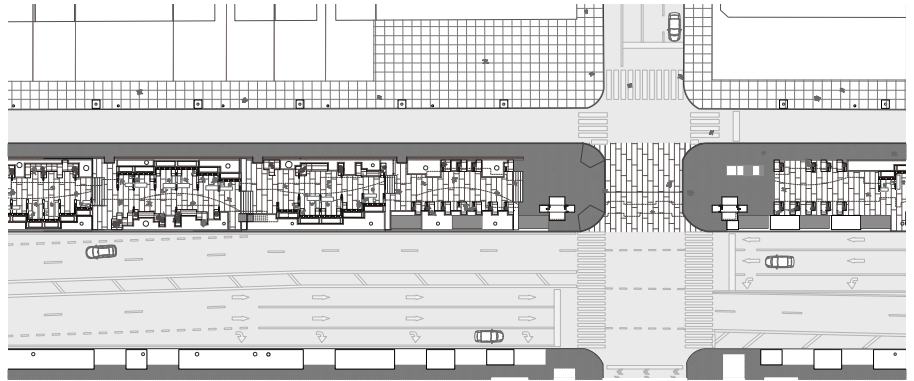


**tianyun sky
zhang**

Columbia University
Graduate School of Architecture, Planning and Preservation



PORTFOLIO

2020 - 2023



Contents

01	_____	Alongside Extraction	04
02	_____	Canopy Market	14
03	_____	Kin House	22
04	_____	Co(Re) Housing	32
05	_____	PS64: Garden School	42
06	_____	Oasis Hotel	48
07	_____	Surviving Manhattan	54

01

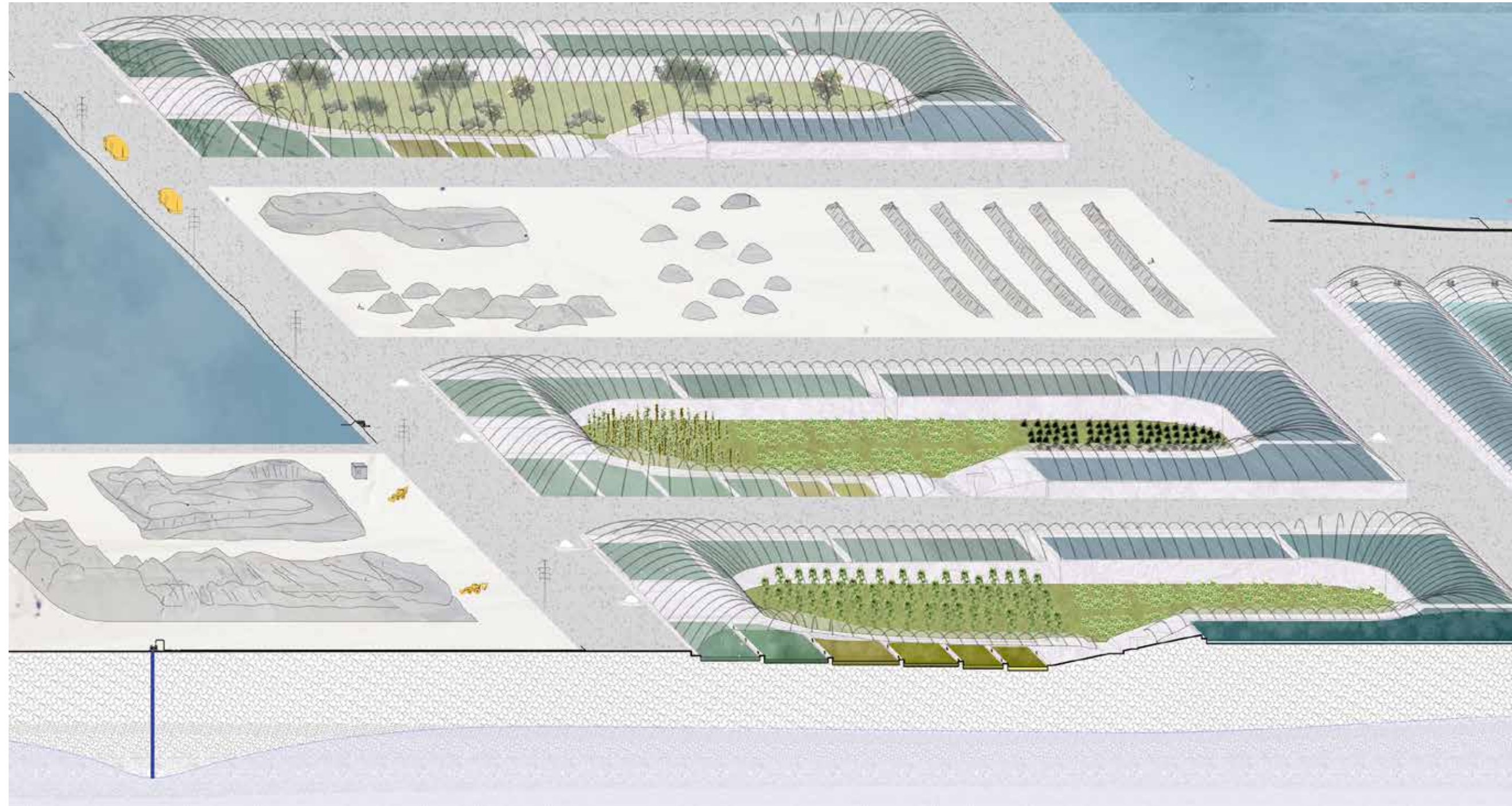
Alongside Extraction

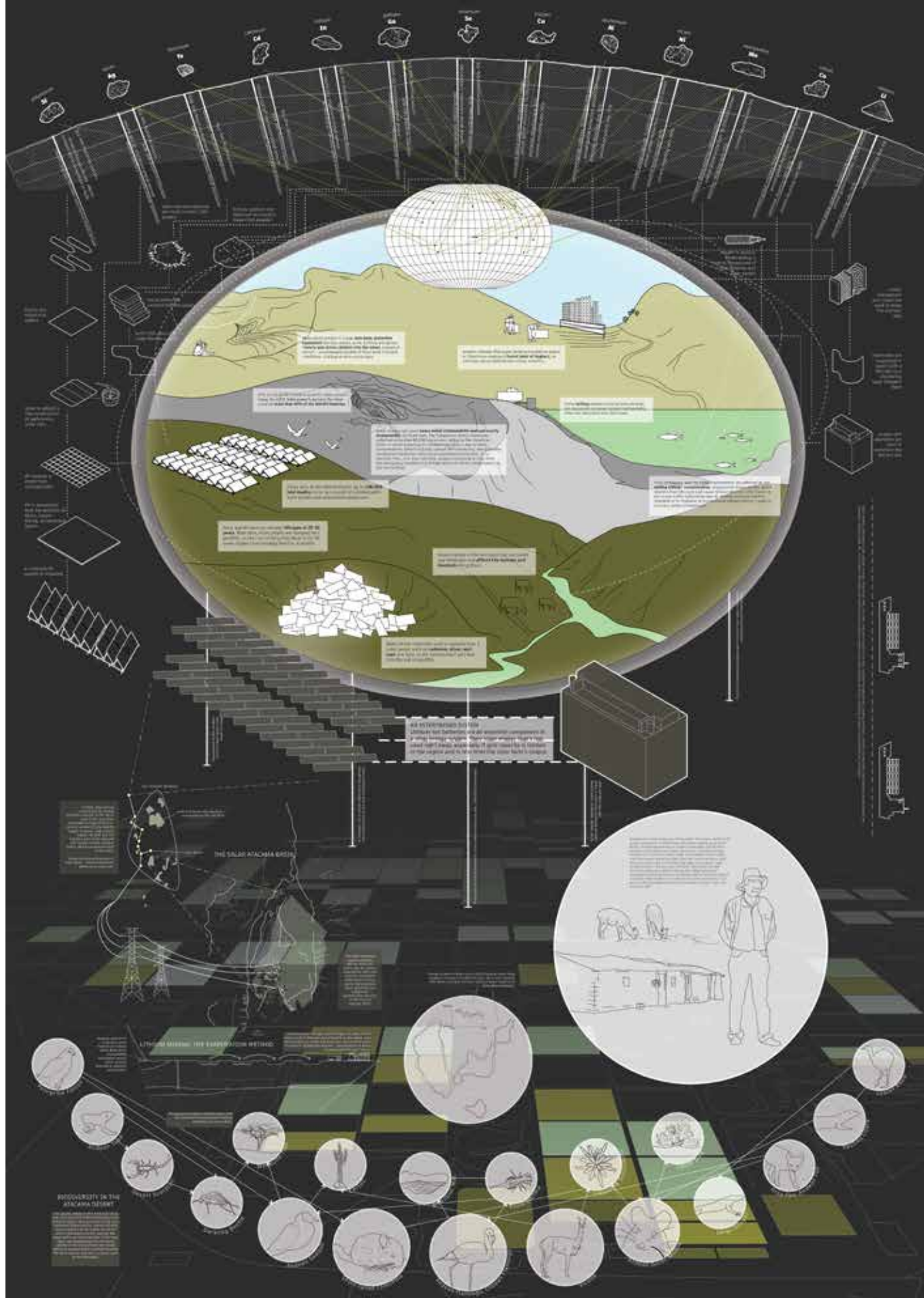
Studio: ADV VI Spring 2023
Critic: Mireia Luzzaraga & Alejandro Muino
Keywords: climate change, de-growth, diversification, redistribution

In Chile, the Salar de Atacama supports 30% of the global lithium supply. The mines extract lithium through pumping brine, which is so intensive that it has caused a significant lowering of water tables across the region. Lagoons have started drying up since before mining operations started, and rivers and streams and entire areas of vegetation have disappeared.

Recognizing that water is the focal point of conflict as well as the key ingredient to the health of the Salar, the intervention aims to reconcile the conflicting interests of multiple agents at the site through capturing and restoring water to agents who have suffered from water loss due to mining activities.

The diversifying of activities that take place on the site proposes an alternative reality for lithium mining. By occupying significant portions of area originally intended for lithium mining and re-dedicating it to farming, lagoons, botanical gardens and biological research, the project reduces the rate and intensity of lithium operations and follows a logic of de-growth.





Lithium is a key component in rechargeable batteries found in solar PV systems, electric vehicles, laptops, cell phones, and cameras. It is not only a part of our daily lives but is critical in the effort of countries around the world to switch away from fossil fuels to renewable energy systems.

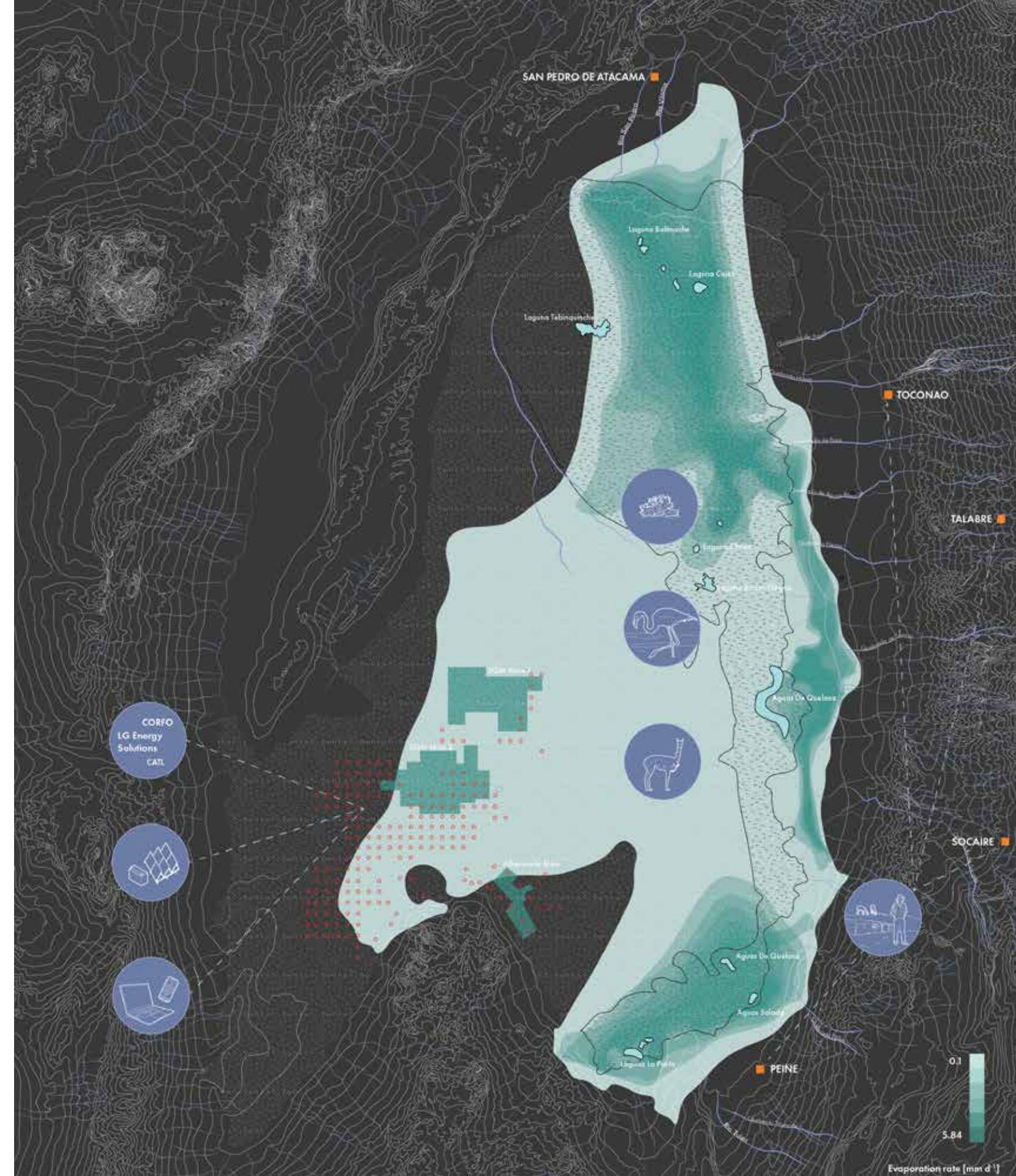
The mines extract lithium through pumping brine, the saline groundwater with dissolved lithium, from underground reservoirs onto the surface into a series of evaporation ponds. In these ponds, the H₂O component of the brine is allowed to evaporate under the sun, leaving behind a more concentrated lithium solution.

