Jacob Lehrer

Computational Architect

1. Custom R&D

Workflows
Sentient Environments
AUTOMATA Lightshow

2. Design

Lincoln Heights Jail (2GAX)
Thallus Robotic Clay Printing
Trash to Treasure

3. Theory

Terrablocks
Distillate
Parametric Architecture

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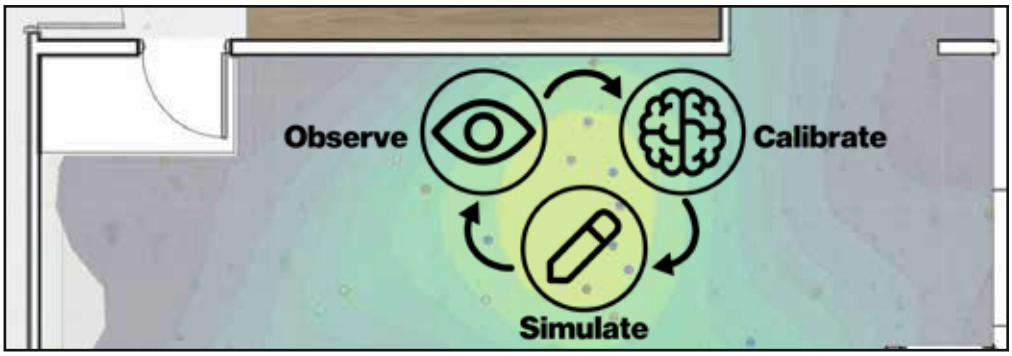
2023-2025

Selected Projects

Custom Workflows

Sentient Environment Engine

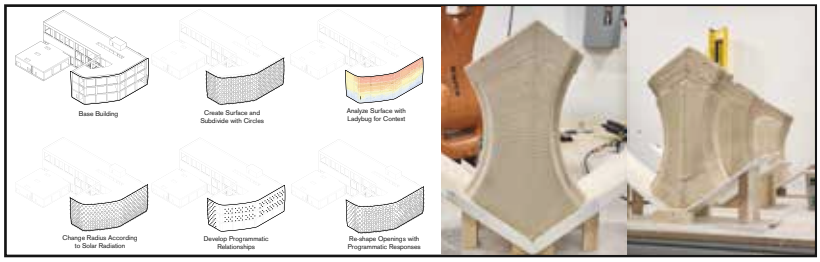
Developed for Wicked Puppies



The Sentient Environment Engine is the three-part system that simulates occupant behavior, tracks it against real behavior, and using Bayesian Optimization and AI, trains the simulation off the custom Computer Vision algorithm. This observe, calibrate, simulate workflow creates a specific digital twin of the exact user typology unlike any other agentic behavior system available. Presented at Parametric Architecture's Design Tech Talk 6.

Ladybug-Based Solar Optimizer + Slicer

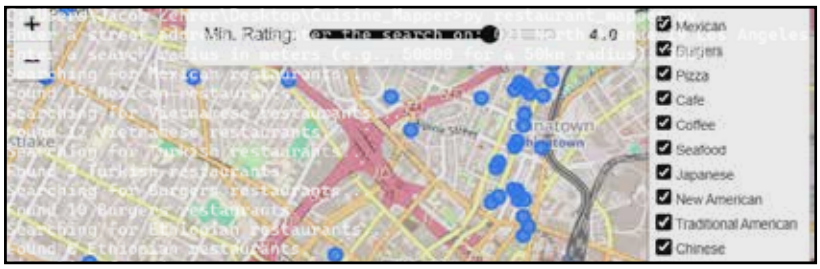
Undergraduate Emerging Technologies Studio 7



Based on a panelized surface developed in Lunchbox, I developed variable panels based on net solar gain over the year to create uniquely shaped panels for a new facade. The openings and radii of fillets react to solar gain, program, and structure. Then, I developed a custom slicer to print these panels on custom bases using a Kuka robot arm. As each panel is unique, the slicer is meant to adapt to the changing geometry and the failures of earlier prints to create multiple walls and central bracing for stability.

Restaurant Mapper

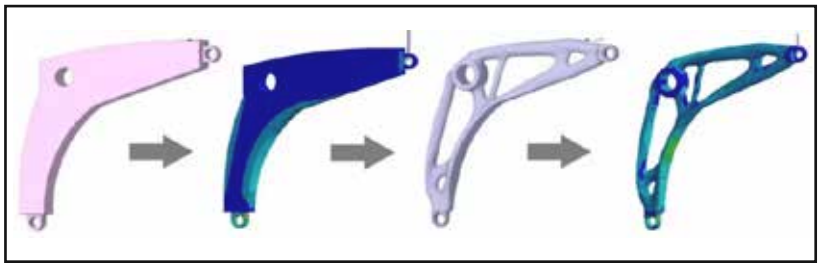
SCI_Arc 2GAX Site Research



A lightweight urban intelligence tool developed in Python, the Restaurant Mapper visualizes restaurant data around any input address, filtering by cuisine and rating. Built during a 5-day food systems research sprint, this tool became a scalable prototype for user-defined POI analysis. Built using Python, Folium, Google Maps API, and the OpenStreetMap API, it can be rerun anytime and give insights into the evolving culinary landscape of an area.

Behavioral Topology Optimization

Experimental Development



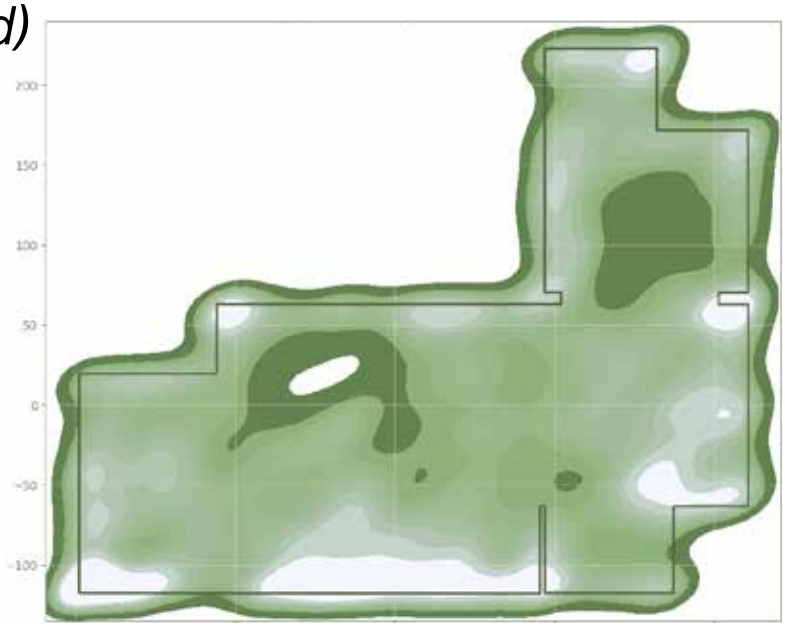
After developing and exploring agentic simulation for behavioral analysis, I am developing a system to use topology optimization in Fusion 360 to "grow" structure through depopulated zones. This uses simpler behavioral simulation early in the design phase to create unique structural designs that can reduce impedance for passengers circulating through large open spaces in typologies like airports, malls, transit hubs, and plazas. The workflow will output meshes that can be rebuilt in GH.

Computer Vision & AI Trained Agentic Behavior Simulation

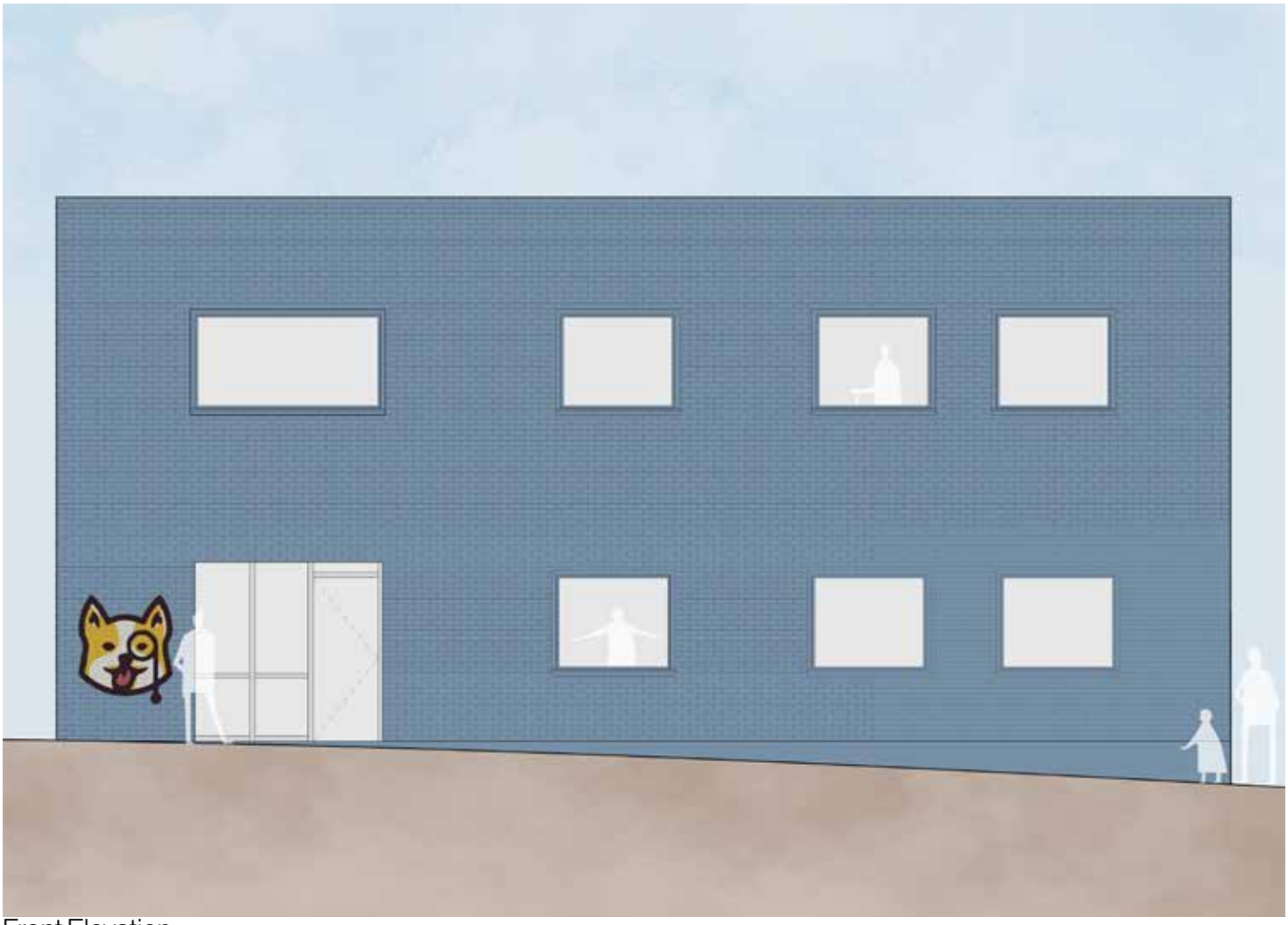
Braintree, MA, 2025 (Permitted)

When tasked to design a doggy daycare, we focused on two questions. How can we design using natural materials, and with a new user typology, how can we get real data to understand behavior patterns? Through this process, we investigated local materials that can reduce noise, smells, and sounds. I also developed the Sentient Environment Engine. This system uses Computer Vision to train an Agent Based Model using Bayesian Optimization to help us better understand behavior patterns in dog daycare spaces. I am currently working to expand this system with more complex users and locations.

