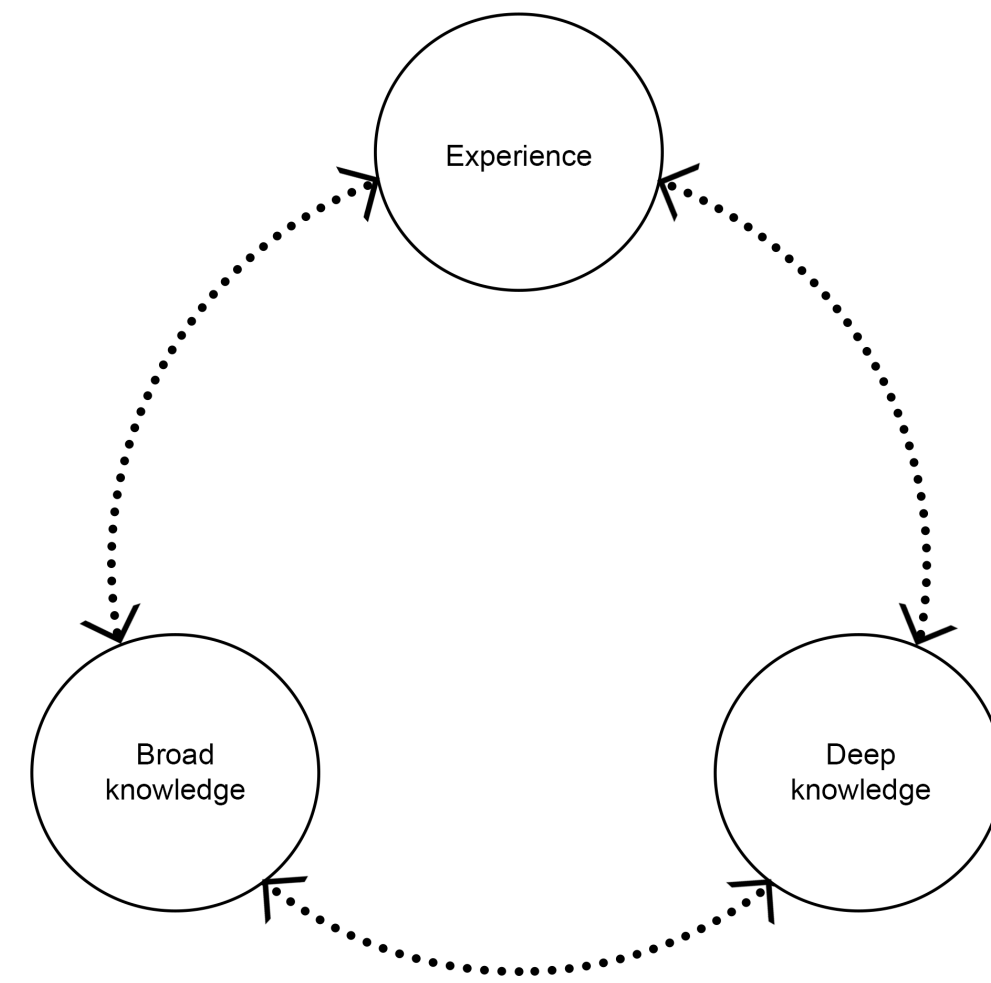


# Booklet

Jeroen Boots - 4375785  
Research tutor - Martijn Stellingwerf  
Design tutor - Roel van de Pas  
Building technology tutor - Freek Speksnijder  
Explore Lab 2020 - Architecture and the built environment - TU Delft

This thesis began by working in the field of Virtual Reality (VR) whilst also studying architecture. The combination of giving people experiences whilst also studying for creating buildings was an interesting combination. Through the work in VR, I experienced the effects of the environment on the behaviour of the person experiencing. At the same time I was learning how to build buildings and how to look at a building from an architectural perspective. A perspective that wants to build beautiful integrated buildings that supply a comfortable indoor space which satisfies most people. This contradiction of creating virtual, very specific, spaces and more general comfort in architecture was and still is very interesting to me. This contradiction, the lack of experience in most architectural design processes and the lack of experience in our learning process started the thought process which led to this thesis.

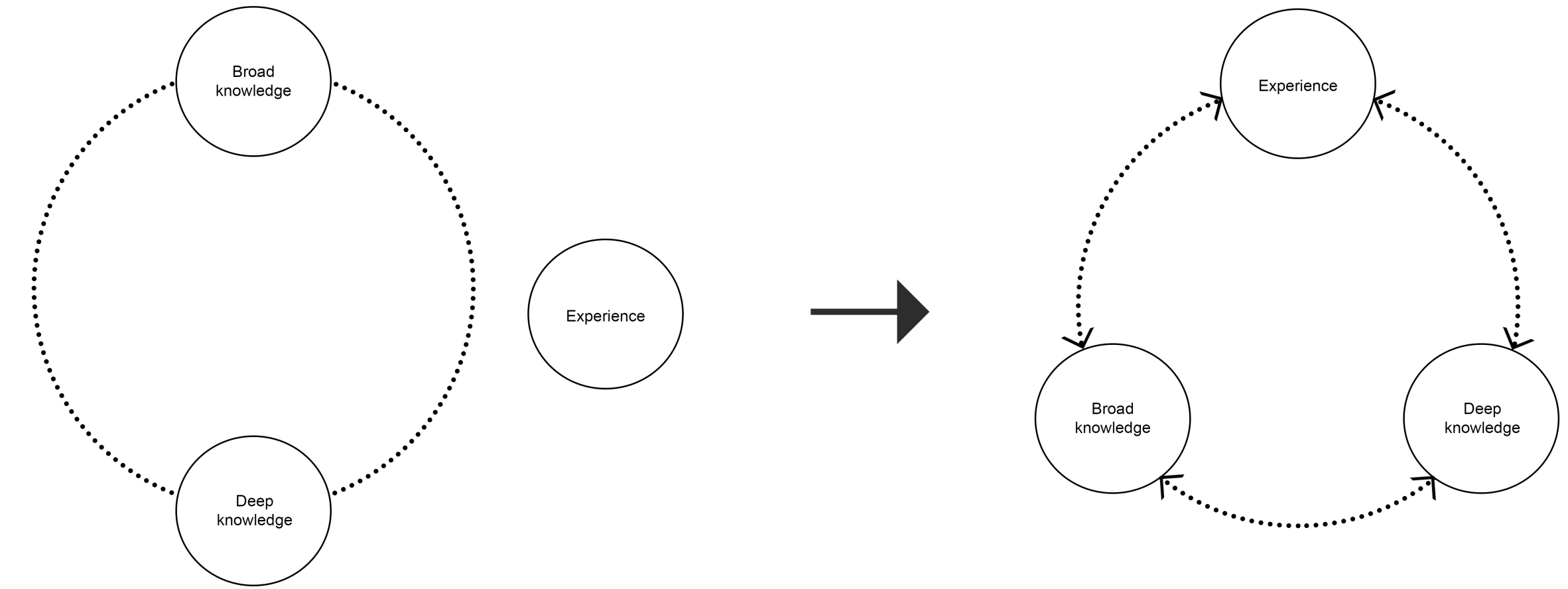
# Research



Trias Discere

The research part of this thesis was focused on what the role of experience was in the history, is in our contemporary society and what the role of experience could be in the future. During the research the answer to the following question was developed: How can we create a new experience based learning system and how to create (digital) architecture for it?. The answer to this question was to create a space and/or building where the philosophy of learning through experiencing, exploring and diving deep into a subject, is an integral part of the design. This philosophy is called: Trias Discere.

# Approach



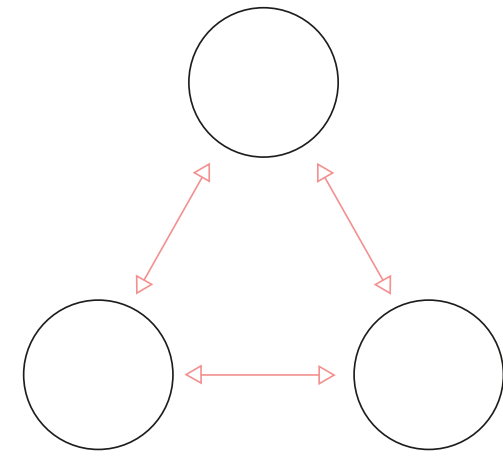
“Normal learning”

Trias Discere

When we think of learning we most often think of reading books and listening to professors or teachers. The teachers give us broad knowledge during a lecture and afterwards, we use books to gain deeper knowledge. This way of learning is very good for sharing specific knowledge from person to person, but not all knowledge can be gained from books and lectures alone. Places at which you can truly experience are even less common. The DEX hub seeks to combine the three ways of learning (experience, broad knowledge and deep knowledge) in one building. Allowing the visitor to seamlessly transition between experiencing, discovering, and understanding all aspects of the ever-changing array of topics, tools, and spaces for people to follow their interests.

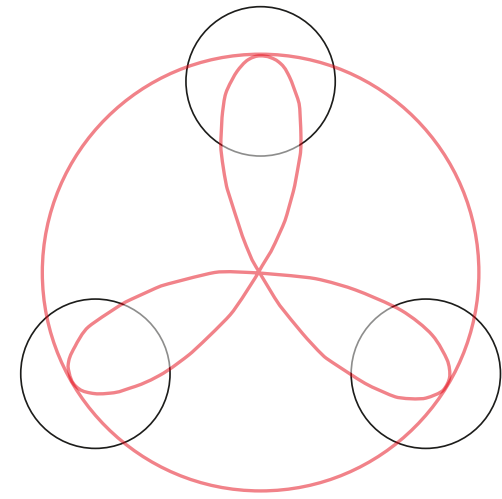
## Design focus

The research sought to learn under what conditions the Trias Discere concept would function the most efficiently. The research was done on learning, attention span, processing, and relaxing. The combination of all these facets that affect our learning process is condensed and summed up in four concepts that have been an important focus of the design.



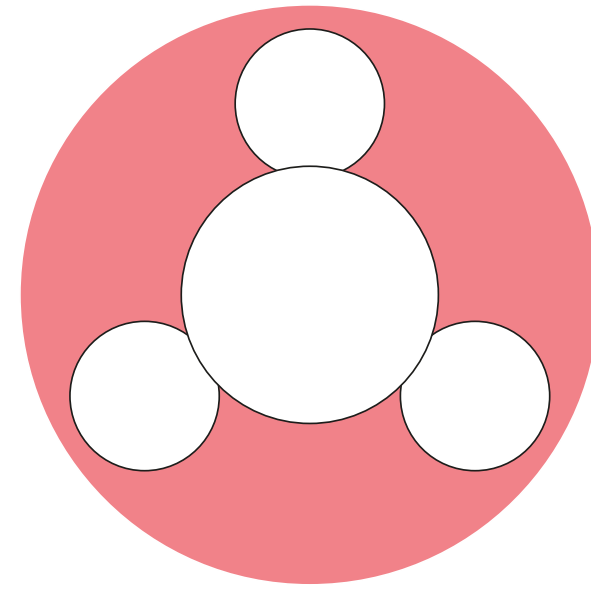
### Trias Discere

The Trias Discere is the philosophy of gaining a better understanding of a subject by switching between multiple ways of learning. The Trias discere will represent itself in the building by creating and providing spaces that embody the different types of learning: experience, broad and deep knowledge.



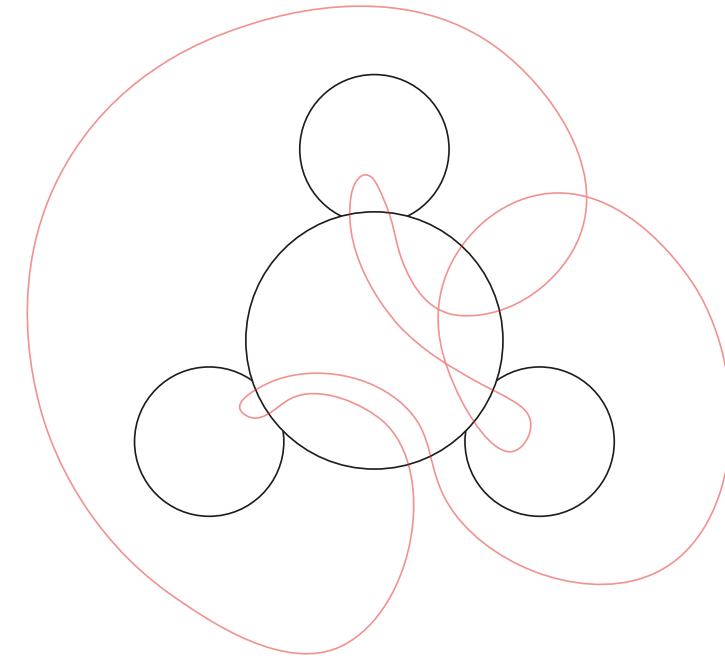
### Transitions

The transition and freedom between types of learning are what make the Trias Discere concept special. The building will be a place in which the student can switch between the multiple types of learning (but also relaxing and processing). Therefore throughout the design process, a lot of attention has been put into creating a building that allows you to follow your path. Regardless of this being linear or random.



### Process

We are not computers. No one can process everything perfectly immediately. Sometimes we don't understand something and then we need to take some time to process the information that we just gained. Taking time to process can be very beneficial to how fast and how well we process the information that we gained into knowledge. Therefore the building will need to have multiple places to retreat to and process the information in your own way at your speed.

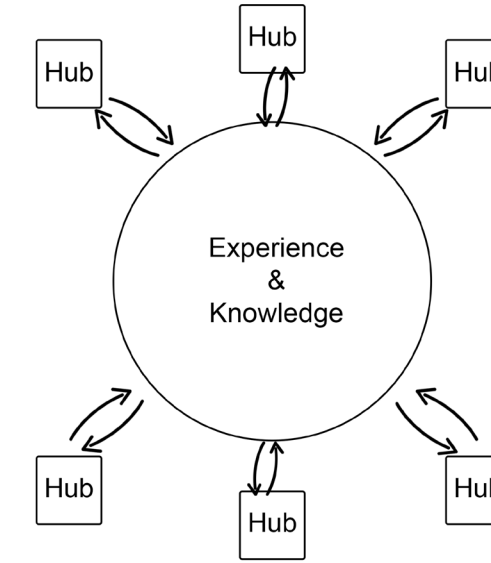


### Relax

Most of us have experienced the dullness after a day of learning or having been at a museum all day. This is called direct attention fatigue (DAF), sometimes called museum fatigue. Taking regular breaks, which offer a different climate and stimulate other parts of the brain can be very beneficial to reducing DAF. This is why the building will have multiple places to relax, distract and meet.