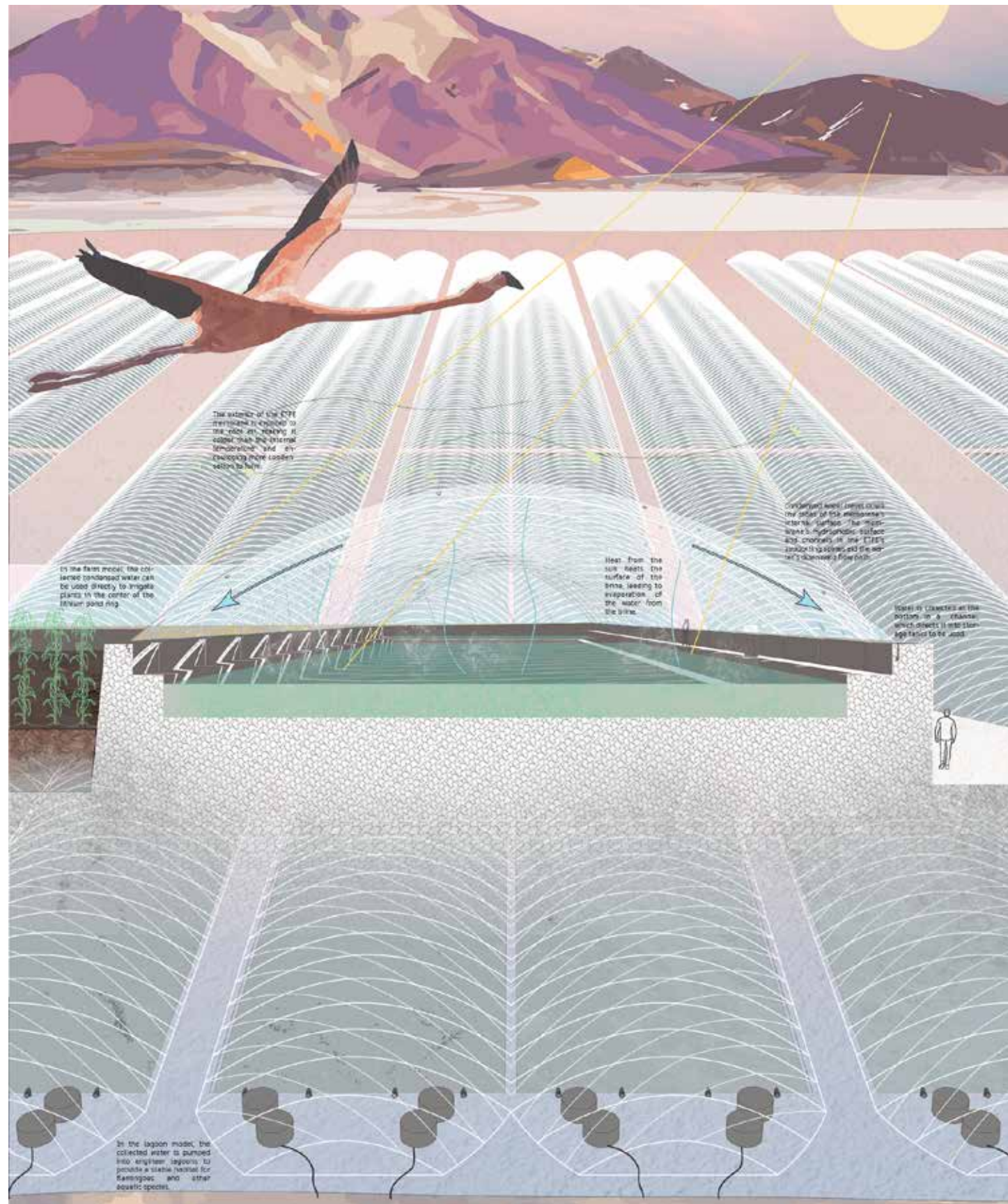
As the brine becomes more concentrated, it is pumped to the next pond, where dissolved minerals besides lithium are removed and it is left to evaporate further. The entire process takes between 12 to 18 months, going through about 15 ponds. The mines occupy an area of about 80 square kilometers, and given the high evaporation rate of 3500mm per year, an approximate 280 billion liters of water is being evaporated from these ponds per year, or 767 million liters per day.

Even though the Atacama Desert is a hyper arid climate, a rich network of biological organisms has evolved and adapted to thrive in this region. This includes vicunas, chinchillas, falcons, lizards, beetles, and a complex microbial system that due to their ability to survive in super dry climates have been of high interest and value to the scientific community. Biodiversity is especially rich in and surrounding the lagoons that form at the foot of the mountains surrounding the salt flat, where fresh groundwater mix with saltwater to form brackish habitats for several species, most notably flamingos, algae, and brine shrimp. The region is also home for several indigenous communities in towns and villages surrounding the salt flat who over centuries have adapted their ways of life to the surrounding climate and ecosystem.

However, the pumping of underground salt water is so intensive that it has caused a significant lowering of water tables across the region. Lagoons have started drying up since before mining operations started, and rivers and streams and entire areas of vegetation have disappeared. In the face of this unprecedented drought, even people, plants and animals who are adapted to survive in the desert have been struggling. Every year, populations of flamingoes, carob trees, marine shrimp have been in decline. Indigenous people who have been unable to sustain traditional water and farming practices have been leaving home to move into large cities.

However, lithium production cannot stop: it is crucial to the global transition to electric and renewable energy. The Salar de Atacama is a site of conflict: between the global and the local, between corporate interests and the preservation of culture, and between different spheres of action and impact of the climate crisis: energy vs biodiversity, carbon reduction vs the conservation of specific ecosystems.





Using the concept of solar stills, ETFE membranes, transparent, lightweight, and yet resistant to the climate, stretch to cover the surface of the brine evaporation ponds. Sunlight passes through the membrane to heat the brine, causing evaporation of the water, and the water vapor condenses on the inside of the membrane, which is cooler as it is exposed to the air on the other side. Condensed water droplets travel down the sides and are collected at the bottom in channels leading to water storage tanks. The captured water is directed to a number of activities and programs that are brought on site, benefitting agents that have been suffering from water loss due to mining. The redirected water is used to either create artificial lagoons and botanical gardens for wildlife or for farms and greenhouses owned and operated by farmers or families from the indigenous communities in surrounding towns and villages.

The farm model takes over existing brine ponds which are drained. Subdivisions are created within the larger basin, with a series of small-scale lithium ponds surrounding a plot of land in the middle which is filled with soil from the surrounding region and used for crops. In the design of this module, the lithium brine completes a full 12-pond evaporation process in a circular arrangement, ensuring that the land in the center can receive irrigation directly with little or no pumping. Each pond is also stepped slightly lower than the previous one, providing a means for the brine to travel from pond to pond with no pumping involved.

Each collection of lithium ponds surrounding a plot of land is a farming module owned by either an individual or a group of individuals, and is replicated on and replaces existing brine ponds of similar size and scale throughout the site. In this manner, the owner of each individual farming module owns the lithium and byproducts produced from the lithium evaporation ponds, uses its water to directly irrigate his or her crops, and benefits from harvesting of both produce and of lithium and byproducts.

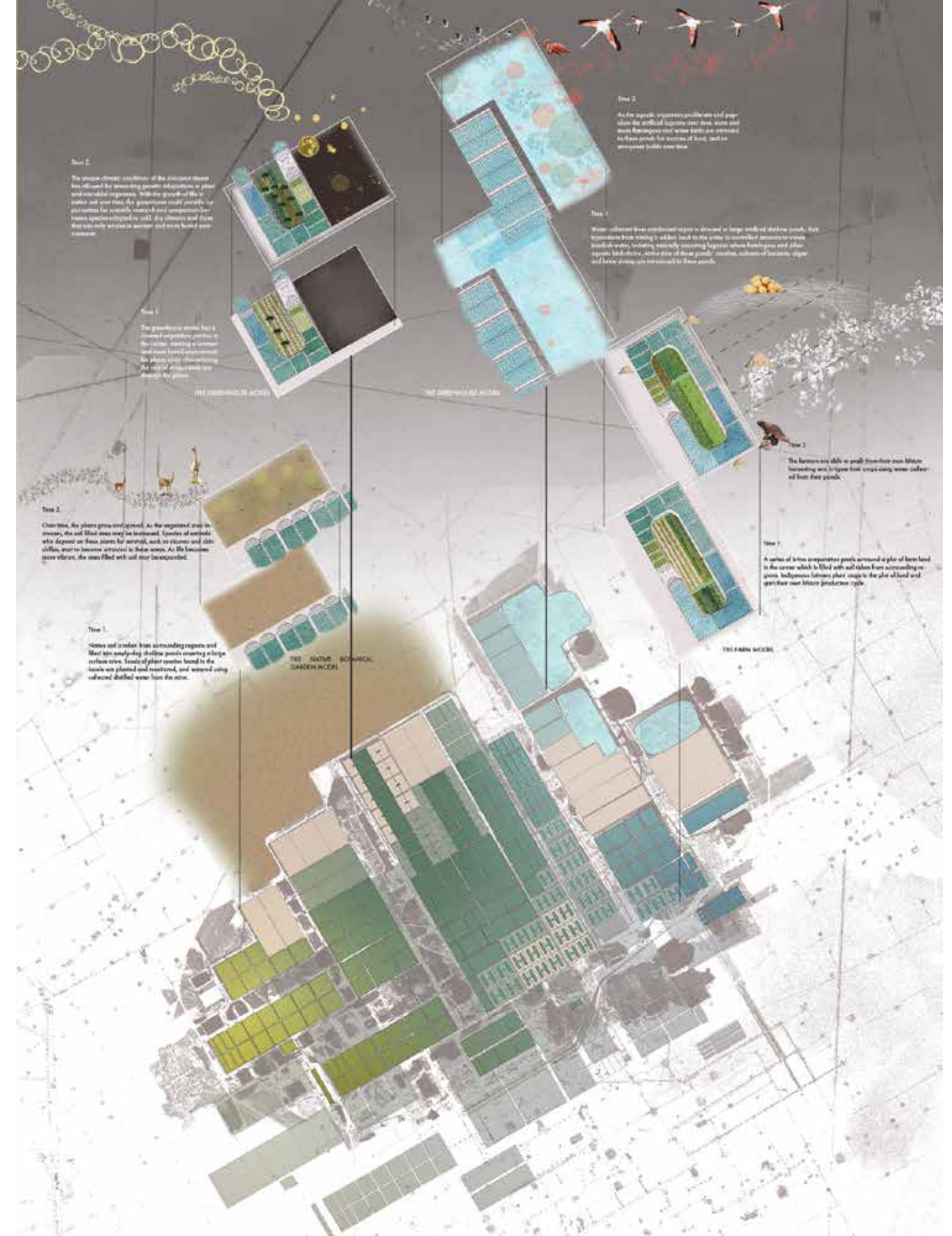
The greenhouse model is similar to the farm model except that the plot of land in the middle is also covered by a separate ETFE membrane. This creates a self-contained, warm and humid environment ideal for either crops or plant species for scientific research. These greenhouse modules are often placed next to open plots of native soil for comparison of microbial and vegetative life in humid vs dry environments.

In the artificial lagoon model, ETFE membranes are placed directly on top of the existing brine ponds owned by the mining companies to harvest their evaporating water. An additional shallow basin is dug next to the ETFE water collection structures, and filled with the harvested water and then maintained by being fed a continuous supply. Imitating the conditions of the naturally-occurring lagoons, salt and minerals byproducts from the mining process are added back into the artificial lagoon at a level ideal for the organisms of the brackish lagoon ecosystem. Naturally-occurring lagoons in the Atacama which have been drying up, have seen their concentrations of dissolved salt rise as a result, making the environment hostile to species living in them such as the brine shrimp and algae. These species form the bottom of the food chain and their survival is dependent on by other animals and birds. By maintaining an ideal balance of salt and water in these artificial lagoons, a stable haven is provided for these aquatic animals.

The native botanical garden model is similar to the lagoon model in that water is harvested from the existing mine ponds and directed to an external adjacent area. Instead of filling a pond with water, soil from the surrounding region is used to fill an area. Seeds of native vegetation are planted in the soil and is irrigated by the collected distilled water.

All models of water harvesting applications grow and evolve over time. For example, in the lagoons, in the initial stage, it is necessary to place initial starting batches of algae and brine shrimp, and their proliferation may be gradual. However, as these smaller organisms populate the lagoons, they will start to draw flamingos and other water birds which are attracted to these lagoons primarily for sources of food. Similarly, in the native botanical gardens, the plants will take time to establish and spread. As they do so, the region will start to resemble a natural wild landscape and will start to attract animals that depend on the plants for food and shelter such as vicunas, chinchillas, and other insects and birds. Over time, the botanical garden expands and can start to connect and overlap with the lagoons, stitching together a larger wildlife landscape.

Over time, farmers may start selling their own lithium to national buyers from Chile, and rich microbial communities in the greenhouses may attract scientific researchers who study the desert's microorganisms.



02

Canopy Market

Studio: ADV V Fall 2022

Critic: Marc Tsurumaki

Special focus: biogenic materials;
mass and thickness; public space

This project focuses on street vendors, an underrecognized and underdeveloped sector of the economy and fabric of the city. It also tests the boundaries on what can be done to improve the pedestrian experience of the act of traveling down a street. Following the interests of the studio on mass and thickness, the project starts from move that thickens the and de-laminates the ground, creating new layers of occupiable spaces.



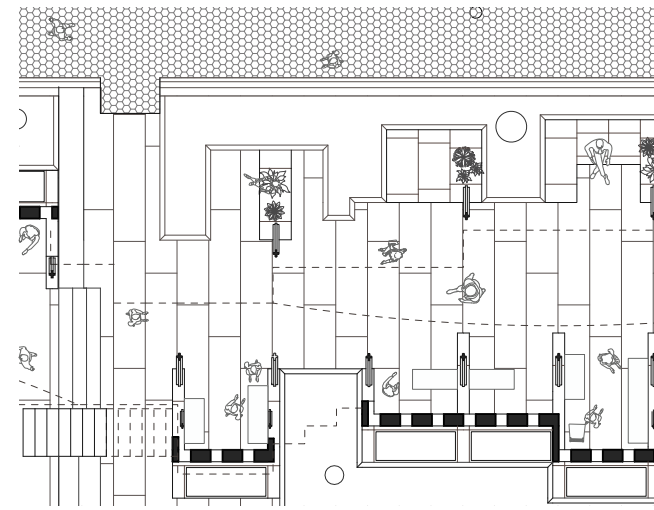
Model photo.



