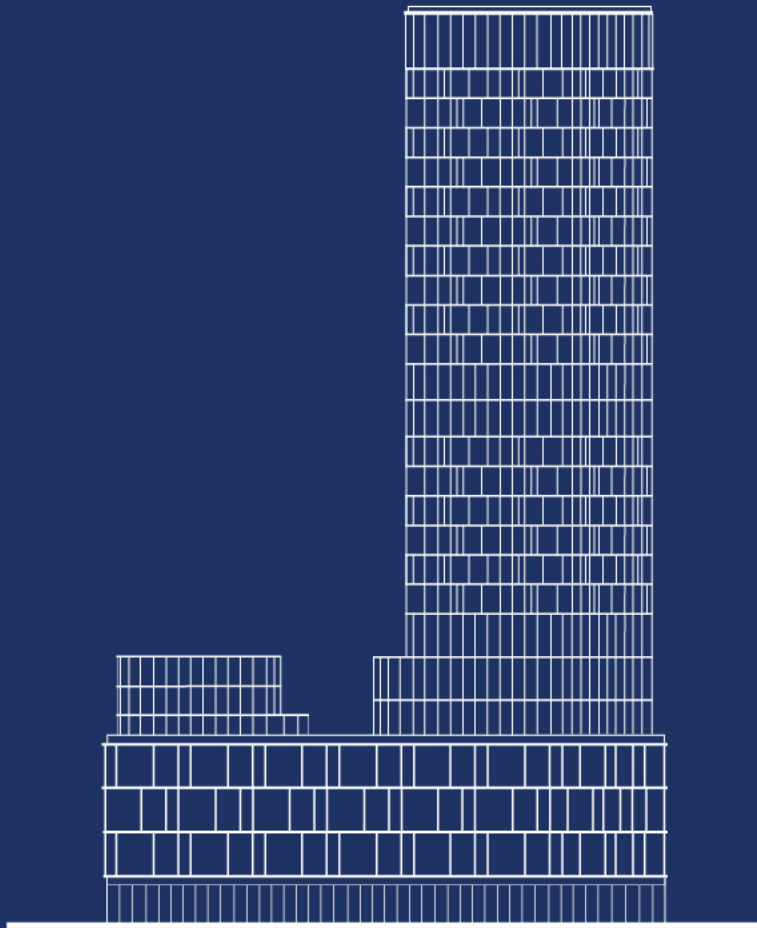


Lumina tower

shedding light on knowledge and ideas



Delft University of Technology

Public Building

Graduation book
July 2024

Colofon

Design booklet as part of the graduation report prepared for the master's degree in architecture at the Delft University of Technology.

Title

Lumina tower

Author

L.J.F. (Luca) Laponder
4853075

Graduation supervisors

Paul Kuitenbrouwer - Project design
Gosia Golabek - Theory & Delineation
Piero Medici - Technical Building Design

Lumina is Latin for “Lumen”, Meaning “**Light**”.
It symbolizes the **enlightenment** of knowledge.
The shedding of light on knowledge and ideas linked
to University, Research and Office.

TABLE OF CONTENT

01	Introduction
02	Assignment
03	Research
04	Concept
05	Architecture
06	Building Technology
07	Case studies
08	Recap

INTRODUCTION

My interest for Public Buildings in architecture started during my Bachelor studies at the ZUYD Hogeschool. In the third year, we had the possibility to go on an exchange abroad. I got the opportunity to work at an architectural bureau in Barcelona. The bureau is specialised in large scale projects and high-rise. During this period, I got the chance to work on lots of different projects. In the concept department but also on the physical projects. This gave me an insight in the different methods that are used for high-rise buildings and also, how important the plinth is in these projects.

However, I never had the chance to design a project of this scale by myself and especially this height. The vertical and hybrid use of the Vertical Campus creates its challenges which relate to the nowadays densifying cities and rare plot size.

This research aims to merge institutional learning with public learning experiences, such as libraries, theatres, and exhibitions, within a vertical campus integrated into the urban fabric. Traditionally, campuses are horizontal and detached from the city, leading to a separation between private campuses and public learning opportunities in urban areas. During the design process after P2, it became clear that public and private space is a definition that changes depending on its function. This development led to a new design for the Vertical Campus and also a redefined research question. For the Vertical campus it means that private space will be replaced by institutional learning and that public space is focussed on public learning, sharing knowledge with visitors. A multifunction location where people gather to share, create and gain knowledge.

Overall, the research about how the Vertical Campus contributes to and extends the public realm in the Hague. It is implemented in the capacity plan of The Hague that we developed for P1. It is also about connecting the existing urban tissue. Buildings should not only reflect to themselves, but should engage in the public realm of the city. This is achieved through a transparent ground floor that connects the elevated square over several floor. These themes go further than only the Public Building Studio. They link to Urbanism, how we connect movement of people through the city and the development of the city of The Hague for Management in the Built Environment. But looking closer to the Vertical Campus itself, the research becomes a guide how we experience spaces. In my introduction of P2 for my research I talked about what we experience when walking towards a large-scale or high-rise building. This experience shows that entering a public building has different boundaries for people. Physical but also psychological. From the outdoor urban space, materials, interior and sizing of the surrounding to the distance between people and how ethical boundaries have impact on us. Linking the different studios in the Faculty of Architecture together will help in the future to do more research about this topic.

Introduction

01

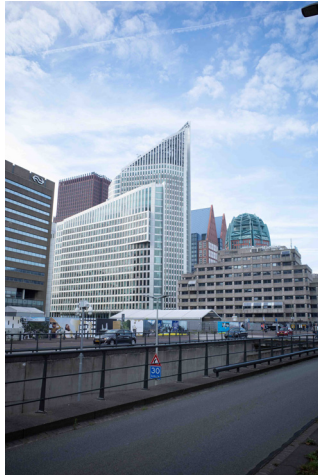
SYLLABUS

The project is located in the Hague. The Hague is the political heart of the Randstad and is located on the West side of the Netherlands.

For the studio, we focused on the area around the station because this is the central innovation district and is known for its high-rise buildings.



THE HAGUE



Showing how dense the area is with buildings combined with the large concrete road dividing the area.



The contrast between the high-rise and intimate neighborhood, this is all in 100 meter difference.



Building against the park, creating a wall between the two areas.

TIMELINE



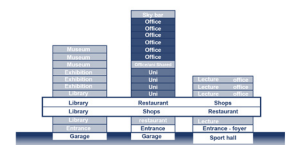
Excursion Oxford and London



P2 The Horizon



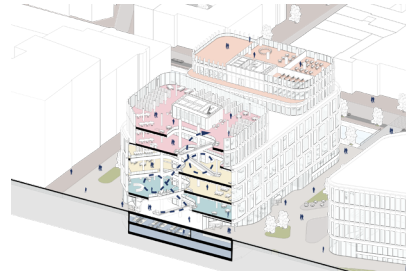
P1 capacity plan



New design proposals



P3 NEW DESIGN

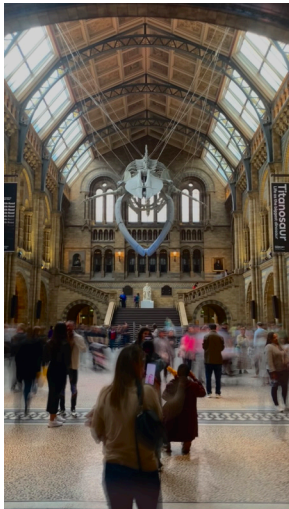


P5 graduation

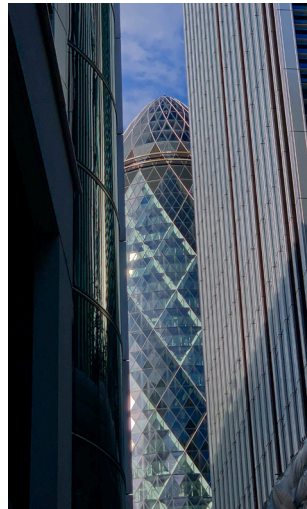
P4



LONDON AND OXFORD EXCURSION



In this picture is visible how the public building is designed. Materials, light, routing and how people move.



In this picture we see the effect of how an area is perceived when several high rise buildings are clustered. But also the reflection and shadow of materials because of the distance between the buildings.



Open for the public or private is very well visible in these pictures. How do we close something for the public and how does the inner courtyard feel. What gives the perception of privacy?



Between the larger project/building is a totally different dynamic visible of the street plan. It is pedestrian accessible and gives a sense of breath between the buildings. It feels open and is different to the way

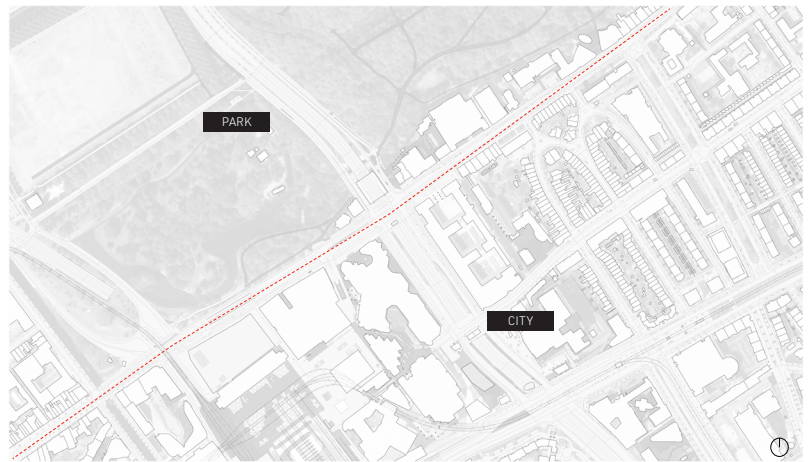
GREEN BORDER



In this picture we see the effect of how an area is perceived when several high rise buildings are clustered. But also the reflection and shadow of materials because of the distance between the buildings.

URBAN ANALYSIS

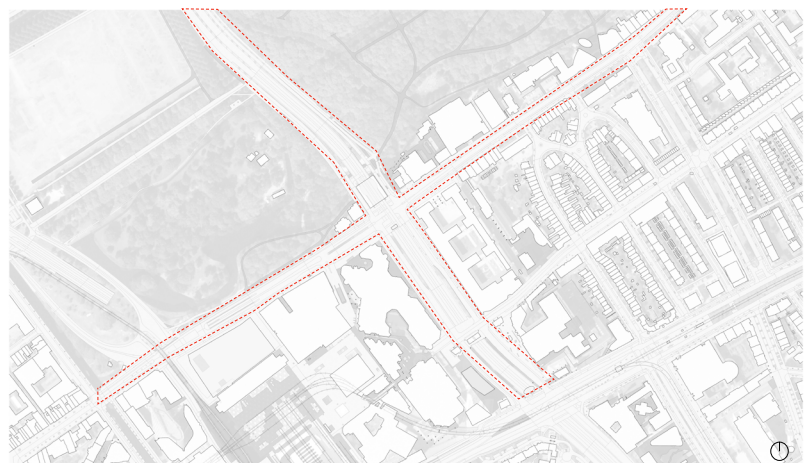
North and south are divided by a road. The park is not connected. The area is divided by a road which is part of the connection network for the area. The road can be seen as the divider between the park and the city. On the park side is one row of buildings and these go from high-rise to low-rise city structures.



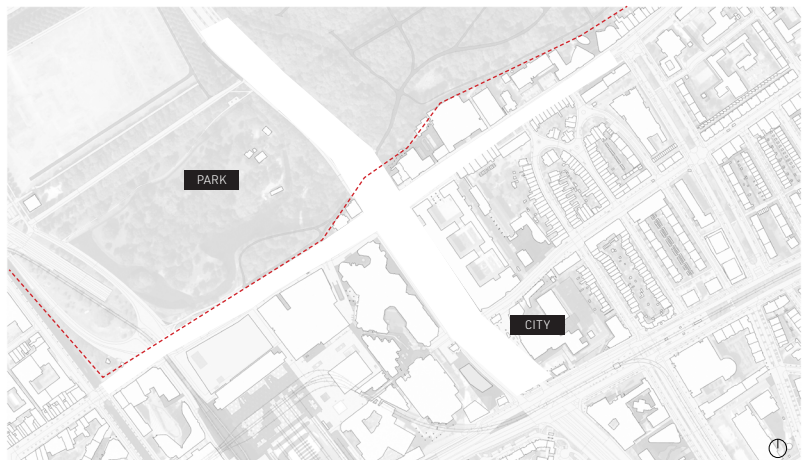
Road is interrupting East and West. This highway is the other divider of the area. This road is partly underground to open up space for movement. However, this area is not used properly now. It divides the area into the large-scale busy commercial area, which is known for its high-rise buildings. Compared to the medium-scale less busy residential area.



The traffic is a problem in this area. The green border is a cross area which has a lot of roads due to the movement around The Hague. This is the A12 and Bezuidehouthouseweg.



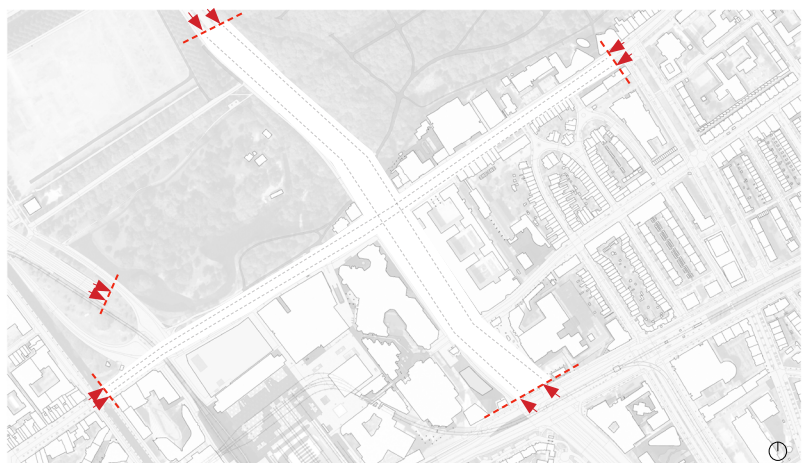
The Haagse bos is framed in a dense urban environment. There is a hard edge around the park because it is protected heritage. Therefore they built around it.



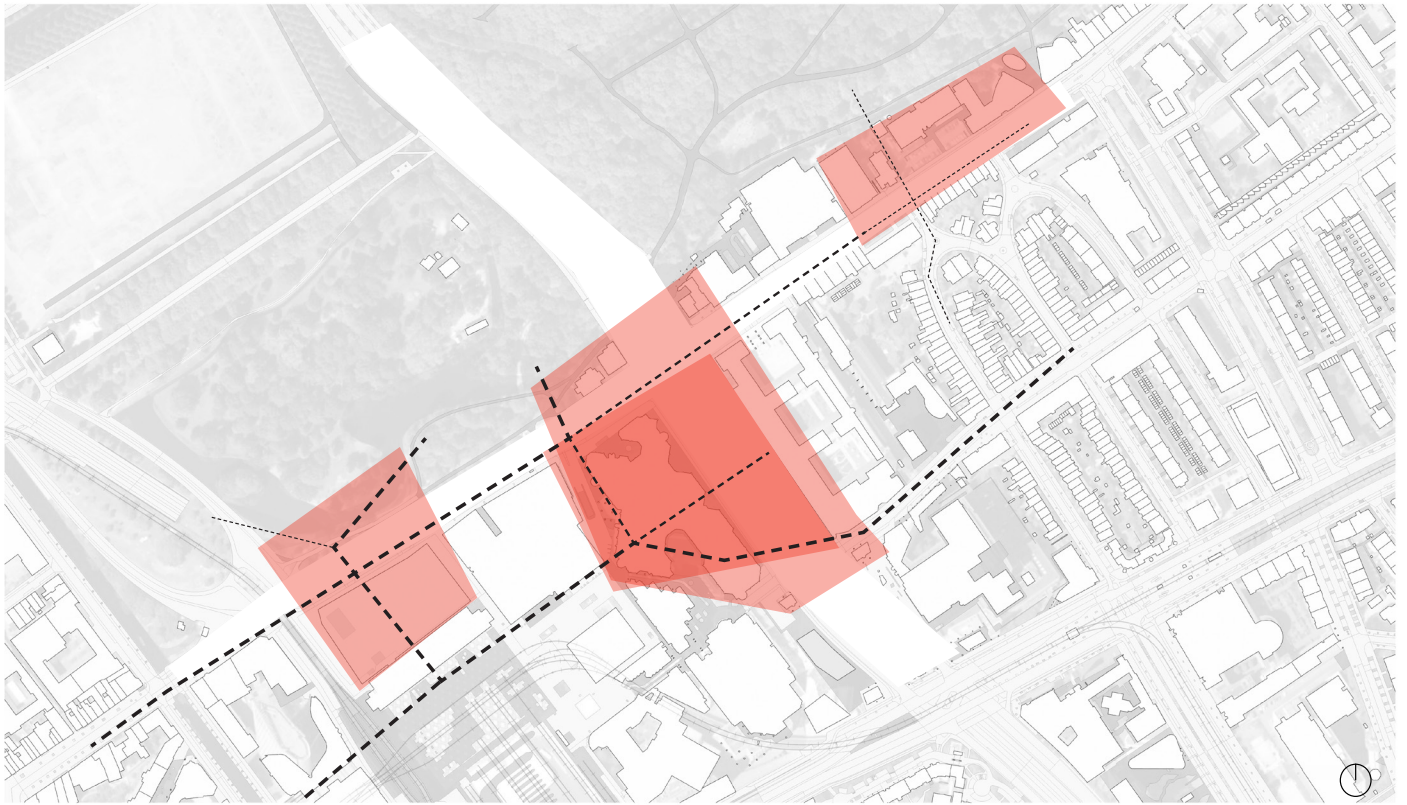
Bringing the park to your doorstep by weaving the city and park back together.



Moving the roads underground to open up the borders that are created by it in the area. Allowing new opportunities to connect and move around in the area.



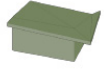
URBAN ANALYSIS



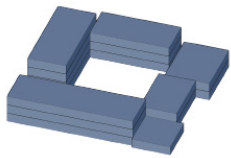
Structuring the new space, Main hotspots to establish:

Public and busy centers. In the area are three places where pedestrian movements comes together. These spots can be used to built new projects and also create urban spaces for the public.

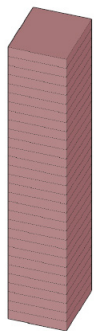
CONCEPT P1



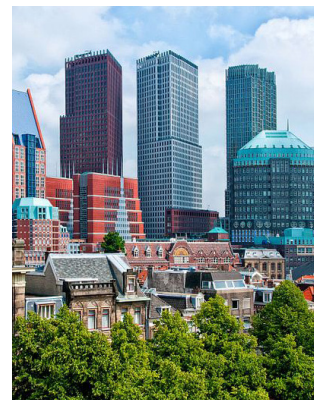
S



M

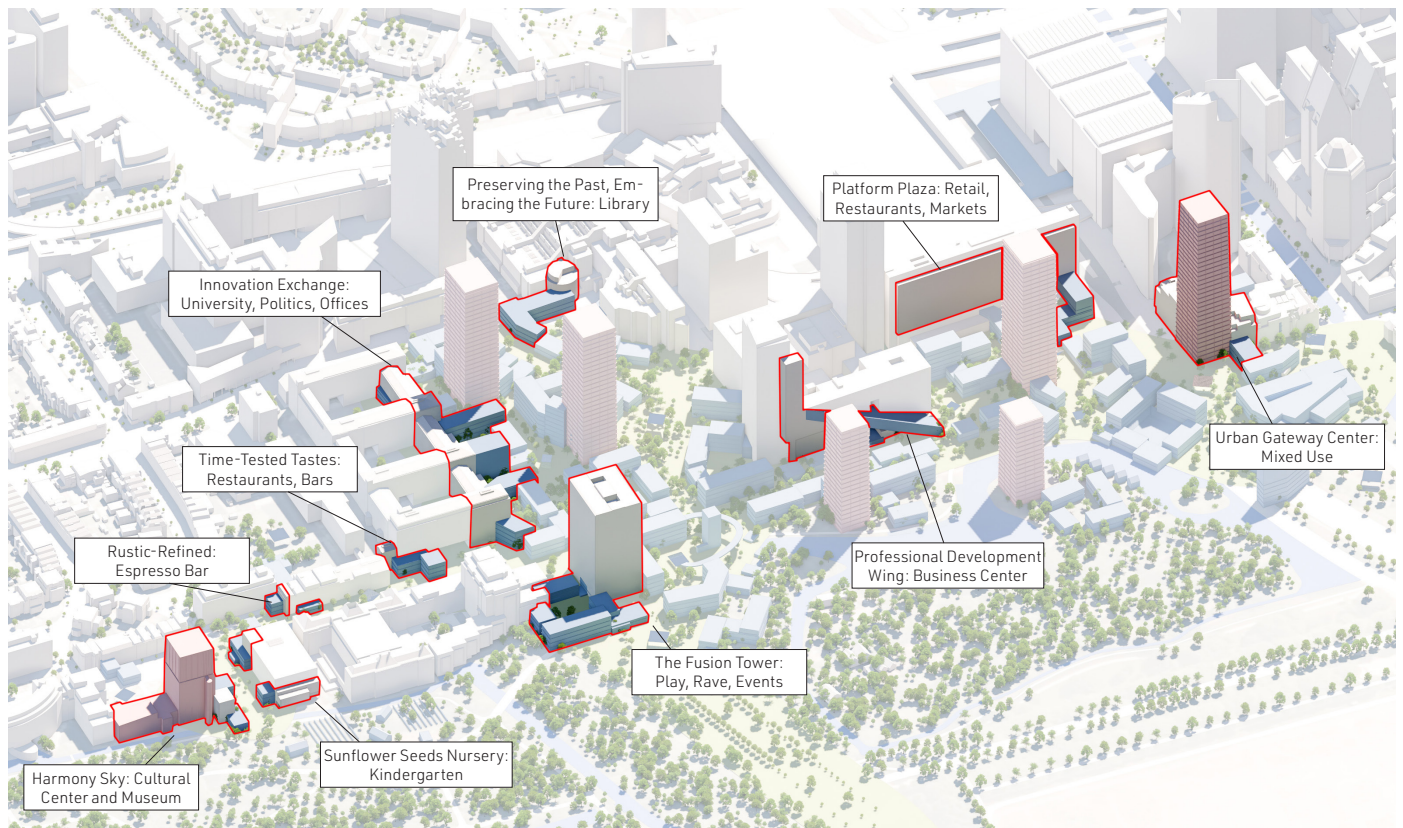


XL

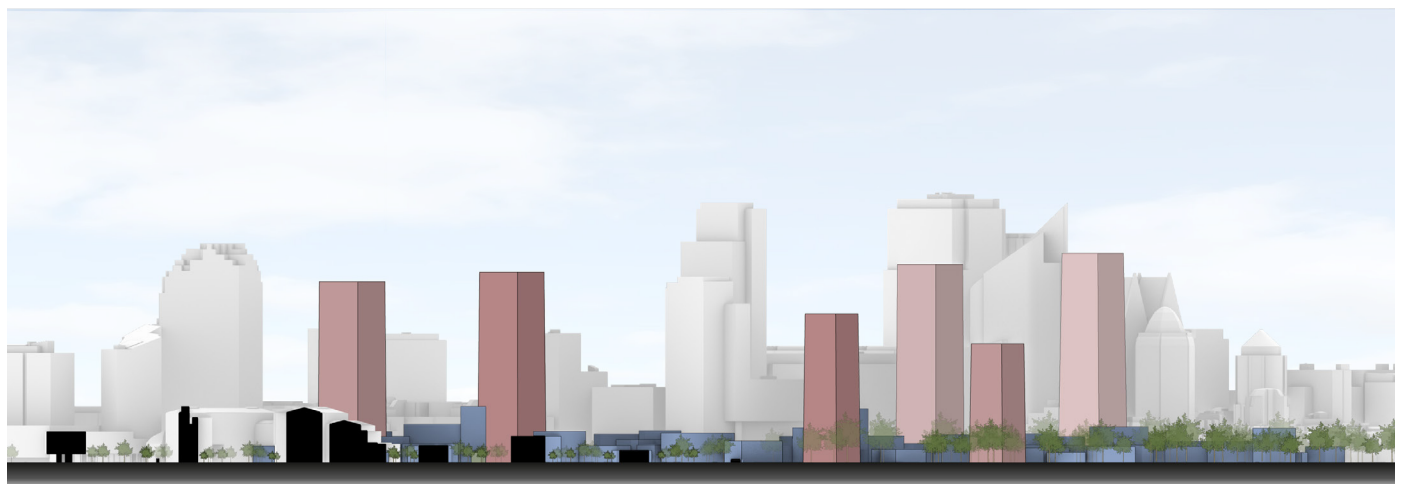


The mix of different scales

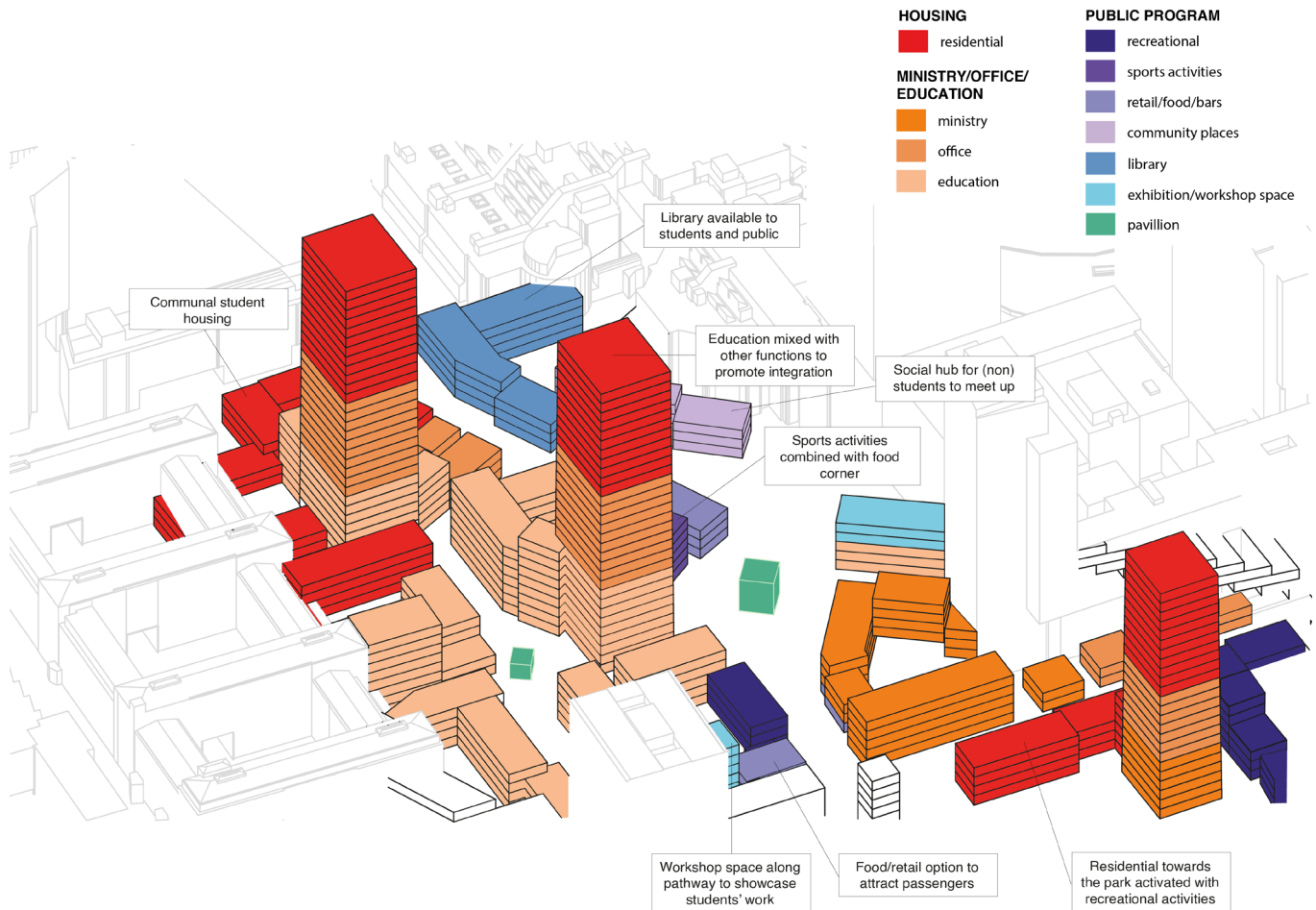
EXISTING AND NEW



The high and mid rise buildings heights are determined by the surrounding buildings. They will fulfill the current gradient. This also means that the high rise buildings are also lower in the park area than in more city inwards.

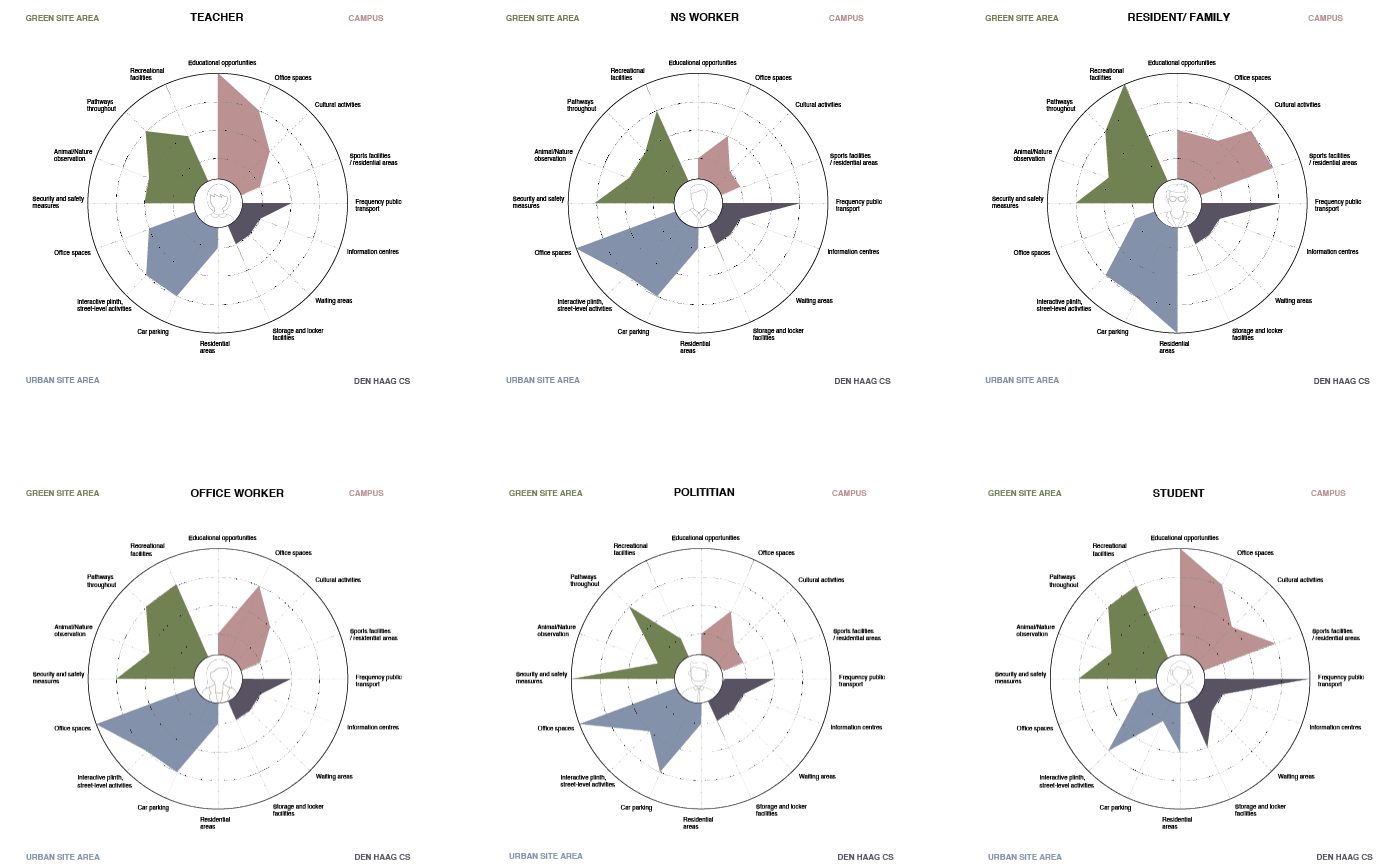



STACKED PROGRAM



We believe that movement is not only stimulated by horizontal mixing but also in the vertical methods. The vertical mixing is achieved in the high rise buildings. the beacons of the area.

PERSONAS





Martin van Dijk, 34 years old

About me
I am a father of two daughters, 6 and 8, and together with my wife we live in The Hague, where I also grew up myself. I work at a contractor in the city.

Goals
I want for our children to be able to attend primary school and visit playgrounds in a safe environment. Regarding myself, I want to keep working my job to provide for my family.

Motivation


achievement	low	high
personal growth	low	high
efficiency	low	high
convenience	low	high

Personality traits

ambitious	low	high
curious	low	high
friendly	low	high
innovative	low	high
pragmatic	low	high
responsible	low	high

Pain points
My family and I live in a rented house. A new educational institution would mean more students looking for housing in The Hague, so a higher demand, which means that probably our rent would increase.

Gain points
A new educational institution would give our children more options to explore in the area once they are ready for high school or university.



Linda Visser, 45 years old

About me
I work for an investment company in the neighbourhood of The Hague Central Station and I live in The Hague.

Goals
Every month our team has a few meetings in conference center New Babylon. Our goal is to keep this going and get other offices to do the same. I think the occupancy rate of buildings in this area would be much higher if such spaces would be shared more.

Motivation

achievement	low	high
personal growth	low	high
efficiency	low	high
convenience	low	high

Personality traits

ambitious	low	high
curious	low	high
friendly	low	high
innovative	low	high
pragmatic	low	high
responsible	low	high

Pain points
A lot of office buildings in the area are only partly occupied during the week, there is a lot of unused office space.

Gain points
A new educational institution would offer opportunities for some offices to move and settle there, so that in buildings left unused new investments can be made.



Peter van Dam, 45 years old

About me
I work as a conductor for NS. I live in Dordrecht but travel to the Hague Central Station multiple times a day.

Goals
The goal of NS is for our passengers to be able to go where they want, as comfortably as possible. We save travel time as time gained. Time that you can use as you wish to have a coffee, work, study, rest or to reflect on your day.

Motivation


achievement	low	high
personal growth	low	high
efficiency	low	high
convenience	low	high

Personality traits

ambitious	low	high
curious	low	high
friendly	low	high
innovative	low	high
pragmatic	low	high
responsible	low	high

Pain points
NS is currently struggling with a shortage of staff. A new educational institution would presumably increase the number of commuters, which means NS might have to employ more staff.

Gain points
A new university, bringing together students from various educational institutions, means that there will probably be more train traffic towards the Hague Central Station. Also, I think such an extensive campus might even attract more tourists.



Robin de Jong, 39 years old

About me
I work for the Ministry Of Agriculture. I live in Rotterdam.

Goals
The goal of our Ministry is to ensure good prospects for the Dutch farming, horticulture and fishing sectors, which are renowned worldwide for producing good-quality food that is safe and affordable. We want to restore and maintain natural areas.

Motivation


achievement	low	high
personal growth	low	high
efficiency	low	high
convenience	low	high

Personality traits

ambitious	low	high
curious	low	high
friendly	low	high
innovative	low	high
pragmatic	low	high
responsible	low	high

Pain points
Public transportation is very busy as it is right now. An increased number of commuters using public transportation would result in a more crowded train or bus for me on my way to work.

Gain points
Building a campus vertically means it reserves only a small footprint in the city. This saved space to maintain natural areas. Also, I think there might be opportunities for cooperation with an educational institution to show students the importance of agriculture.



Linda Jansen, 32 years old

About me
I am a teacher at Hogeschool Inholland in the Hague. I have lived in The Hague my entire life.

Goals
By teaching my students I hope to not only reach them the required knowledge to graduate, but also fully prepare them for the world that is waiting for them.

Motivation


achievement	low	high
personal growth	low	high
efficiency	low	high
convenience	low	high

Personality traits

ambitious	low	high
curious	low	high
friendly	low	high
innovative	low	high
pragmatic	low	high
responsible	low	high

Pain points
I often only do work related stuff at university, but when I do take a break, I like to go outside. I would probably do this more often if the square in front of our entrance was not so uninviting. The university does have a garden, but it is not easily accessible and therefore often left unused.

Gain points
The square could use more greenery and some coffee or food stalls. The garden should be easily accessible, and I also think connecting greenery and parks throughout the city would also cause people to connect more.



Sofia Bianchi, 25 years old

About me
I am an international business student at Hogeschool Inholland in the Hague. I live in The Hague, but I grew up in Italy where I graduated from my bachelors.

Goals
After my masters I would love to stay in the Netherlands and find a job here. I appreciate the structure and calmness the country offers unlike Italy.

Motivation

achievement	low	high
personal growth	low	high
efficiency	low	high
convenience	low	high

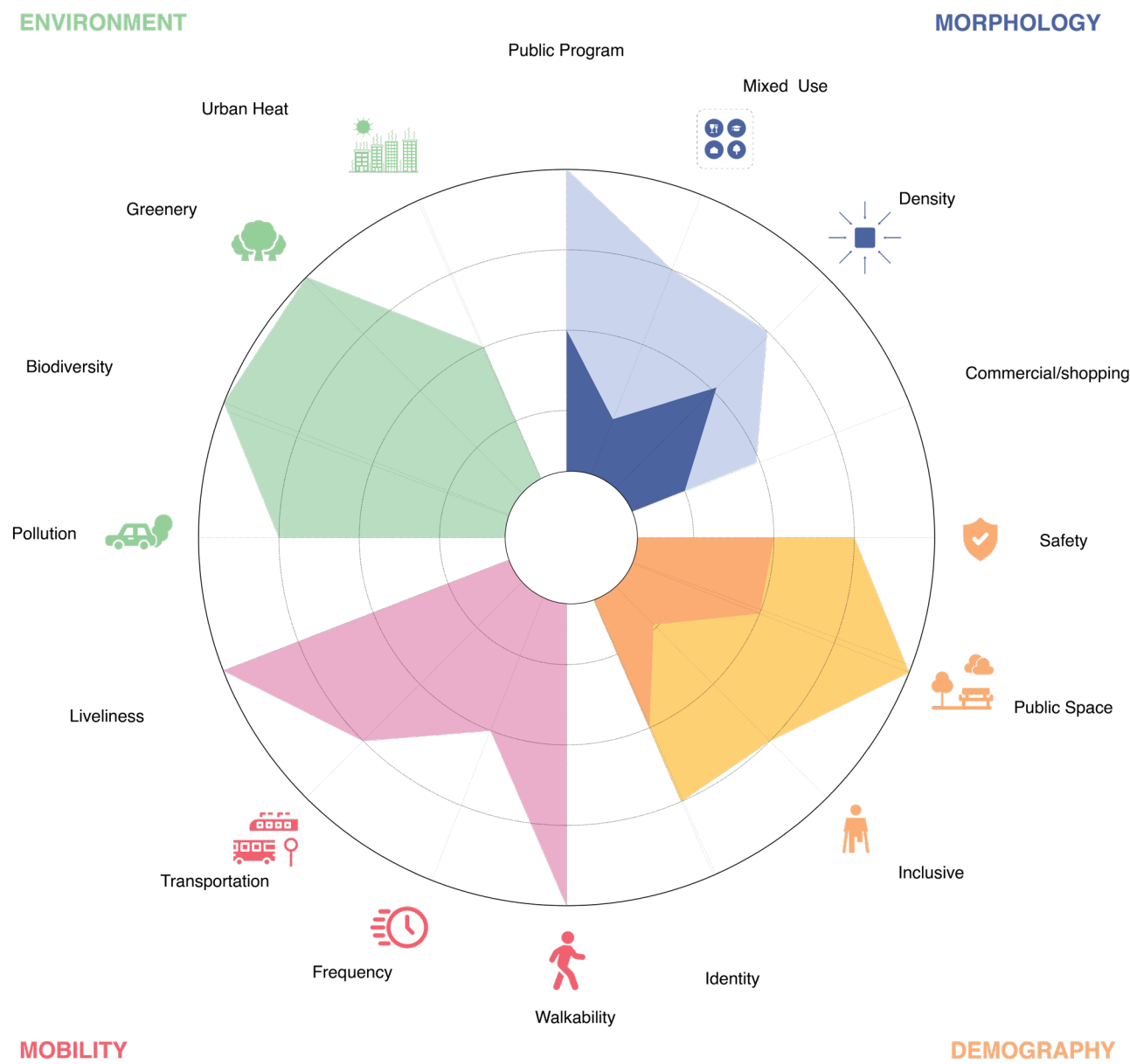
Personality traits

ambitious	low	high
curious	low	high
friendly	low	high
innovative	low	high
pragmatic	low	high
responsible	low	high

Pain points
Being a busy student I value the breaks we get during lectures. However, my university does not offer a qualitative outside space to properly enjoy. For example, the square in front of the entrance is grey and boring, there are only few seating areas, and no shelters. Because of this, I spend most of my breaks away from university, sometimes going to de Spui.

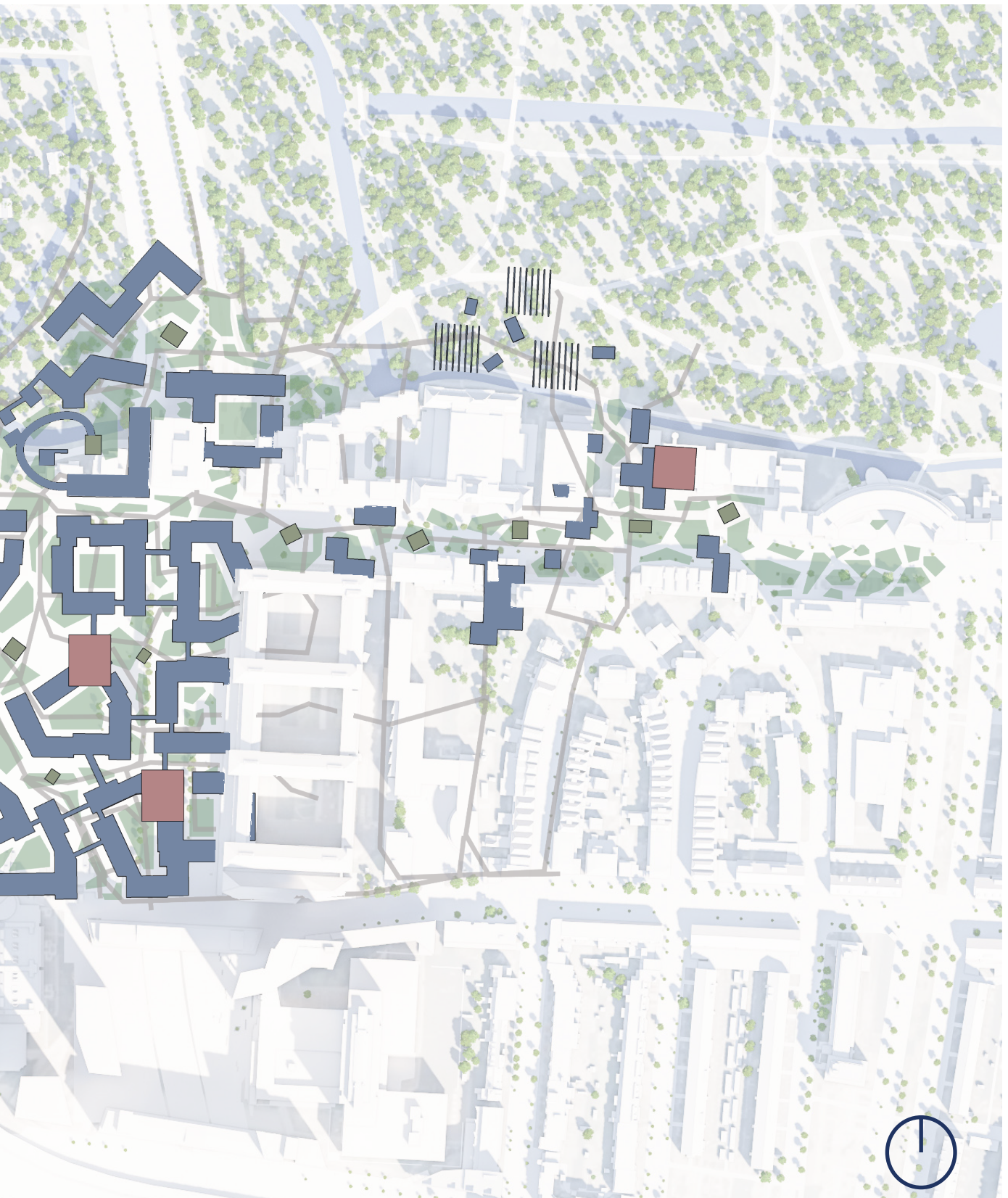
Gain points
My university would gain and have more time spent at it if they were to redesign the square so that it would be more attractive to stay at. For example, adding greenery, seating areas, and shelters.