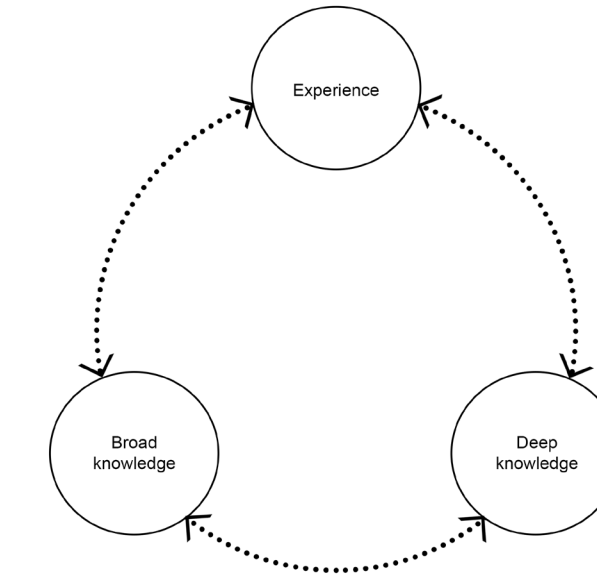
## DEX Concept

These concepts, together with the idea of creating a space in which the Trias Discere can fully be expressed, have been used to create the first building in which the student can seamlessly transition between experiencing, exploring, and diving deep into subjects. The name for the building is the DEX hub, the decentralized experience hub.



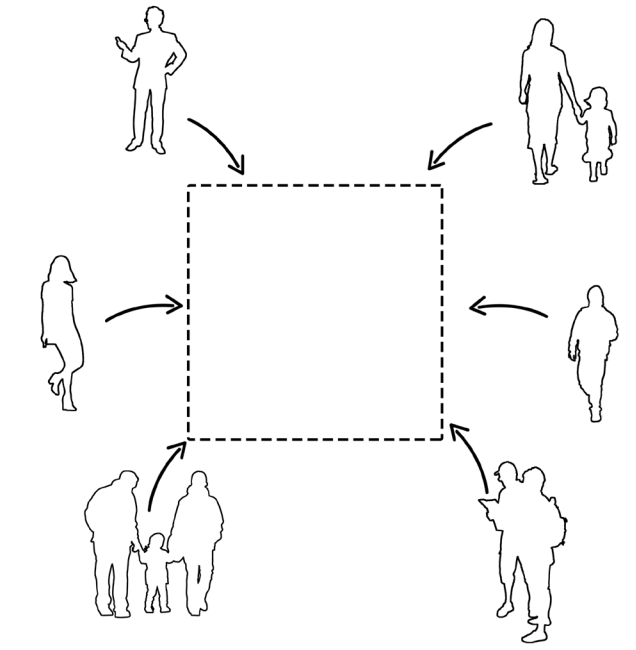
### Decentralized knowledge

The core of the DEX hub is the sharing of knowledge and experience. In contemporary society, large hubs of knowledge (e.g. universities and schools) form the pillars of how we learn. However, these often have a threshold (grades, money, or status). The approach of the DEX hub is the opposite; everyone is welcome to gain knowledge. The DEX hub will be a network of decentralized knowledge nodes at which people can learn. Newfound knowledge is expected to be shared and added to the community knowledge pool.



### Trias Discere

The Trias Discere is the philosophy that a lot can be gained by cycling through different types of learning. Switching between deep learning (e.g. books, documentaries, design classes), broad learning (e.g. videos and lectures), and experience (virtual and actual) will give the student a more complete understanding of the subject. In the end, the student will know how it works and what to do.



### Accessible for everyone

The DEX hub will be accessible for everyone. Everyone can be a student and use the facilities regardless of income, status, or background. The DEX hub will be situated not in the center of an already existing place of knowledge, but in places where knowledge is less accessible. Not the city center, but the peripheries.

# Site

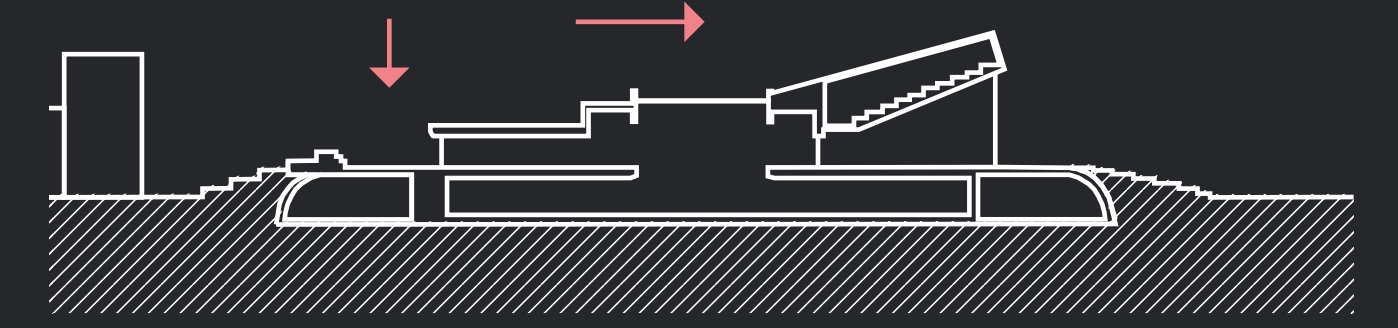


# Site concept

Connect to the urban grid

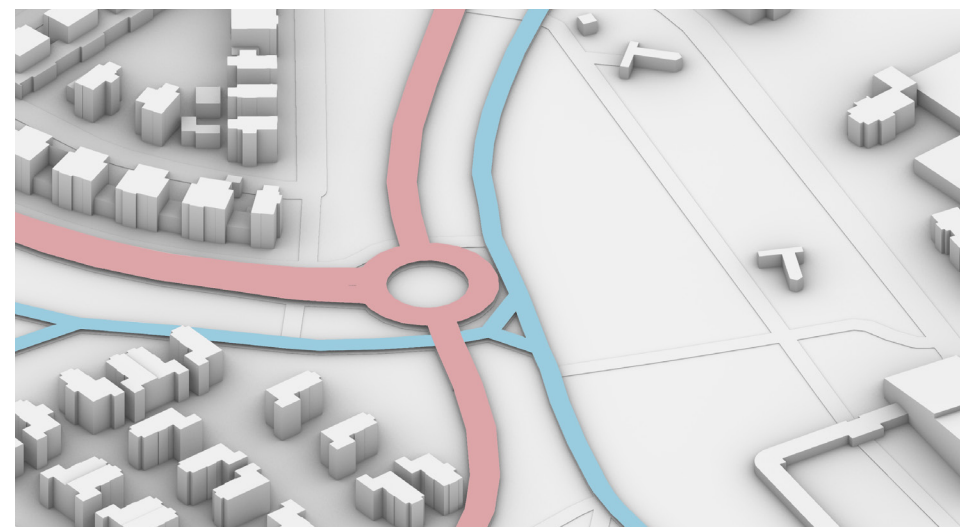


Respect the surrounding



# Site progression

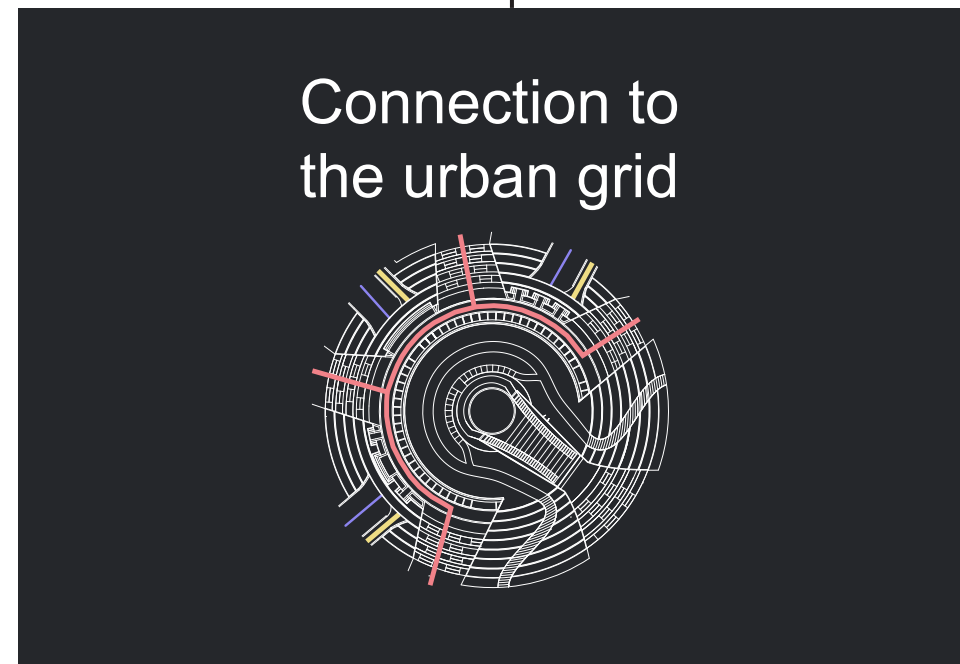
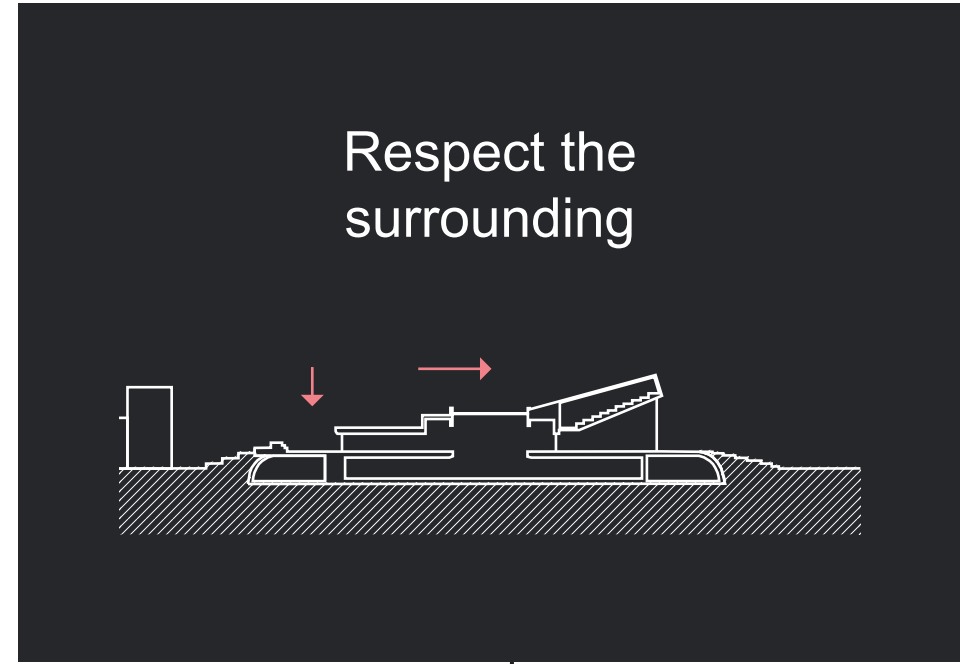
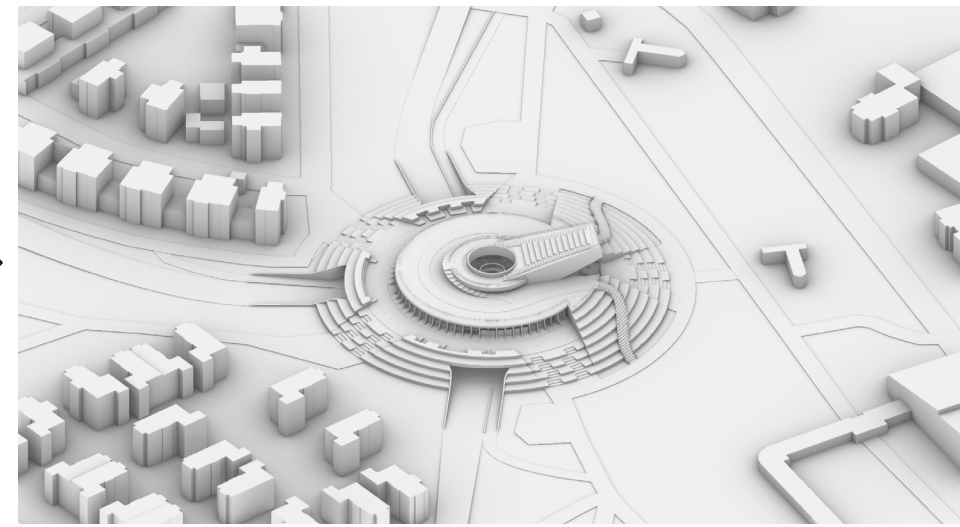
Original situation



Step 1: Underground



Step 2: Find shape

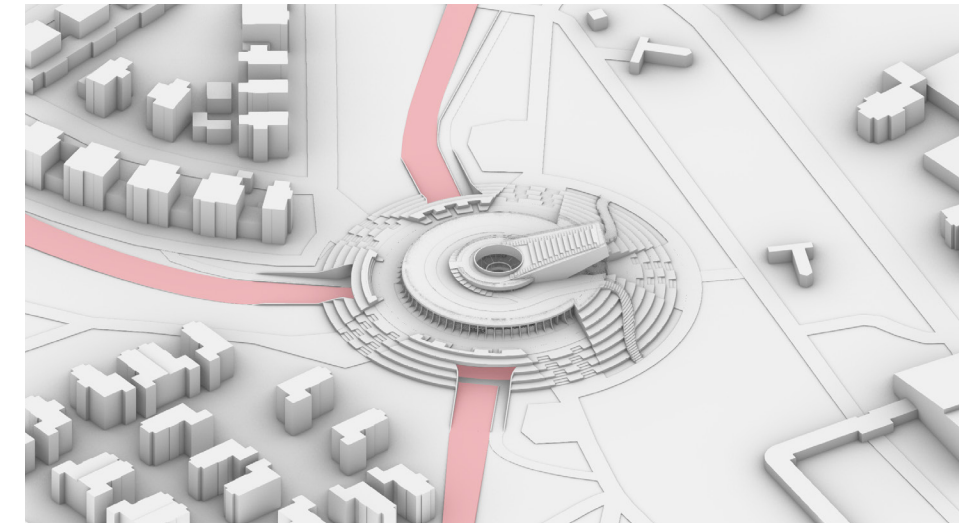


The site chosen is the roundabout connecting the big loop of The Lindt and the smaller loop of The Lindt. The Lindt is a recreational path in Leidsche Rijn. The original situation is a roundabout with multiple pedestrian crossings. The site was chosen because of its potential to be used as more than just a roundabout and because its location is outside of the city center.

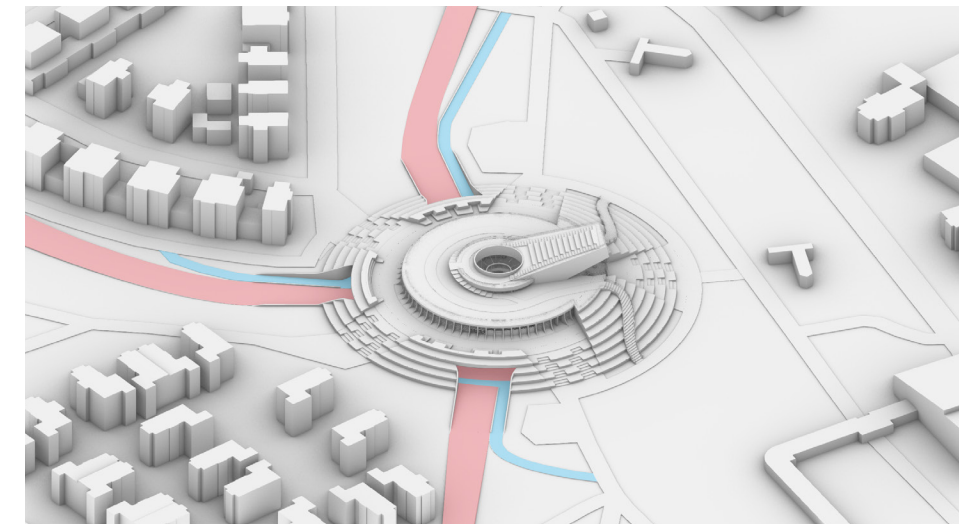
To create space, the first step was to move the roads underground. This made it possible to lower the height of the DEX hub, preventing the DEX hub from becoming too high and a building that would stand out too much.