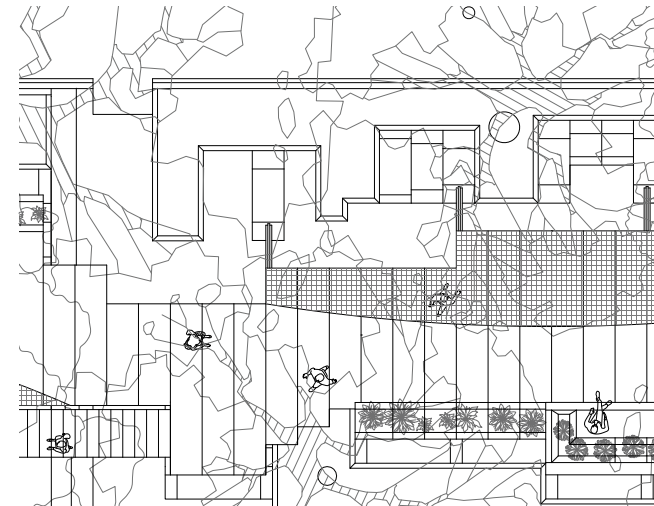
Map of Eastern Parkway and surrounding area showing concentration of vendor license applications.

The site is located along a portion of Eastern Parkway, a 3.8-mile pedestrian promenade in New York City's Brooklyn in the neighborhood of Crown Heights. It traverses the Parkway's intersection with Nostrand Ave and lies at the intersection of many interesting conditions.

This neighborhood enjoys the presence of a higher-than-average percentage of street vendors, many of whom live in the area. The street vendors are a largely unaccounted-for portion of the economy composed of business people, family supporters, entrepreneurs and artists who make a living selling their goods independently on the streets. However, obtaining a vendor license in NYC is a long and arduous process, with the number of applicants far outnumbering the cap on licenses. The penalty for selling without a license is steep, a price that many vendors cannot afford to pay.



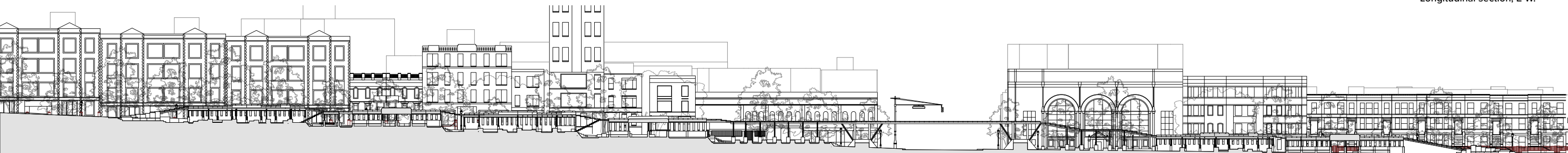
Plan fragment, ground level.



Plan fragment, walkway level.

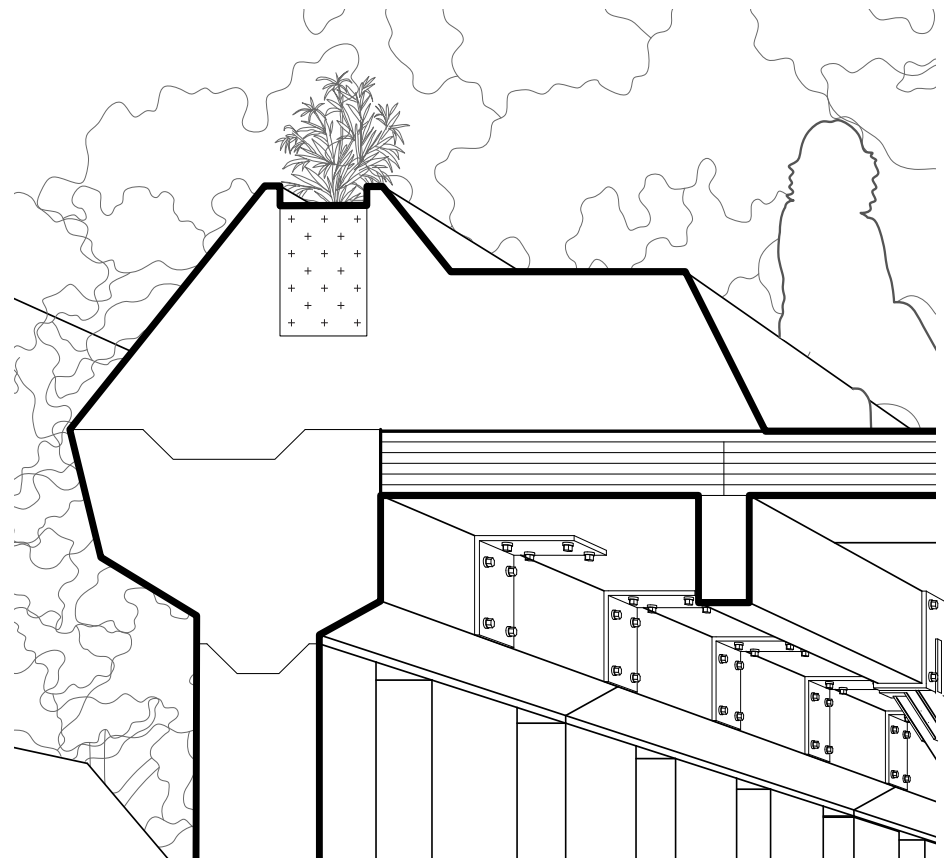
The intersection is centrally-located in the highest concentration of people who have applied for and are awaiting vendor licenses, and it is one of the busiest commercial zones of the neighborhood where high foot traffic creates a higher need for spaces where pedestrians and stop and rest. Topographically, it is also situated at a uniquely steep portion of the promenade.

The curving and weaving movement serves three functions: it enables the structure's co-existence and mutually-enhancing relationship with the trees; it creates natural eddies in the movement of pedestrians; it maximizes light opportunities for the vendor spaces below.



Longitudinal section, E-W.

The Canopy Market seeks to augment the existing conditions of the site by accommodating and adding to what is already there. None of the existing trees are removed in order to erect the new structure. The roof of the market, also the floor of the upper walkway, is consisted of CLT panels harvested from local, renewable farms, and interweaves between trees.



Construction detail.



Model photo showing view above walkway.

Plan, ground level.





The project takes advantage of the currently underutilized stretch of the parkway by thickening it as a ground plane, creating an upper and lower layer, which is effective in reducing the promenade's planar and unidirectional quality.

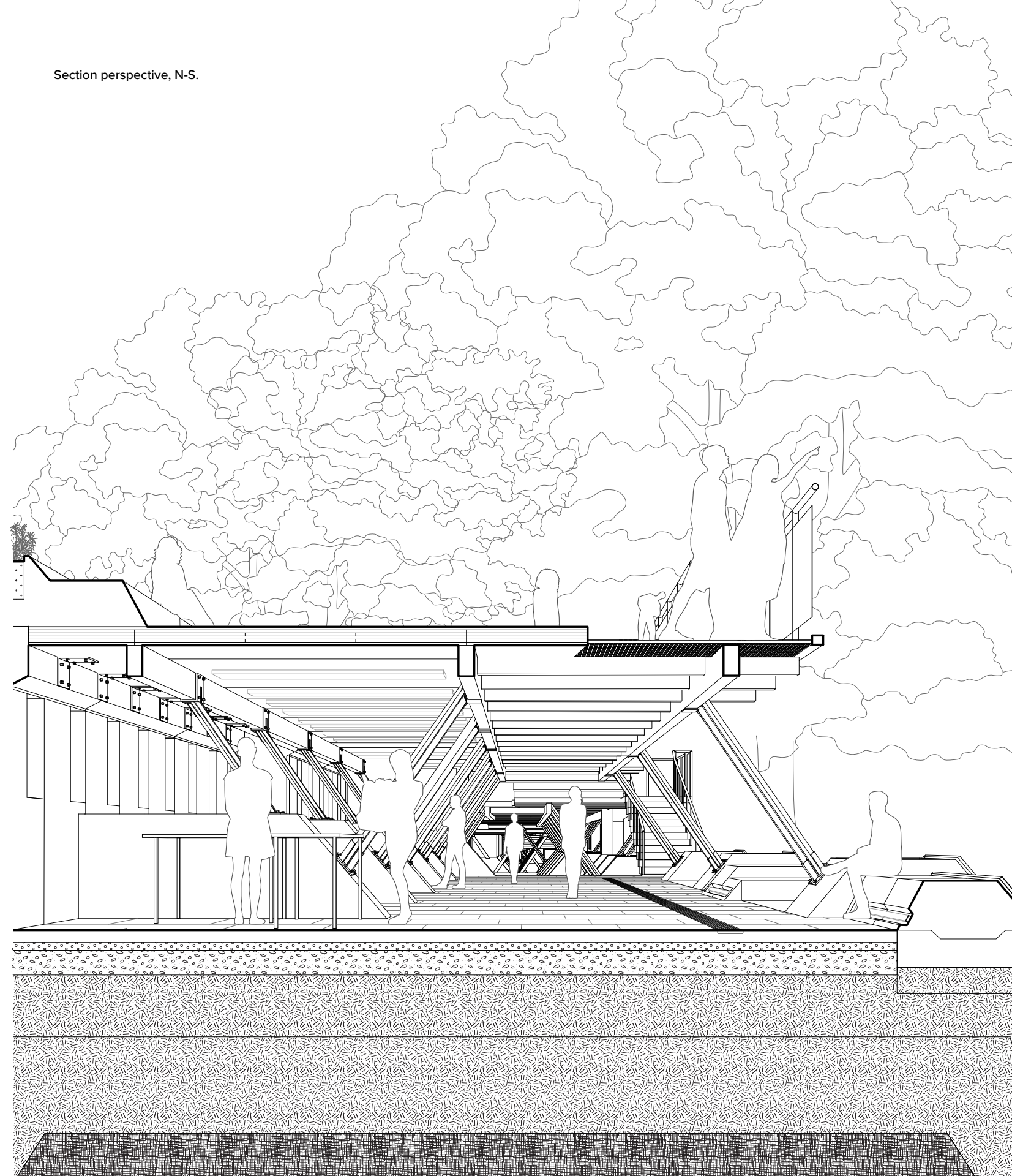
A walkable pavilion is on the top layer, and on the lower layer is a sanctioned space where street vendors who have been unable to procure a license can sell without being prosecuted.

Renderings, view from road.



Renderings, view from walkway.

Section perspective, N-S.

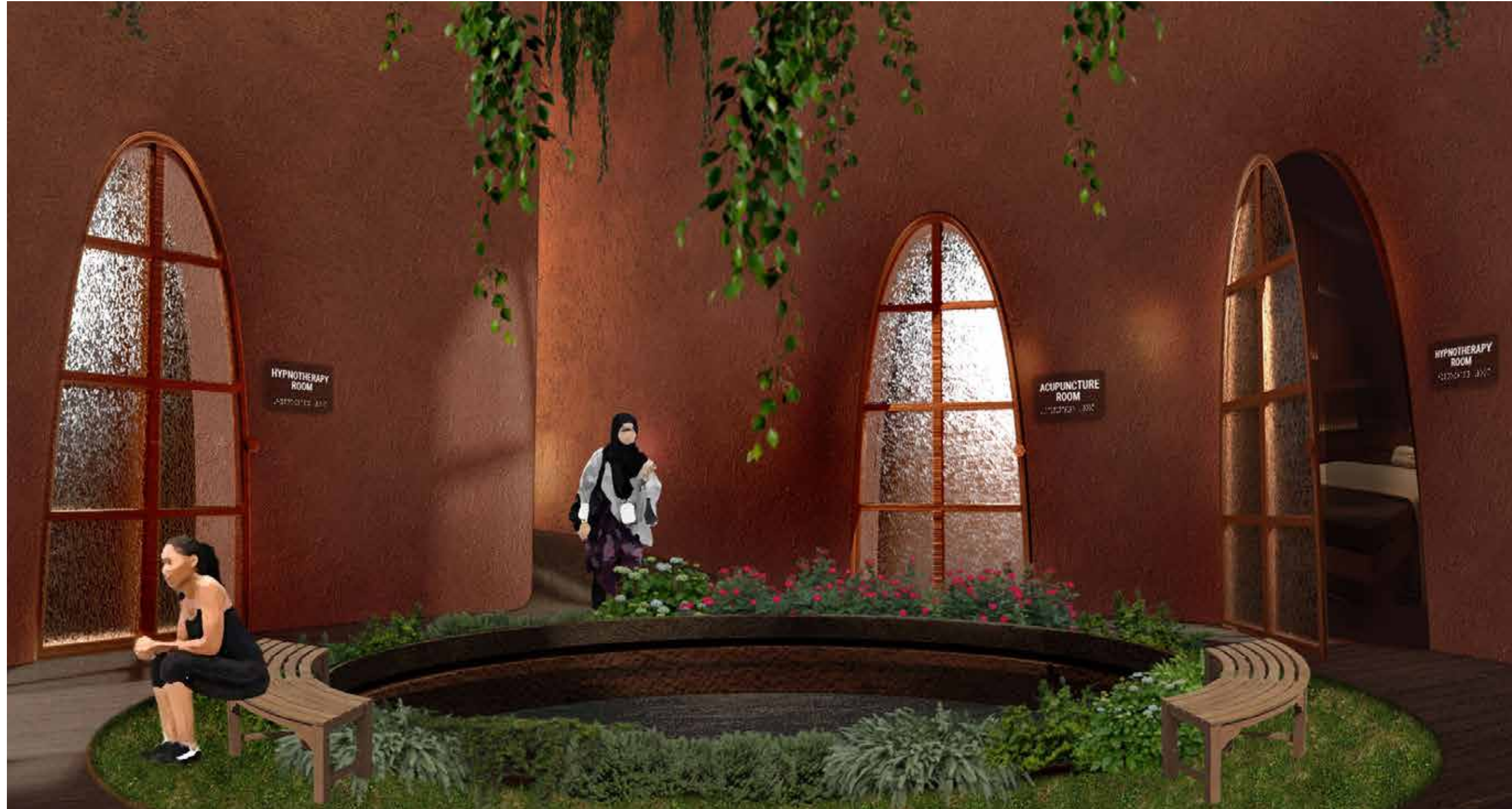


03

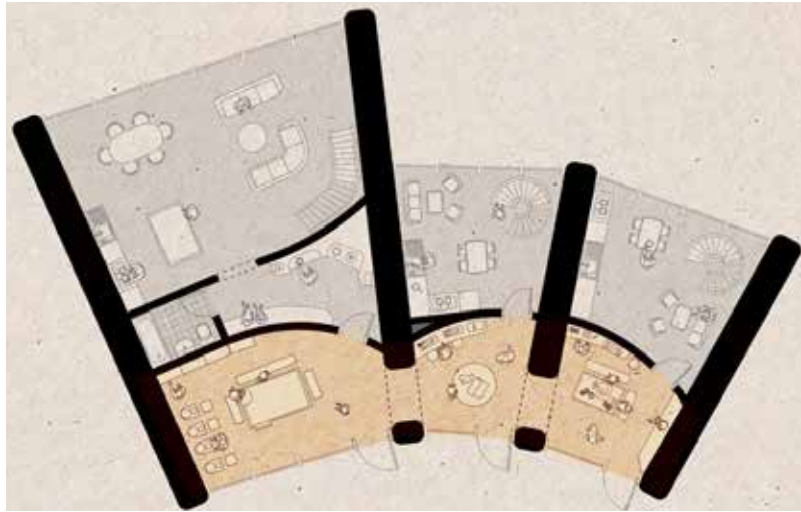
Kin House

Studio: ADV IV Spring 2022
Critic: Bryony Roberts
Collaborator: Rose Zhang
Special focus: earthen building technologies; mental health; community-building