PERSONAS MEETS PROGRAM

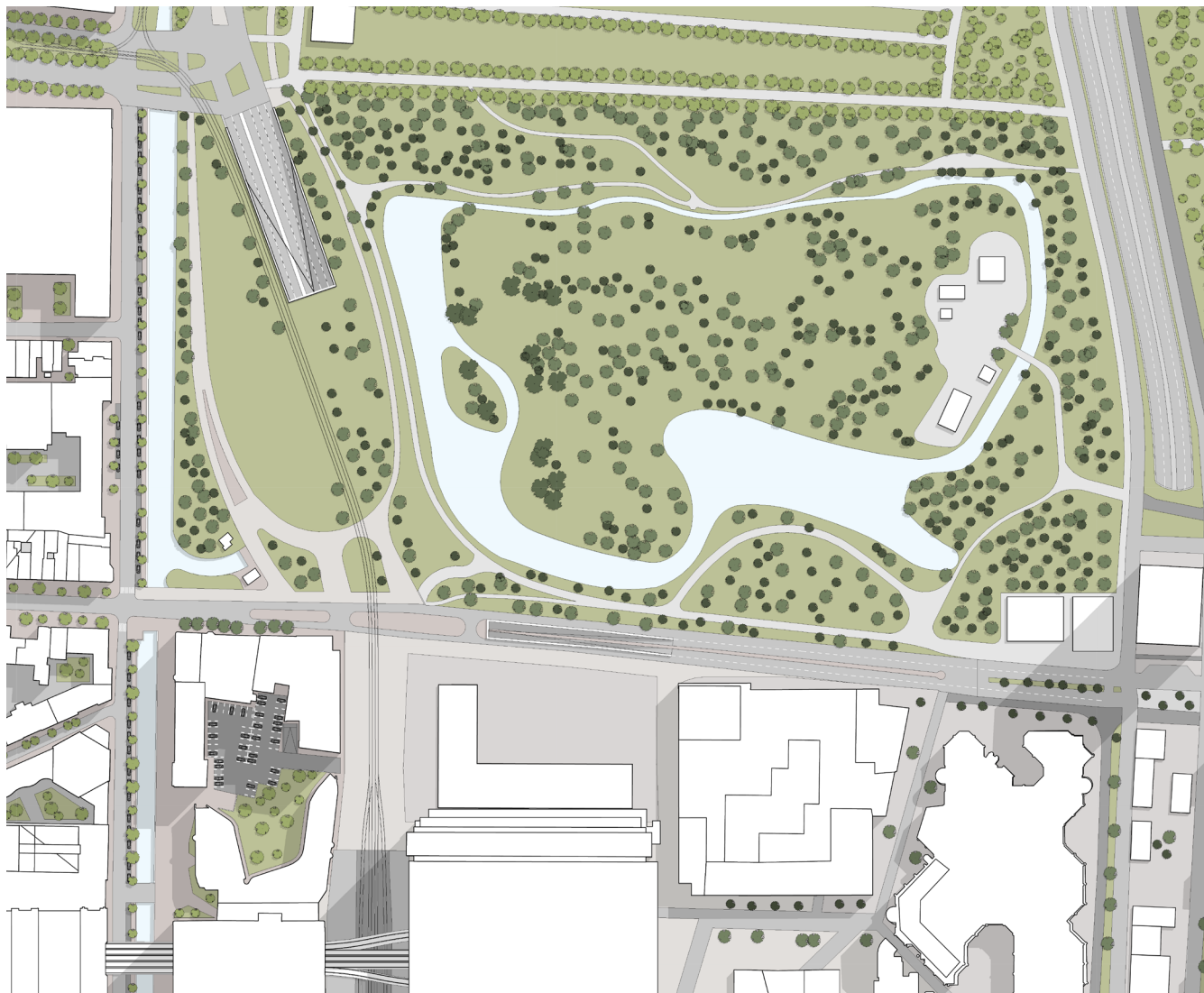


P1 CAPACITY PLAN

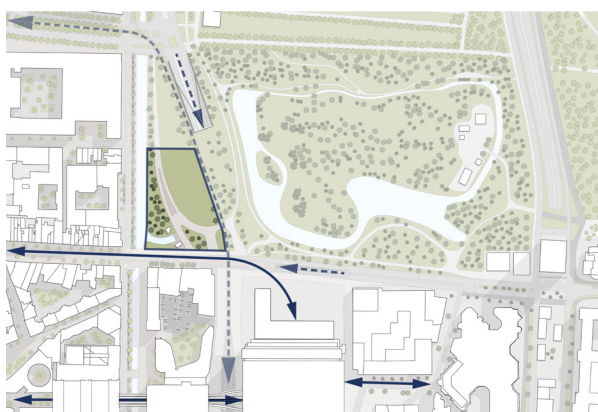




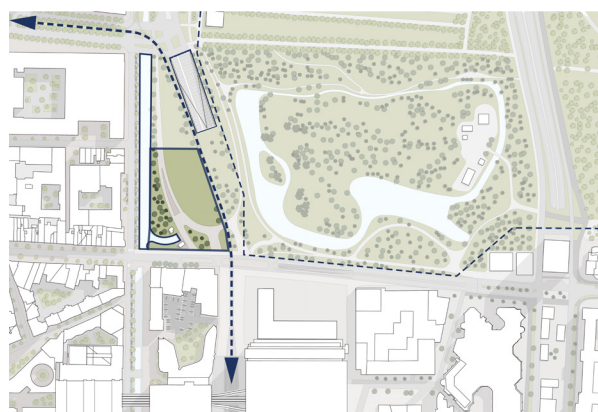
BUILDING AREA



Zooming in on the park area, first of all because of the extended research. Secondly because I want to built on a free spot in the city. I already did a heritage project, theror I chose a plot that was empty.

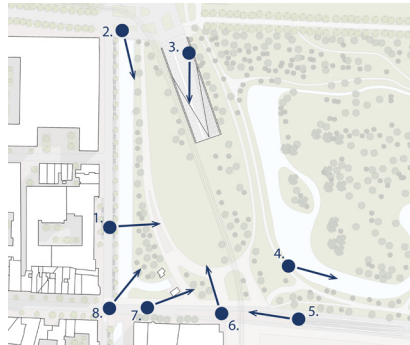
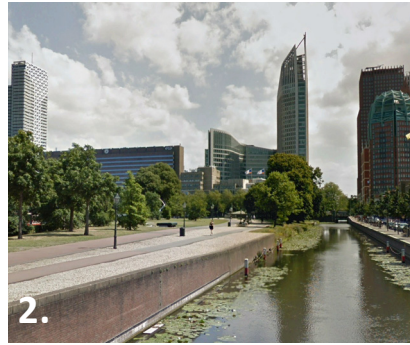


The plot is defined by its boarders. This is a tunnel, tram and waterfront.



Understanding how the historical boarder is placed compared to the plot

SIGHT LINES



And a good question is, why is this plot empty compared to the rest of the Hageue? This has to do with the history of the park. The historical border is the edge of the Haagse Bos, it means that the plot is a designed extension but is not protected. Building in this plot helps to connect the routing from the city to the station and also connects the campus functions lying next to the plot.

Assignment

02

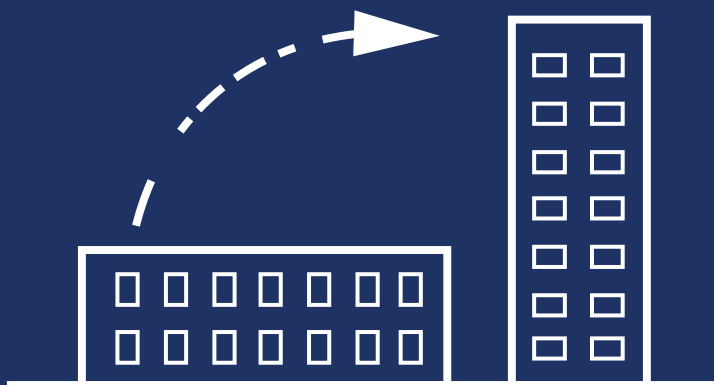
STUDIO THEME



Why should we build vertical?



The densification of the city

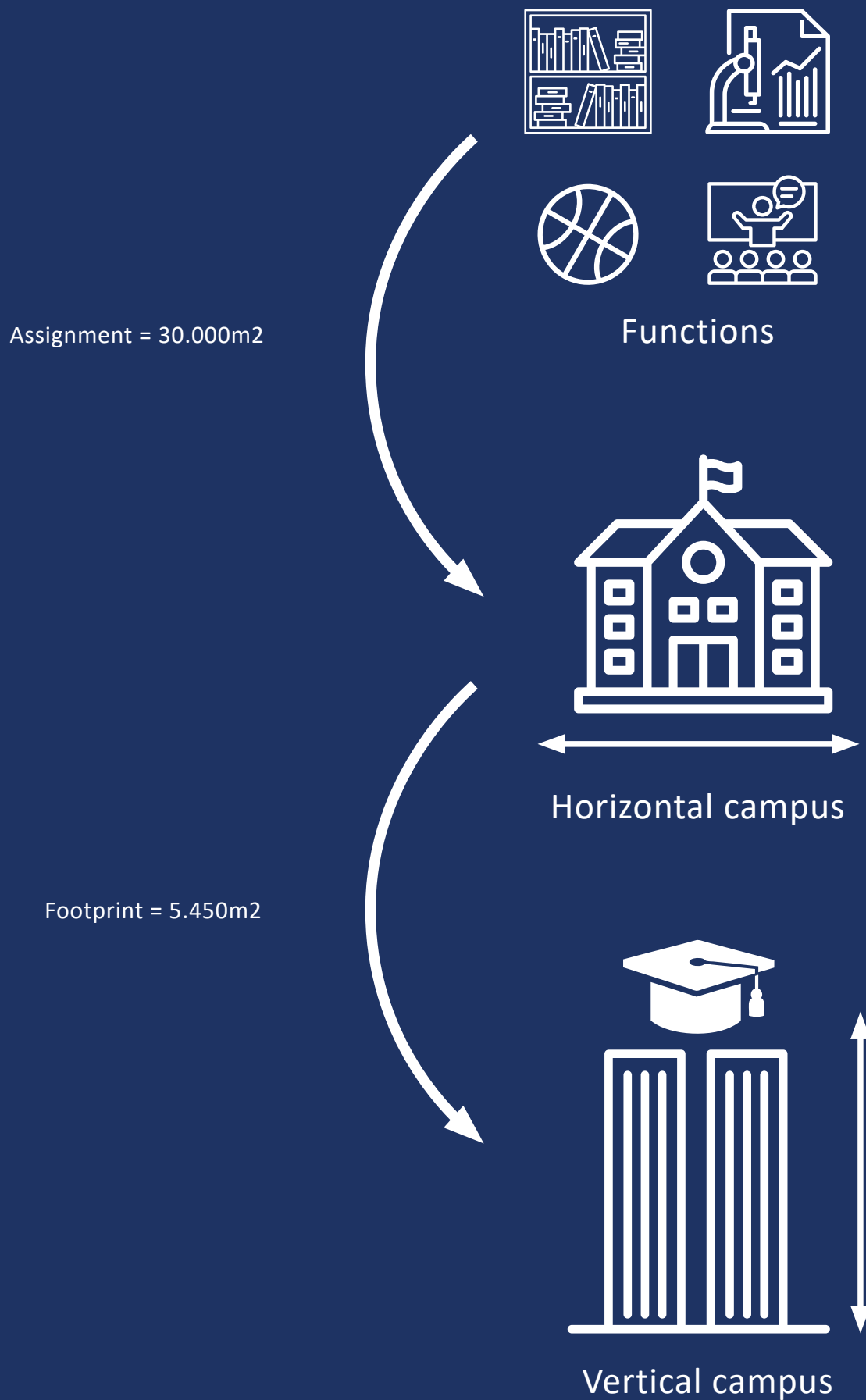


Developing new typologies

The ever growing cities

Studio question:
Creating the Vertical campus

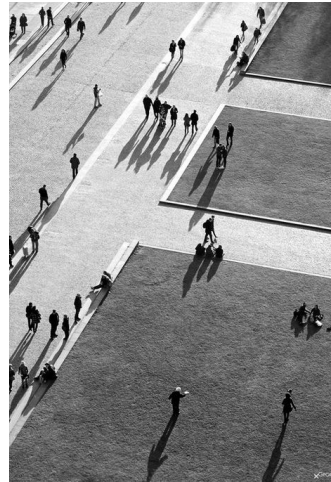
STUDIO ASSIGNMENT



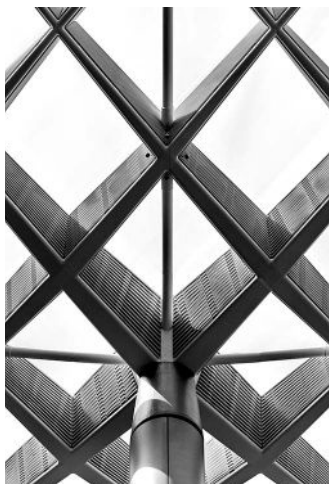
GUIDELINES



closed



open



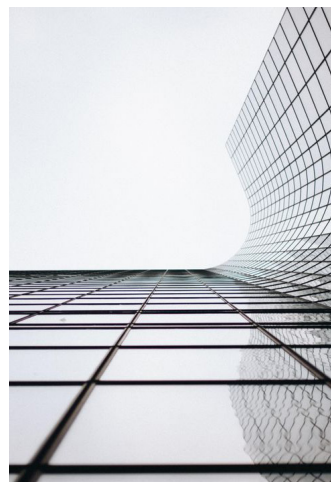
generic



wander

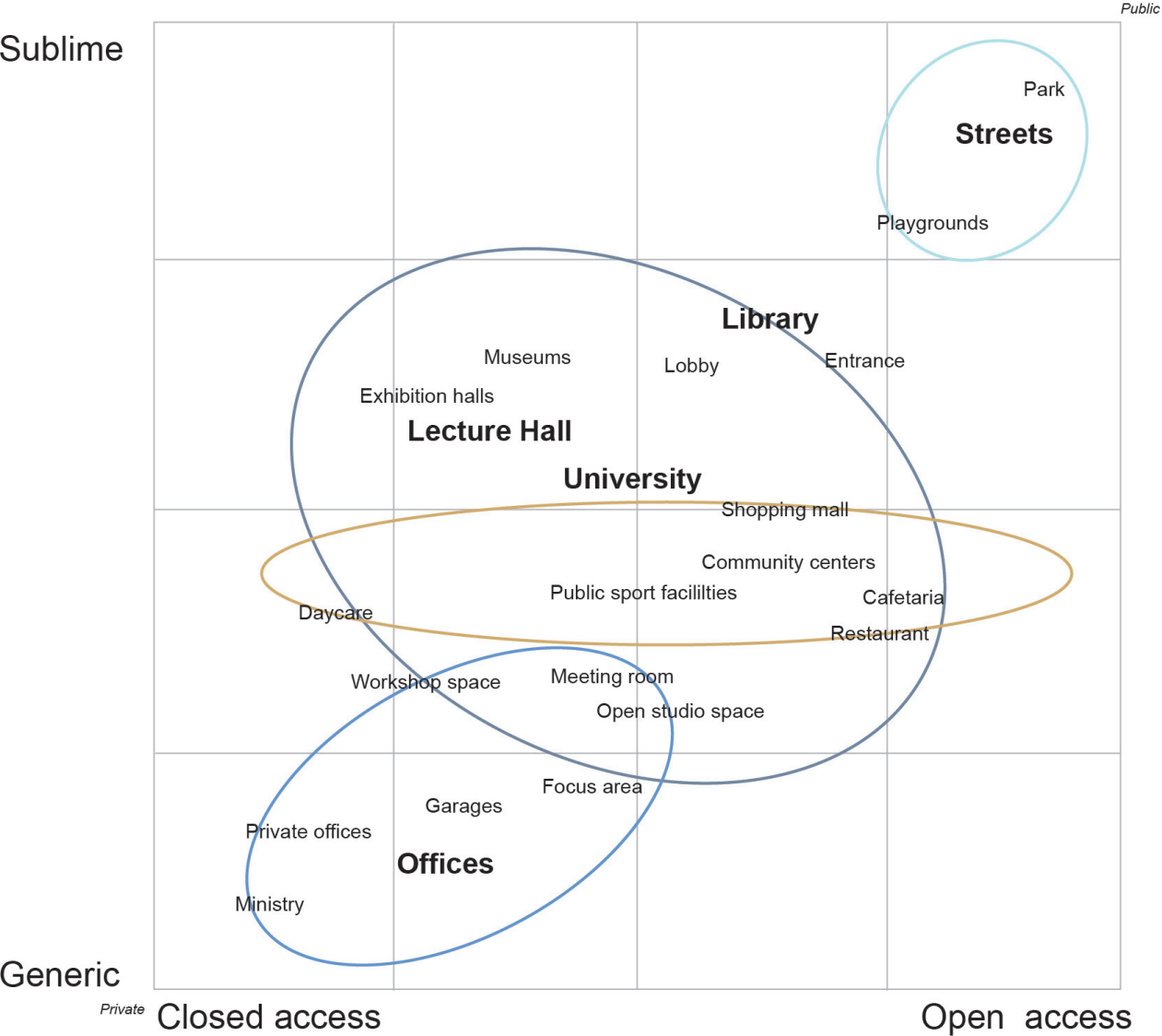


sublime



abstract

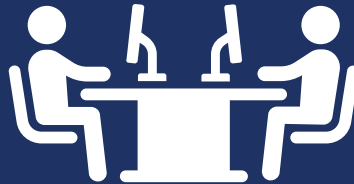
CATEGORISE



- Community
- Practice
- Urban
- Learning

FUNCTIONS

Practice



Learning



Community



Urban



Learning methods

- Private office
- Meeting room
- Study space
- Garage

- Workshop
- Focus area
- Ministry
- Office

- Library
- Lobby
- Meeting Room
- Exhibition hall

- Museum
- University
- Studio Space
- Elementary

- Sport hall
- Cafeteria
- Shops

- Daycare
- Community center
- Restaurant

- Playground
- Street
- Park
- Public transport

- Seating
- Shelter
- Gathering

TOTAL FOOTPRINT

Studio syllabus Design brief

1 . Entrance	(xxxm2)
2 . Commerical Spaces	(1050m2)
3 . Café and lounge	(xxxm2)
4 . Play and learn	(2870m2)
5 . Learn and Discover;	(1100m2)
Studio space	
6 . Library and Media center	(3550m2)
7 . Workshop	(850m2)
8 . Centre for Advanced Virtuality	(800m2)
9 . Learn and Develop;	(2200m2)
Research spaces	
10 . Teaching, Learning &	(1100m2)
Development Spaces	
11 . Lecture/ Theater	(2250m2)
12 . Exhibition Space	(500m2)
13 . Sports	(1800m2)
14 . Office Spaces	(10700m2)
15 . Outdoor grounds	(xxxm2)
16 . Storage, Mechanical Utilitites	(4520m2)
and Circulation Space	xxxxx
17 . Bicycle Parking	(1600m2)
18 . Delivery of goods	(200m2)

Added program

1 . Cafeteria	(xxxm2)
2 . Museum	(980m2)
3 . sport extra	(1350m2)
4 . Skybar	(800m2)
5 . extra zaal?	
6 . workhub	(2200m2)

Removed program

1 . Car Parking	(xxxm2)
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Total area of the buildings

51.150 m2

Research

03

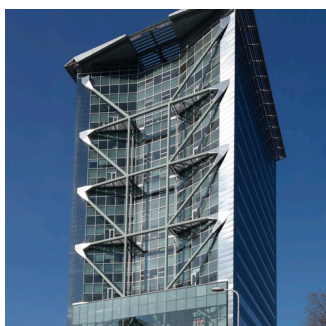
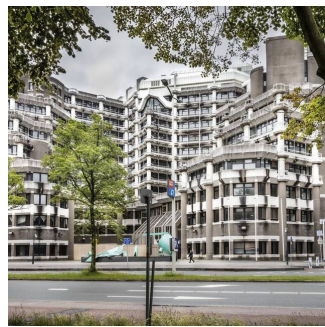
CURRENT SITUATION



Individual islands - Height contrast

LANDMARKS THE HAGUE

Private & single function



DISTOPIA



Detachment of the public realm



alm, self-referential buildings

DISTOPIA

MANIFESTO

“multiplicity as a property of buildings in order to make them less singular in function, more productive, more transformative and more resilient.” -

Manifesto Public Building



Buildings should not only reflect on themselves, but should engage in the public realm of the city when looking into the urban scale. For the building scale should offer more than housing its own function. It should offer undefined spaces for crowds and people to meet.

Research question

**How does the Vertical campus contributes to and extends
the public realm in the Hague?**

SUB QUESTION

**How can a public hybrid building introduce and combine public and
instutionalized learning in an attempt to exchange knowledge?**

PROJECT AMBITION

PUBLIC AND INSTITUTIONAL LEARNING

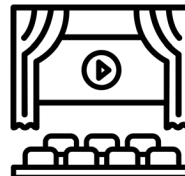
Solving the separation between **university campuses** and **public learning** in cities by creating a new typology of **campus** within the city. In this way, **mixing** public and institutionalized education, exchange of knowledge.

PROJECT AMBITION

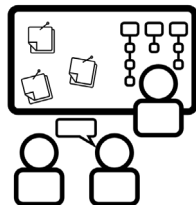
PUBLIC LEARNING METHODS



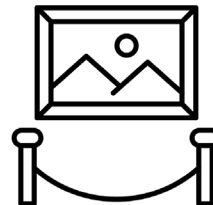
Library



Theater



Workshop



Museum

INSTITUTIONALIZED LEARNING

University



Library



Faculty



Elementary



Lecture



Sport



Research

INSTITUTIONALIZED LEARNING



Referring to the **structured and formalized** educational processes that occur within established institutions such as schools, colleges, universities, and professional training organizations.

PUBLIC LEARNING



Referring to **sharing knowledge** by activities and experiences accessible to the public. It emphasizes **informal** and cultural engagement by enhancing collective learning outside formal institutional settings.

RECAP

CITY

Public learning methods



CAMPUS

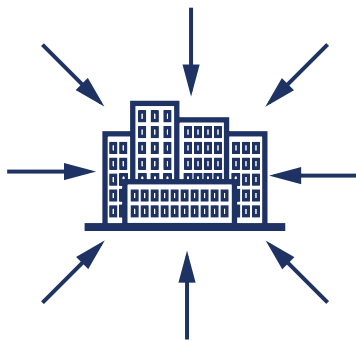
Institutionalised learning



+



Combining the traditional campus into the city



High density character

+



Spread out character



Proposes a new vertical typology

VERTICAL CAMPUS (IN THE CITY)

Studying - Research - **Exploration**

Discussions - Creating - **Leisure**

Sports - **Shops** - **Gathering**

Multiple Public & Institutional functions



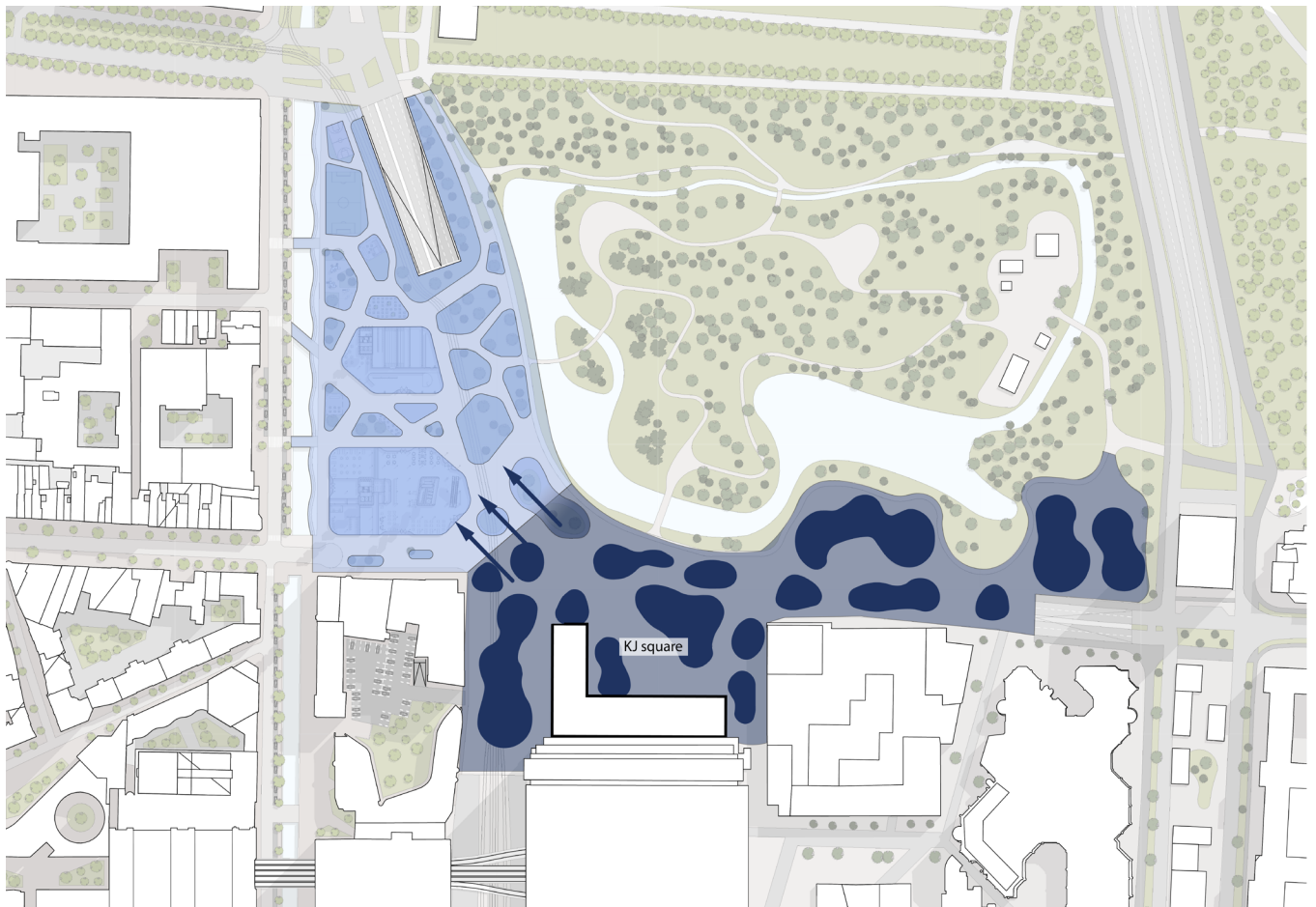
RECAP

The rest of the research with case studies can be found in the final chapter of this book.

Concept

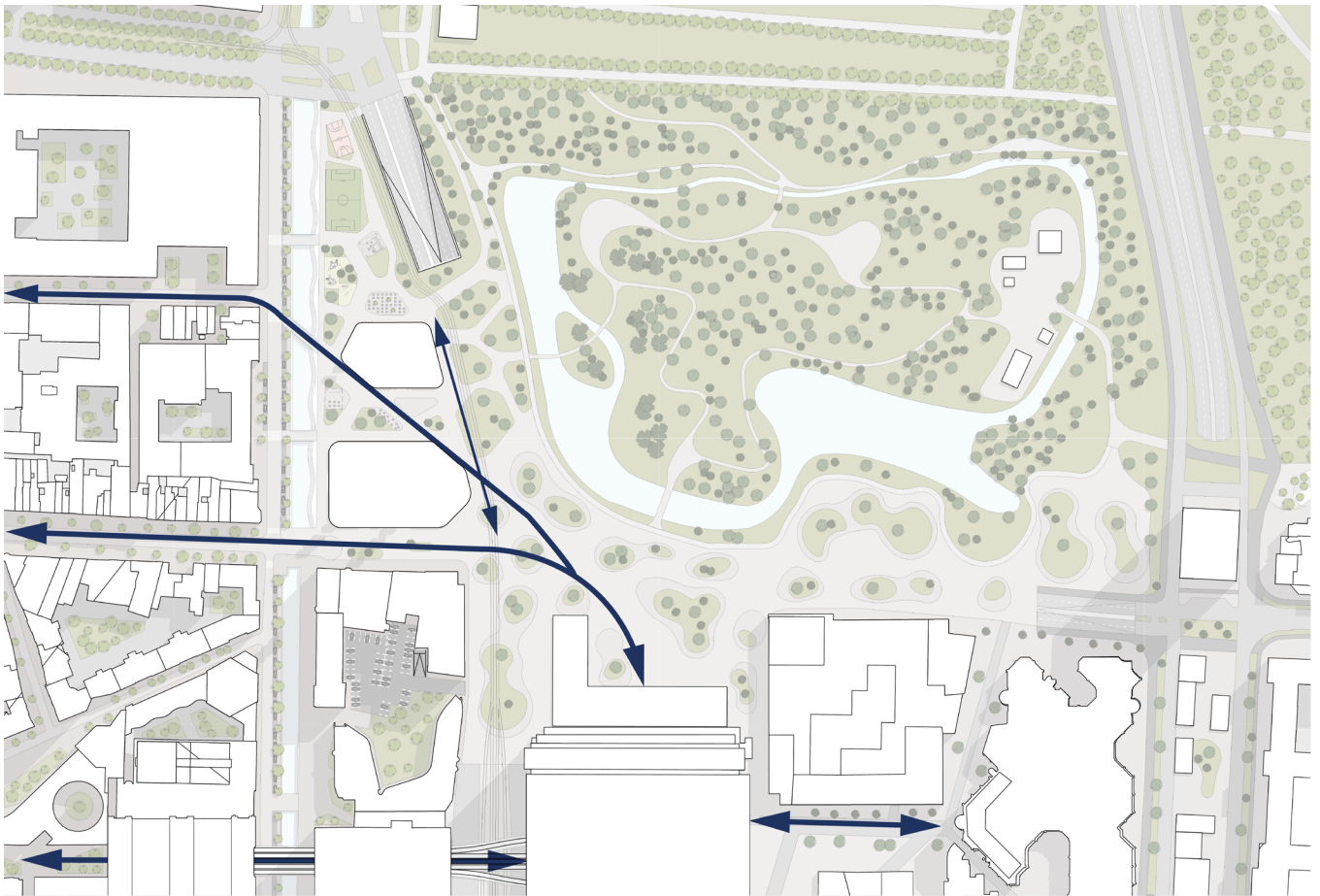
04

EXTENDING MASTERPLAN



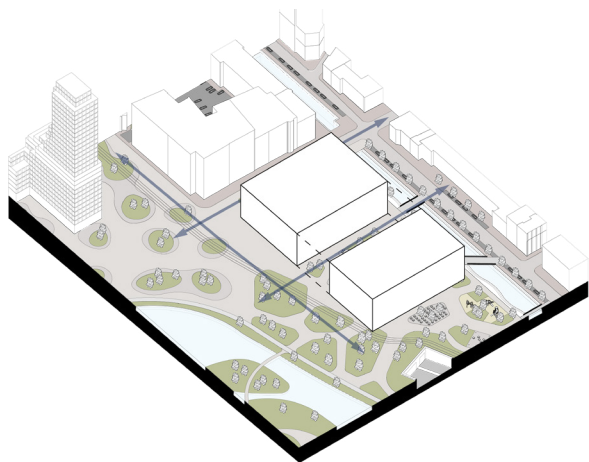
Extending the masterplan from Powerhouse, which is organic, to soft edges.

EXTENDING MASTERPLAN

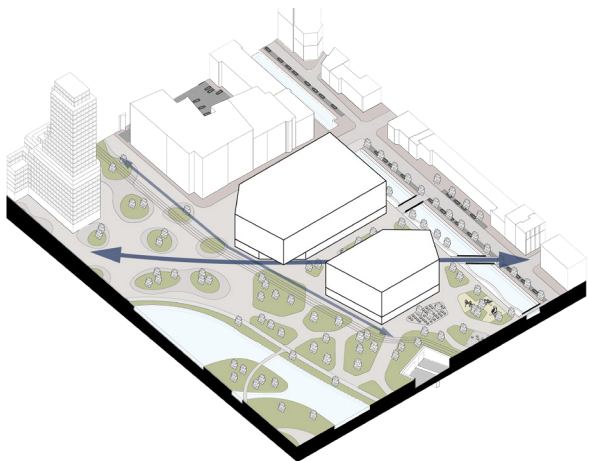


Extending campus network - Pedestrian area

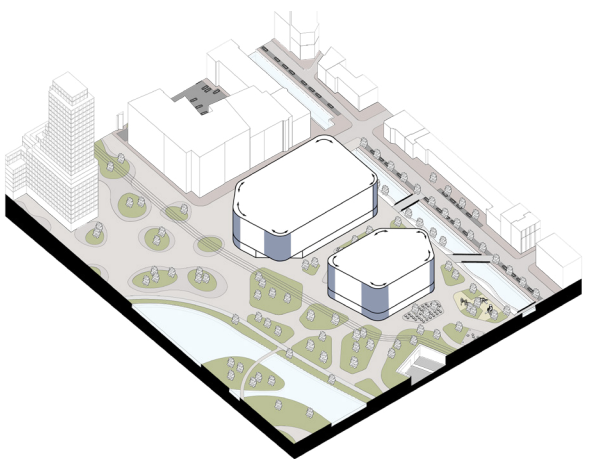
EXTENDING MASTERPLAN



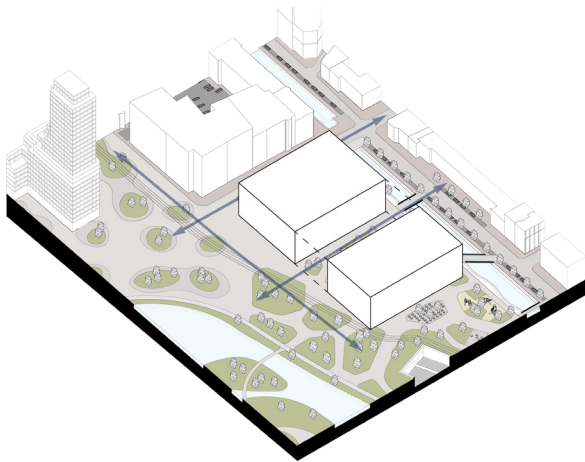
Starting with the materiality. The bulding is made from Terrazzo composite, which is a concrete mix combined with recycled beton granulaat. This material comes in many colors.



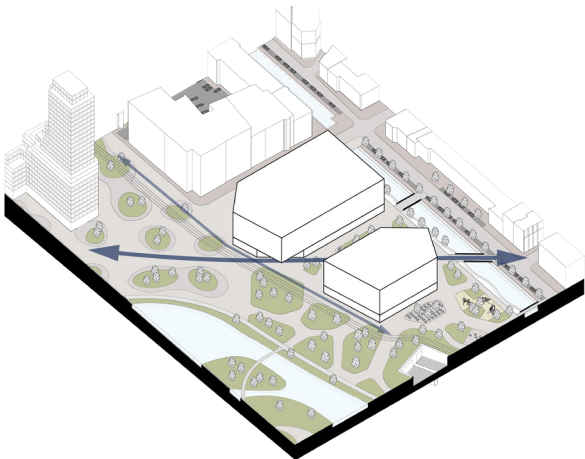
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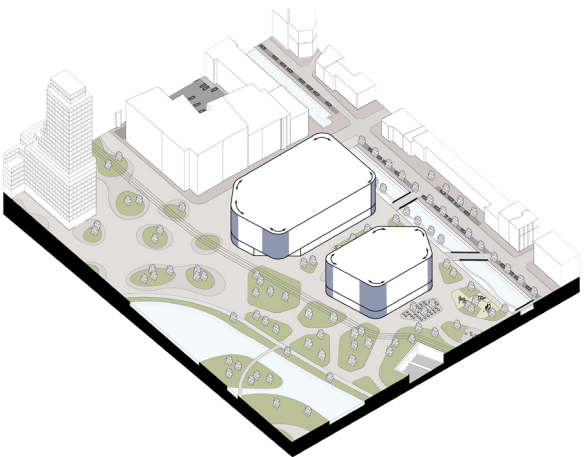
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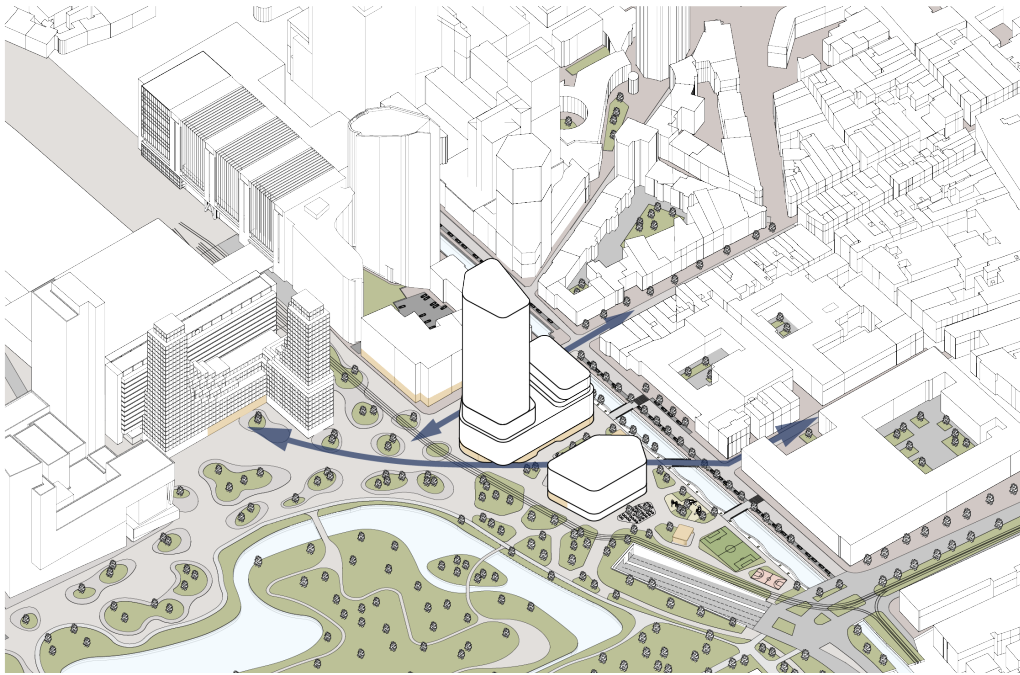
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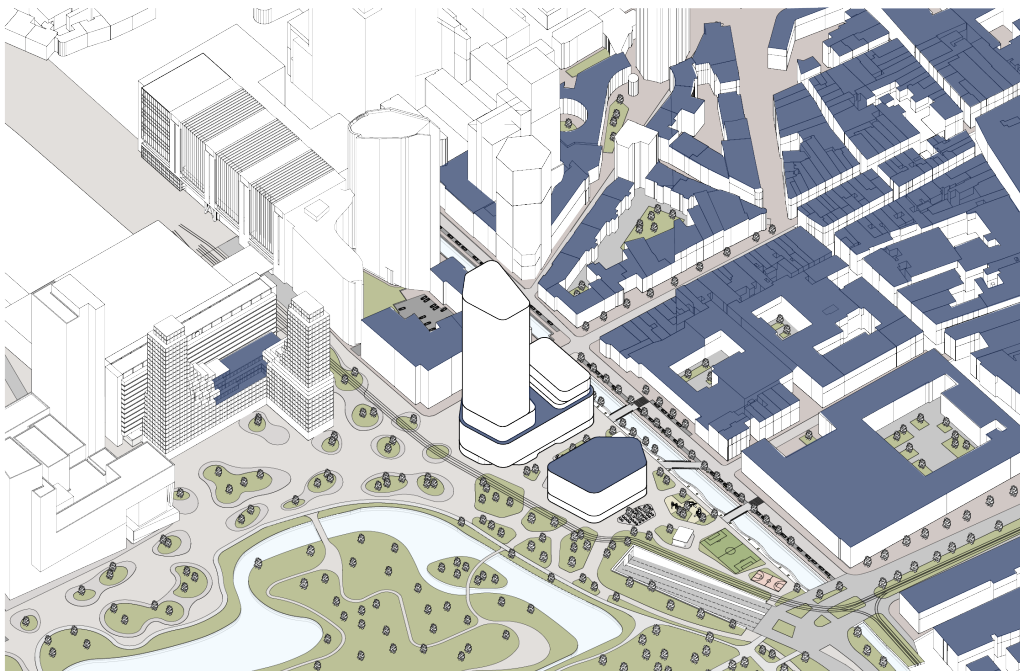
Starting with the materiality. The bulding is made from Terrazzo composite, which is a concrete mix combined with recycled beton granulaat. This material comes in many colors.