Design Lead, R&D Lead: Jacob Lehrer
Interior Designer: Jennifer Medina
Architect of Record: SHED Architects
MEP: Design Learned, Inc.
Contractor: Vantage Builders



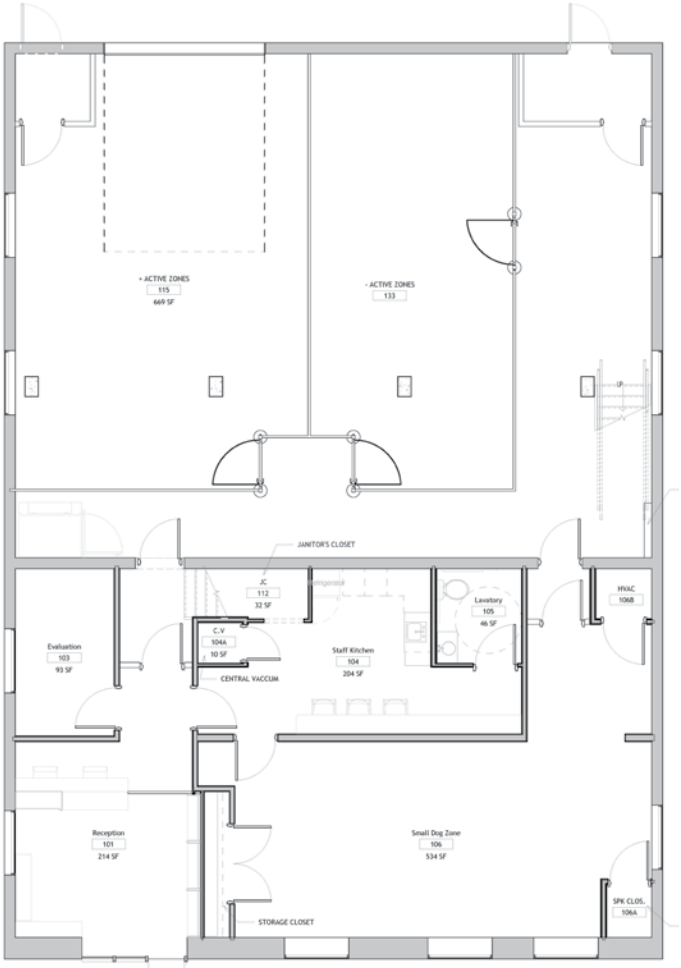
Aggregated Agentic-Driven Heatmap



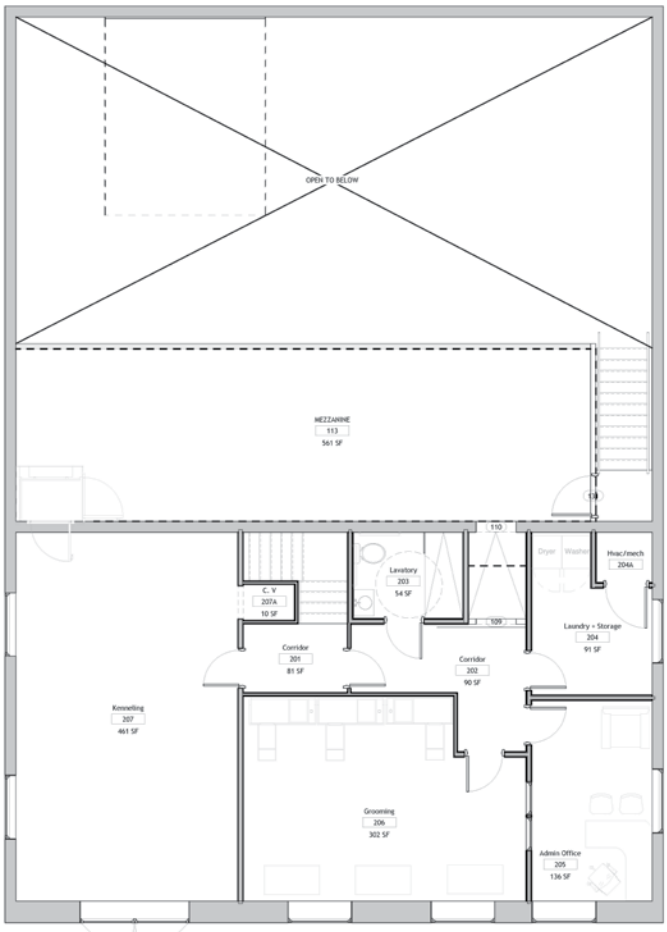
Front Elevation

Surrounding Context

Outdoor Playspace Addition



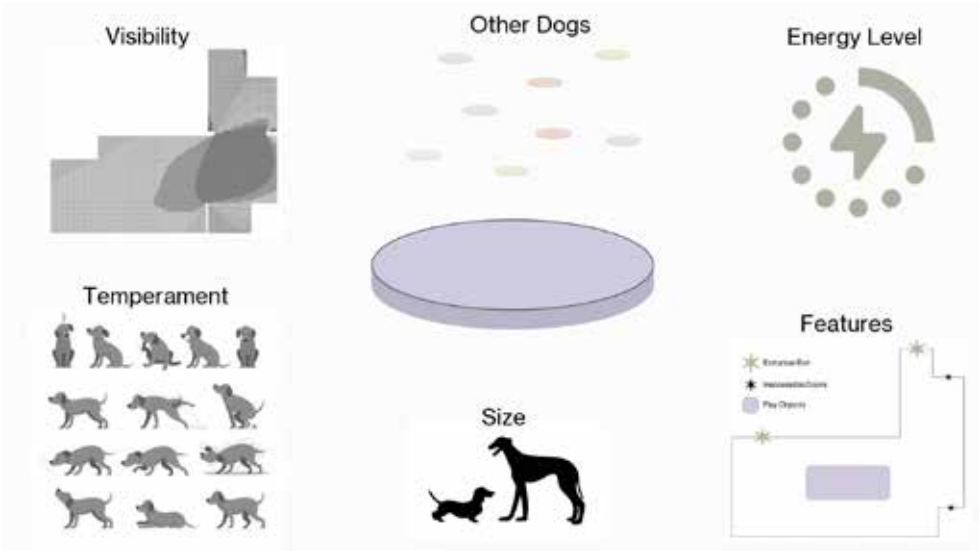
Floor 1



Floor 2

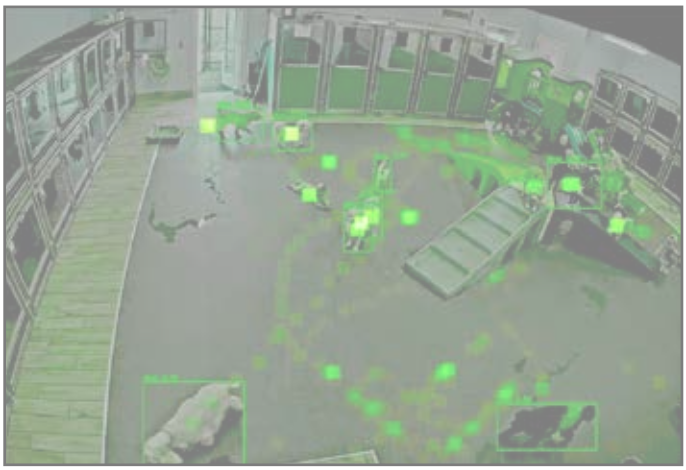
How Do Dogs Move?

I developed a custom python system to simulate dogs randomly walking around an enclosed space to understand this unique user typology. By simulating the space digitally using real data, we are better able to adapt to the dog's true movement and reactions to space, allowing my client to earn an 80% increase in permitted capacity from the Braintree Planning Department. The concept is to create a basic simulant for dog behavior, analyze real dogs using computer vision, then train the simulation on the real data. This algorithm gets better every day, leading to an eventual goal of having this system running live in the operating daycare to provide real-time insights into the behavioral patterns of the dogs in my client's care. Then, in future franchises, we can customize layouts to the specific dogs in the area.

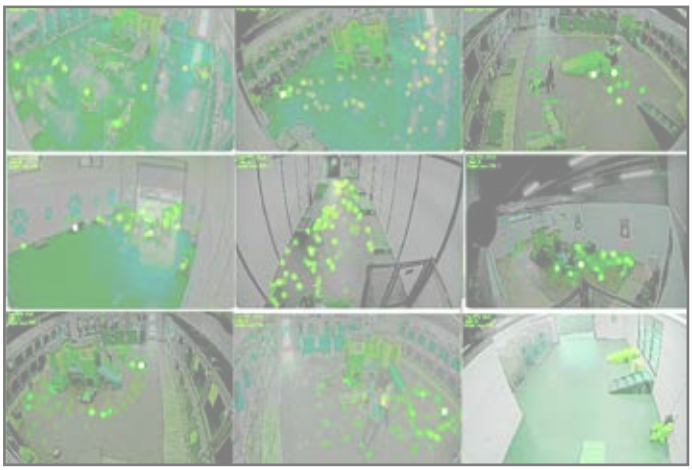


Simulation Factors

Final Simulation Pass for Planning Board

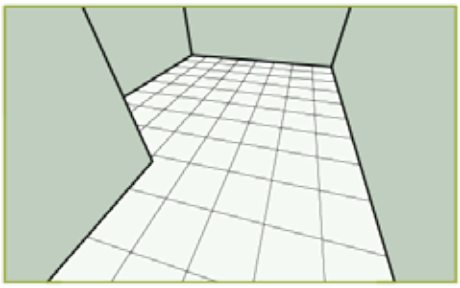


Single Location

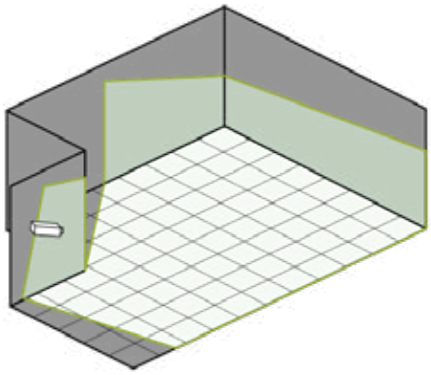


Nine Locations Simultaneously

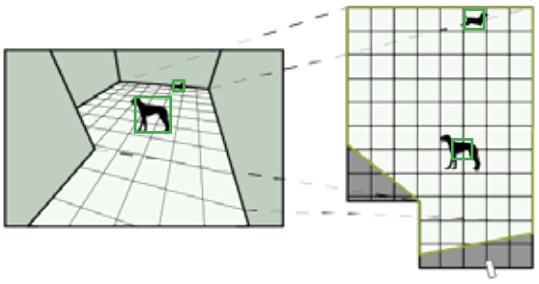
Real-Time Tracking



Grab Angled Camera View

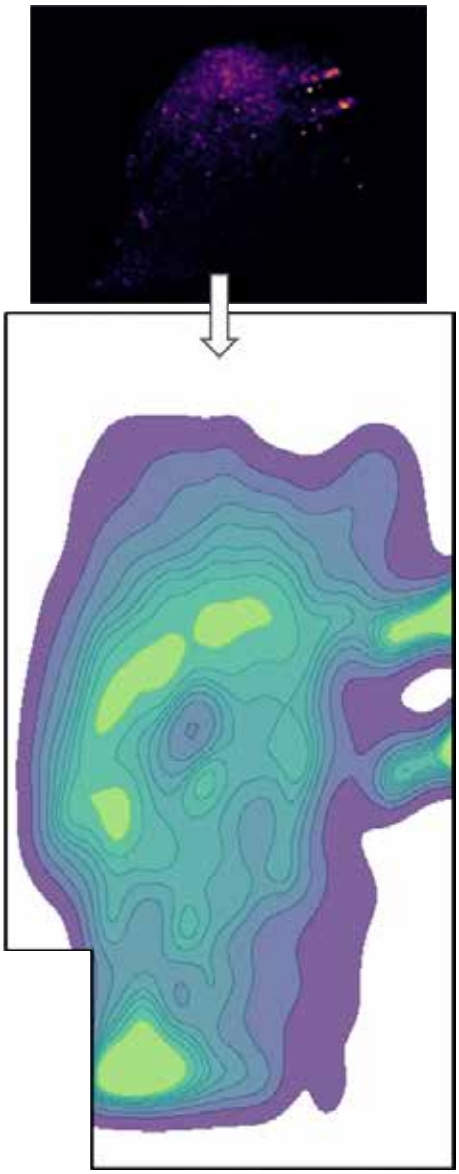


Approximate Plan and Camera in 3D Space



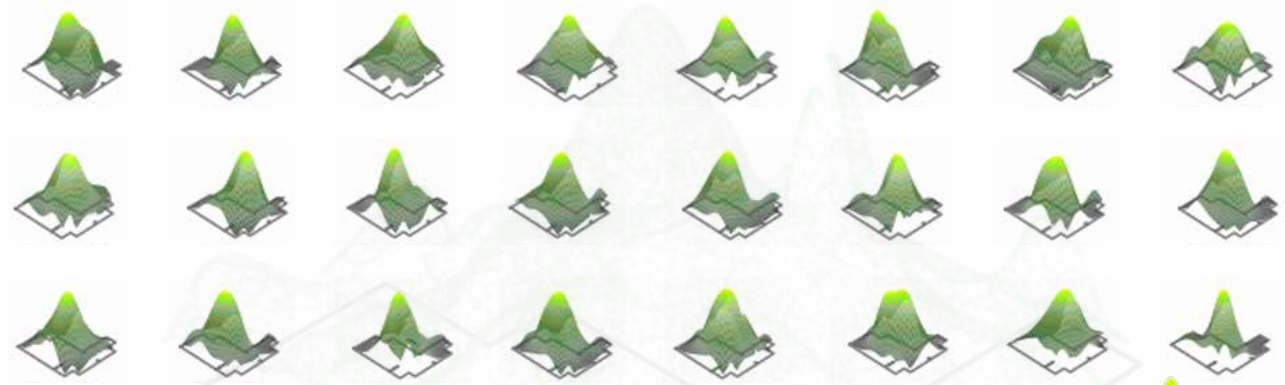
Apply Homography Algorithm for 2D Tracking

