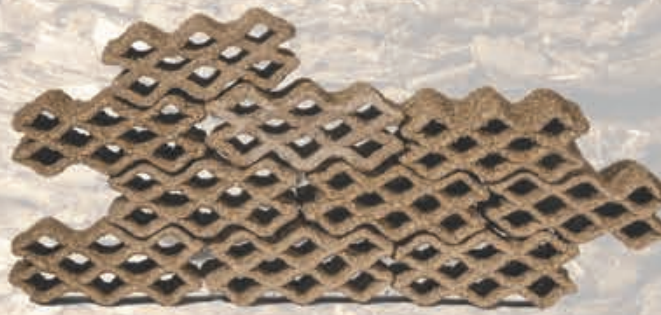


Fig. 5. Bending strength results of the 3D printed earth-fiber composites with manual-mixed vs. machine mixed methods. Error bars indicate the standard deviation.



VERTICAL STACKING



HOIZONTAL STACKING



LATERAL STACKING



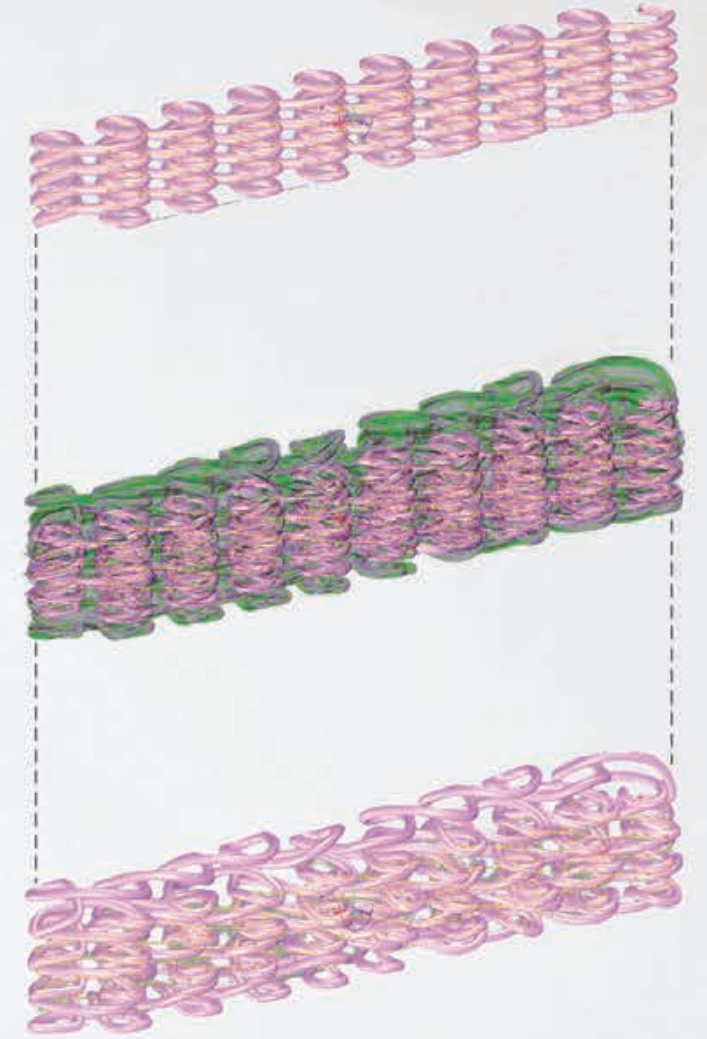
LIGHT STRAW CLAY



LIGHT COB

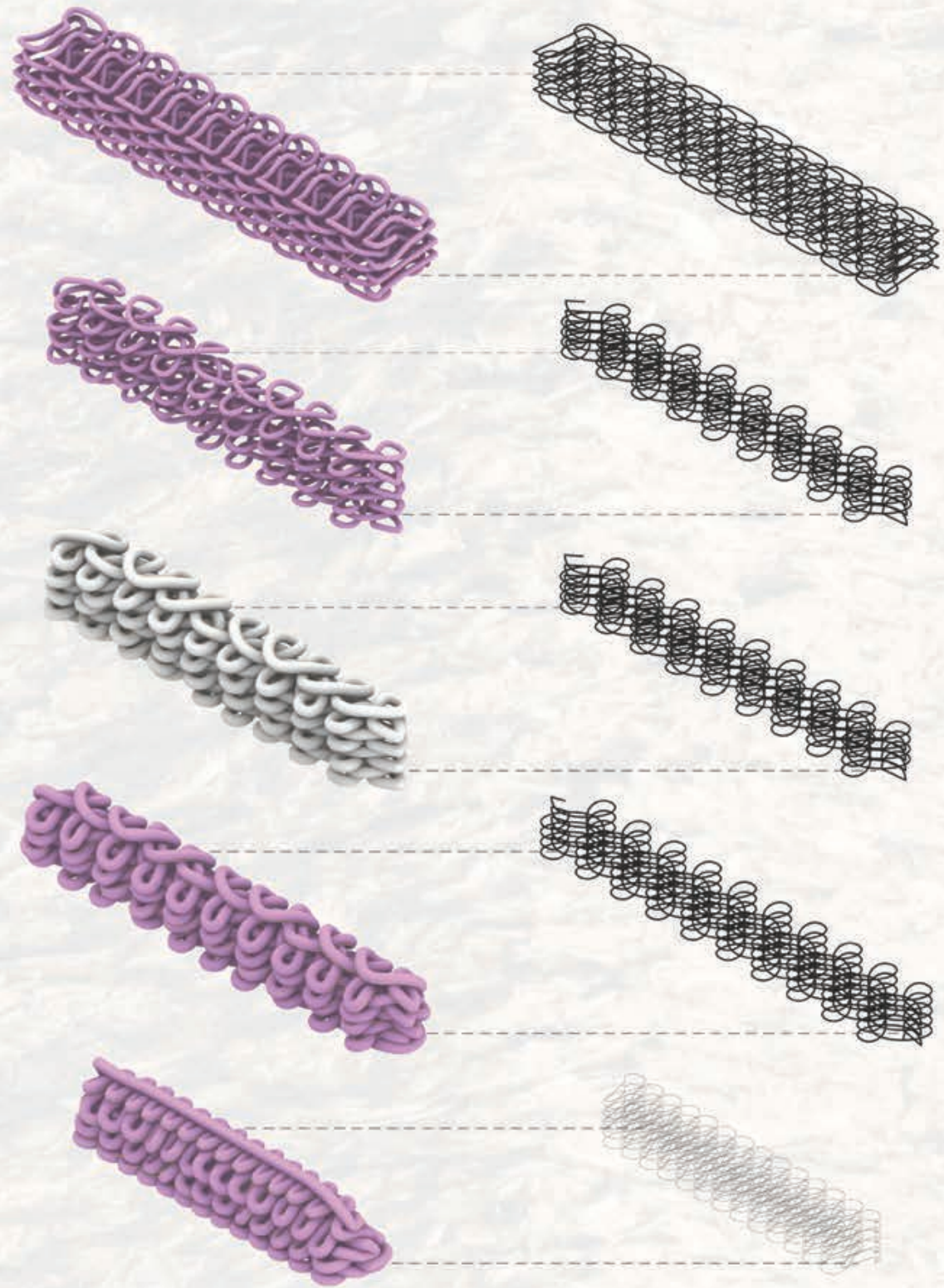


COB

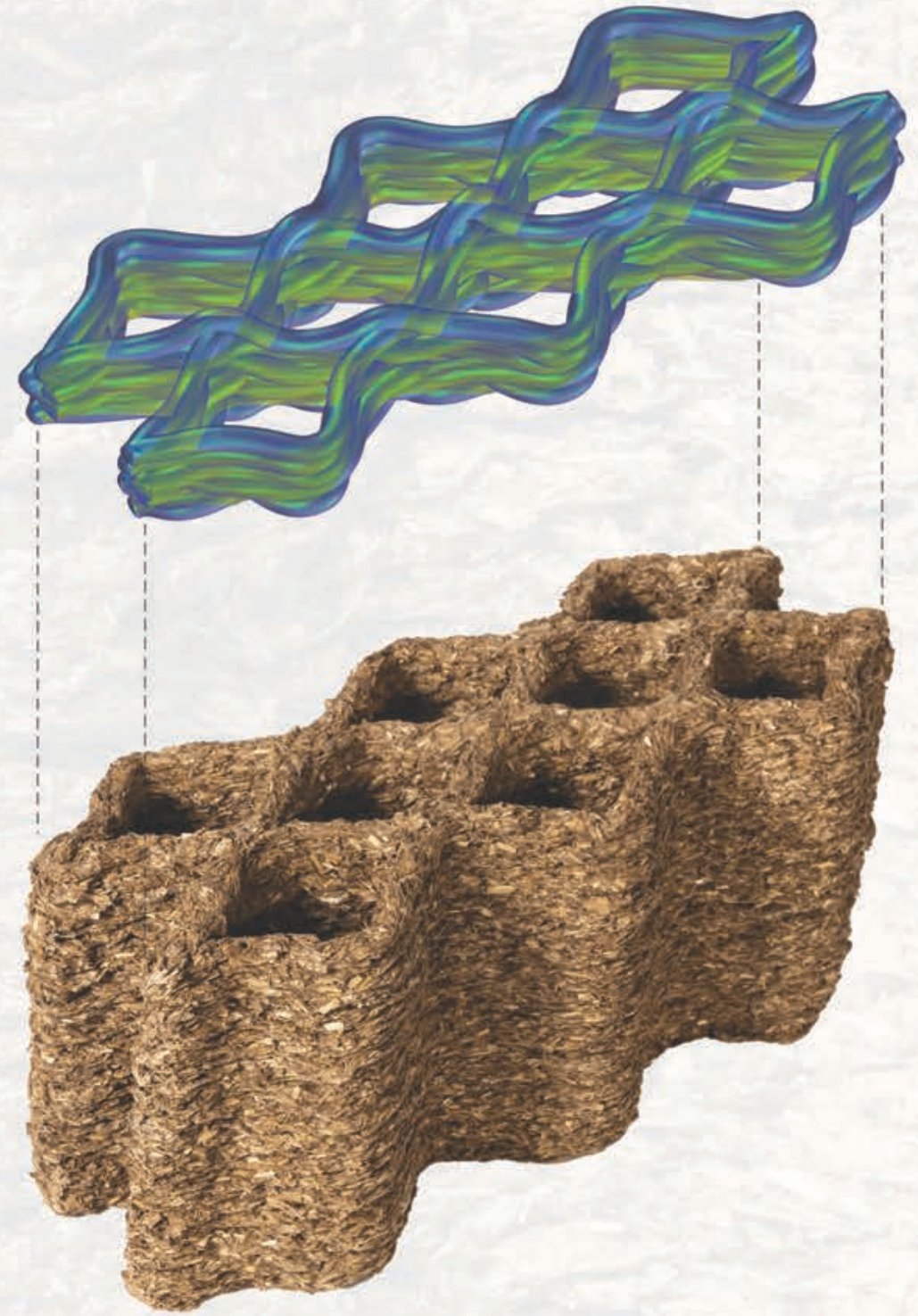


GRAVITY SIMULATING ANALYSIS





GRAVITY SIMULATOR



MATERIAL 3D PRINTING FORCASTING

Semester: Fall 2021 - Spring 2024

Role: Founder, President (Fall 2023 - Spring 2024)

Advisor: Galia Solomonoff

FOUNDER OF AIAS TO PRESIDENT



AIAS

COLUMBIA
UNIVERSITY

