AMERICAN UNIVERSITY OF BEIRUT

THE CITY AS A MACHINE

by
SALAMEH WALID ABLA

An Undergraduate Architecture Design Thesis
submitted in partial fulfillment of the requirements
for the degree of Bachelor of Architecture
to the Department of Architecture and Design
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at the American University of Beirut

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Approved by:

Rana Samara, Senior Lecturer
Thesis Advisor
Department of Architecture & Design

Date of project presentation: May 11, 2021

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ABSTRACT

Title: The City as a Machine

With the state of Beirut's current social, economic, and environmental infrastructure, its relationship with its inhabitants is at the tipping point of becoming uninhabitable. Beirut River, once a riparian river, now an empty canal, is an example of the outcome of this lacking infrastructure.

So then how can regenerating Beirut River help inform its inhabitants of the political, social, and environmental issues that hinder their day to day lives. This research hypothesizes a key role for Beirut River, inviting the river to reclaim its natural role as a catalyst for the flourishing the city, by implementing environmental, social, and civic components along its spine. By Looking into our current relationship with the river, the issues we are facing, and how to go about them, new ideas will develop that will help guide the re-purposing and regenerating of the currently unused infrastructure into a catalyst for energizing and educating the city and its people.

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Advisors

RAAFAT MAJZOUB

RANA SAMARA

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INTRODUCTION

THE CITY AS A MACHINE.

Salameh Abla

Final Year Project

THESIS STATEMEN

With the state of Beirut's current social, economic, and environmental infrastructure, its relationship with its inhabitants is at the tipping point of becoming uninhabitable. Beirut River, once a riparian river, now an empty canal, is an example of the outcome of this lacking infrastructure.

So then how can regenerating Beirut River help inform its inhabitants of the political, social, and environmental issues that hinder their day to day lives. This research hypothesizes a key role for Beirut River, inviting the river to reclaim its natural role as a catalyst for the flourishing the city, by implementing environmental, social, and civic components along its spine. By Looking into our current relationship with the river, the issues we are facing, and how to go about them, new ideas will develop that will help guide the re-purposing and regenerating of the currently unused infrastructure into a catalyst for energizing and educating the city and its people.

1900

1924

Current State

1905

1950

Current State

DRIVING FORCES

SOCIAL

Get Beirut river to exist again as a social space, to encourage interactions and activities for the comunity around it.

1. *Meet up spaces*
2. *Leisures spaces*
3. *Communication spaces*
4. *Art space*
2. *Auditorium*
3. *Theater*

ENVIRONMENTAL

Use Beirut river as a space to combat some of the environmental issues in Beirut

1. *Wastewater Treatmeant*
2. *Park*
3. *Agriculture*
4. *Irregation*

ECONOMIC

Revitalize the econimic scene along the river bed, highlighting the work of craftsmen's from around Beirut.

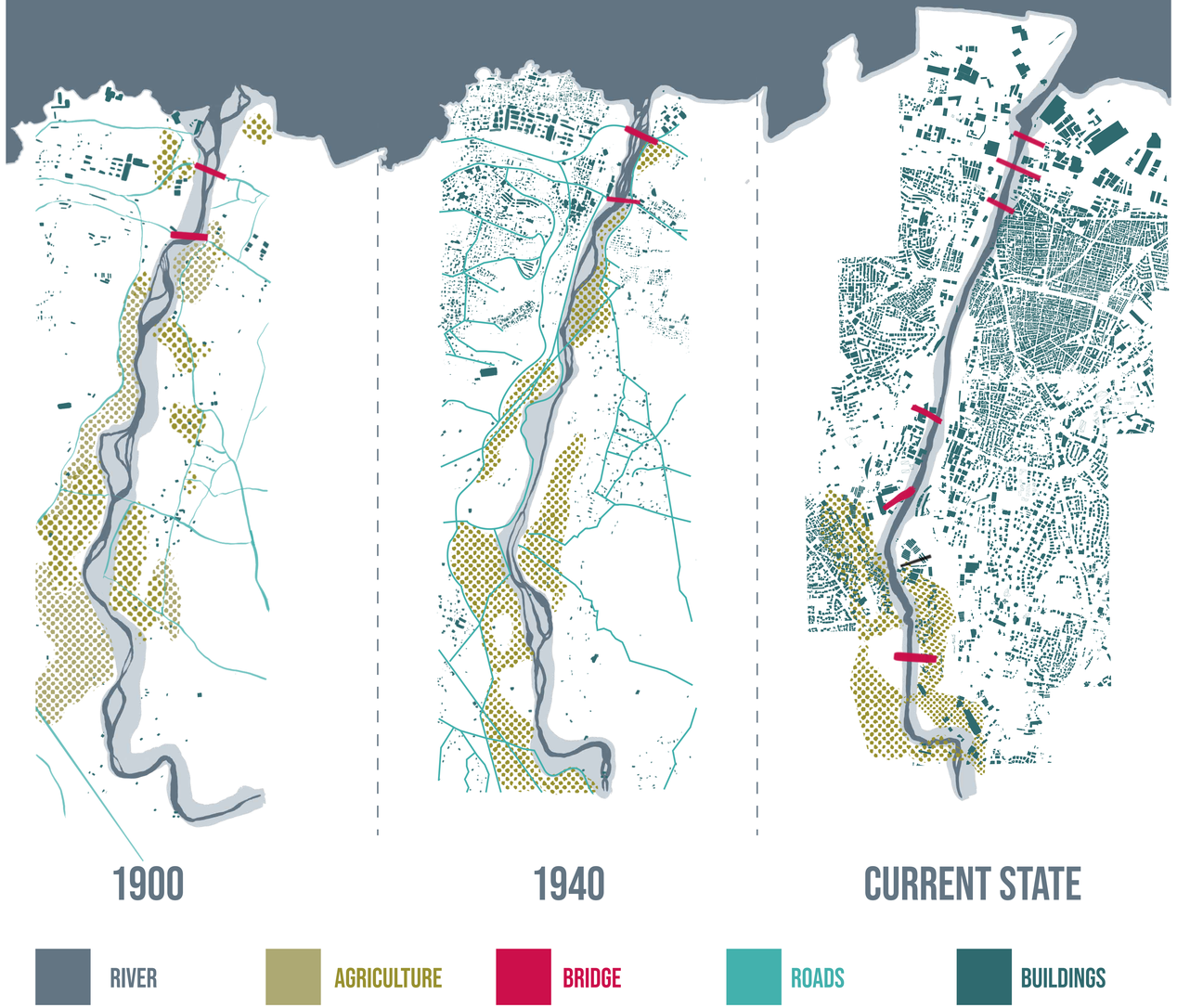
1. *Open Markets*
2. *Closed Markets*
3. *Workshops*

It starts with focusing on the Beirut River, taking advantage of its location and using it as an axis for ideas to tackle the issues at hand.

The project is to act a feed back loop. A collection of varrying nods situatated along the river who's funcions are determined by their sorroundings, and each providing the project with the tools required to maintain itself, while also offering aid to the people along the river bed. Social, Environmetal, & Economic nods will all deal with common issues that the people and river are facing at the moment, interlocking at times, and using one another to help feed the larger solutions at hand.

BREAKDOWN

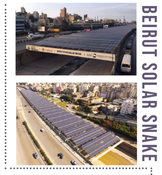
BEIRUT RIVER OVER THE YEARS



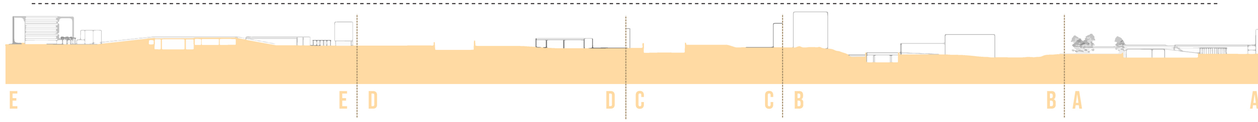
The site analysis starts with a trip through the ages, taking a look at Beirut River over the years, till current date.

The mappings highlight the shape of the river itself over the years, till the late 1970's when it was canalized. It also focuses on the development of urban life over the years, forming densly packed living spaces, like Bourj Hammoud.

Agriculture and transportation are the last two topics of interest. Agriculture, once a practice carried out along the river banks, started to deminish with the developemt of the urban spaces along the banks. Railroad systems that also used to exist along Beirut River were removed over and replaced with roads and bridges.

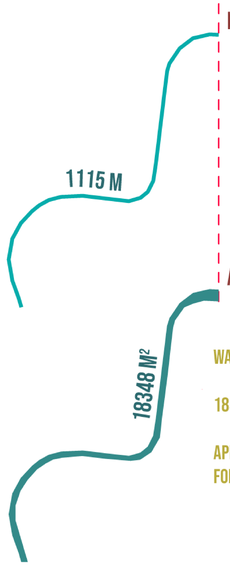


IN 1998, THE RIVER UNDERWENT A NEW CON STRAINT WHEN THE SOLID WASTE COMPANY, SUKOMI, TIGHTNED THE RIVERS TIP TO RECLAIM LAND FOR ITS FACTORY. THE RESULT WAS A DANGEROUS BOTTLE NECK EFFECT WHICH PROVED ITS FATALITY IN 2003, WHEN A FLOOD DESTORYED THE BRIDGE LOCATED AT THE TIP



POSSIBLE EXPANCES OF AGRICULTURAL AREAS AROUND THE RIVER

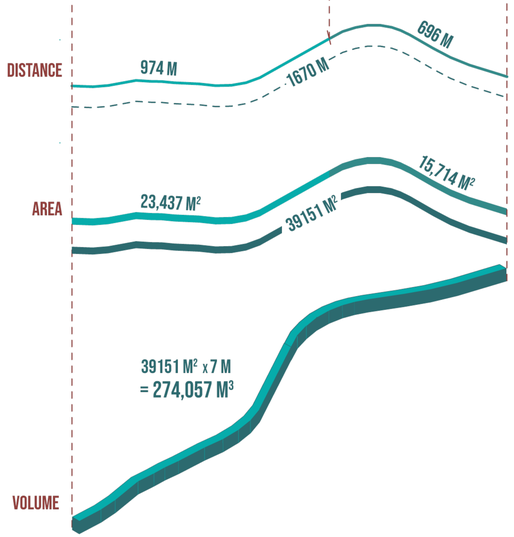
TYPES OF CROPS GROWN	HECTARS
OLIVES	58531
CEREALS	
WHEAT	46675
BARELY	12586
POTATO	14800
GRAPES	10950
FRUIT TREES	
CITRUS	
ORANGE	10572
LEMON	3844
APPLE	9390
CHERRY	7733
APRICOT	6251
ALMOND	6217
BANANA	2790
LEGUMES AND VEGES	
TOMATO	3104
COCUMBER	1903
WATERMELON	2384
CAULIFLOWER	1903
CABBAGE	1368
LETTUCE	1281
BEANS	1368
FABA BEANS	1874

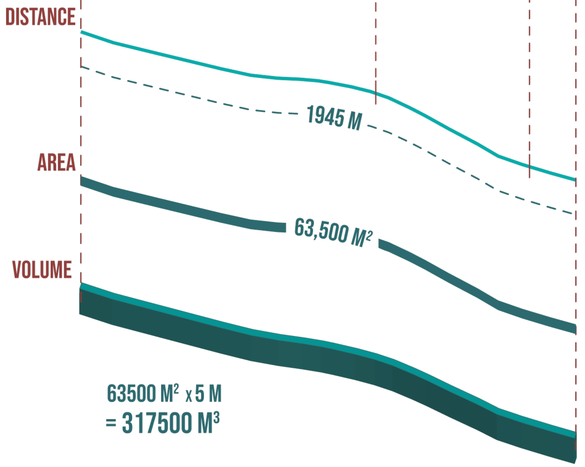


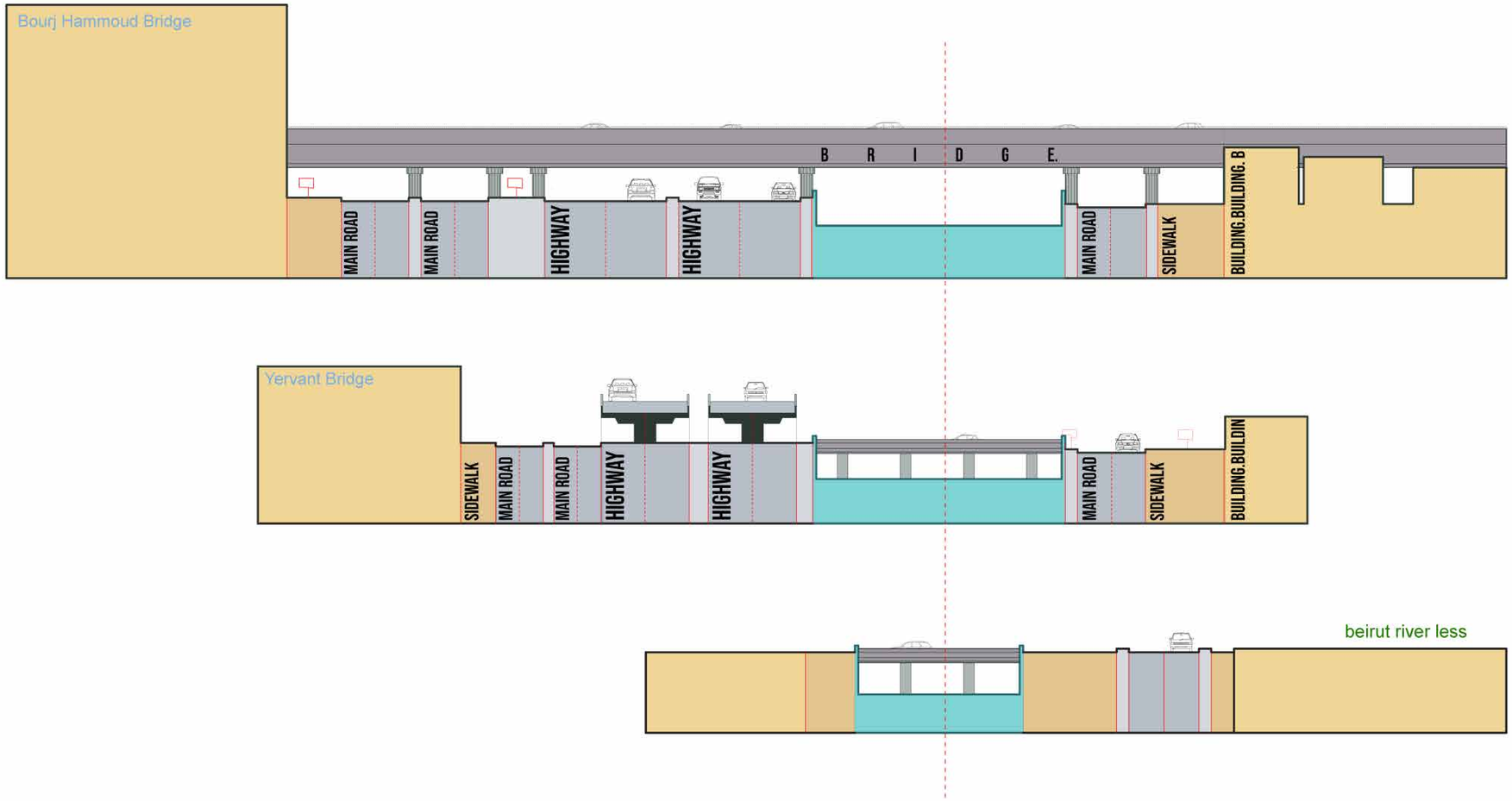
WATER NEEDED TO IRRIGATE THE AREA.