Custom Computer Vision Workflow

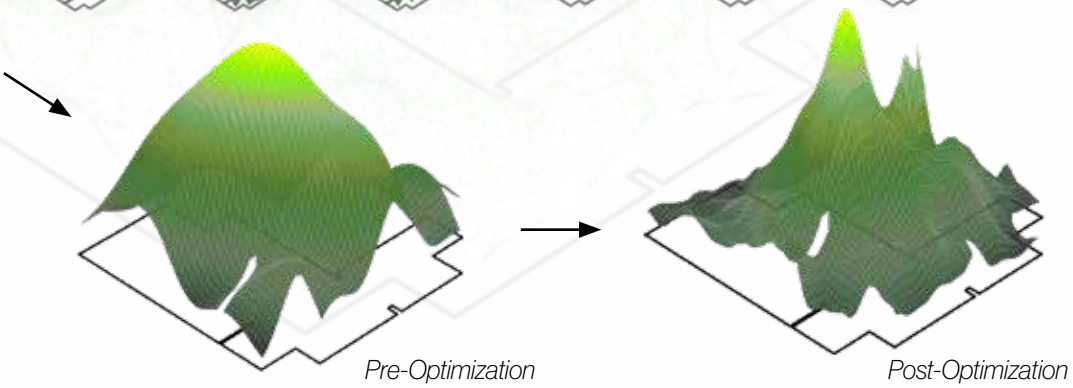


7/12/25 Ballantyne Playroom 8am-6pm

Computer Vision Data Processing

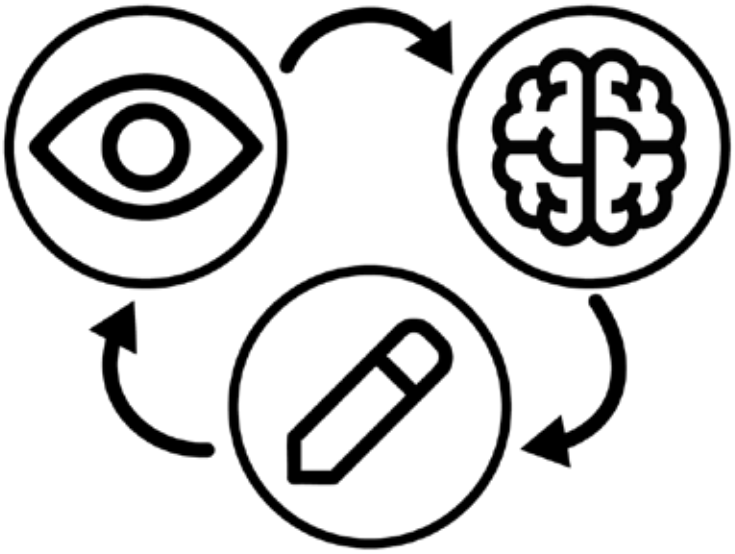


24 Runs



Pre-Optimization *Post-Optimization*

AI Calibration and Aggregation



Observe

Cameras
Occupancy Sensors
Computer Vision
POI Tagging
Path Estimaiton

Calibrate

Homography Mapping
Bayesian Optimizaiton
Evaluation
Deep Learning
Active Reporting

Simulate

Agent States
Python Simulation
Heatmap Development

Presented at Design Tech Talk 6 by Parametric Architecture

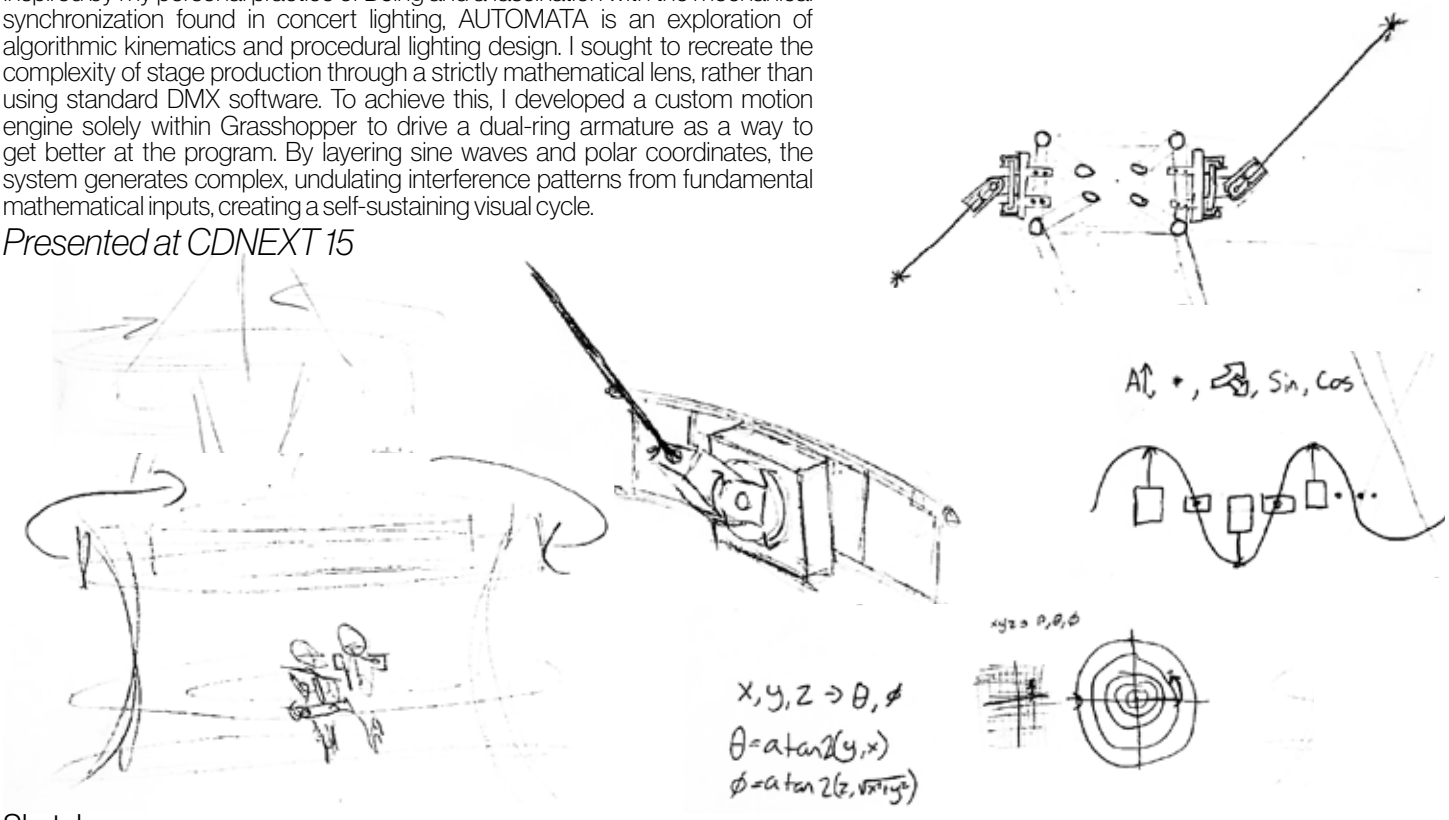
Presented at Gateway Office at Boston Arch. College

In Preparation for Submission to ACADIA 2026

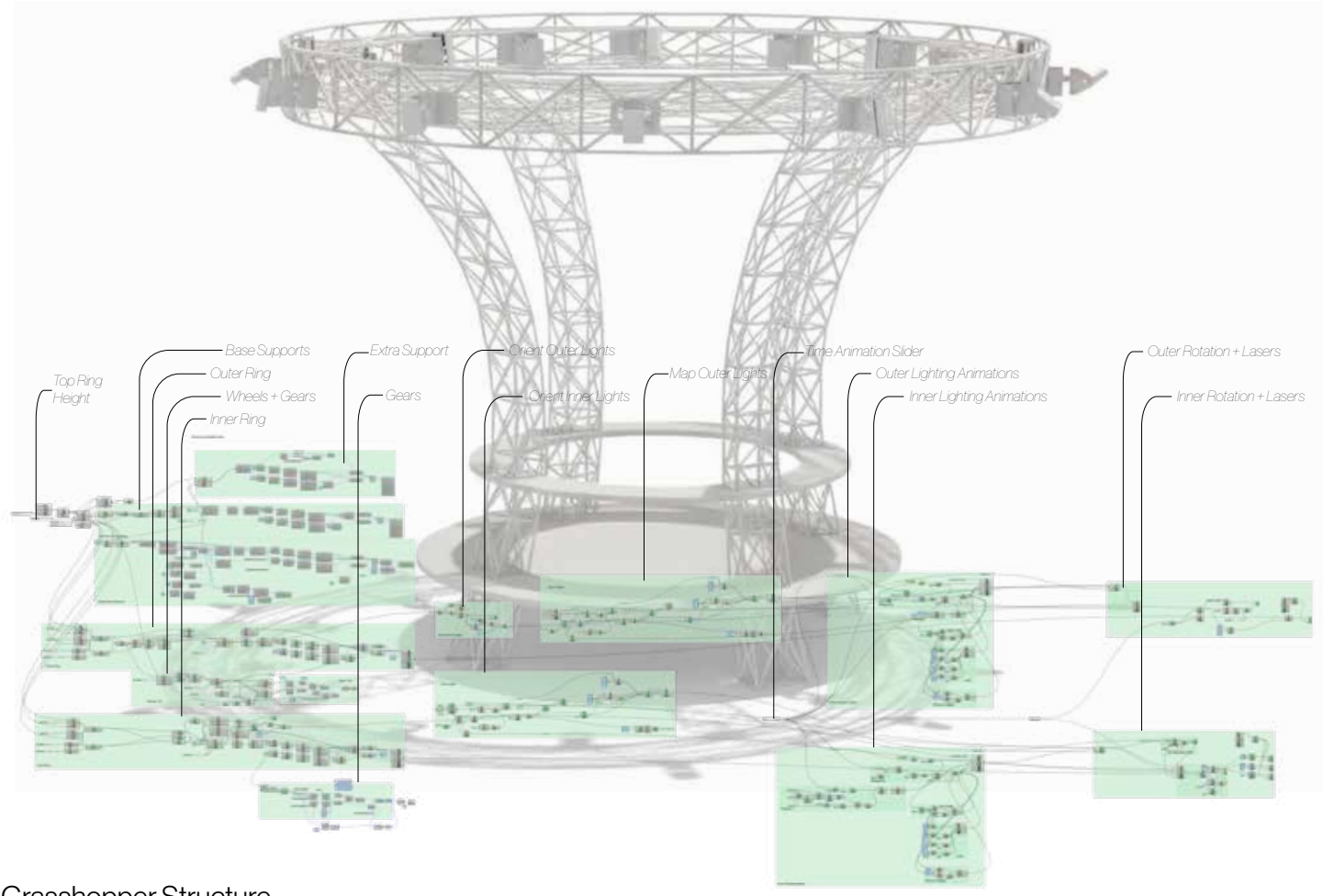
AUTOMATA

Inspired by my personal practice of DJing and a fascination with the mechanical synchronization found in concert lighting, AUTOMATA is an exploration of algorithmic kinematics and procedural lighting design. I sought to recreate the complexity of stage production through a strictly mathematical lens, rather than using standard DMX software. To achieve this, I developed a custom motion engine solely within Grasshopper to drive a dual-ring armature as a way to get better at the program. By layering sine waves and polar coordinates, the system generates complex, undulating interference patterns from fundamental mathematical inputs, creating a self-sustaining visual cycle.