MEMBERSHIP & LEADERSHIP

REVISED



AIAS
COLUMBIA
UNIVERSITY

Harvard **XR2024** XRxAI
Extended Intelligence

A I A S

COMPETITION #1

Title: 5 World Trade Center Competition

Typology: NYC Housing

Category: Conceptual

Teammates: E.J. Shin (Served as Designer), Omer Gorashi

"it's really hard to win the competition" DISCOURAGING

COMPETITION #2

Title: Harvard & the Legacy of Slavery Memorial Project

Typology: Memorial

Category: RFQ

Teammates: E.J. Shin (Served as Project Coordinator), Mikhail Kossir, Mariam Jacobs, Omer Gorashi

COMPETITION #3

Title: Tartu Downtown Cultural Centre Architecture Competition

Typology: Cultural Center

Category: RFP

Teammates: E.J. Shin (Served as Design Lead), Mikk Pärdi (NEED arhitektid), Omer Gorashi, Mikhail Kossir, Anna Kim, Will Cao, Sherry Te, Jared Antonio, Val Flanon, Enrique B...

COMPETITION #4

Title: The City of New York Pedestrian Protection Designs

Typology: Pedestrian Protection

Category: Department of Building RFP

Teammates: E.J. Shin (Served as Designer), Mikhail Kossir, Maria Berger

COMPETITION #5

Title: APT Timber Bridge Competition

Typology: Bridge

Category: School Competition

Teammates: E.J. Shin (Served as Engineer), Adam Brodheim, Elaf Alsibyani, Ellie Phetteplace, Michelle Leach, Winnie Michi, Jerry Schmit.

AND! THAT'S NOT TRUE!

DESIGN
COMPETITION

YEARN. ARE YOU COOL?
PARTNER?
EVEN MORE?