The second step was to find a shape that would be respectful to the nearby houses and would also help connect the urban grid more. Eventually, a hill was formed which contains, the now lowered, roundabout. The hill could be used by pedestrians, where traffic and cyclists can travel through the underground roundabout. This resulted in a building that is well integrated into the area.

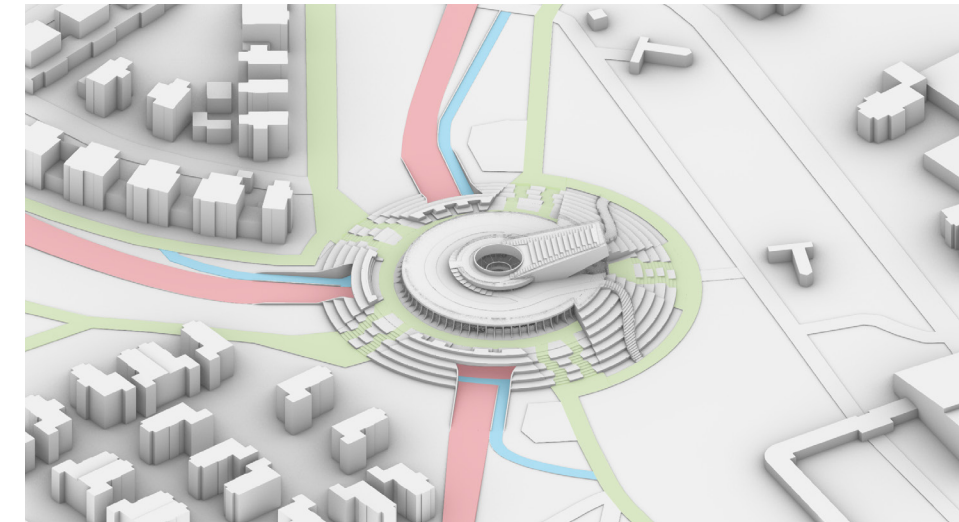
Automotive flow



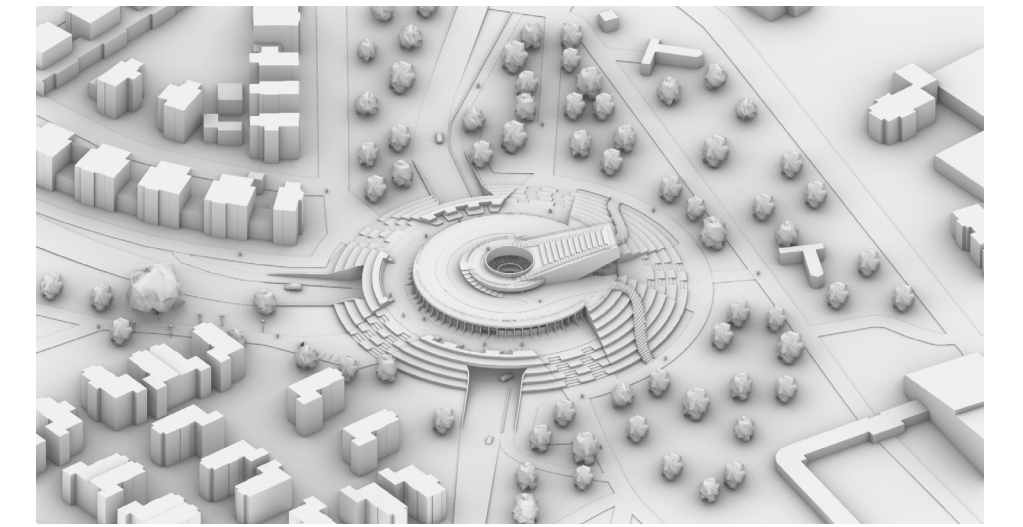
Cyclist flow



Pedestrian flow

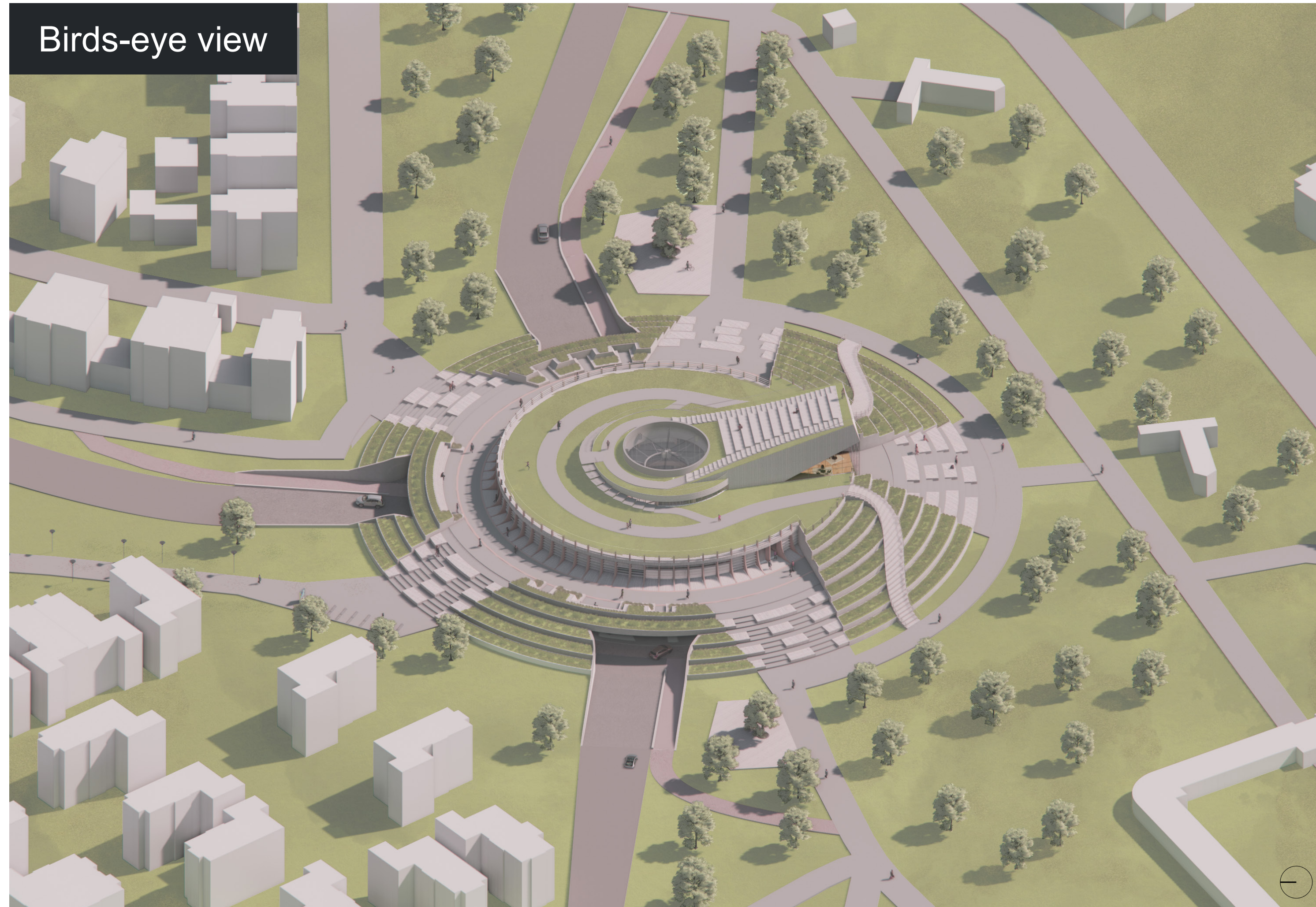


Final shape



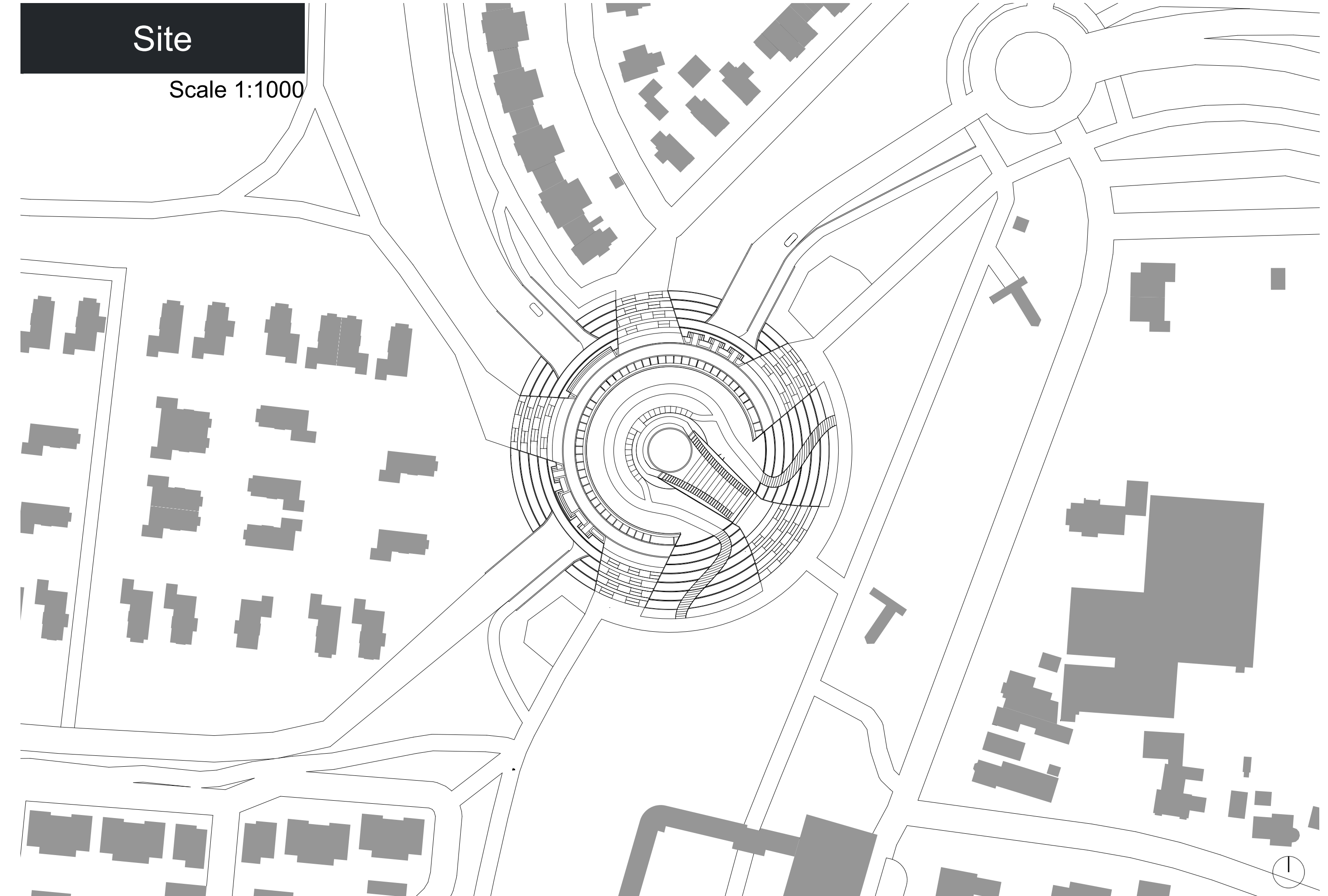
The final shape is a hill that blends in the landscape around the building. The part of the hill that is raised makes the building unique and a landmark in the area. Over and underneath the hill, the different types of transport each have their own route. The pedestrians moving over the hill and the cyclists and cars underneath the hill.

Birds-eye view



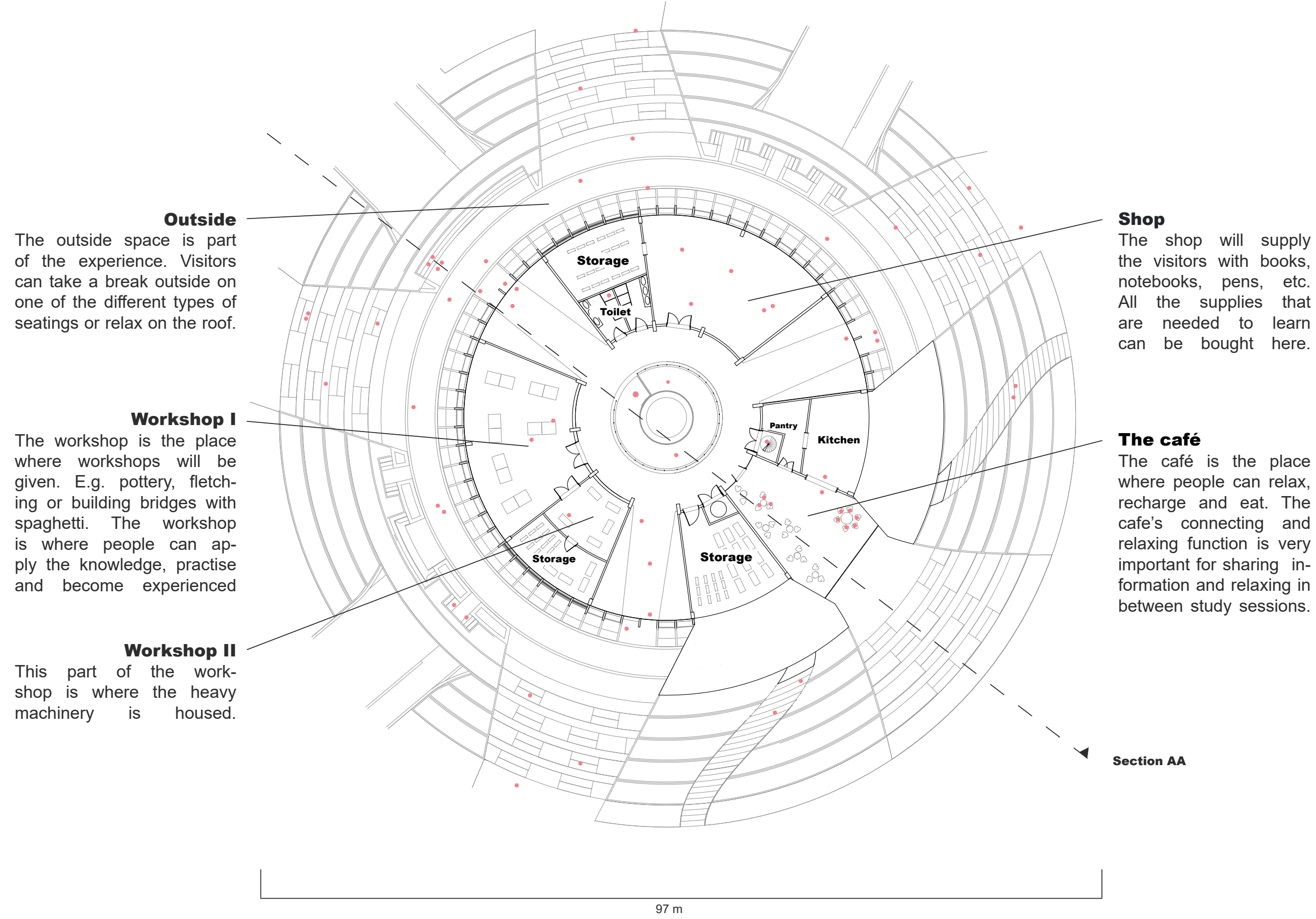
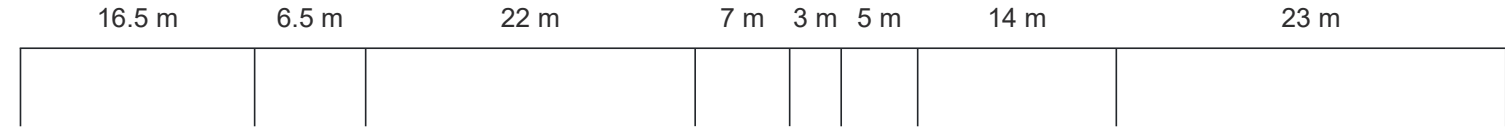
Site

Scale 1:1000



# Floorplan 0

Scale 1:500



**Outside**  
The outside space is part of the experience. Visitors can take a break outside on one of the different types of seatings or relax on the roof.