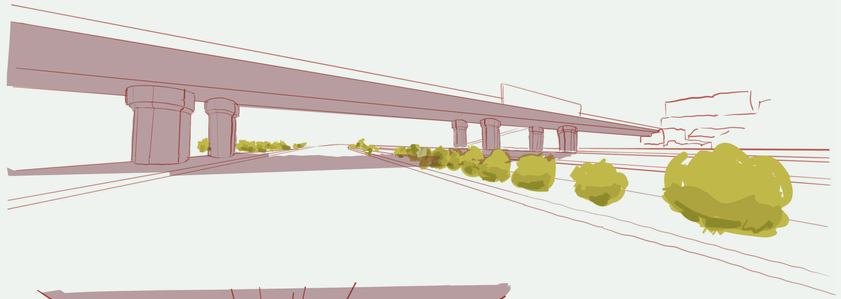
18348 M² = 1.8348 HA

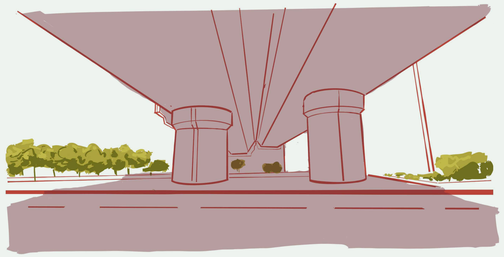
APPROXIMATE VALOE OF IRRIGATION NEED
FOR AREA = 1.8348*1.5
= 2.75SS L/S
= 0.00275 M²/S
= 237.6 M² IN A DAY

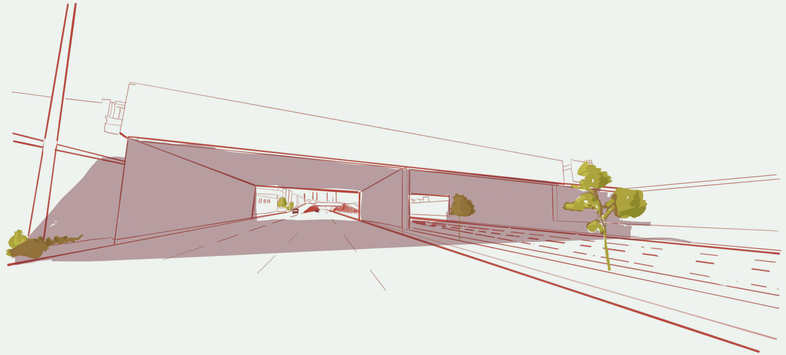


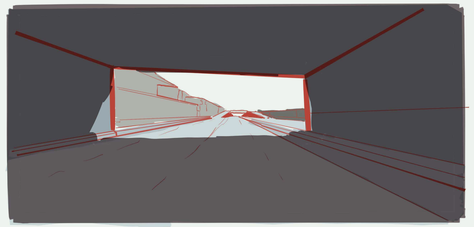


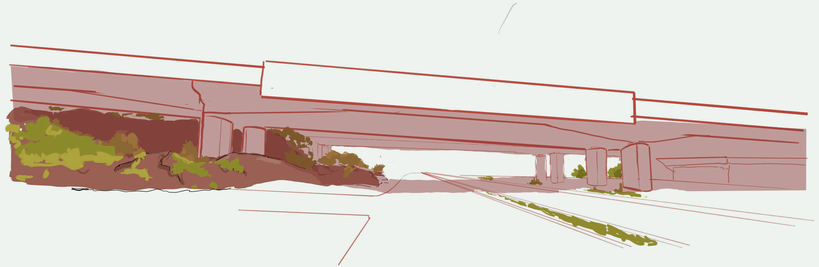

Bourj Hammoud Bridge
B R I D G E.
MAIN ROAD
MAIN ROAD
HIGHWAY
HIGHWAY
MAIN ROAD
SIDEWALK
BUILDING.BUILDING. B
Yervant Bridge
SIDEWALK
MAIN ROAD
MAIN ROAD
HIGHWAY
HIGHWAY
MAIN ROAD
SIDEWALK
BUILDING.BUILDIN
beirut river less

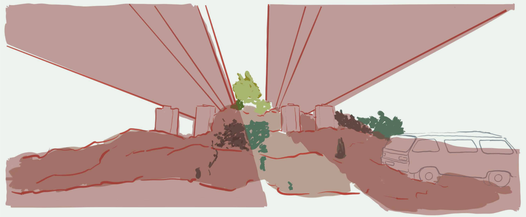






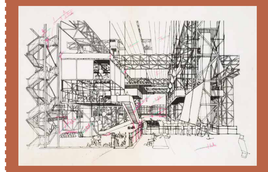


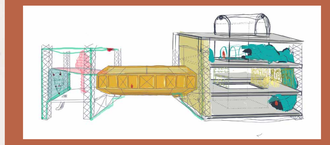




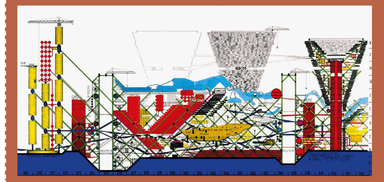
INSPIRATION & CASE STUDIES

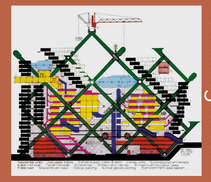
EXPOSED / ENFORCED





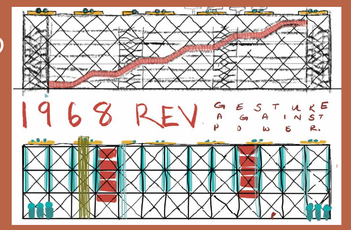
FUN PALACE
Cedric Price

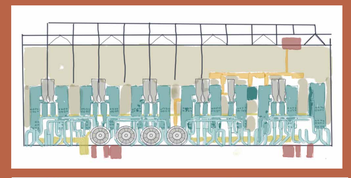


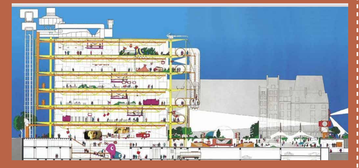


PLUG IN CITY
Archigram

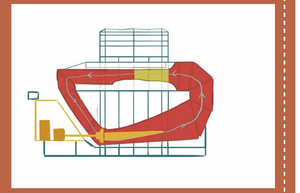
CENTRE POMPIDOU / Rogers_Piano

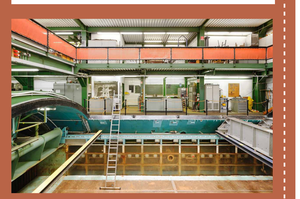


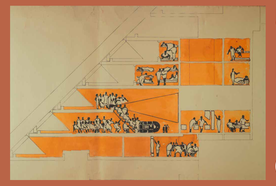




THE CIRULATION TANK OF THE HYDROLICS LABORATORY







D L R G

Ludwig Leo

MATERIALITY

/

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL

AESS NEEDS TO MEET 2 CRITERIA

1. structurally sufficient to support the primary needs of the structure.
2. Exposed to views, and forming a significant part of the architectural language of a project

3 PRIMARY CONDITIONS THAT FEED THE DETAILING

1.Viewing Distance: 6 meters is concidered as the basic unit/threshold, at which the level of detailing is concidered.

2. Building Type/Function: Different functions require different types of steel

3. Cost increase: AESS Costs > Standard Structural Steel

COATING + PROTECTION: This directly affects the durability of the steel. Surface preparation of steel is the primary means to ensure adhision and quality.
The finashes and AESS itself need to be designed to be cleaned. Colors affect the frequency of maintenance. Metalization is a substitute for paint, which protects the steel for a significantly longer time than paint.

MEMBER TYPES

Hot Rolled Steel Sections
Tubular/Hollow Structural Sections
Round Hollow Structural Sections
Square/Rectangular Hollow Structural Sections
Elliptical Fabrocated Sections
Custom Fabricated Sections

CATEGORIES OF AESS

AESS 1 - BASIC ELEMENTS:
- First step above standard Structural Steel.
-Can be equiped for basic elements such as roof trusses for arenas, warehouses, canopies and big box retail store.

AESS 2 - FEATURE ELEMENTS:
-Structures that are intended to be at a diststance larger than 6m.
-Can be vews in buildings where the expressed strcuture forms an important, integral part of the architecture

AESS 3 - FEATURE ELEMENTS:
-Structures viewed from a distance of 6m or less.
- A way for the architect to show the audience the art work of metal work.
-Requires a smoother, more uniform, and durable finish, since people can come into contact with it. Its used in places like airports, shopping malls, hospitals ...

AESS 4 - SHOWCASE ELEMENTS:
-When the form is the only feature showing in an element.
Highest standard of quality expectation on AESS.

AESS C - CUSTOM ELEMENTS:
-Requires a customized approach to design and specialization

CONNECTION TYPES

Bolted Connections
Welded Connections
Pin Connections

HOT ROLLED STEEL SECTIONS

TUBULAR STRUCTURAL SECTIONS

ROUND HOLLOW STRCTRL SECTIONS

BOLTED CONNECTIONS

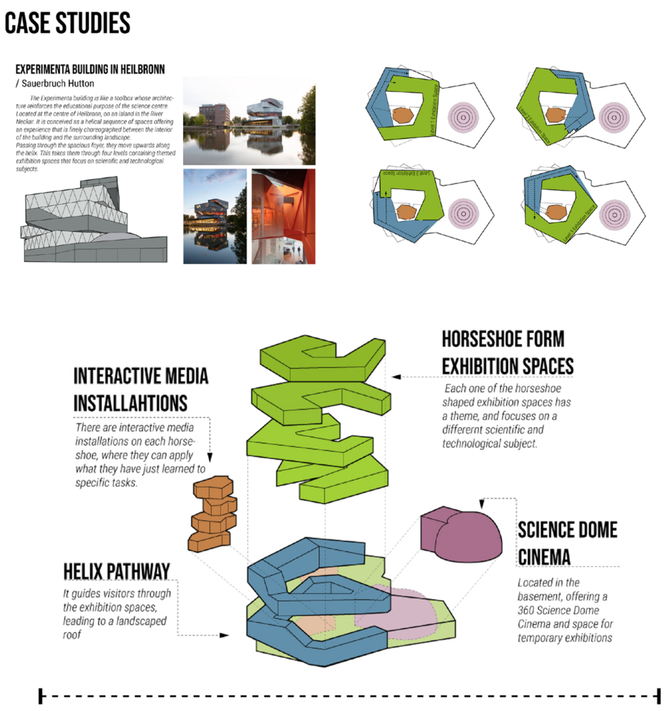
WELDED CONNECTIONS

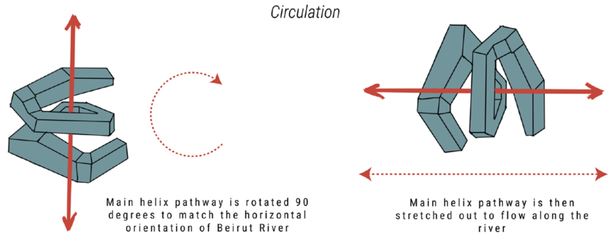
PIN CONNECTIONS

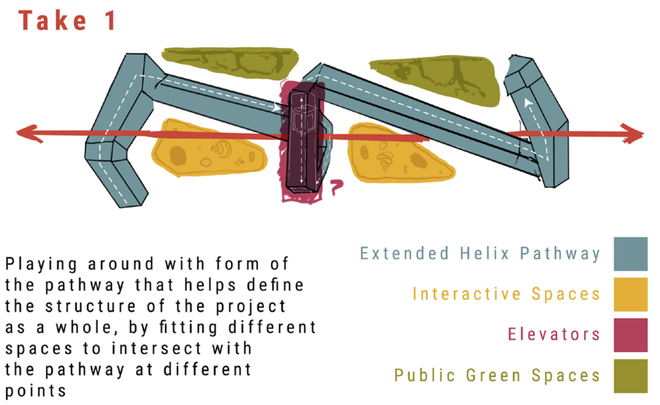
TERRI MEYER BOAKE : Architecturally Exposed Structural Steel

A. EXPERIMENTA BUILDING SAUERBRUCH / HUTTON

Circulation: *This case study brought about thinking of circulation through the project, and how different aspects of the system can be placed around to best suit the experience of the people interacting in this space*

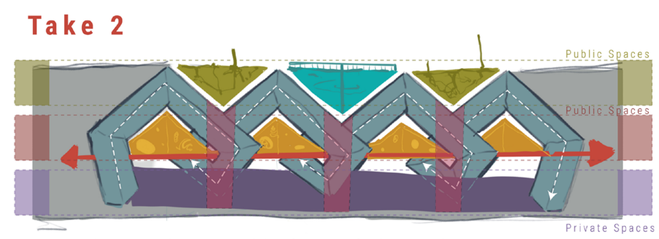






Playing around with form of the pathway that helps define the structure of the project as a whole, by fitting different spaces to intersect with the pathway at different points

- Extended Helix Pathway
- Interactive Spaces
- Elevators
- Public Green Spaces

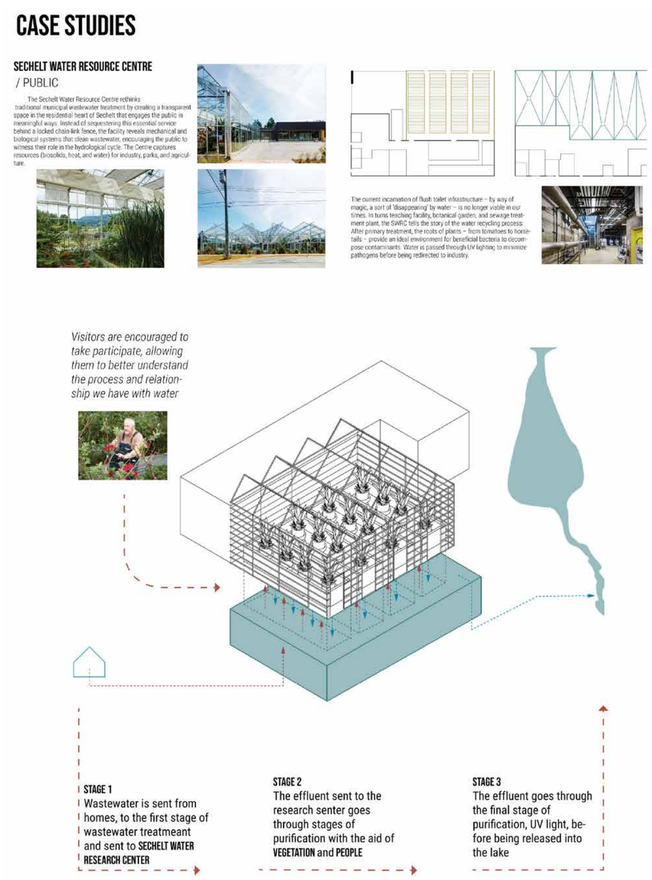


Exploring the possible form of the pathway even more. Tucking away the treatment plants undernearth the ground level, leaving public spaces on the street level, and between the two divisions, an interactive inbetween that involves the person and the structure.Learning Experiences

- Extended Helix Pathway
- Interactive Spaces
- Elevators
- Public Green Spaces
- Public Water Treatment
- Wastewater Treatment