ACCIDENTALLY POLEMIC

COMPETITION #1

Title: 5 World Trade Center Competition

Typology: NYC Housing

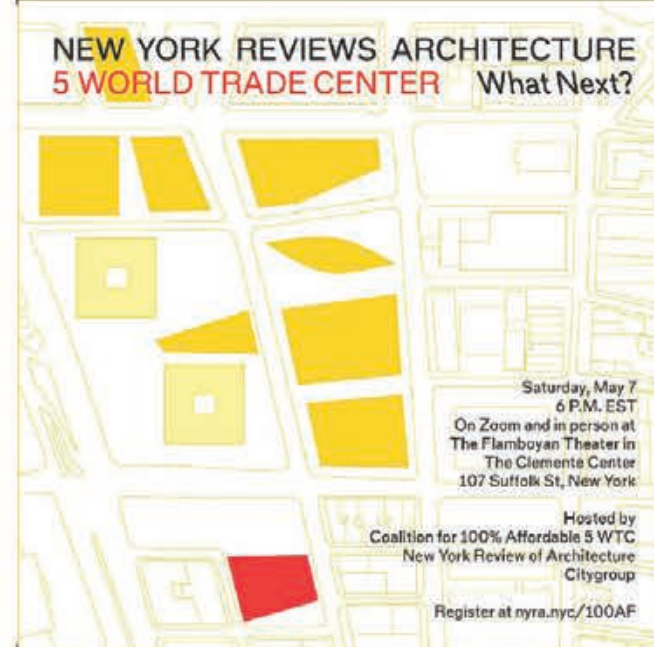
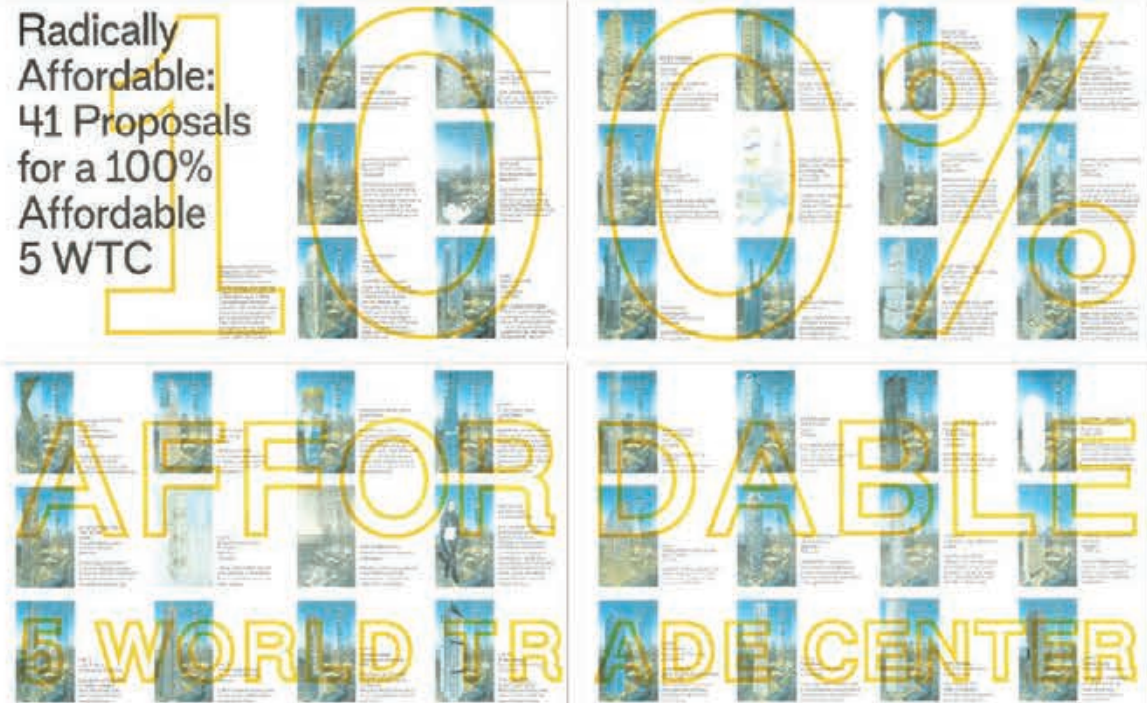
Category: Conceptual

Teammates: E.J. Shin (Served as Designer), Omer Gorashi

SHINGORASHI

This proposal for 5WTC stands as a provocation and critique of the dialogue between the naive altruism of housing activists and the 5WTC committee, as well as the other underlying issue of NY's glass curtain-wall skyline. Disrupting the current collection of "glass boxes" that have replaced Yamasaki's original twin towers, our project takes a formal elevation that pays homage to public housing projects throughout the city. However, the material transition from conventional brick, often used in public housing, to glass masonry, used in MVRDV's Crystal House, highlights the oxymoronic nature of placing affordable housing in the city's skyline of luxury glass boxes.

While activists argue for 100 percent affordable housing at 5WTC, it is necessary to question what the glass boxes of NYC's skyline stand for. If used in affordable housing, glass facades create transparency into the intimate spaces of populations vulnerable to exploitation unwanted spectatorship by mega-real estate tycoons. The scaffolding intentionally left in the proposal, and the jaggedness of the facade's material transition represents the fact that trying to please all parties will lead to a stalemate. Our problematizations, therefore, question whether or not we genuinely intend to tackle housing in America or if, if, instead, this stands as merely a symbolic gesture.