**Workshop I**  
The workshop is the place where workshops will be given. E.g. pottery, fletching or building bridges with spaghetti. The workshop is where people can apply the knowledge, practise and become experienced

**Workshop II**  
This part of the workshop is where the heavy machinery is housed.

Storage

Toilet

Pantry

Kitchen

Storage

Storage

**Shop**  
The shop will supply the visitors with books, notebooks, pens, etc. All the supplies that are needed to learn can be bought here.

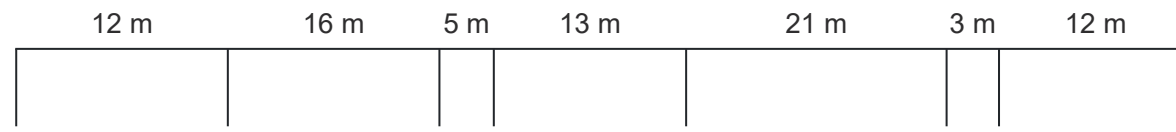
**The café**  
The café is the place where people can relax, recharge and eat. The café's connecting and relaxing function is very important for sharing information and relaxing in between study sessions.

Section AA

97 m

# Floorplan -1

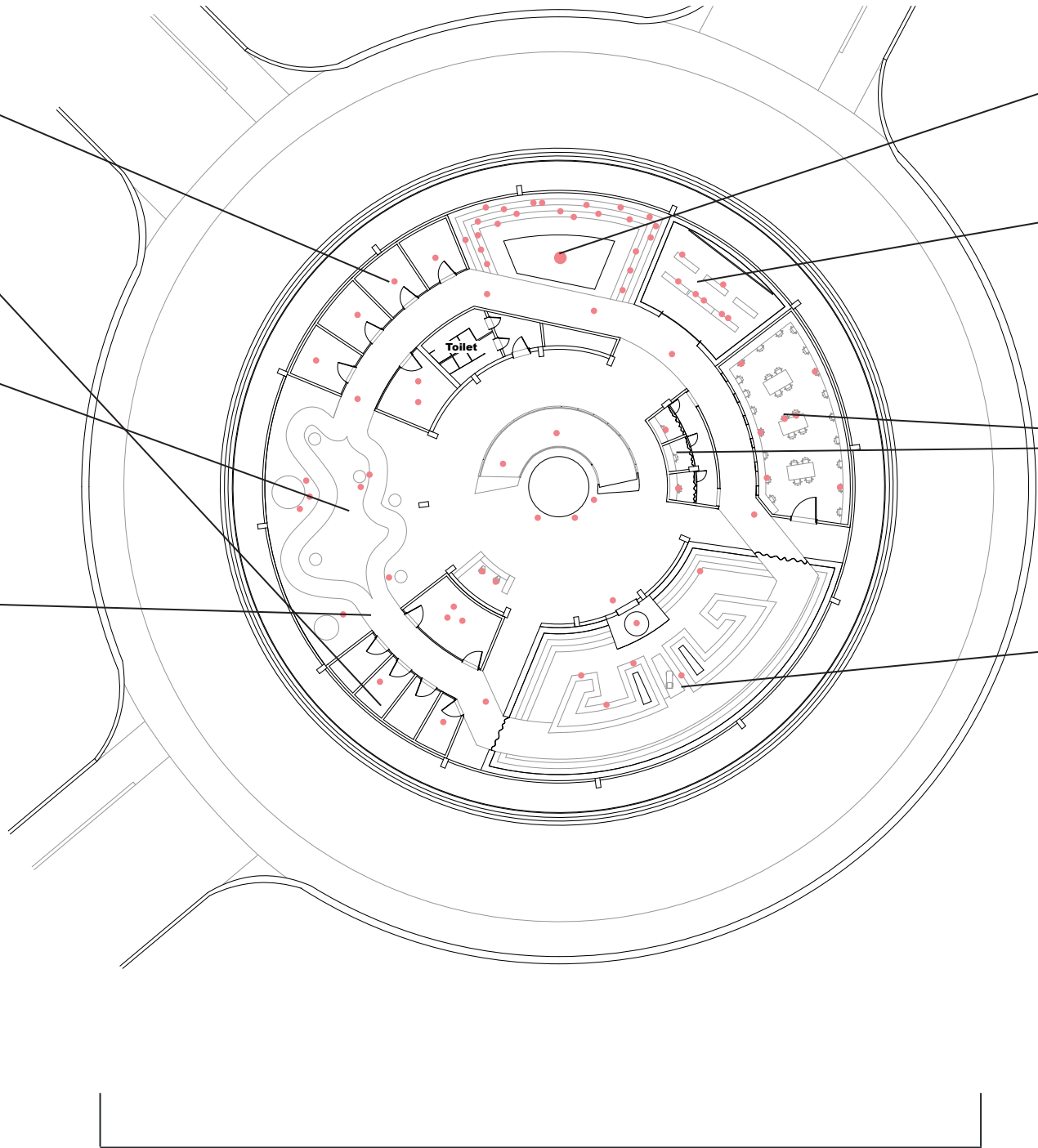
Scale 1:500



**Virtual experience spaces**  
These rooms are designed to experience VR experiences. The rooms have a simple layout and can be closed off by a curtain.

**Experience space**  
The very noticeable open space is where objects (both real and virtual) will be displayed. This space will also function as a starting point for many first time visitors.

**Route**  
The route is the core element of this floor. The route connects the different rooms and inherently the different types of learning. On the ground, lines indicate what kind of learning the room is part of.  
Red = experience  
Green = broad  
Blue = deep



**Theater / play space**  
Open platform for expressing and sharing.

**Video room**  
An atmospheric room where documentaries will be played. In this room scheduled and requested documentaries will be played for a wider audience.

**Workspaces**  
Private and quiet workspaces for the visitors to use.

**Deep space**  
Space where resources that give deep knowledge will be displayed. E.g. books, holograms, models.

102.5 m

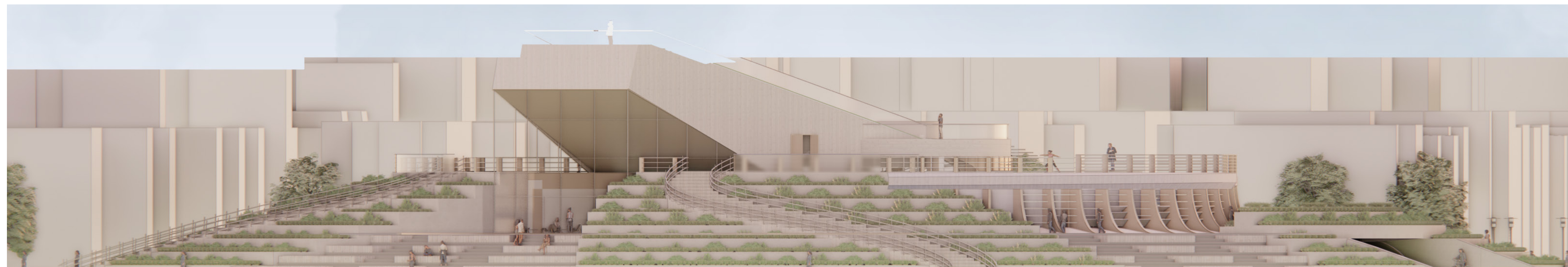




# Elevations

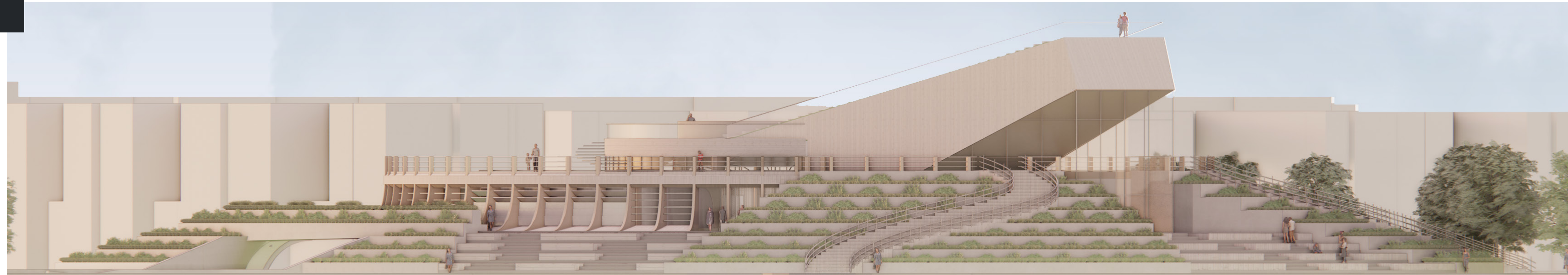


**Elevation - North**

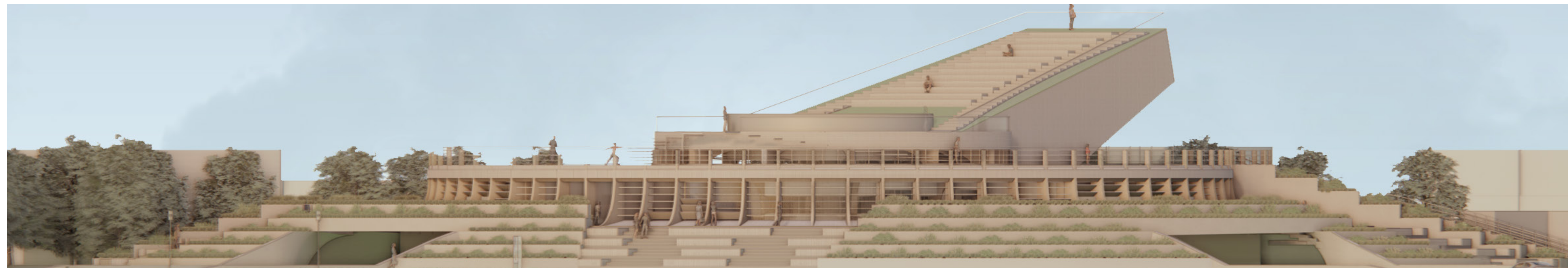


**Elevation - East**

# Elevations



**Elevation - South**



**Elevation - West**

See drawings document  
for on scale drawings.

# Section

See drawings document for on scale drawings.