EXTENDING MASTERPLAN

Matching the urban fabric

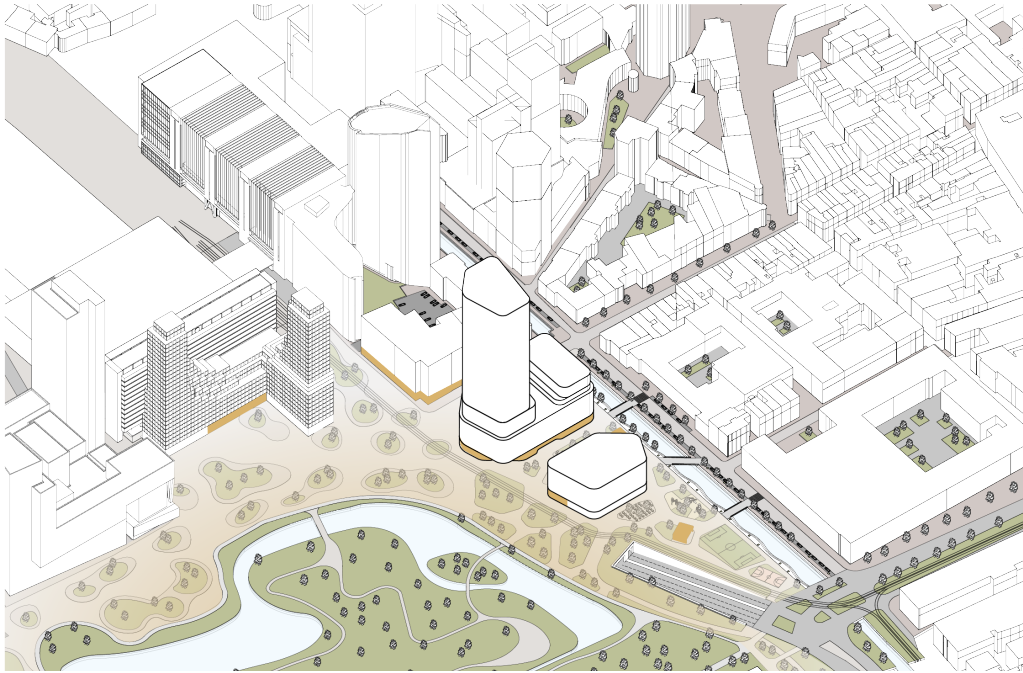


Flow station - campus and city

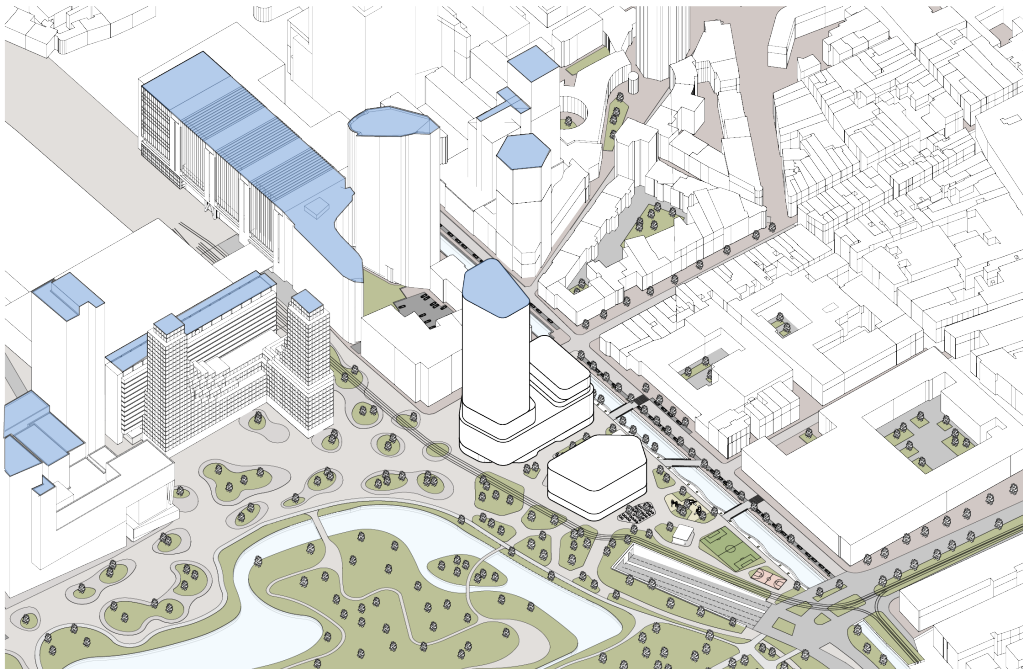


City height

EXTENDING MASTERPLAN



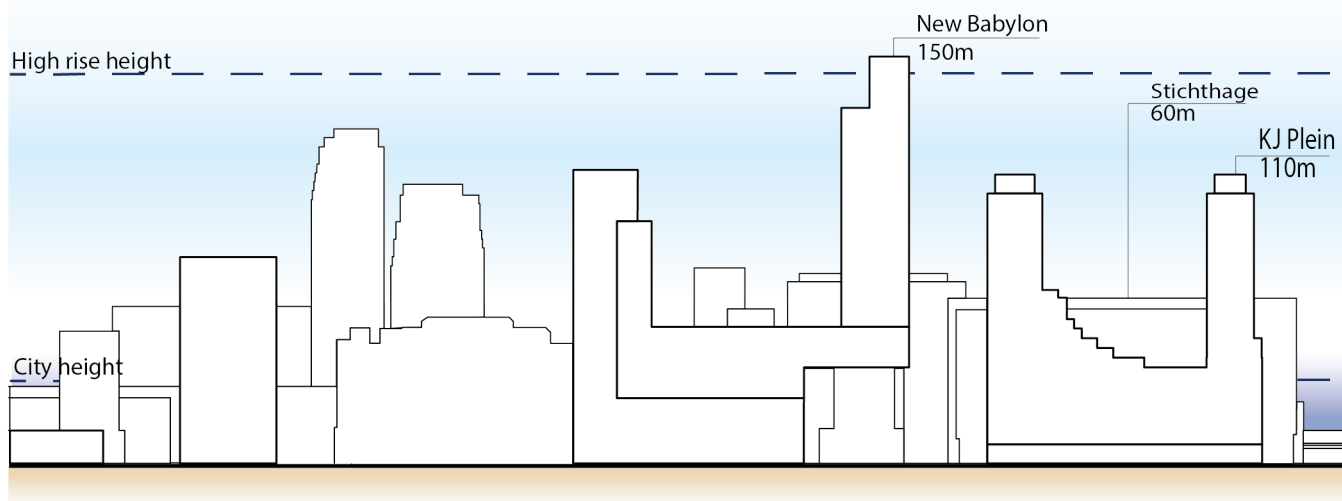
Creating a transition zone between park and city



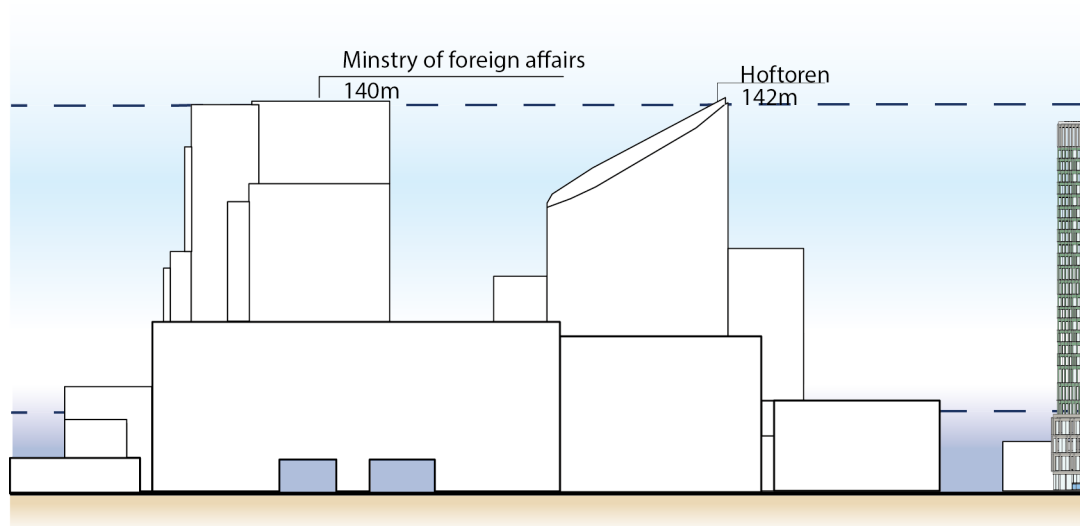
Station area height

HEIGHT

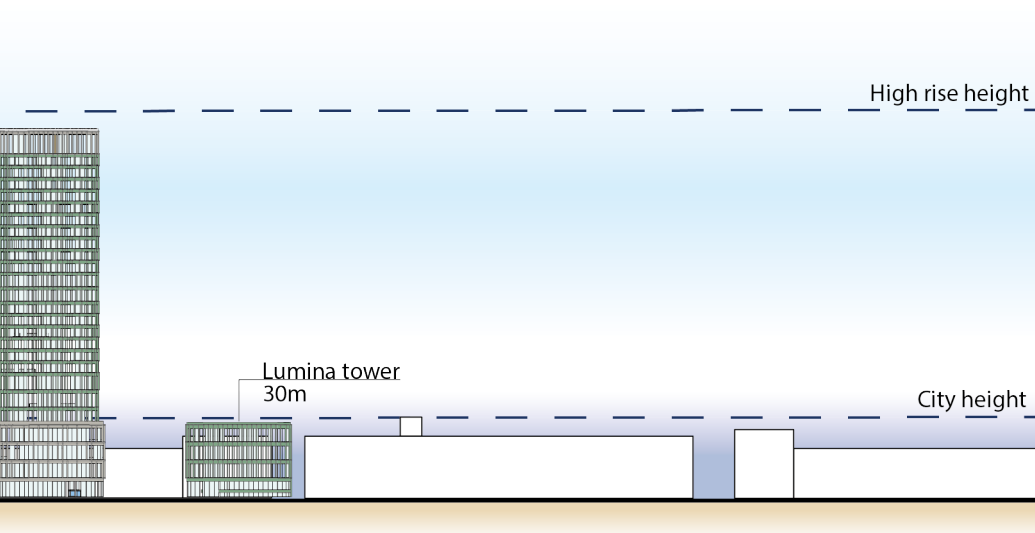
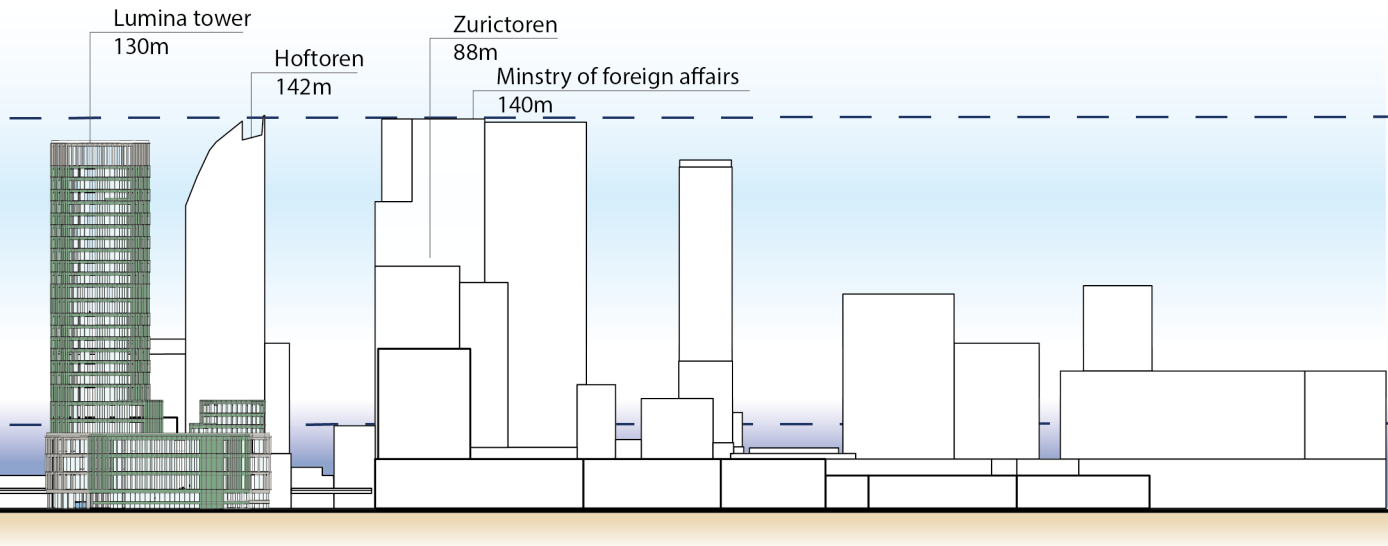
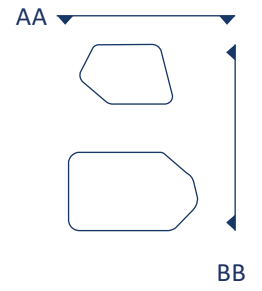
Matching the urban fabric height



AA



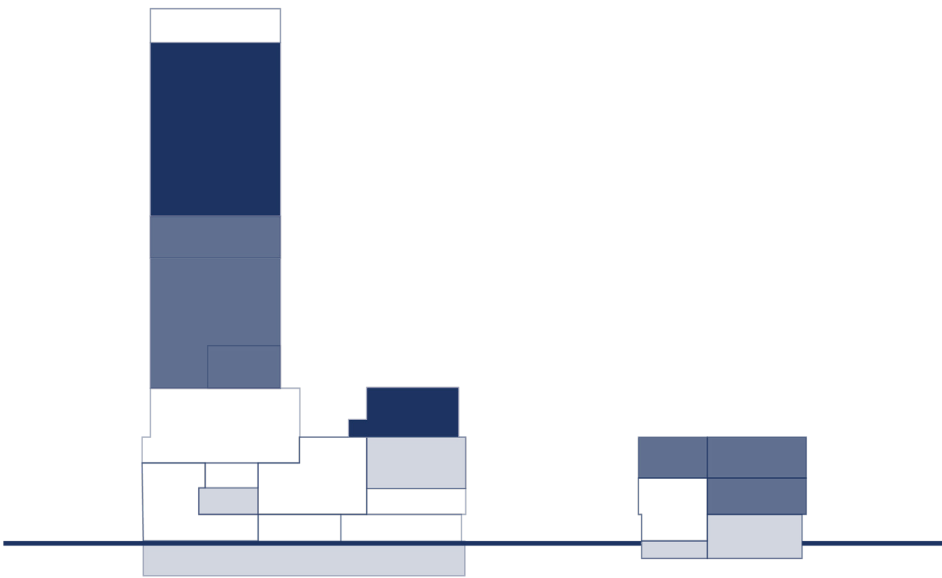
BB



THE CONCEPT

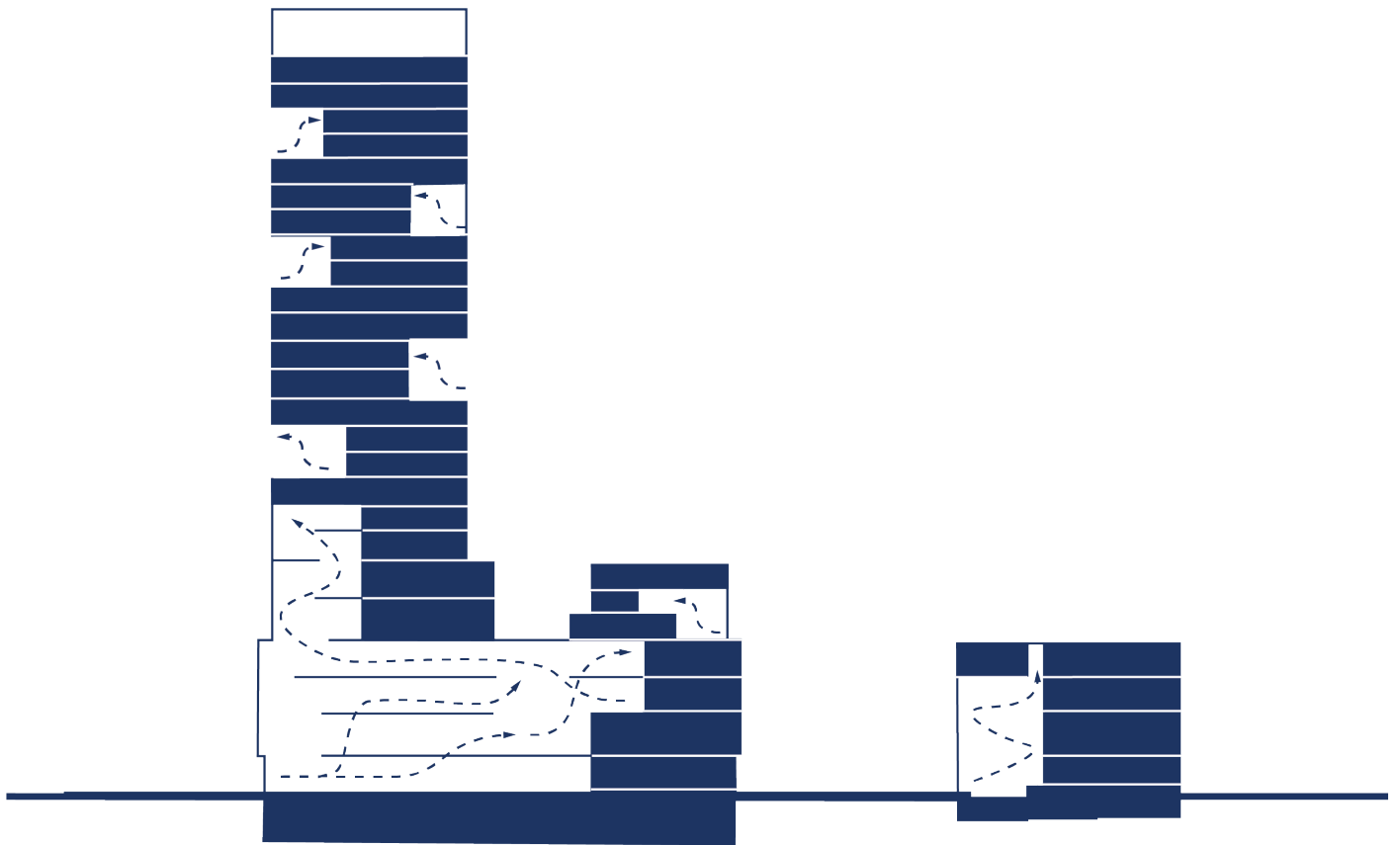


Elevated plinth over 4 levels



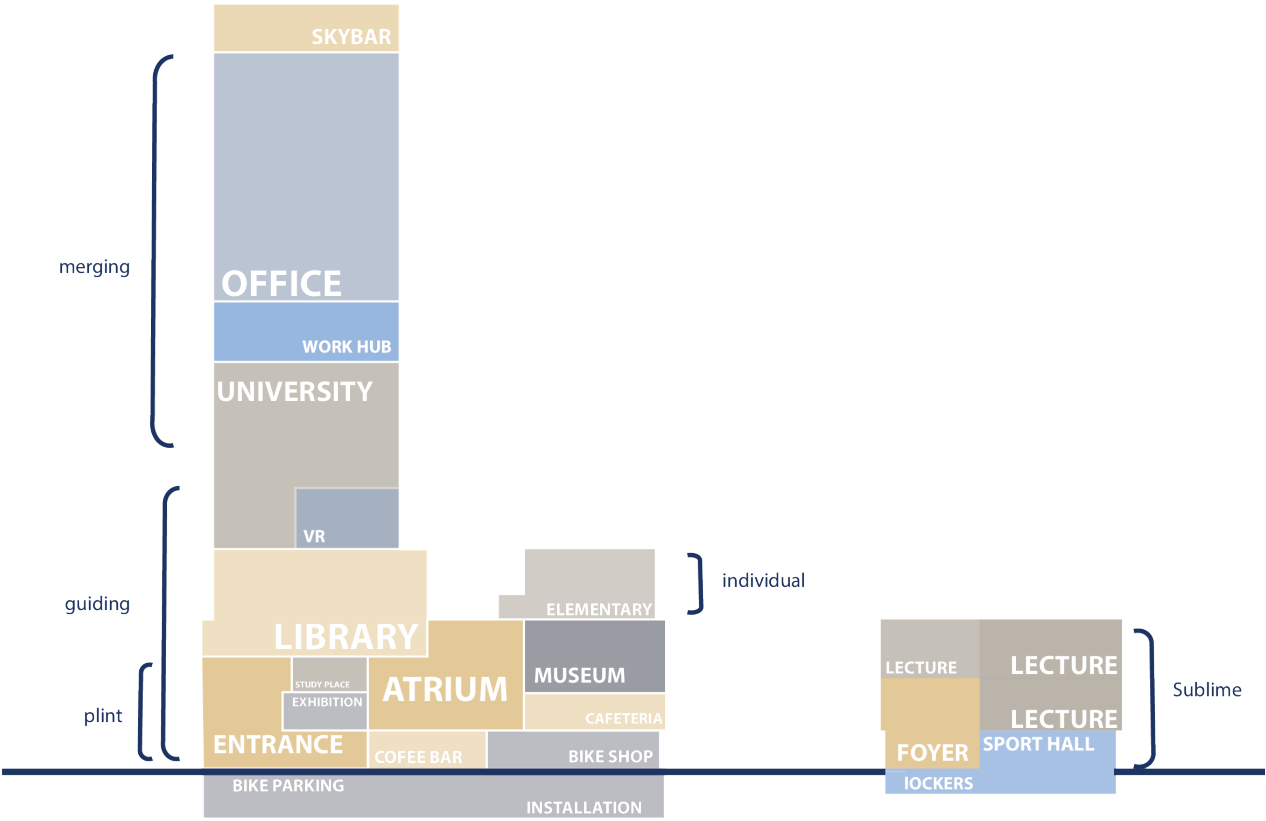
Public - Institutionalized

THE CONCEPT



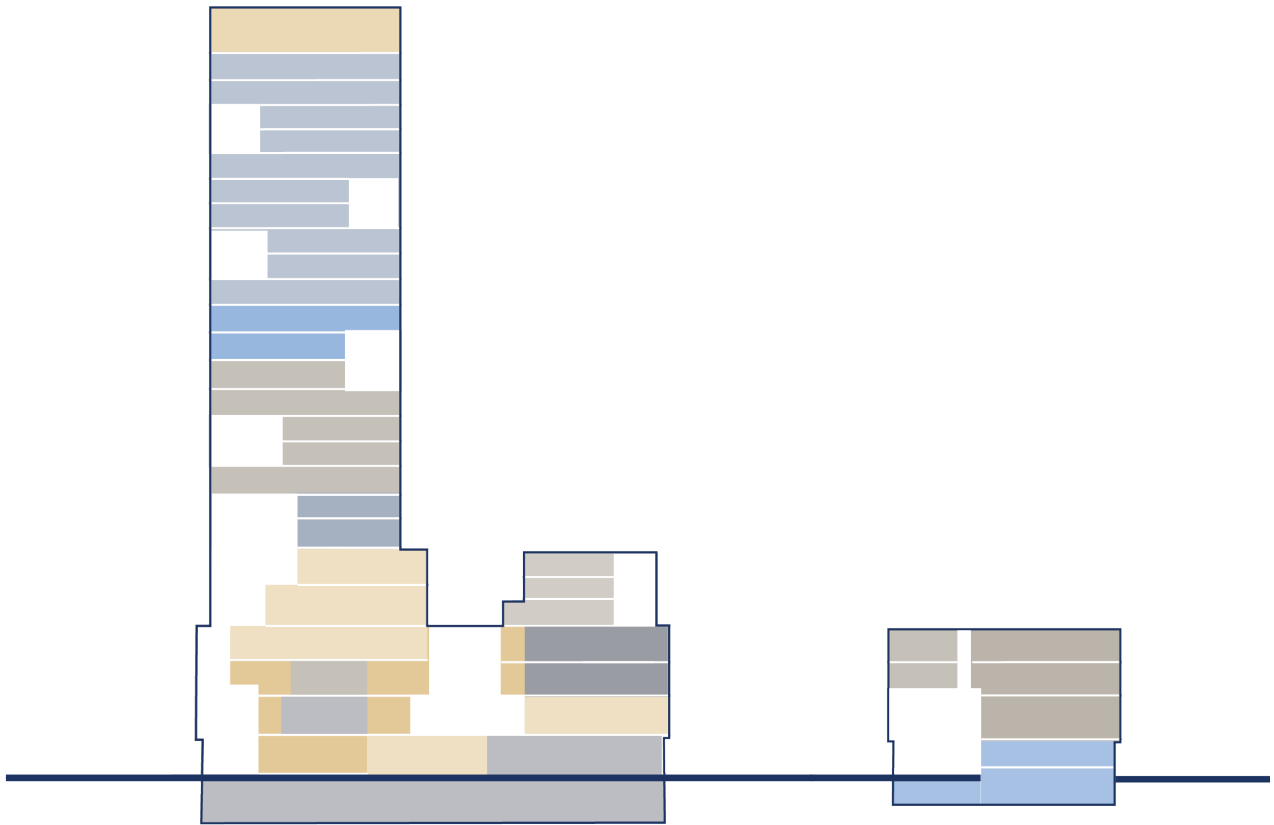
Wander inbetween voids

FUNCTIONS



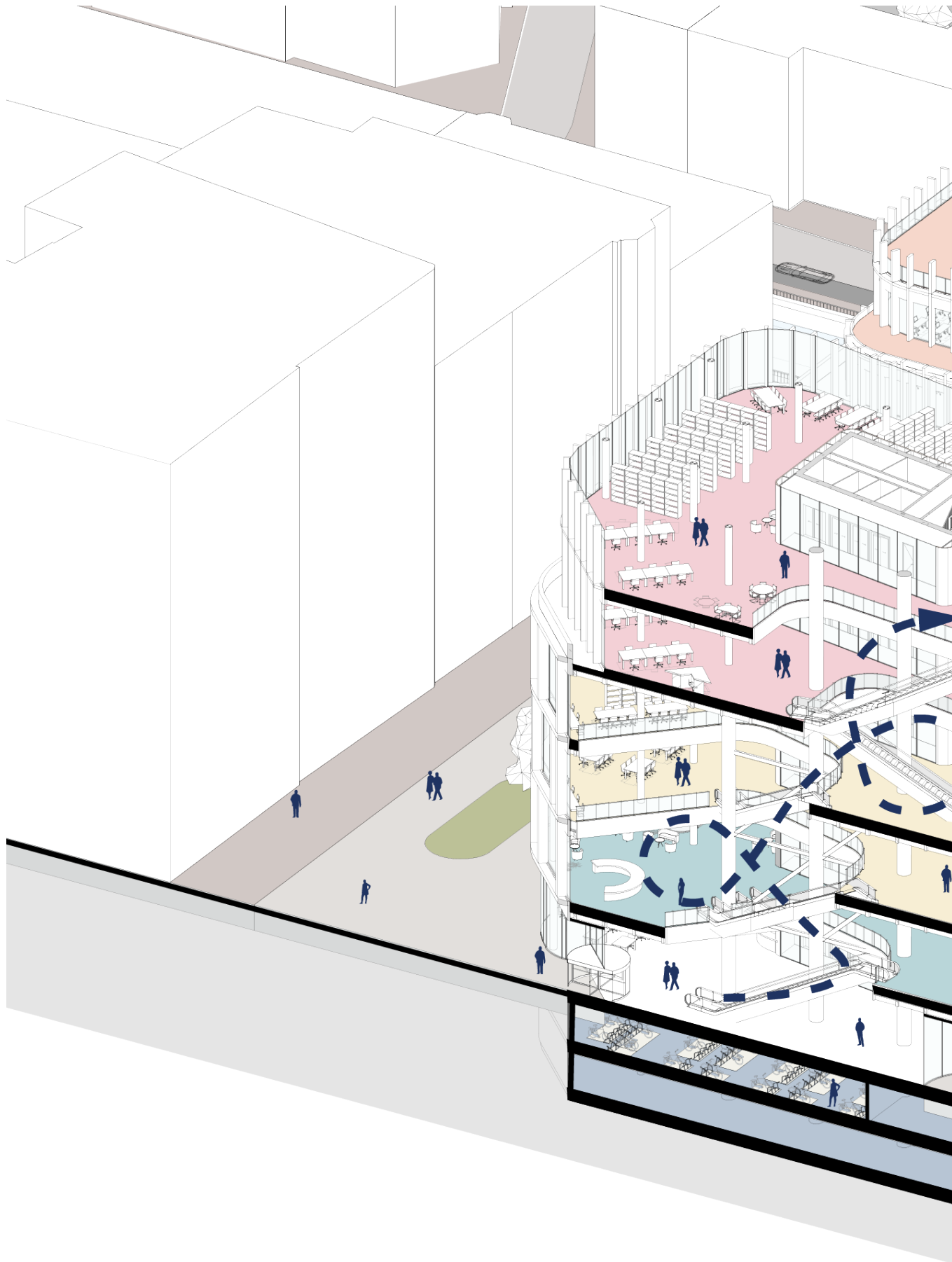
Clustering functions with the guidelines

VISTAS - VOIDS

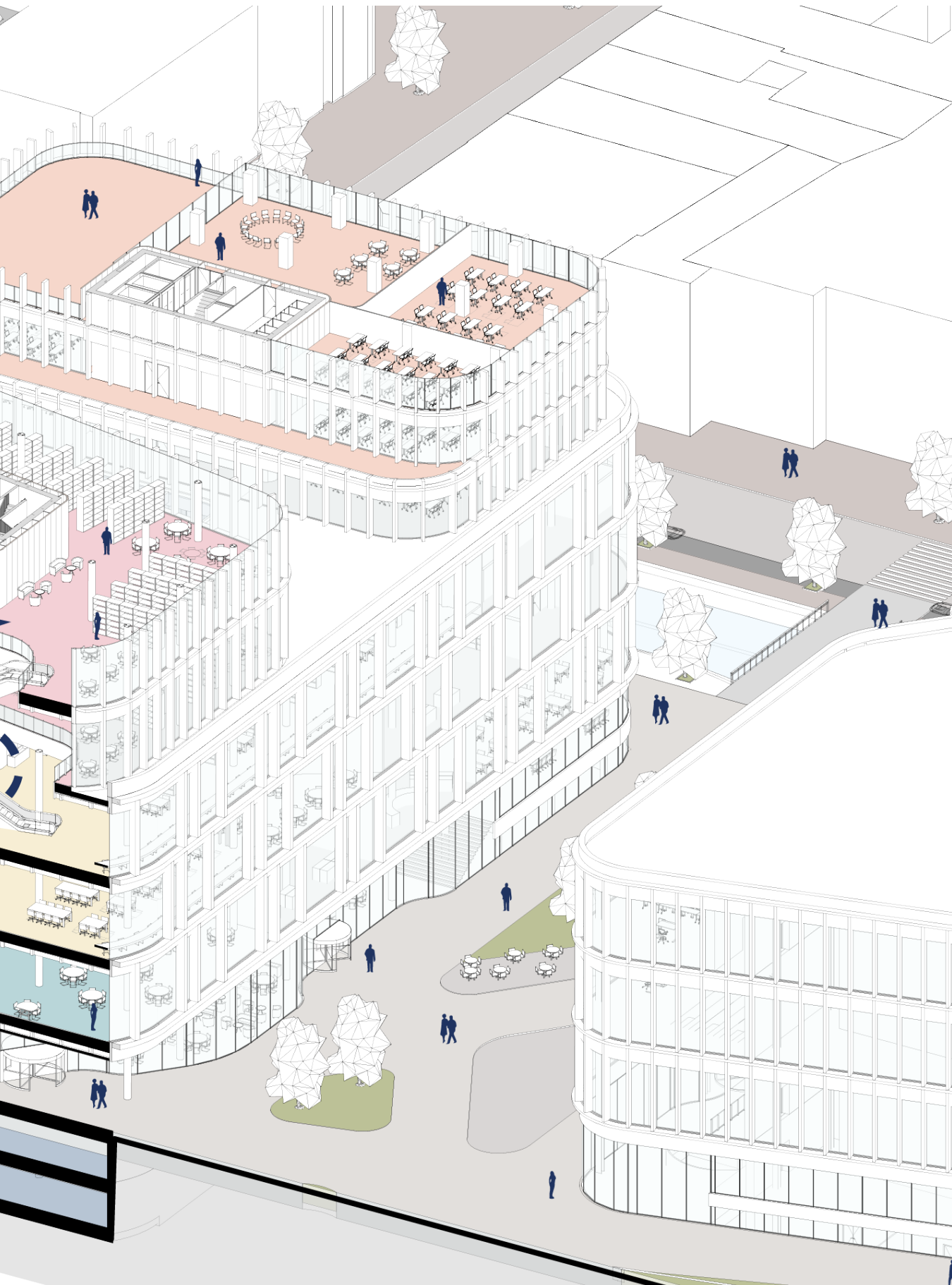


Connecting functions by voids, showcasing functions and movement

VOIDS



Changing vistas and view lines unfold



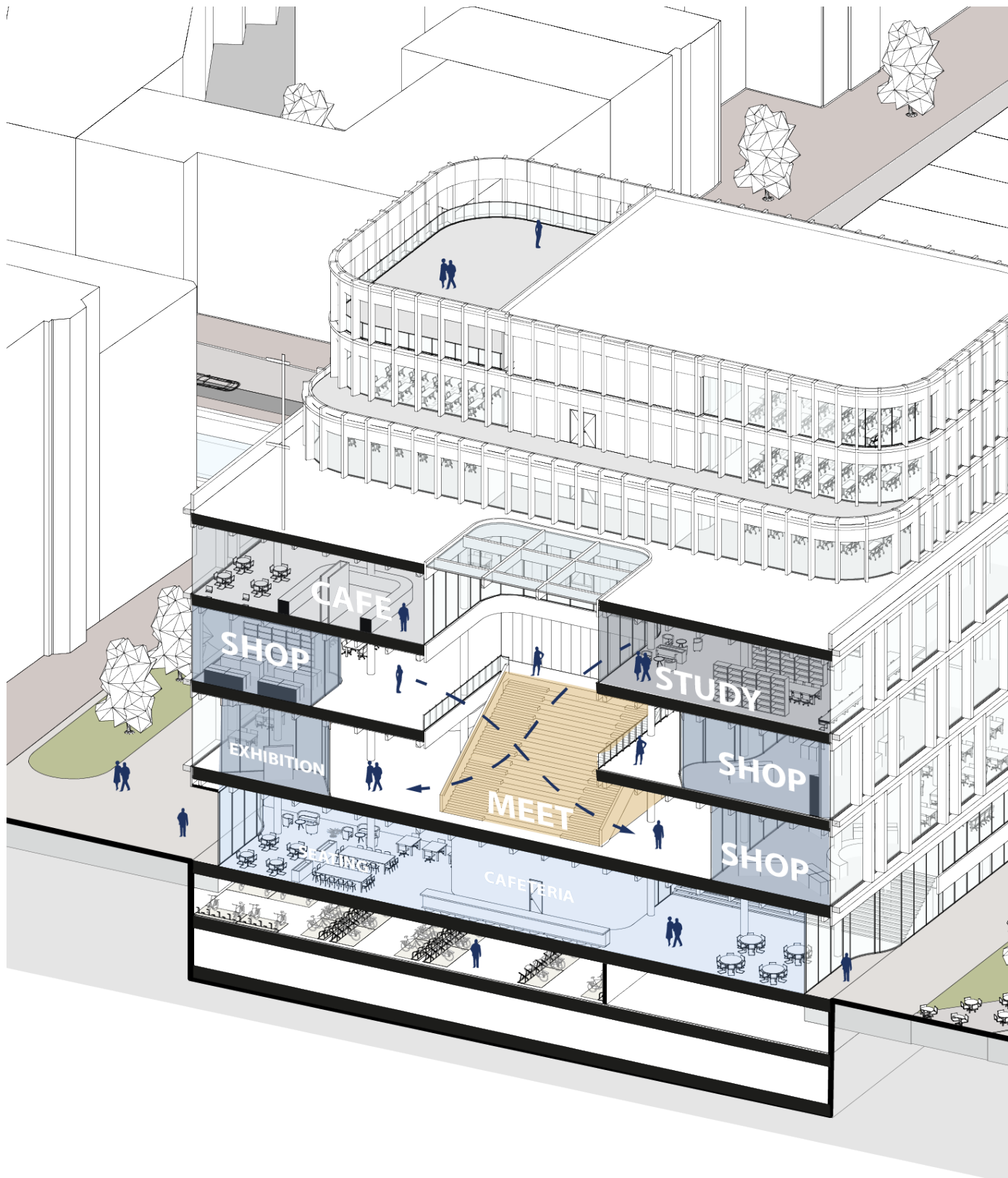
as you navigate through the building.

FIRST FLOOR VOID

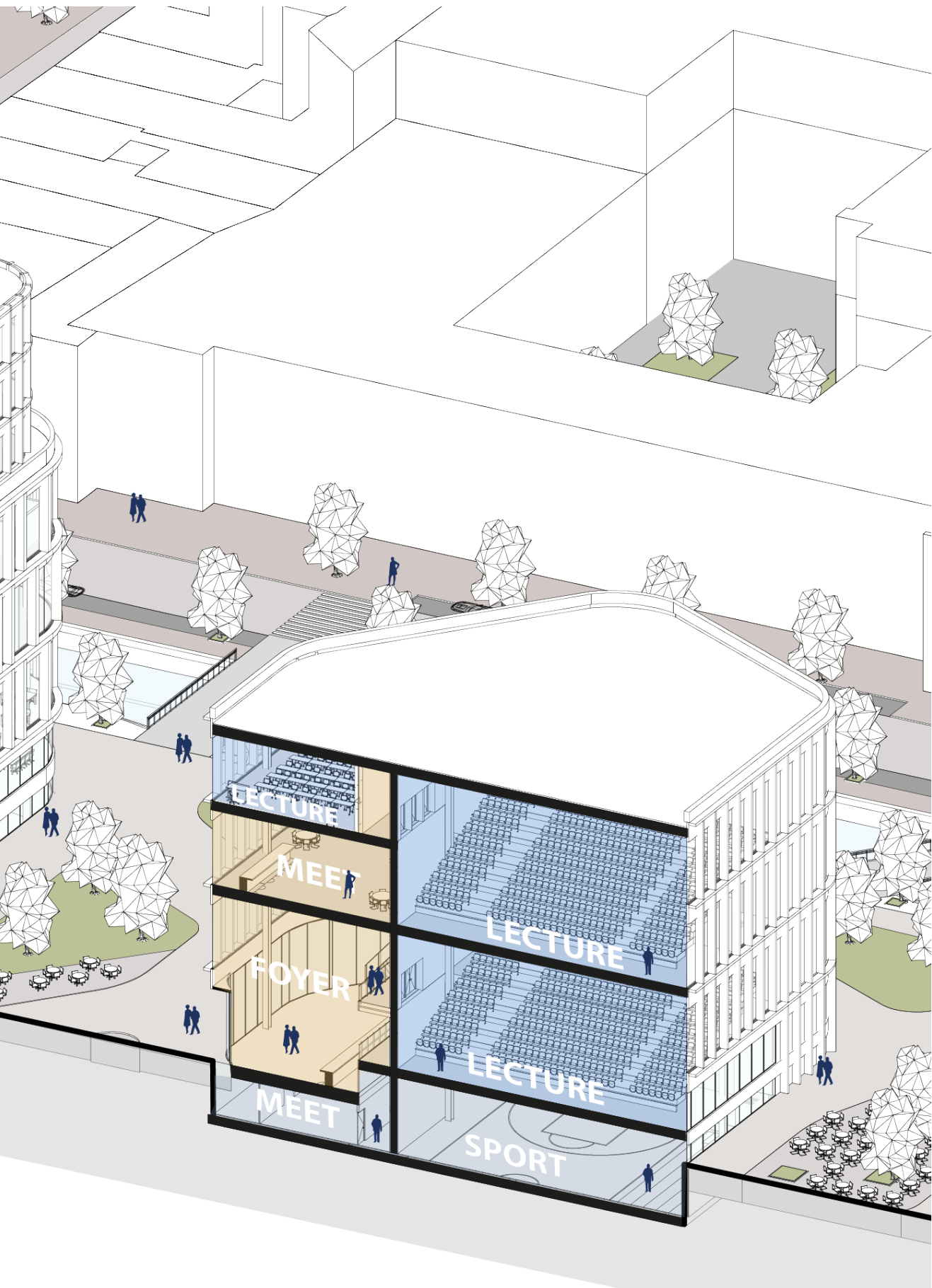




ATRIUM



Cultural and insti



stitutional learning

UNIVERSITY GATHERING HALL





Architecture

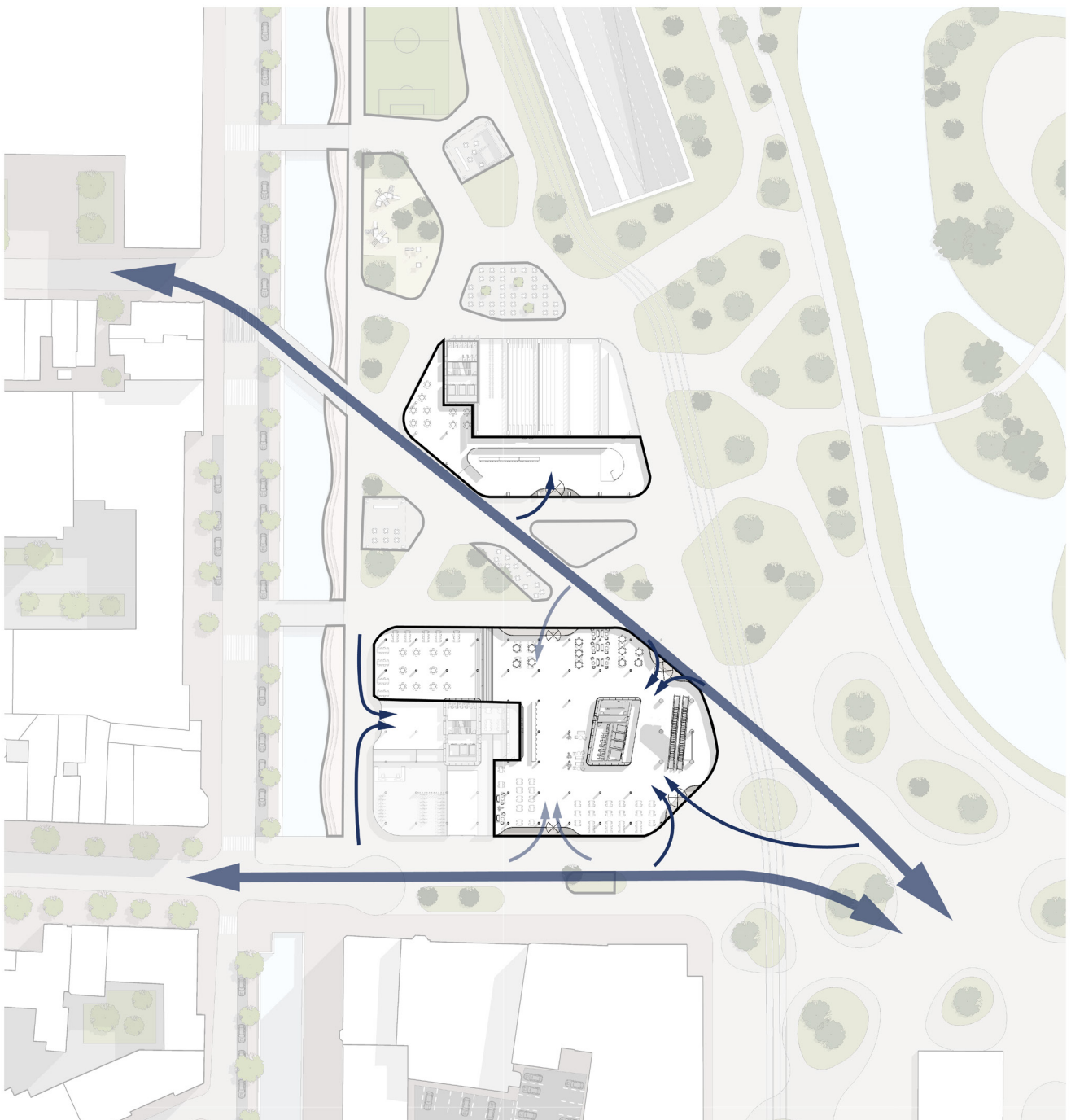
05

Masterplan

Outdoor space

The flow inbetween the buildings is designed to guide people to the multiple entrances of the building. It allows visitors to have easy access on both buildings without the need to search for the entrance. The head of the building has four entrance points. Allowing to cross the building in a shorter method or to experience the outdoor space when following the flow, this allows to extend the outdoor to the indoor of the buildings.

When walking over the flow area users will see different types of public activities. These functions are for the public and campus. Open space with no functions in them and specified functions that are preserved by the campus or city.





Sport pavilion



Soccer field



Playground



Terraces



Gathering



Water square



Waterfront



Public bike storage



The sport pavilion is the gathering point for different sports on the plot and city. A place to meet people of all ages.



Partly used by the sport pavilion. The external hours are open for the public



A public playground that will be used mostly by the elementary.



The terraces are outdoor seating places for the city.



An undefined covered outdoorspace that is used for open event, marked or stands.



A water storage system is placed that is also used as attraction for the children to play and aesthetic in the flow space.



The waterform is a place to meet and see the historic buildings located on the other side of the water.