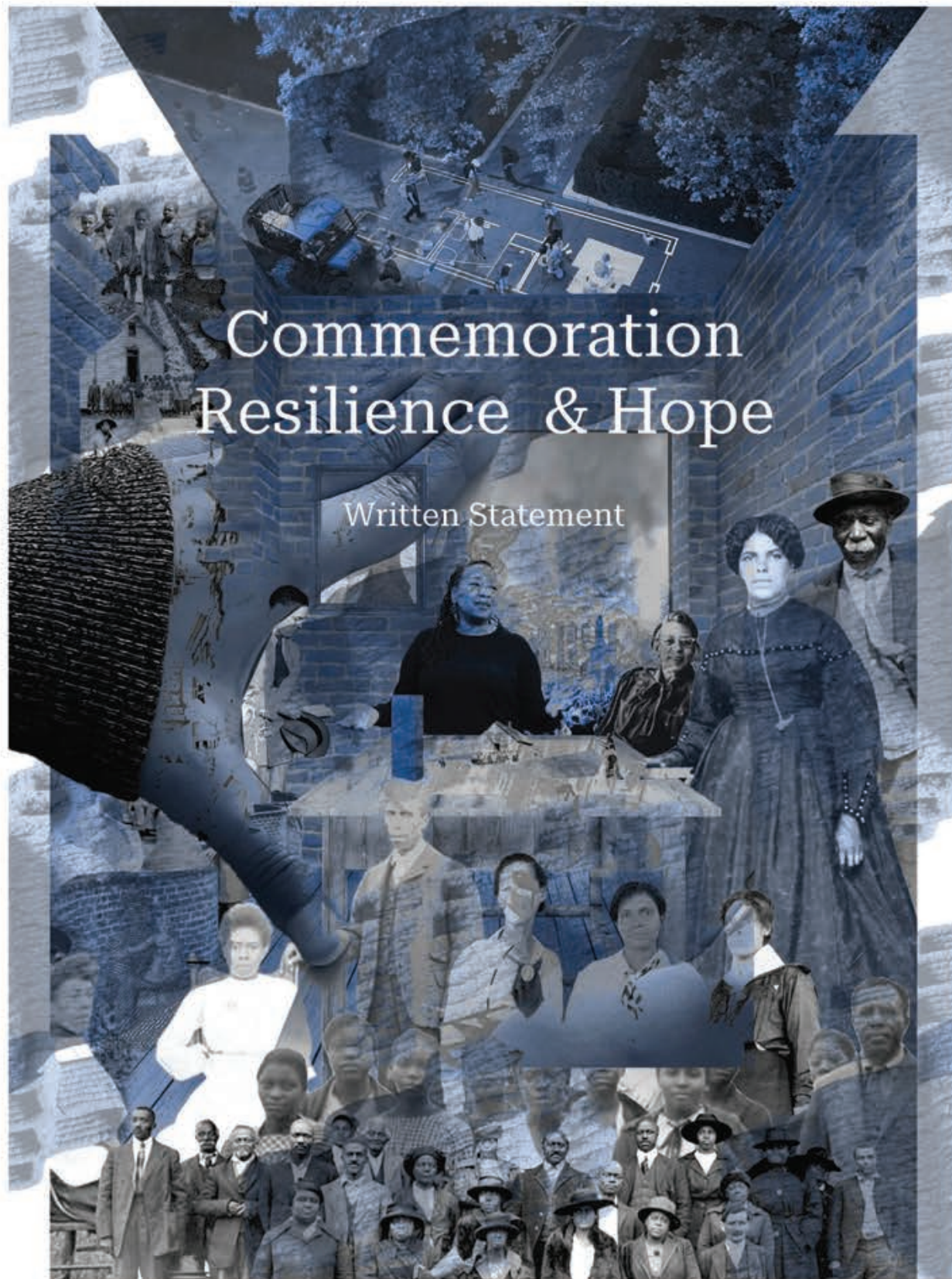
COMPETITION #2

Title: Harvard & the Legacy of Slavery Memorial Project

Typology: Memorial

Category: RFQ

Teammates: E.J. Shin (Served as Project Coordinator), Mikhail Kossir, Mariam Jacobs, Omer Gorashi



Our architectural practice is firmly grounded in a commitment to engaging the complexities of histories and their profound impact on communities, recognizing the imperative of addressing contemporary contexts to create spaces that serve as platforms for commemoration, resilience, and hope.

At the core of our approach lies the belief in architecture's transformative potential to contribute positively to communities affected by historical injustice and violence. Through collaborative efforts with diverse stakeholders and active engagement with local communities, we ensure that our designs authentically reflect the lived experiences and aspirations of those they serve.

As designers and historians, we acknowledge our responsibility to challenge existing power structures and advocate for institutional redemption, including our own, that have played a role in perpetuating historical injustices. Through empathetic yet strategic partnerships and community-driven design choices, we aim to create spaces that honor history, provoke reflection, and inspire action toward more just and accountable futures.

Our understanding of reckoning and commemoration goes beyond the confines of static monuments. We envision our work as part of an ongoing dialogue within civic communities, inviting activation, ritual, and contemplation. Our designs strive to maintain relevance both within the historical context of past injustices and the evolving concerns of the future.

Moreover, our extensive experience collaborating with institutions, both professionally and academically, equips us with the necessary skills to engage effectively with the Harvard community and other stakeholders throughout the creative process. We have a proven track record of working with municipal offices, civic institutions, and diverse community groups to ensure that our projects resonate with and serve their intended audiences authentically. Aligned with the imperative for institutions to confront their historical entanglements with slavery and its enduring legacies, we commit to recognizing and honoring the ongoing legacies of the enslaved, engaging with the com-