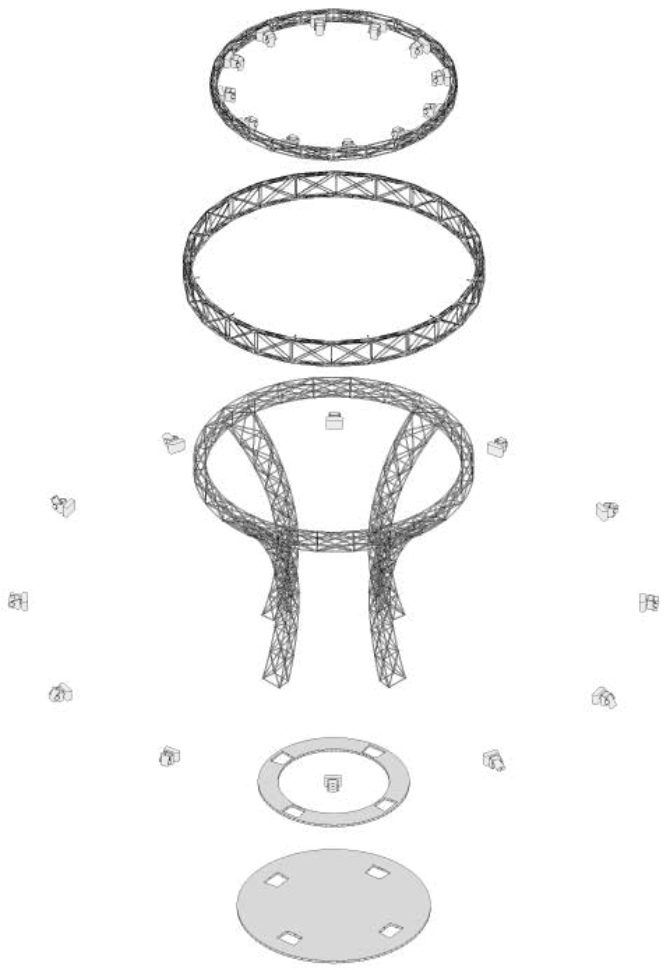
Presented at CDNEXT 15



Sketches

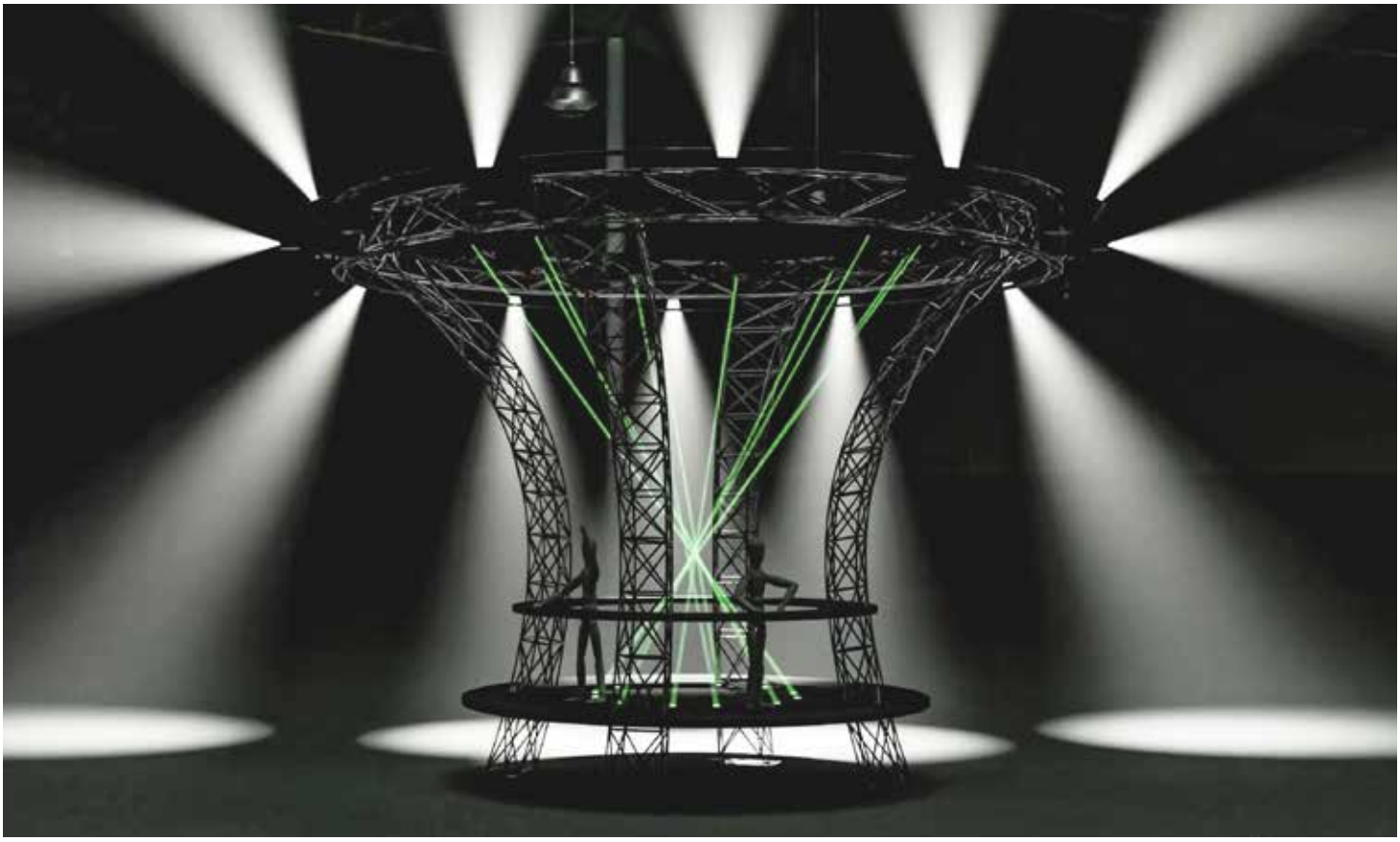


Grasshopper Structure



Exploded Axon

One Angle	*All lights are fed the same angle and are pointing the same way*
Two Angle	*Alternate lights are fed a +/- angle and create two focal points*
Four Angle	*Lights are fed a +/- angle then alternating are half the angle*
Stagger	*Using a sine function, angles are staggered on a frequency*
Dual Stagger	*Based on a pattern of +/-, the sine wave staggers twice*
Random	*Random angles are moved between over thirty frames*
Point Track *(Interior Only)*	*Using polar coordinates, a point is tracked in a central zone*



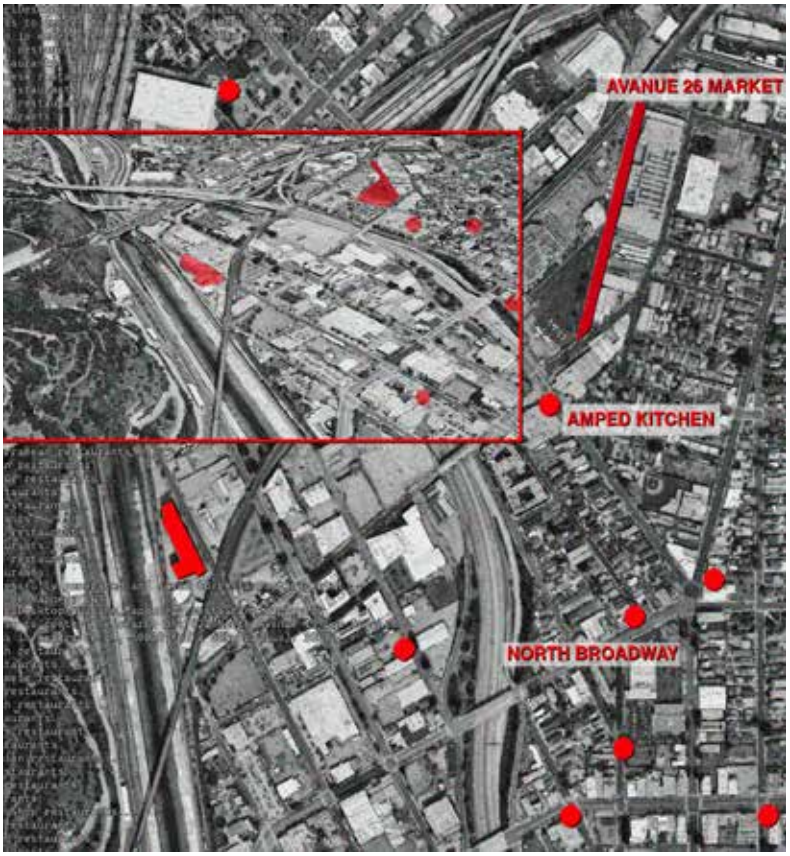
Rendering

Lincoln Heights Jail

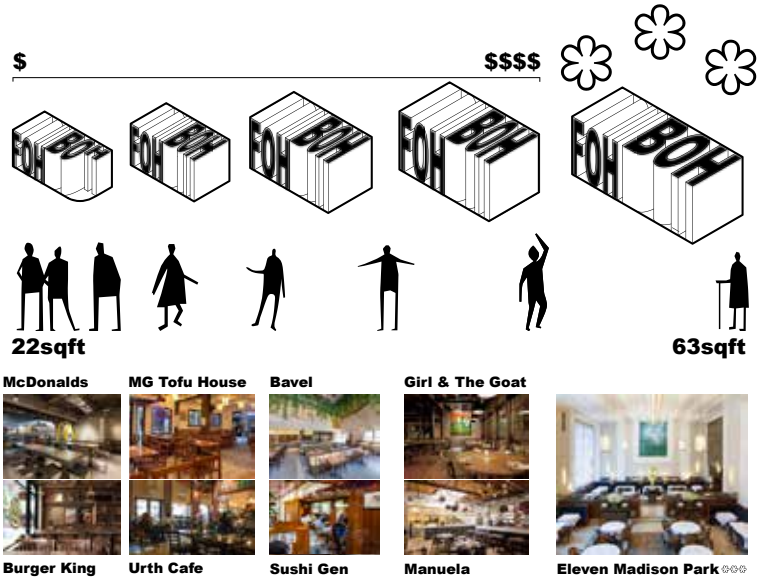
SCI_Arc 2GAX, 2025

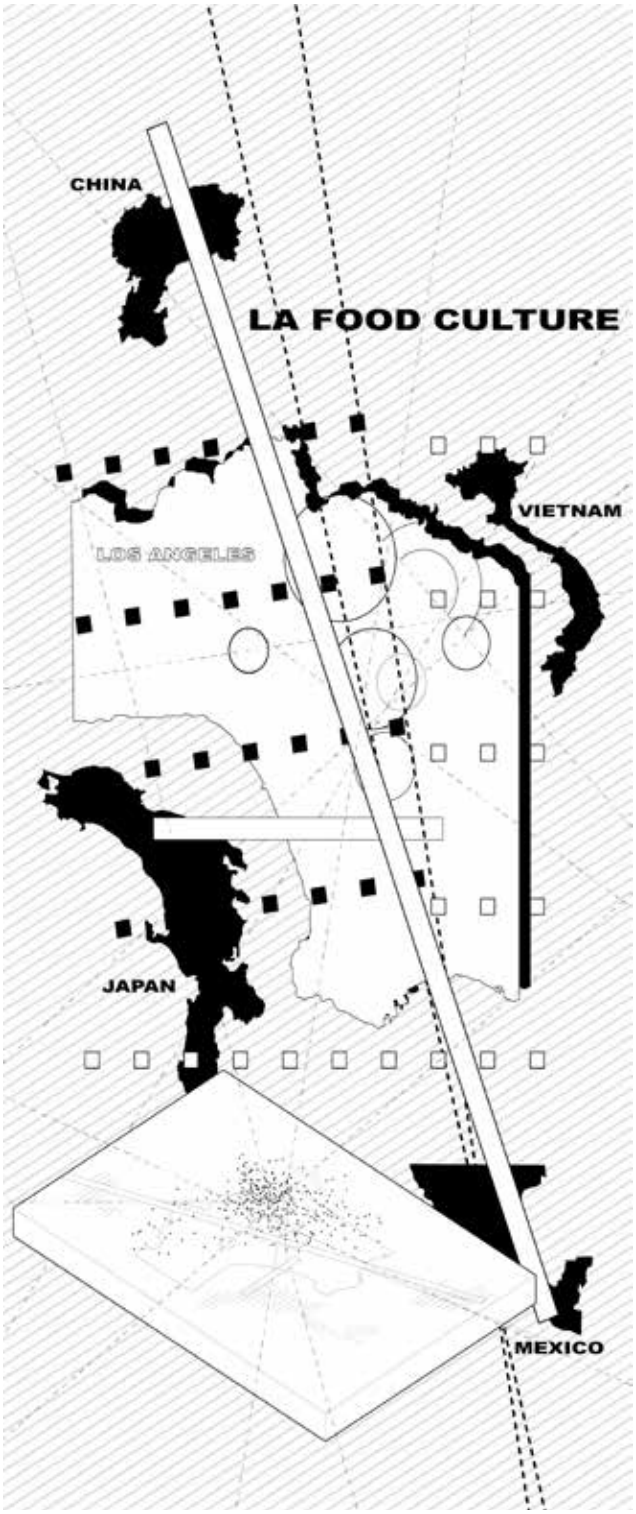
The Lincoln Heights Jail is currently abandoned, my teammate and I were tasked to turn it into a multi-use space with a hotel, office space, event spaces, and we added research areas for environmental remediation and street food markets to increase community engagement. We used two conflicting systems, an irregularly regulated grid, and angularly cut moulding pieces disrupting the grid. Our final concept uses layers of porosity to invite the community in, and the off-grid infrastructure to construct space and dictate the architectural aesthetic. We also used simulation and computational tools to inform our design, like the restaurant scraper pushing restaurant spaces south and CFD wind analysis to create systems to break strong winds and divert them to cool the interior spaces. Our final presentation included a large detailed chunk model that we fabricated from 3D printed pieces.