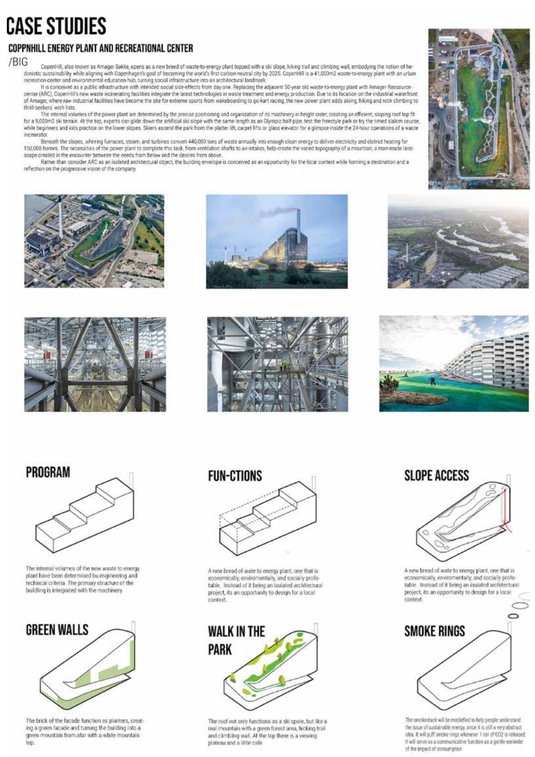
B. SECHELT WATER RESOURCE CENTER / PUBLIC

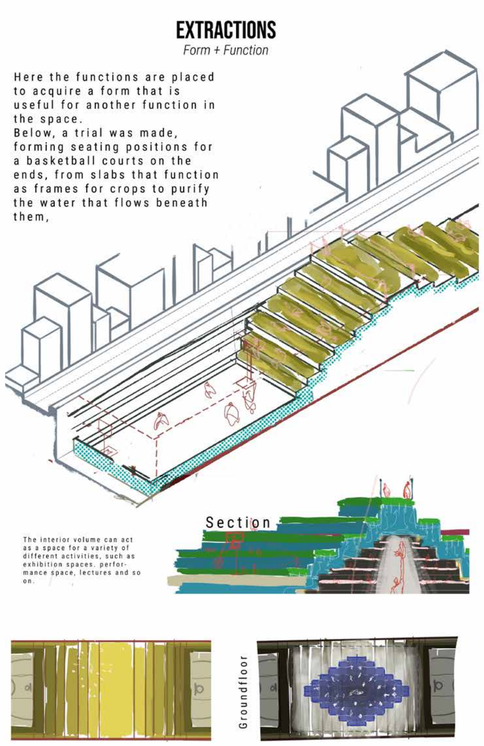
Interaction: *The main takeaway from this case study was how to get the Beiruti's both interacting with the river, and indirectly learning about it as well.*

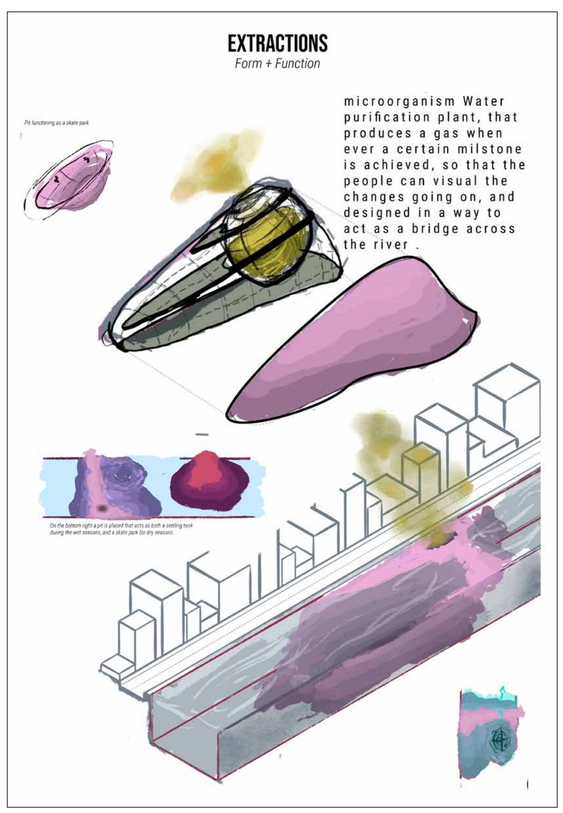


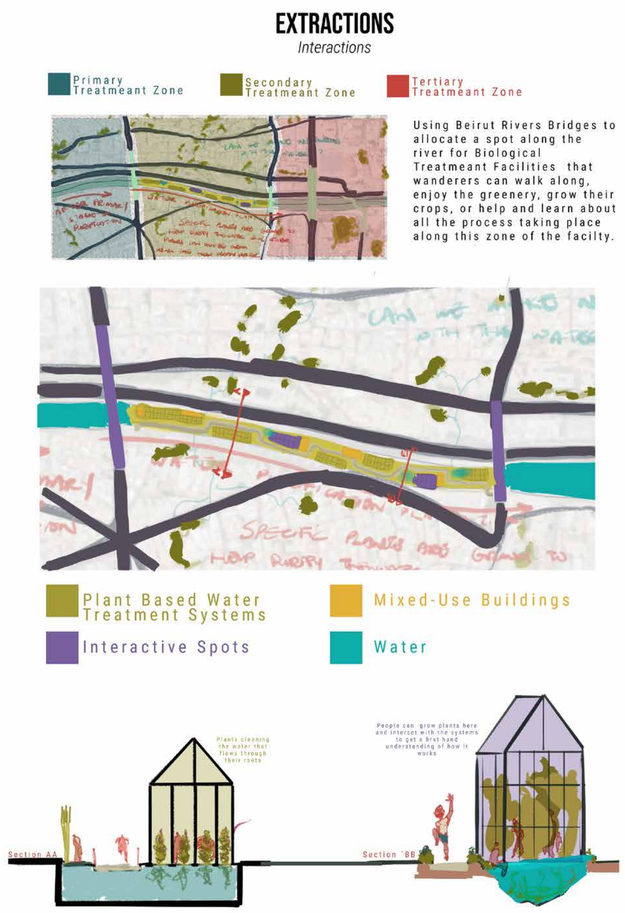
C. COPPENHILL ENERGY PLANT AND RECREATIONAL CENTER / BIG

Form + Function: *The key feature of this power plant is the slope that was designed at the roof of the building, which was possible due to the way the machinery and volumes of space were placed, and this brought about ideas of how forms can help define functions throughout different parts of the river.*

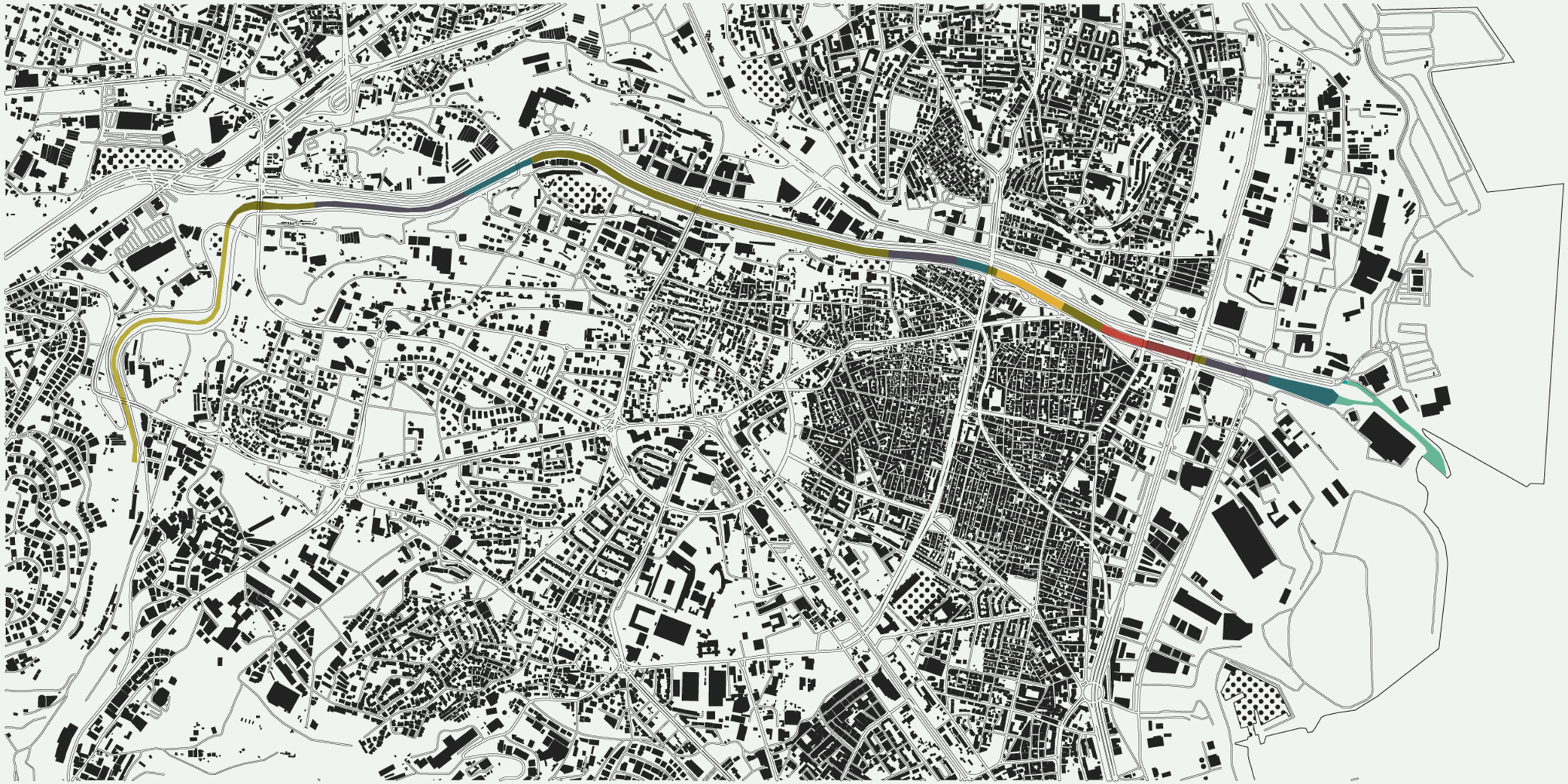








STRATEGIC PLAN



AGRICULTURAL ZONE

PARK

WASTEWATER TREATMENT OBSERVATORY

CONSTRUCTED WETLAND

COMMUNICATION HUB

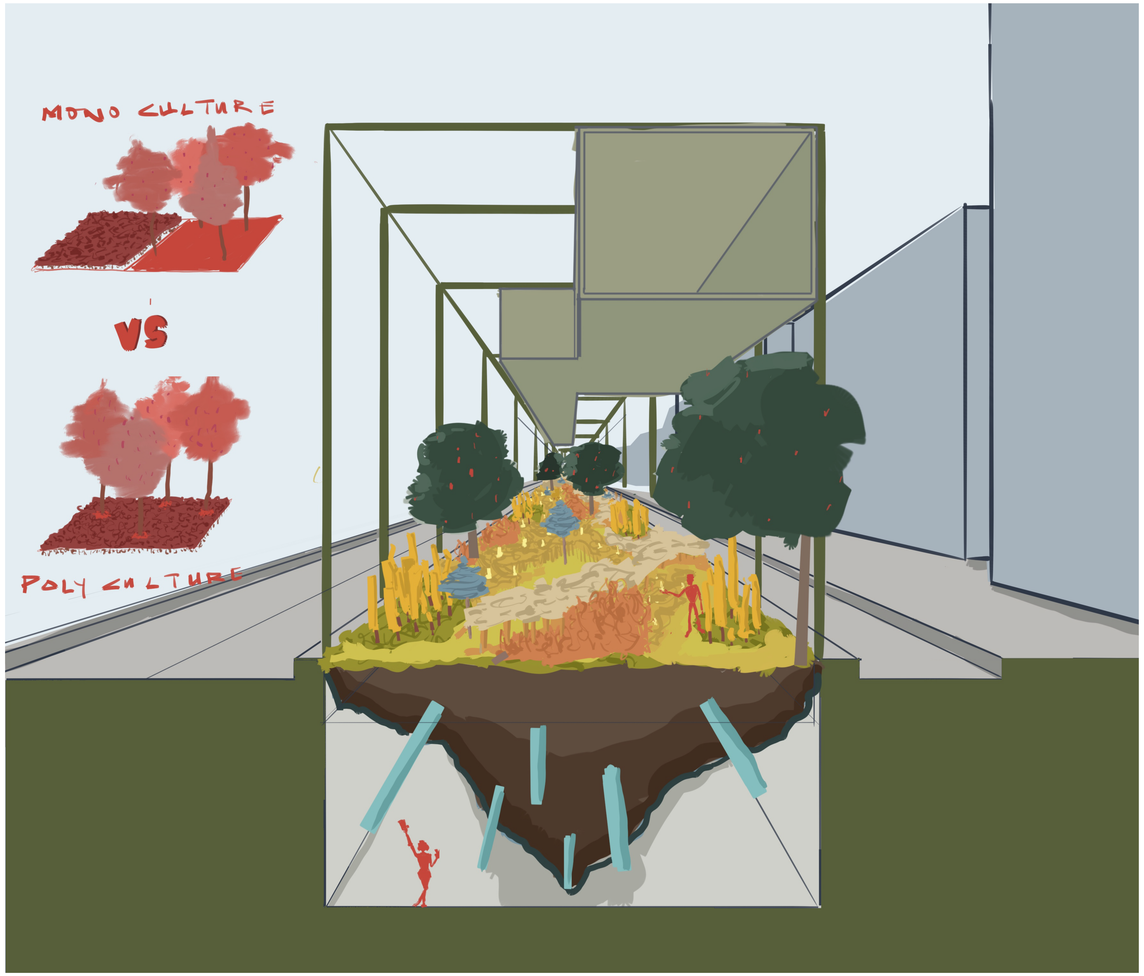
SOCIAL HUB

CULTURAL HUB

THEME PARK

The system stars at the Agricultural Zone, and as such, it felt right reintroducing argriculture back into the city in this specific area. Originally, this part of the reparian river was deditated to agrculture. Over the years, especially so after the canalisation of the river, and dense urbanisation of the spaces around it, it had a massive drop in agriculture sor-rounding it. The idea is to bring back an agricultural field into the city , that is run and maintained by both its inhabitant s and the machine itself.

AGRICULTURAL ZONE. AGRICULTURAL ZONE. AGRICULTURAL ZONE. AGRICULTURAL ZONE. AGRICULTU



This zone a very impoartant part of the system, and is where wastewater is sent to be purified, and then sent back into the system, to be further distributed back to the sorround city and its needs, and the systems own needs as well. The process of wastewater purification undergoes 3 main steps, which can then aslo be subdivided:

1. Preliminary Treatmeant

a. Bar Screening: The first step of the purification process starts with bar screenings, which are large metal bars used to collect, and
discard of large objects that have drowned into the seware system, such as toilet paper, diapers, face wipes and so on.

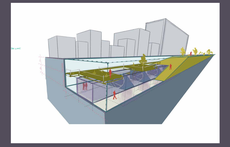
b. Grit Chamber: The grit chamber does much of the same thing as the bar screening, expect it focuses on smaller,
lighter things. It works by slowing down the flow of water, through a chamber to allow for the sinking of heavier
materials to the bottom of the chamber, where they are
collected.