The underground parking under the Lumina tower, allowing external users to also park their bike here. Guiding people into the building

WATERFRONT





ENTRANCE





ENTRANCE





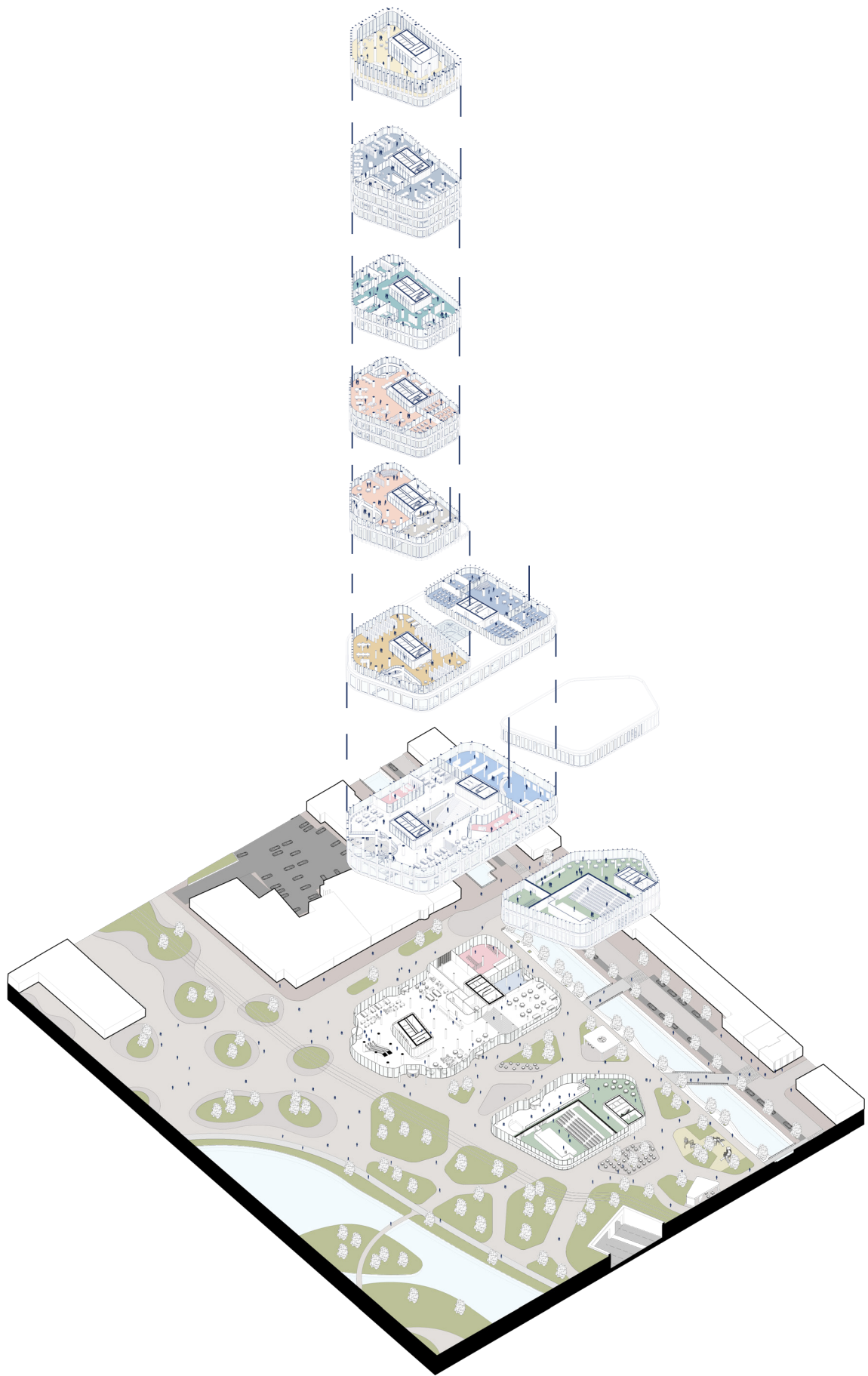
Floorplans

This exploded axo is used to showcase how the functions in the building are stacked combined with the impact of the voids.

The higher we get into the tower the less functions there will be on every floor. Meaning going from a multi function floor to a more private and strict floorplan.

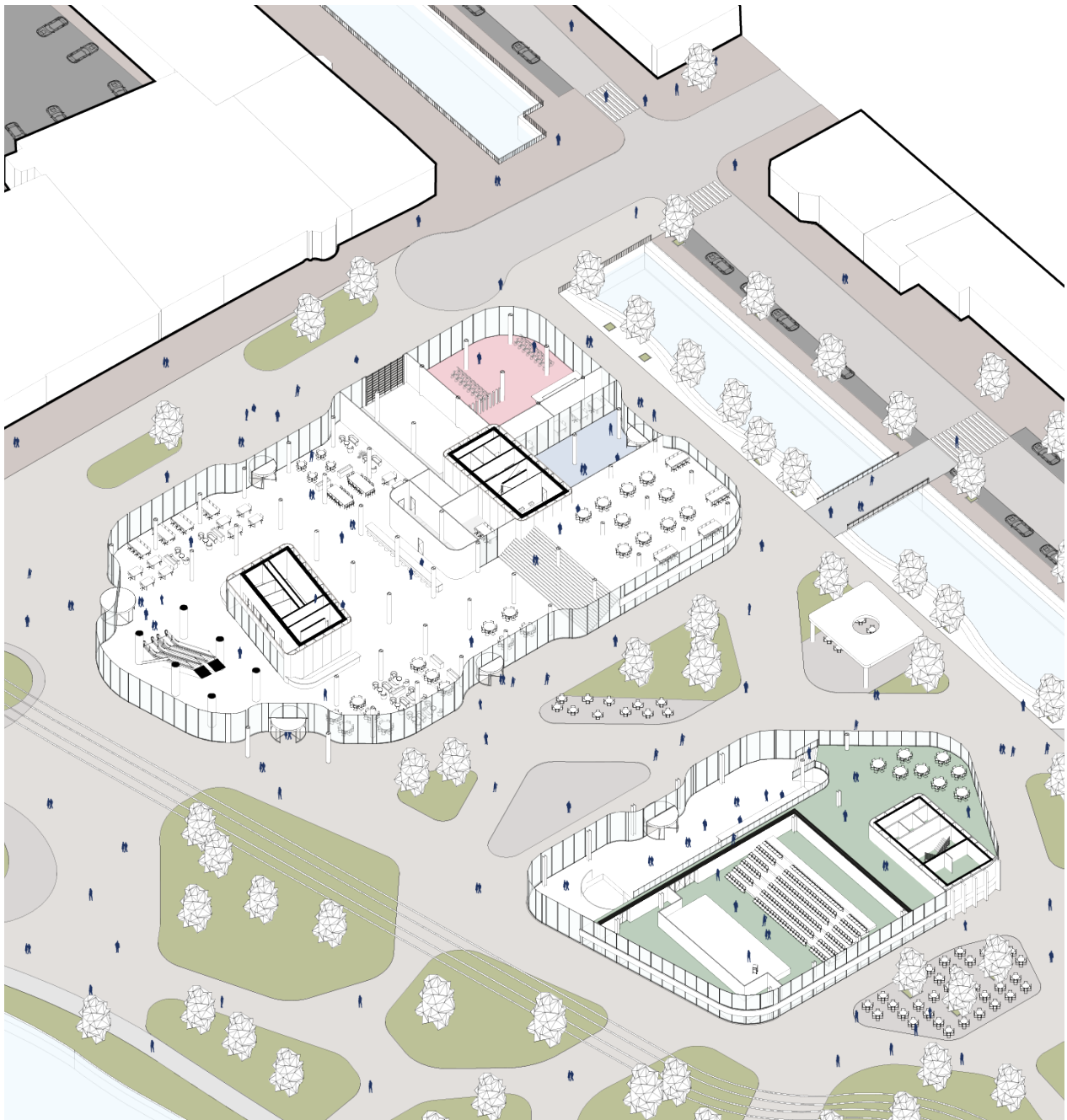
Because of the long list of functions in the program there is chosen to highlight the biggest functions that have boundaries in them. In the plinth are several functions that are not highlighted because they have an open floorplan with the movement spaces.

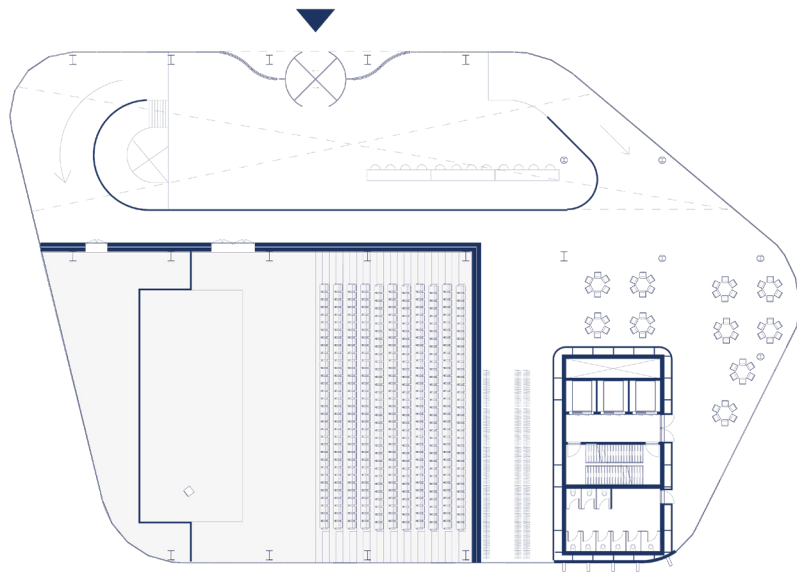
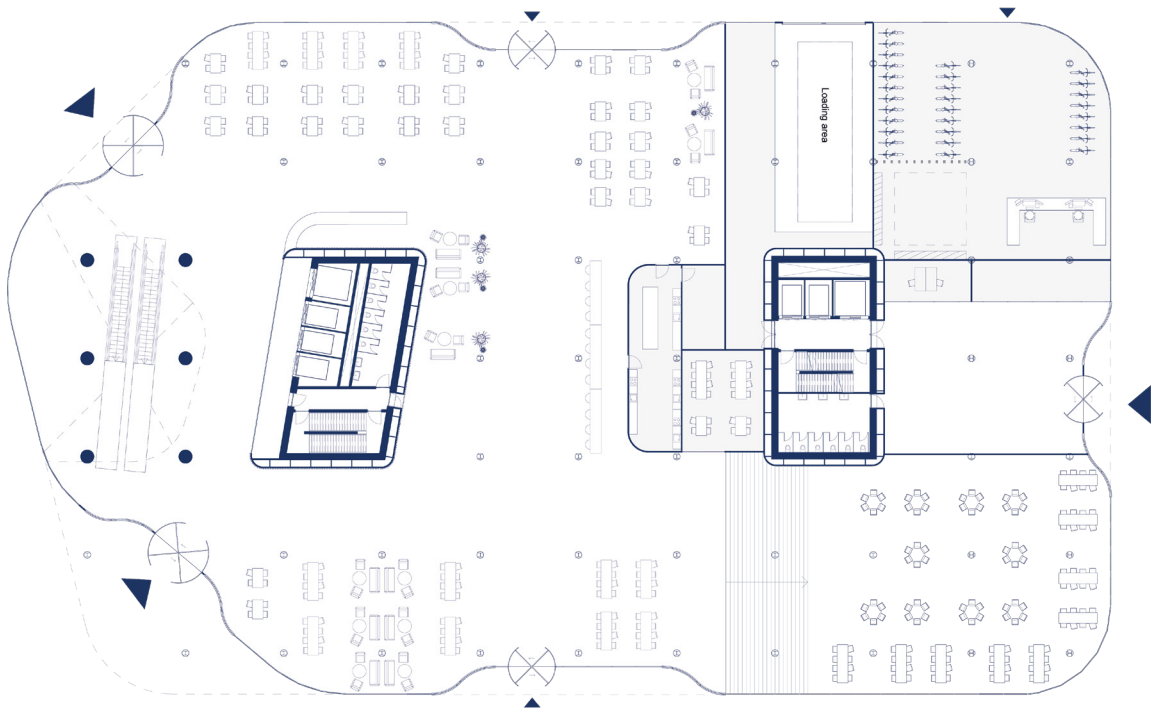




GROUND FLOOR

One of the most or the most important floor of the building. How does the building connect with the urban environment. The multiple entrances around the head of the building combined with lounges, view lines to the void into the plinth and the cafe help to stimulate curiosity.





Elementary



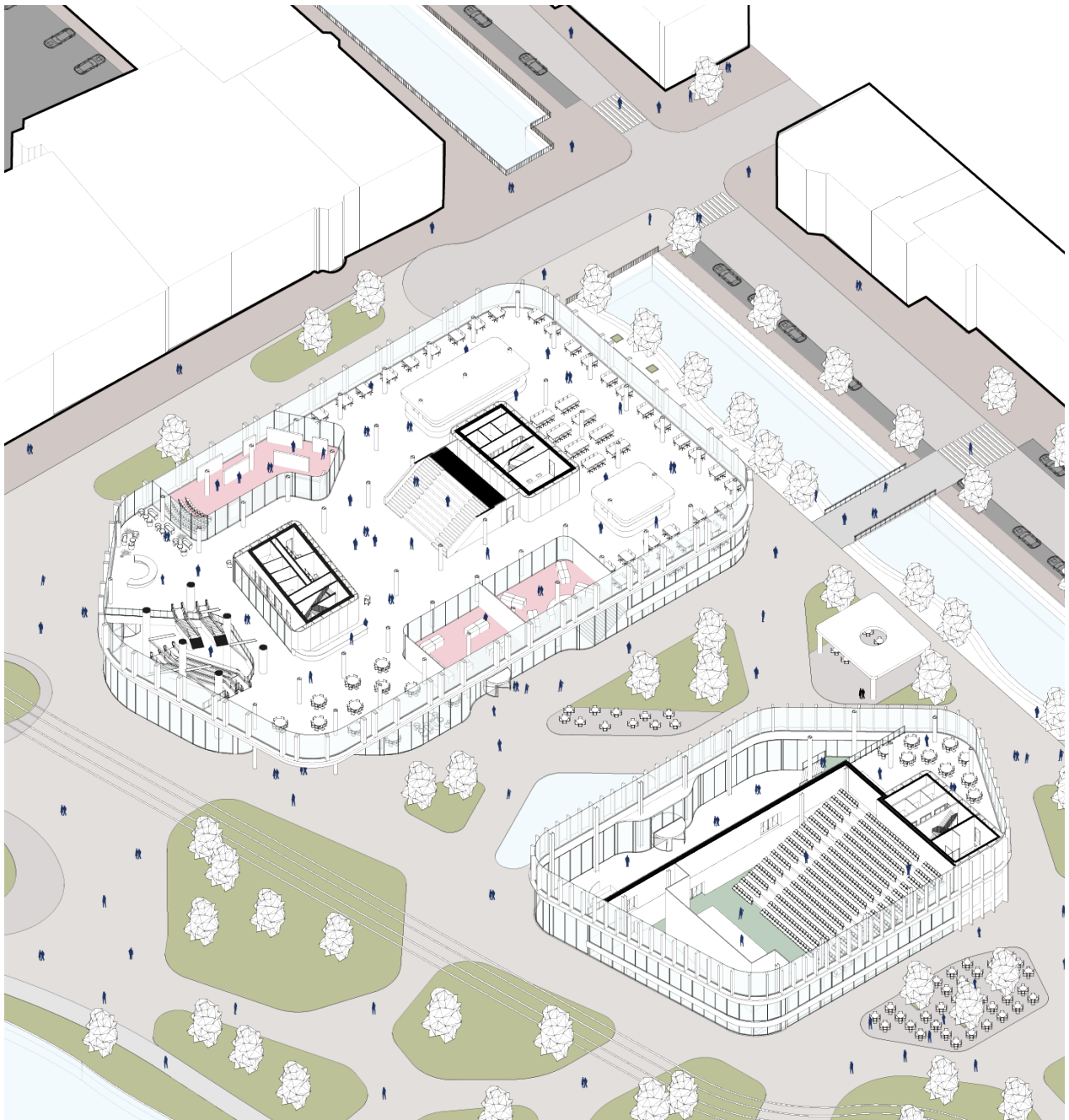
Commercial

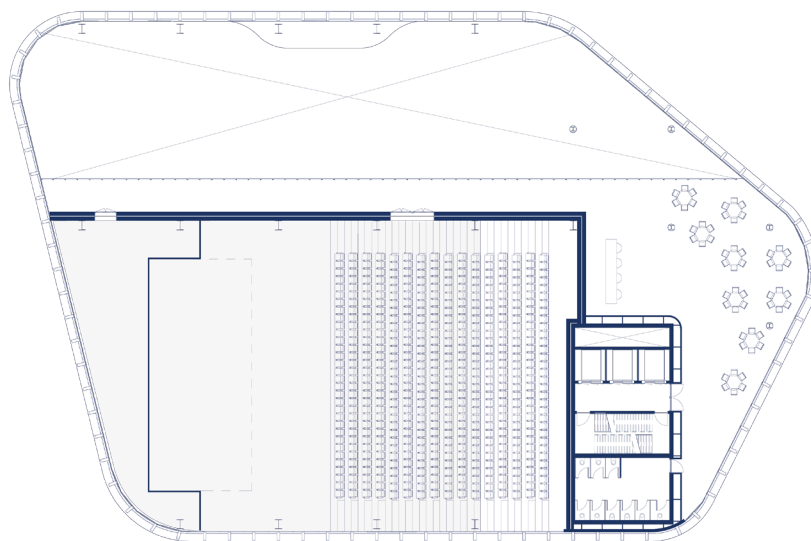
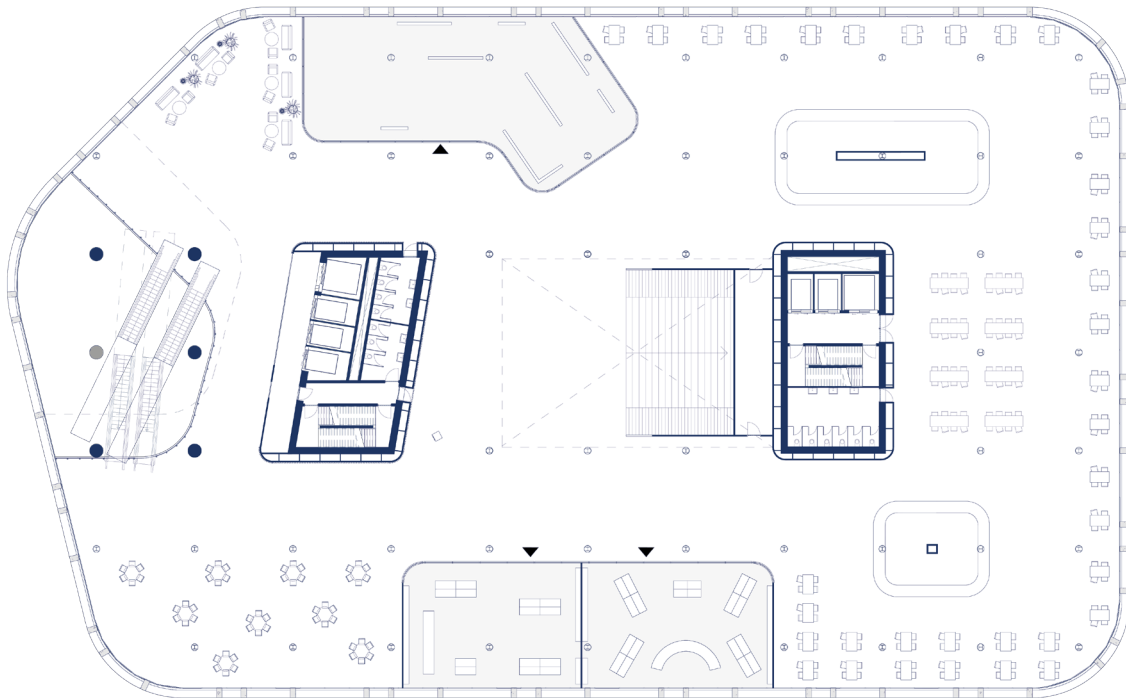


Lecture

FIRST FLOOR

This is the first floor elevated plinth, allowing users to explore and see the knowledge showcased by the university combined with shops and study spaces. These floors don't have borders. The only border is transparent glazing to showcase their underlying function. In this way the people are show what happens in the building.





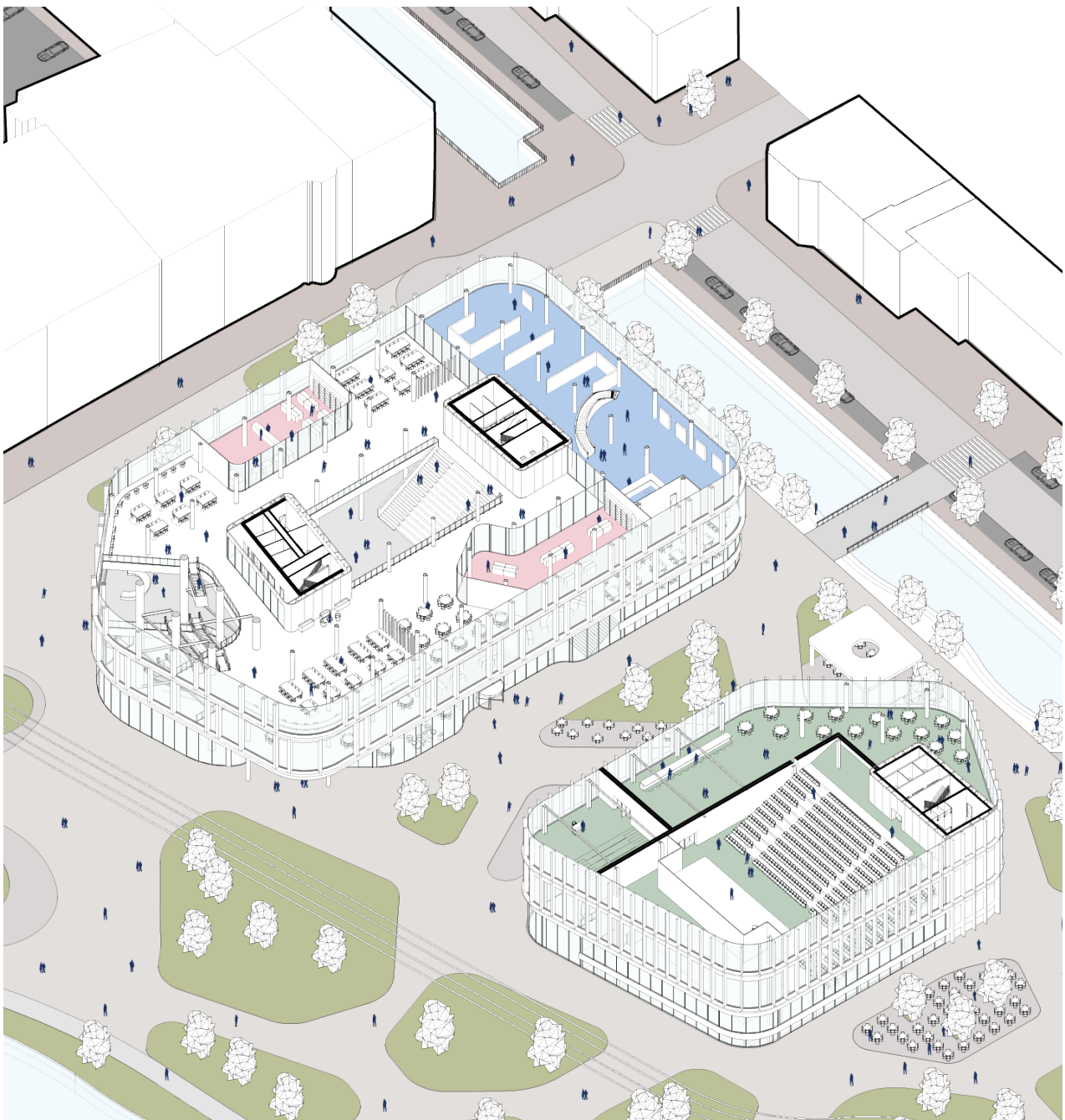
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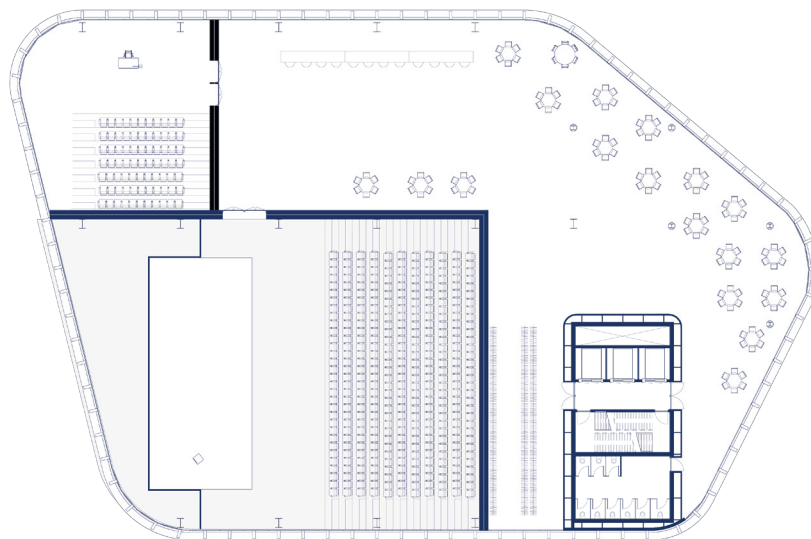
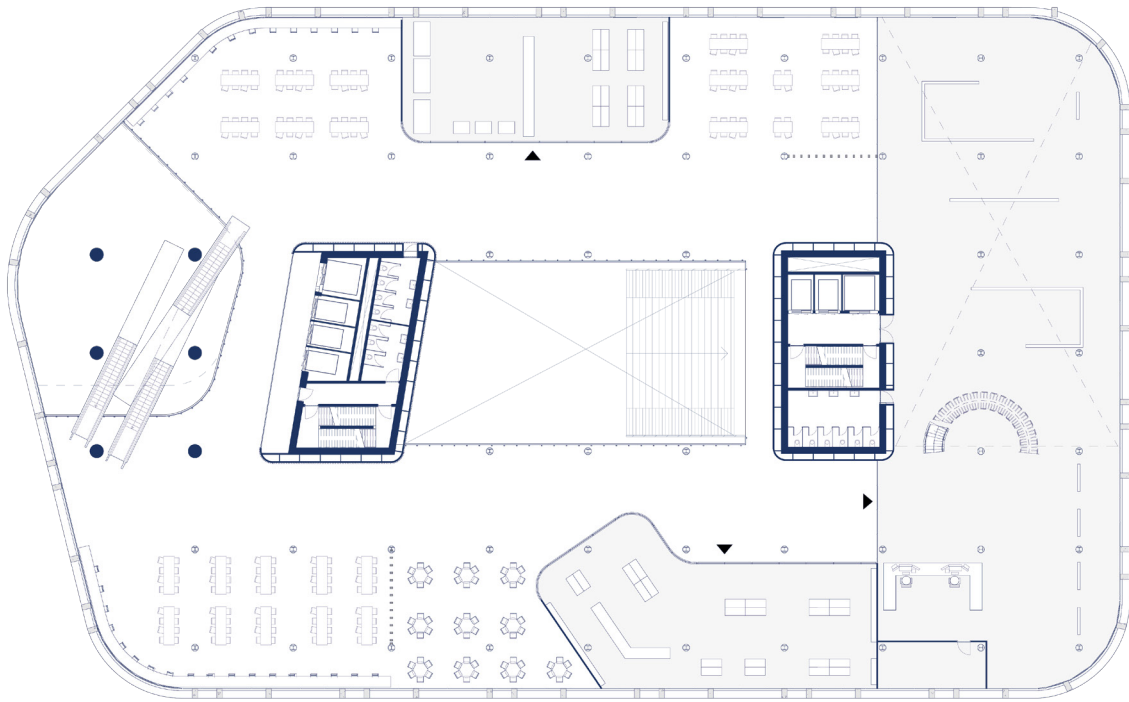


Lecture

SECOND FLOOR

This floor is the a mix of several functions. There are a lot of working spaces, individual or in groups combined with the shops that are directly linked with the university. Thinks about a material book or print shop. For the foyer in the secondary building there is a seperation for the foyer on ground floor and for the top levels. Creating a division for the different sizes of groups that will come to this building.





Exhibition/Museum



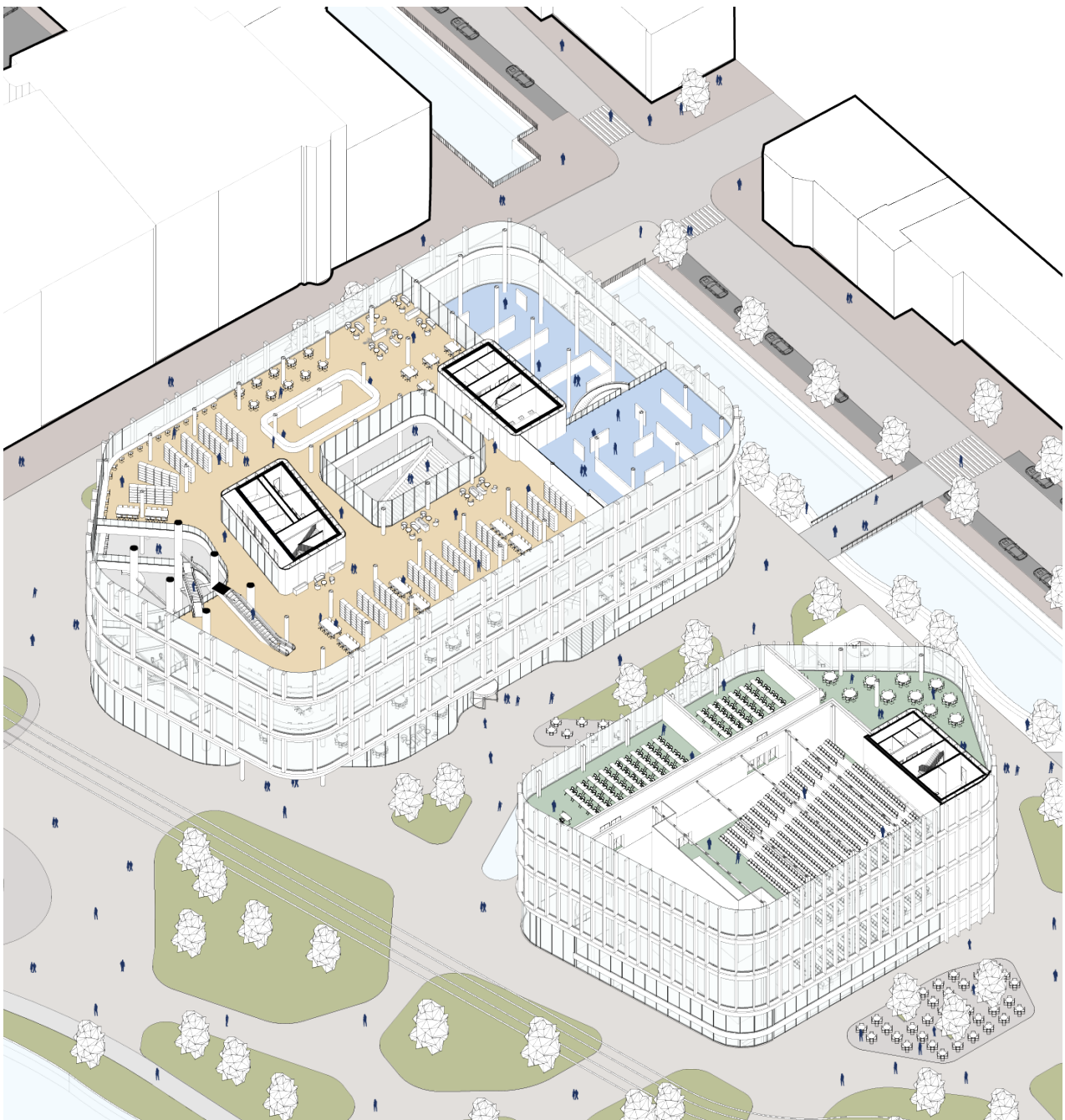
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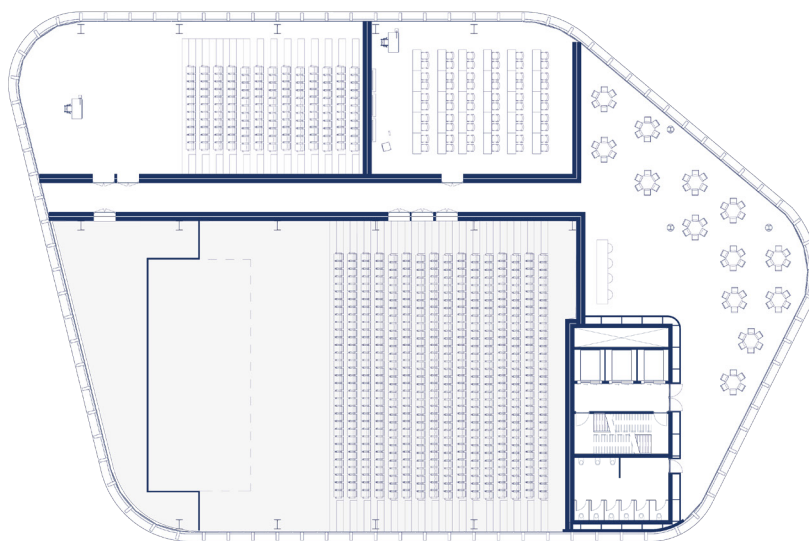
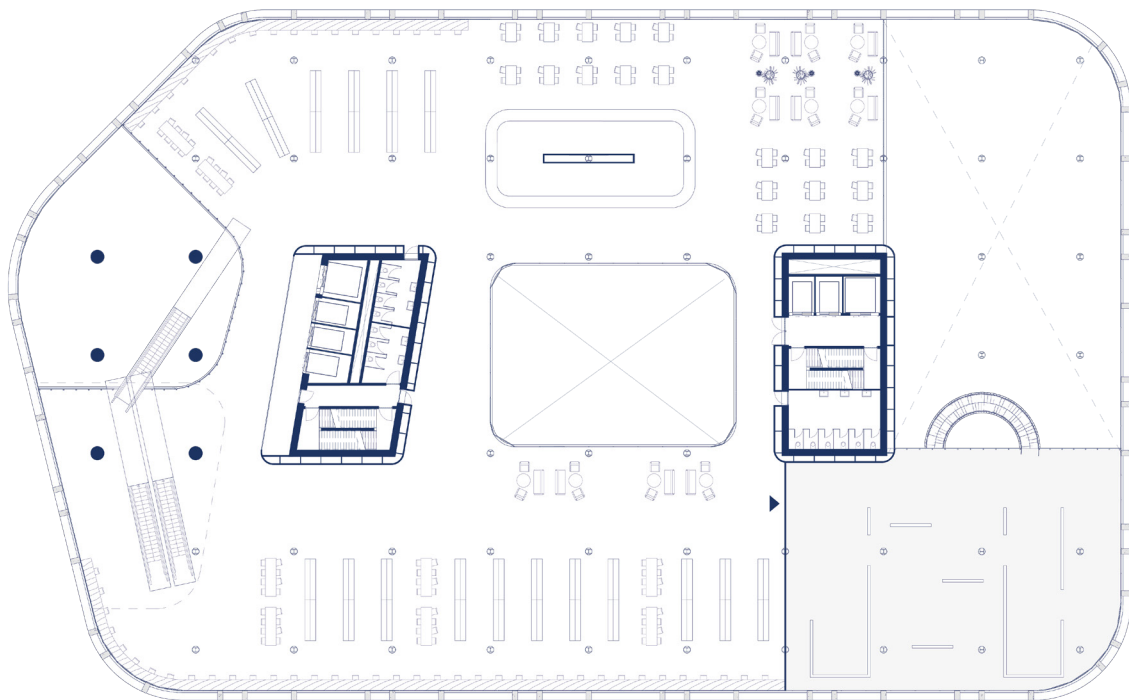


Lecture

THIRD FLOOR

This floor is the open concept of the library. The library functions merges into a cafe where users can sit when reading a book or look through the window into the museum. It is also the top floor of the plinth, looking in to the atrium.





Exhibition/Museum



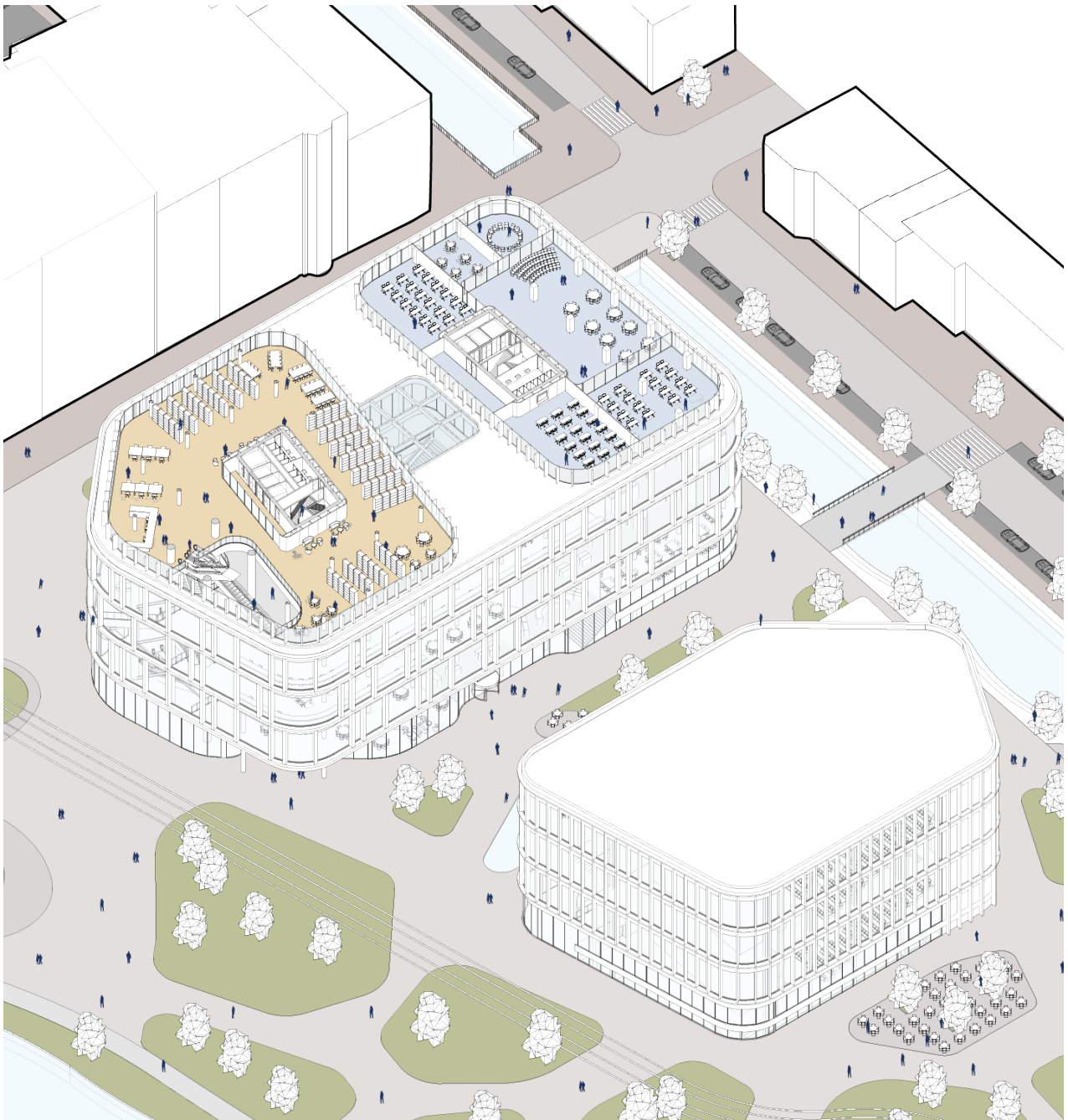
Library

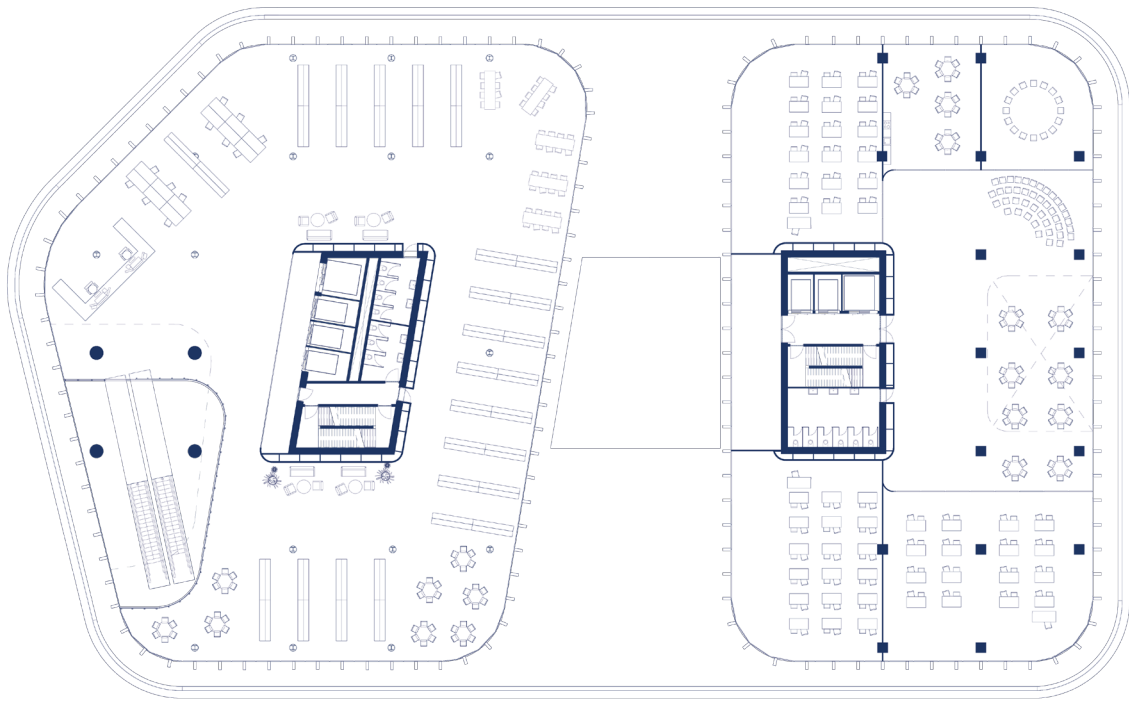


Lecture

FOURTH FLOOR

This floor houses the elementary with a square and also the library of the main tower. The void is moved to the side to reduce the connection sound that can travel from the entrance all the way up to this floor. It also helps to create a more intimate floor of the library because it's a singular function for this area.