Design Partner: Jonathan Kadau

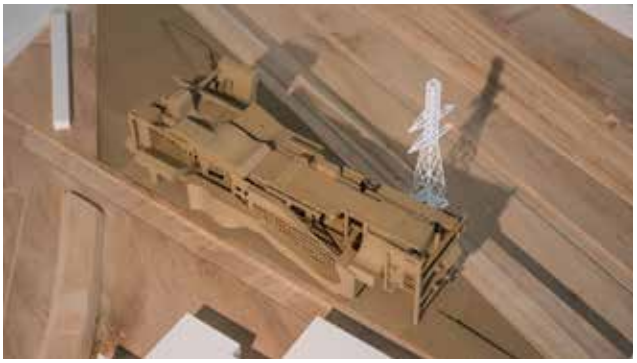


Custom Mapping Algorithm

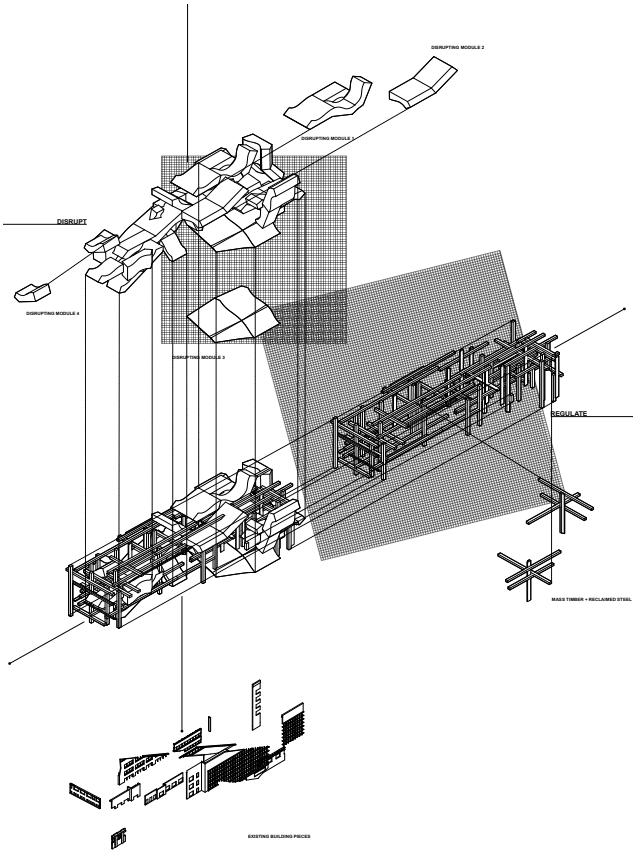




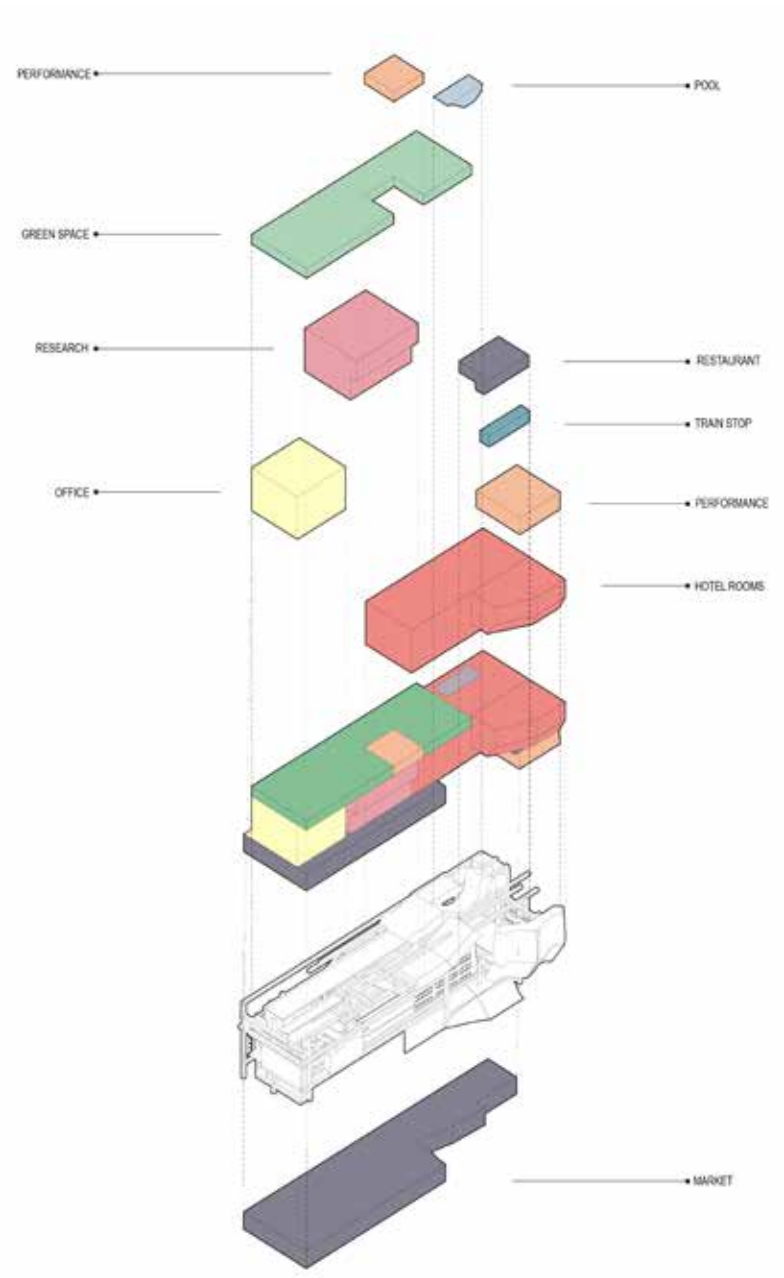
Initial Concept Model

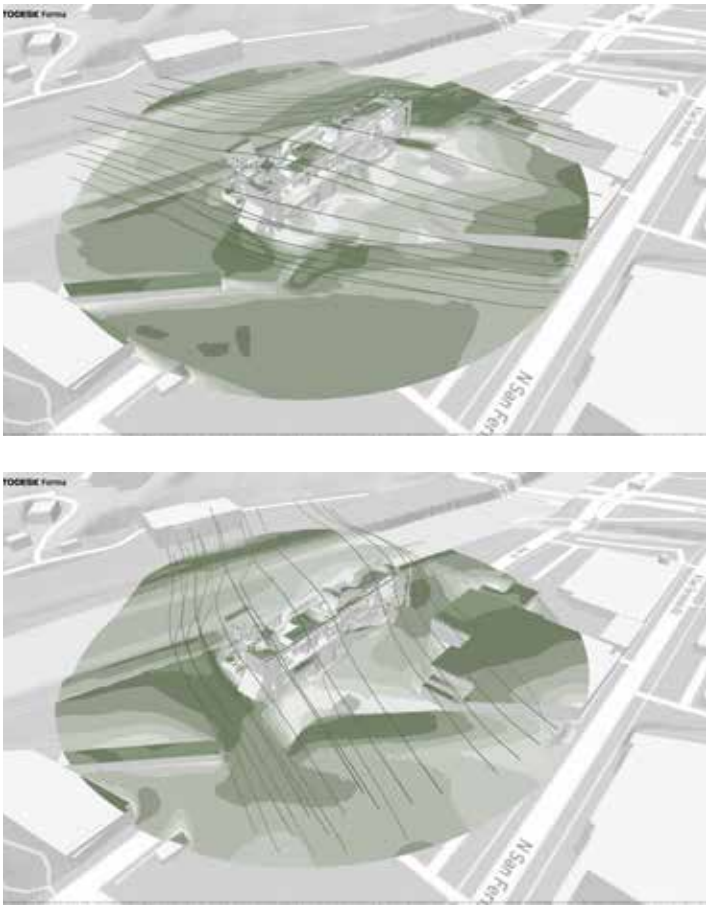


3D Printed Building Model

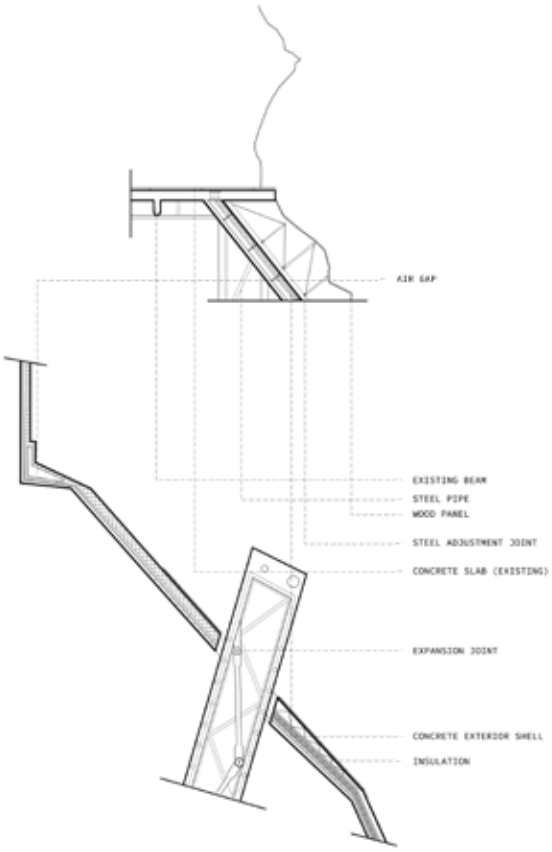


System & Program Diagram

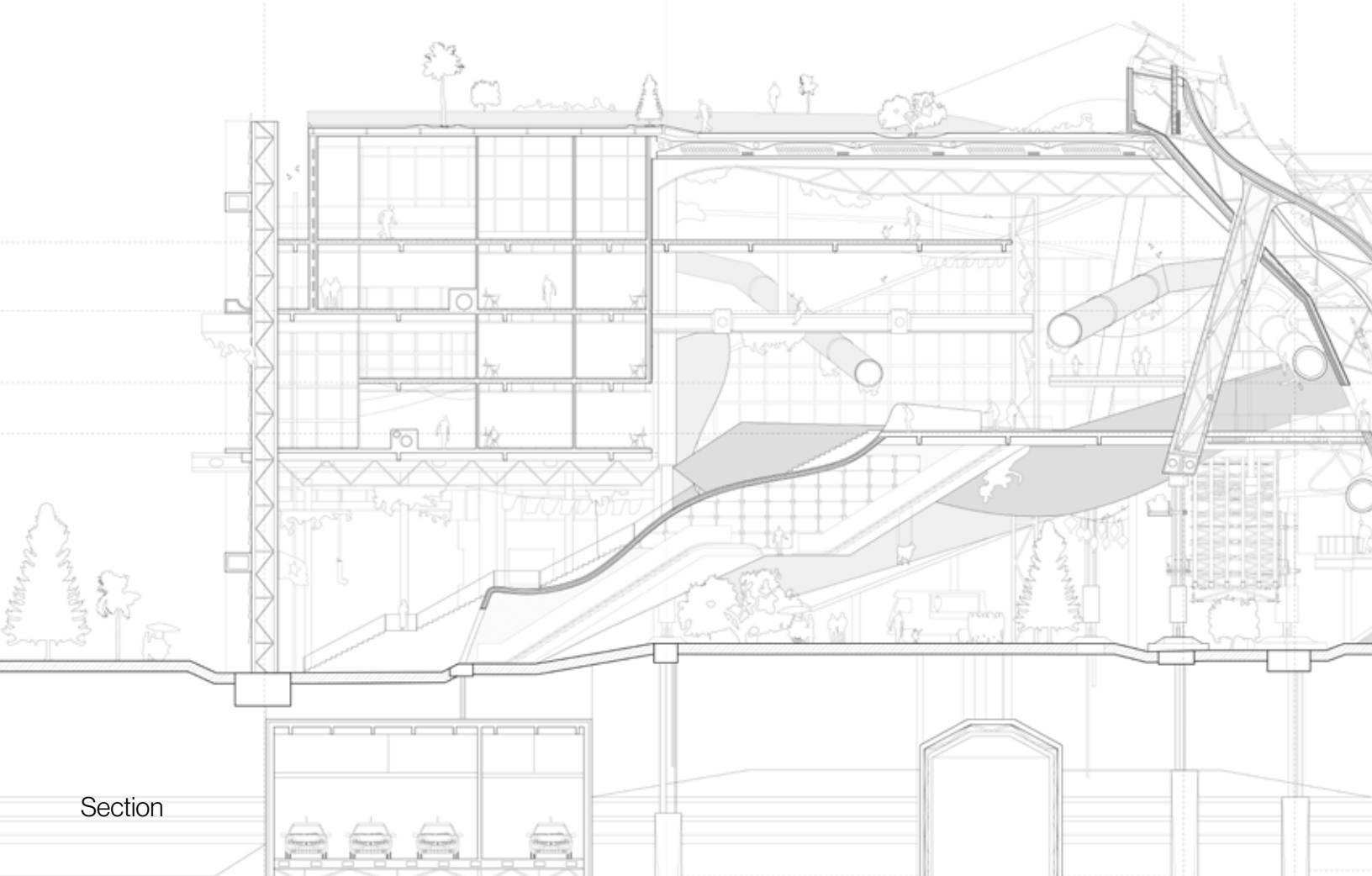




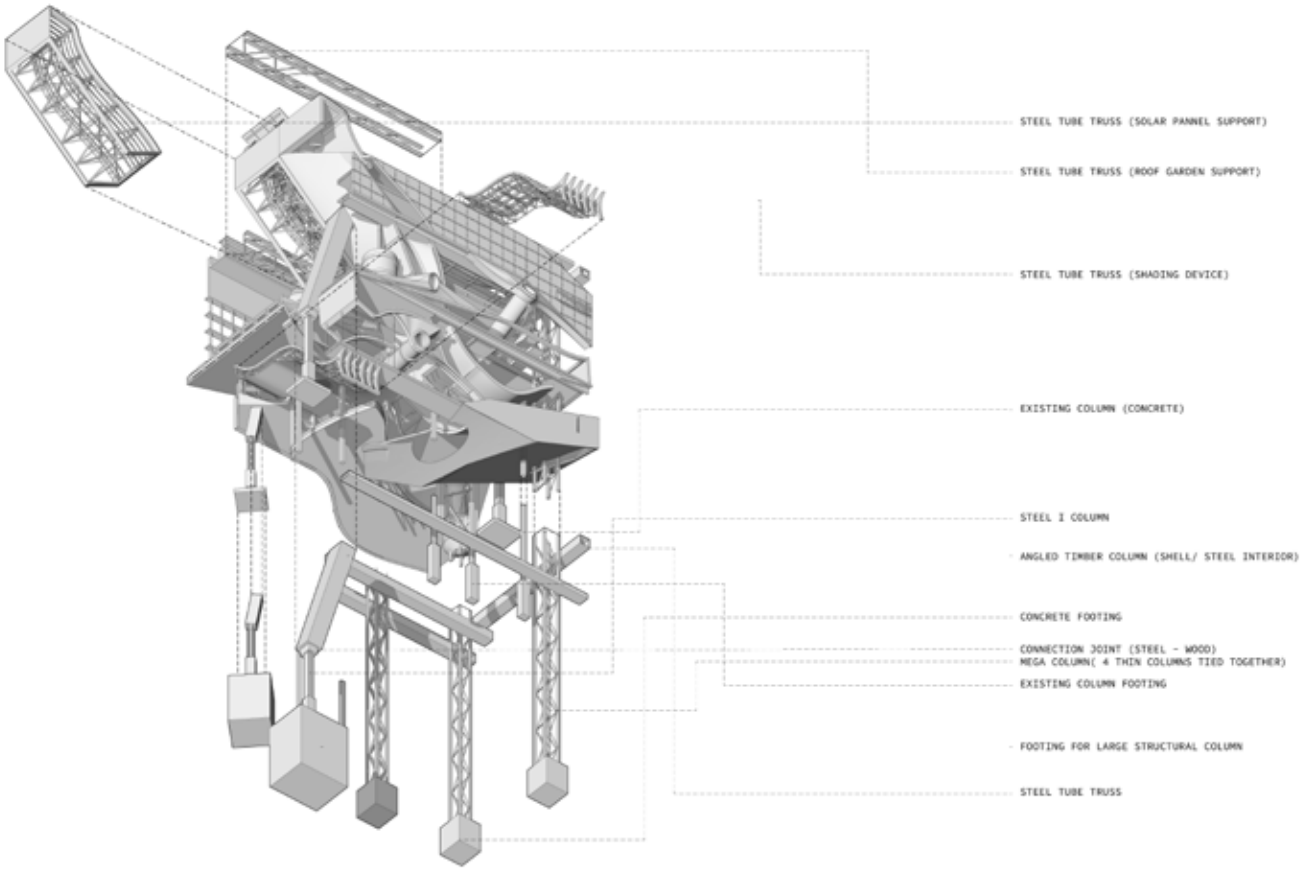
Forma Wind Comfort Analysis



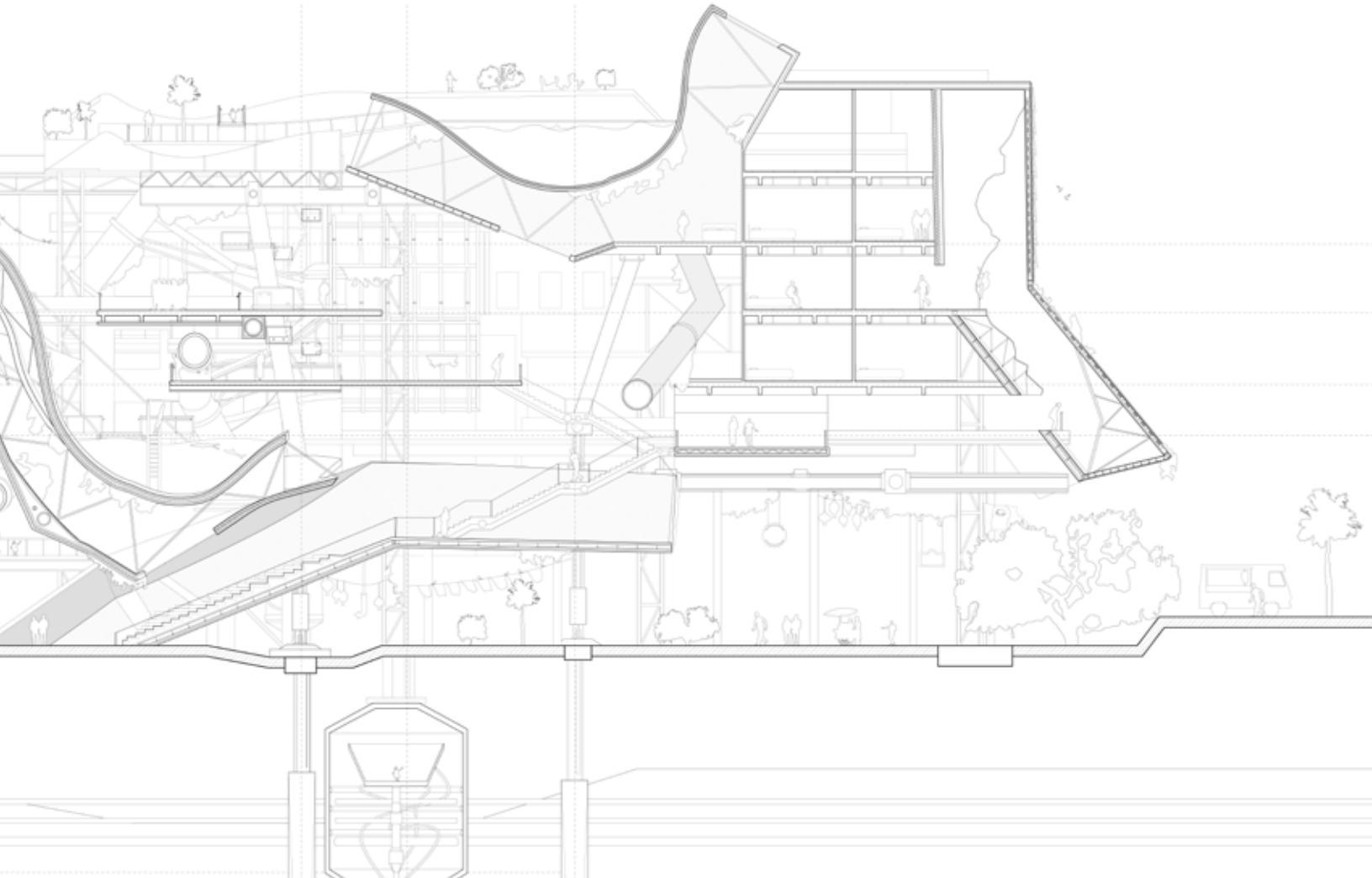
Material Construction Details

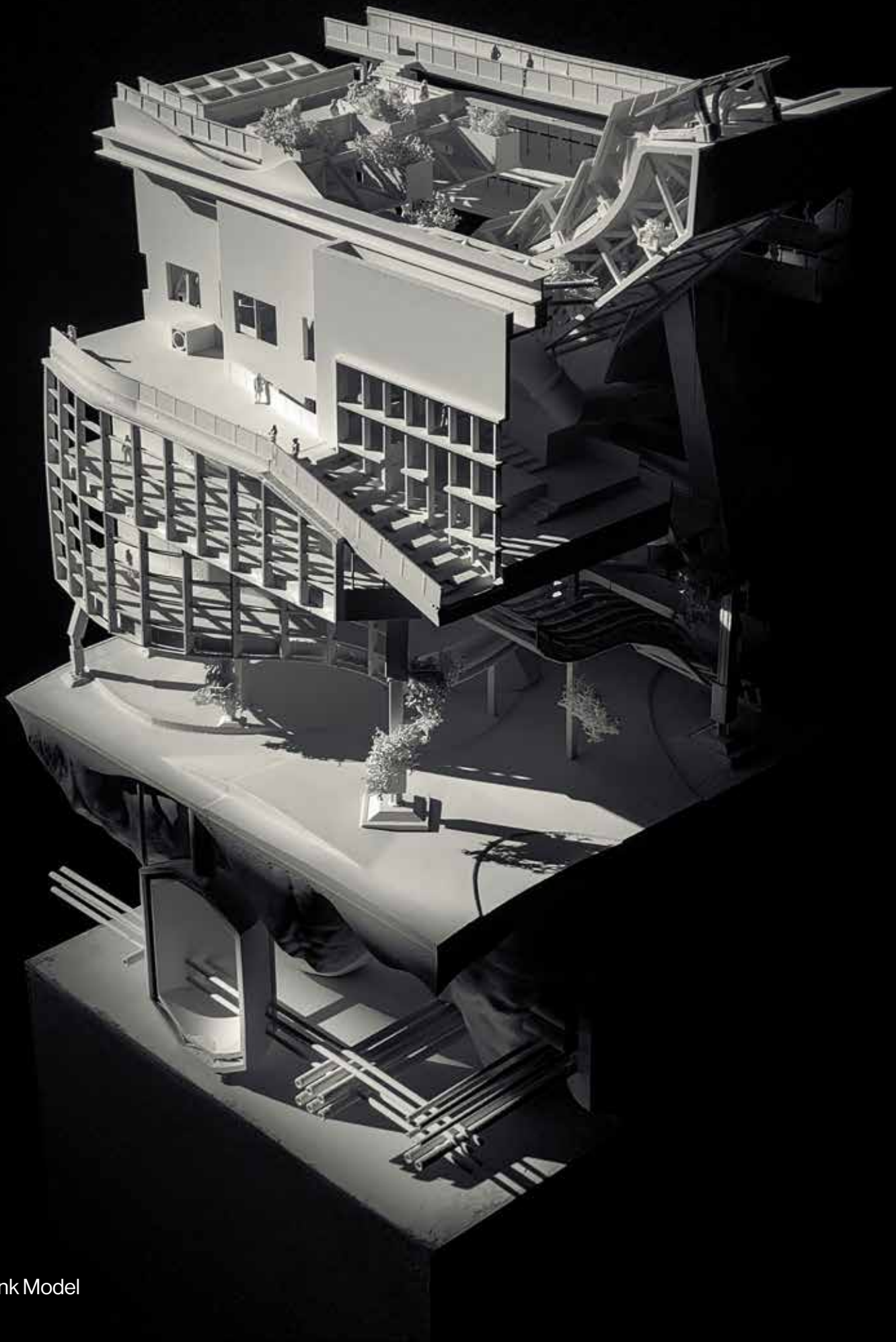


Section

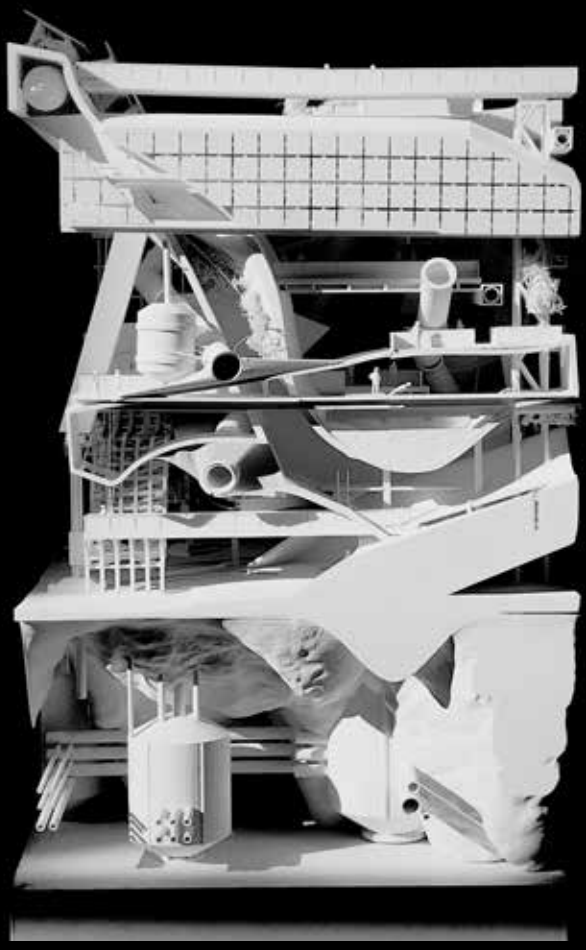


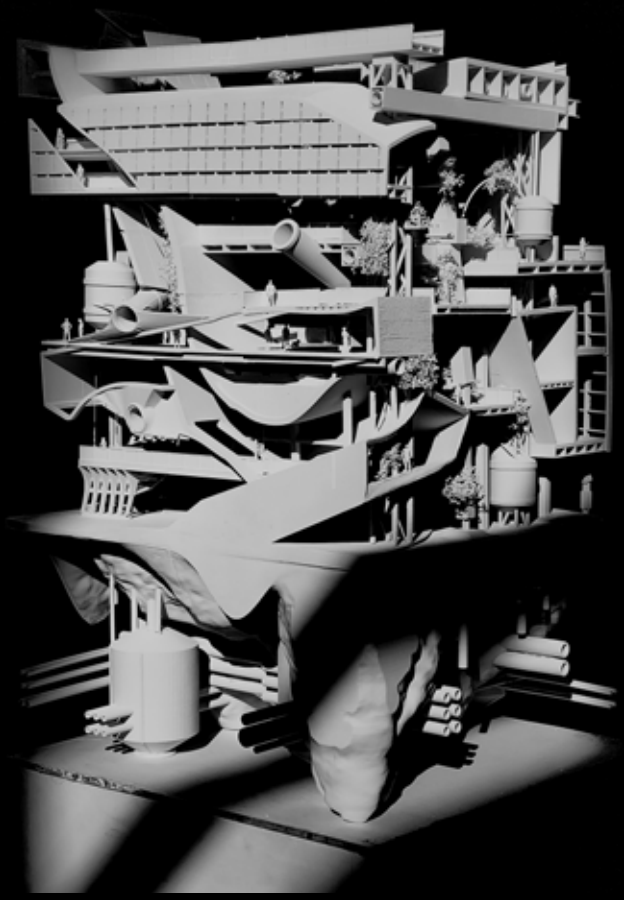
Structure Systems





Chunk Model





Thallus Pavilion

ARCH 7800-03, 2023