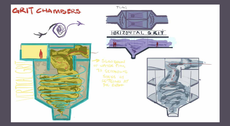
2. Primary Treatmeant- Sedimentaion Tanks:

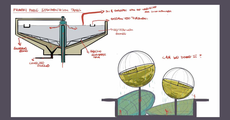
Effluent is passed throgh into these tanks, where in they are allowed to settle down completely, inorder ot further seperate more subsbstances from the solid. Substances like oil and greece collect at the top, where they are scooped out with a rotate rod, and heavier substances such as sludge will sink to the bottom of the tank, and collected using a sludge scrappng arm.

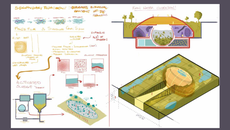
3. Secondary Treatmeant-

-Suspended Growth Systems/Activated Sludge Method: This part of the system takes place in the micro-verse. In activated sludge process wastewater containing organic matter is aerated in an aeration tank in which micro-organisms,
metabolize the suspended and soluble organic matter. In
activated sludge systems the new cells formed in the reaction are removed in the form of a sludge in settling tanks. A part of this settled biomass, described as activated sludge is returned to the aeration tank and the remaining forms waste or excess sludge.

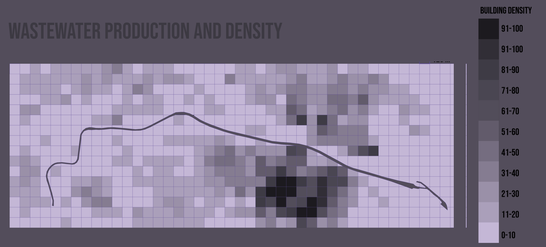


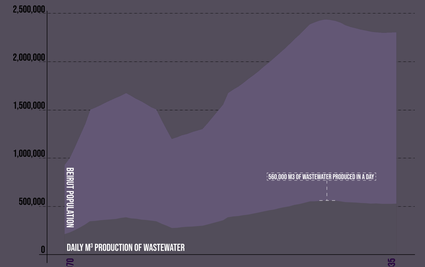




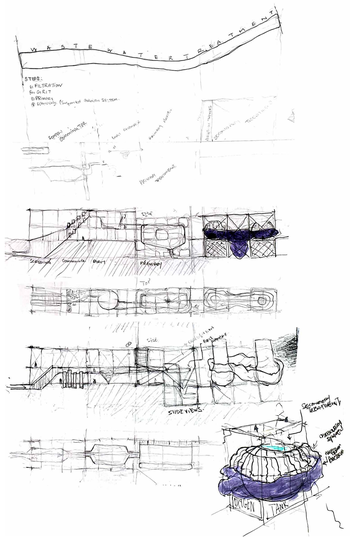


WASTEWATER PRODUCTION AND DENSITY

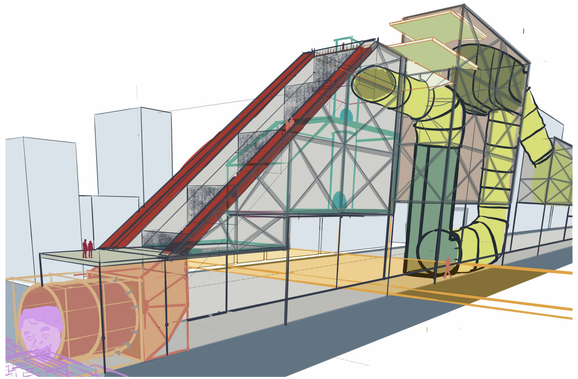


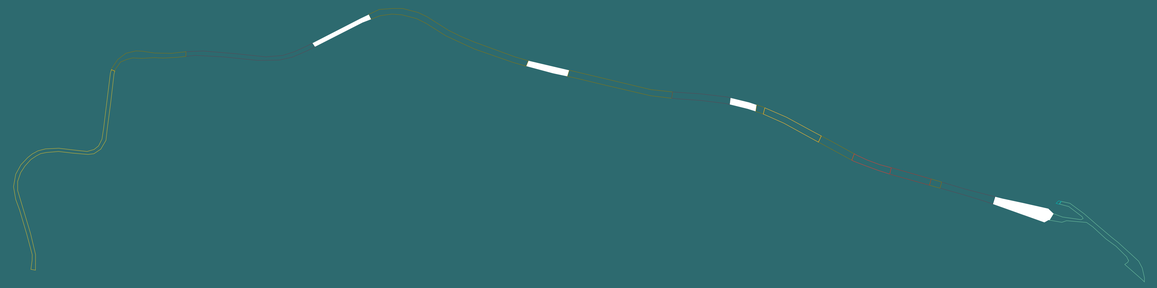


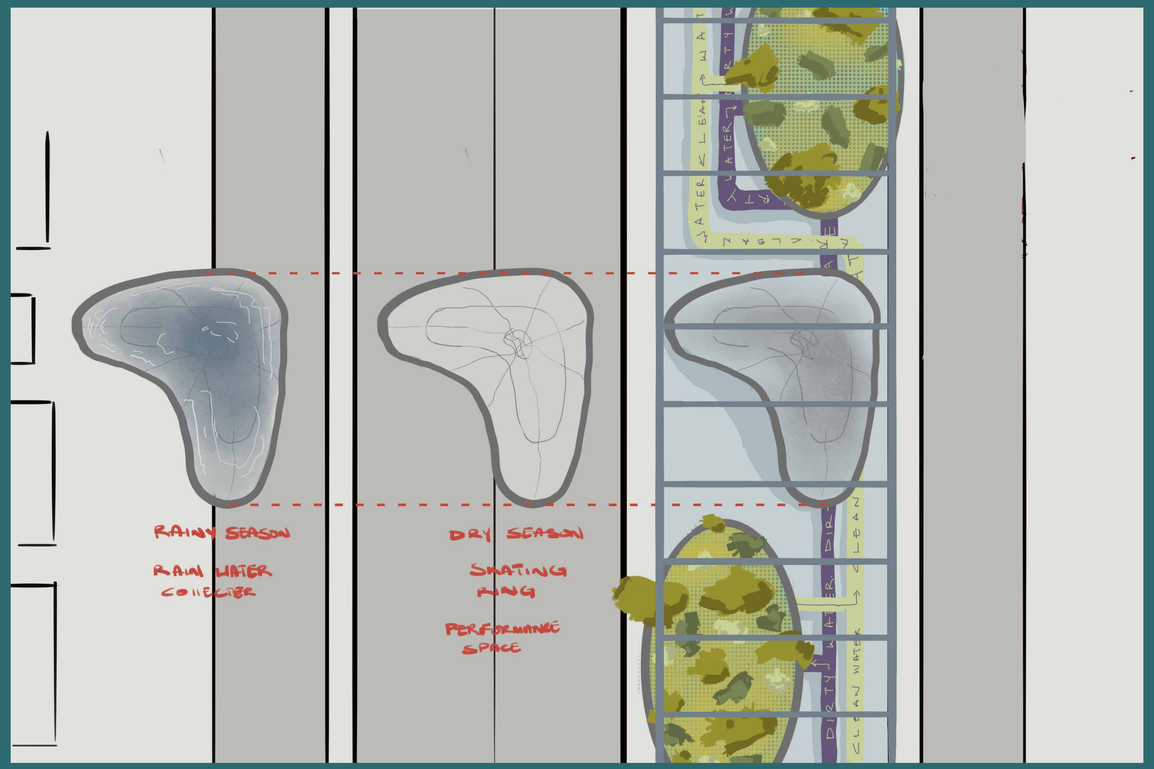
WASTEWATER TREATMENT OBSERVATORY. WASTEWATER TREATMENT OBSERVATORY. WASTEWATER



WASTEWATER TREATMENT OBSERVATORY. WASTEWATER TREATMENT OBSERVATORY. WASTEWATER





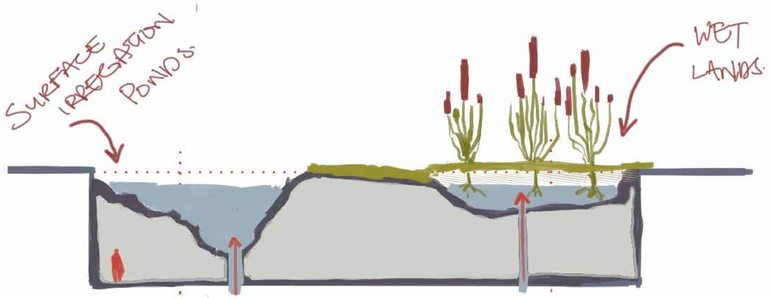


CONSTRUCTED WETLANDS. CONSTRUCTED WETLANDS. CONSTRUCTED WETLANDS. CONSTRUCTED

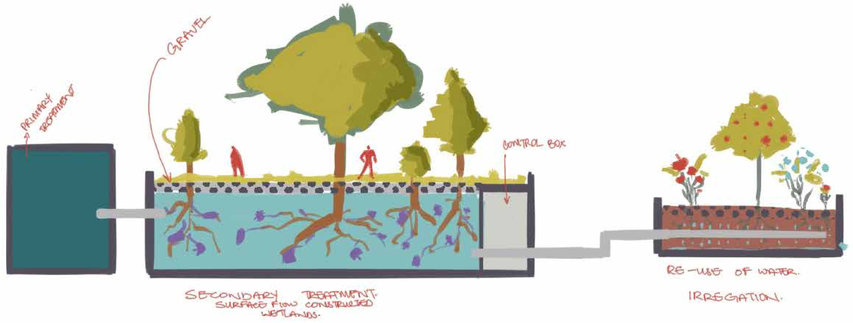
It is an organic wastewater treatment system that uses water, plants, naturally occurring microorganisms and a filter bed, usually of sand, soils and/or gravel.

The idea is that the plants, microorganisms and substrates together act as a filter and purification system. First, water is slowed as it enters the wetland, allowing for the sedimentation of solids. Thanks to the flow of water, plant roots and the substrate remove the larger particles present in the wastewater. Pollutants and nutrients present in the wastewaterare then naturally broken down and taken up by the bacteria and plants, thereby removing them from the water. After treatment in a constructed wetland, water can be safely released into surface waters or used various purposes

A Constructed Wetland is a man made artificial wetland used to treat residential or industrial wastewater, greywater or storm water runoff. It is an alternstive to Activated Sludge, and falls under the fixed film type of secondary treatment.



CONSTRUCTED WETLANDS:



CONSTRUCTED WETLANDS. CONSTRUCTED WETLANDS. CONSTRUCTED WETLANDS. CONSTRUCTED

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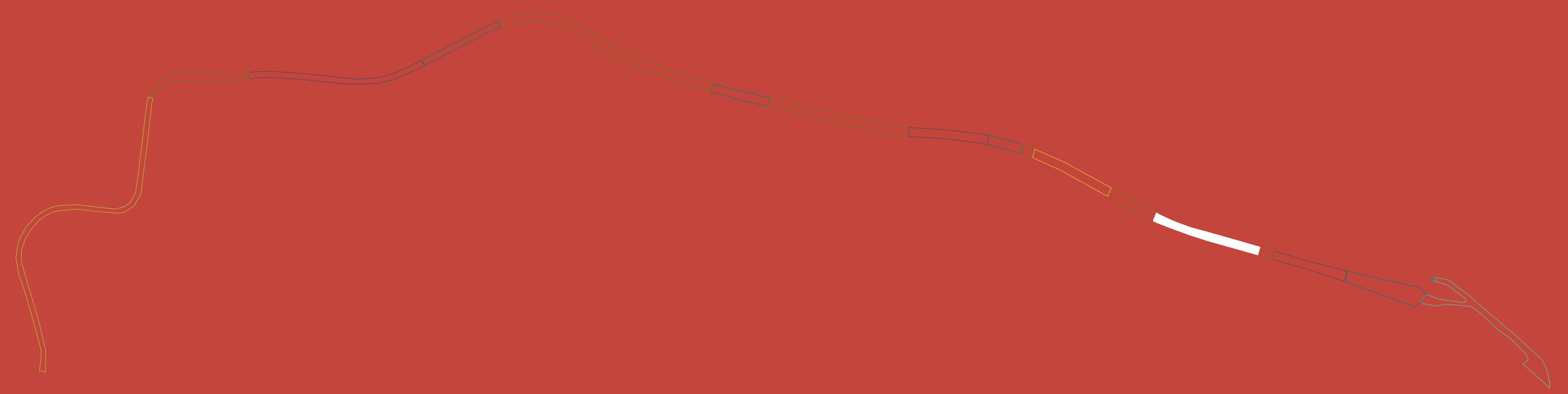
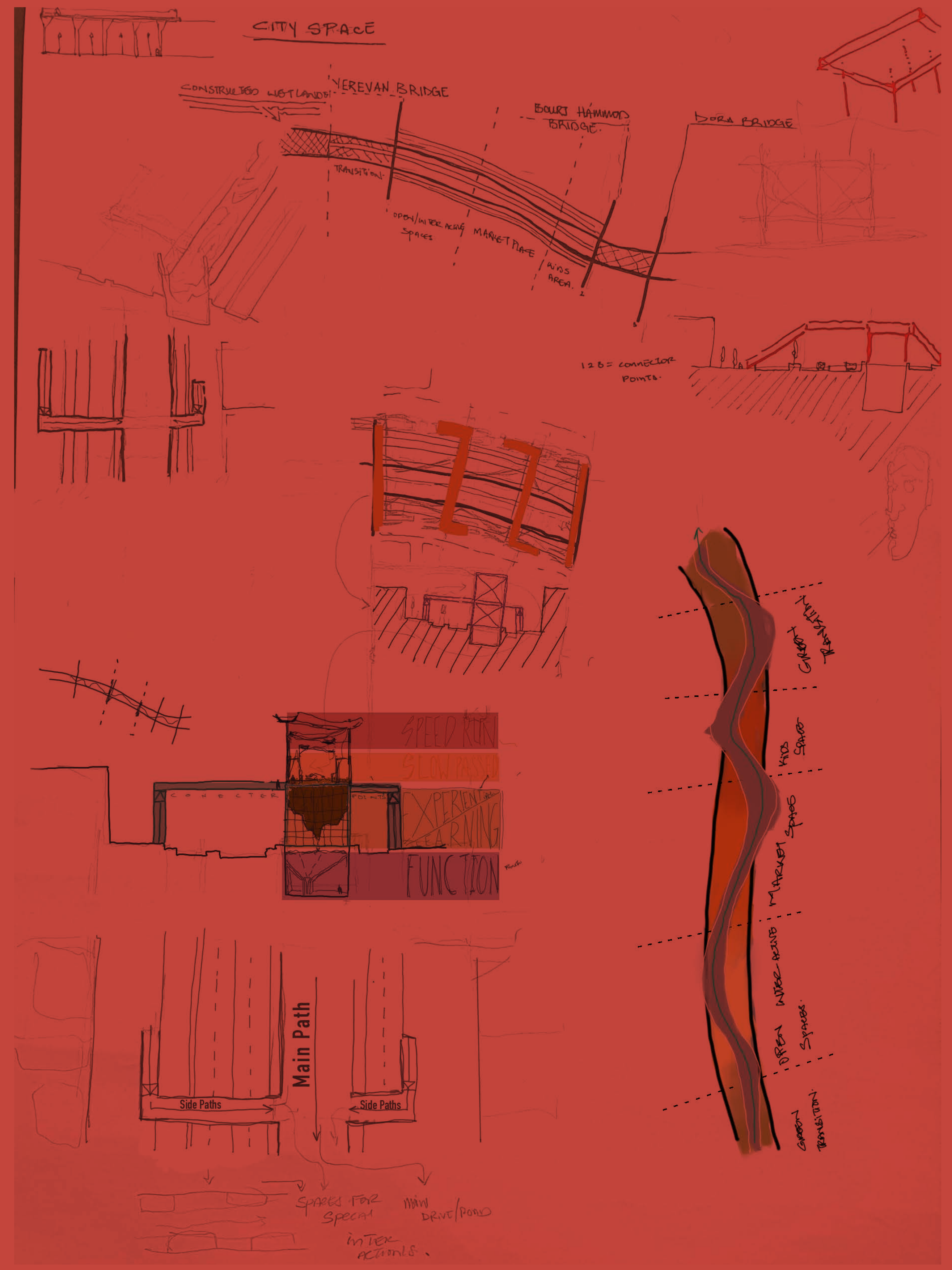
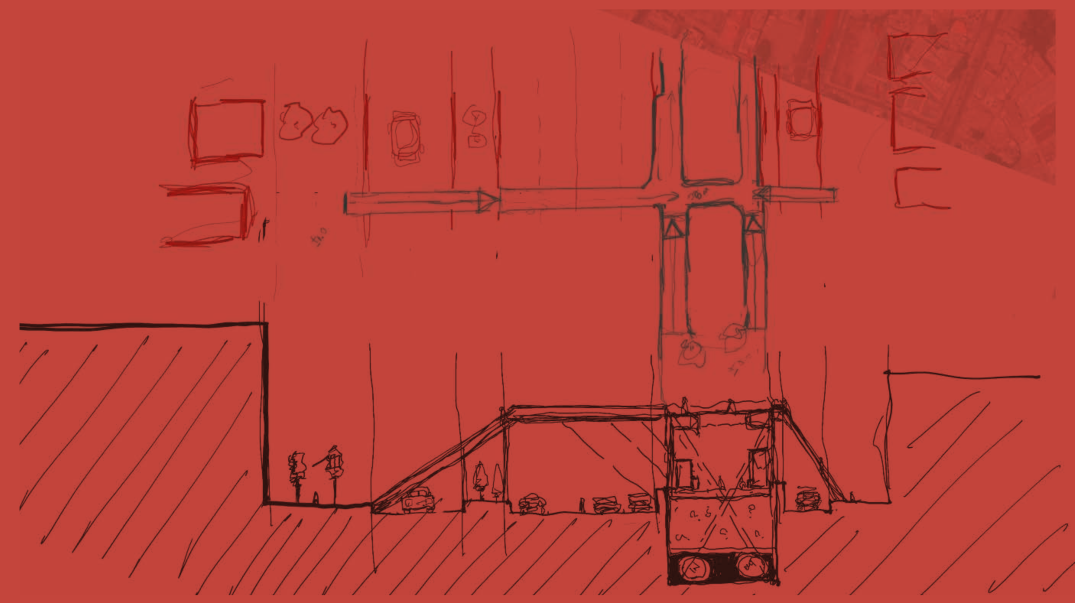