4 m

2.5 m

14 m

5 m

13 m

19 m

9.5 m

3.5 m

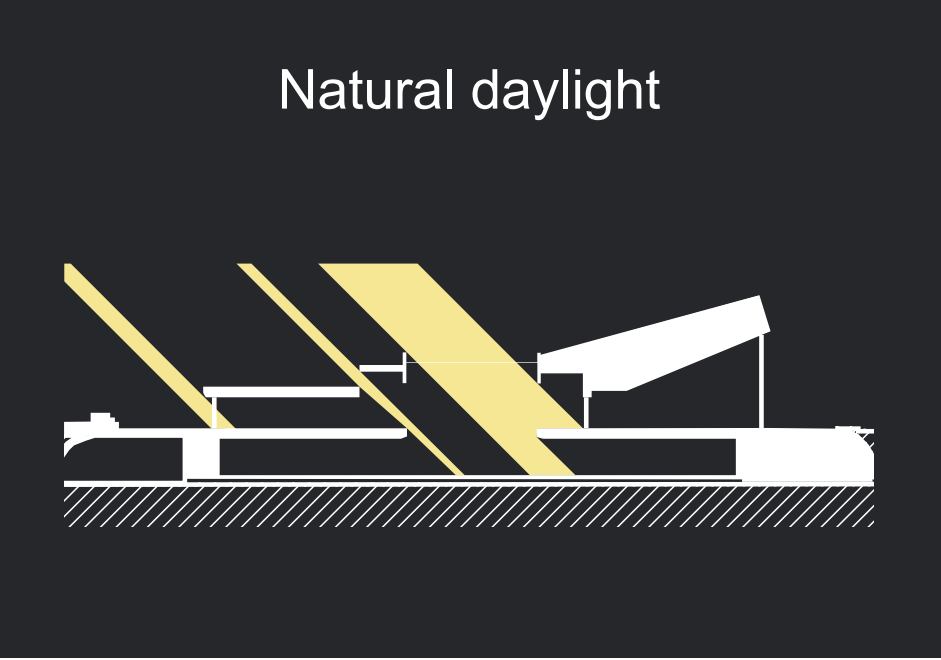
3 m

2 m

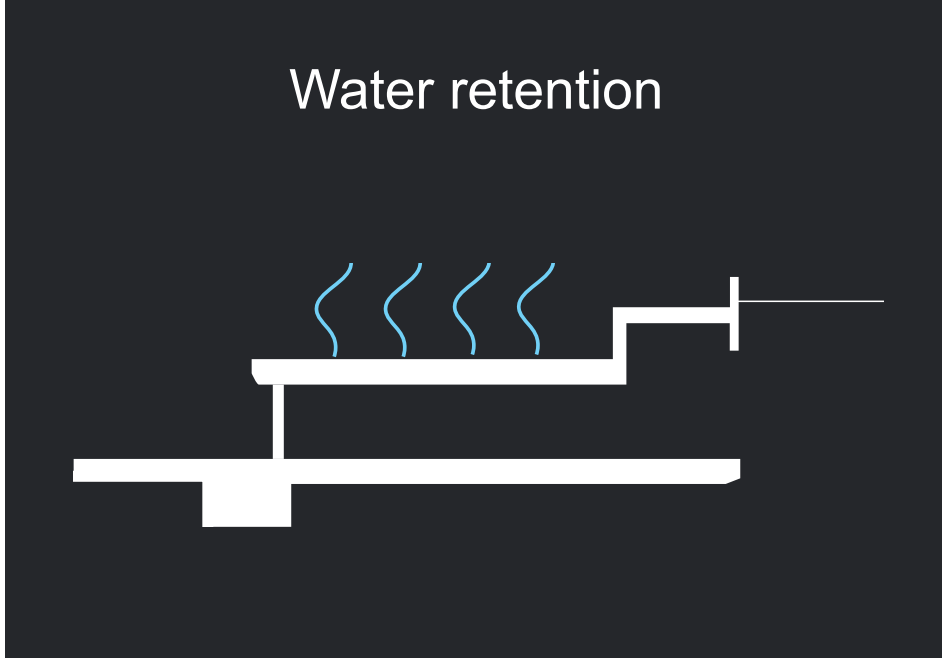
## Section AA



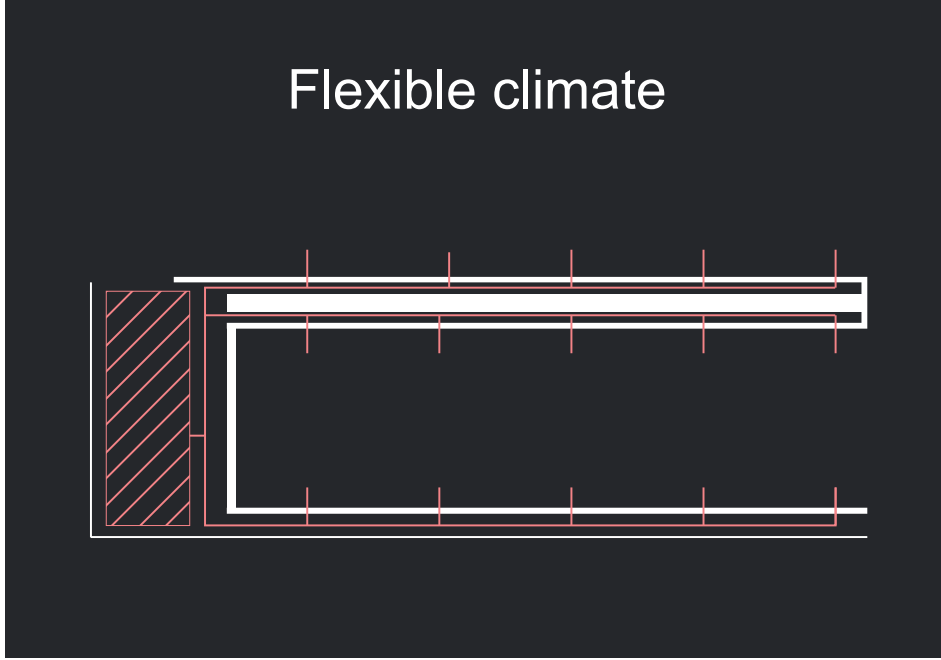
# Climate



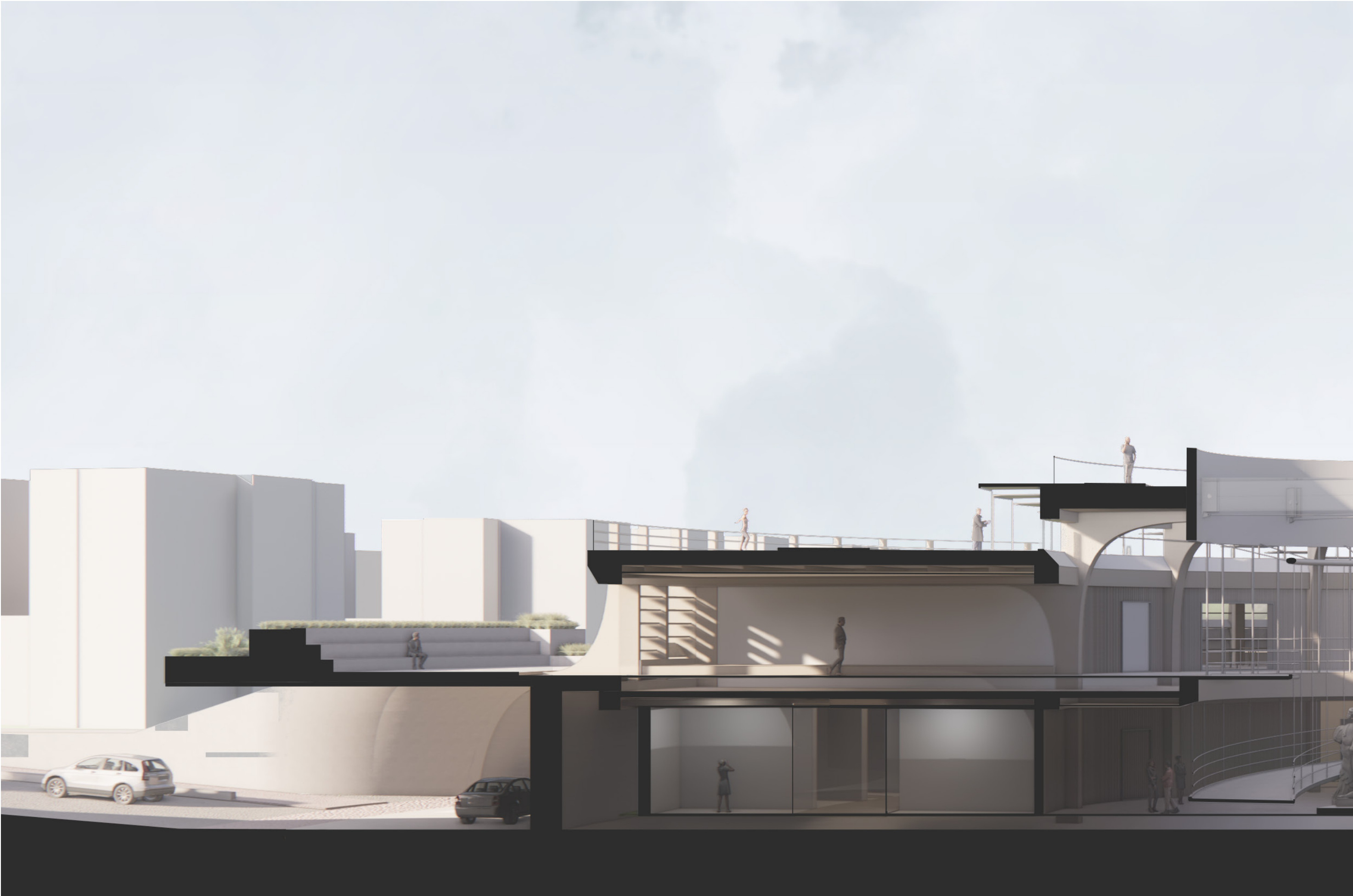
The building is open and has windows at all sides. This allows the building to be mostly lit by using natural daylight. To reduce the amount of light or increase privacy, horizontal lamellae are placed in front of the facade. These lamellae can rotate to control the amount of natural light. The lightwell in the center of the building provides the underground floor with as much light as possible. Reducing the need for lighting and the feeling of being underground.



The roof of the building is used to plant new vegetation which will add to the diversity of the area, whilst at the same time retaining water and preventing rain from going straight to the sewers. The building in total will add more m<sup>2</sup> of vegetation and open surfaces than there previously were at the site.

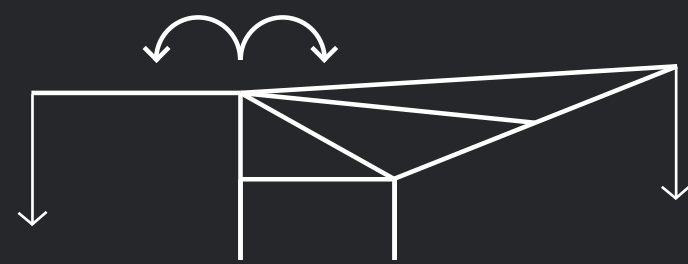


The lowered ceiling, the raised floor and the outer climate ring, combined with thought out detailing, give the building a flexible climate system and floorplan. The flexible floorplan and climate system allow the building to be able to adapt and grow with new ways of learning.



# Structure

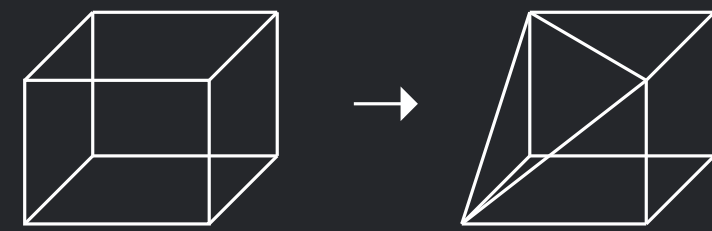
## Counterbalancing forces



The building has large spans and an overhang that protrudes more than 10 meters. Due to these spans and overhang, a lot of forces and momentum will be at play in the building.

Therefore the forces that are at play in this building have been used to counterbalance other forces. For example, the momentum of the large sloped lecture room will be countered by the hanging floor and stairs in the center of the building. This allows for smaller dimensions of the affected structural elements.

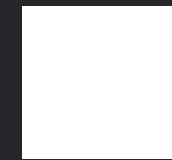
## Designed to adapt



The building is supported by a column and beam load-bearing structure. This allows the building to be able to adapt to changes in use and ways of learning. The raised floors and lowered ceilings can be swapped or removed if needed. The raised floor is supported by CLT panels which are connected by bolts and screws. By using bolts and screws, the panels can be removed and used in other projects.

## Two life spans

25 years

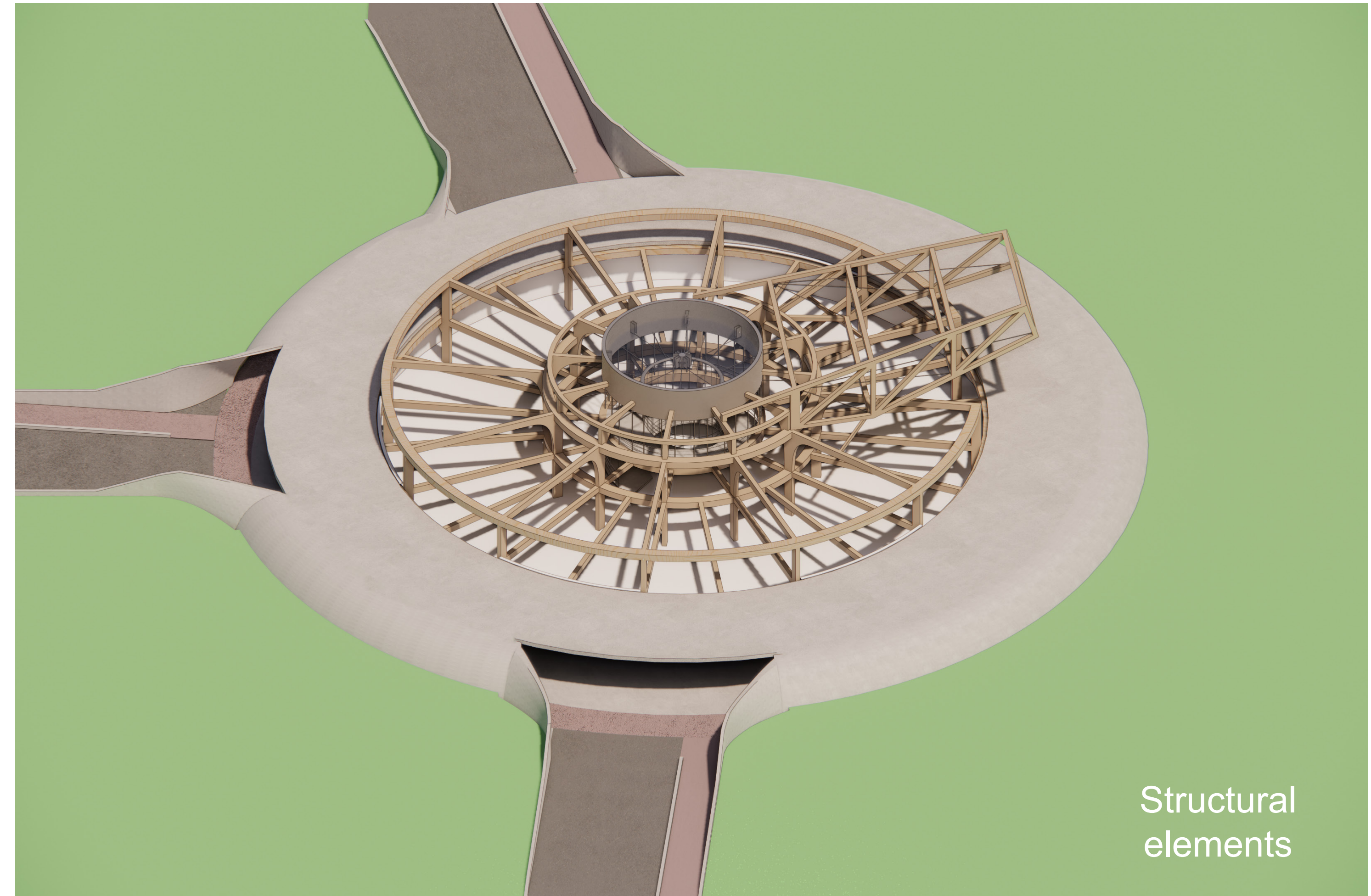


100+ years



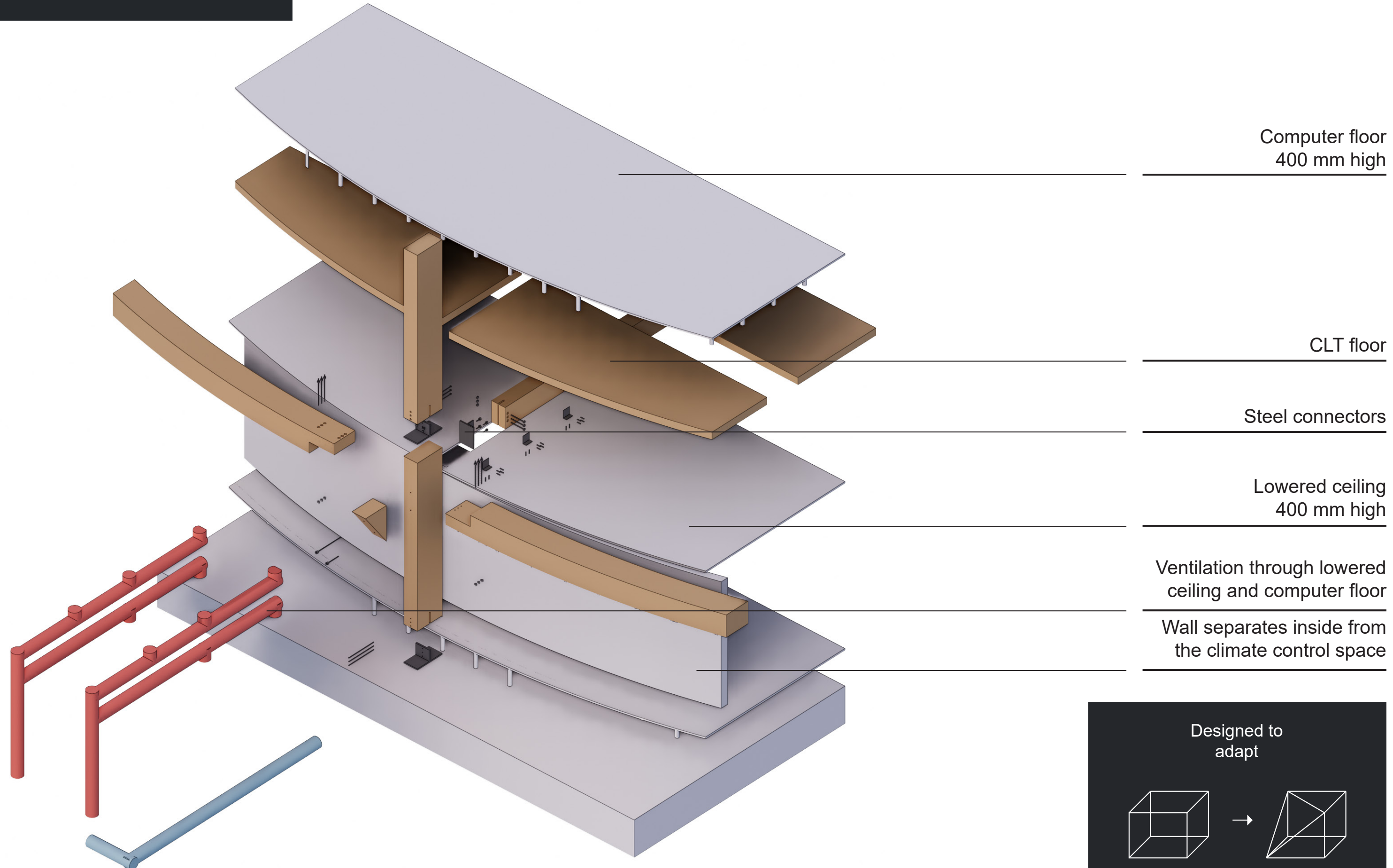
The building consists of two separate parts: the roundabout and the DEX hub. The two are separated from each other because of their life span, likeliness to change and use.