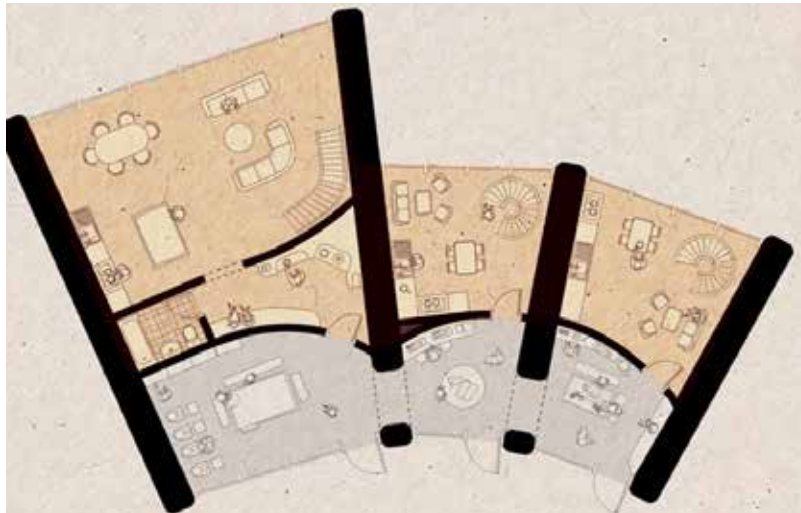
Kin House provides the space for healing through relationships - relationships with others as well as with the self. The facility targets those who have a history of opioid addiction. Specifically, we target those who have been addicted in the past but have recently undergone a detox treatment. The danger of relapse is especially high following an intensive addiction program, and Kin House supports individuals during this critical period through therapy treatment and providing the tools, spaces and equipment for the development of new, healthy relationships and interests, and as well as medical support for physical health.



Render, therapy space view.



Typical residential cluster, first level.



Typical residential cluster, second level.



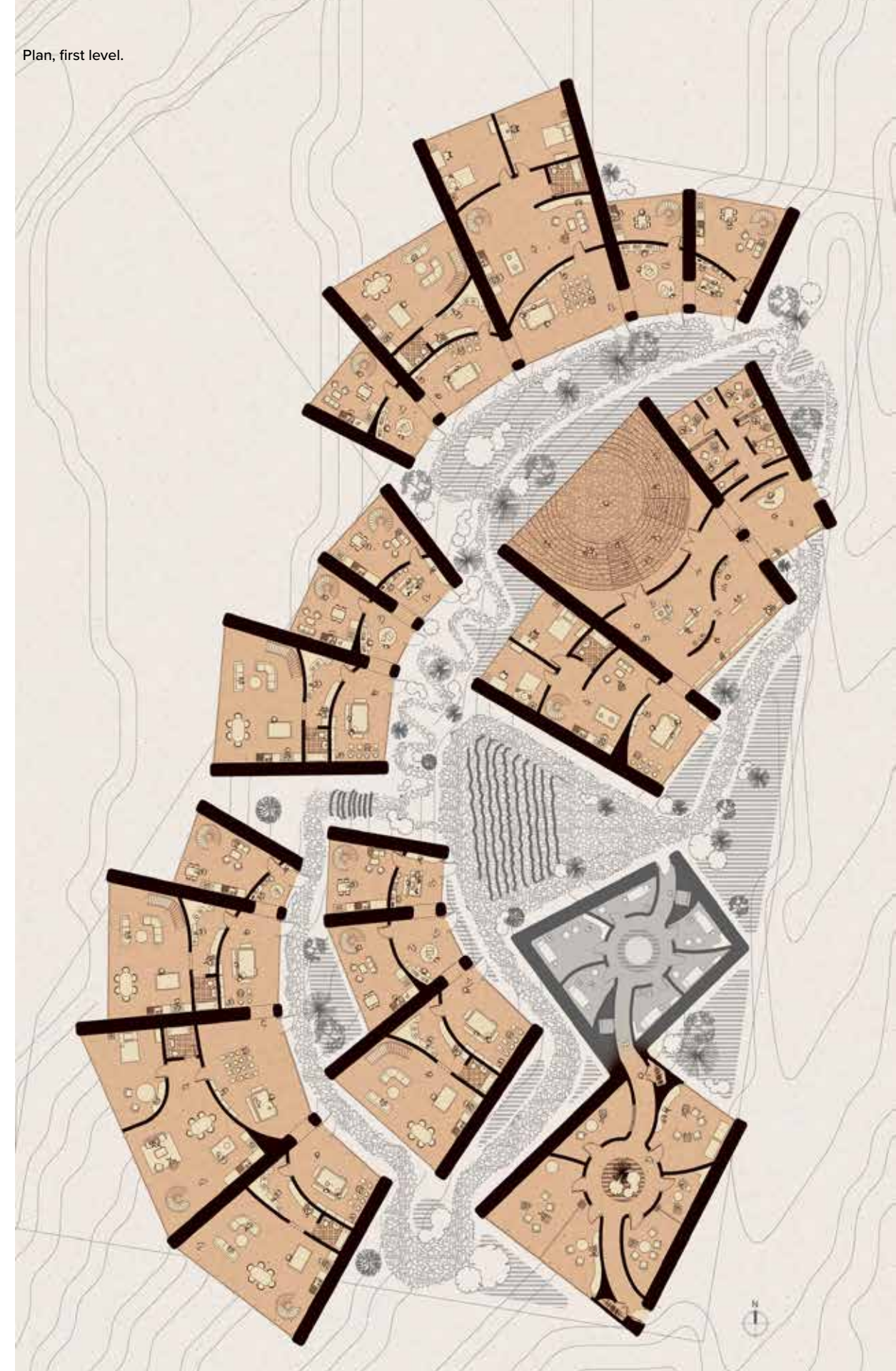
Rendering, view from shared making space.

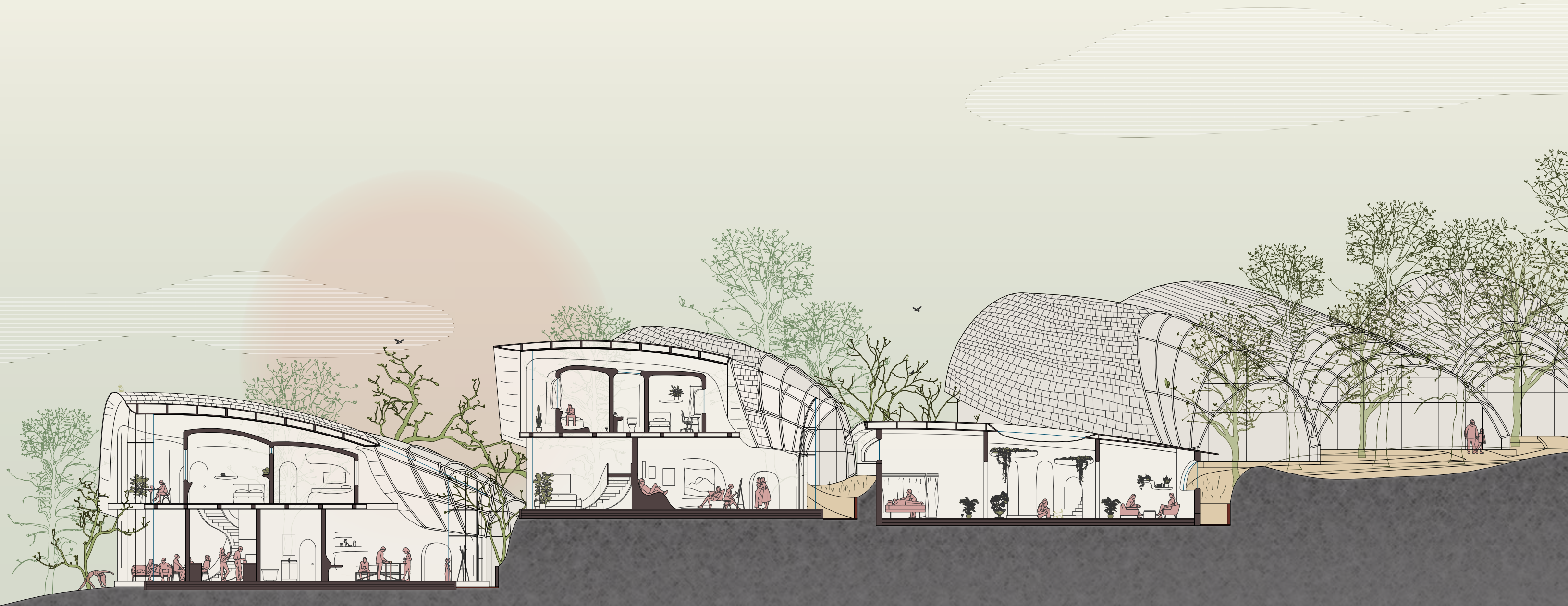
A cluster is formed by several shells, which are co-living houses that begin to emanate outwards.

On the narrower part of each shell is connected to other shells. This area is the making space of each cluster, which provides space and equipment for crafts such as pottery, painting, fabric art etc. This area can also be used for various career counseling and money management workshops.

Shells vary in size and provide between 1 and 5 bedrooms each, all located on the second floor, and the size of each shell determines the number of residents. Residents can choose to stay in larger shells if they wish for a high degree of sharing in their living situation, or opt for a smaller one if they prefer solitude or less sharing.

Plan, first level.

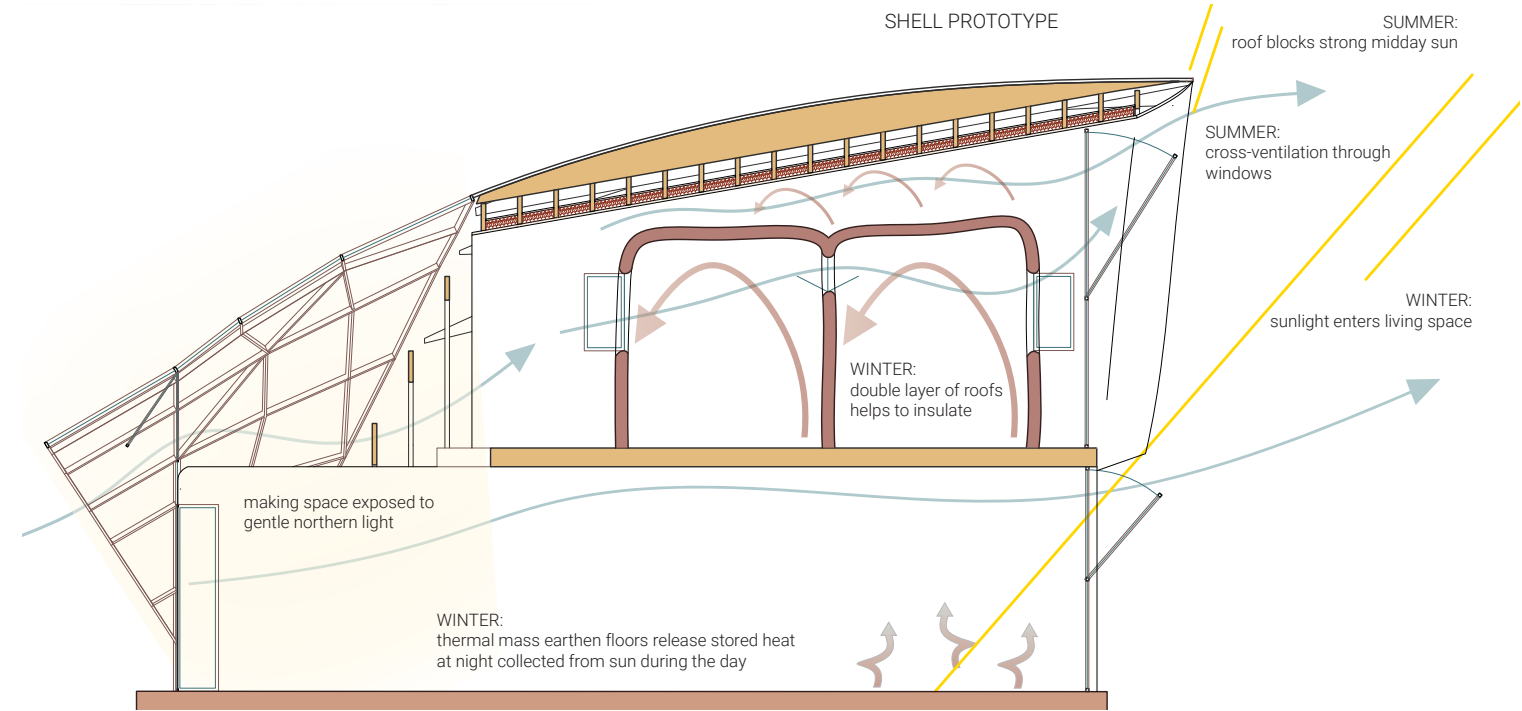




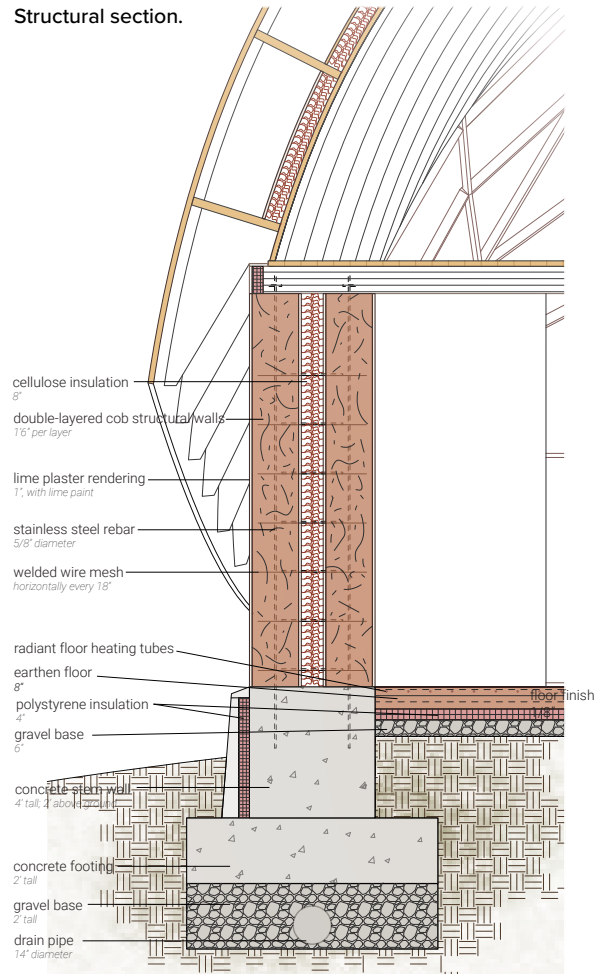
To minimize environmental impact, and maximize therapeutic effect, cob was chosen as the building material. It has a long history of being sturdy, long-lasting, low-carbon, with a soft, organic aesthetic. A mixture of sandy clay soil, straw, and water, Cob is built up by hand into the desired form, then dries and hardens into thermal mass structural walls.