Bourj Hamoud was the focus of the first part of this bridge. Through different mappings of the landuse of the area, the main pedestrian walkway can be divided into parts, each catering to different types of social needs and interactions such as open/interactive spaces, a market place to help revitalize Bourj Hammouds many talented artisans, a kids area and sports functions, both social functions lacking in this part of Beirut.

One of the issues that arose after the canalization of Beirut River in the late 90's was this new invisible barrier that settled down and got comfortable nestled between the rough exposed cheeks of a dry, polluted river. With only 2 bridges along this part of the river, Yerevan Bridge and Bourj Hammoud Bridge, going over to the other side of river, got a little more time consuming, especially when taking a pedestrian approach of manoeuvring instead of a vehicular one.

The idea started here with the placement of a number of pedestrian bridges across the river beds, starting from one side of the pedestrian walk, to the other, making accesibility and interactions between both sides of the river accessible. These bridges would have different levels across which different experiences can manafest themselves.





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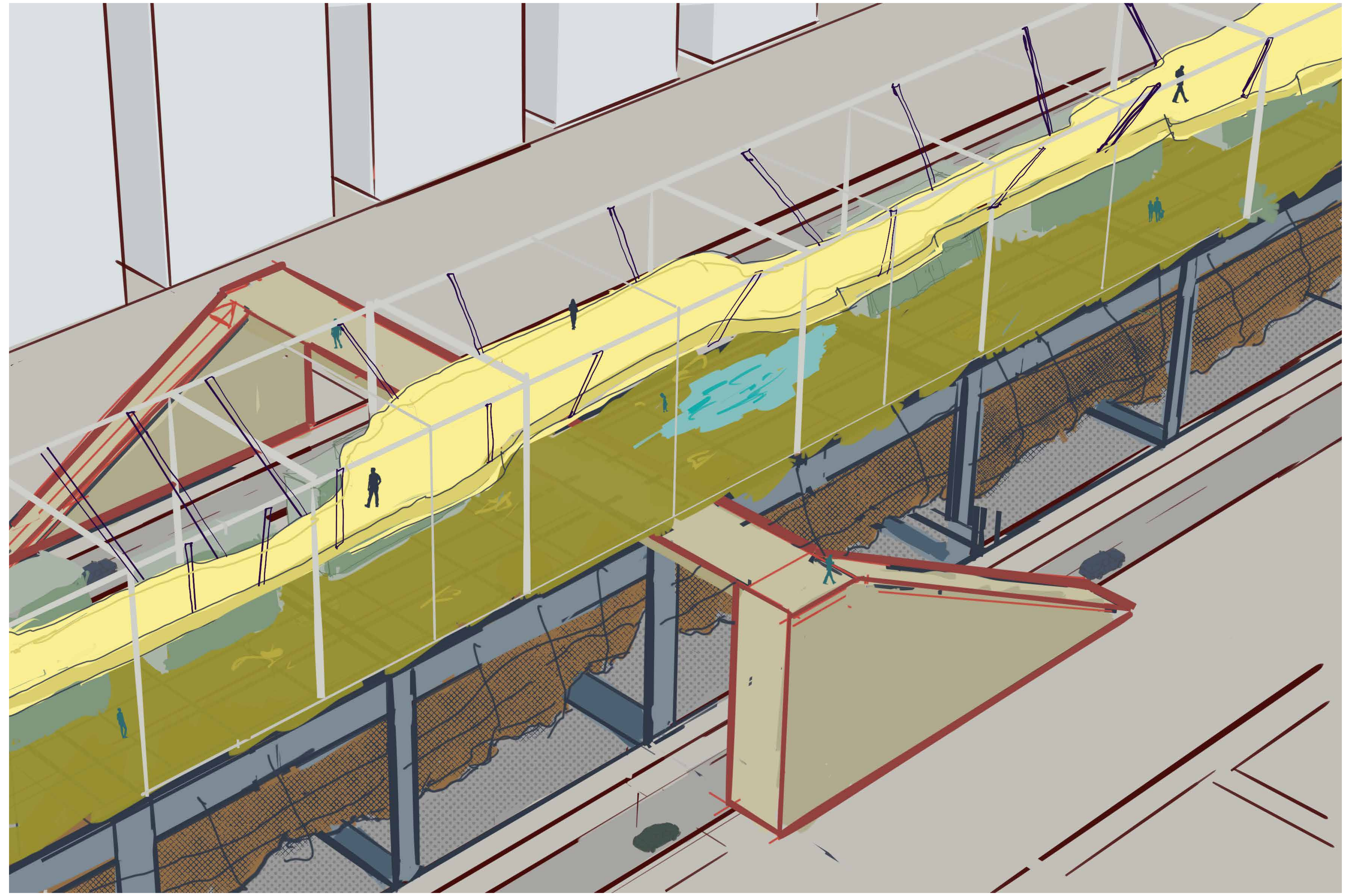
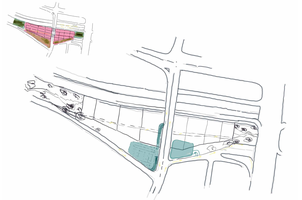
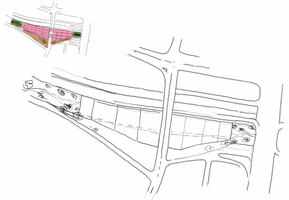
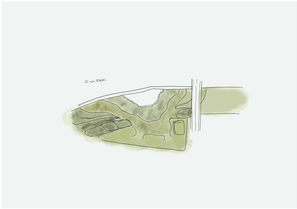


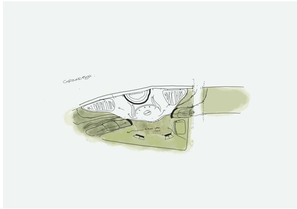
IMPLIMENTATION

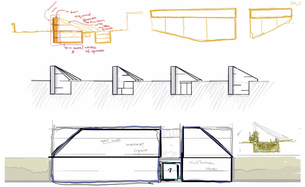
PROCESS OF EVOLUTION

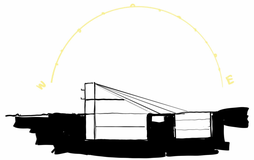


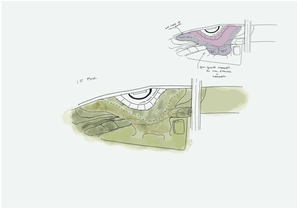


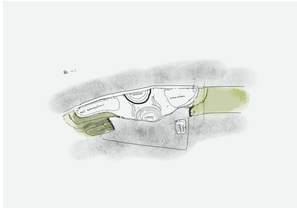


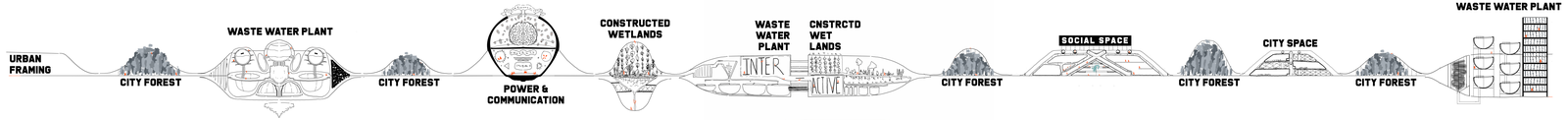


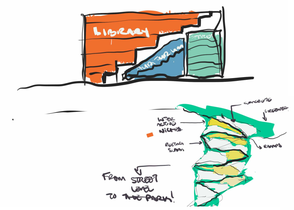


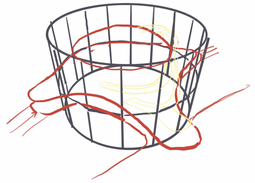


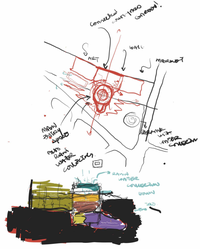


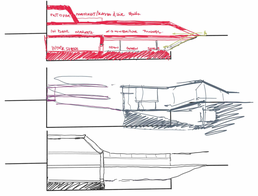


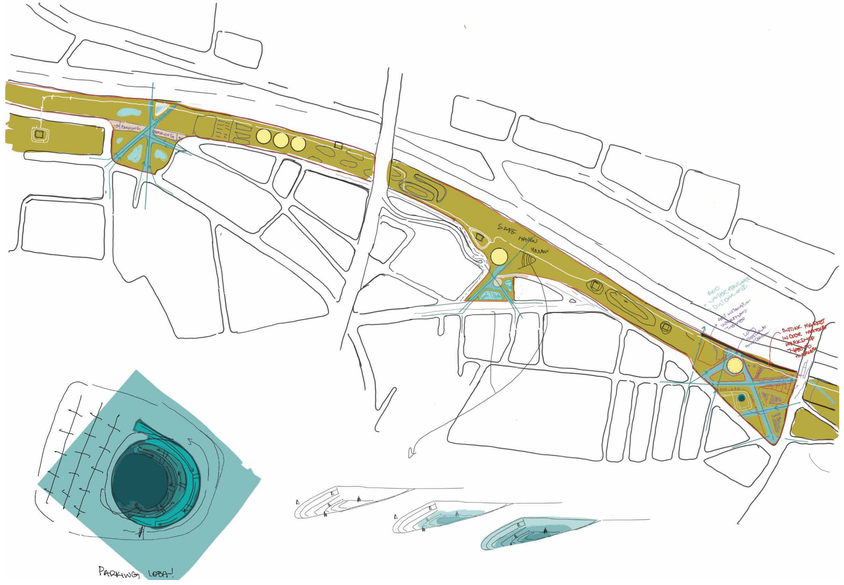


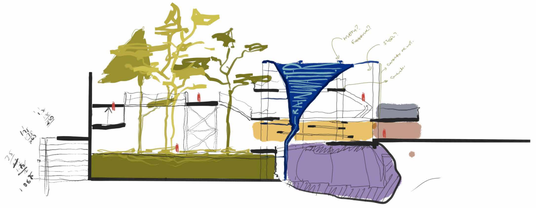

LIBRARY
FROM STREET LEVEL TO THE PARK!