COMPETITION #3

Title: Tartu Downtown Cultural Centre Architecture Competition

Typology: Cultural Center

Category: RFP

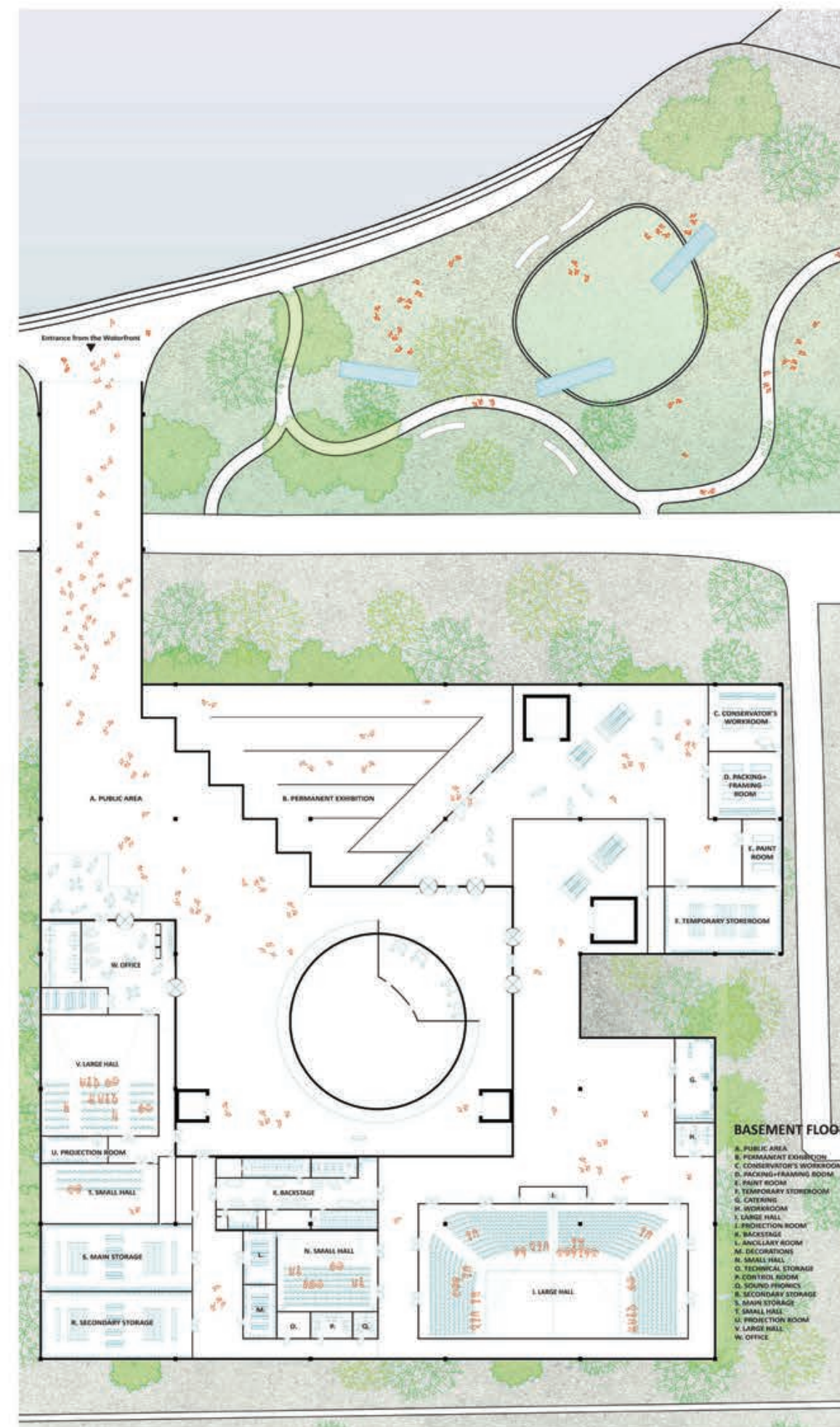
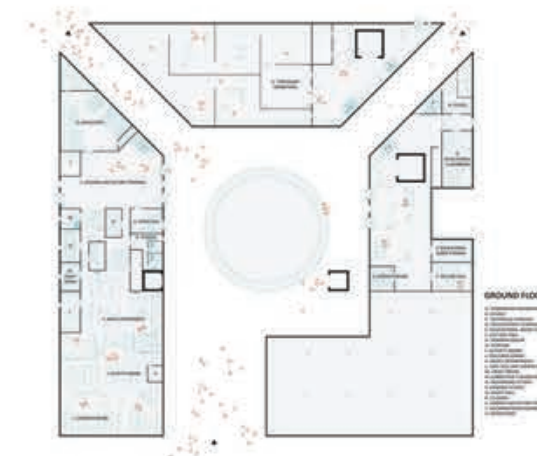
Teammates: E.J. Shin (Served as Design Lead), Mikk Pärdi (NEED arhitektid), Omer Gorashi, Mikhail Kossir, Anna Kim, Will Cao, Sherry Te, Jared Antonio, Val Flanon, Enrique Bejarano.



WATERFRONT VIEW



PUBLIC CINEMA FACADE



COMPETITION #4

Title: The City of New York Pedestrian Protection Designs

Typology: Pedestrian Protection

Category: Department of Building RFP

Teammates: E.J. Shin (Served as Designer), Mikhail Kossir, Maria Berger

ALTERNATIVE DESIGN #3 SIDEWALK LEVEL PEDESTRIAN PROTECTION THE LED SHED

Type: Sidewalk

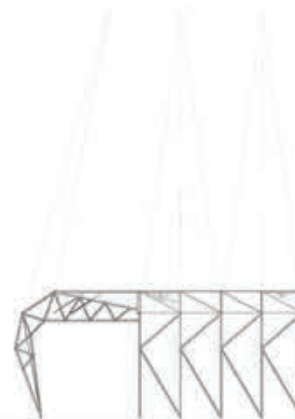
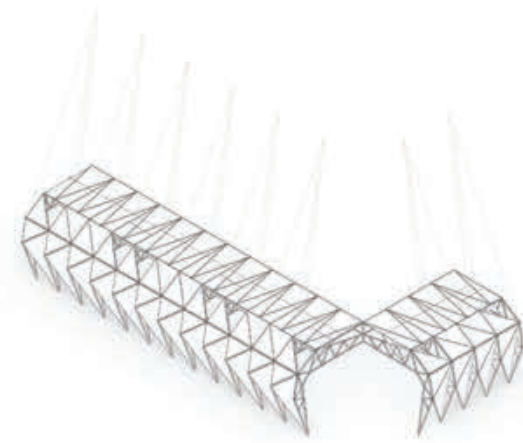
Load: Light-Weight