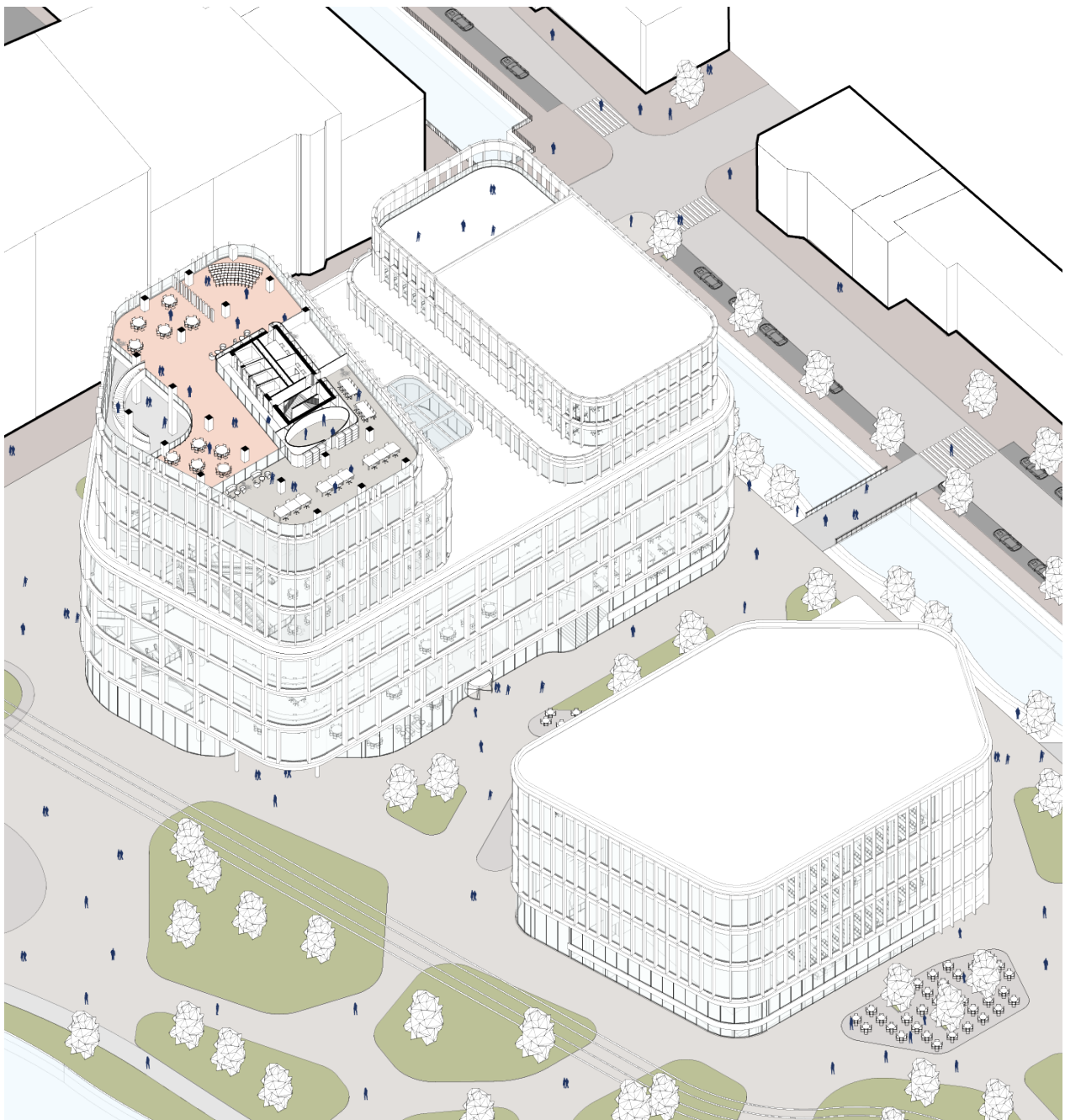
Exhibition/Museum

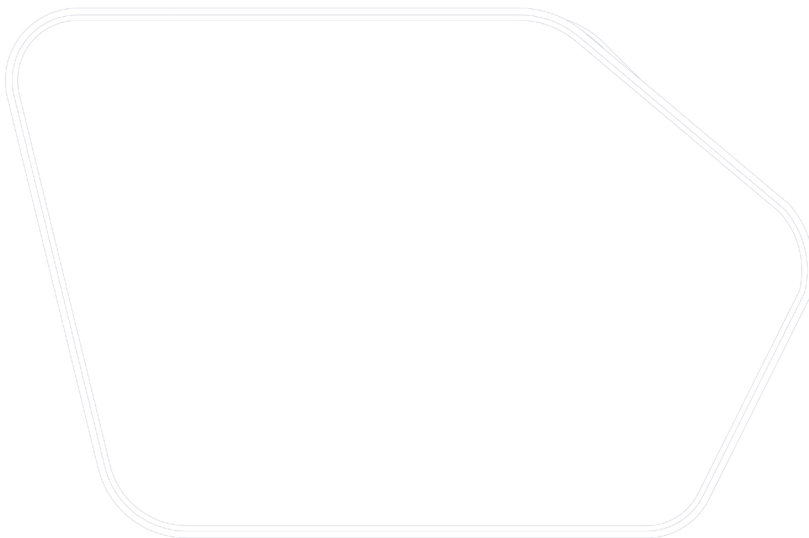
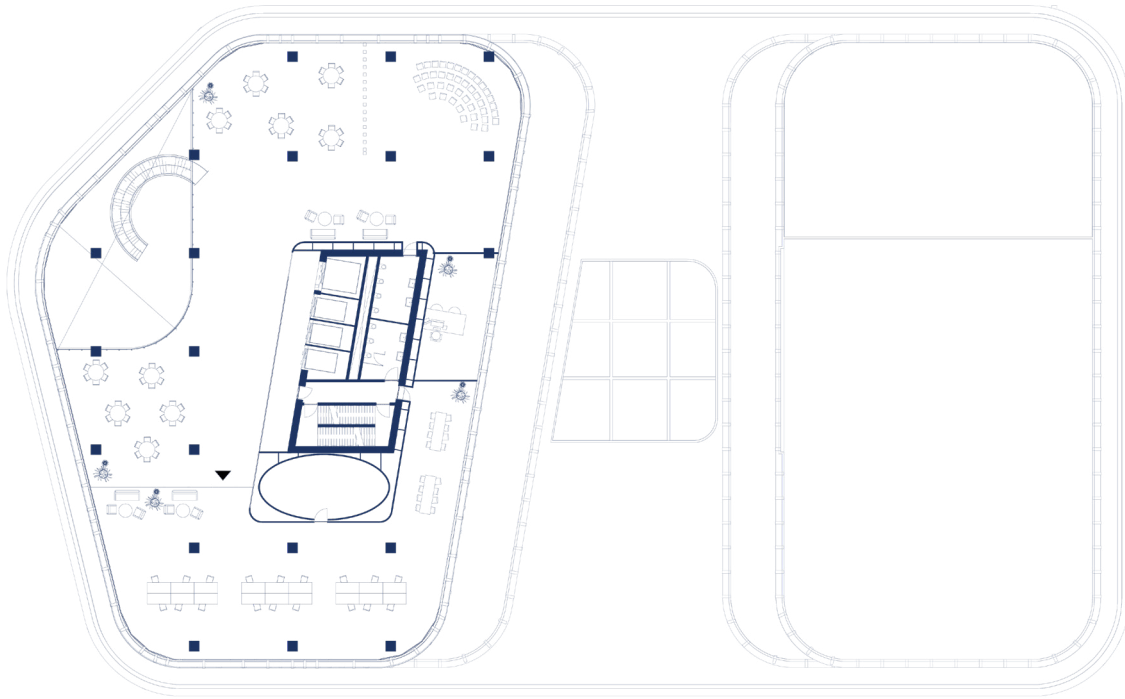


Library

SEVENTH FLOOR

The university entrance starts on the seventh floor and is divided into two levels, but it connects three levels in total. The voids helps to connect multiple study spaces and lounds but it also houses VR department of the building. The VR is placed on 1/3 of the floorplan at the entrance to showcase their ongoing developement to the students. This can also be showed in the exhibition hall of the plinth.

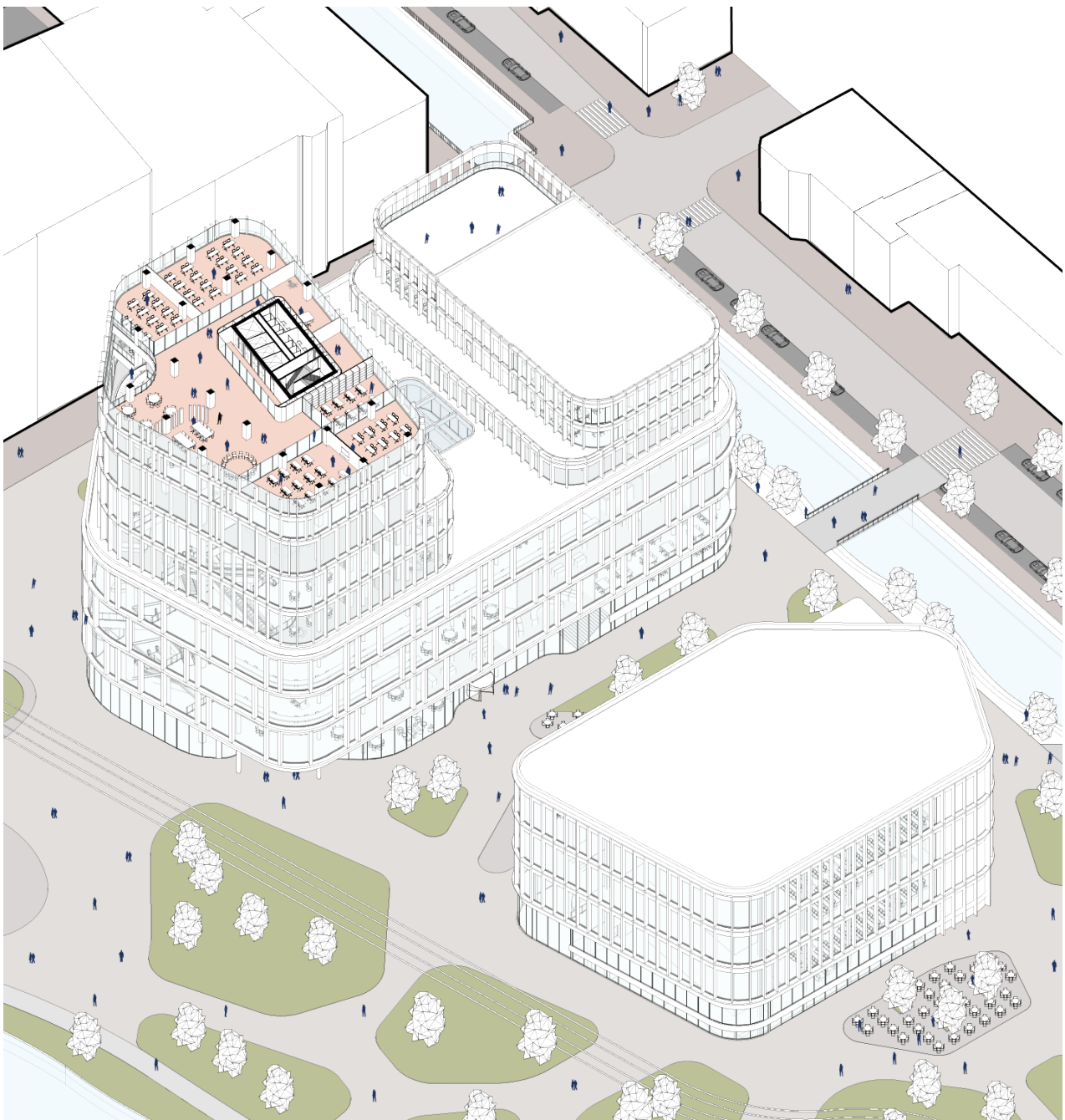


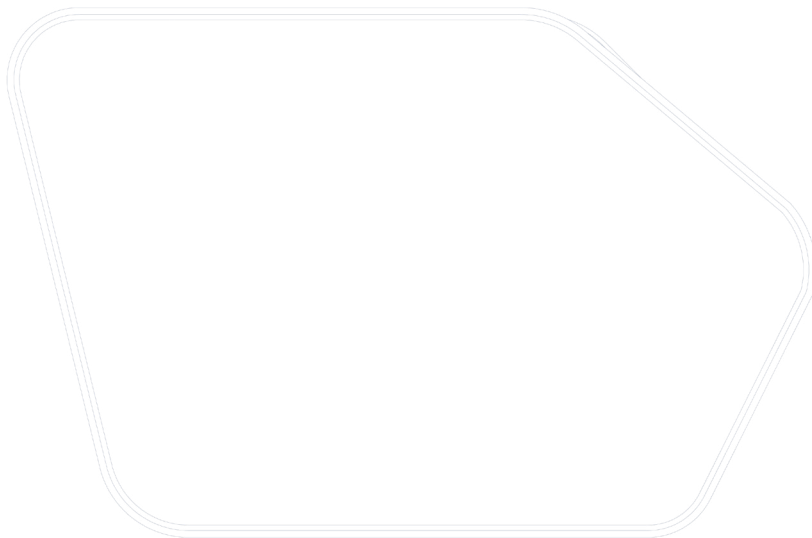
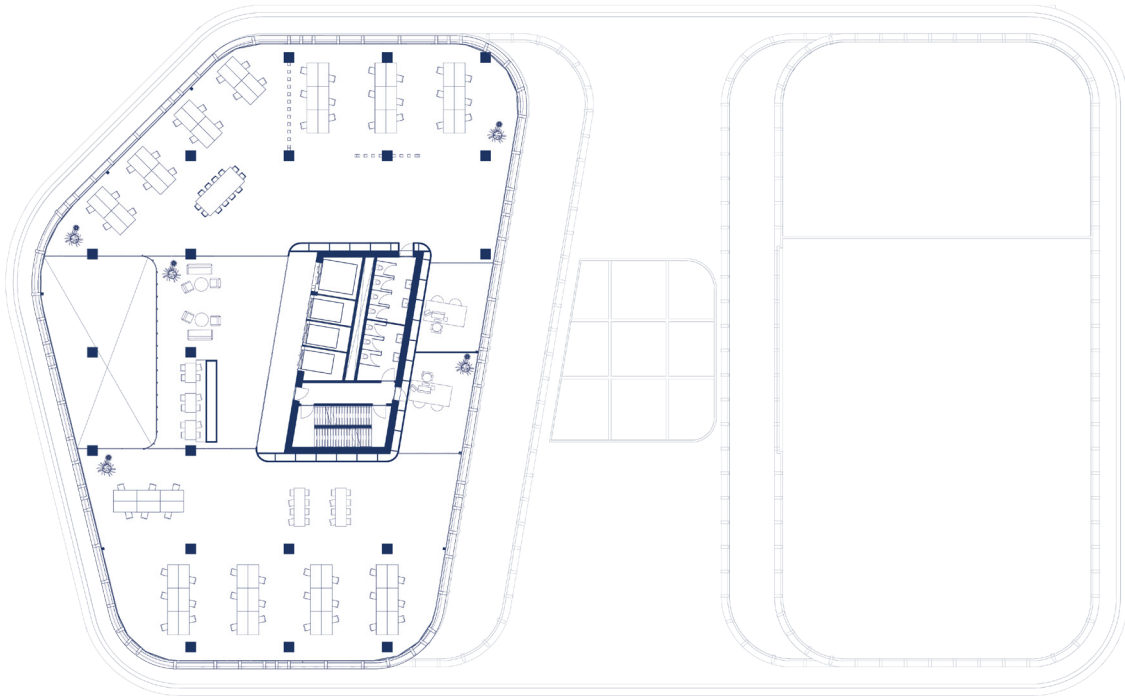


University

EIGHT FLOOR

The university floor that is focussed on the traditional classroom design. This floorplan is needed for all the small scale lectures that are still given nowadays. In the future these rooms can be removed or used for another functions when we will have more online lectures.

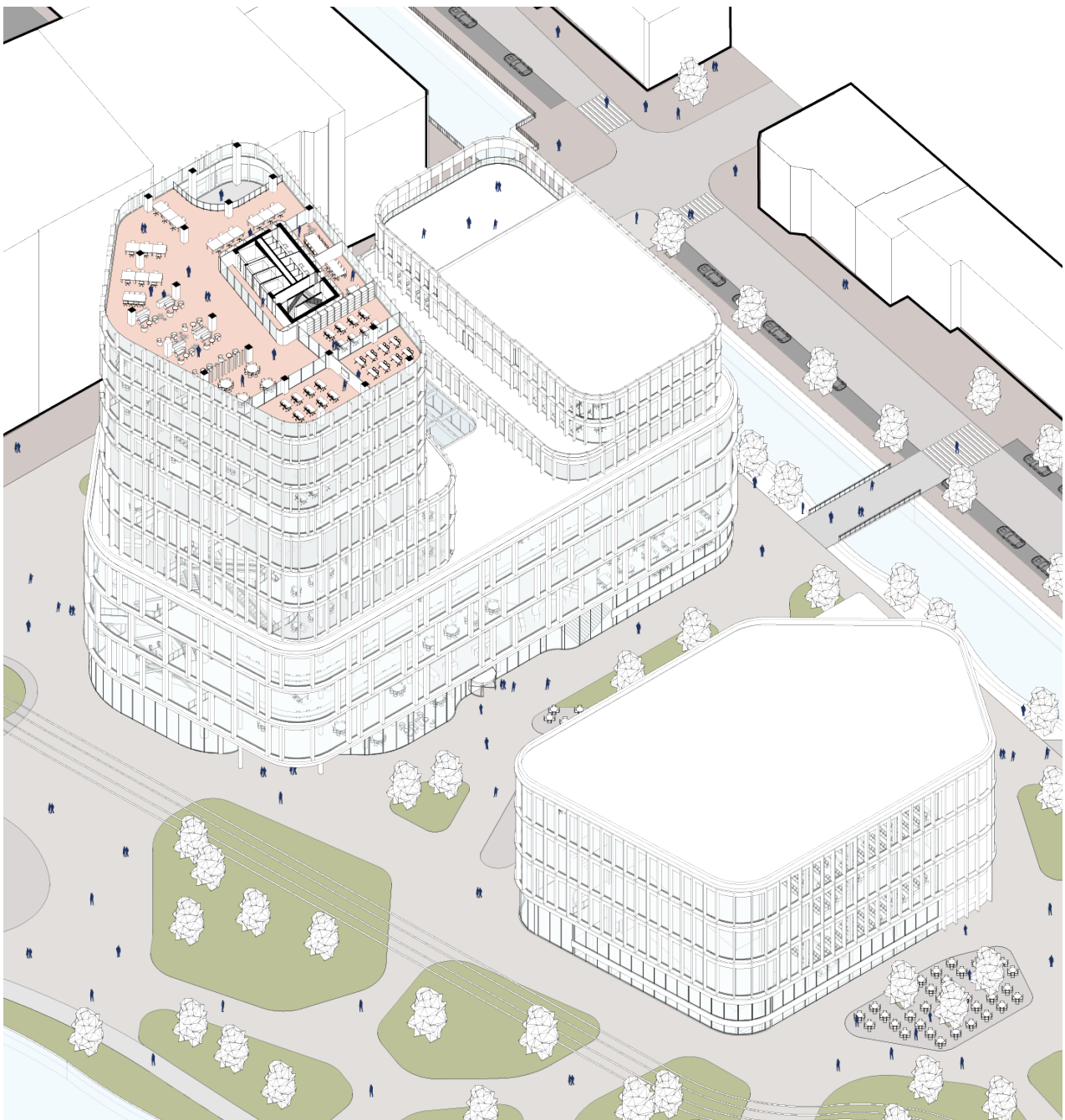


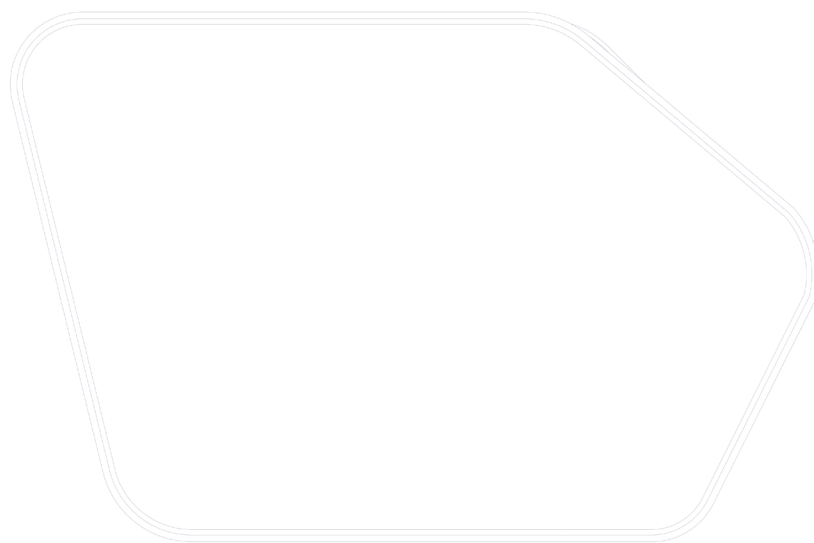
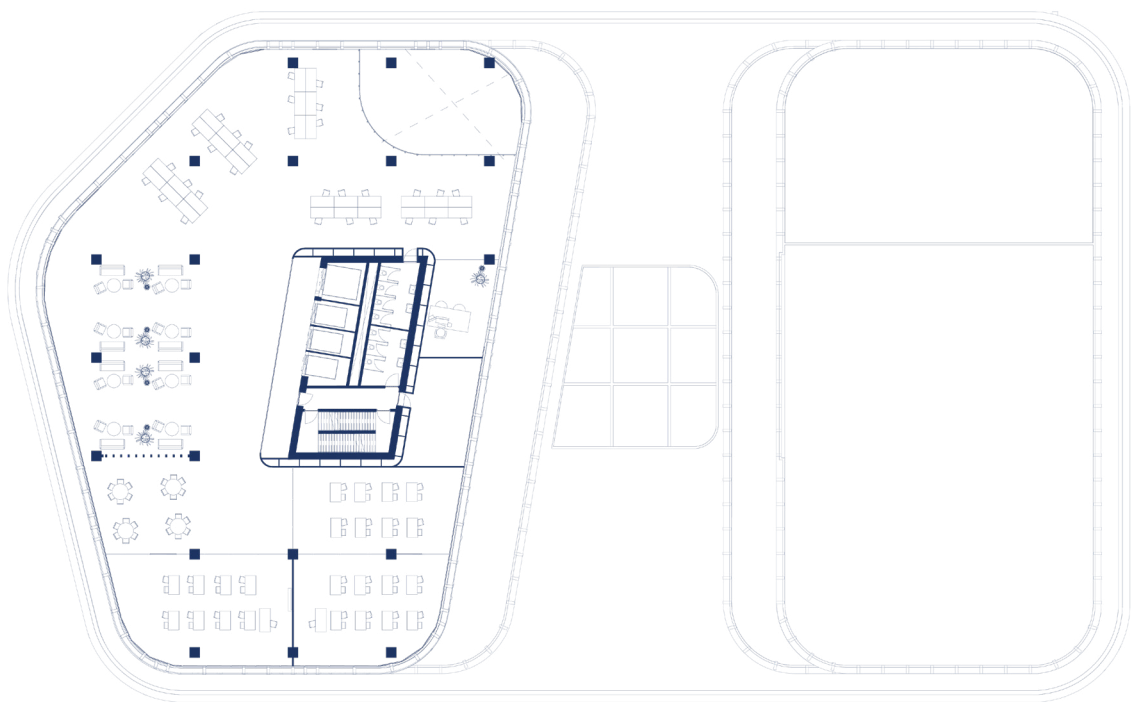


University

ELEVENTH FLOOR

A mixed floorplan for the university. Having classrooms, study spaces combined with the void to connect with the other level helps to create an environment that will allow students to wander inbetween lectures and find their space to study. This can also be in the library or in the plinth.

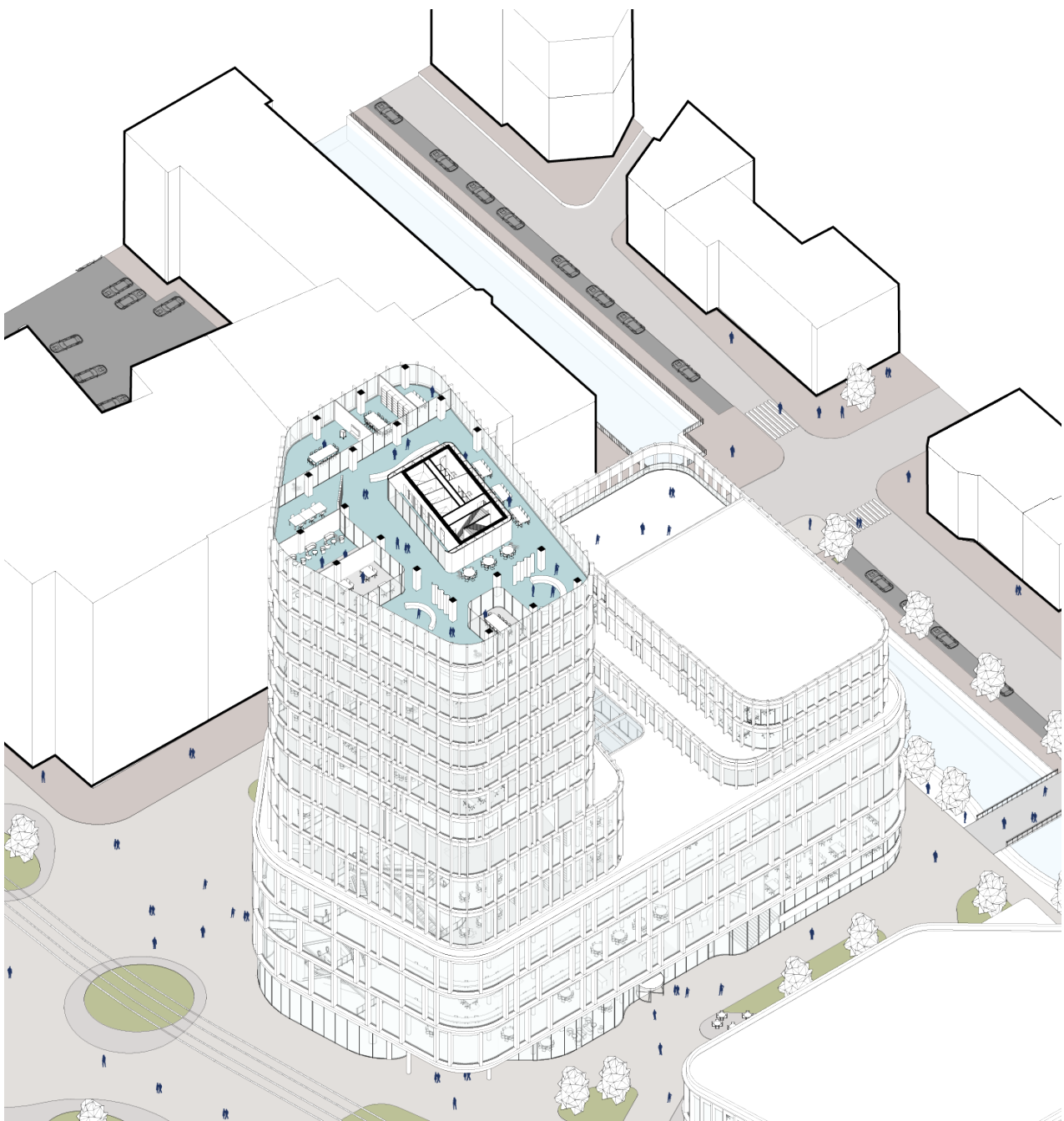


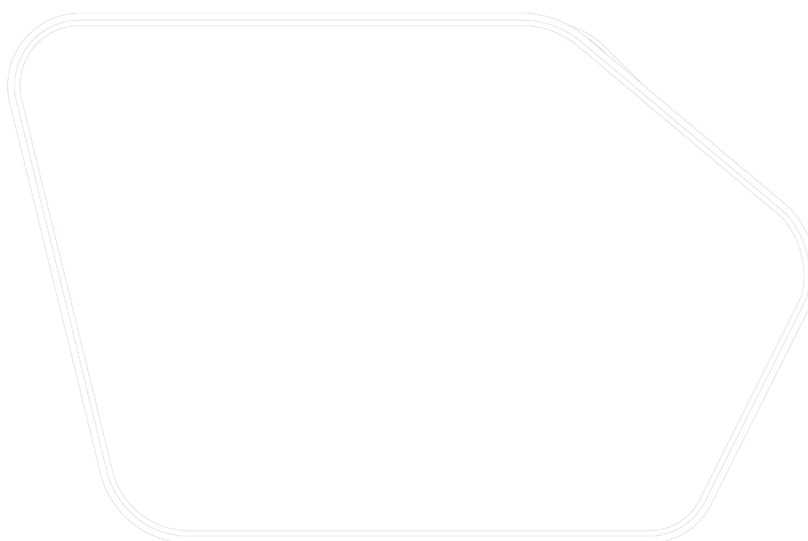
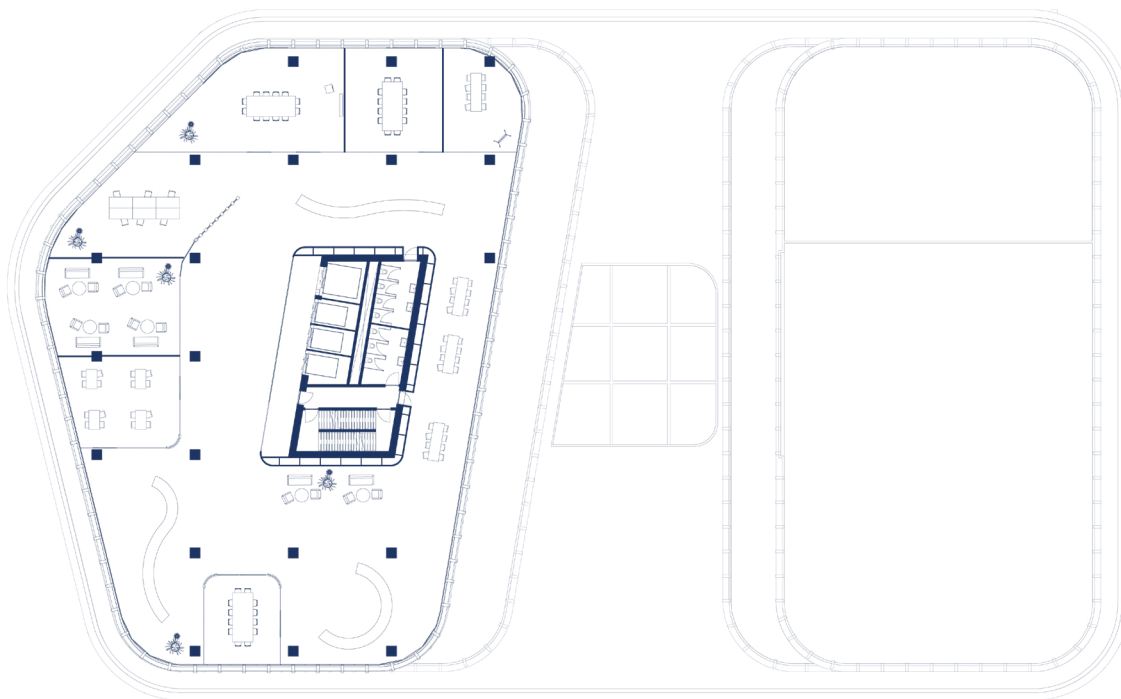


University

FOURTEENTH FLOOR

The workhub is a floor that can be used by the office and university, it's a place where open en closed meeting rooms and lounge spaces are placed. the sizing can be adjusted to the growth and need development of the building. This allows the office and university to meet in the formal and informal spaces, allowing them to mix, meet and gather.

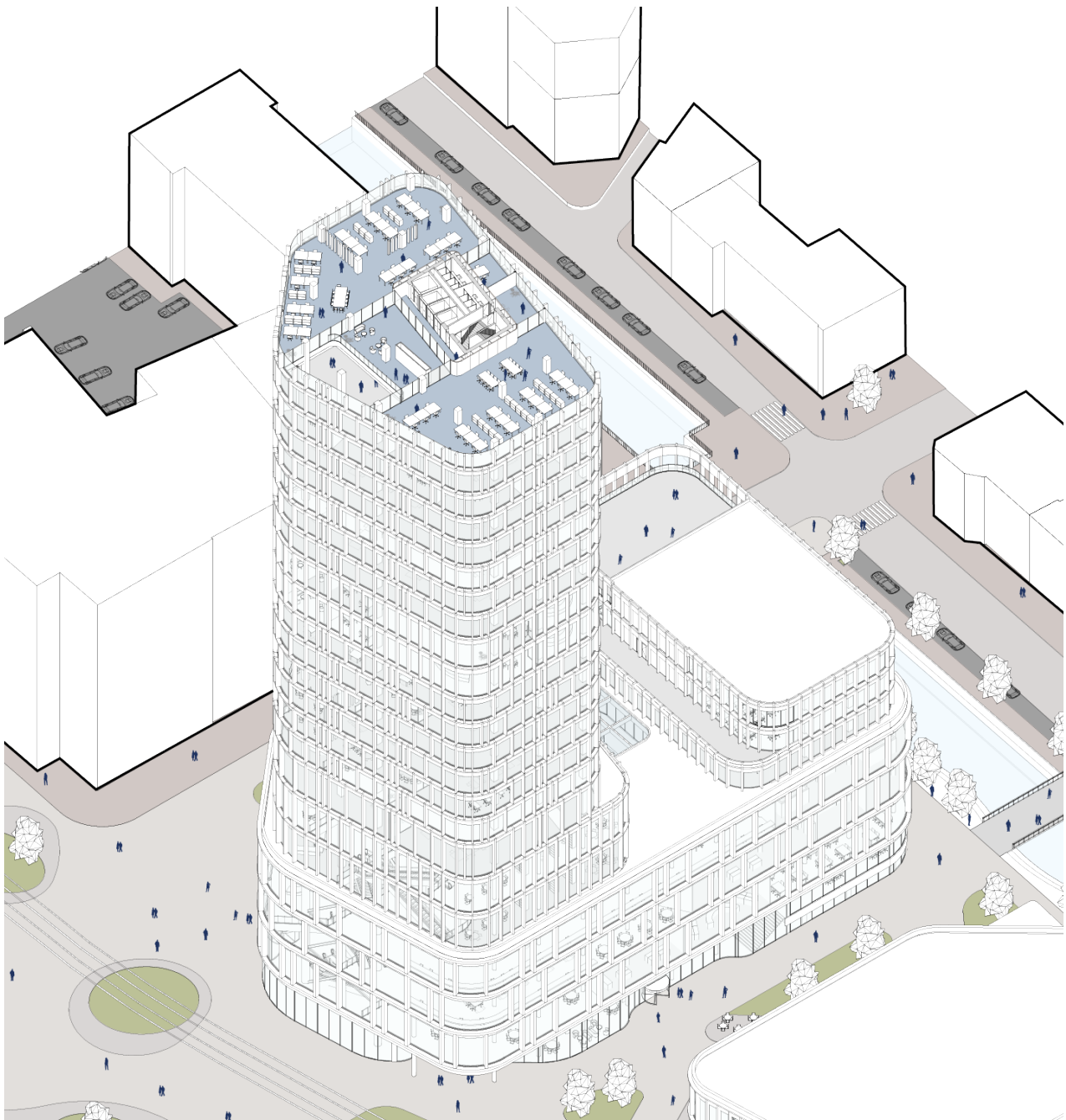


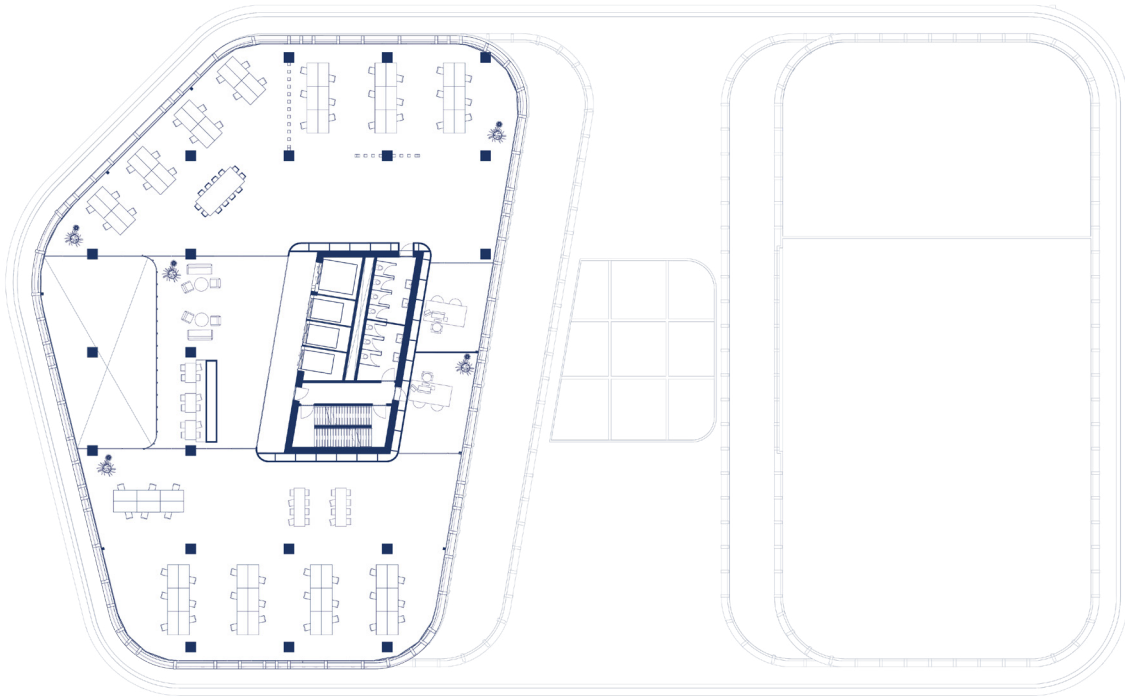


Workhub

TWENTY SECOND FLOOR

This is a typical office floor. In the building, three types of office floors are repeated. The large office that uses one whole floor. The medium floor, as seen here, is divided into two offices and an in-between space. The third one is divided into small startups allowing small businesses to have a chance to grow.

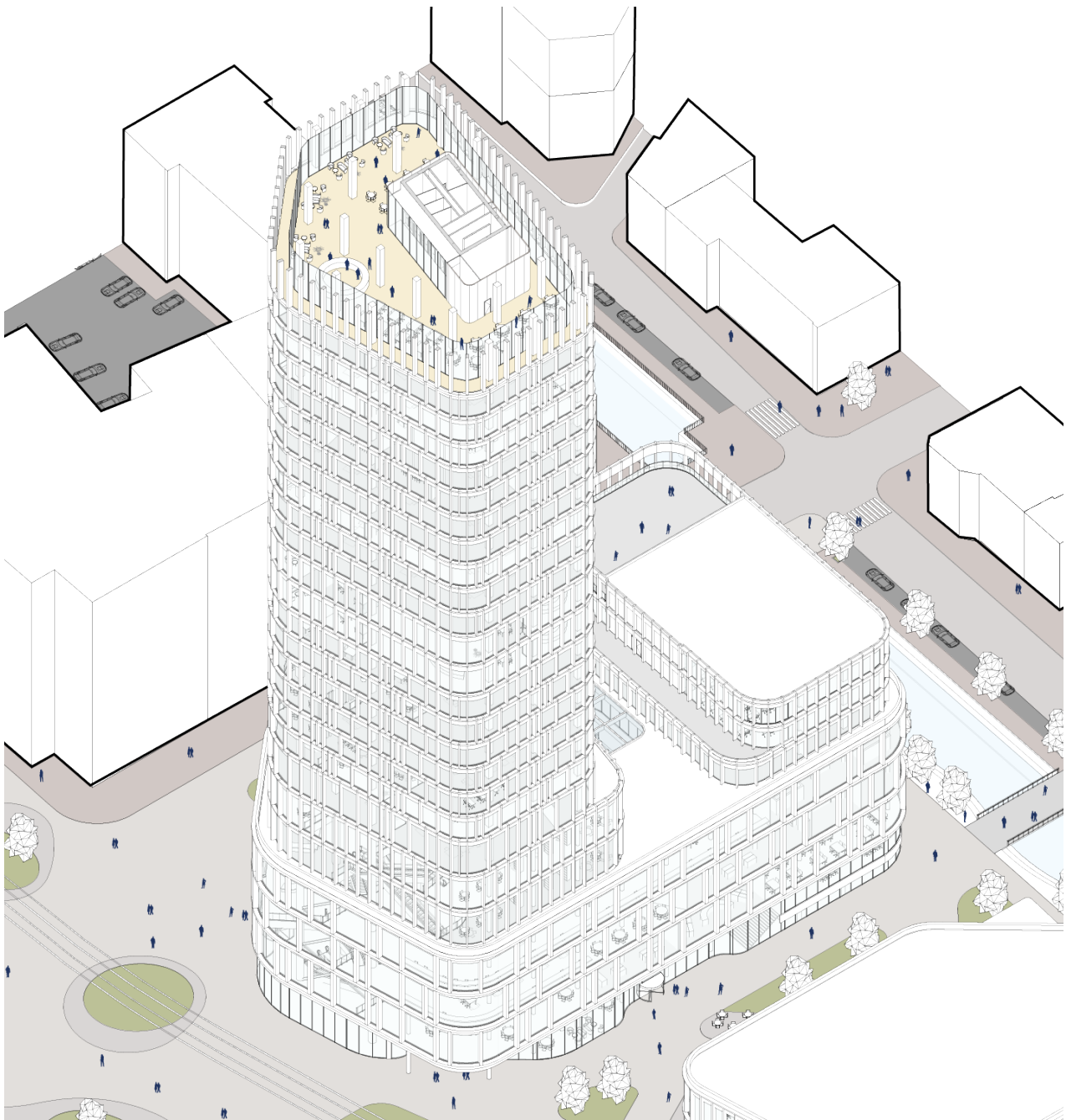


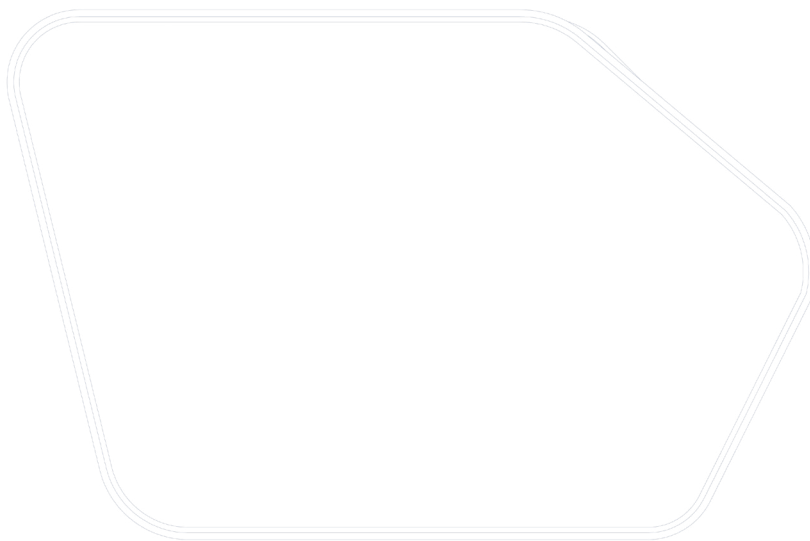
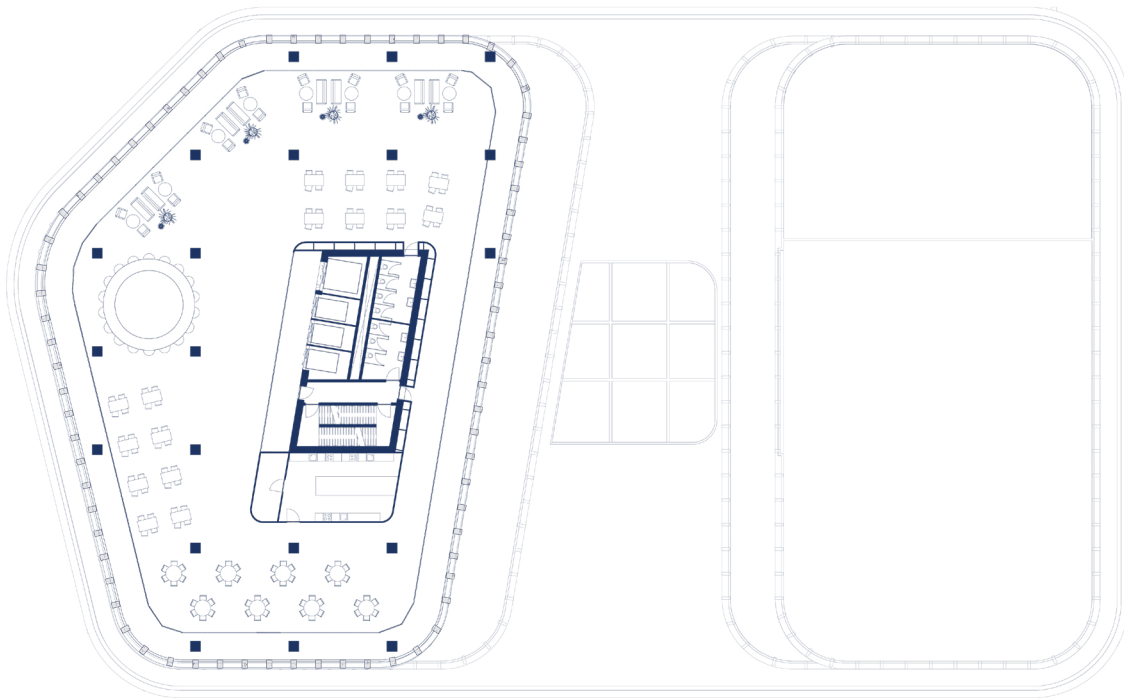


Office

TWENTY FIFTH FLOOR

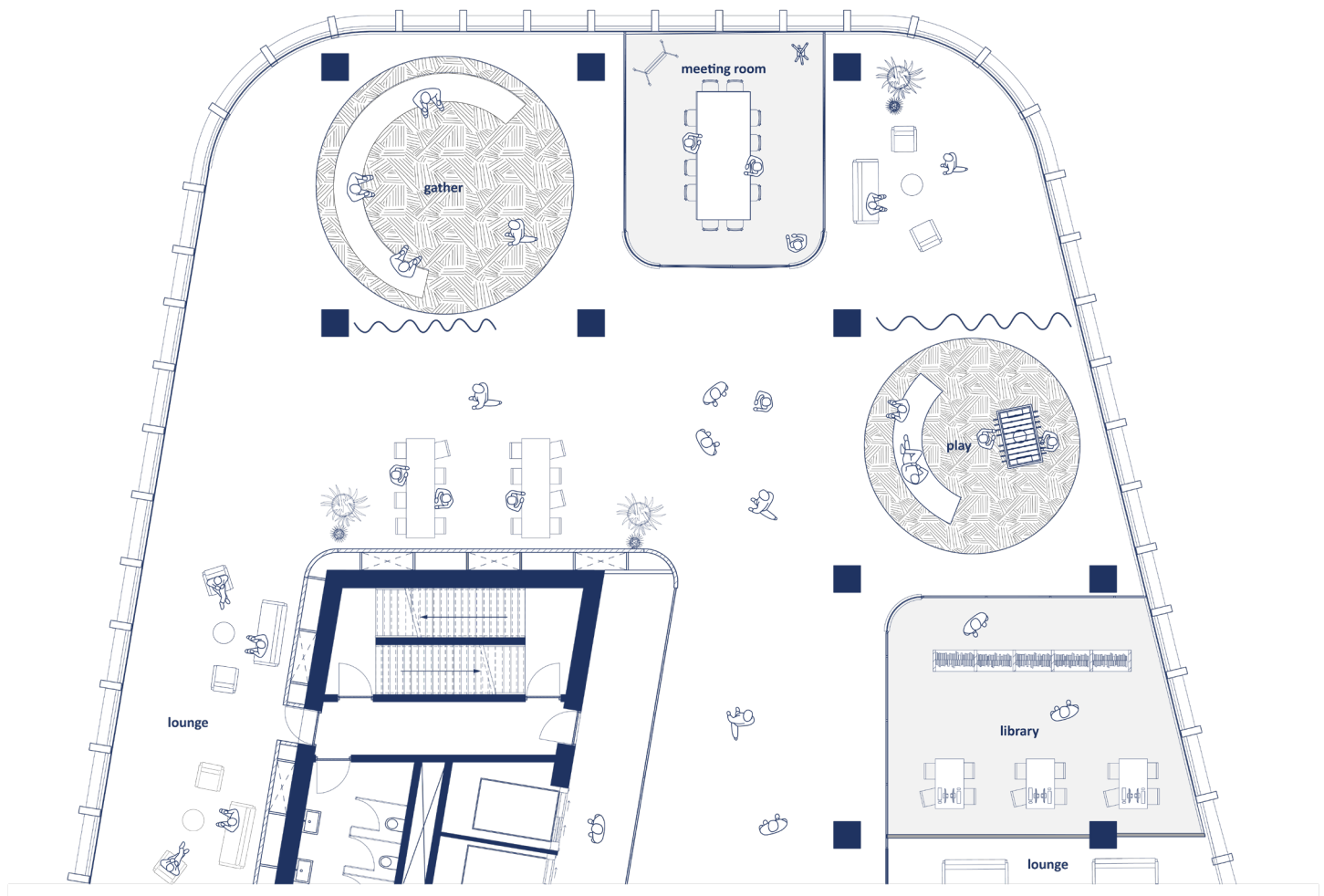
The skybar is the crown of the building. Having a setback that allows to have a 360 view around the city and park by the use of a complete glazed facade.