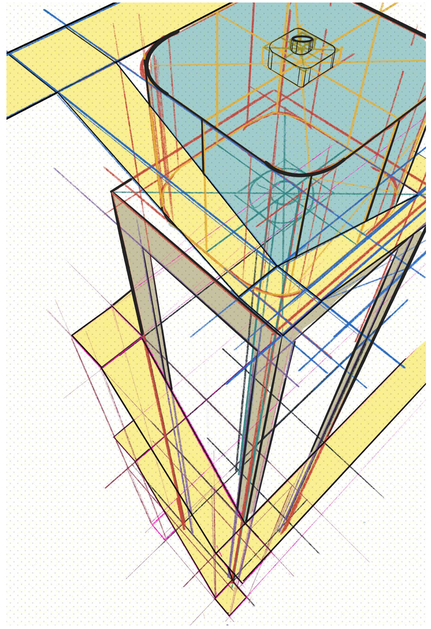


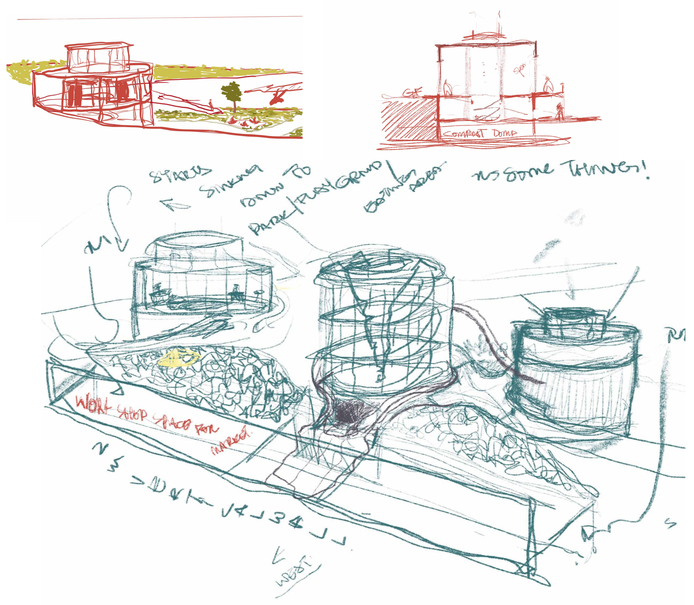


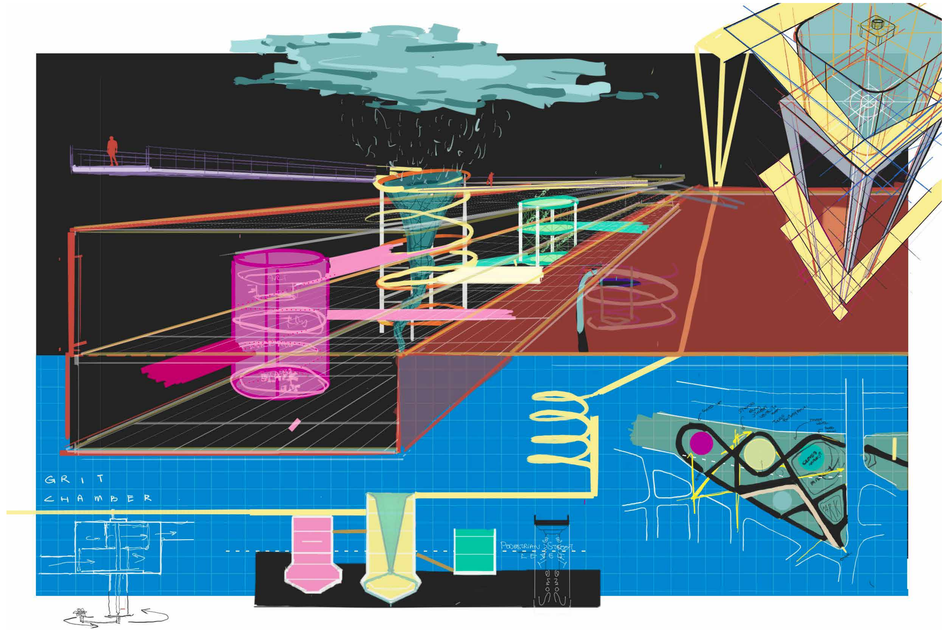

PARKING LOBBY

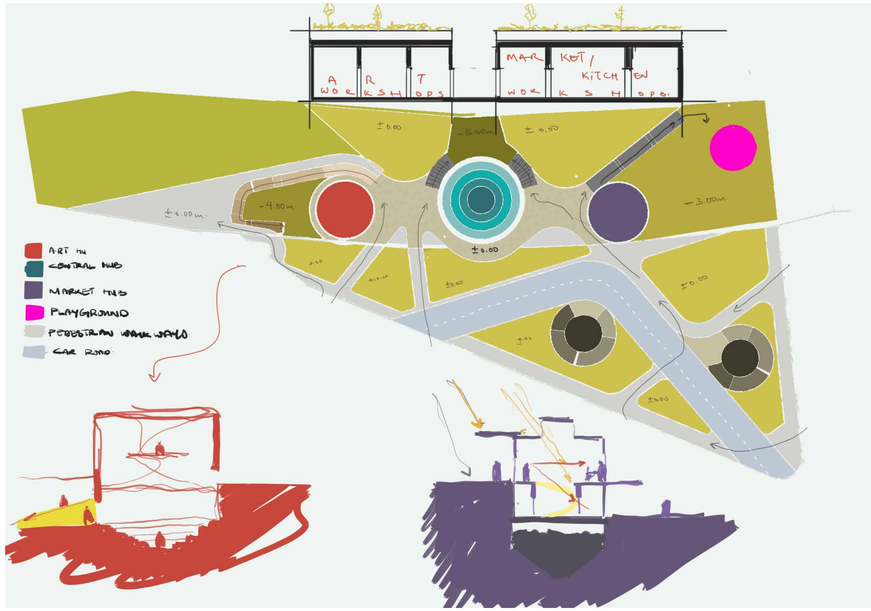


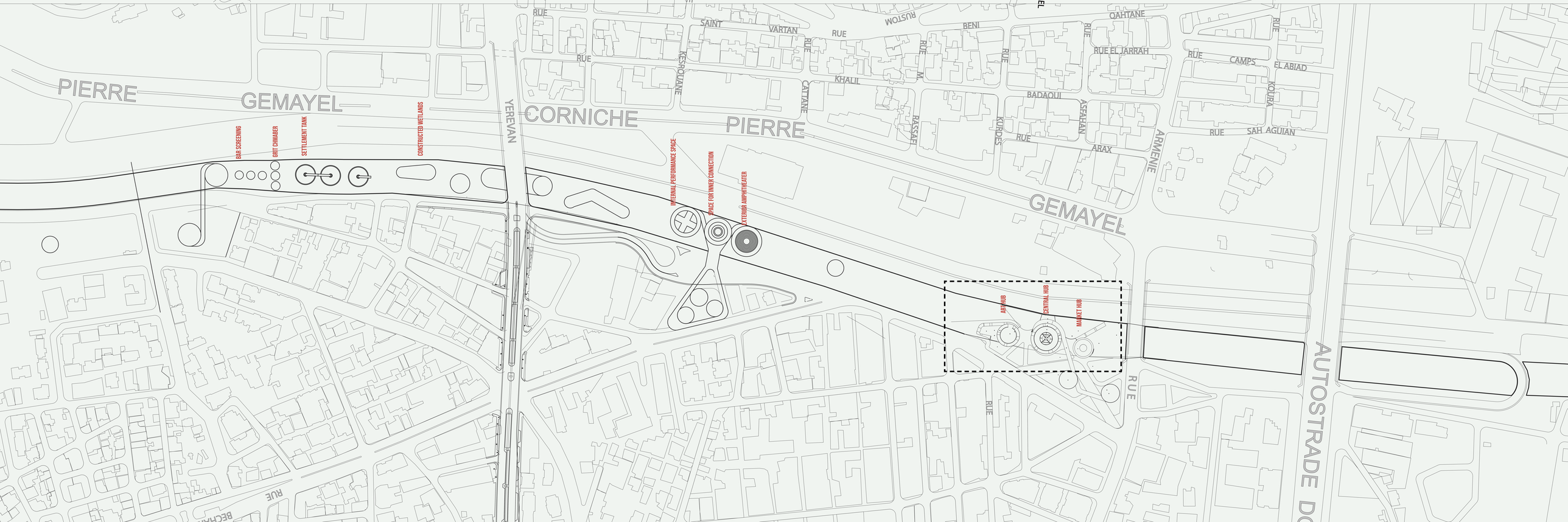
WALK SLOPES




Compact Dump
STAIRS
SINKING DOWN TO PARK/PLAYGROUND BETWEEN BUILDINGS
WORK SHOP SPACE FOR ARTISTS
WEST


GRIT
CHAMBER


ART HUB
CENTRAL HUB
MARKET HUB
PLAYGROUND
PEDESTRIAN WALKWAYS
CAR ROAD


PIERRE
GEMAYEL
CORNICHE
PIERRE
GEMAYEL
YEREVAN
AUTOSTRADE DO
RUE
SAINT
VARTAN
RUE
RUSTOM
BENI
QAHTANE
RUE EL JARRAH
CAMPS
EL ABIAD
KOURA
SAH AGUIAN
KESSOUANE
KHALIL
CATTANE
RASSAFI
BADAOUI
ASFAHAN
KURDES
ARAX
ARMÉNIE
BAR SCREENING
GRIT CHAMBER
SETTLEMENT TANK
CONSTRUCTED WETLANDS
INTERNAL PERFORMANCE SPACE
SPACE FOR INNER CONNECTION
EXTERIOR AMPHITHEATER
ARTHUB
CENTRAL HUB
MARKET HUB

RUE
KOURA
CAMPS
SAHAGUIAN
RUE
RUE
QAHTANE
RUE EL JARRAH
ARMENIE
RUE
ASFAHAN
ARAX
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GEMMAYEL
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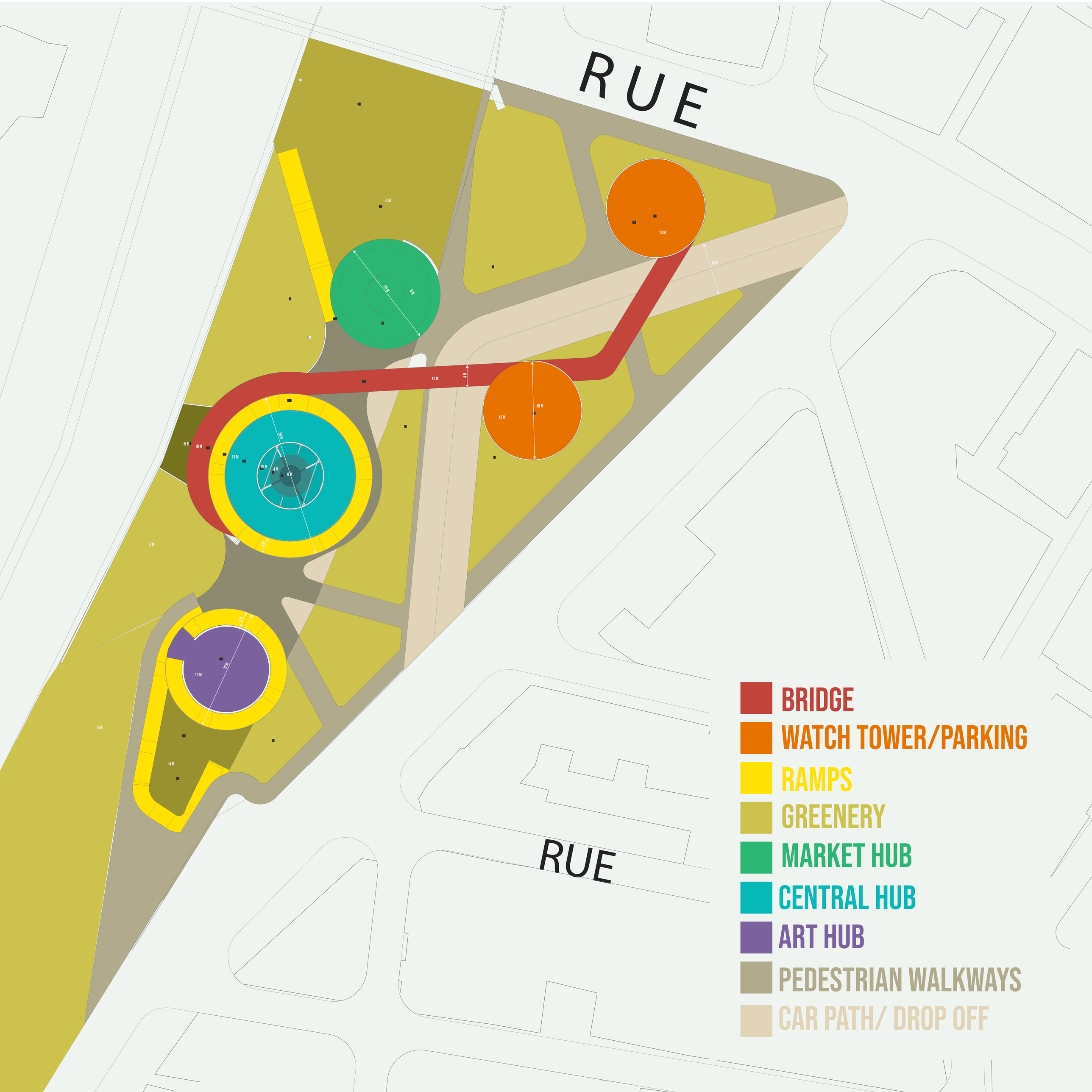
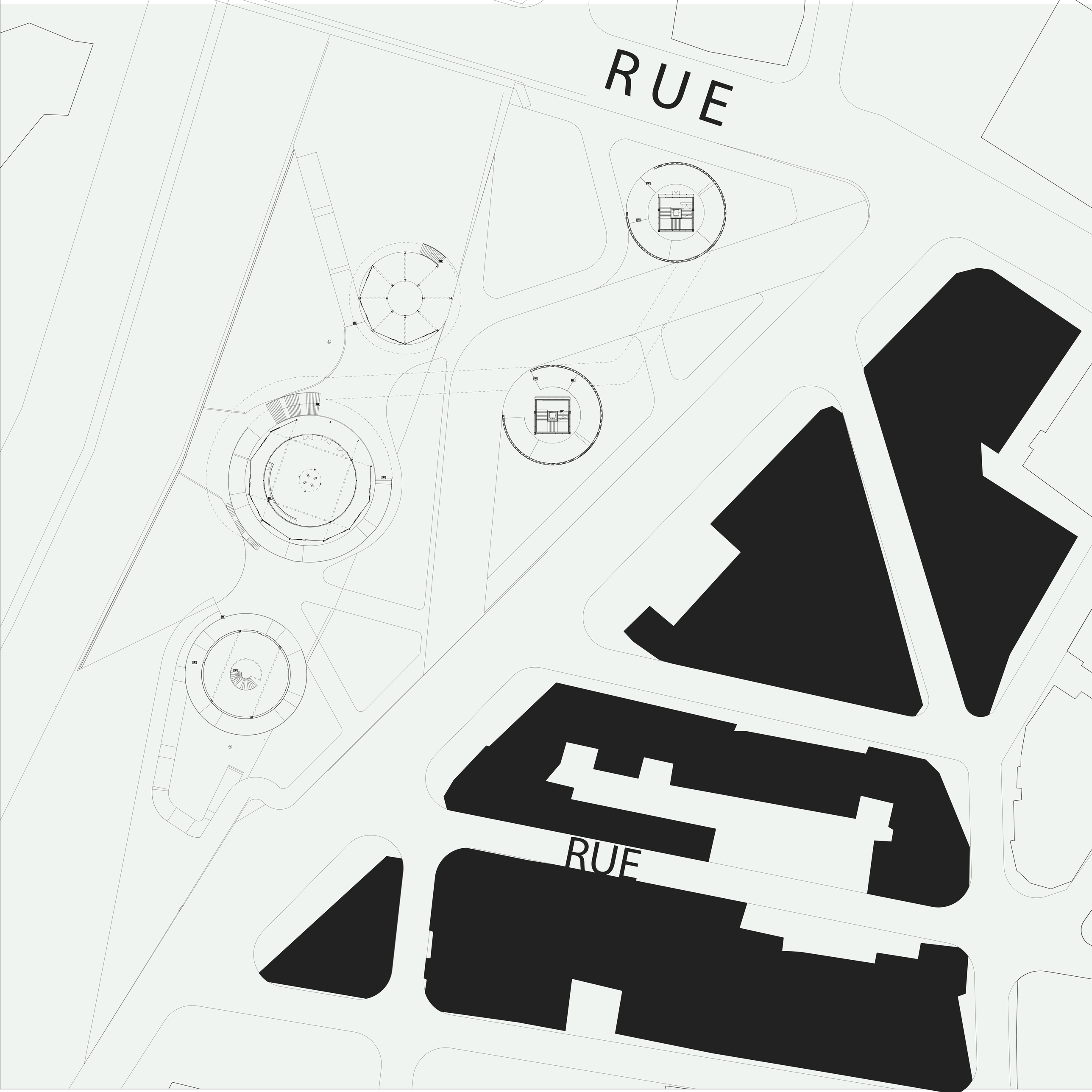
KURDES
RUE
RUE
M.
RASSAFI
KHALIL
CATTANE