The roundabout will most likely remain the same for a very long time and needs to be durable. Therefore concrete is chosen as the main construction material. The DEX hub is built to adapt and change with the users and usage of the building. Therefore a material with a shorter life span is chosen: wood. This material and the demountable detailing create a library of materials that can be changed, taken apart, and even rebuild on another location if the DEX hub needs to change.



Structural elements

# Structure



Computer floor  
400 mm high

CLT floor

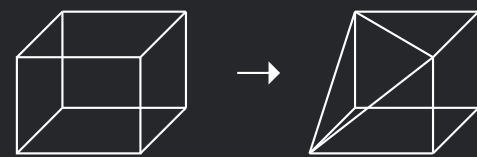
Steel connectors

Lowered ceiling  
400 mm high

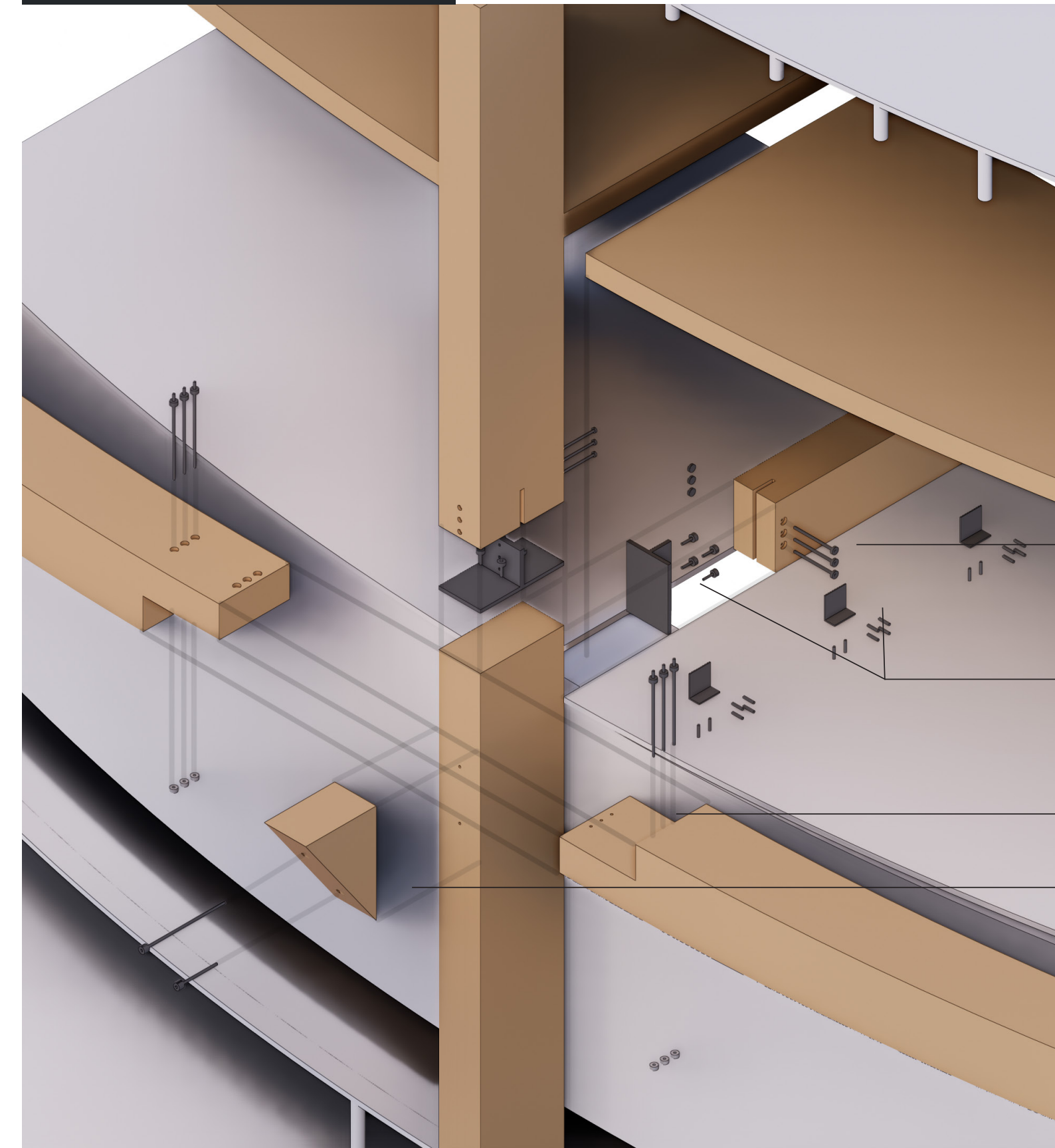
Ventilation through lowered  
ceiling and computer floor

Wall separates inside from  
the climate control space

Designed to  
adapt



# Structure



Computer floor  
400 mm high

CLT floor  
220 mm

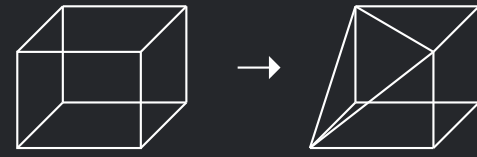
Bolts used to connect make  
disassembly & reuse  
possible

Steel connectors

The ring beam will be  
connected with vertical bolts

Support for ring beam

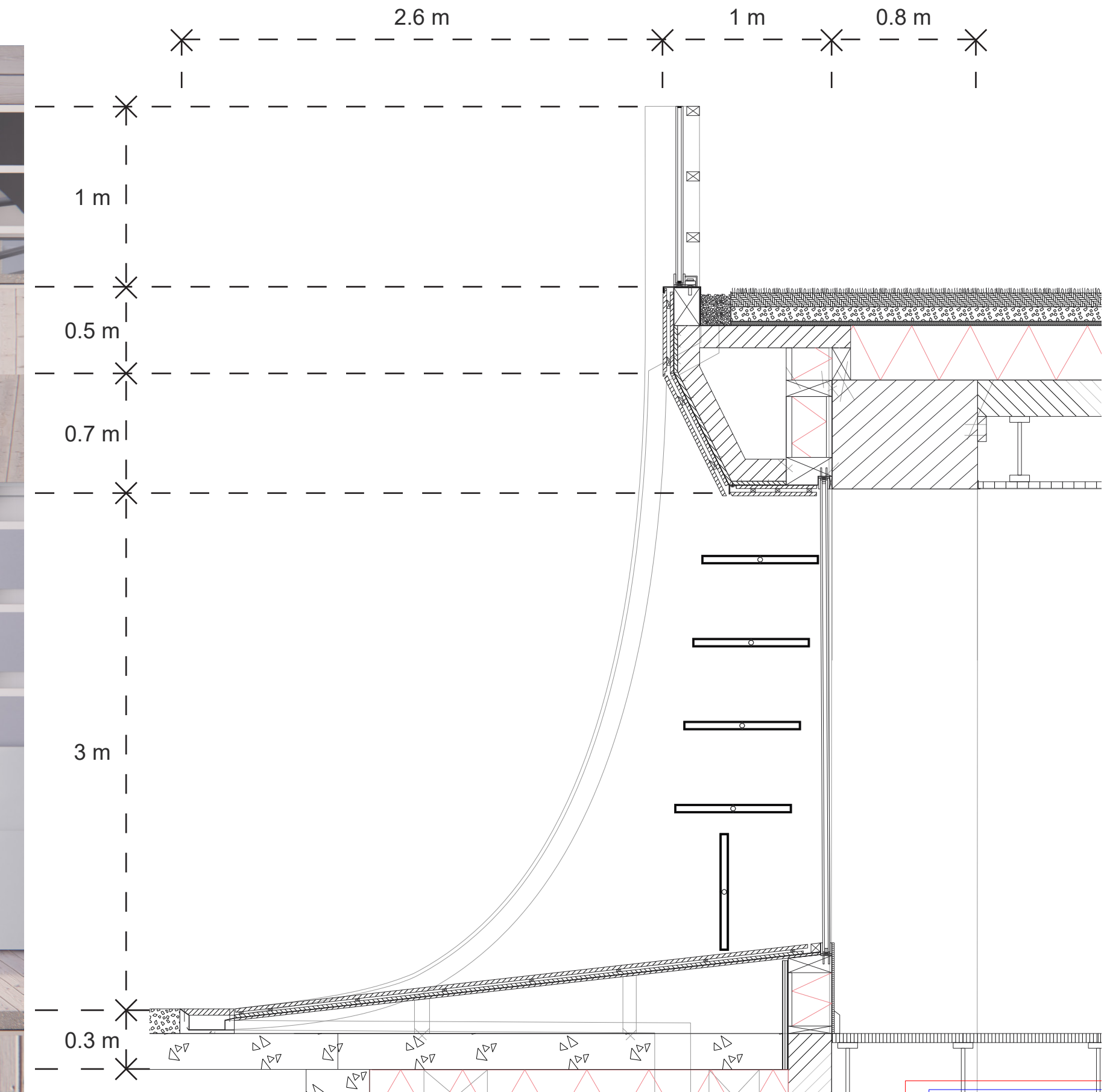
Designed to  
adapt



# Facade fragment

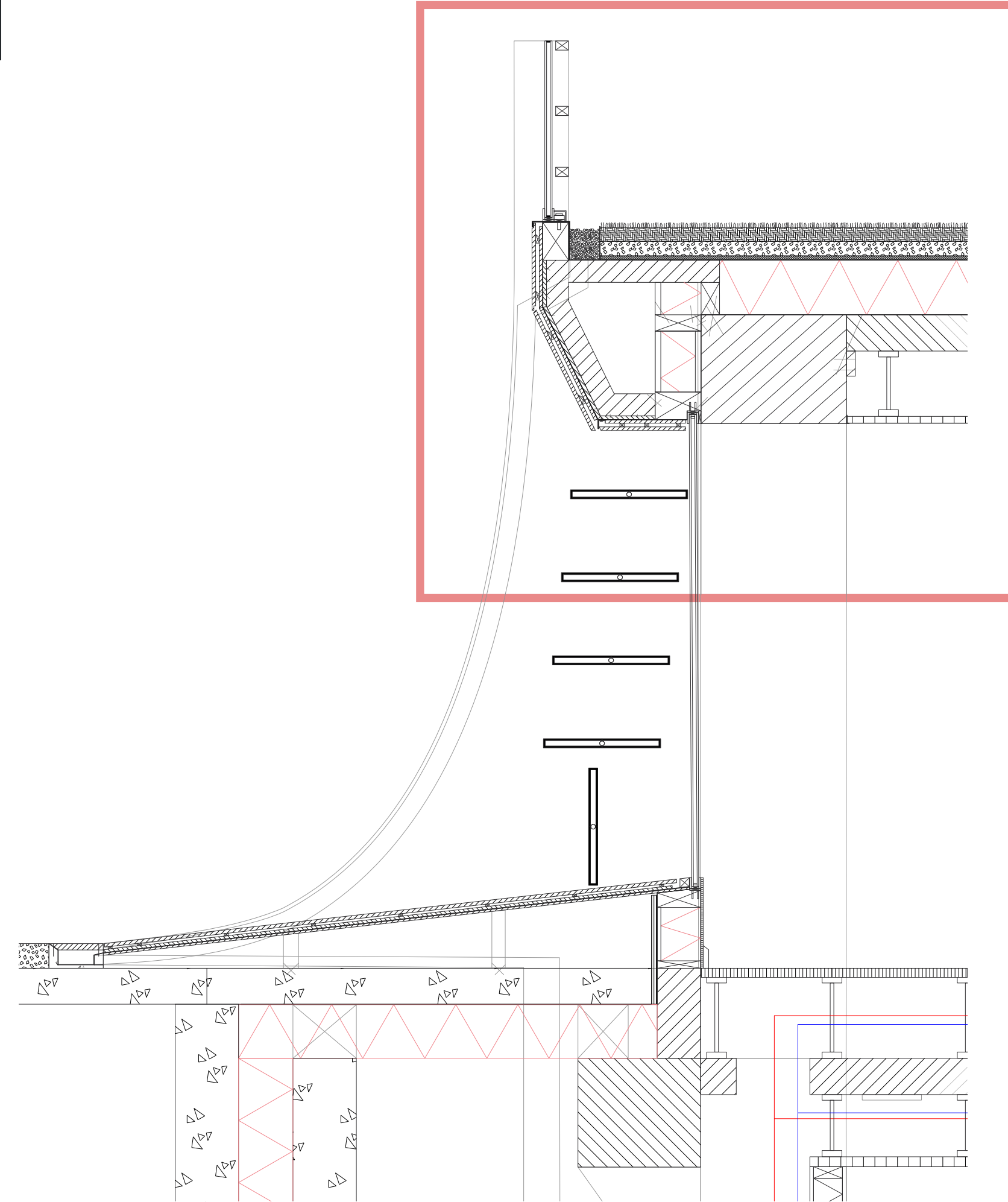
The facade is made of a wooden rabet structure and horizontal aluminum lamellae. These lamellae are rotatable by the users of the building. The lamellae can follow the sun's direction in summer to keep out the majority of the sun. In case events or workshops are held which need more privacy, then the lamellae function as a privacy regulator. By rotating the individual lamellae, the visibility from outside to inside can be regulated. Giving a more private environment if needed, but also a very open aesthetic when the rooms are not in use or when more daylight is needed.

The CLT beams support the edge of the roof and continue through the roof edge to function as a balustrade.