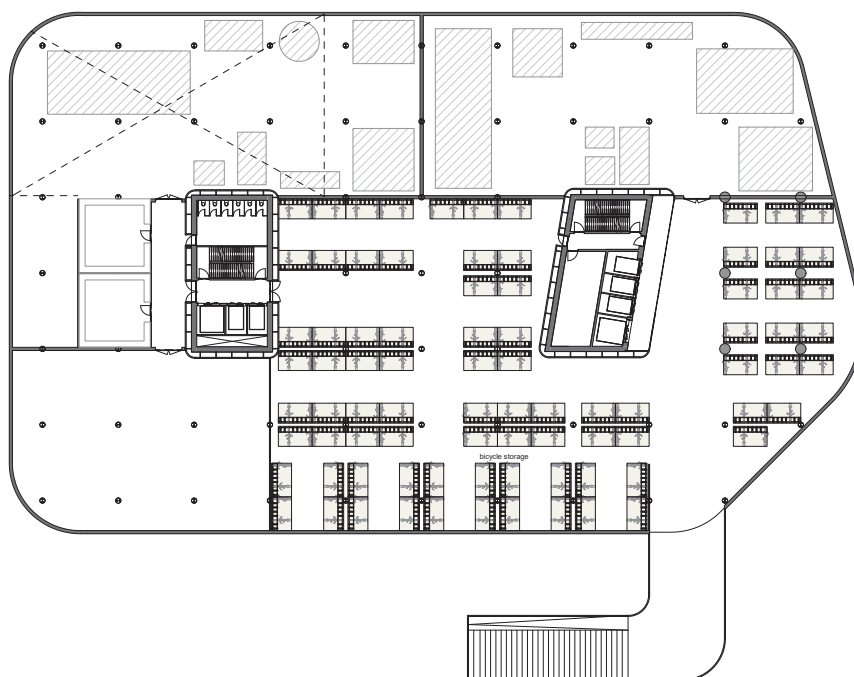
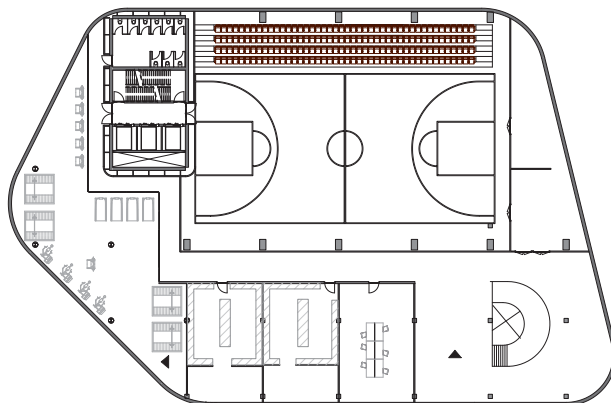
Cafe/Canteen

typical floorplan



The workhub is located on the fourteenth floor. A place where formal and informal functions meet, this is the university and the office. It has different types of presentation spaces combined with seating, small library and play lounges. Stimulating a break at the workhub for the office and university.

BASEMENT



The underground public parking is here located combined with storage, installation, a workshop space and the sport hall combined with fitness.

UNIVERSITY ENTRANCE





EXHIBITION - MUSEUM



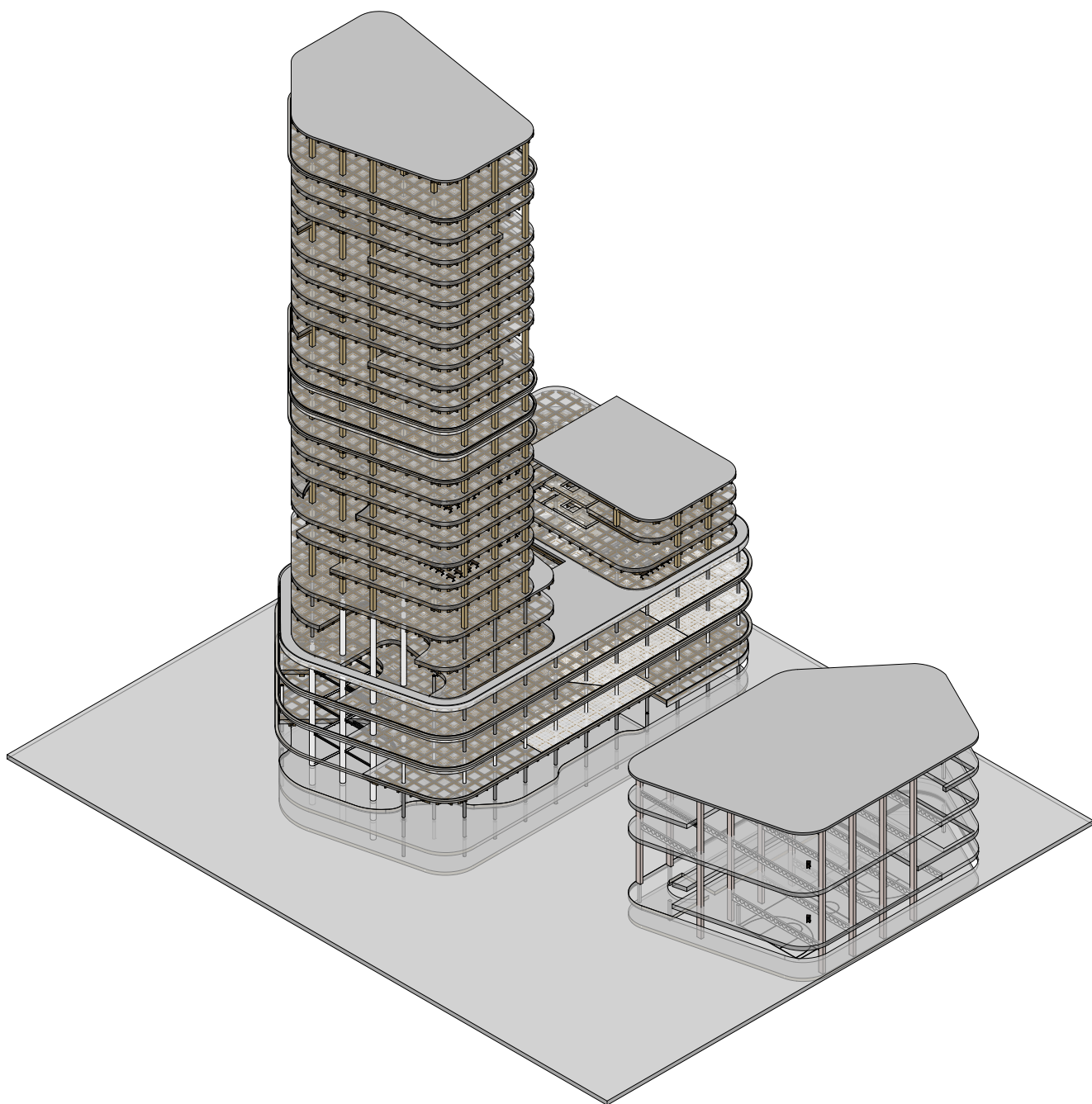


BUILDING TECHNOLOGY

06

STRUCTURE

This chapter explains what research is done for this buildings. For the structure I did a lot of reserach to crea a sustainable building structure. However, projects in CLT of this scal is a very new develepment. Therfor I used reference projects, (the highest in the world right now) the rule of thum and also a CO2 footprint. To have a look what impact CLT, steel and cocrete have when used in the project.



GRID OPTIONS

Multiplied by 3

6 x 6

Smaller grid, used in housing.
Program asks for larger open space.
However no beams needed.

7.2 x 8.1

The inbetween where open space and
sizing of the structure are in balance.
However, square grid is preferred.

6.3 x 8.1

Rectangular grid, orientated in
the length of the building. Saves
thickness floor, short orientation.

8.1 x 8.1

Large grid with a lot of useable
space. However, losing space by
the beams and placement of the
columns.

7.2 x 7.2

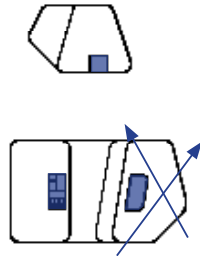
The inbetween where open space
and sizing of the structure are in
balance.
Beams are needed.

9 x 9

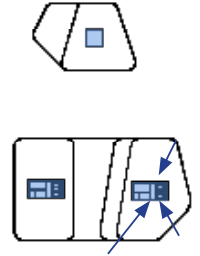
Large grid with a lot of useable
space. However, losing space by
the beams and placement of the
columns.

CORE

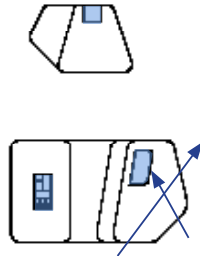
- Central position
- Close to each other.
- Visibility entrance preserved.
- Top core orientated towards square
- **Space between core and facade is tight.**



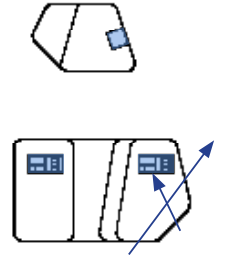
- Main building blocking both connections
- Cores are not stable for the structure.
- Top core limits the lecture hall position



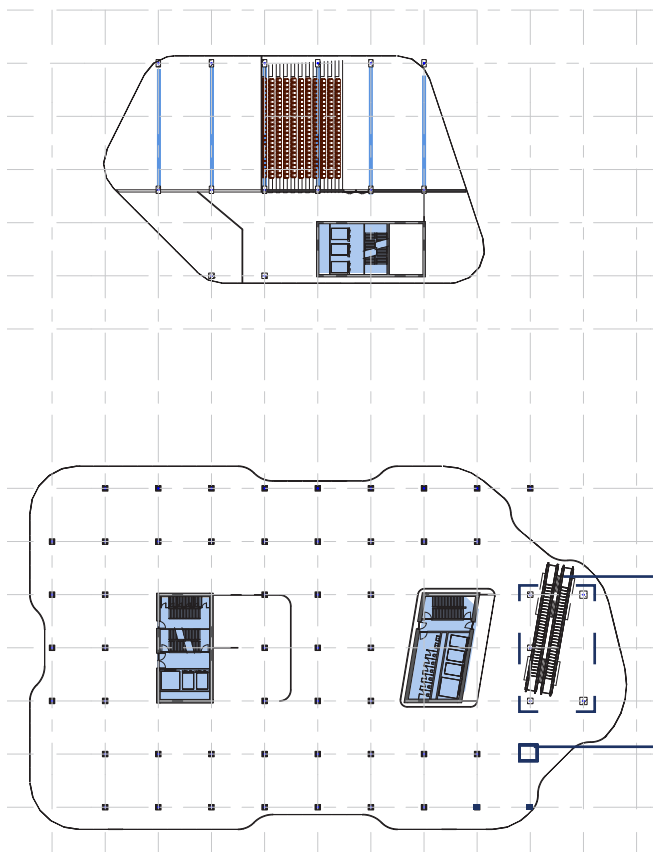
- Dividing the floorplan, left core.
- Top one core on the wrong side square
- Blocking view entrance
- **Core not positioned correct**



- Cores positioned correct, however not stable now
- Top core could be, however blocks view park.



GRID



7.2 x 18
theater and sport

7.2 x 7.2
For the general building

Using the same grid in the whole building. Office and university needs flexibility and future development.

Extra heavy, due to height

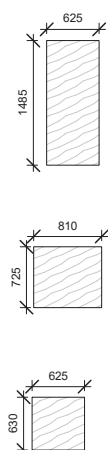
Removed due to entrance

Mjøstårnet Norway

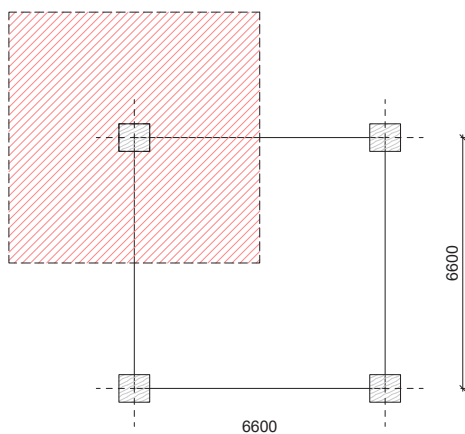
Grid 6600 x 6600 mm

Function: Office

3 types of columns



Supporting field



Floorplan size: 17m x 37m

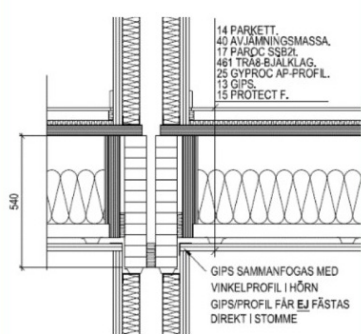
Amount of floors:18

Floor height: 3.8m-4.0m

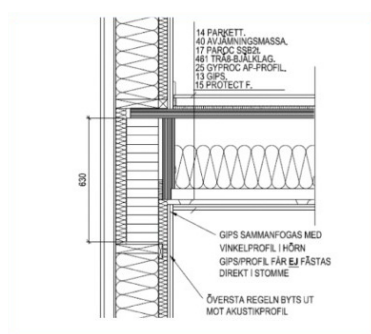
Beams

(395 x 585mm)

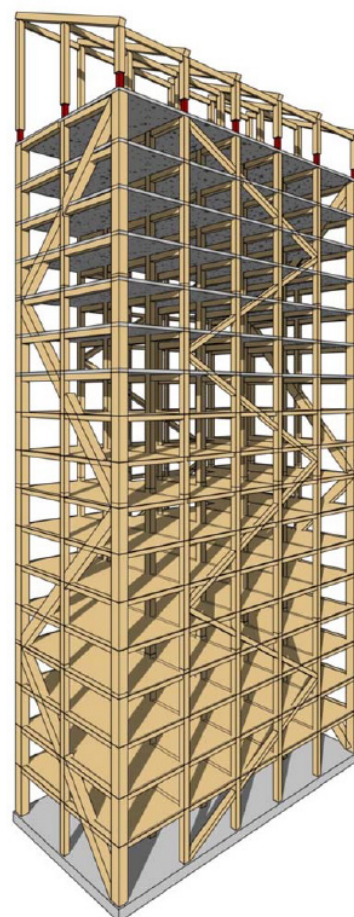
Floor Trä8



Sound reduction by the use of seperated floors.



Hollow structure



SPÄNNVIDDSTABELL

Bjälklagstjocklek vid bostad, nyttig last 2,0 kN/m² (egentyngd innerväggar 0,5 kN/m², installationslast 0,15 kN/m²)

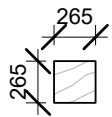
Spännvidd (m)	Kassetthöjd (mm)	Inklusive pågjutning och gipstak på akustikprofil (mm)	Total vikt / m² inkl. pågjutning och gips (kg/m²)
4	345	455	163
4,5	345	455	163
5	345	455	163
5,5	345	455	163
6	390	500	166
6,5	390	500	166
7	435	545	169
7,5	435	545	169
8	480	590	172

Brock Commons Canada

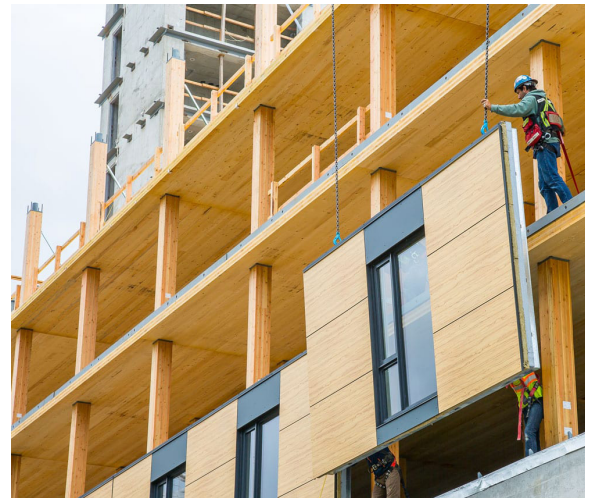
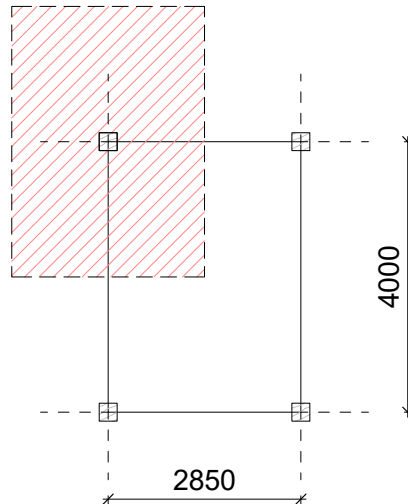
Grid 4000x 2850 mm

Function: Housing

3 types of colums



Supporting field



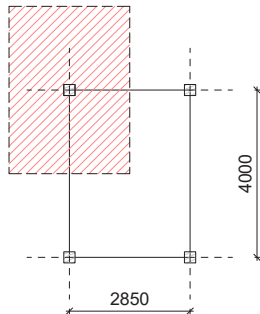
Grid: 4x2.85m

Columns between 265x265mm and 265x215mm

Core: 450mm concrete

Inbetween 7m -7.5m gives 545mm
thickness including sound acoustics
and finishing.

SCALING



Square meters= 11.4m²

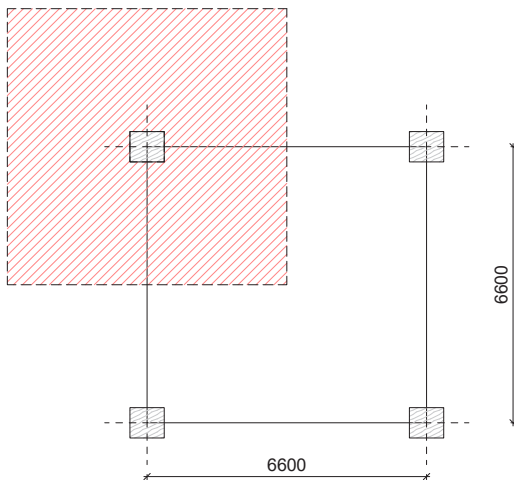
Columns= 265 x 265 mm

Scaled to 7.2= (51.8m²) is x 4.5

Scaled to 6.6= (43.5m²) is x 3.8

Gives= 1200 x 1200 mm for 7.2m

Gives= 1000 x 1000 mm for 6.6m



Square meters= 43.5m²

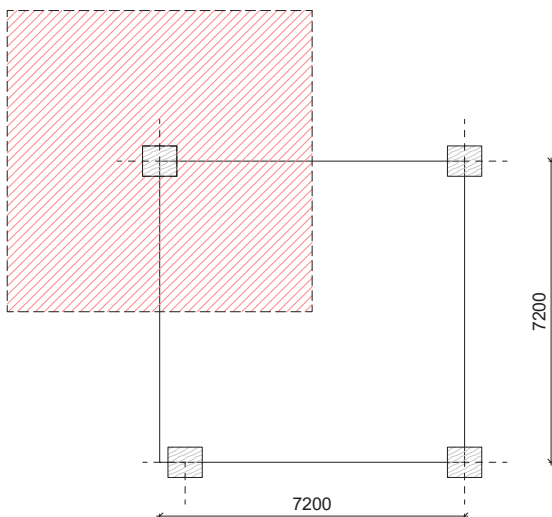
Columns= 625 x 625 mm

Scaled to 7.2= (51.8m²) is x 1.2

Scaled to 2.85= (11.4m²) is x0.26

Gives= 750 x 750 mm for 7.2m

Gives= 163 x 163 mm for 2.8m



Average between 750-1200 is 975 mm

Chosen for weight is 800x 800 top floors and 900x900 bottom floors because the 750 is more to the original sizing

Rule of thumb

Column Concrete

Width = Length/12 or L/15
Height 6m plint area

between 500x500 and 400x400

Width = Length/12 or L/15
Height 5m top plint area

between 420x420 and 330x330

Width = Length/10 or L/12
Height 3m Tower

between 300x300 and 250x250

All sizes without extra top weight

Beam Concrete

Height = Length x 1/20
Length grid = 7.2m

Height = 360 mm
Width= height x 1/2 or 1/3

Width= 180mm or 120 mm

Column steel

Width = Length/20 or L/25
Height 6m plint area

between 300x300 and 240x240

Width = Length/20 or L/25
Height 5m top plint area

between 250x250 and 200x200

Width = Length/20 or L/25
Height 3m Tower

between 150x150 and 120x1200

All sizes without extra top weight

Beam Steel

Height = Length x 1/15 or 1/20
Length grid = 7.2m

Height =480 mm or 360mm

HEA500? or 450

Rule of thumb

CLT beams

Wood spans = Length x 1/20

Grid is 7.2 overspan

$7.2 \times 1/20 = 360\text{mm}$ for a regular wood beam

$7.2 \times 1/17 = 420\text{ mm}$ for CLT wood

Width = 1/3 or 1/4 x height

90-120 or 105-140mm width

Beams Concrete

Height = Length x 1/20

Grid is 7.2 overspan

$7.2 \times 1/20 = 360\text{ mm}$

Column Concrete

Size = Length x 1/12

Height 3m

$3 \times 1/12 = 250\text{ mm} \times 250\text{ mm}$

Spans = Length x 1/12

Height 6m

$6 \times 1/12 = 500\text{ mm} \times 500\text{ mm}$

Bottom weight is higher so will be 750x750 mm tower and 400x400 normal 3m columns due to top weight

Column CLT

Width = Length /20

Height 3-6 meter

3 or 6/20 =150 or 300 mm for a regular wood

Floor CLT

CLT doesn't overspan more than 6m, therefore a hybrid system is used

Floor Concrete

hollow core slab floor

Height= 1/35 x length

Height= 205mm

Used 200 or 260 but 260 is too big

The flooring is mostly wood. However, there are some exceptions. Such as the lecture halls and the basements.

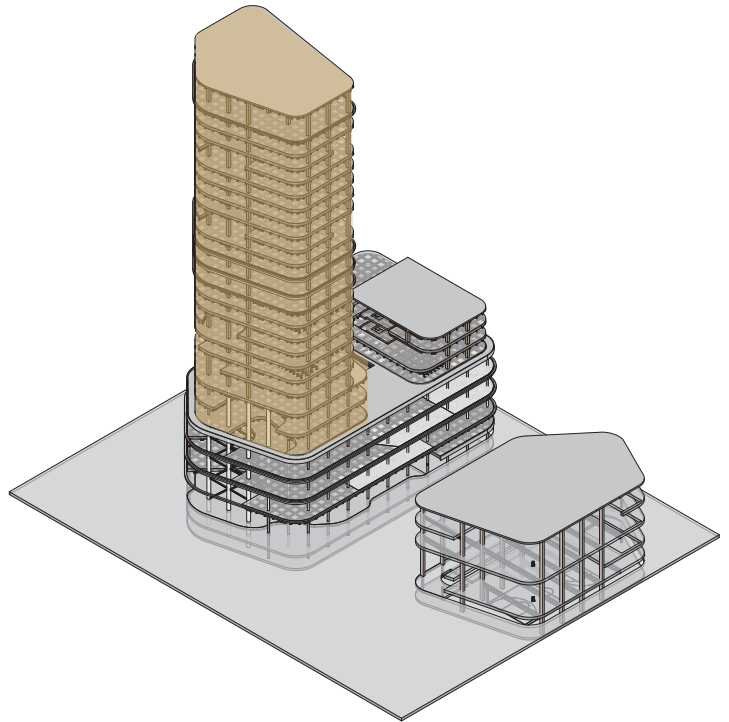
Scaling CLT

BROCK COMMONS	Beams	Column	Floor
	Not found	Grid= 2.850 x 4.000 mm Total square= 11.4m ² Columns= 265 x 265 mm Scaled to 7.2= (51.8)is x 4.5 and (43.5) is x 3.8 Gives= 1200 x 1200 mm or 1000 x 1000mm	Not found
	Mjøstårnet	Grid= 6.600 x 6.600 mm Total square= 43.50 m ² Columns= 625 x 625 mm Scaled to 7.2= (51.8)is x 1.2 Gives= 750 x 750 mm	545mm thickness including sound acoustics and finishing.
	Rule of thumb	Width = Length /20 Grid is 7.2 overspan 7.2/20 =360 x 360 mm for a regular wood	Not found
	Final	Between 1200 x 1200 and 750 x 750 Chosen for weight is 800x 800 top floors and 900x900 bottem floors because the 750 is more to the original sizing	Minimal of 545mm and CLT is 435mm the rest is finishing

Final structure

Structure

The building technology concept is transparent in its translated by the visibility of the structure. The concept is prefabricated and repetitive in a certain way. Starting with the materiality.



Floorplan

The regular grid doesn't fully fulfill the curved shape of the building. The waffle structure combined with the IPE and edge columns help to support the overhang and weight of the facade. Creating a stable structure.

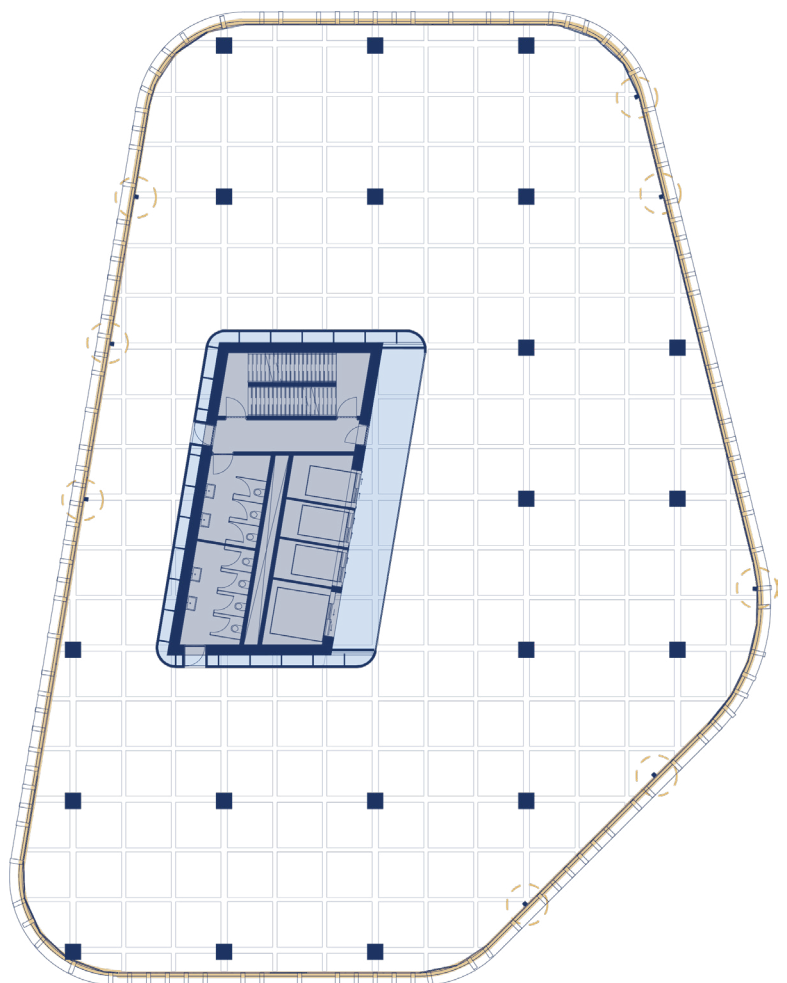
The core houses the elevators, restrooms, emergency exits and the main installation shaft. However, due to the decentralised ventilations system combined with the rounded edges of the building. An outer layer is created around the core to fulfill be used as storage, shafts and esthetic.

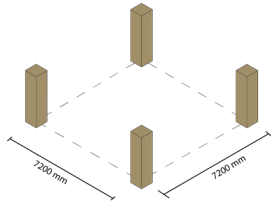
Over view tower:

FLOOR= Hybrid CLT floor 545mm
 Max 1000-3000mm overhang and steel square colums
 CLT Beam= 435x 585mm
 Steel edbebeem Beam =IPE 400

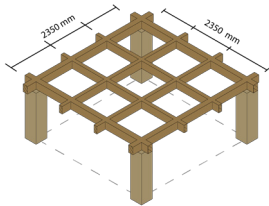
Overview columns tower

CLT Columns = between 800x800 and 900 x900 (3-4m)
 CLT Columns = double floor 1000 x 1000mm (6-8)
 Concrete Columns = 3m gives 400 x 400 mm
 Concrete Columns = 6m gives 750 x 750 mm
 Concrete Columns = 6m gives 750 x 750 mm
 Concrete Columns = 12m gives 1000mm
 Concrete Columns = 25m gives or steel is an option

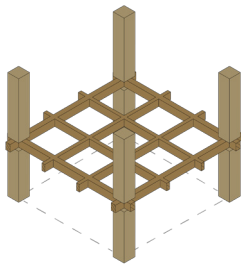




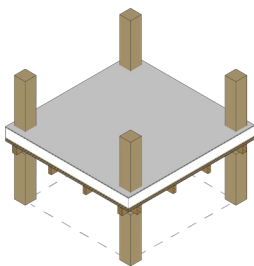
The base shape of the building is divided into a 7200 by 7200 grid. This is larger than the regular grid we know for CLT, which is 6000x6000. However, it doesn't mean it isn't used in projects.



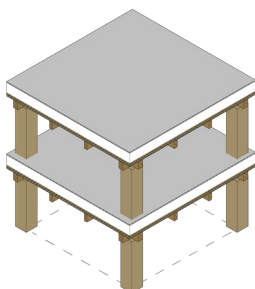
A waffle structure is used for the beam structure. The structure functions as one connected slab, which creates stiffness, providing the opportunity to create voids and overhang. The height is 450mm and 2400 mm C-C span



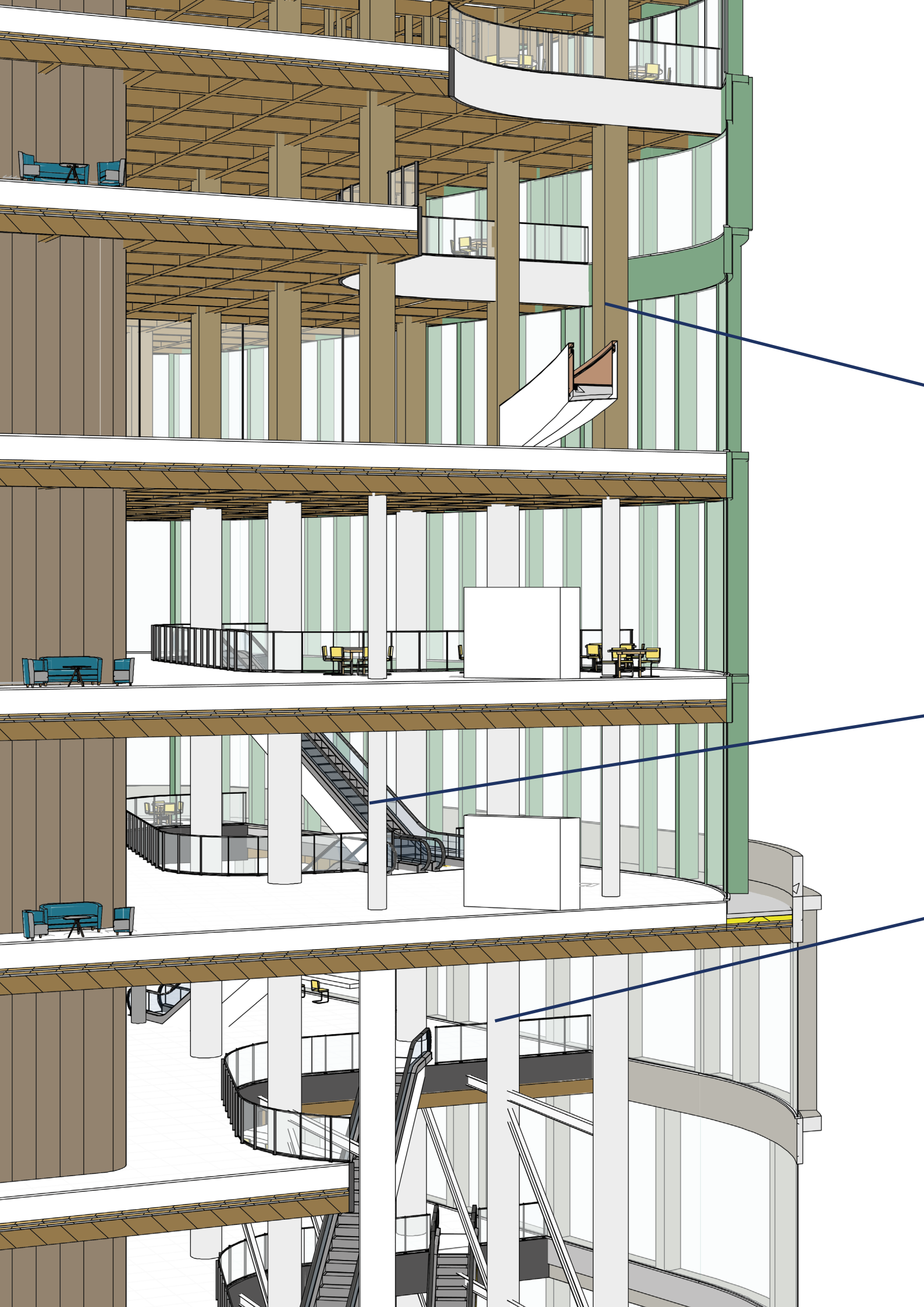
The columns are stacked by the use of a steel connection which consists of two steel tubes that slide over each other.

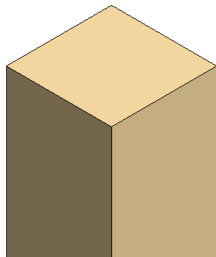


The floor is 200mm CLT because of the small overspan of 2400mm and the top floor is elevated to store the ventilation and installation.



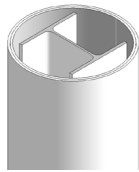
This process is repeated for the towers on top of the plinth in the project.





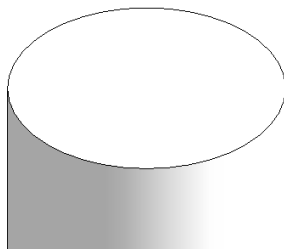
CLT structure:

- 750 x750 mm
- towers only



Steel structure:

- HEA300 + Round cast
- Plinth, up to 4th floor



Concrete structure:

- 1000 mm
- 6 Entrance columns

Structure

The building technology concept is transparent in its translated by the visibility of the structure. The concept is prefabricated and repetitive in a certain way. Starting with the materiality.

Span = 18m
Height = 6-9-11mm

This will use a concrete box in box design. Concrete is used for the absorbtion of sound in this building

Height 6m:

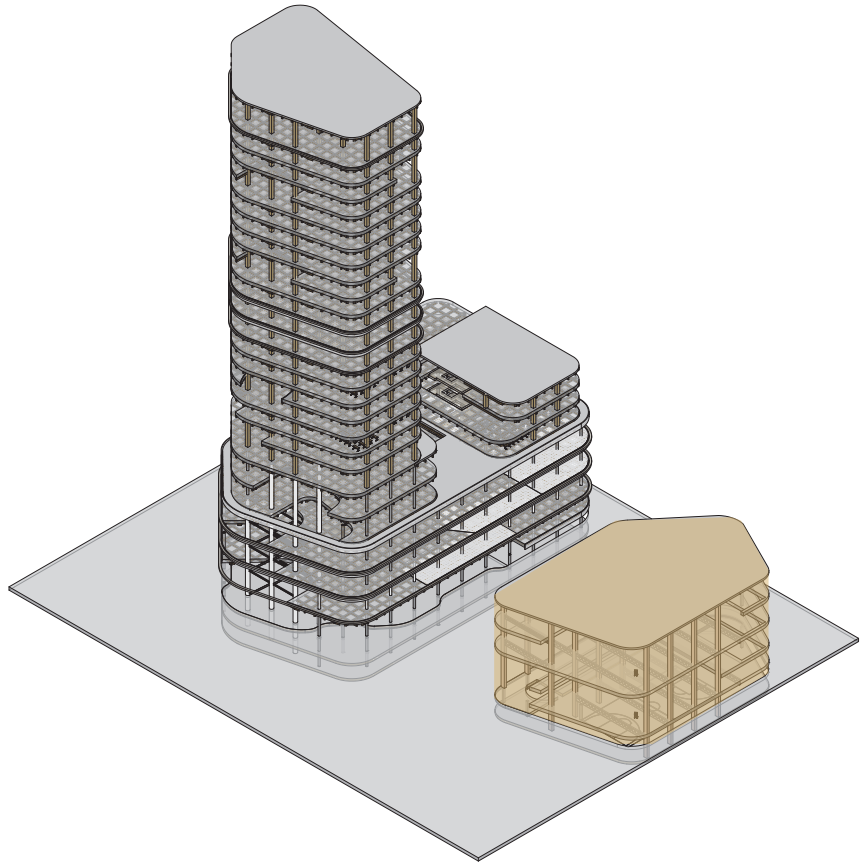
Colum= Size = Length x 1/12
 $6 \times 1/12 = 500 \text{ mm} \times 500 \text{ mm}$

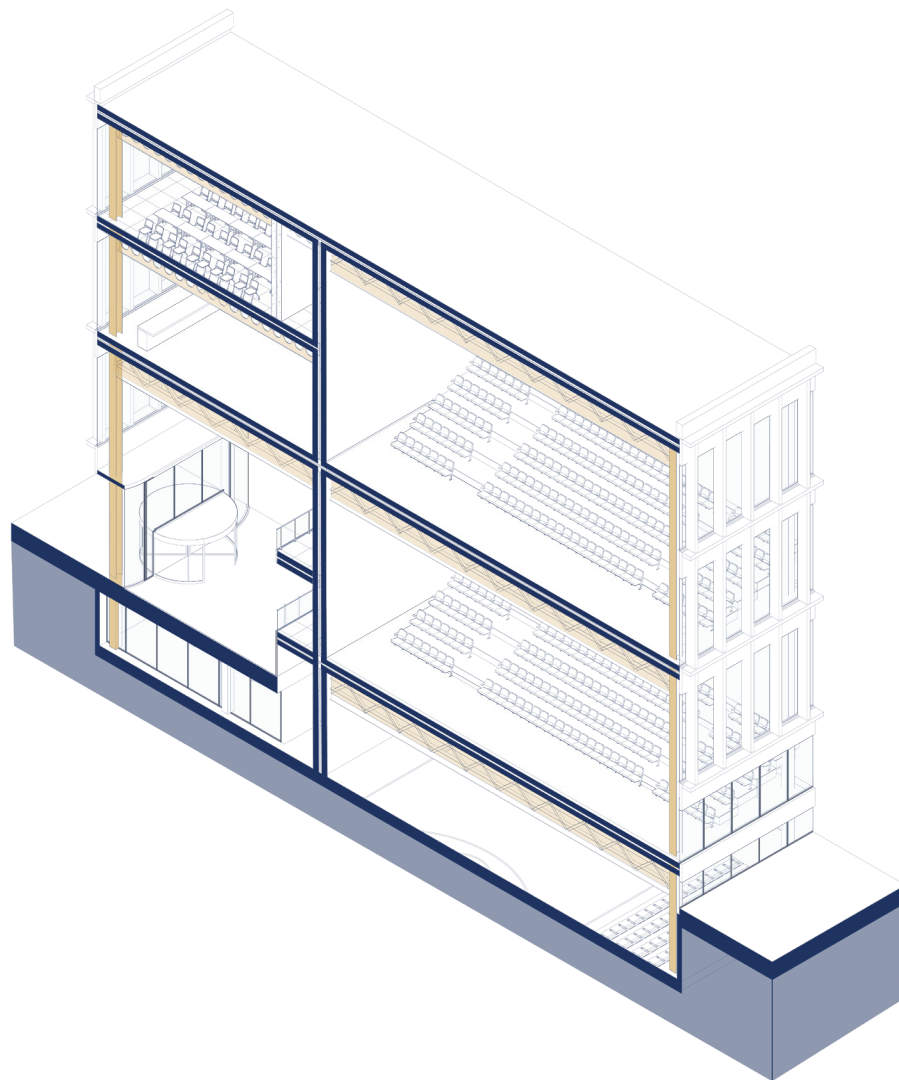
Height 9m:

Colum= Size = Length x 1/12
 $6 \times 1/12 = 750 \text{ mm} \times 750 \text{ mm}$

Height 11m:

Colum= Size = Length x 1/12
 $6 \times 1/12 = 920 \text{ mm} \times 920 \text{ mm}$



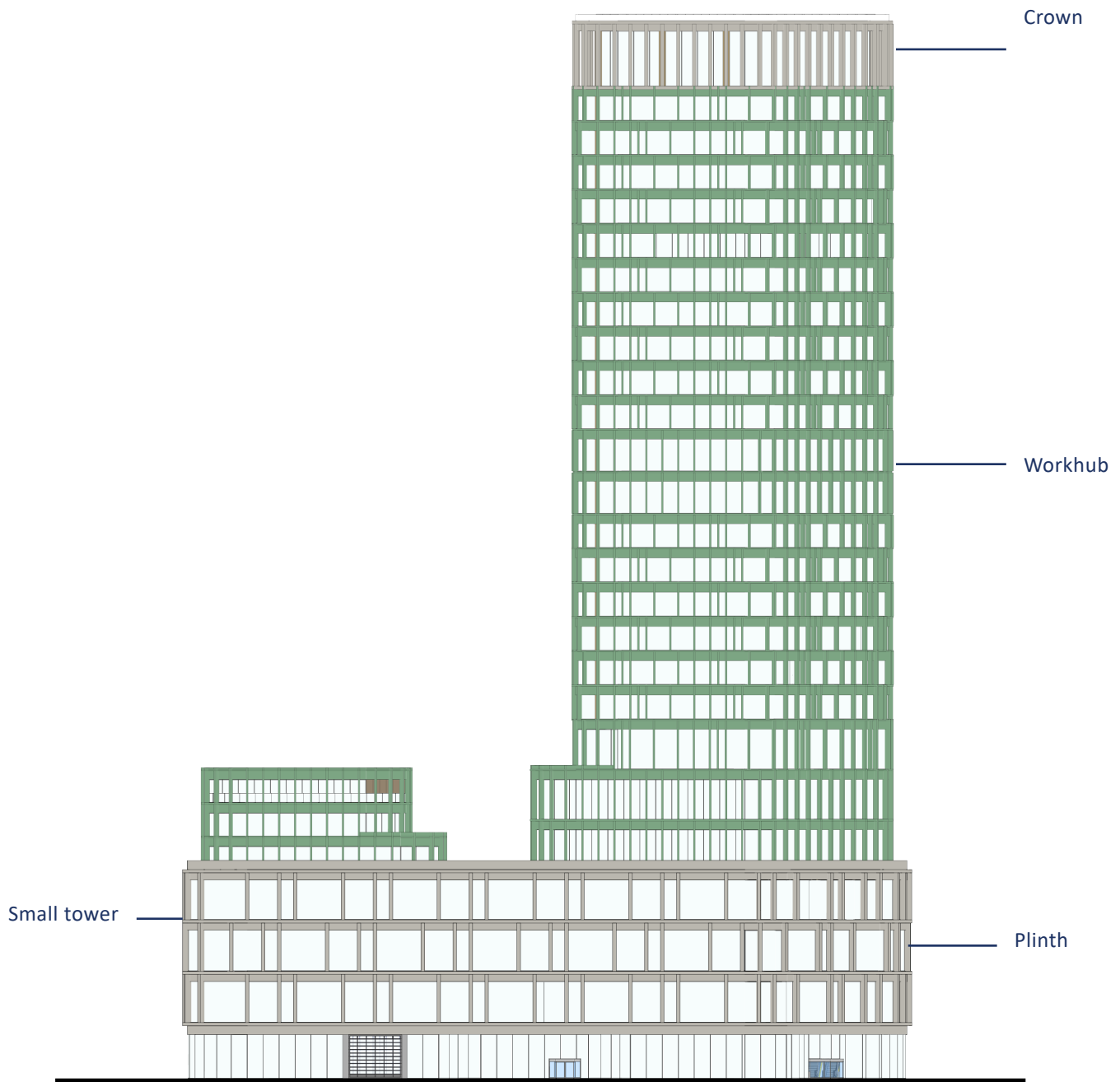


This building has the same ground rules as the main tower. The grid is multiplied because of the large open space that is needed for sport and theater. For the theater, a concrete box in box method is used to ensure a soundproof environment combined with trusses

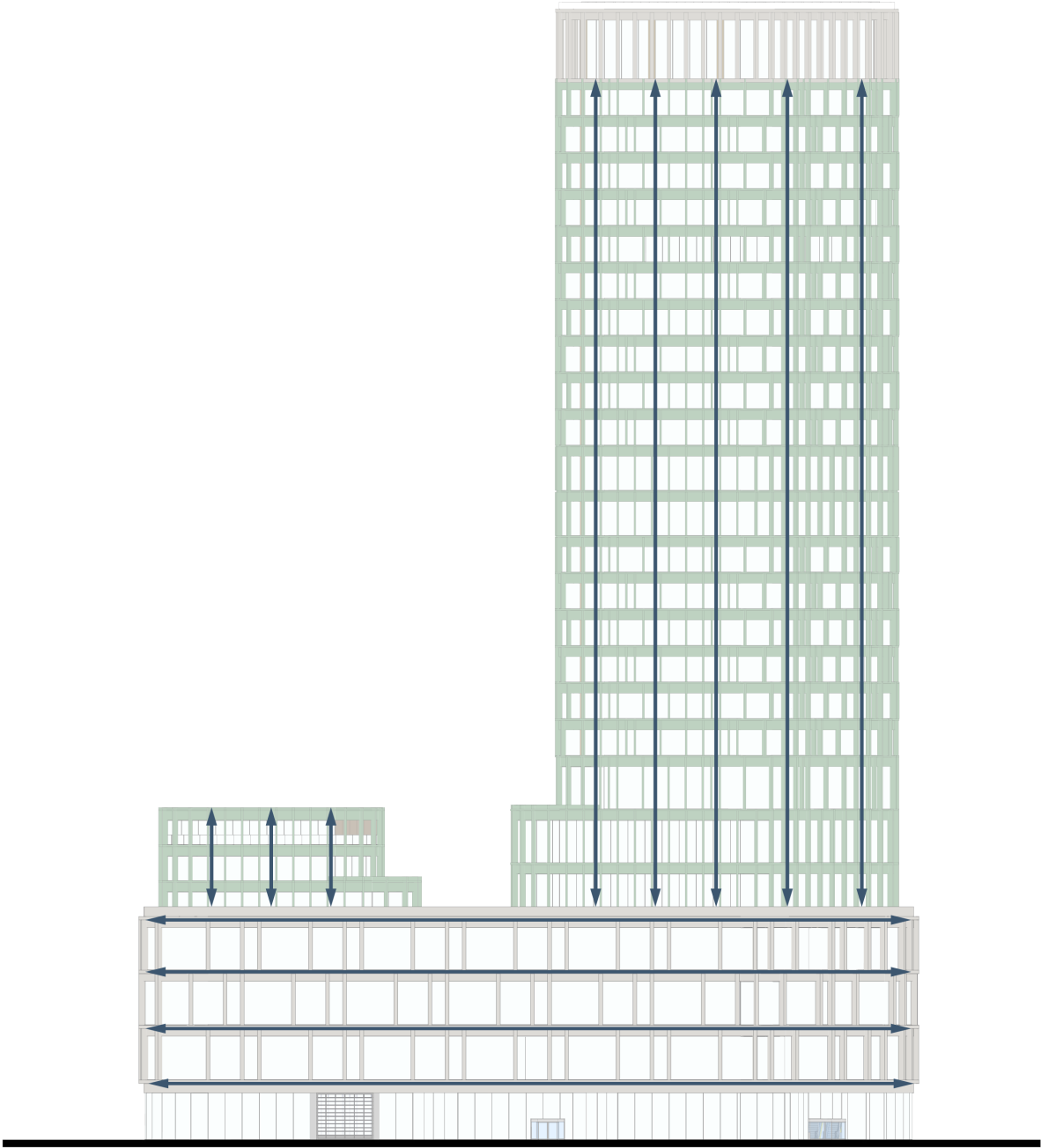
Materiality

The building is made from Terrazzo composite, which is a concrete mix combined with recycled concrete granulate. This material comes in many colors. Besides the rhythm there is also a division in material as said before. The plinth will be in a light grey which fits the buildings on the stadium side of the city. The towers will be in a green terrazzo for two reasons. The first one is to be iconic in the skyline of the Hague. All buildings are in white or brick colors. The second reason has to do with the connection with the park. Standing tall as a tree. The secondary building is also in the green terrazzo because it is placed towards the park and is used to create an in-between in the new flow from the station to the city.