RUE
RUE
-3 M
13 M
10 M
20 M
6 M
10 M
4 M
13 M
18 M
-5 M
10 M
16 M
20 M
10 M
4 M
0 M
4 M
0 M
4 M
12 M
12 M
0 M
-4 M
BRIDGE
WATCH TOWER/PARKING
RAMPS
GREENERY
MARKET HUB
CENTRAL HUB
ART HUB
PEDESTRIAN WALKWAYS
CAR PATH/ DROP OFF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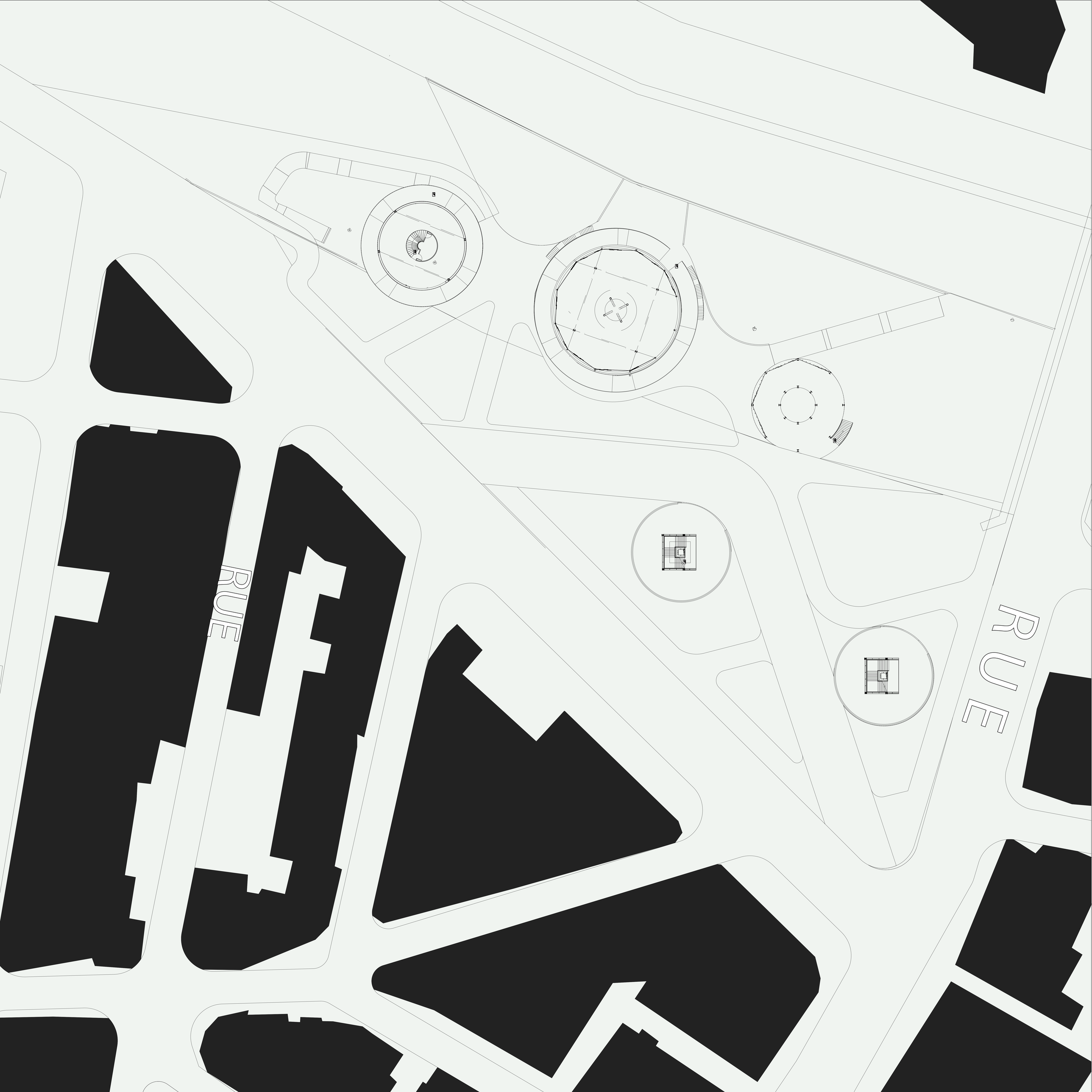
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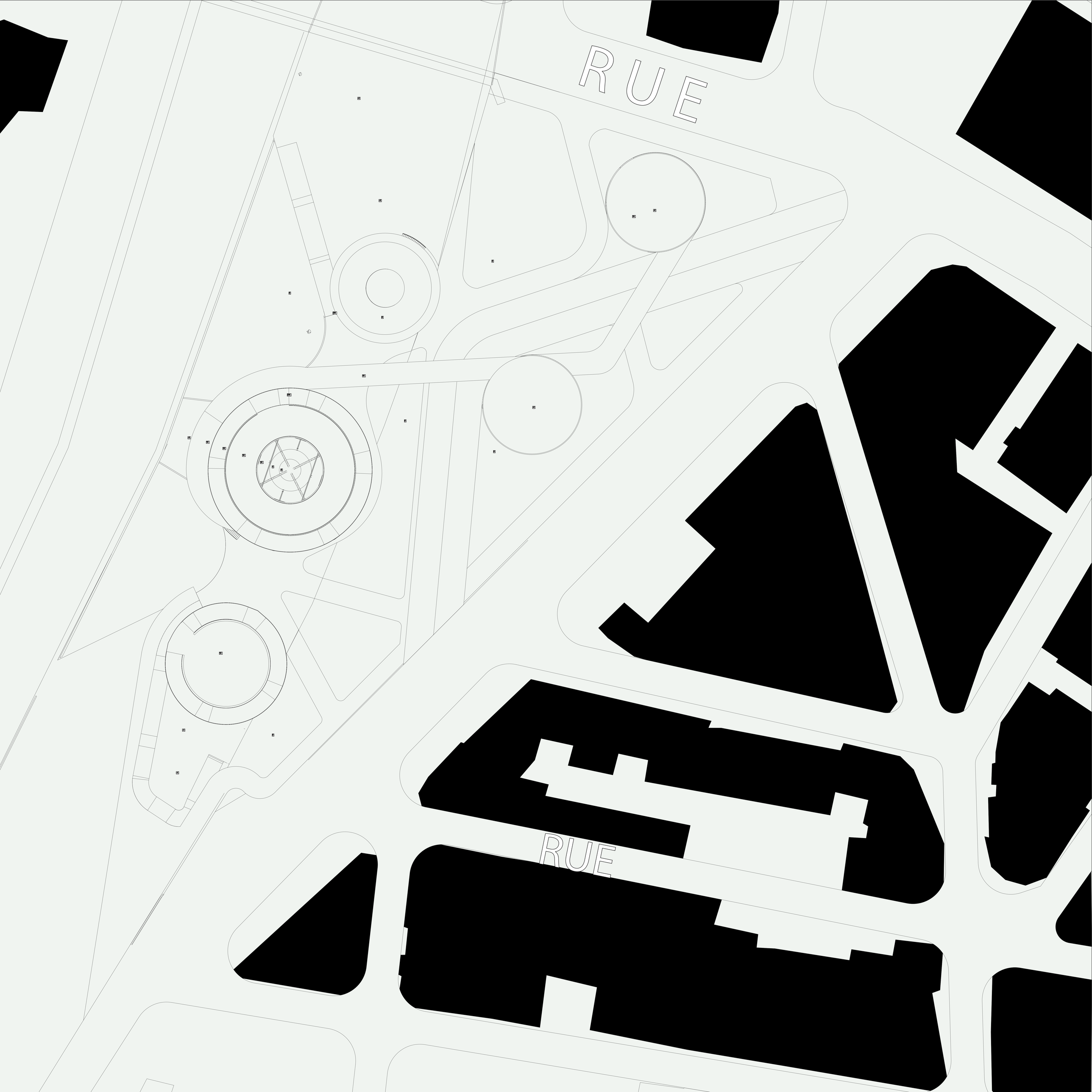
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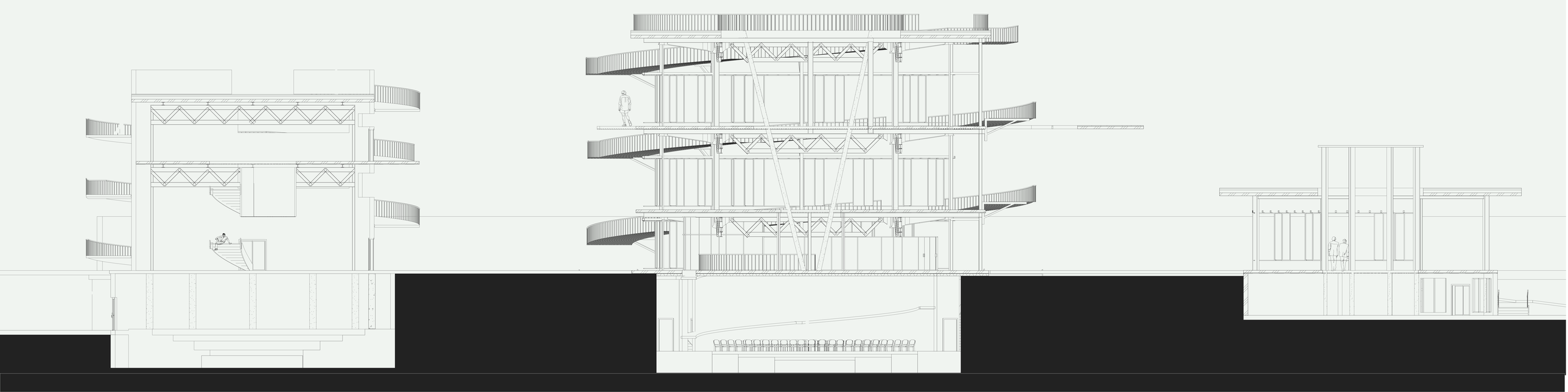
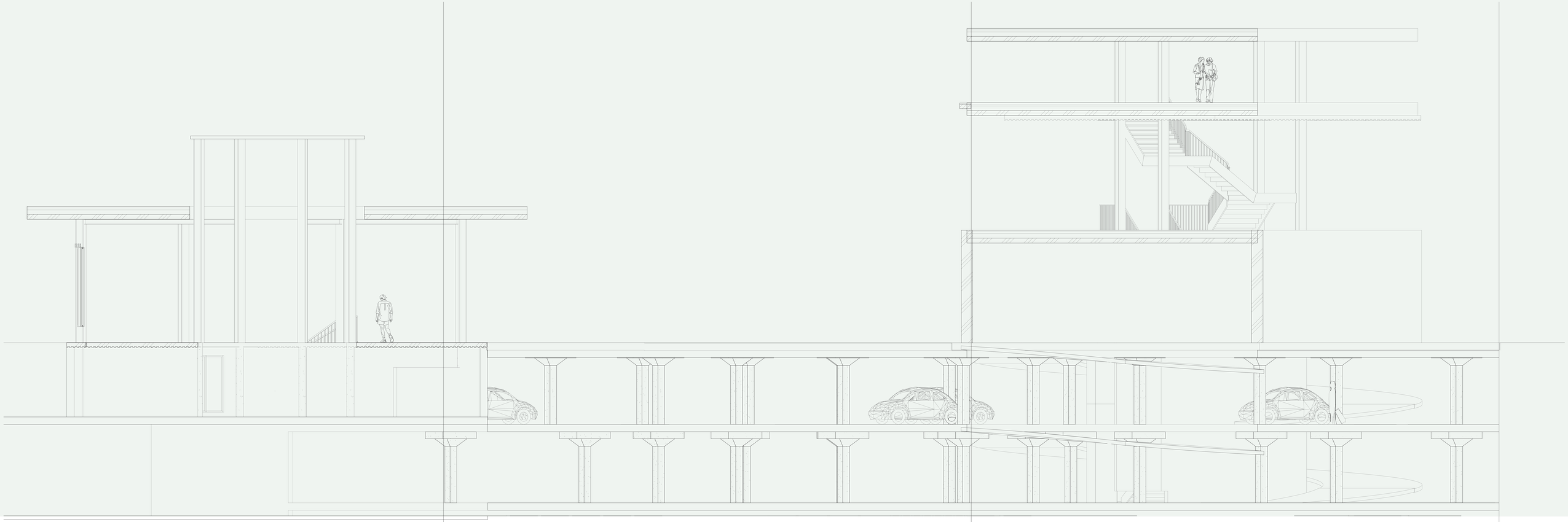
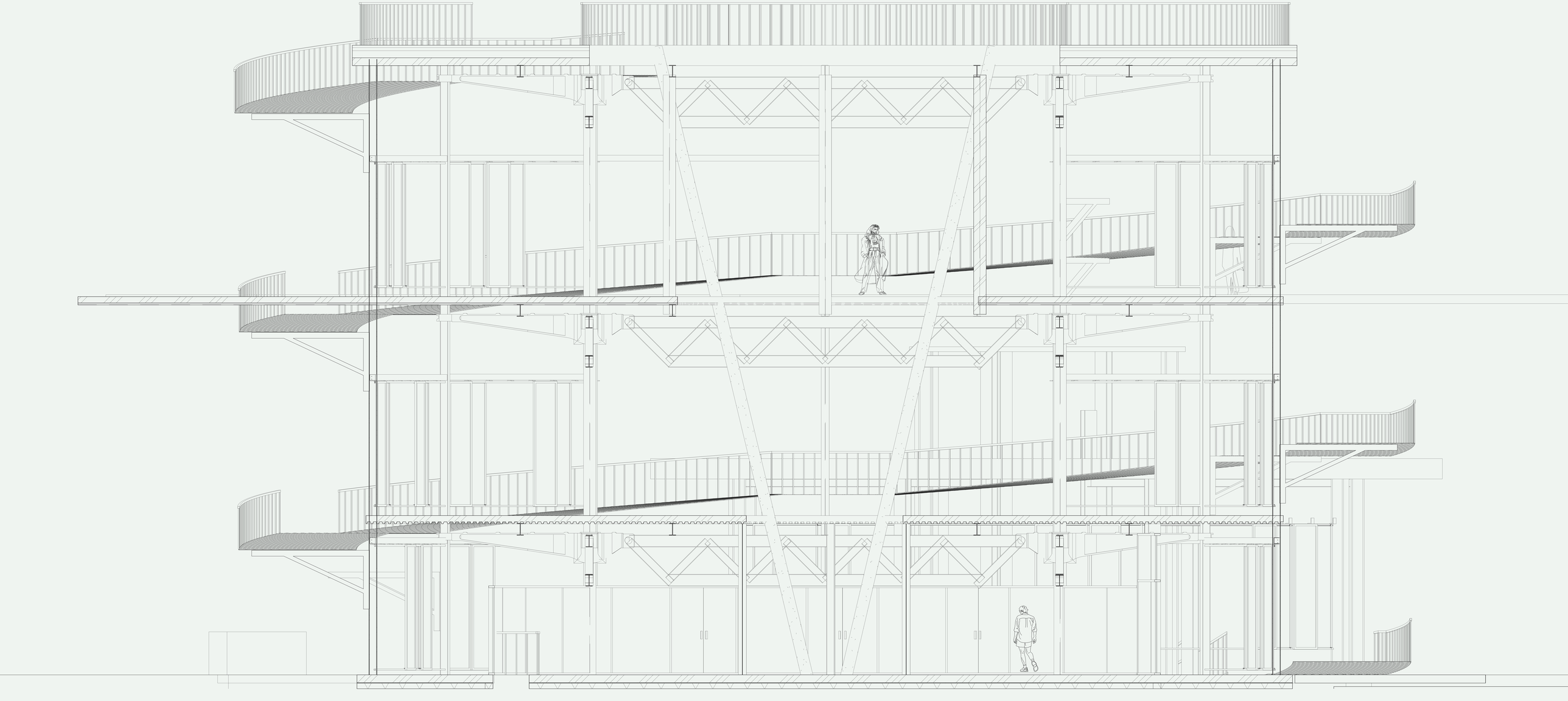
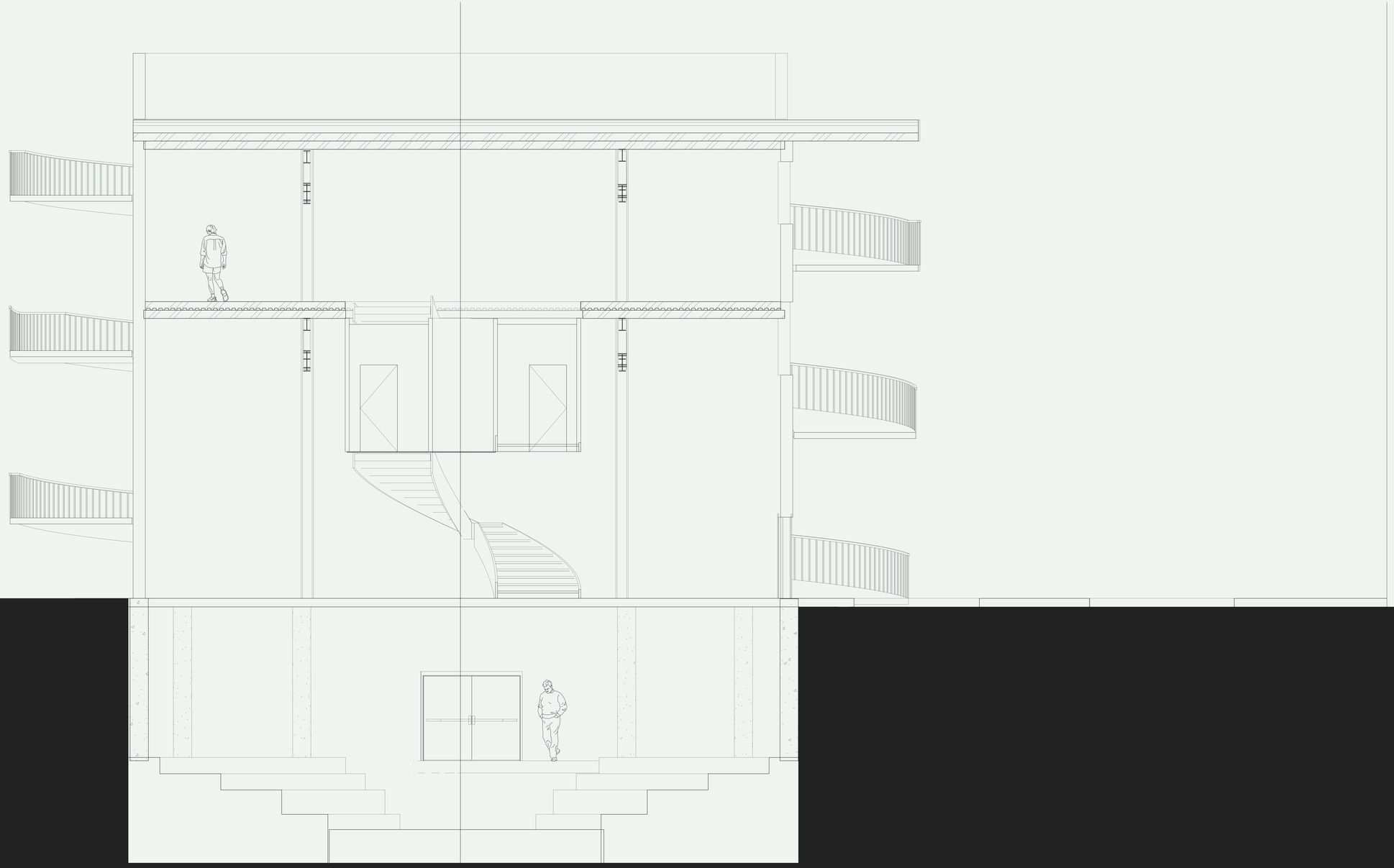
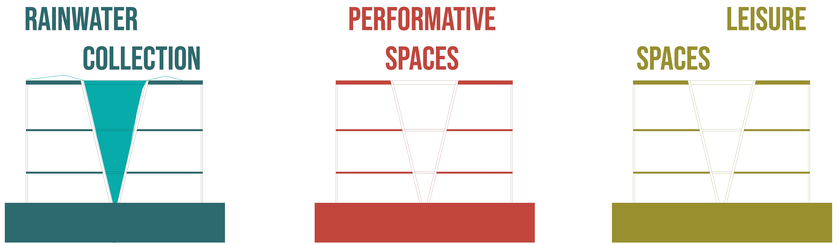
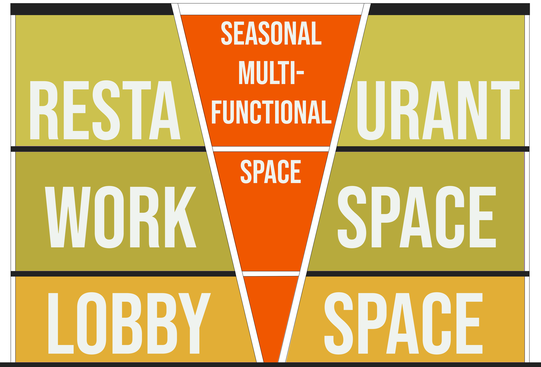