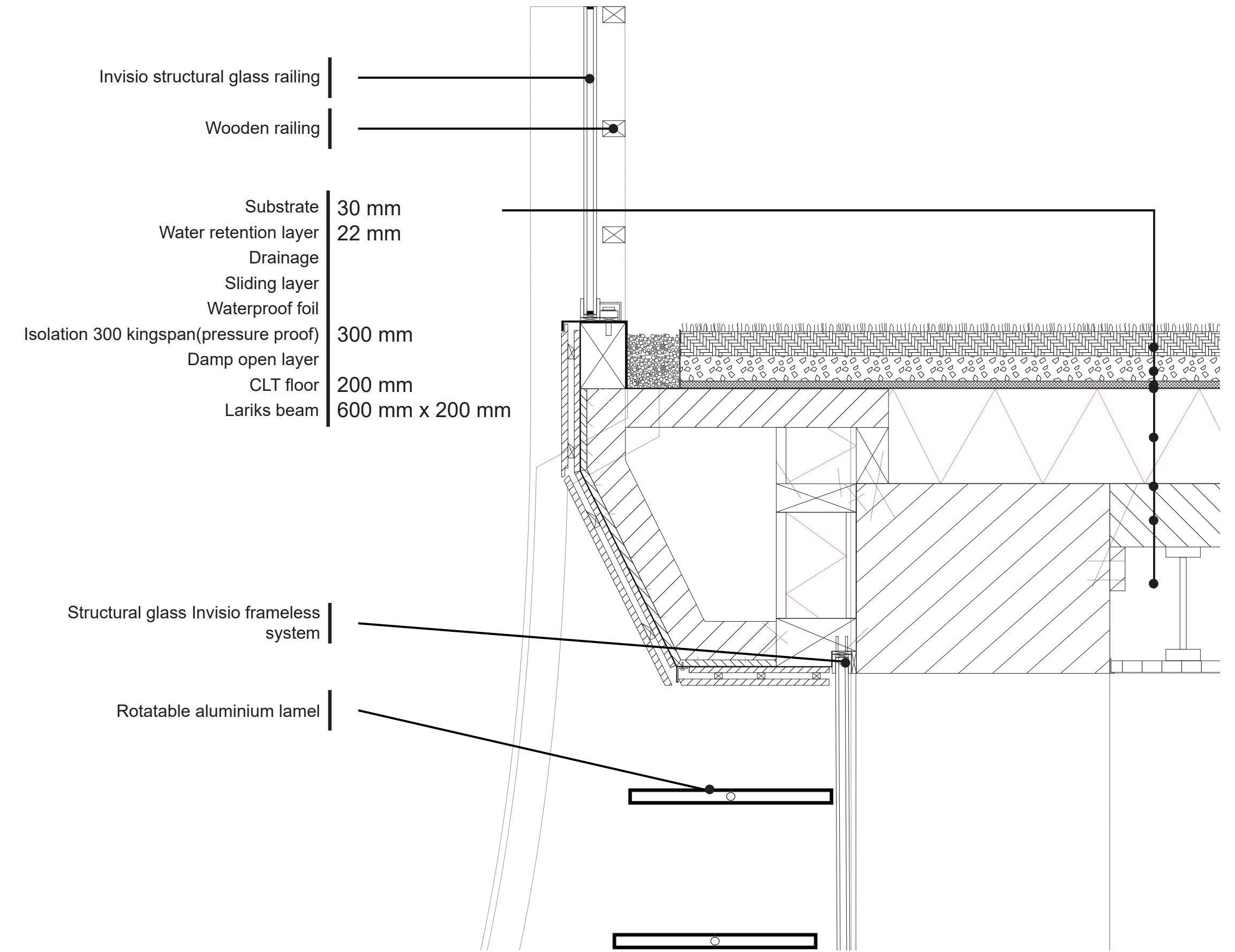


Scale 1:10

# Detail



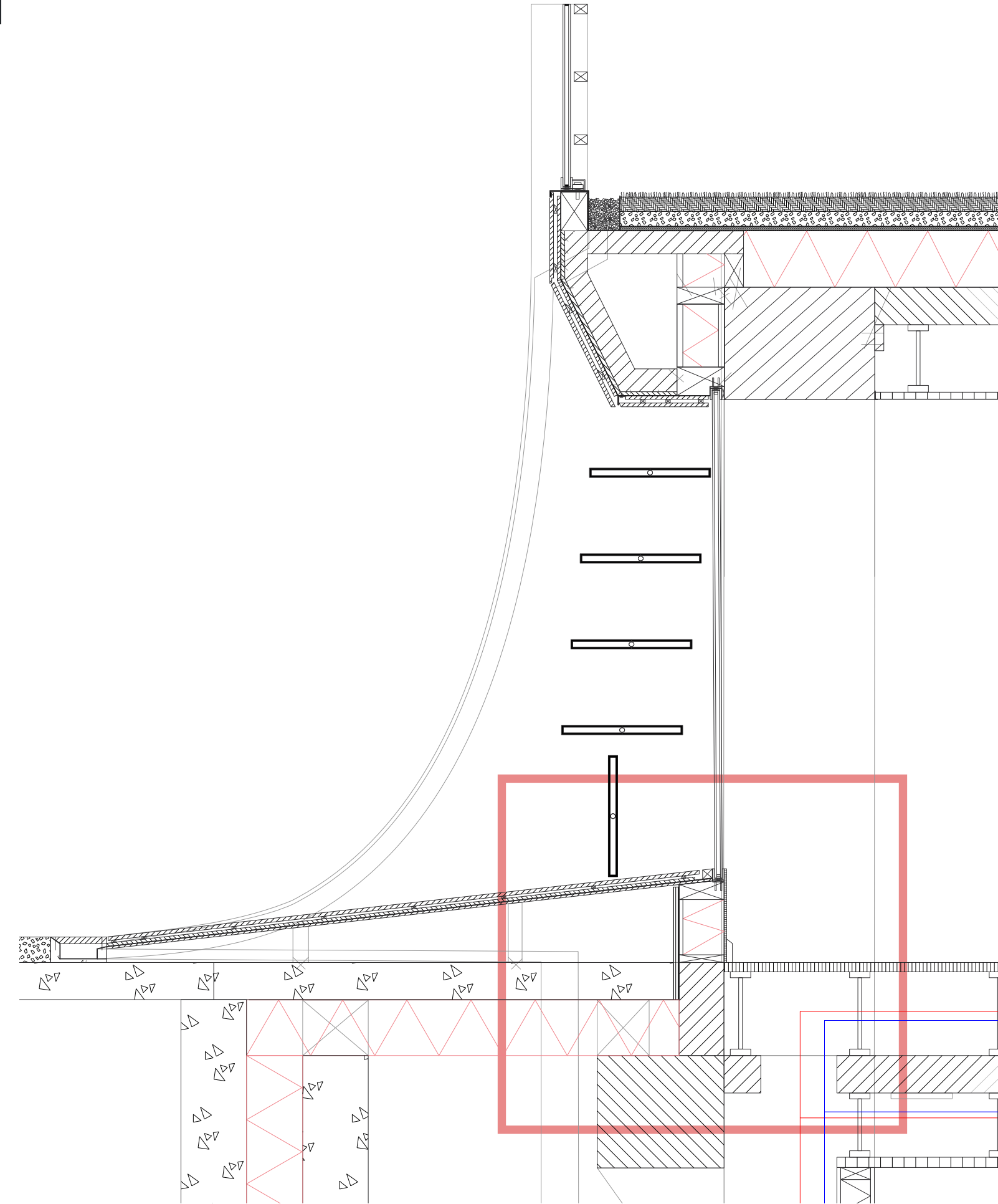
Scale 1:10



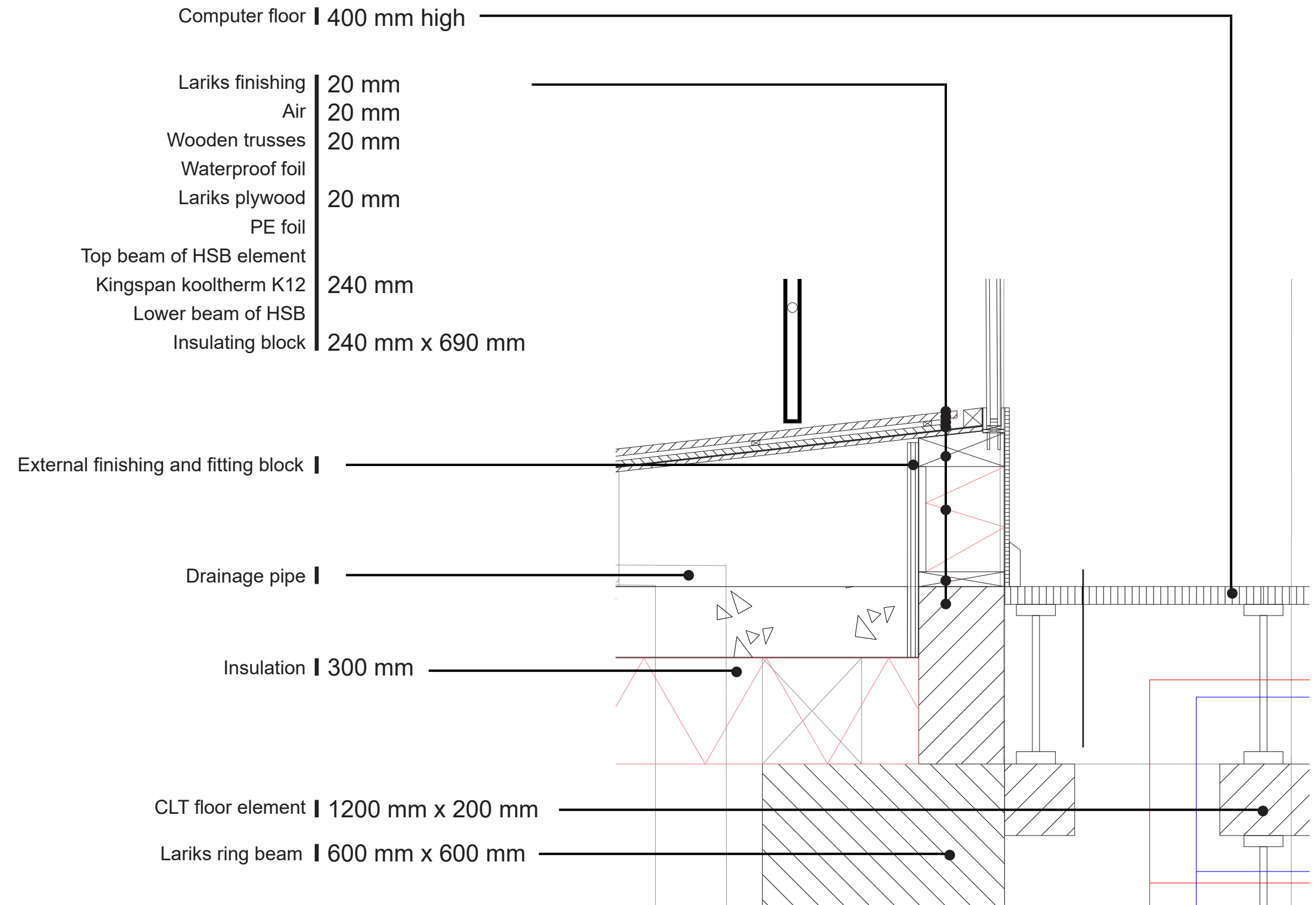
Scale 1:5



# Detail

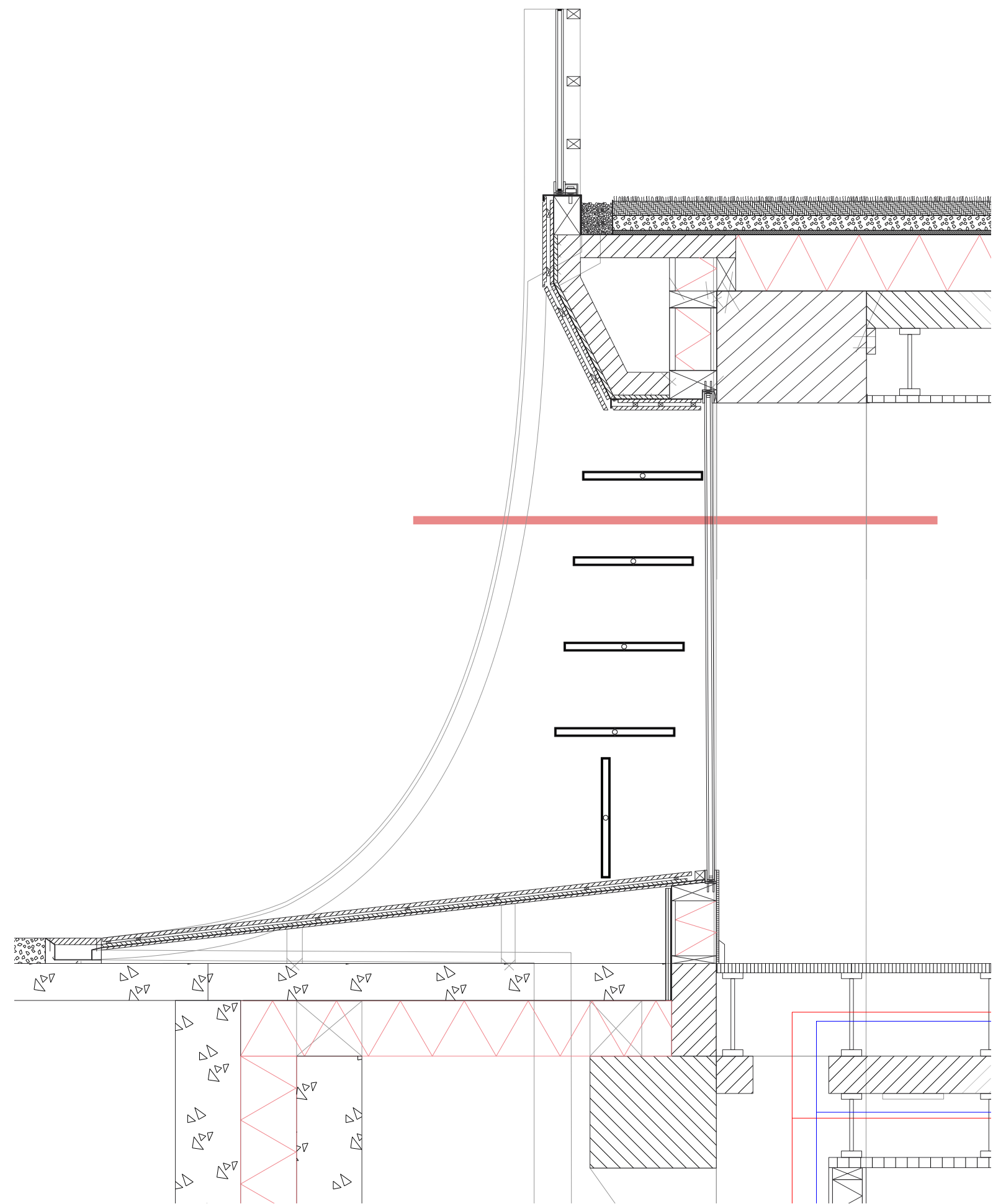


Scale 1:10



Scale 1:5

# Detail



Scale 1:10

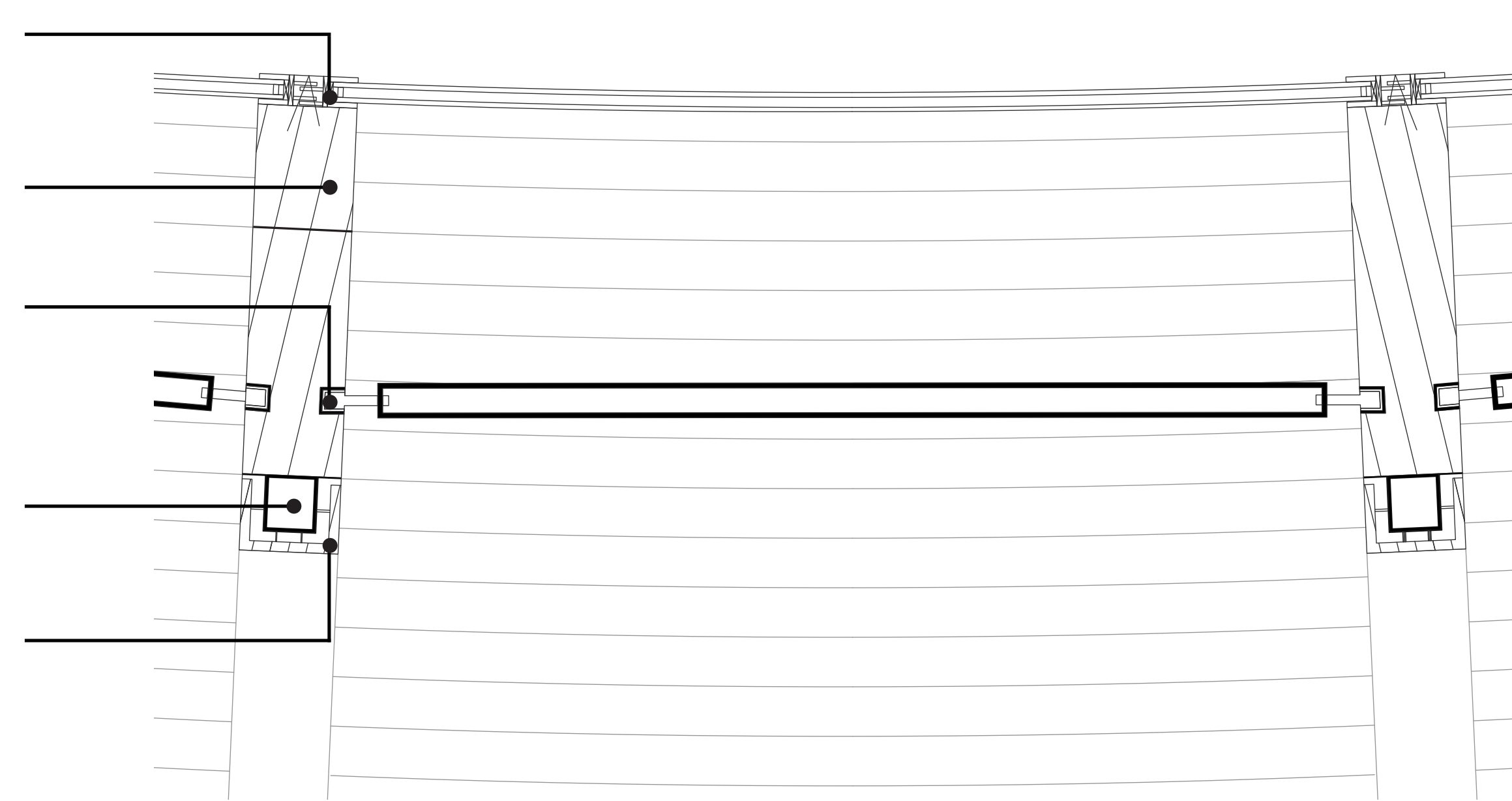
IQ structural glass system

Lariks CLT column

Socket for rotating lamel

Integrated drain

Lariks wooden top guard



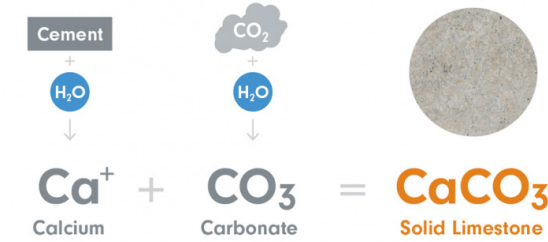
Scale 1:5

## Materials



### Wooden CLT panels

- + Prefab
- + CO2 positive
- + Regulates indoor climate
- + Natural and warm look
- Larger dimensions compared to steel and concrete
- Mass is relatively large compared to concrete and steel
- Shorter life span compared to concrete and steel



### Carboncure concrete

- + Reduced carbon footprint by storing CO2 in the concrete
- + A lot of shapes possible
- + Durable, lifespan of 200+ years possible
- Relatively large CO2 footprint compared to wood



