Casestudy: Rotterdam

Introduction.

The municipality of Rotterdam has applied for a pilot project in their city. Rotterdam is the second-largest city of the Netherlands. It is located in the province of South Holland, at the mouth of the Nieuwe Maas channel leading into the Rhine–Meuse–Scheldt delta at the North Sea. Its history goes back to 1270, when a dam was constructed in the Rotte, after which people settled around it for safety. In 1340, Rotterdam was granted city rights by the Count of Holland. Rotterdam is Europe's largest port and is major logistic and economic centre. In 2019 it has a population of 644.527. The near-complete destruction of the city centre in the World War II Rotterdam Blitz has resulted in a varied architectural landscape. In the city centre, historic buildings and characteristic post-war reconstruction architecture clash cheerfully with the hypermodern skyscrapers built in more recent decades. Rotterdam has the ambition to become circular and is therefor applying for world first living structure to show the rest of the world how to make it happen.



Customer.

At present, the Municipality of Rotterdam is busy creating an environmental vision for 2030. An environmental vision is a story, image or website that shows a municipality how it wants to design the physical living environment. With physical living environment is meant everything that is needed to live, live, work, study, recreate and so on in Rotterdam. Such as water, air, soil, nature, roads, buildings. The Municipality wants the physical living environment of the entire territory of Rotterdam to be filled in together. Five perspectives have been developed for this: the circular city: Rotterdam offers space for sustainable energy, recycling and experimenting. The compact city: Rotterdam as a compact, attractive city on the river. The healthy city: Rotterdam makes healthy living in the city possible by being climate adaptive and creating more green in the city. The inclusive city: Rotterdam offers space for meeting and participating. And finally the productive city: Rotterdam offers space for the new economy and innovation in which every member of society can participate.



Urban Plan.



1 M4H
Experimenting in Rotterdam's maker district.

2 OLD WEST
One of the most polluted streets in the NL turns green.

3 HOFBOGEN
Old abandoned train station ready for redevelopment.

4 KRALINGEN
It all starts with education at the multi cultural Arent school.

5 ENTREPOT
The former harbour of Rotterdam showcases its rich history.

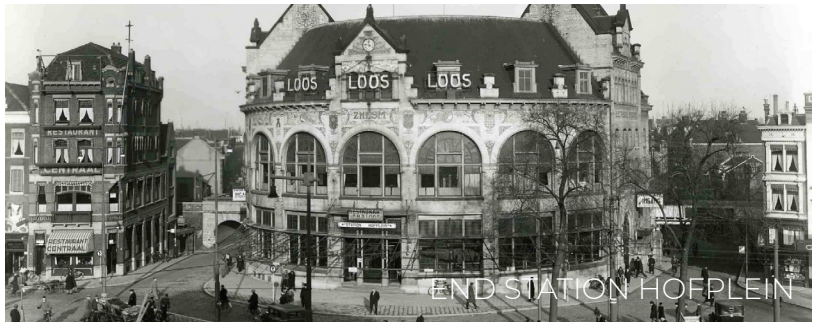
6 ZUIDPLEIN
This modern shopping center is the hotspot for consumerism

Hofbogen.

In 1908 the hofbogen opened as Netherlands first electrical train track. The track was built to connect Rotterdam with The Hague and Scheveningen (beach) via smaller villages as alternative for the established Rotterdam-Delft-The Hague track. The reason for setting up a new train track was the exodus of the wealthy class towards these small villages, where taxes were lower. The municipality of Rotterdam agreed upon the construction of a new train track but demanded it would not intervene with other traffic in the city. Therefor first part of the track existed out of a 1,9km train viaduct nicknamed after its characteristics reinforced concrete bows: de hofbogen. In 2010 the last train was scheduled and now a plan is approved by the municipality to transform the bows into offices and commercial real estate while they demanded the deck to be a public park. Ever since its first innovative experiment this monumental building has been screaming for the deserved attention. With the ability to connect the unconnected the hofbogen makes a great showcase for the living architectural system.