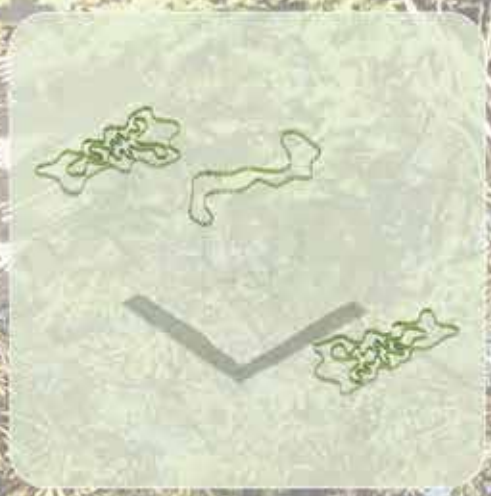
Based on the Thallus Patern by ZHA CODE, We developed a system to print clay using robotics and simulate multiple curves at a time on a complex surface using Grasshopper and Maya. Separate panels are simulated based on the height of the panels to reduce weight on the roof and increase denisty on the base by adding or removing initial curves.

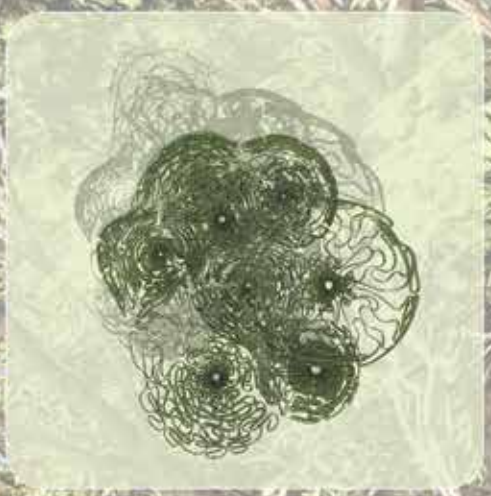
Simulation, Slicing, Rendering: Jacob Lehrer
Surface Modeling: Dante Egizi
Maintenance Tech: Coleman Connor
Printing Assistant: Skylar Chardon

ARCH7800-03 // TECTONICS OF ROBOTIC MANUFACTURING

RESEARCH INTO FDM, LINEAR AND MULTI-AXIS 3D PRINTING

SECTION





ELEVATION

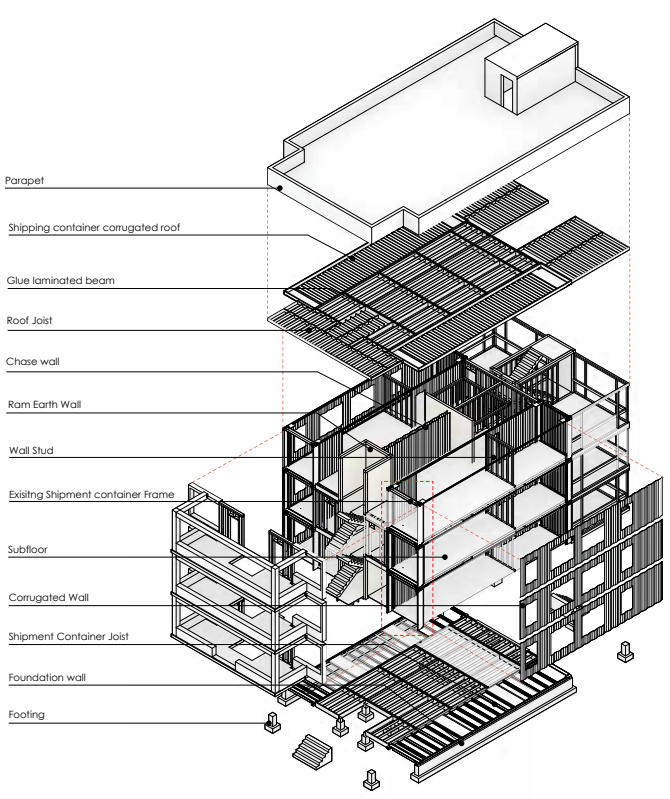
Solar Decathalon