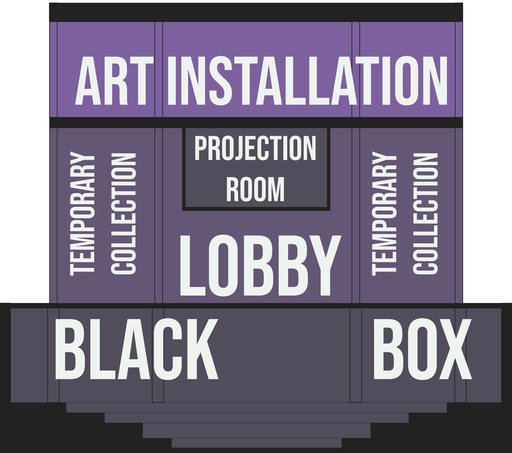
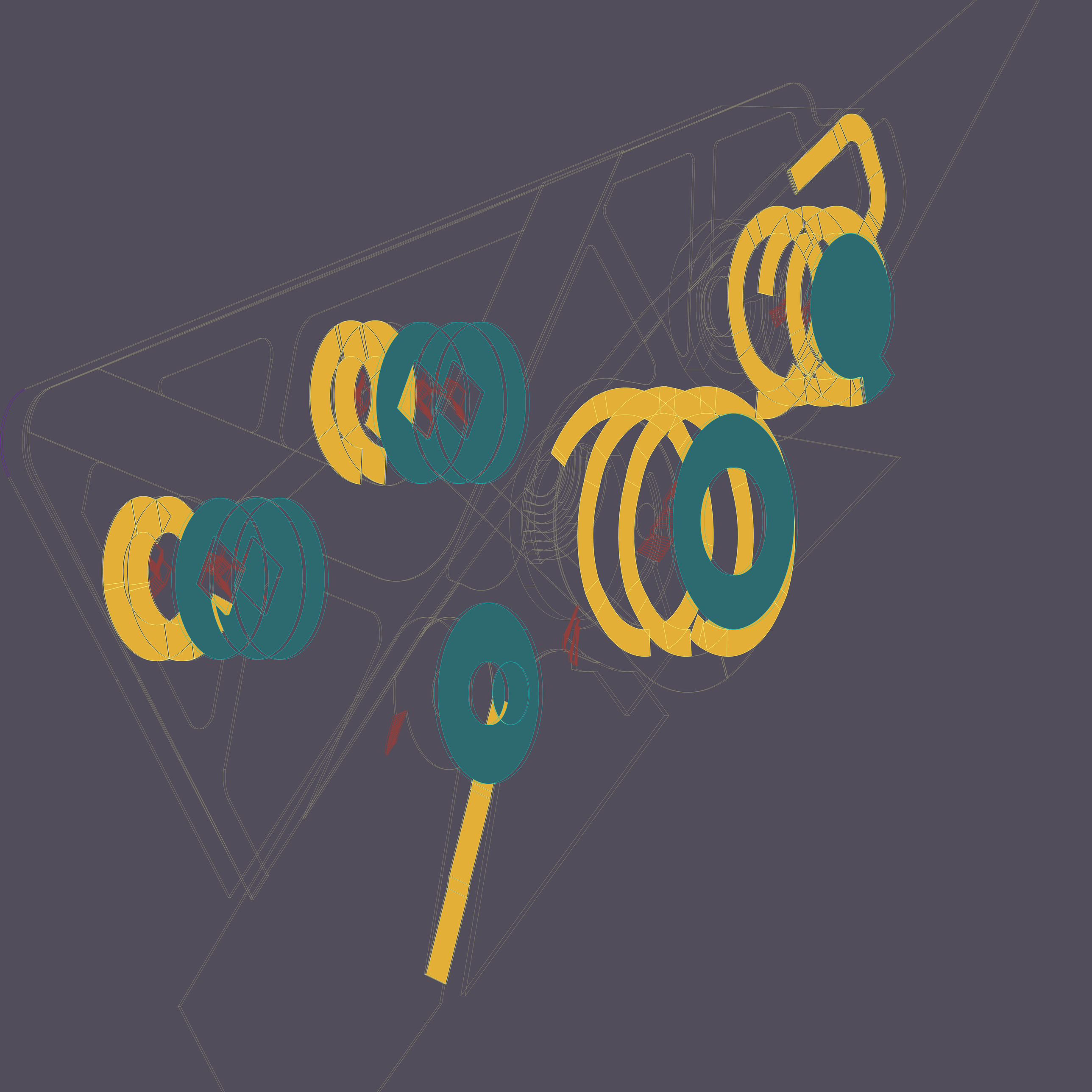
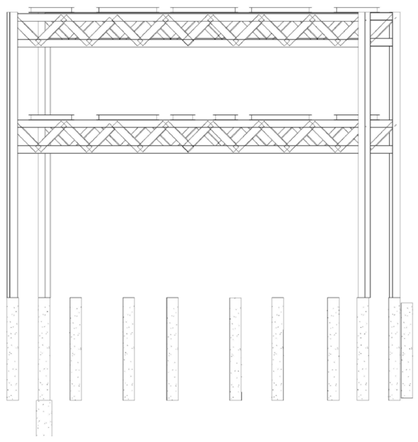
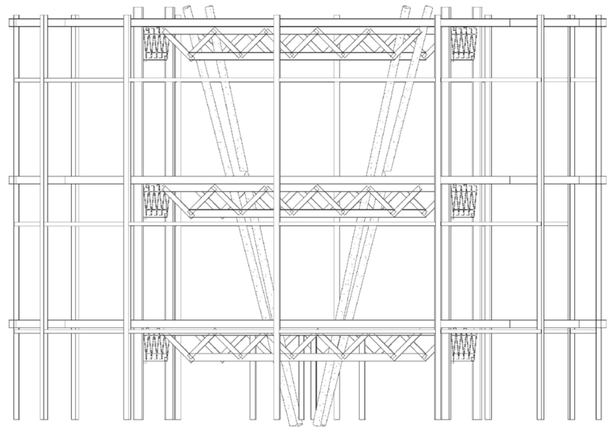
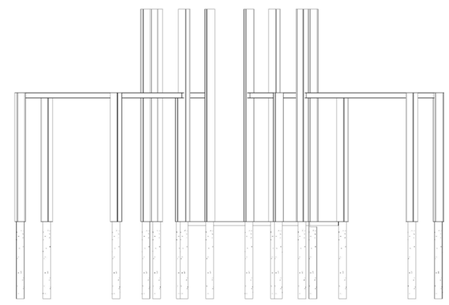
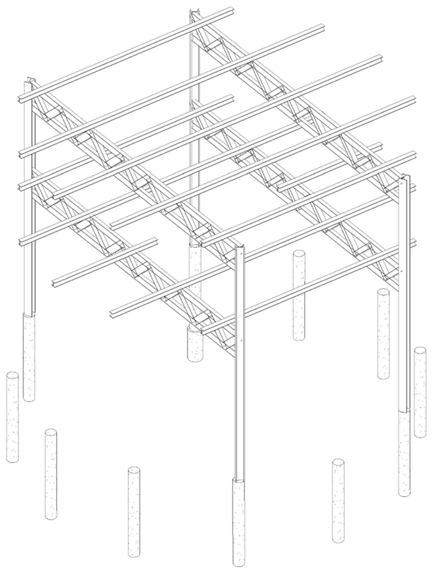
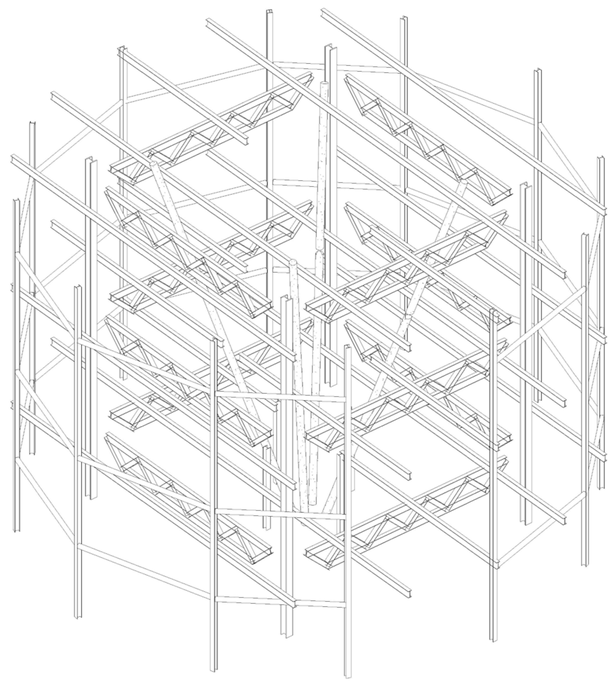
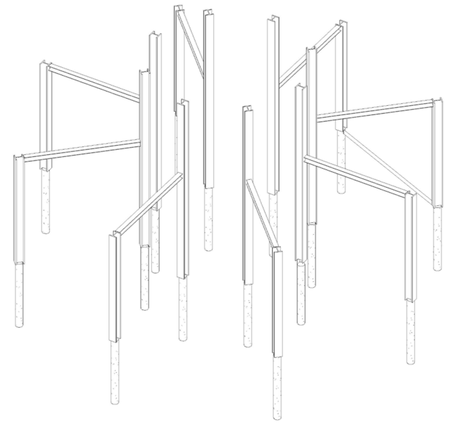





RAINWATER
COLLECTION
PERFORMATIVE
SPACES
LEISURE
SPACES


SEASONAL
MULTI-
FUNCTIONAL
SPACE
RESTA
URANT
WORK
SPACE
LOBBY
SPACE

OPEN MARKETS
CLOSED MARKET


ART INSTALLATION
TEMPORARY
COLLECTION
PROJECTION
ROOM
LOBBY
TEMPORARY
COLLECTION
BLACK
BOX