In healing spaces, reverberation can be very agitating, triggering stress, anxiety, headaches, etcetera. Cob can effectively absorb sound, with a sound absorption coefficient above 0.7.

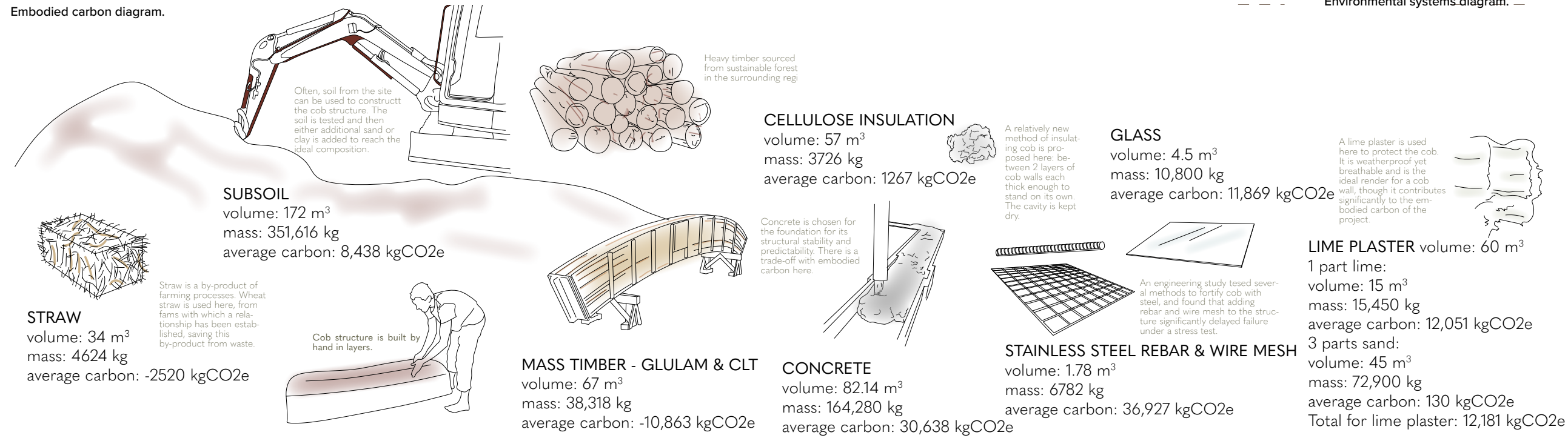
Cob also requires periodic maintenance and can be readily made as a collective activity, through which can generate a sense of home ownership. Cob allows residents to also build out custom mini-spaces in their homes under supervision, such as seating, platforms, and storage for those who wish to further personalize their space.



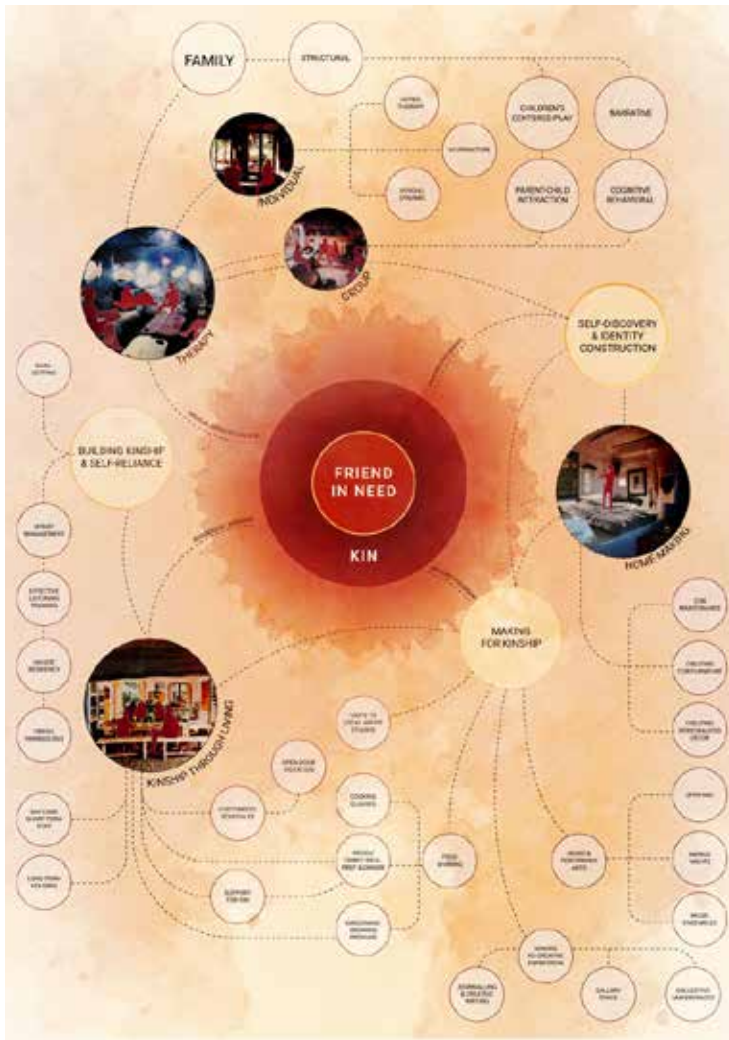
Structural section.



Embodied carbon diagram.



Environmental systems diagram.



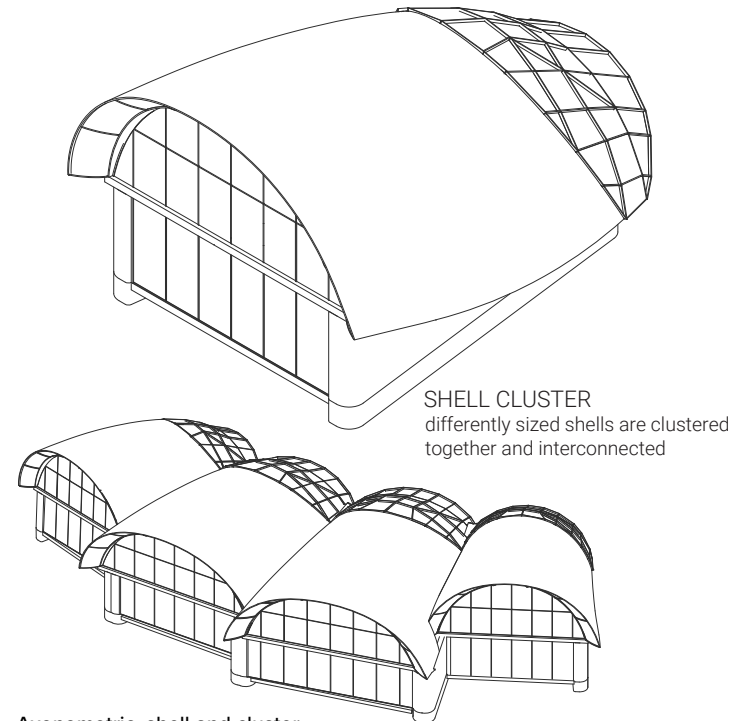
Concept diagram.

We identified that there was a serious lack of connection—intimate, familial, as well as access to help and support—for people struggling with substance addiction. We propose that relationships are not ancillary to healing, but imperative.

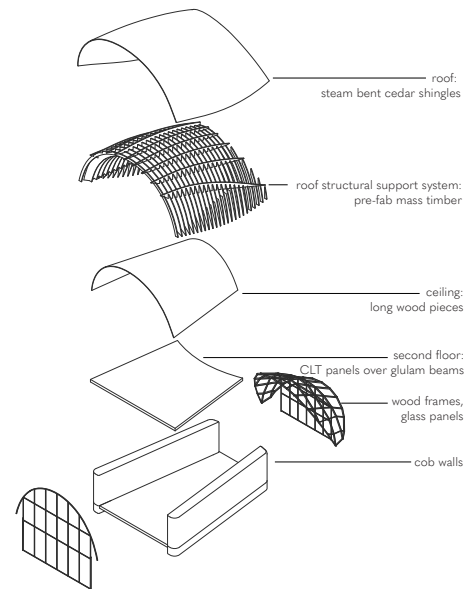
The building of relationships is key in our project. In addition to providing treatments such as group therapy and events to help build social skills, we emphasize using art and craft-making as a route to self-discovery and bonding with others. Our living spaces are also designed to facilitate the development of relationships.

To make the entire site accessible to all and also to minimize tripping hazards, continuous gently-sloping trails are implemented throughout the site. Paths are preferred to ramps as they are less steep and therefore more wheelchair-friendly. The trails include wide, straight paths as well as portions of meandering paths through clusters of trees, which in addition encourage interaction with nature and the plethora of existing trees.

Site Plan.



Axonometric, shell and cluster.



Exploded structural axonometric diagram.

Massing model.



04

Co(Re) Housing

Studio: Core III Fall 2021
Critic: Benjamin Cadena
Collaborator: Hallie Chuba
Special focus: mass timber; mixed-use; affordable housing

In this multi-generational housing project, various levels of interior to exterior, public to private, large to small spaces are layered, interconnected, and paired to create a rich and inviting environment.

The commercial character of this neighborhood is deeply connected to individual business owners living in the community. To encourage and support further growth of these businesses, we opened up the ground plane of the block to shops and restaurants owned by locals. This increases the space in this bustling location that is dedicated to small, family-based commerce. Those who are either owners or employees of businesses on the ground floor are given privileged access to unit availability and selection.



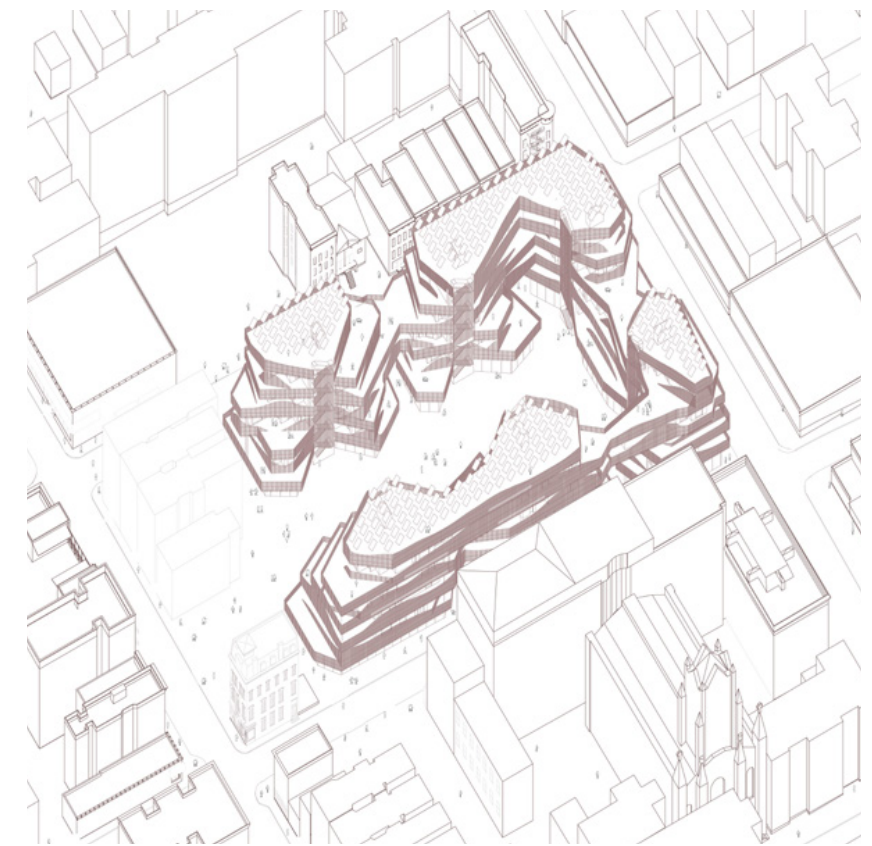
Rendering, view from street.

Rendering, view from outdoor space (shared among residents of the same floor).



By providing communal areas ranging in scale and inviting ambiguity into spaces in terms of how they are to be activated, we encourage different and individualized ways of engaging with the space and with the community. Circulation, private and shared outdoor spaces blend into one another, thus fostering camaraderie and making possible multiple scales and types of social gathering.

The site is surrounded by a thriving community of small, locally-owned businesses in the neighborhood. To help strengthen this characteristic even further and provide support to ensure future growth of this vibrant commercial life, we opened up the ground plane to provide space for locally-owned shops and restaurants. In addition to supporting those businesses, this move would invite foot traffic into the central courtyard, making it both an extension of the street and a place that the residents could enjoy.



Site axonometric.