### Lariks wood (cladding and beams)

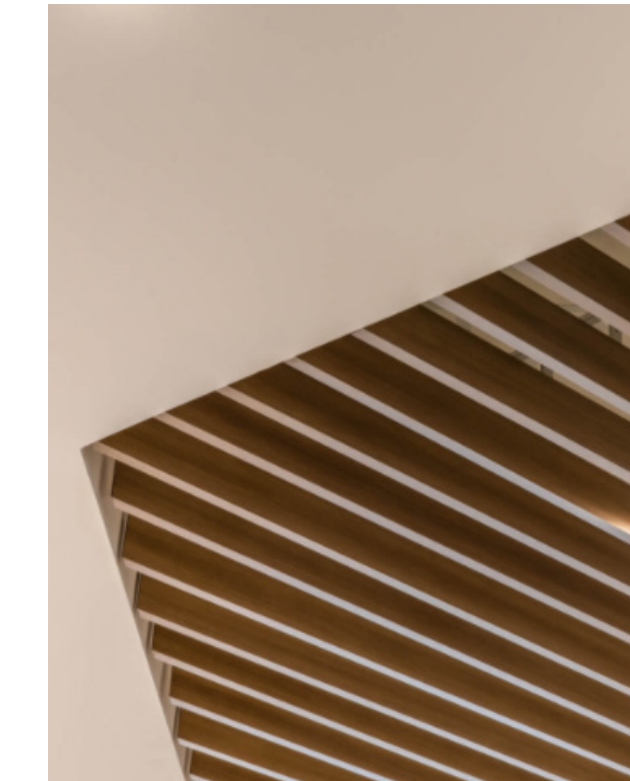
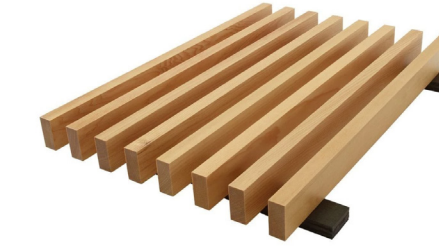
- + European grown sustainable wood
- + Non-chemically(steam) treated to increase lifespan to 25+ years.
- + Sustainable end of life alternatives
- Relatively short life span
- Fewer shapes possible than concrete

## Elements



### Computer floor

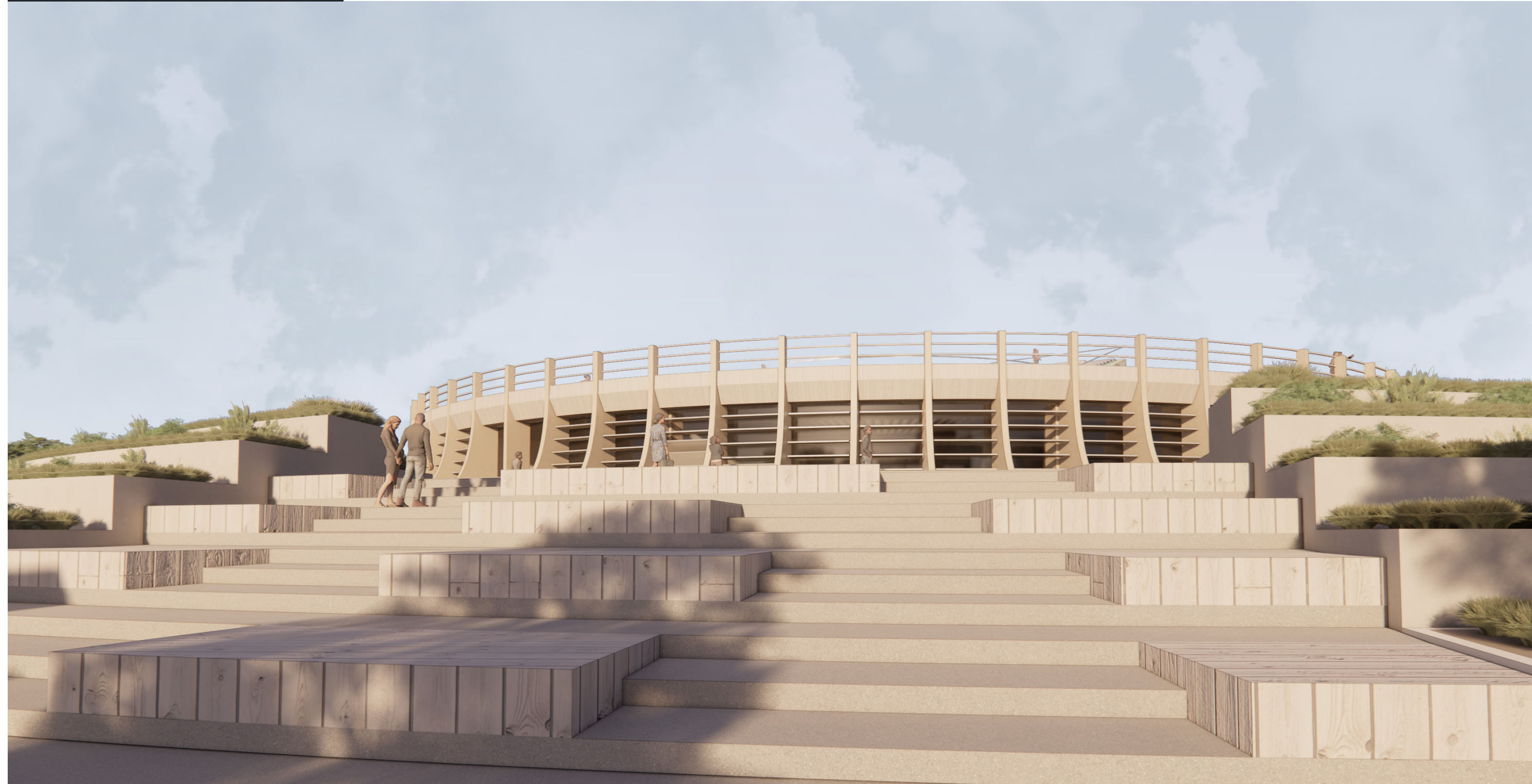
- + Integrated climate systems possible
- + Options to reduce contact sound transmission in between floors
- + Easily interchangeable floor finishings
- Limited choice of finishings
- Hollow sound depend on the finishing
- Load limitations



### Lowered ceiling

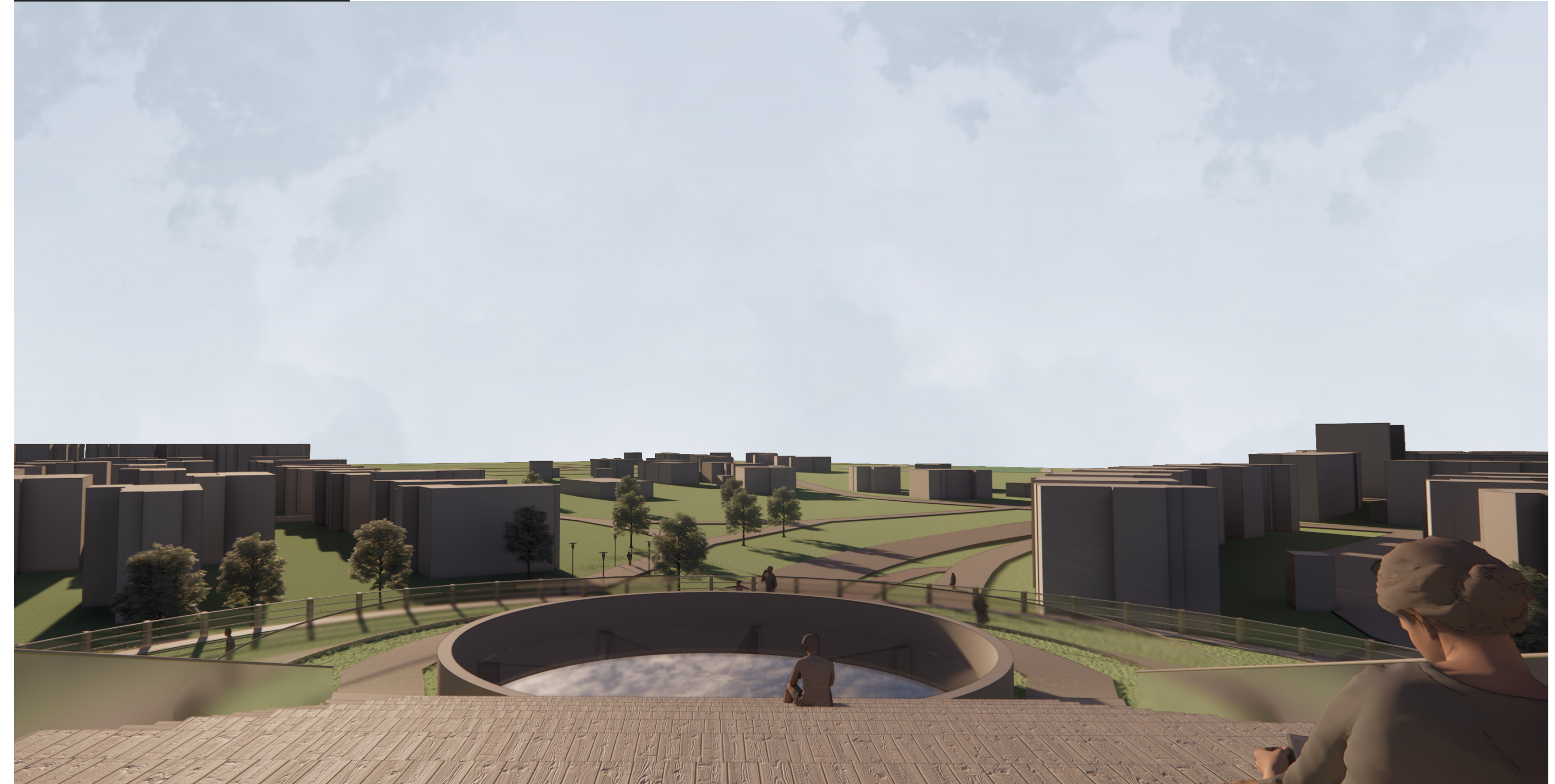
- + Flexible climate system possible
- + Maintenance friendly
- Lowered ceiling height
- Limited amount of finishing

Render



**Render - Approach**

Render



**Render - Top of building**

Render



**Render - Path on building**

Render



**Render - Hallway**

Render



**Render - Main hall**

Render



**Render - Exposition**