Structure: Steel truss, steel cables

Roofing: Polycarbonate sheets, LED screens

Case Study: W 42nd St & 7th Ave, Times Square, Manhattan 10036

Expanding on the "cocoon" typology, this design caters to more commercial areas and uses. Using the area of Times Square as a context, this proposal leverages the use of advertising as a means of funding its existence. By strategically inserting LED screens within the roofing and cladding geometry, advertisements are camouflaged serving as artificial lighting for the occupants. By being removed from eye-level, these advertisements serve as dynamic lighting rather than visual disturbance, and act as an economic engine to fund the construction of the sheds.



COMPETITION #5

Title: APT Timber Bridge Competition

Typology: Bridge

Category: School Competition

Teammates: E.J. Shin (Served as Engineer), Adam Brodheim, Elaf Alsibyani, Ellie Phetteplace, Michelle Leach, Winnie Michi, Jerry Schmit,

Bull's Bridge

Assumptions:

1. Bridge is symmetric
2. Each truss carries half of the load
3. Load is distributed over different "additions" of bridge based on relative stiffness

width of bridge $b = 12$ ft
span of bridge $L = 90$ ft

Stage 1.

Town Lattice Truss - assume only the blue bridge in my sketch is there

Calculation objective: Estimate max. load carrying capacity
Assumption: Max load carrying capacity is based on stress, check deflection for reference
Bridge was carried

height of truss $h = 12$ ft

Dead load bridge

White pine deck density - make guess about wood species $\rho_{wp} = 31$ pcf
Assume 4" thick wooden deck - make guess about thickness based on span
 $DL_{deck} = \rho_{wp} * 4 \text{ in} = 10.333$ psf

Dead load of truss - needs to be calculated $DL_{truss} = 200$ plf

Length of cladding in section $Cladding = 12 \text{ ft} + 8 \text{ ft} + 8 \text{ ft} + 12 \text{ ft} = 40$ ft
north + roof part 1 + roof part 2 + south

Cladding thickness $th_{cladding} = 2$ in
Dead load of cladding $DL_{cladding} = \rho_{wp} * th_{cladding} * Cladding = 206.667$ plf

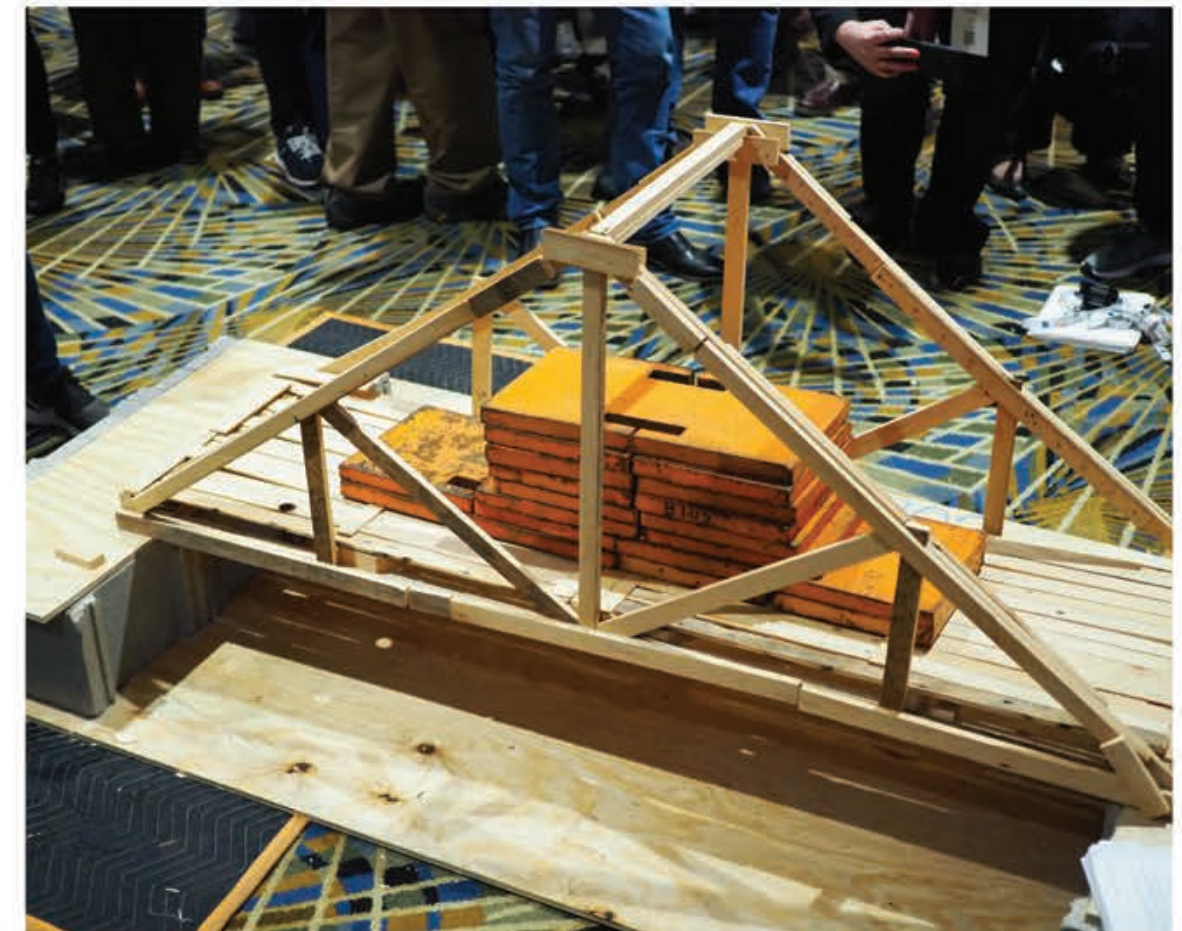
Dead load per truss $w_{DL} = \frac{DL_{deck} * b}{2} + DL_{truss} + \frac{DL_{cladding}}{2} = 365.333$ plf