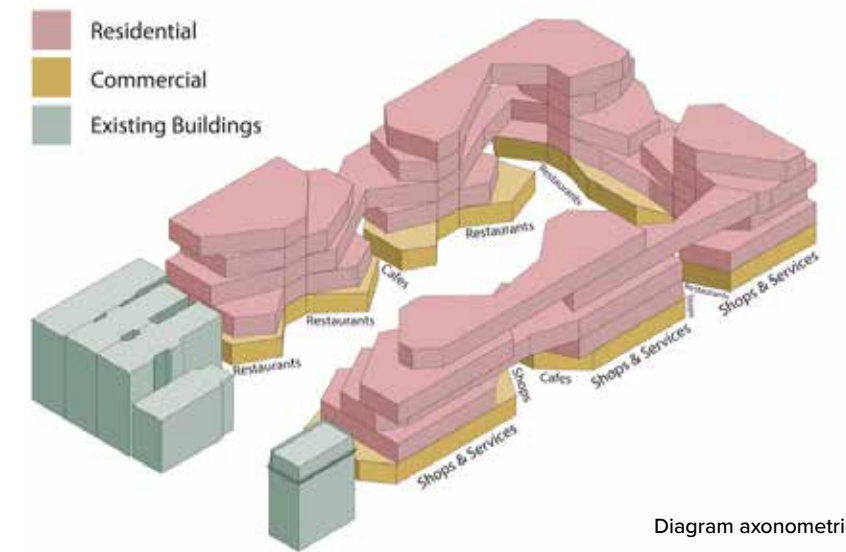
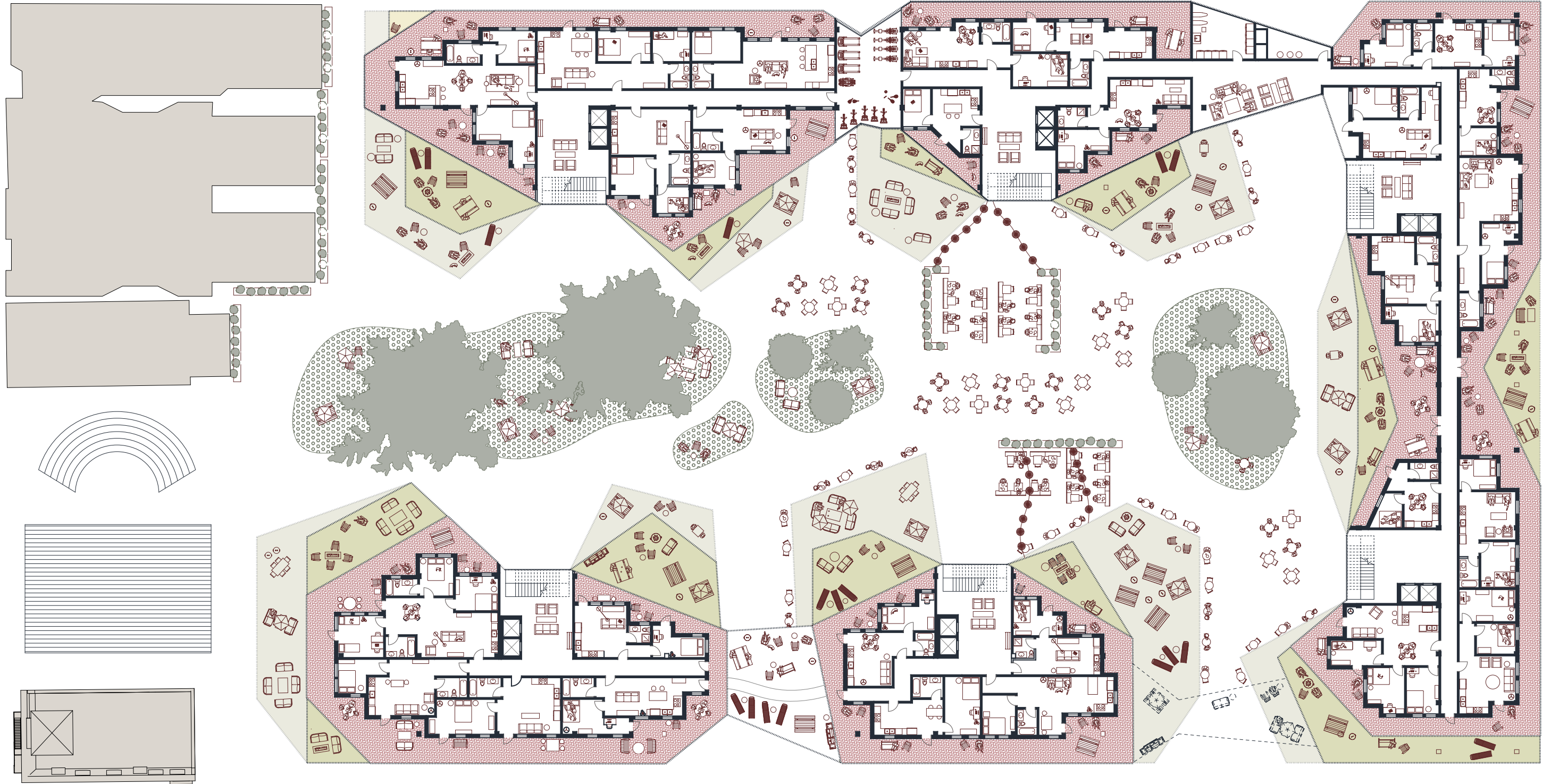


Diagram axonometric.

Study models.







Section perspective, N-S.

Creating accessible outdoor spaces for the residents is a main priority for the design, resulting in establishing a tiered outdoor space. We implemented an outer perimeter of wooden louvers, which creates a transition space between the indoor and outdoor space. They create an experience that allows residents to have a small space to have their morning coffee without being entirely exposed to the elements. The louvered shell creates an opportunity for both shade and privacy, while still allowing every apartment to have semi-outdoor spaces right outside of their units.

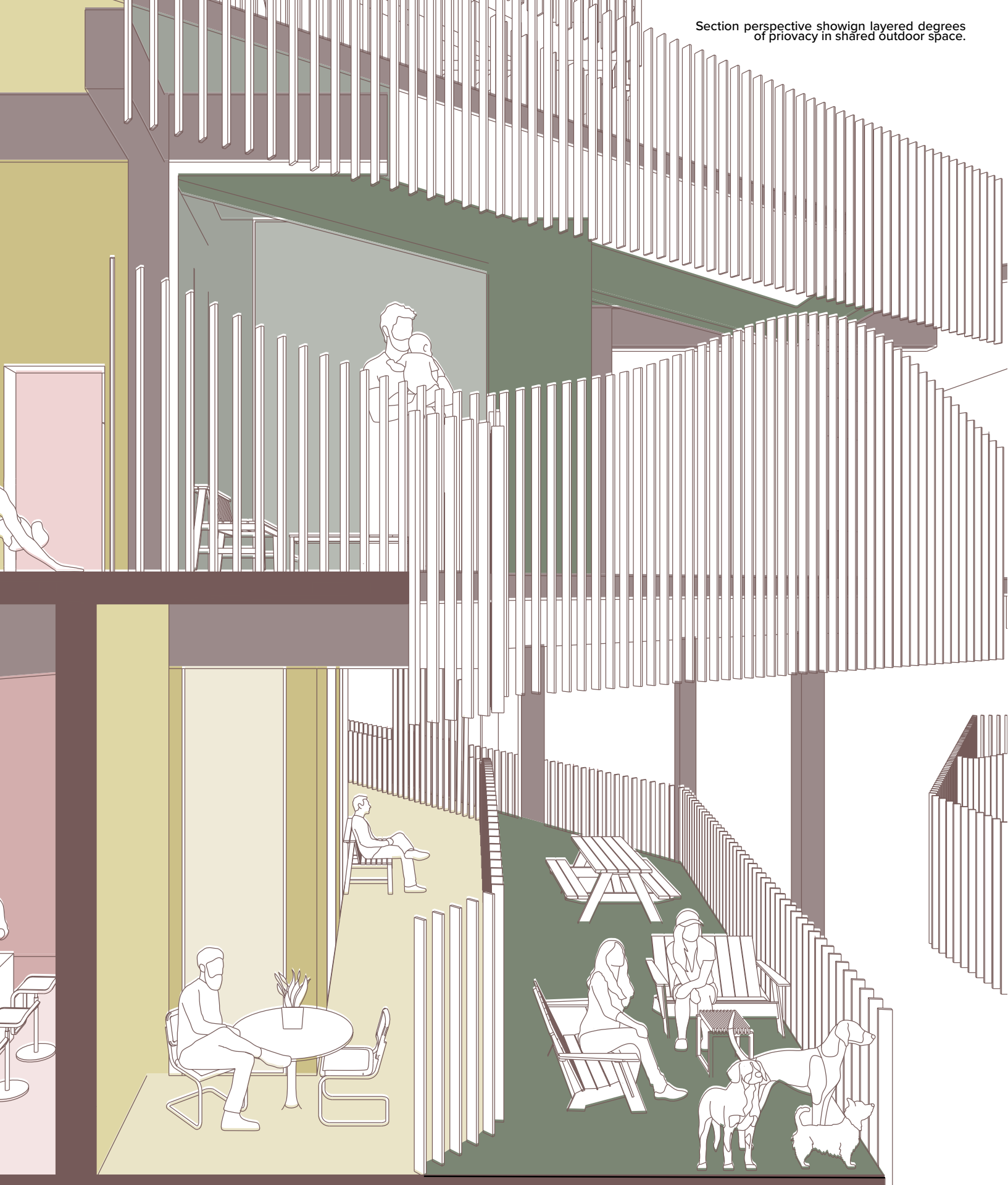


Model photos.

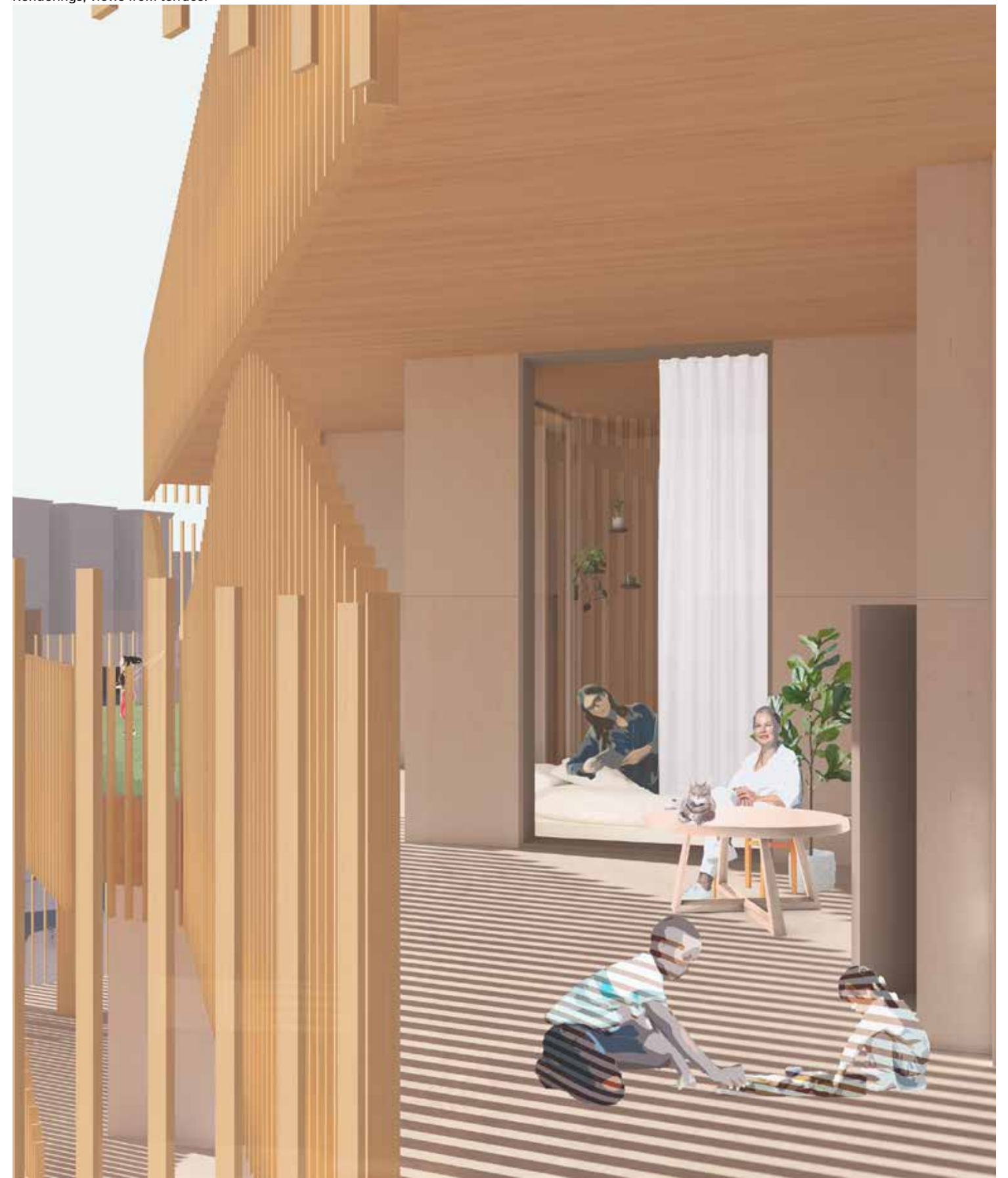
The variety in shape and size of the outdoor terraces as well as the semi-outdoor transition spaces promotes engagement of the spaces in flexible and myriad ways.

All of the transitional spaces are connected on each floor encourages neighborly interaction and brings in New York stoop culture from the scale of house to the scale of housing.

Section perspective showing layered degrees of privacy in shared outdoor space.



Renderings, views from terrace.



05

PS 64: Garden School

Studio: Core II

Critic: Gordon Kipping

Special focus: education;
rooftop farm; diversity and
community

The former PS.64 school building, currently standing empty in the Lower East Side of Manhattan, has historically held historical meaning to its community, yet has also been a site of contention for decades. This project aims to reinvigorate the building as a school and also as a gathering place for the community.

The project transforms the existing school building through a series of additions and subtractions, reusing demolished masonry and using mass timber for new structure to minimize carbon footprint. The school doubles as a greenhouse urban farm, bringing food production and education together in an exciting intersection.



Section perspective, N-S.

Diagram, poverty rate.