Studio 8, 2023 (Finalist)

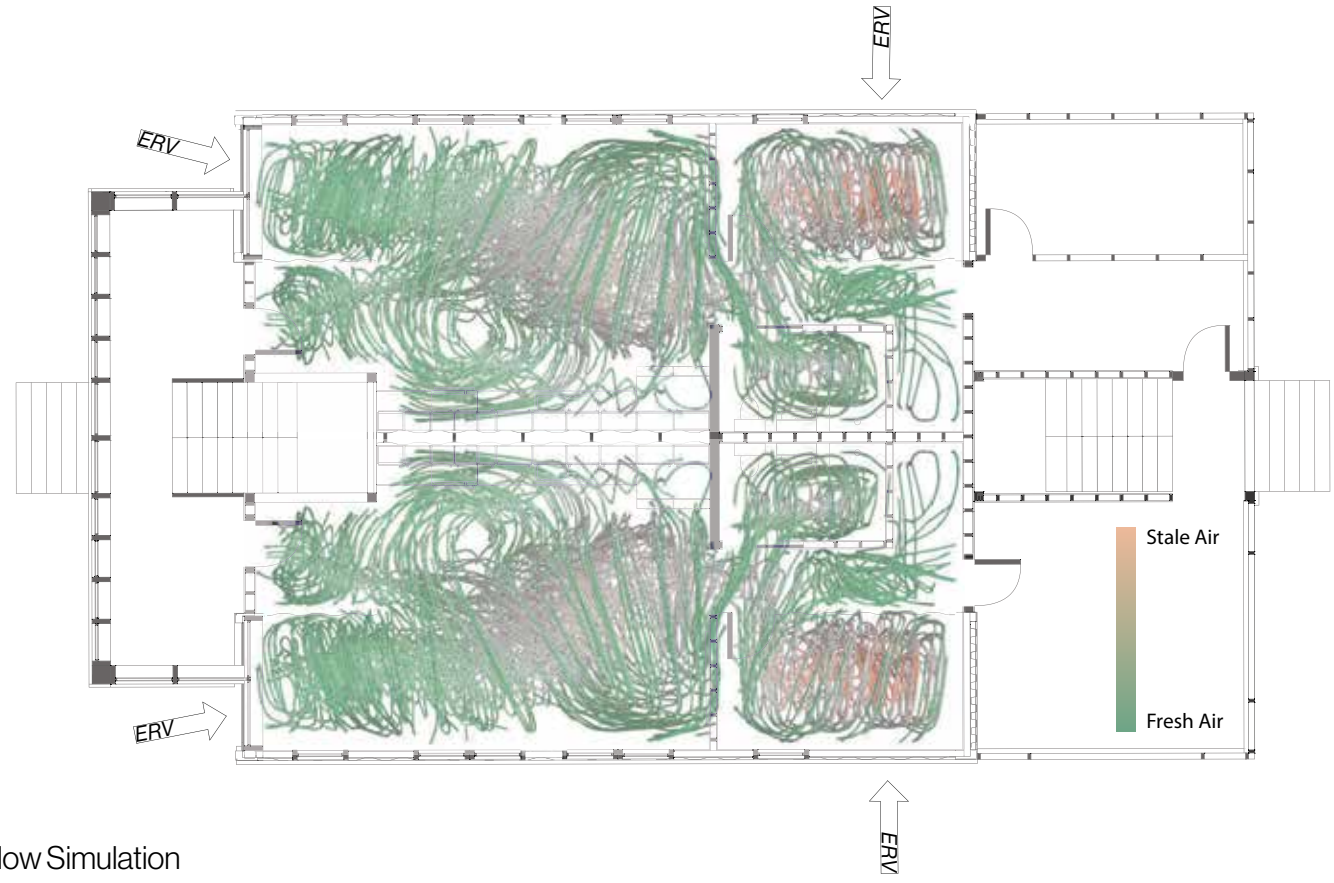
Boston has some of the most expensive housing in the country, so our challenge for the 2023 Solar Decathalon was to build an affordable, sustainable multi-family housing project. Our solution used shipping containers from the nearby port to accentuate reuse and reduction of virgin material extraction. The key systems strategy was to separate airchanges from heating and cooling, using Energy Recovery Ventilators and Heat Pumps. We also used a solar pavillion on the roof to offset electricity use.

Concept + Team Lead: Antoni Kareklas
Sustainability, Systems, Simulations: Jacob Lehrer
Structure: Nanh Trinh
Interiors: Madison Goldfarb
Exterior + Graphics: Jenna Gormley