Using the pros of the Terrazzo tiles as an advantage to improve prefabricated facade panels and creating a repetited facade. In the following pages, it is described in more detail how this works technically.

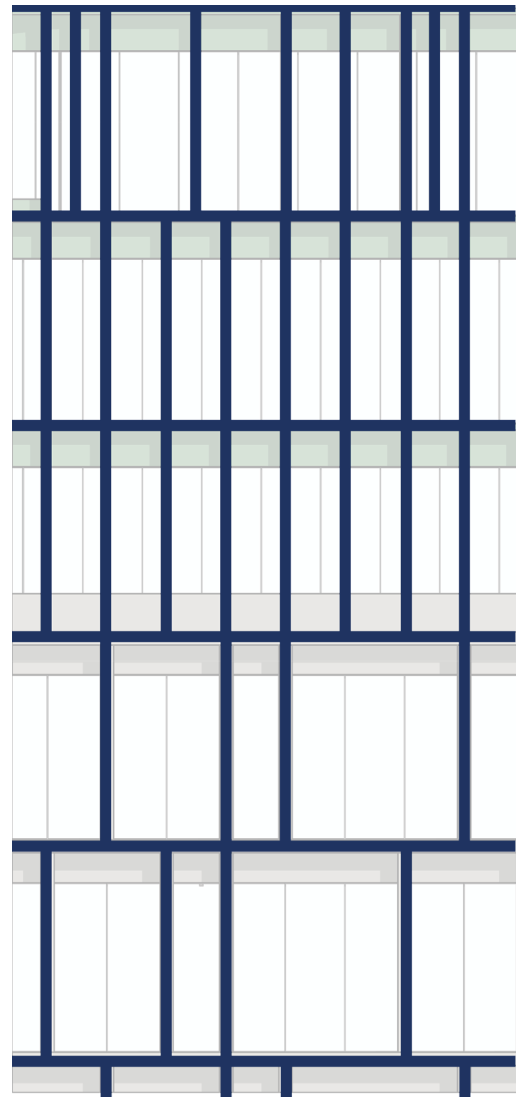
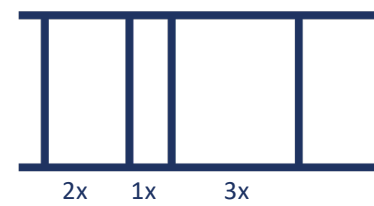
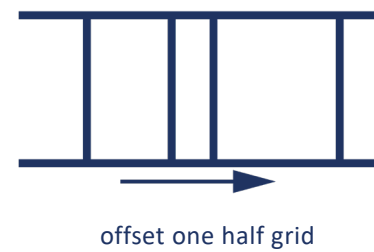


FACADE DIVISION



Horizontal orientation combined with vertical

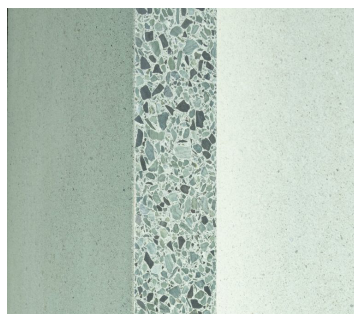
FACADE RHYTHM



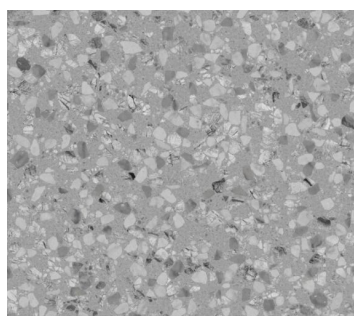
Facade material

In the image on the right you see how the material is divided over the building. The façade will be made from terrazzo composite. This is a concrete mix with recycled concrete granulate and it comes in lots of different colors. The plinth will be in a light grey which fits the buildings on the stadium side of the city. The towers will be in a green terrazzo for 2 reasons.

The first one is to be iconic in the skyline of the Hague. All buildings are in white or brick colors. The second reason has to do with the connection with the park. Standing tall as a tree. The secondary building is also in the green terrazzo because it is placed towards the park and is used to create an in-between in the new flow from the station to the city.



Terrazzo composiet



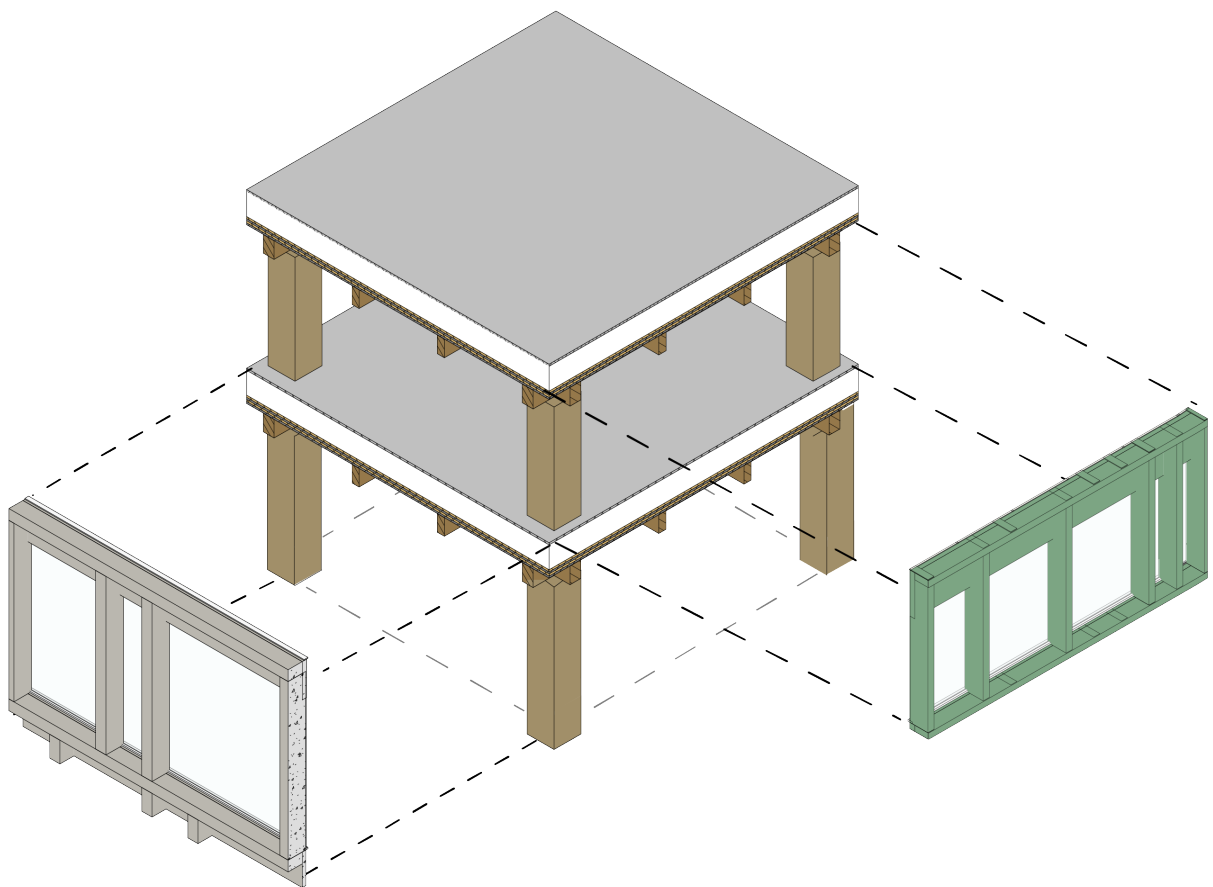
Oscuro terrazzo



Prefabrication

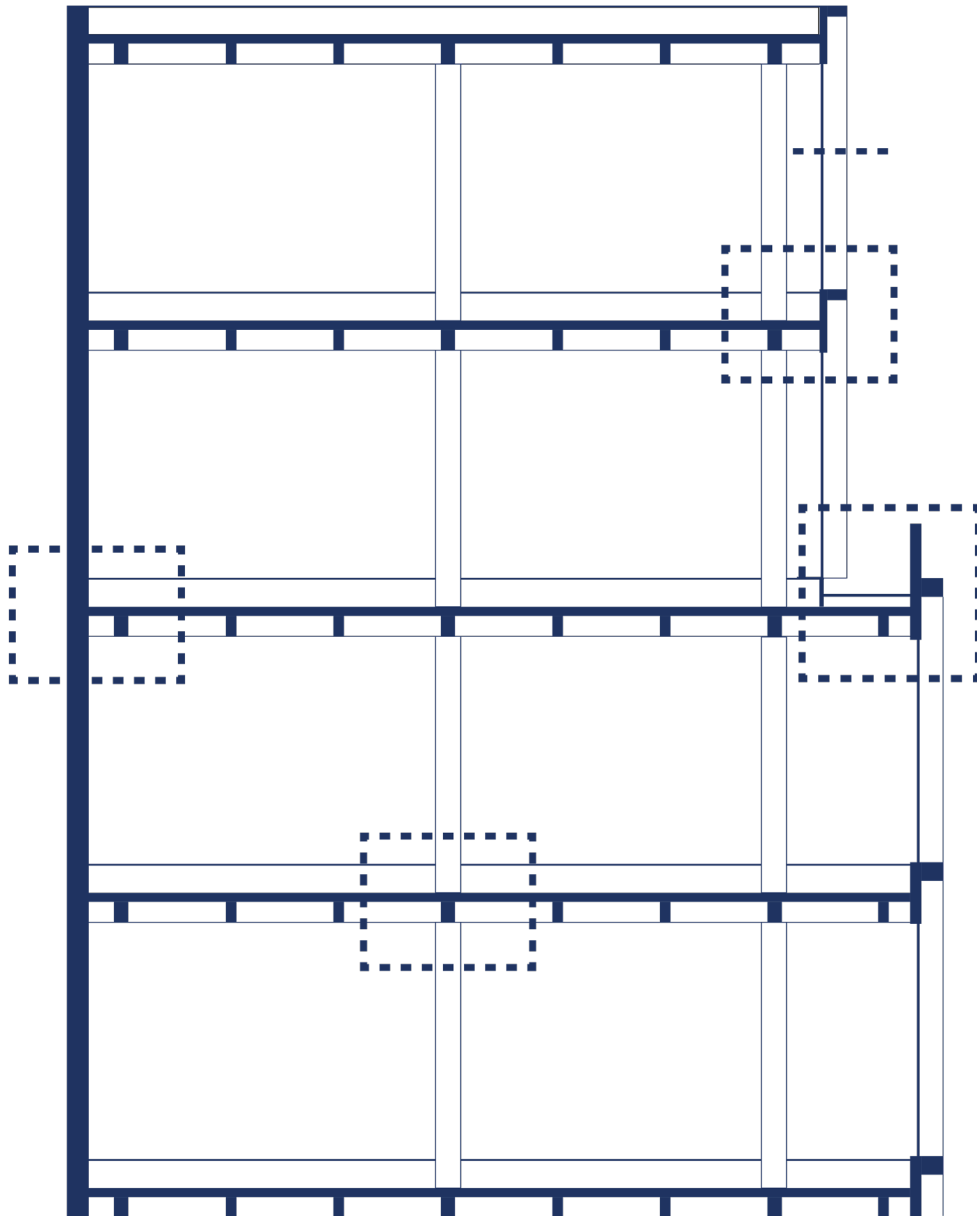
The facade consist out of repetitive panels, switching in sizes to create places where open or more framed views around the building. This can be achieved because of the use of terrazzo tiles. Thes tiles are prefabricated and mounted on the building.

The repetition of the facade allows to speed up the building process.



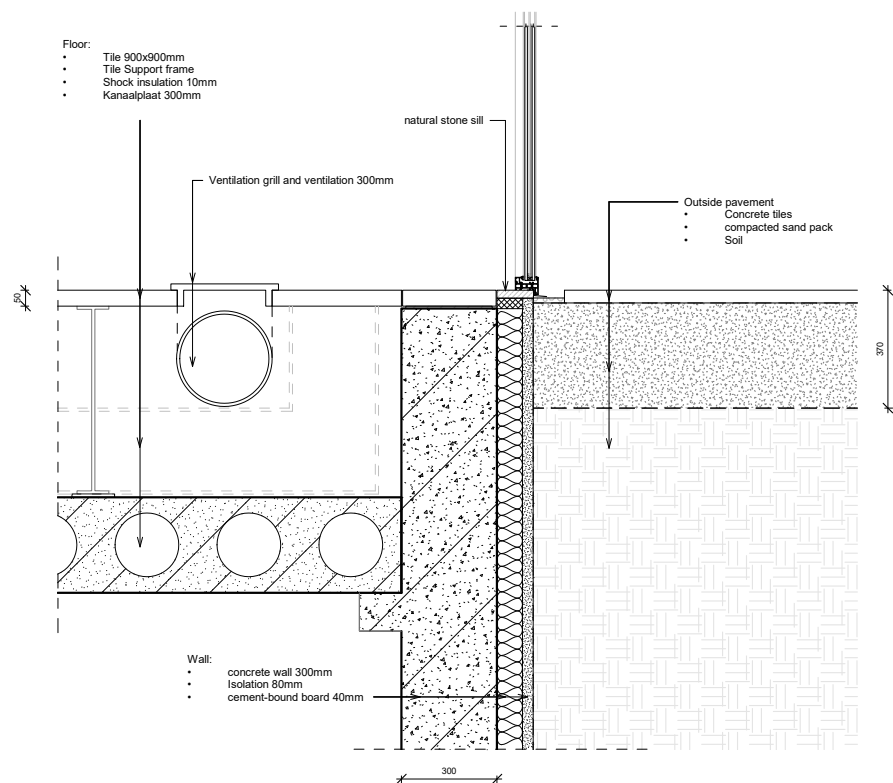
Changing rhythm and different profile thicknesses

Details



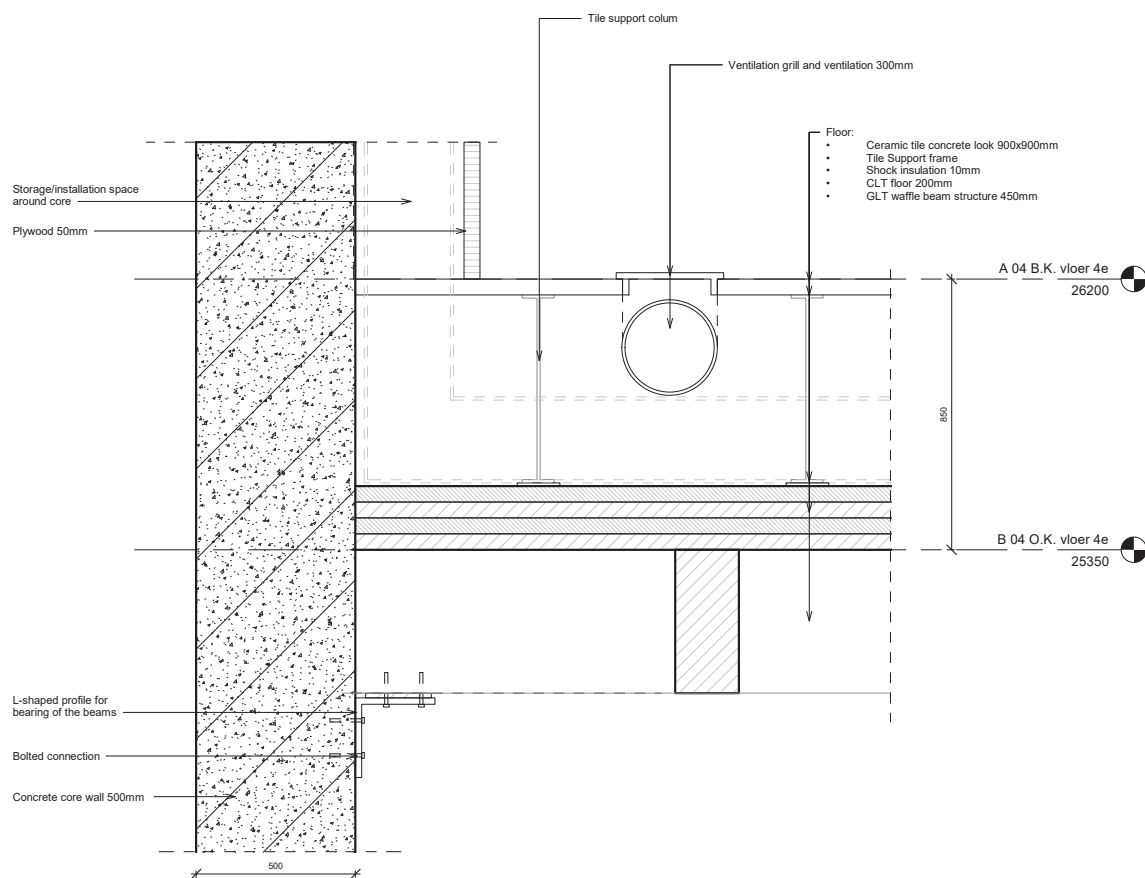
Ground floor detail

The basement of the building is made from concrete. Supporting the weight of the building, combined with isolating from the groundfloor. The basement has a chanel flooring combined with 300 mm concrete walls that are isolated on the outside. These measurements help to prevent heat loss and create thermal mass. Also important to mention is the horizontal connection in ground floors. The outside floor is layed on a sand base layer and the tiles are not directly connected to the facade. In this way the materials do not directly connect. But also prevent water splash against the facade.



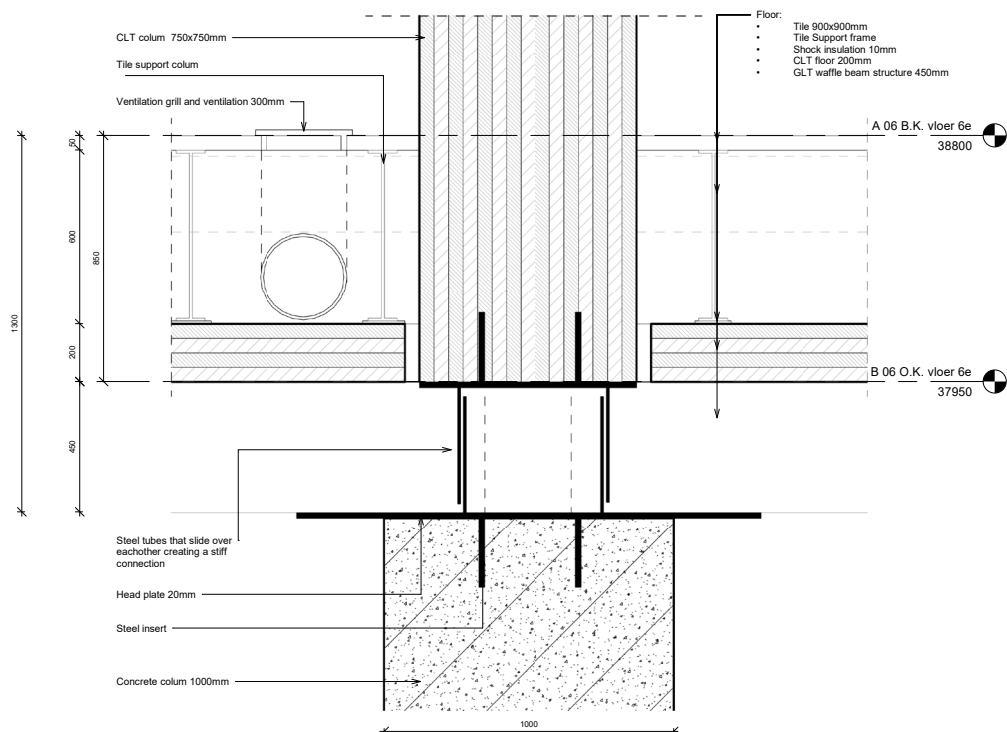
Core detail

This detail shows how the waffle structure is connected to the concrete core. It also shows how the ventilation is diverted from the flooring to the outer layer of the core, the installation space.



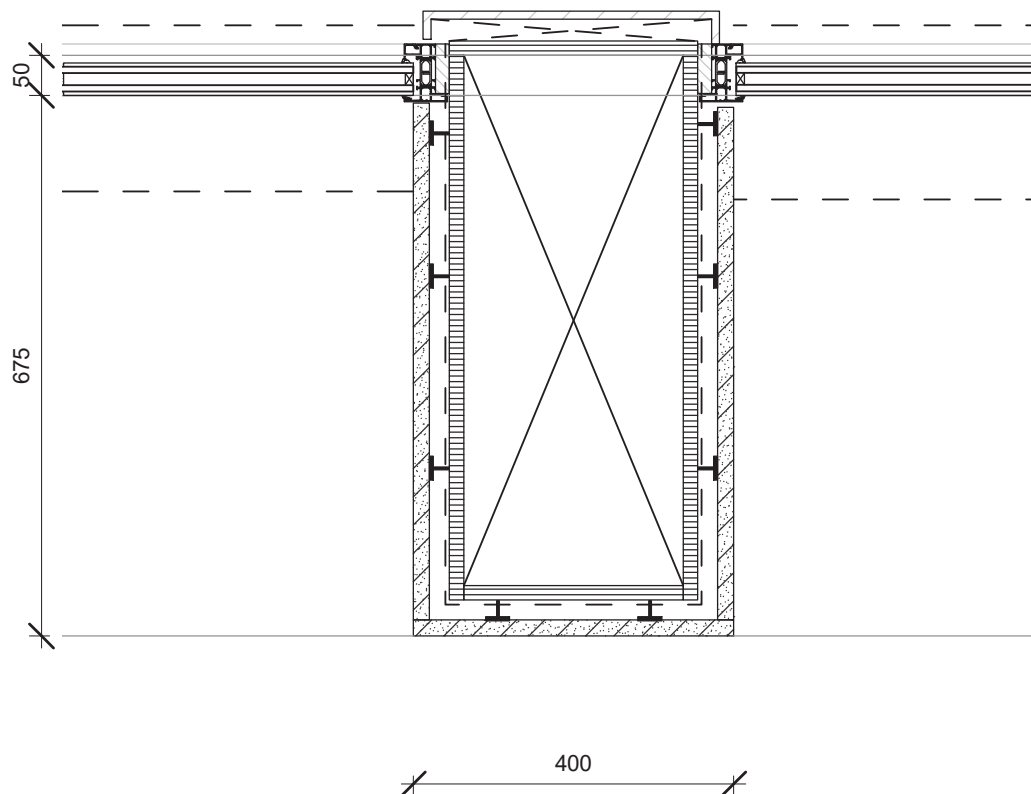
Column connection detail

Because of the enormous height of the entrance, concrete columns were used to support the weight of the tower. Between two columns is a steel connection. The connection consists out of two tubes that slide over each other, creating a stiff connection that can be prefabricated. Allowing for a faster building process and also connecting different types of columns.



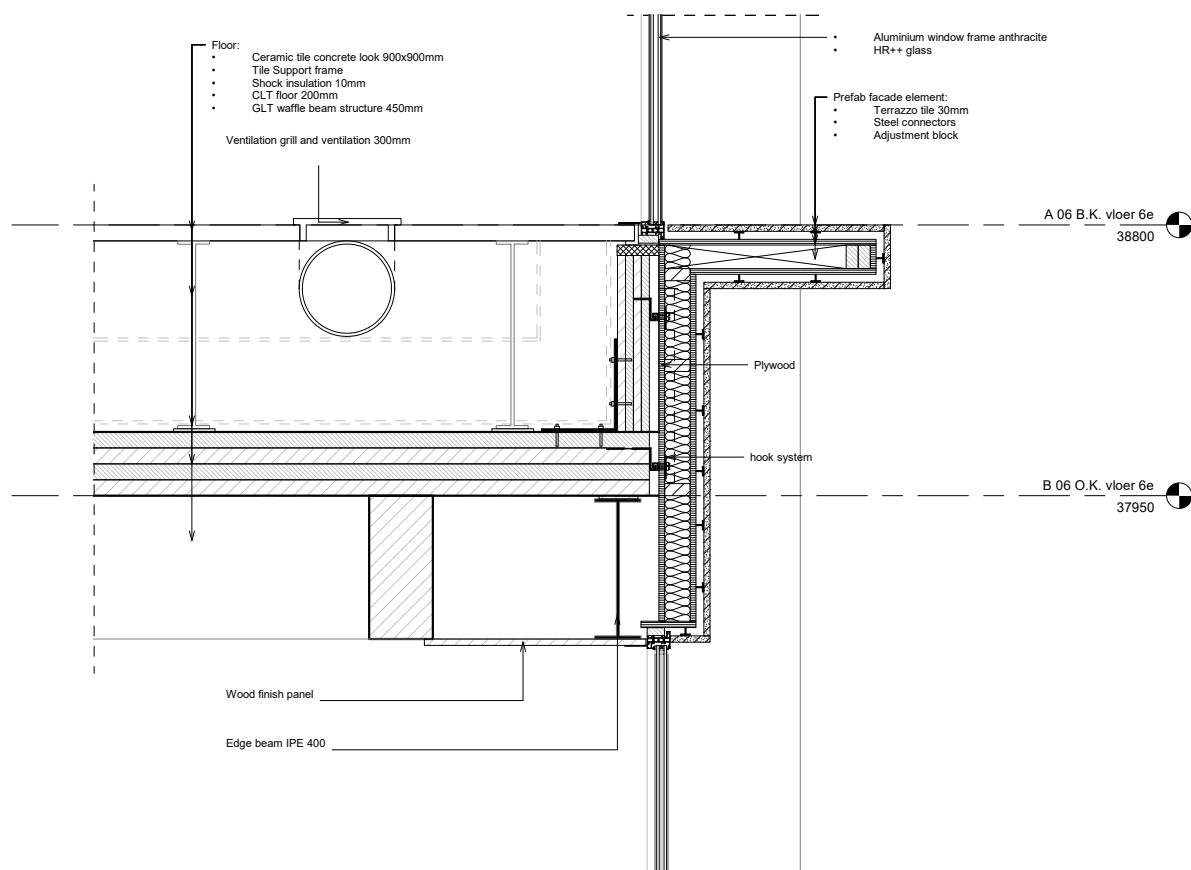
Facade fragment horizontal detail

This detail shows how the vertical slaps allows to have a repetitive prefabricated facade. The slaps are used to open up the facade or create a more closed expierience. The detial also shows how the Terrazzo tiles are attached. They are hung with a system allowing the tile sructure to be replaced easily when needed.



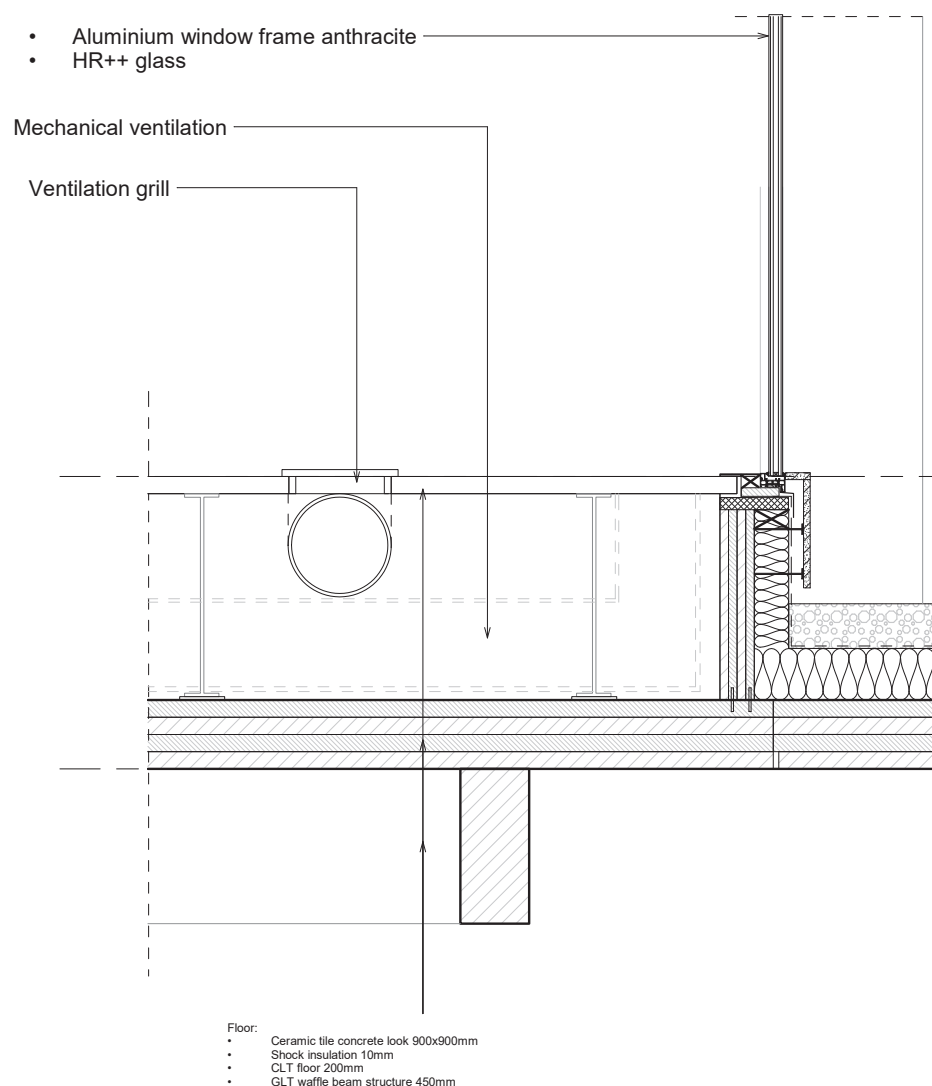
Floor detail

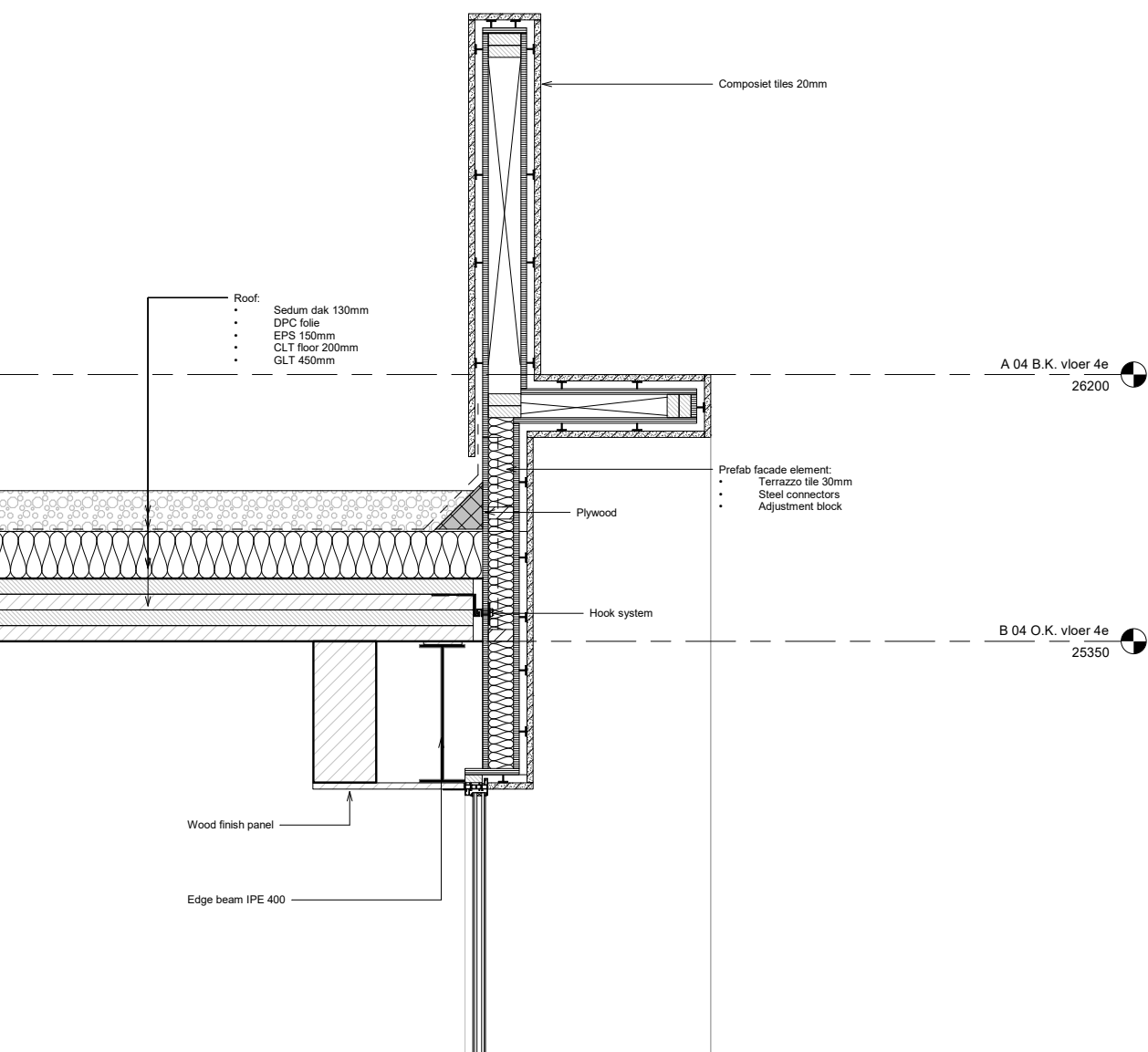
This detail shows the connection on the xx floor. It shows in s detail how the facade connects with the structure of the building. The facade is hung and bolted onto the CLT floor. The overhang of the CLT is supported by the IPE beam and waffle structure to prevent buckling. Between the facade and the IPE beam is an internal sunshading mechanism placed callled ducoscreen.



Roof detail

This details shows the setback connection. The facade is placed with a setback after the third floor, this is where the plinth ends. Due to the elevated floor a height gap between the roof and internal floor appears. This height difference is used for insulation and a sedum roof and to prevent backsplash against the facade panels. Another important aspect is the prefabrication of the facade and therefor also the railing. The plinth facade is extended to connect merge from the facade into a railing.v The whole system is hung to the flooring by the use of an anchor system.





Climate

One of the ambitions was to make a flexible building. A flexible building is a building that is able to change to needs of the users. Allowing for new layouts in the building. Flexibility can be achieved in several ways, but in this case it was achieved by the use of an elevated floor where the ventilation and installation is placed.

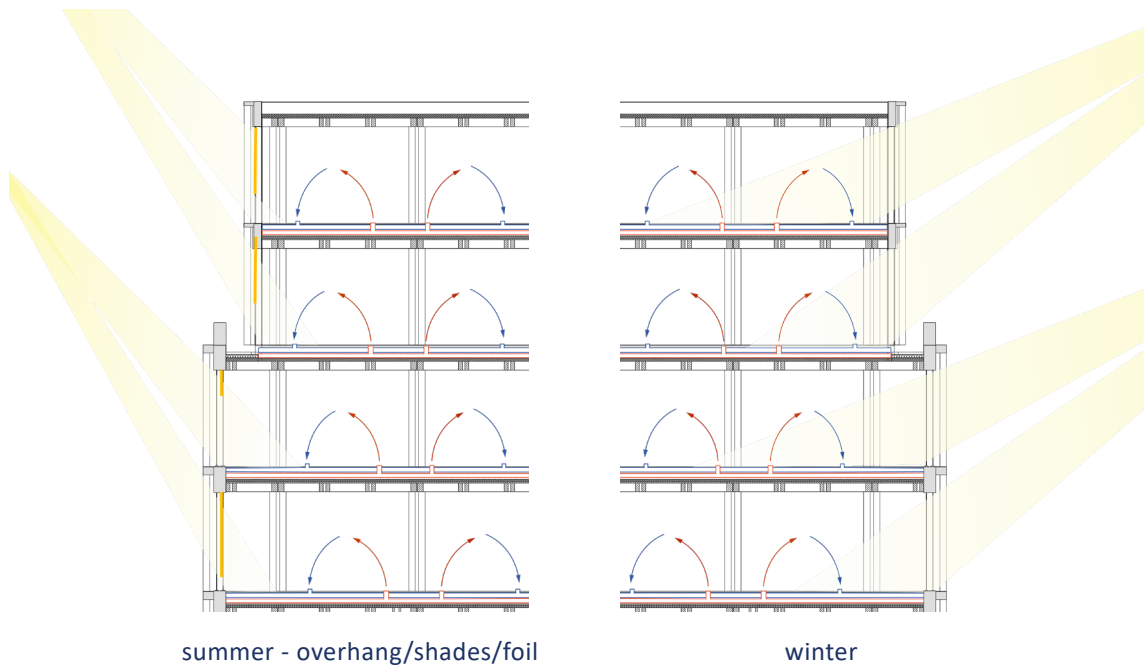
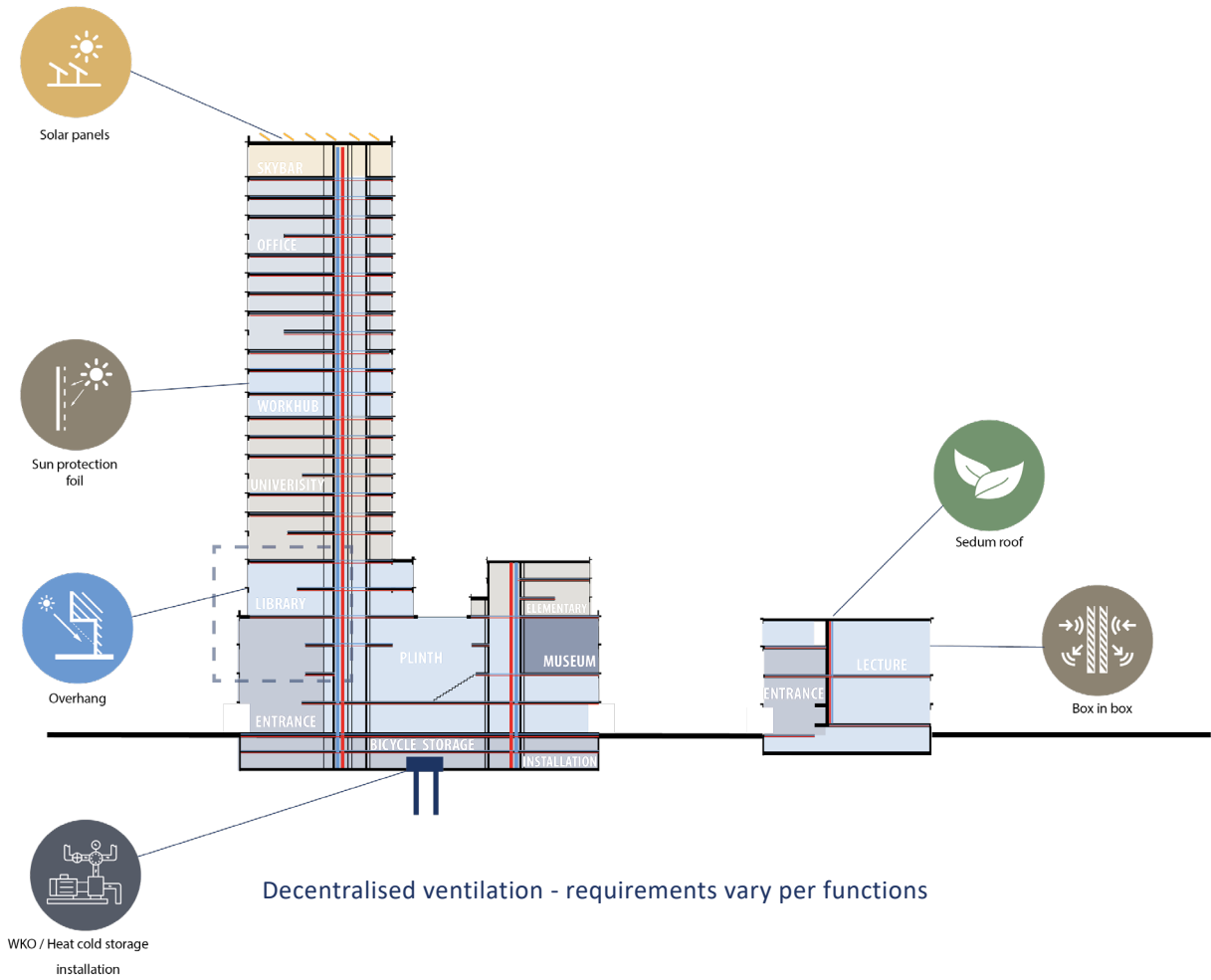
For this to work, the floor height needed to be very high to store all the installation and both ventilations, 600mm high. Besides this, the elevated floor needs to be supported for the public use. Asking for a structure where the floor can be placed on in a modular way. The modular pattern allows easy access to the installation and placement of the ventilation and therefore flexibility for new wall layouts.