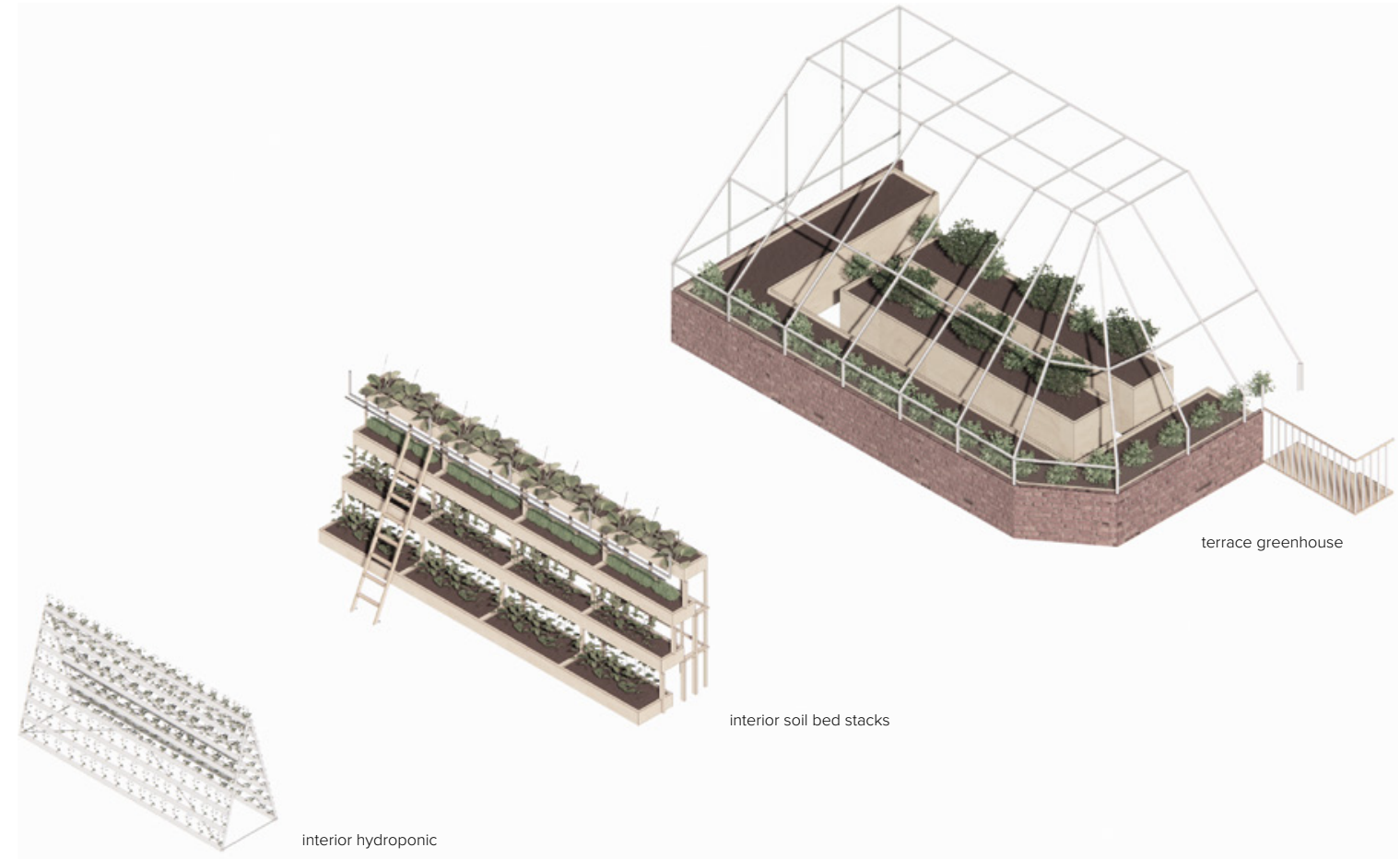


Diagram, racial diversity index.

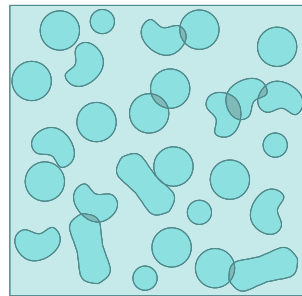


Research indicates a significantly higher-than-average poverty level and racial diversity index in the Lower East Side of Manhattan, where this project is located.

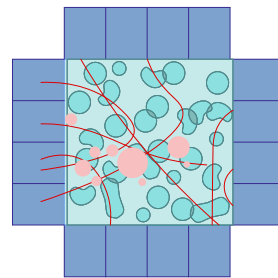
The project addresses issues of equality and diversity through the design of classrooms and communal spaces that encourage cross-social-group interaction and equality.



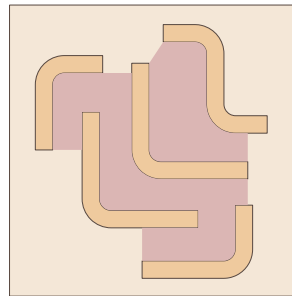
Planting strategy diagrams.



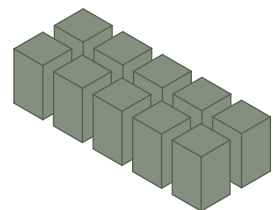
Promoting Equality
student lounge with similarly sized, equally desirable seating areas, reducing role of group hierarchy in obtaining seats.



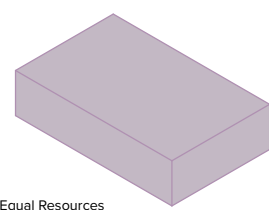
Promoting Mingling & Chance Interaction
student lounge doubling as circulation space, increasing the likelihood that students from different social groups see and interact with each other. Red lines show walk paths, red dots show where students stop in their paths for interaction.



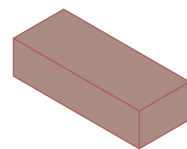
Promoting Inclusivity
cafeteria with long L-shaped tables, discouraging clique-based seating and increasing intimacy. Pink areas show where seats are positioned between two tables.



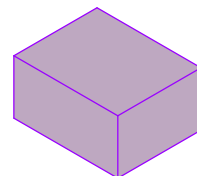
Valued & Visible Work
conspicuous maintenance spaces distributed throughout.



Equal Resources
library with high quality learning equipment and materials for each student.



Staff Equality
lounge space for all staff who work at the school, not just teachers.



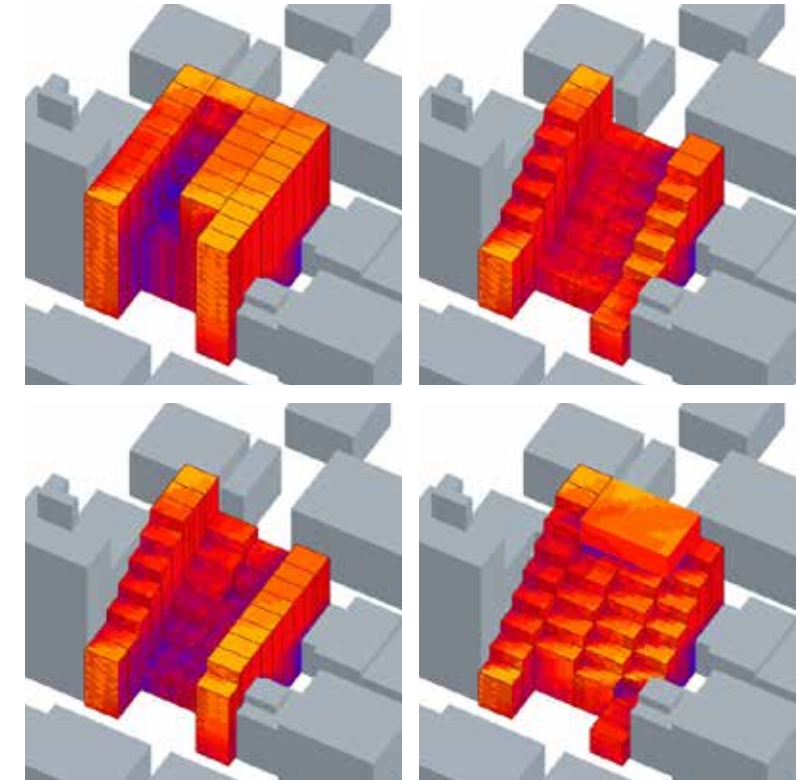
Space for Living
residence area for students living in unhealthy or dangerous environments or whose parents are homeless.

Spatial strategy diagrams.

Sunlight is crucial in this project both for planting and lighting purposes.

Radiation analyses were conducted and building form was studied and optimized according to solar exposure.

Planting strategies were carefully designed and a system developed for interior planting and hydroponic planting.



Radiation analyses, grasshopper.



Rendering, view from exterior.



Rendering, classroom view.

Learning should be as much about taking on responsibility to the world and observing the rhythms of life as about learning and developing facts and skills.

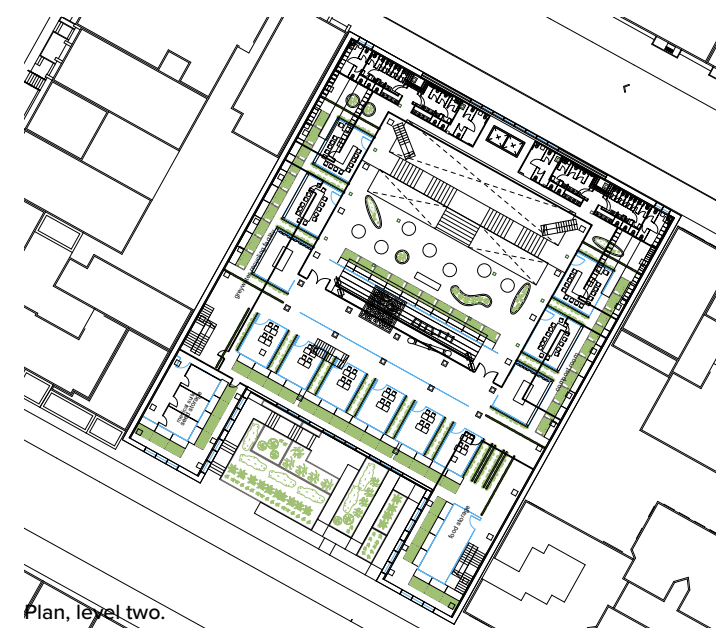
At the Garden School, experiences of learning is intertwined with experiences of the surrounding environment. The entire school building is transformed into an urban farm with indoor and outdoor planting, and students have the opportunity to observe, nurture, take on responsibility for, and taste the fruits of labor of these plants as part of their education.



Rendering, view from atrium.



Plan, level four



Plan, level two.



Plan, level nine.

06

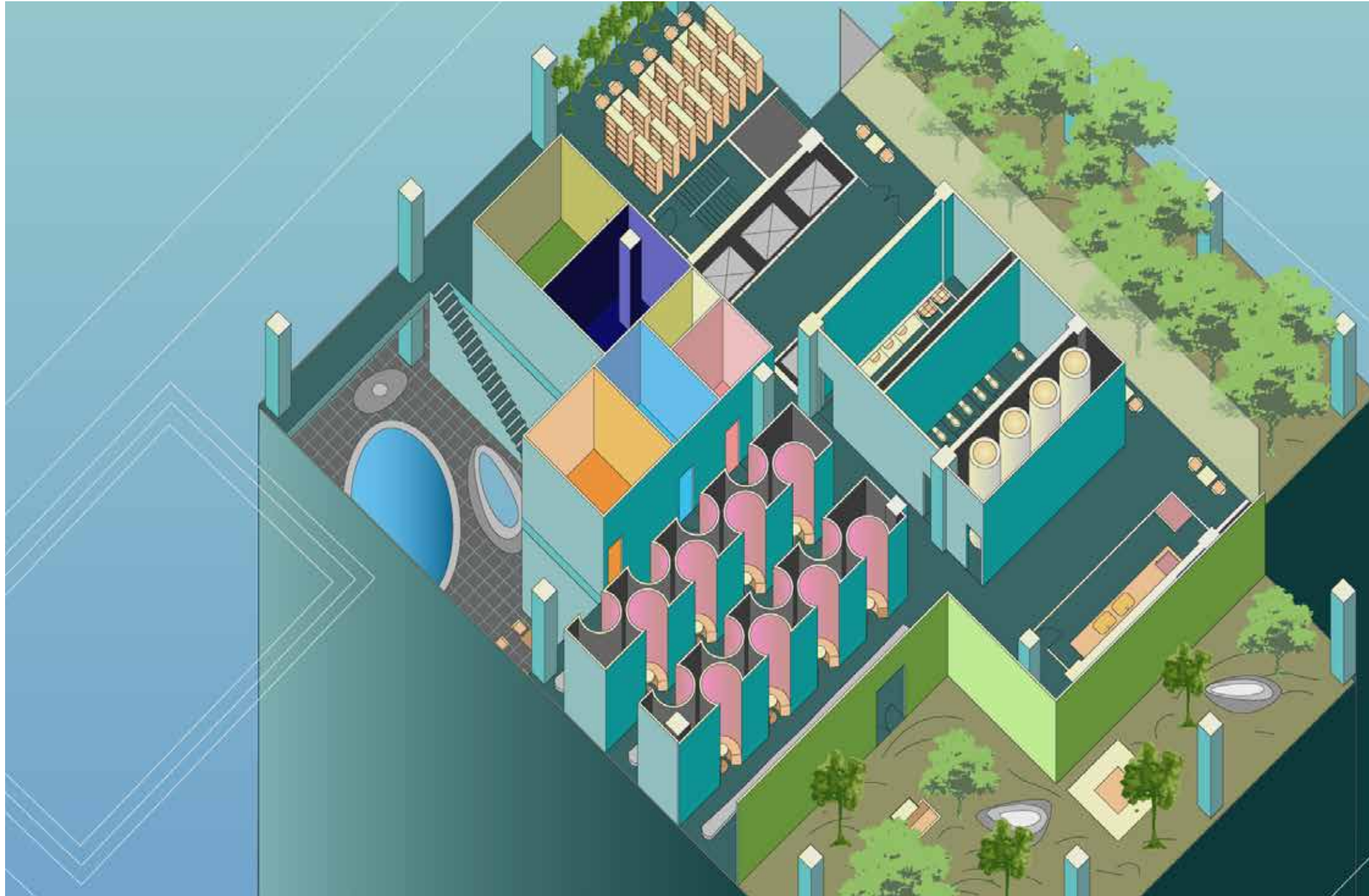
Oasis Hotel

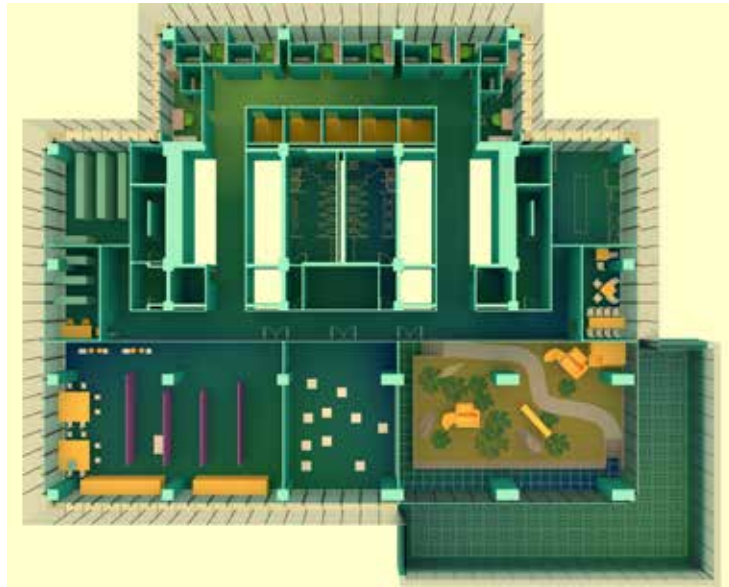
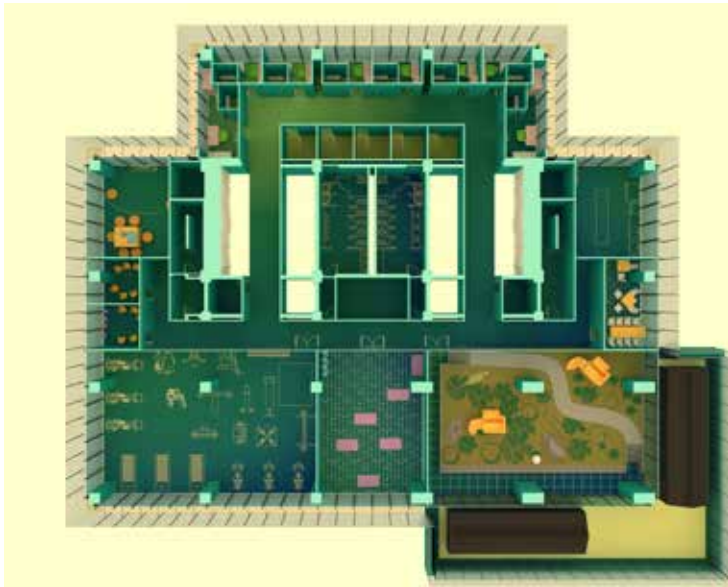
Studio: Core I