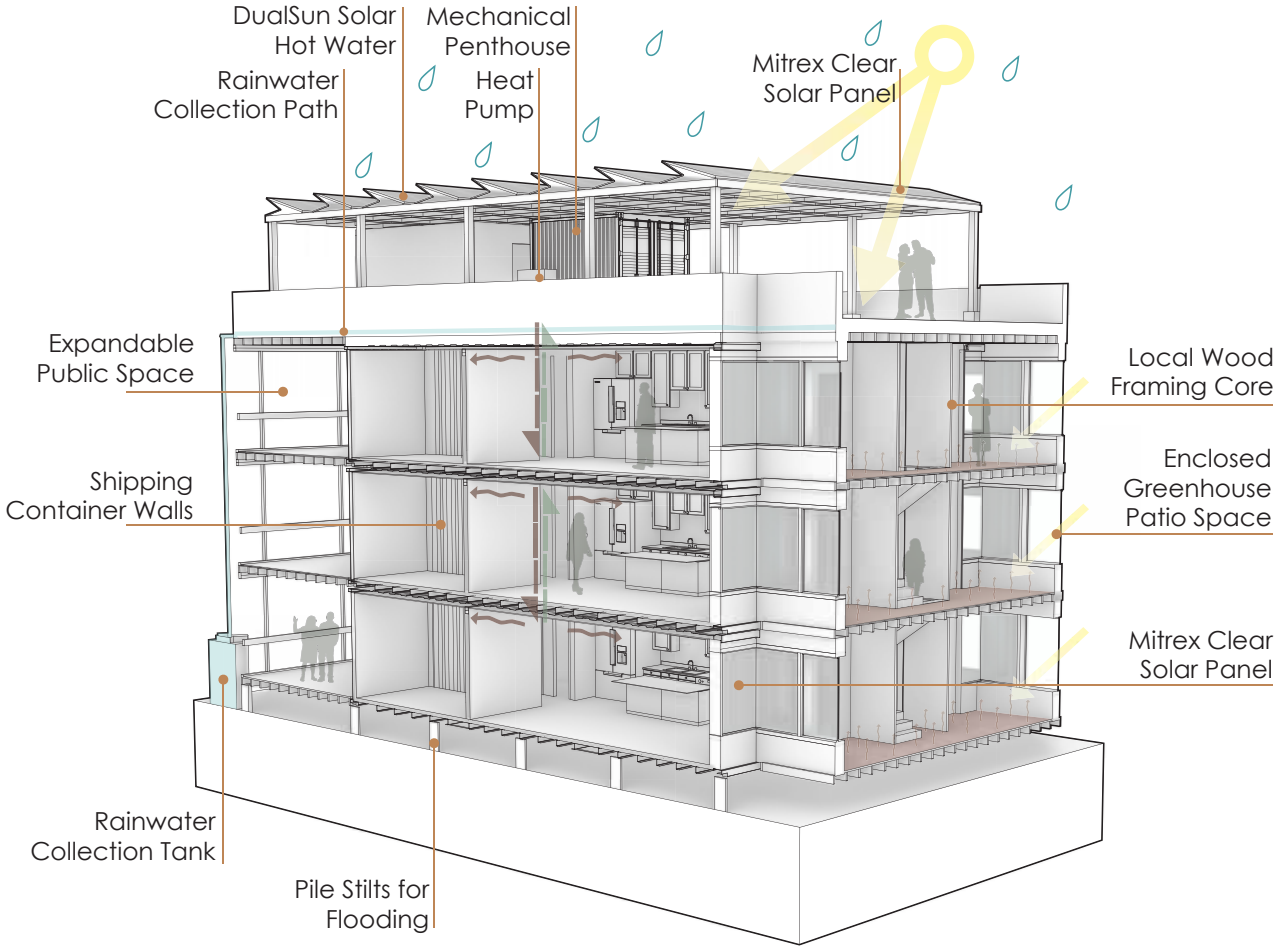
Ground Floor Plan



Exploded Axon



Airflow Simulation

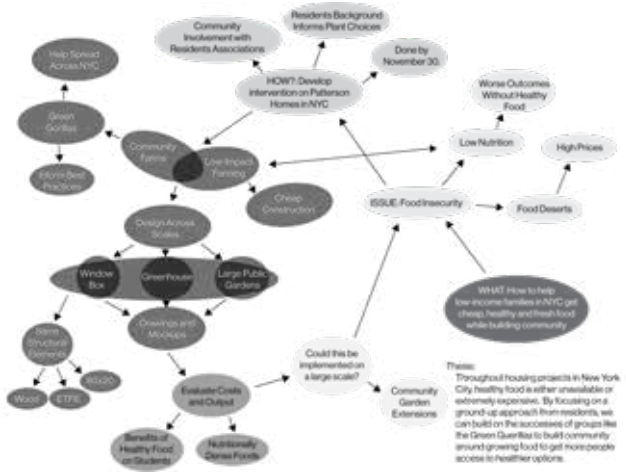


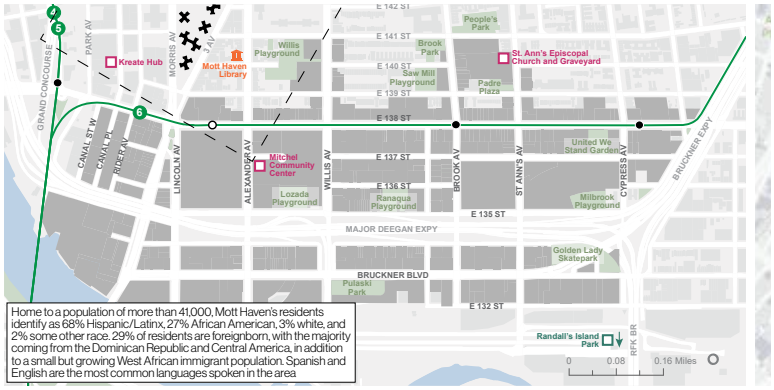
System Diagram

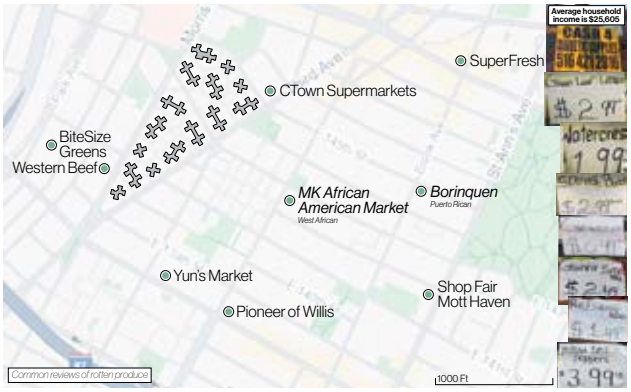
Terrablocks

MIT 4.325, 2024

Throughout housing projects in New York City, healthy food is either unavailable or extremely expensive. By focusing on a ground-up approach from residents, we can build on the successes of groups like the Green Guerillas to build community around growing food to get more people access to healthier options through the act of constructing growing spaces. This research was done before my 2GAX Lincoln Heights project, providing me a unique perspective on food inequity and accessibility needs in large cities.

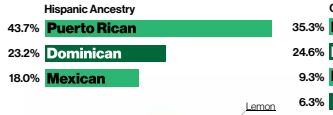


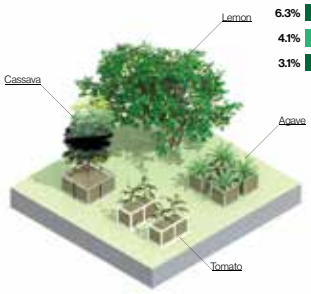




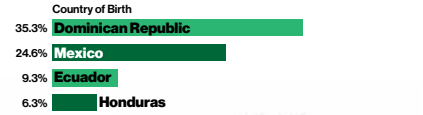
Puerto Rico

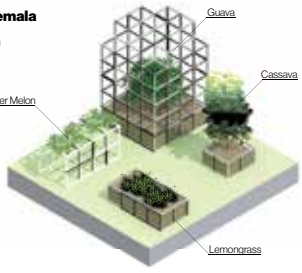
Dominican Republic





Mexico





Ghana

Distillate

Independent, June 2024

"Distillate" is a physical and metaphorical investigation into the extraction and blending of data sources with no regard for their origin or context. By presenting data collection as an eroding fountain inspired by six separate interviews, This project delves into shifting architectural methodologies in the new era of ubiquitous AI by harnessing research from construction projects, white papers, and extensive data archives. The resulting fountain connects viewers to diverse perspectives worldwide through six pathways, each crafted from local materials. As these fountains erode, they blend into a collective distillation—a fluid history of architecture across continents. This project unveils the intrinsic chemical and societal secrets that underpin our diverse design languages.

Interviews

Tathagat Bhatia
Lucknow

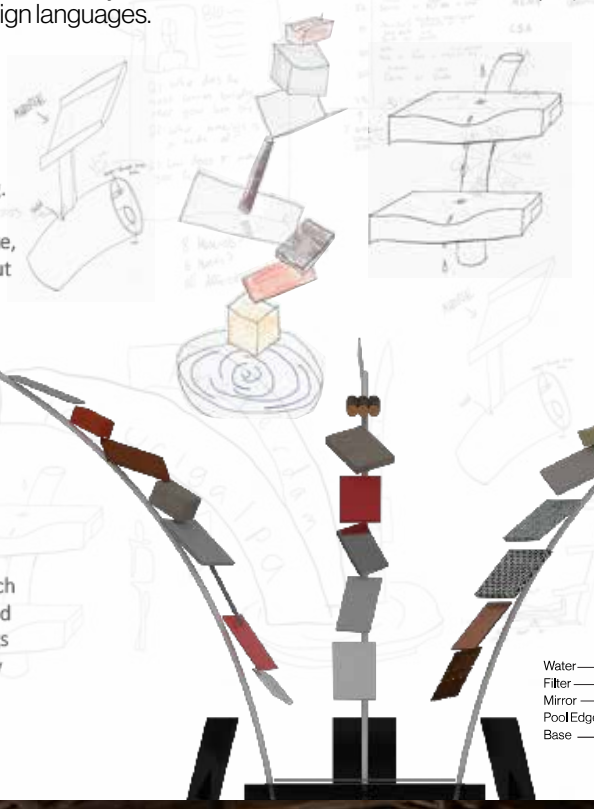
"The dust when you're there, like it's quite irritating. It gets everywhere. It gets on your clothes and, like, outside and like, the clothes need to be washed. Like, pretty often your shoes become, like, really dirty. But I think reflecting on it makes me quite nostalgic"

Jennifer Medina
Tegucigalpa

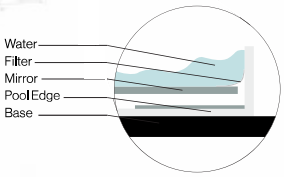
"It's a lot of nature when you go there even and you wouldn't think in the city there would be a lot of nature. But there is. There's a lot of mountains, greenery, birds, parrots specifically"

Liz Grinspoon
Boston

"It's just such a beautiful place to be and there's such a center with all of these people and celebration and it's just this very lively, energetic place. The buildings are the backdrop for all of it, and they make the city look different than any other place that I've been."



Video



Parametric Architecture

2024 - Present

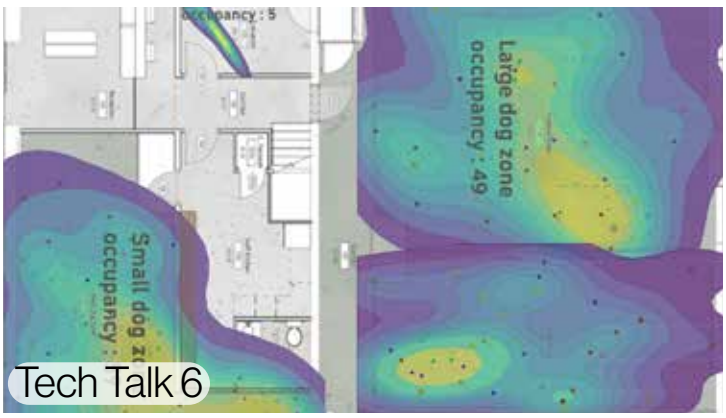
Since presenting AUTOMATA at CDNEXT 15, I have worked to produce two workshops, a chapter in their publication Future[Tectonics], and presented the Sentient Environment Engine at the Design Tech Talk 6.0. Expanding my own pedagogical practice has allowed me to better understand the tools I use. For example, through teaching Ladybug, I discussed the ethical implications of AI and the mathematical frameworks behind systems like ChatGPT.

PAACADEMY Page

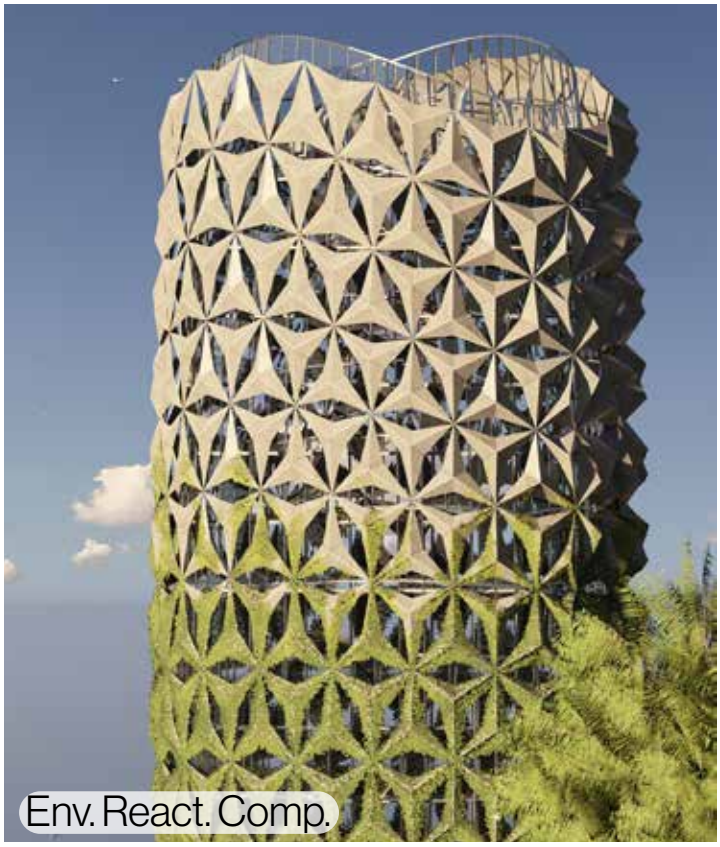
Future[Tectonics]


Plugins 101

Beginner Bundle



Tech Talk 6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