In the schematic sections on the right, it is shown how this is all achieved. In summer, when the temperature rises during the day, the overhang, the internal ducoscreen and sun protection foil is beneficial for keeping the temperature at a reasonable figure. The overspill is compensated by the mechanical ventilation system. The sedum roof also adds to the cooling of the building, giving the building mass.

In winter, when the temperature is lower and the sun stands lower on the horizon, the sun is used for extra daylight. The overhang is not so significant that it is always providing shade. In the winter it allows to have direct sunlight in the floorplans.

Unfortunately, the biggest part of the building is mechanically ventilated. This had to do with the large spaces that are needed for the public and institutional functions. Because of the amount of different functions, there is chosen to use a decentralised ventilation system. The central location of this installation is placed in the basement of the building. However, on every floor is space reserved around the core combined with storage space. These cabinet like doors that store the individual installations that are needed per function allowing an optimized temperature controlled environment.

If the suction of the ventilation is not enough for the building, spill ventilation can be placed through the ceiling directly to the ventilation channels. This is made possible in between the elevated floor. In the elevated floor are two types of shafts, the supply and exhaust ventilation. Each shaft is 300mm high.



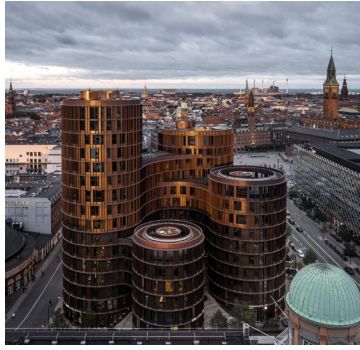
Case studies

07

Casestudies

By the use of case studies I tried to get a better understanding of how these buildings work. The next questions helped me map this;

- How does the entrance flows and how are people guided.
- How does the architecture translate to their floorplan, iconic vs timide.
- Did the structure create the floorplan or is the floorplan adjusted to the structure and how is public and private mixed.



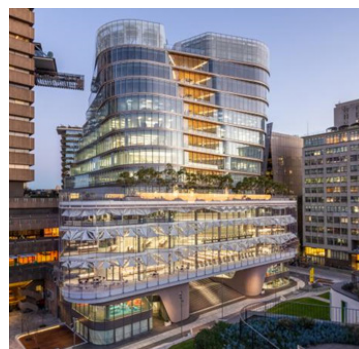
**Axel tower
Copenhagen**



**Maersk
Copenhagen**



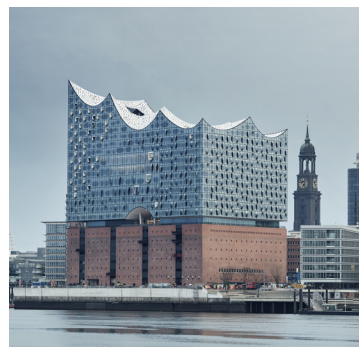
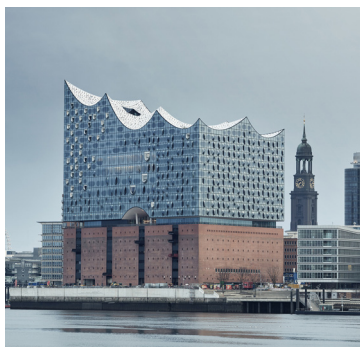
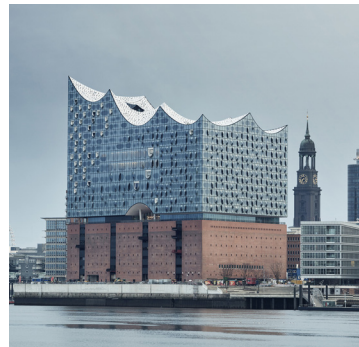
**Bookcity
Shenzhen**



**UTS Library
Australia**



**Elbphilharmonie
Hamburg**

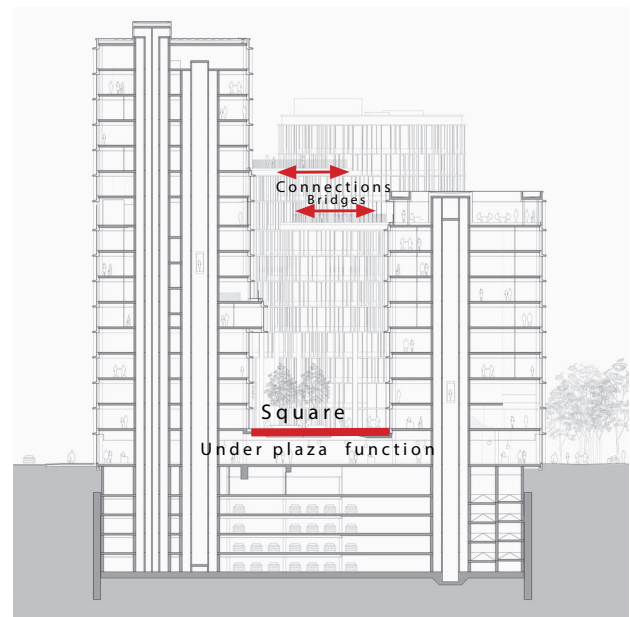


Axel towers - Copenhagen

Location: Copenhagen, Denmark
 Architect: Lundgaard & Tranberg
 ARkitekter
 Function: Office & retail & urban
 space
 Building year: 2017
 Square meters: 40.000m²

This project is iconic in the skyline of Denmark due to its round shapes and height. However, the color scheme merges with the city. The project is located in the city center of Copenhagen, close to the station. The design consist of five towers, each having its own height and diameter. The different towers are connected with bridges. These bridge stretch over several floors and xxx. Besides the height difference in the towers is there also a elevated plaza. The center courtyard of the project is elevated, asking people to explore what to find there.

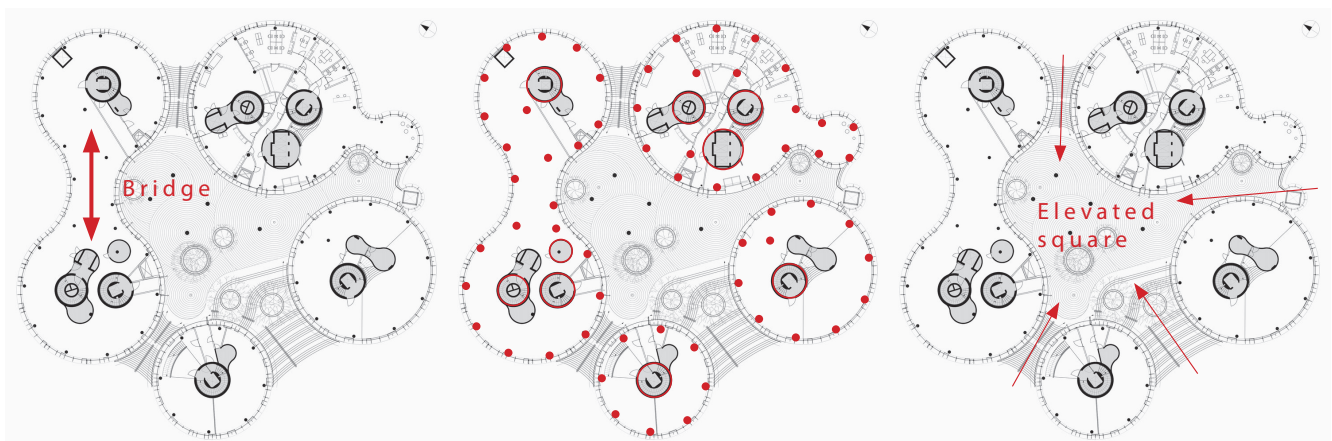
Another aspect is the structure. The building has round cores and columns placed in circles. The center placed cores creates a small floorspace but it is experienced as dynamic and complicated.



Plaza



Placement



Spaces

Structure

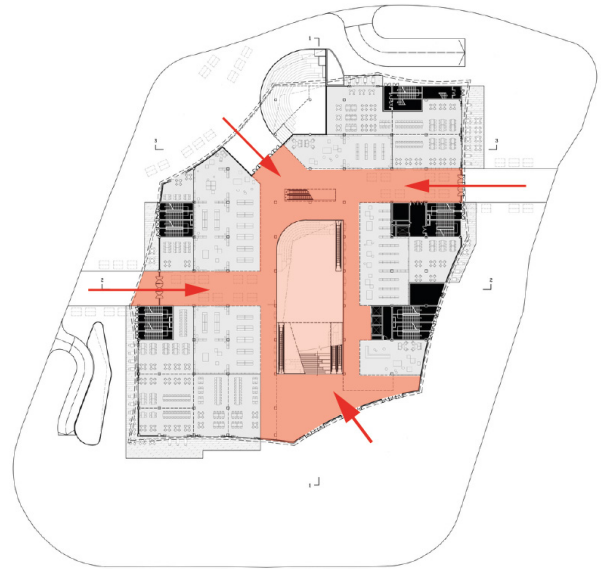
Entrance

Bookcity - Shenzhen

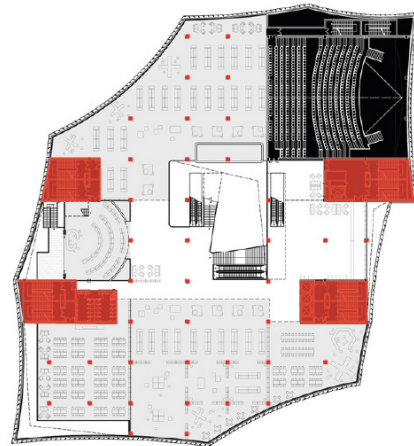
Location: Shenzhen, China
Architect: Atelier Global Limited
Function: Library & auditorium
Building year: 2020
Square meters: 45.500m2

This projects **remarked** me due to the regular grid, with small changes due to the needs of their function, combined with an unique facade. The grid is not compromised by the facade and the functions will have the most efficient floorspace. The layout is based on one central atrium that is connected on the groundfloor on four sides. Allowing visitors to enter the building from all sides from a horizontal movement to a vertical. The atrium allows views over several levels, stimulate people to explore.

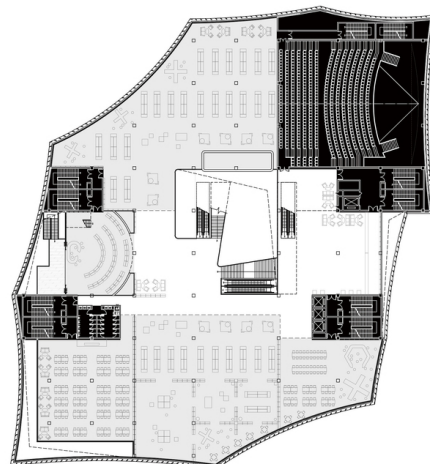
Another interesting part of this project is the public and private function balans. The only private functions are the theater, storage and supply spaces. The core is placed on the outside of the floorplan to create the large atrium.



Entrance



Structure

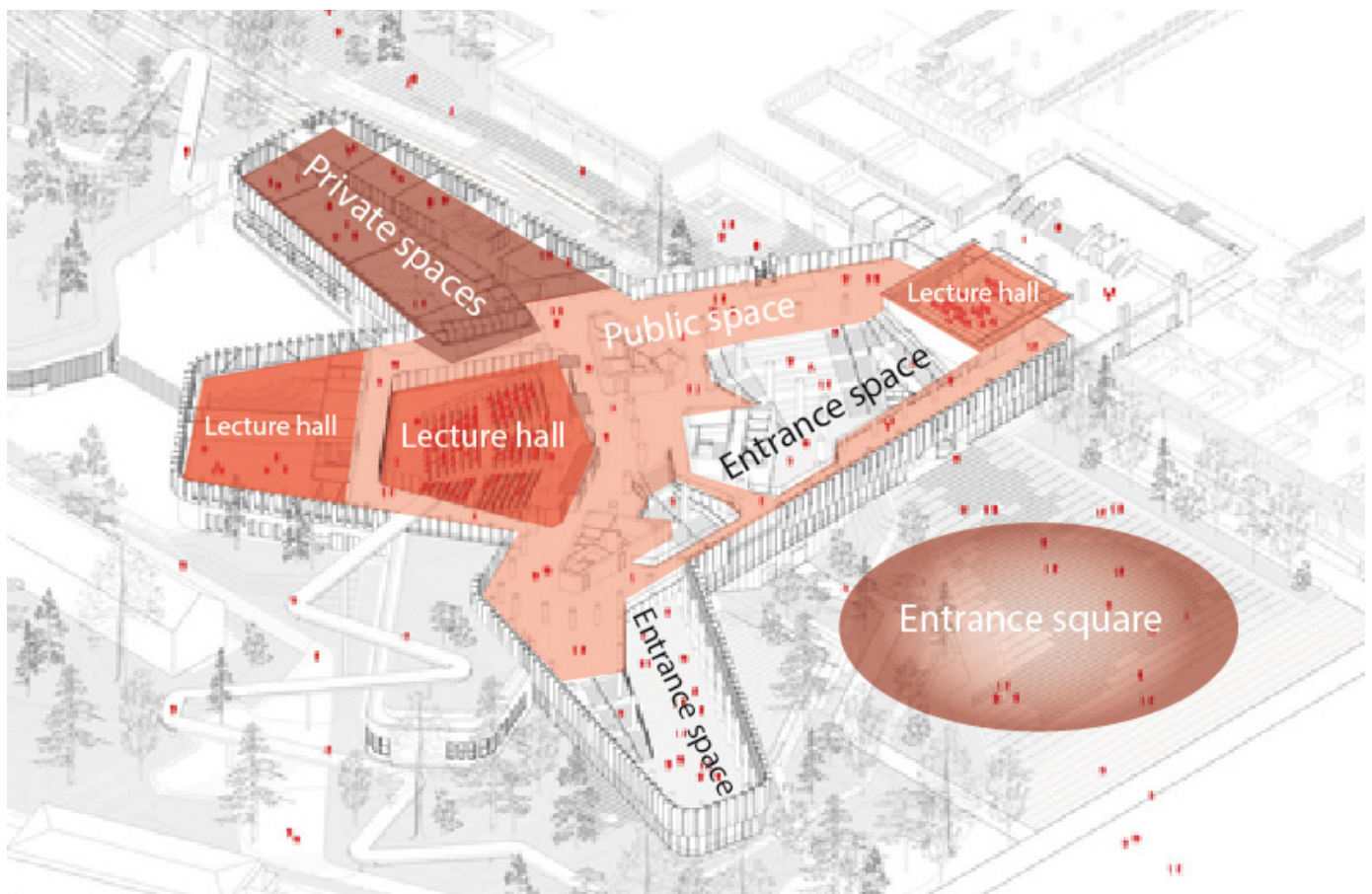


Spaces

Maersk - Copenhagen

Location: Copenhagen, Denmark
Architect: C.F. Møller Architects
Function: University & auditorium
Building year: 2017
Square meters: 42.700m²

wat over de outdoor plot vertellen nog
xxxx



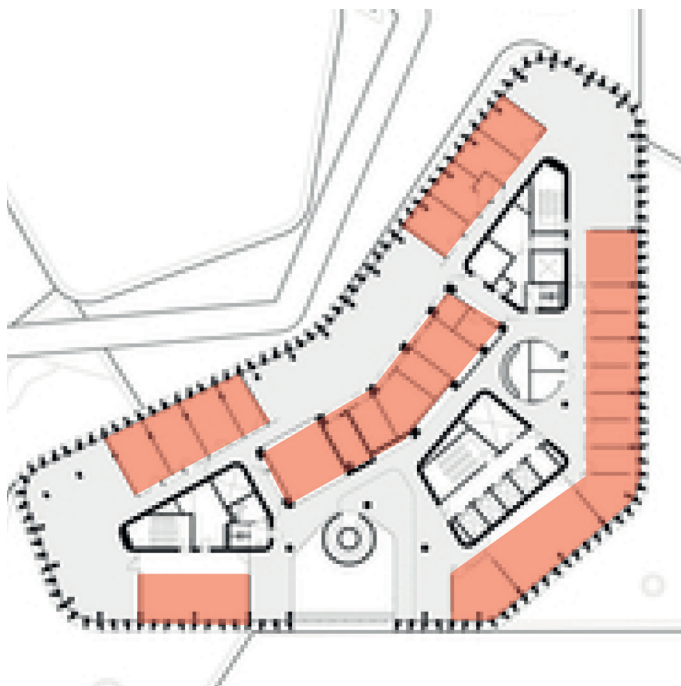
Entrance - public - private - flow

Fascinated by how the outdoor level elevated to the first floor in the building. How does the public space enters the private building. This project is known by its unique shape and optical illusion. The illusion of sizing. The building doesn't appear to be very wide in some angles but the floorpan suggest otherwise.

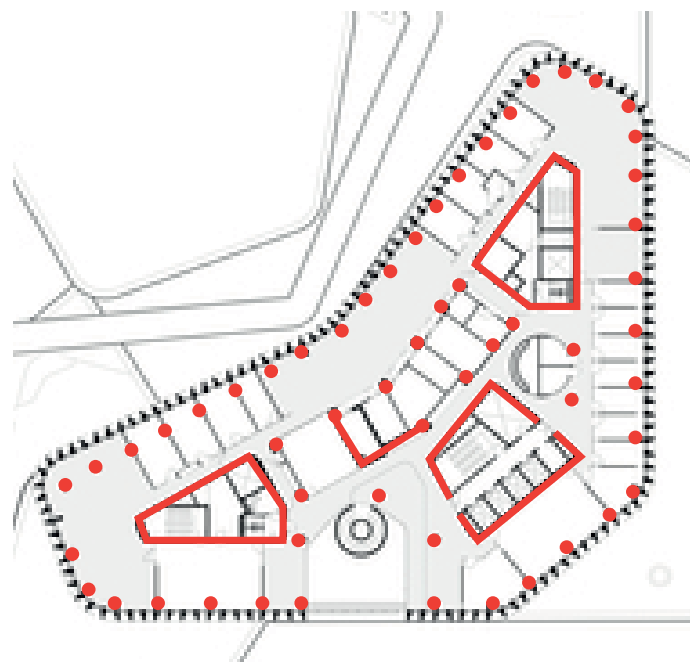
Interesting in this project is how they dealt with the placement of three cores and how the columns are placed due to the round corners and diagonal lines in the building.

The first floor is an open floorpan that mixes between lecture halls and private spaces. Allowing users to mix between these large functions before going higher into the building.

central void uitleggen



Flexibility



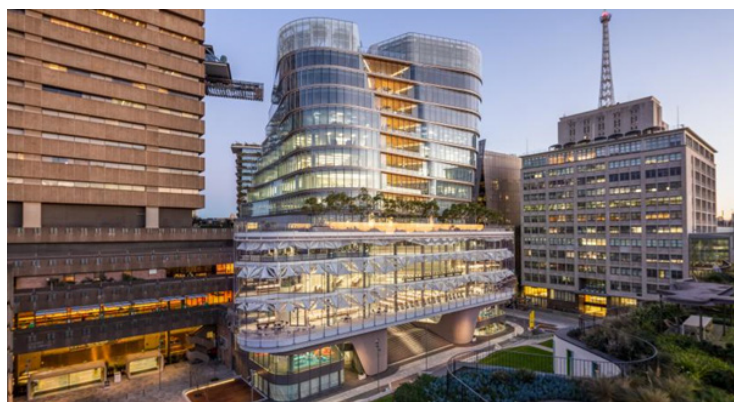
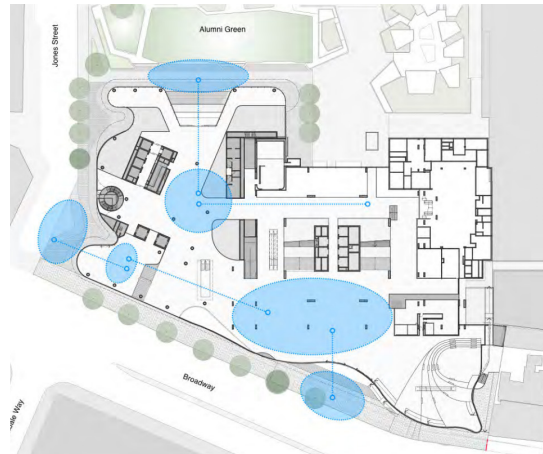
Structure

UTS - Australia

Location: Sydney, Australia
 Architect: Francis-Jones Morehen
 Thorp (FJMT)
 Function: Faculty of Law and UTS
 Library
 Building year: 2019
 Square meters: 32.400m²

XXXXXX

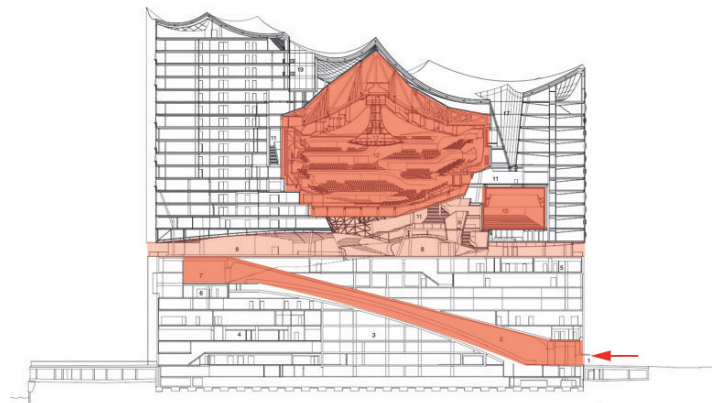
- Different volumes and exper
- Connections even with sever
- Public private combination,
 library



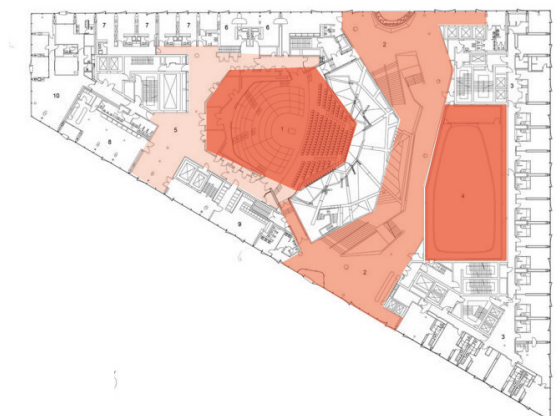
Elbphilharmonie - Hamburg

Location: Hamburg, Germany
Architect: Herzog & de Meuron
Function: Theater & residential & hotel & bar & public space
Building year: 2017
Square meters: 120.000m²

The biggest project of the case studies and housing the most functions. This building is known for its theater design that is shown in the facade design. One of the key points of the building is the mid level public floor, but it is also the boundary. How easy is it for people to go into this building and reaching this floor. They tried to solve it by the use of a long escalator which guides you to the platform. Also interesting in this floorplan is the division of public and private spaces due to the stacking in functions. Corridors are that become narrow and closed of from the public.



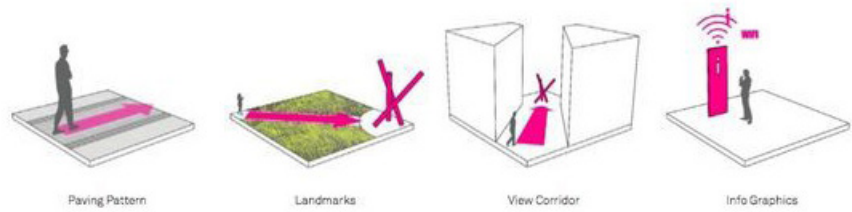
Vertical functions



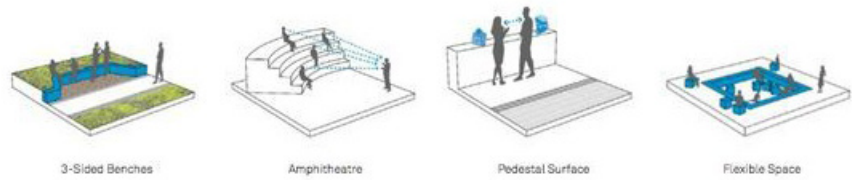
Horizontal functions

TYPES OF BOUNDARIES

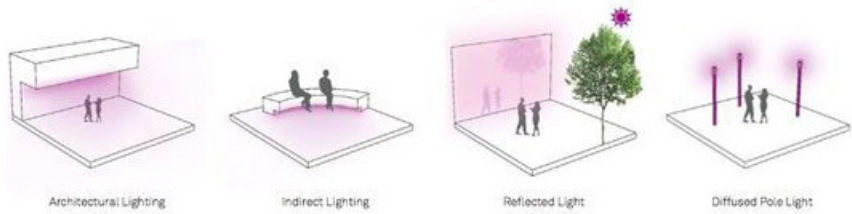
1. wandering



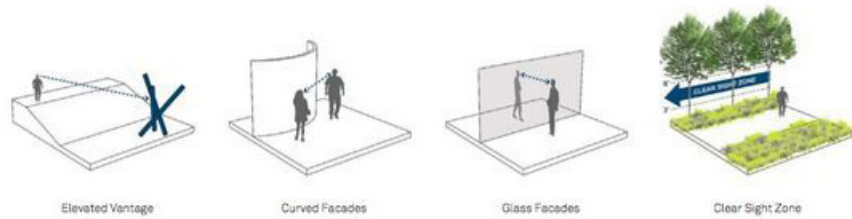
2. interaction



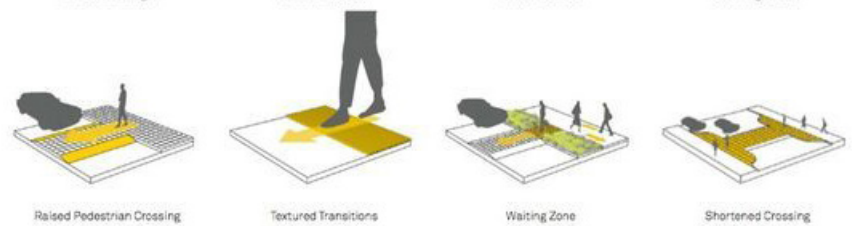
3. lighting



4. visibility



5. mobility



TYPES OF BOUNDARIES

Physical boundary – visible boundaries

Type of boundary	Explanation
Security/surveillance boundary	Access is only allowed by card/ticket/id
Economic boundaries	Commercial or residential space
Legal boundaries	Property lines or zoning laws
Community and civic boundaries	Designated public areas or spaces
Temporary boundaries	Events or gathering

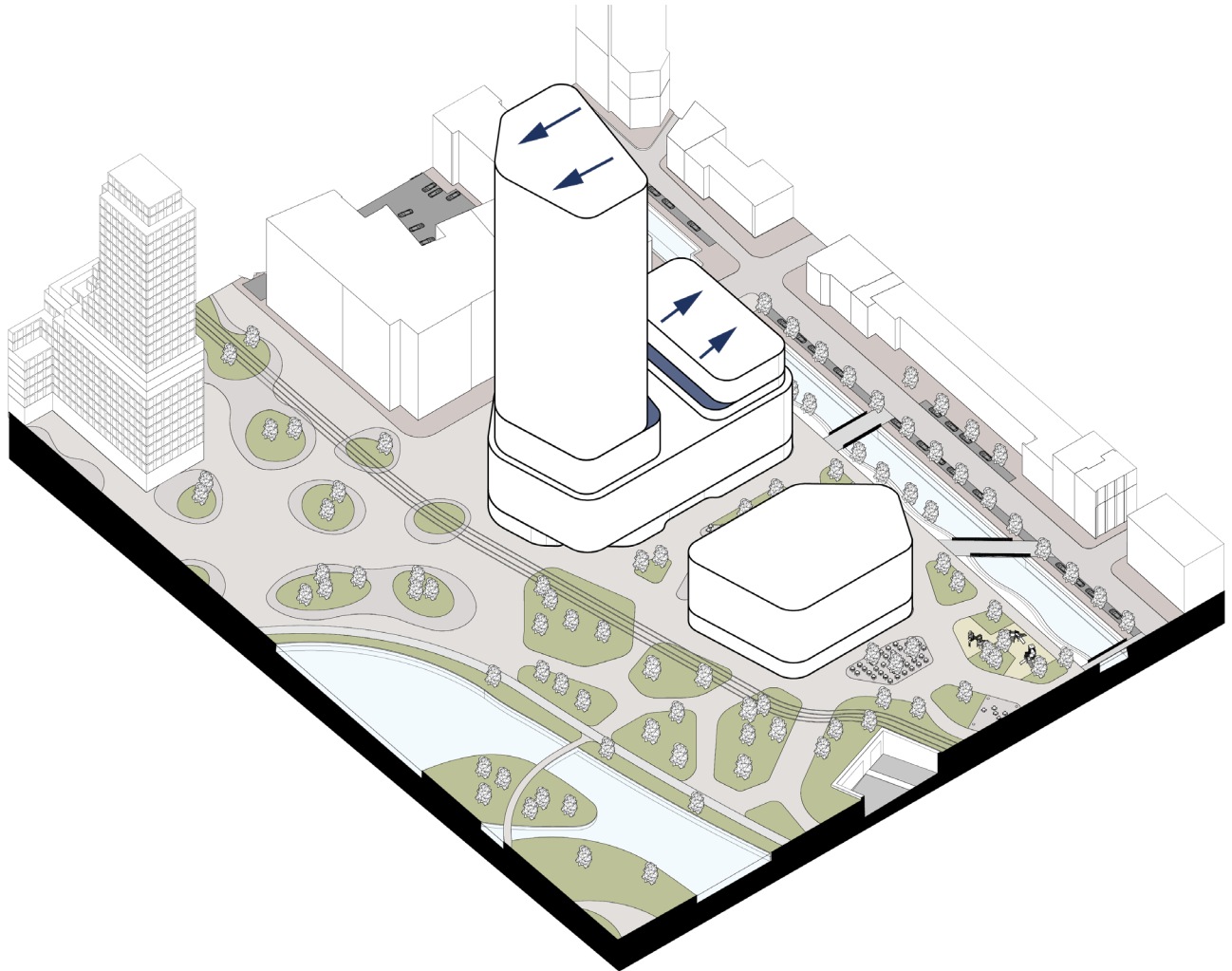
Psychological boundary – everything we feel inside our body (emotions)

Type of boundary	Explanation
Territoriality	Public vs private intimate space
Ethnic boundary	Accessible by a group or race of people
Social identity and group dynamics	Conformity and in/out-group dynamics
Privacy needs	Intimacy in space
Personal space	The distance of your inner comfortable space

Recap

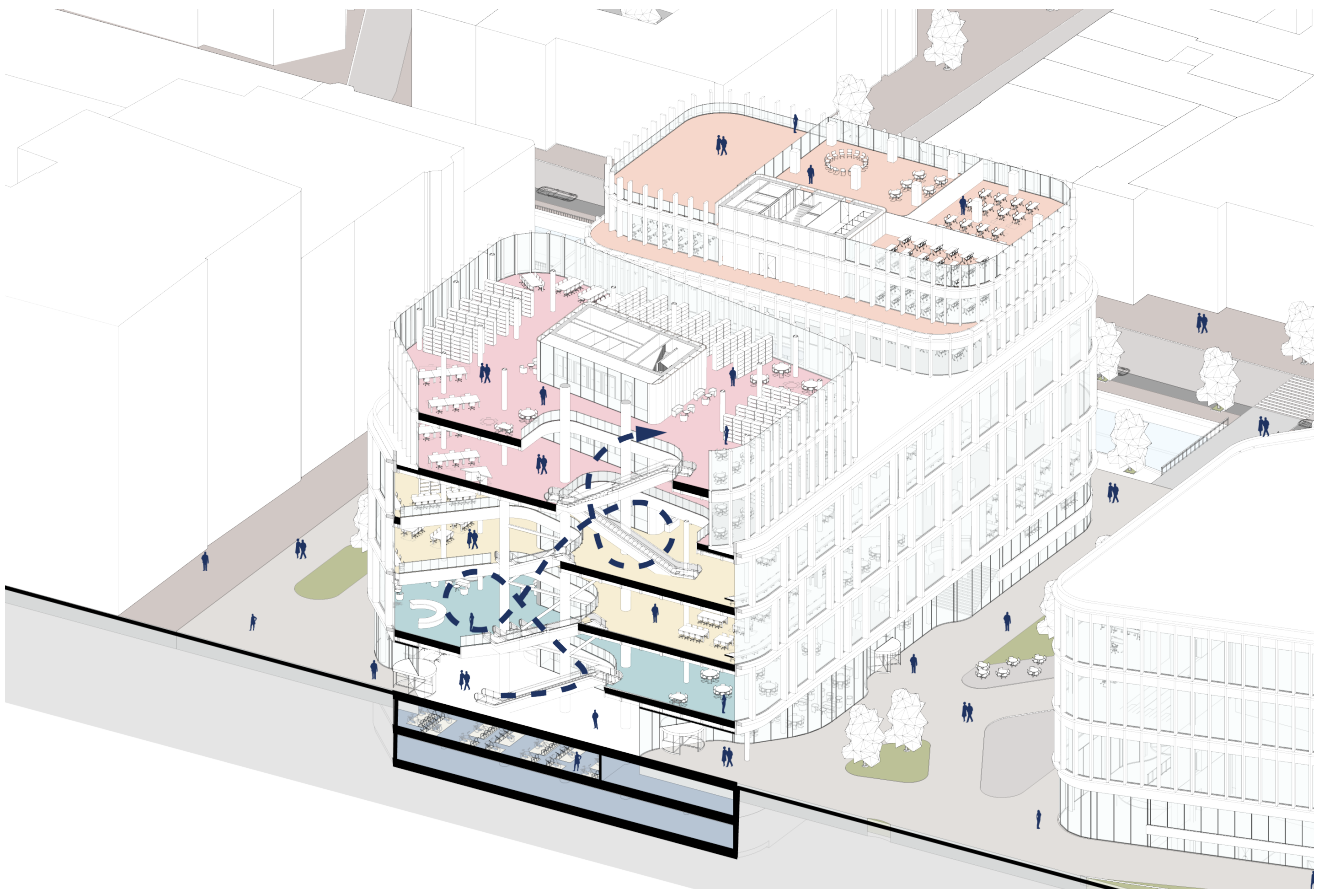
08

HYBRIDITY



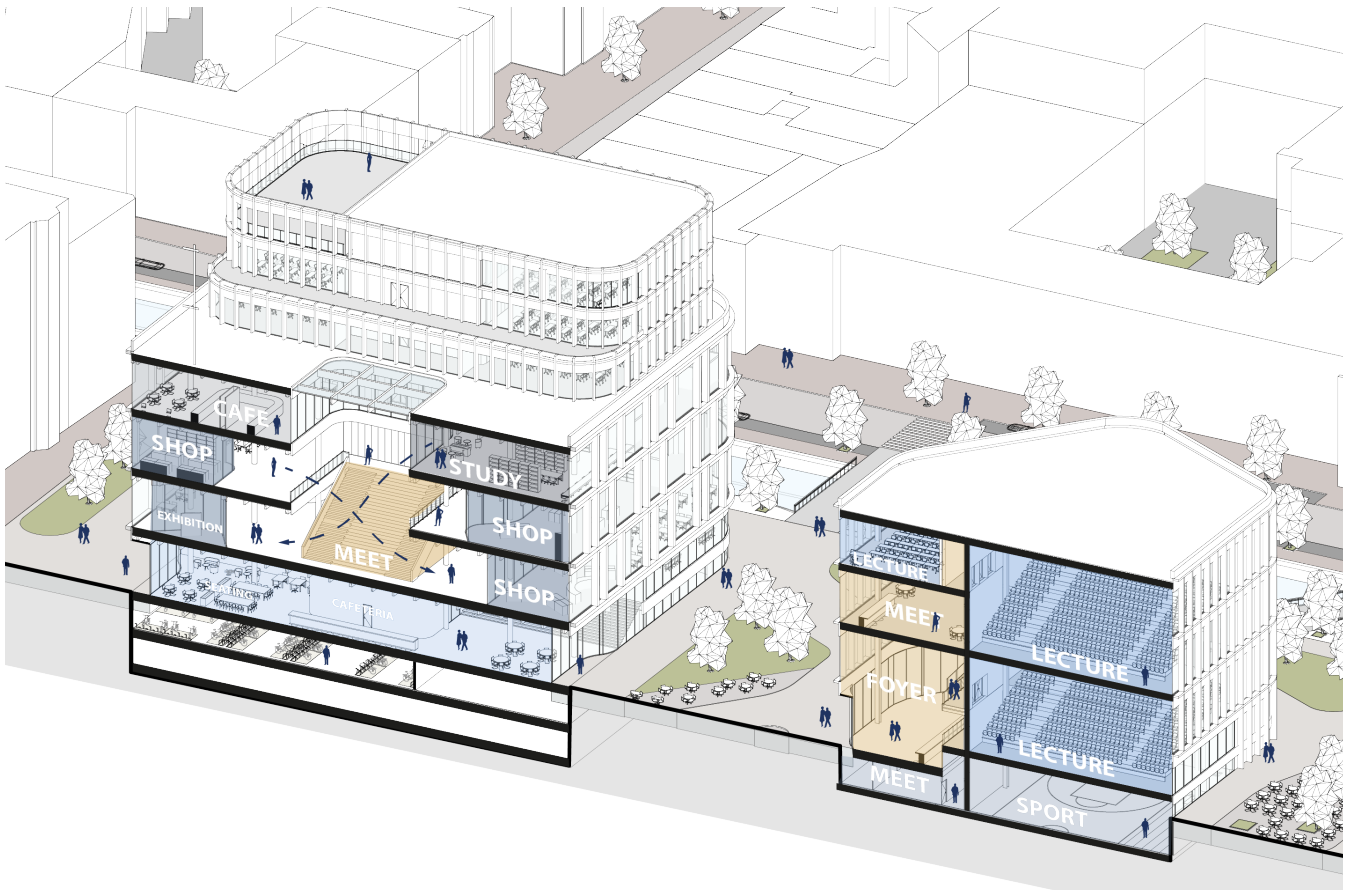
Extending the campus network of The Hague and Randstad

MULTIPLICITY



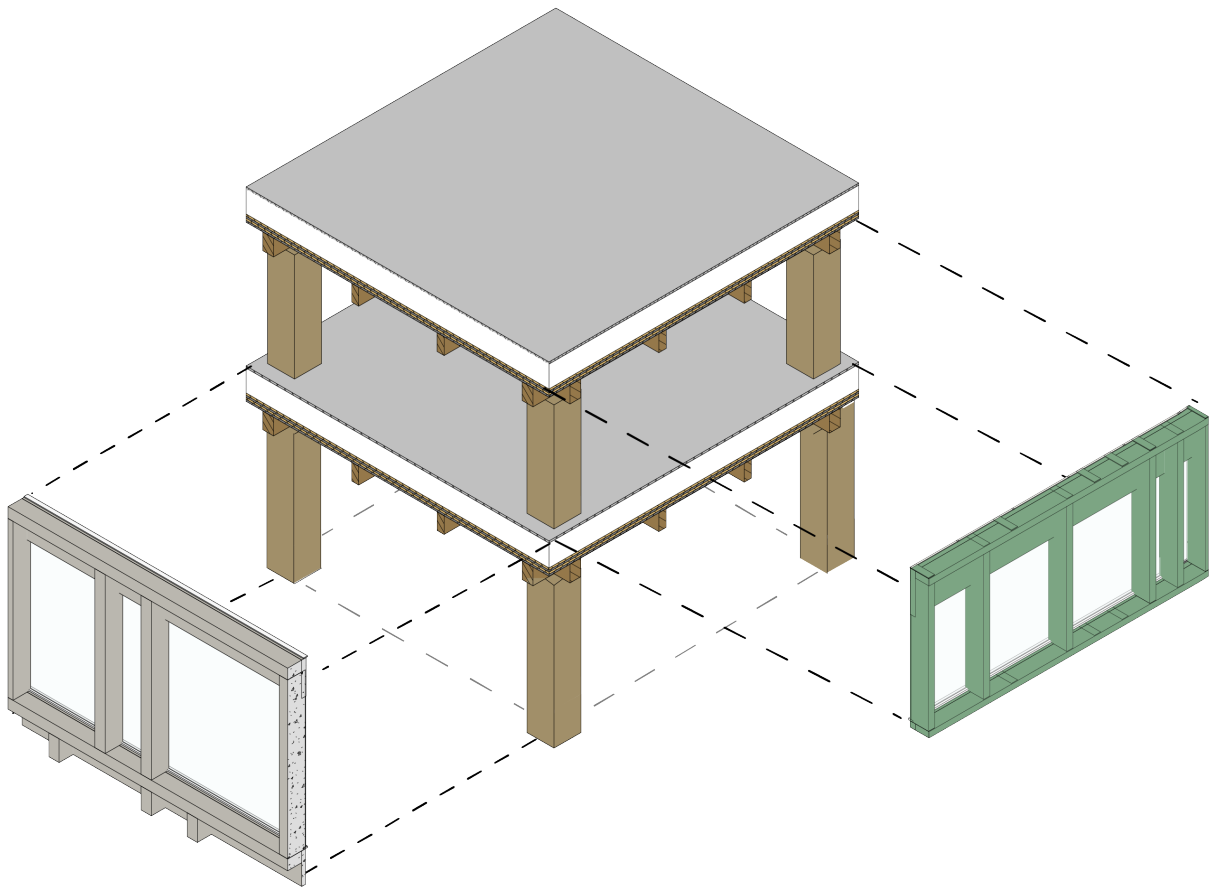
Creating undefined spaces that serves more than only as movement spaces combined with their actual function. The voids and views stimulate curiosity.

LIFELONG LEARNING



Wander and meet as a visitor in the atrium where institutionalized functions, display and share their knowledge

SUSTAINABILITY



Prefabricated facade elements combined with a flexible ventilation system. Achieved by the use of an elevated floor and a waffle beam structure.