Critic: Emmett Zeifman

Special focus: performance envelopes, double-skin thermoregulation layer, mental health

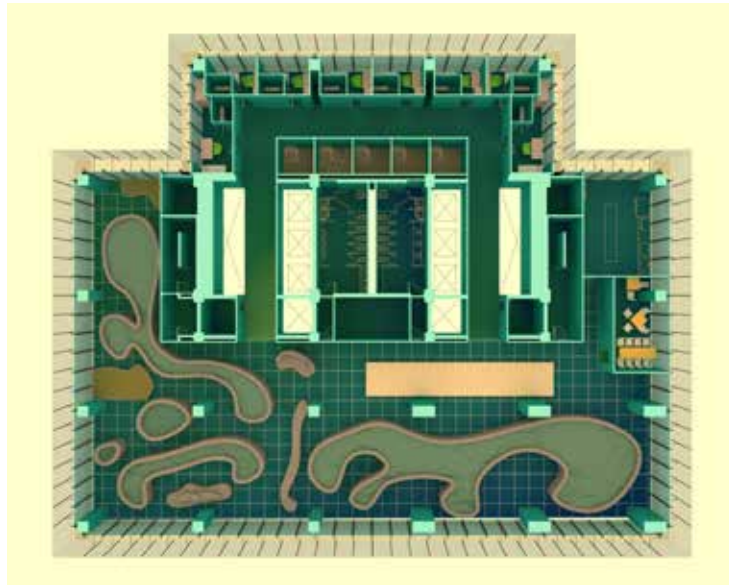
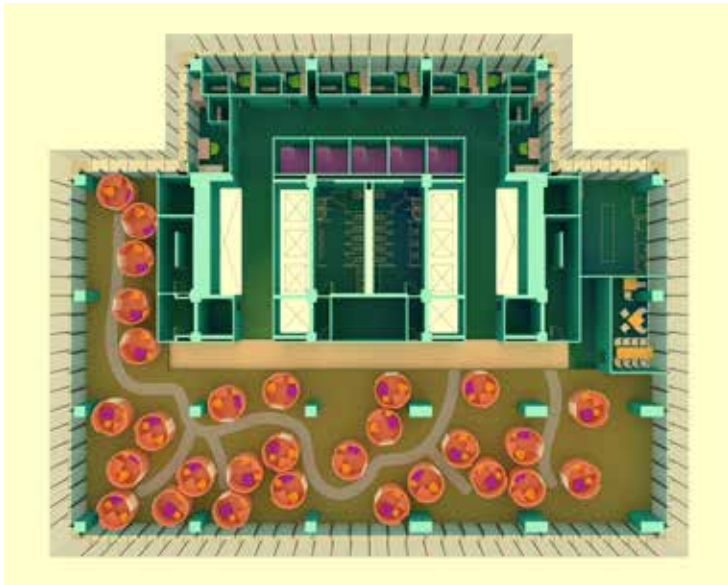
The Seagram building embodies the culture of regulated and standardized human labor and the environment that they are in for the purpose of capital gain. By being a publicly-funded program to which all residents of New York City have an allocated number of stays per year, and The Oasis Hotel addresses a glaring issue in the city—the lack of public space for mental health—and transforms the Seagram building into a space where resources are devoted wellbeing needs on both the individual and societal level.





In the hotel, spaces are defined by multiple aspects of sensory experience, varying in size, openness, materiality, temperature, function and ambiance, each combination addressing a different psychological need.

Here are 4 floor plans showing typical layouts of "activity floors" and "repose" floors. The hotel rooms, communal kitchen and dining room repeat on every floor..



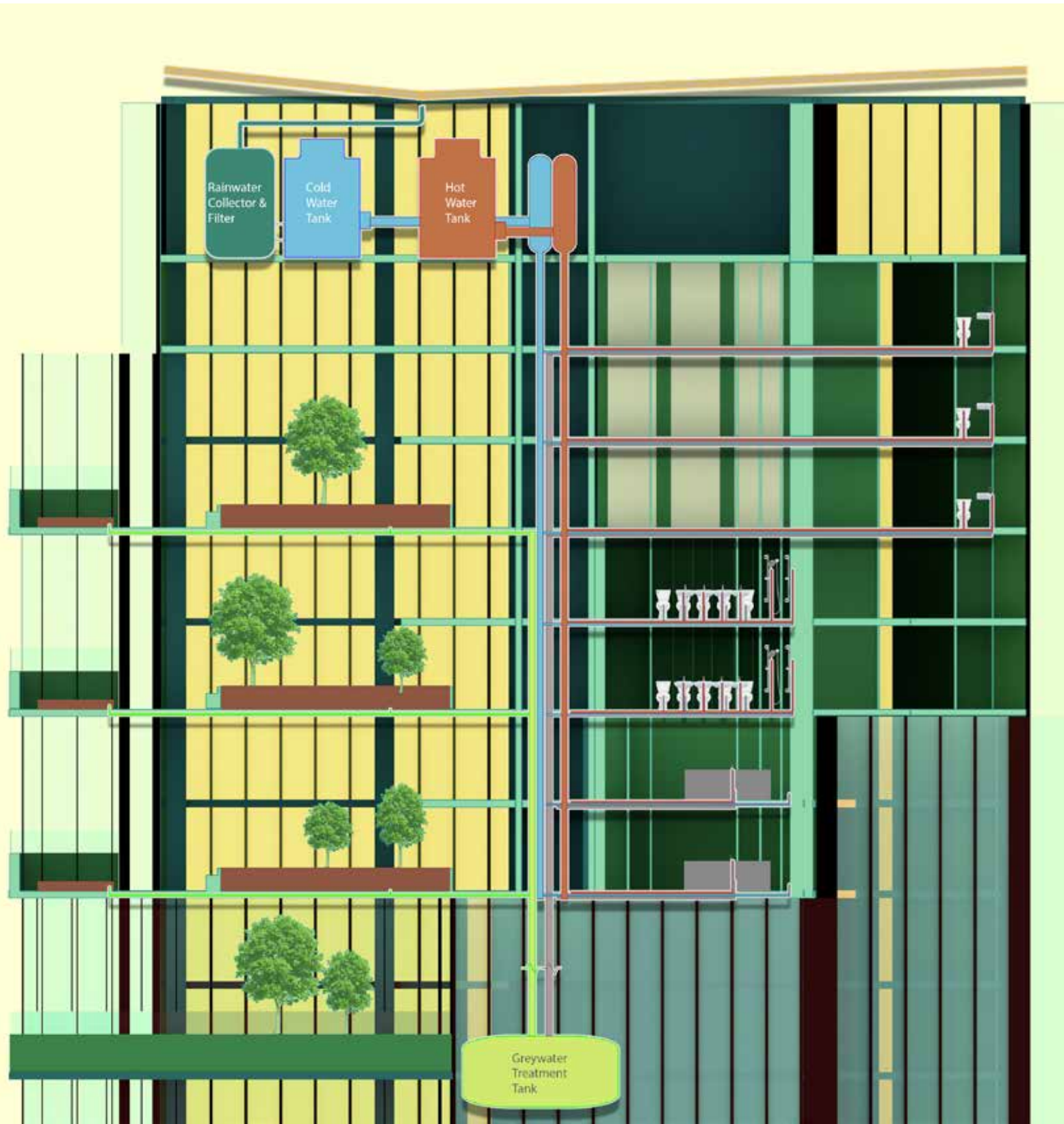
Typical "activity floor" 1, includes gym, yoga room, game room and terrace.
 Typical "activity floor" 2, includes library, art studio, reading room, and terrace.
 Typical "repose floor" 1, indoor garden with individual counselling rooms.
 Typical "repose floor" 2, indoor swimming lagoon.



The project began with incorporating elements that challenge the traditional functions served by furniture and rooms.

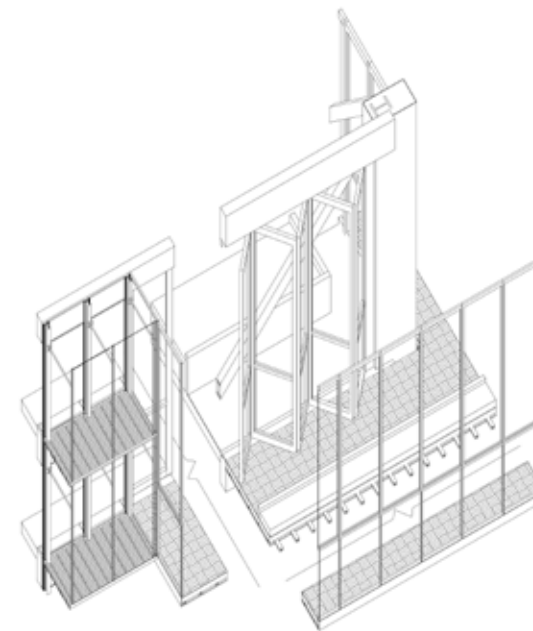
A more technological experimental form of this hotel could exist in a hypothetical society where holistic human and environmental well-being are prioritized over capital gain.





The project incorporates a double skin facade system for temperature regulation, operable glass walls on the terrace, and a rainwater collection and greywater collection system.

The model on the right shows how the double skin facade fits onto the existing curtain wall, and the drawing below demonstrates how the double skin facade system, original facade, and operable glass walls on the added terraces all fit together.



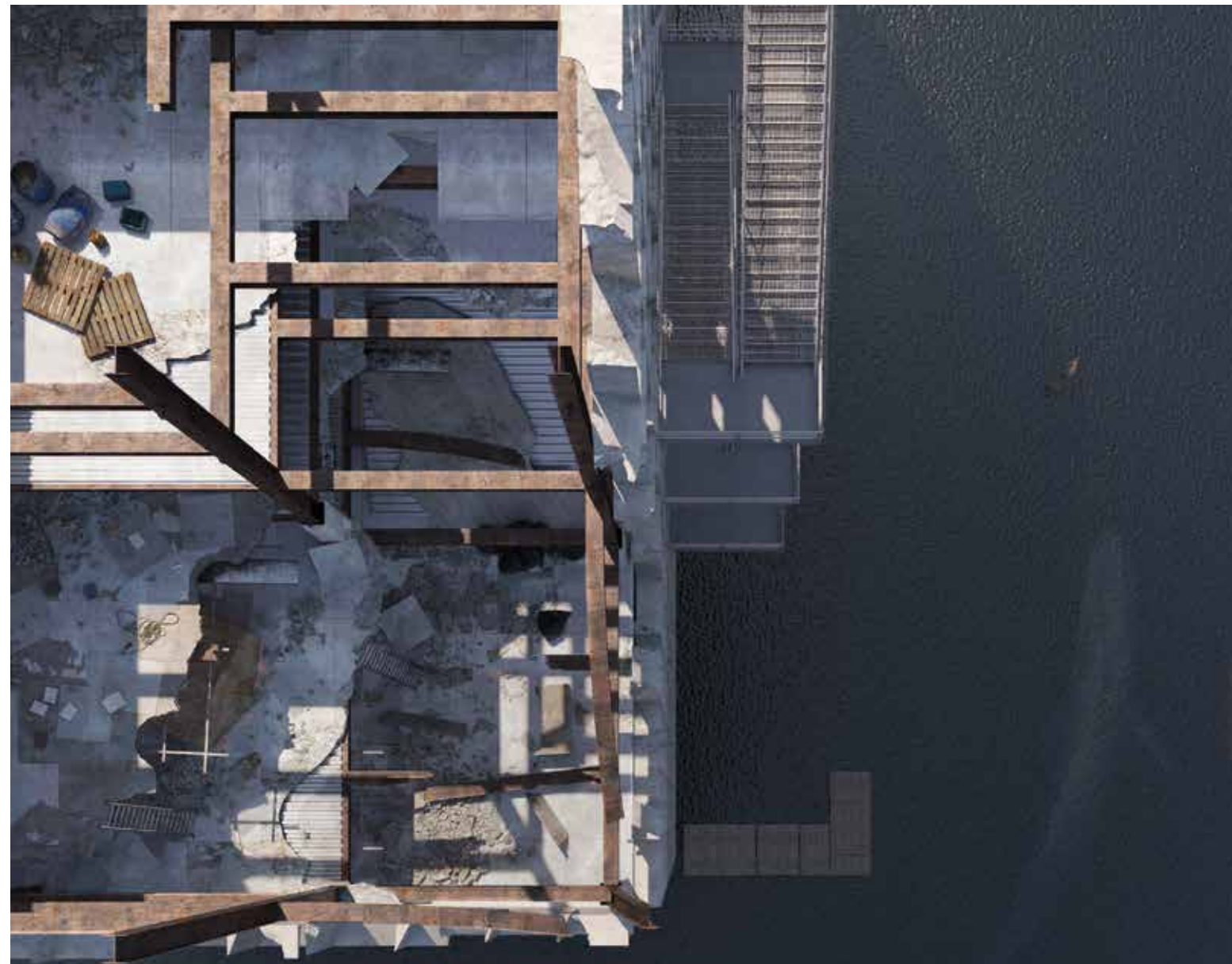
07

Surviving Manhattan

Elective: Techniques of the Ultrareal
Instructor: Phillip Crupi
Special focus: hyper-realistic rendering

A fictional narrative was constructed: what would Manhattan look like after extreme sea level increase and flooding? These renderings showcase a typical New York City skyscraper after a catastrophic event, but with signs of life. Modeled and rendered in 3DS Max.

Interior view. Overhead view.



Building view.