Live load on bridge - this is what we will want to make comments about

Change this value iteratively - Start with something low for the 1830s: 25 psf ?

$LL = 25$ psf

Live load per truss $w_{LL} = \frac{LL * b}{2} = 150$ psf * ft



Semester: Winter 2023 -

Role: Co-Founder, Partner

Teammates: Mikhail Kossir, Paras Jain

I'VE DECIDED

I DON'T NEED

ANYONE'S

APPROVAL

AND TO NEVER

BECOME A

CAD

TITAVIO

money

OWNERSHIP

OPENED ATELIER

WITH MIKA KOSSIR,

THE

HOUSING PARTNER

TITAVIO



TITAVIO is a spatial design practice based in New York City with international offices in Seoul and Uttar Pradesh. Our team merges architecture, engineering, and design thinking as a means for **functional, sensible, and aesthetic solutions to design problems.**

With experiences that range from exhibition design as part of the Venice Biennale, to a number of international projects, the office's work focuses on the development of **highly conceptual and multi-scalar spatial designs.**

WE OFFER:

Residential Interior Designs:

- Tailored solutions for private residences, encompassing single and multi-family homes, apartments, condominiums, and mobile/manufactured housing.
- Innovative designs seamlessly marrying aesthetics with functionality for an elevated living experience.

Hospitality Spaces Designs:

- Bespoke designs for high-end hotels featuring modern and innovative elements, providing a fresh and luxurious experience.
- Thoughtful designs for hostels, resorts, and spas, leveraging contemporary design to enhance guest experience and relaxation.

Personalized Furniture Design and Shopping:

- Customized furniture design embracing modern aesthetics seamlessly integrated with innovative solutions.
- Collaboration with skilled craftsmen for personalized pieces blending artistry with contemporary functionality.
- Curated selection of modern and innovative furniture through

TITAVIO



Our designers closely collaborate with clients, blending expertise and artistic sensibilities to craft designs that resonate with the client's unique identity and vision.

We see our work as the crystallization and organizing of moments of culture and activity in space, with the core belief that design is everywhere and that it exists equally at the scales of the poster, the building, or the city.

WE DESIGN FOR EXTREMES

Our work strives at existing in the function of, and responding to the extreme natures of contemporary living. We push concepts and ideas to the limit in order to extrapolate moments of extreme pleasure out of situations of extreme pressure. We are drawn to mutually enriching collaborations with clients interested in elevating their spatial experiences; yielding sublime, novel, and boundary-pushing atmospheres.

TITAVIO



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CORE 1
HALFWAY HOUSE

CORE 2
ALICE SCHOOL

CORE 3
WATER RINGS: MANHATTAN HOUSING, APPENDIX

ADV. 4
THE WASH HOUSE: RECLAIMING WASHOKAN

ADV. 5
GREEN REVIVAL: KINGSBRIDGE ARMORY'S URBAN FARMING TRANSFORMATION

ADV. 6
WALK TO HOME: BIOMIMICRY TO CARBON-SEQUESTRATION CITY

ADR
HANGJAK, KOREAN TRADITIONAL ARCHITECTURE

STUDIES
NEW ARCHITECTURE: SPATIAL NARRATIVE

SCHOLARSHIP
NATURE IN THE LAB

MEMBERSHIP & LEADERSHIP
AIAS

PARTNERSHIP
COMPETITIONS

OWNERSHIP
TITAVIO

I AM TRULY GREAT FOR THIS PEDAGOGIE

even the student protest sign that caused chaos; teaching lessons

This portfolio showcases my journey over three years, questioning and redefining the role of architecture. Each project reflects a commitment to merging aesthetic, functional, and sustainable practices, demonstrating how noble, conscious design can empower communities, restore ecological balance, and extend the cultural continuity of spaces. Through these projects, I explore how architecture is not merely physical matter but an invisible tension within the built environment, enacting lasting change.

“agree, red is not a color”

“and now what?”

E.J. Shin, the Post-Deconstructivist

GSAPP
2021 - 2024



TITAVIO
2024 -