AFTER WWII


ELECTRIC TRAIN



END STATION HOFPLEIN


CONSTRUCTION

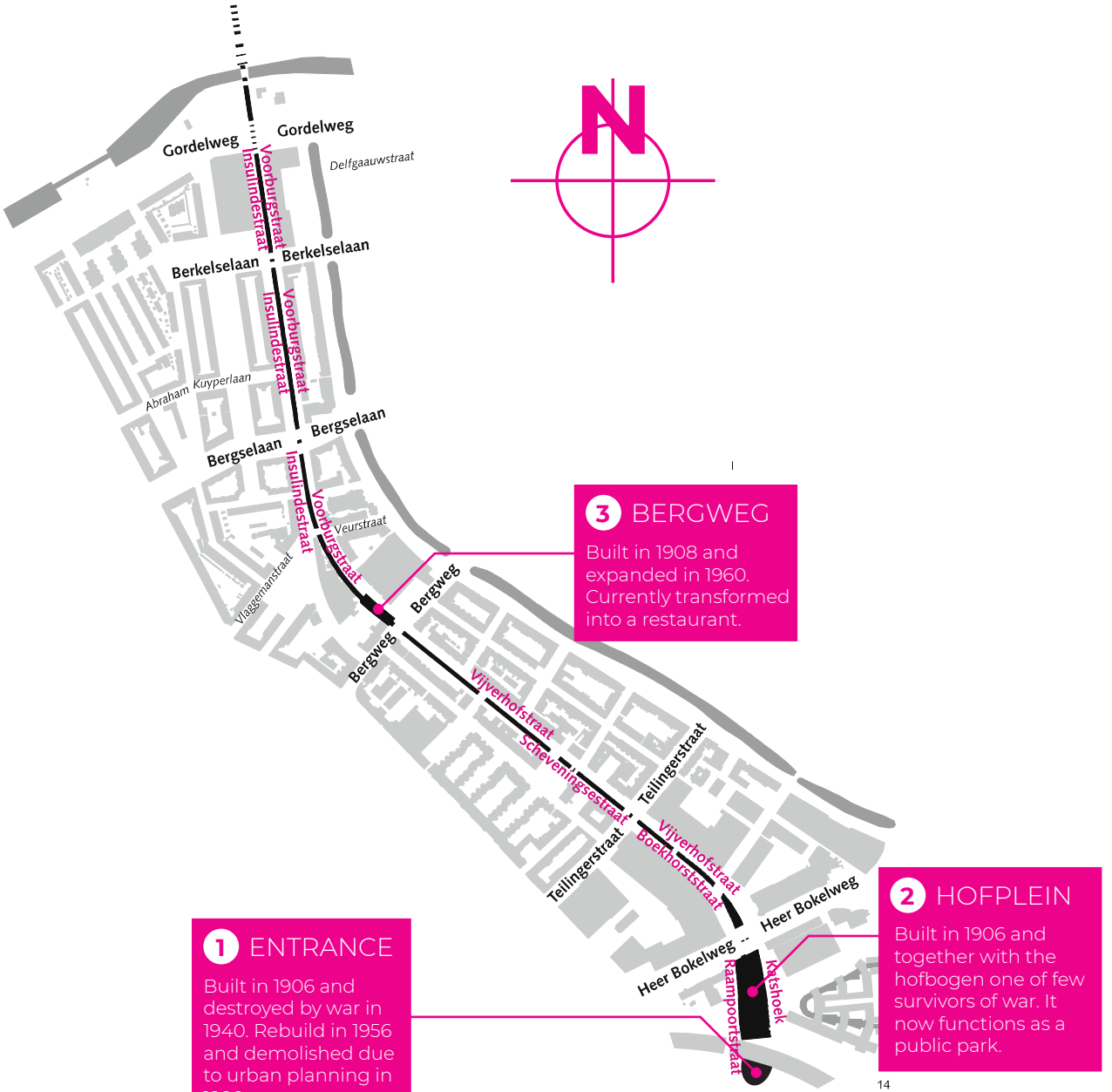


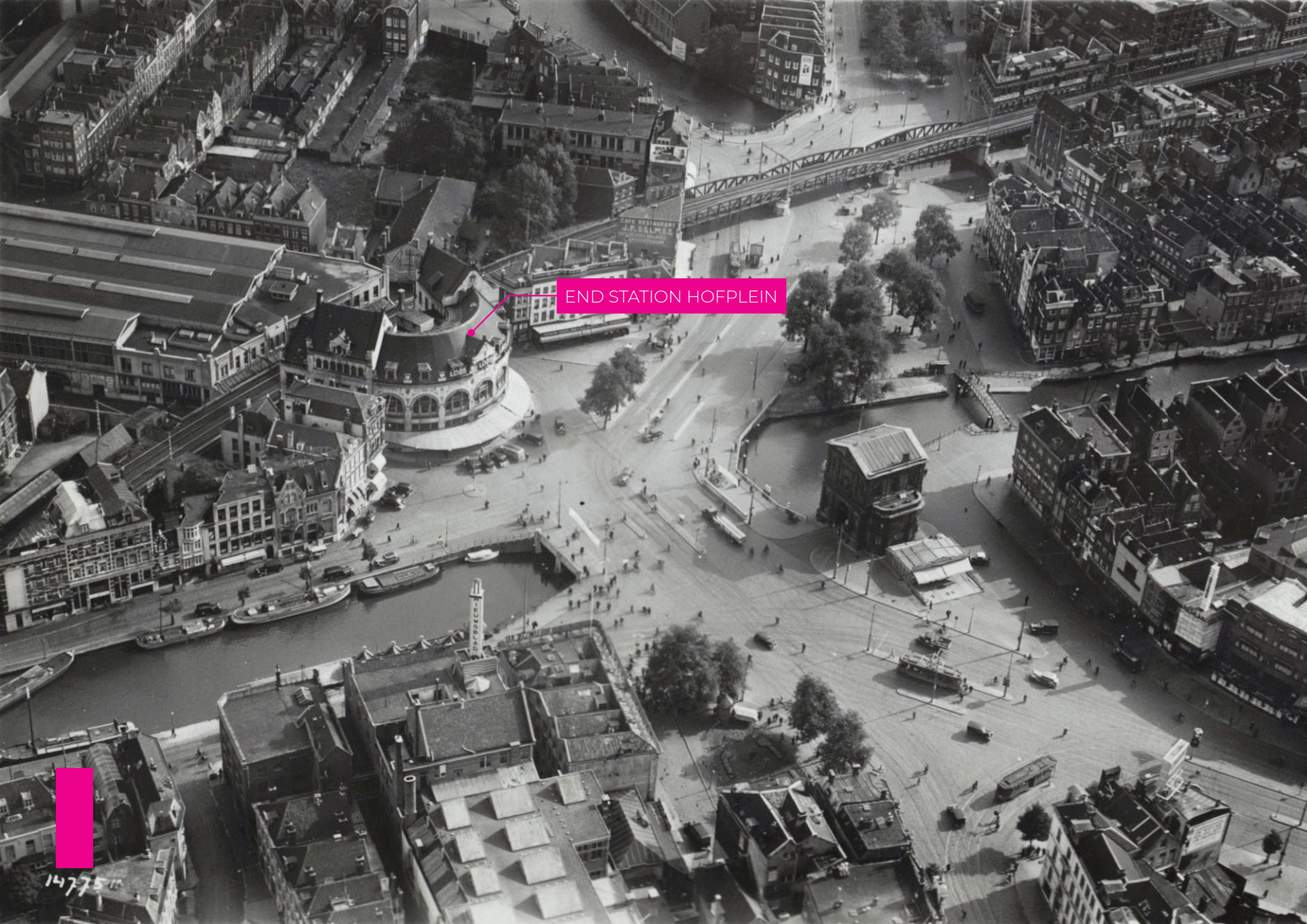
MID STATION BERGWEG


VIJVERHOFSTRAAT

Stations.

Originally the Hofplein line had two stations that were part of the integral design of the viaduct: the Hofplein end station and Bergweg mid station. The bombing of 14 May 1940 led to considerable damage to both buildings, after which travelers had to deal with an emergency building for several years to do. At the end of the 1950s, railroad engineer Sybold van Ravesteyn designed two new station buildings at the same locations along the Hofplein line for the Dutch Railways. Of these two post-war stations, only Bergweg station still exists, but has become prey of the Italian fast food chain Happy Italy. Hofplein station was demolished in 1990 as a result of a major infrastructure change in the Rotterdam rail network and city planning. In which the Hofplein square was moved towards the south. After that, the owner no longer opted for the construction of a new head station. The Hofplein station building, the Bergweg midstation and the viaduct remained intact. When the train stopped running in 2010, the Hofplein line became an abandoned national monument full op potential redevelopment.



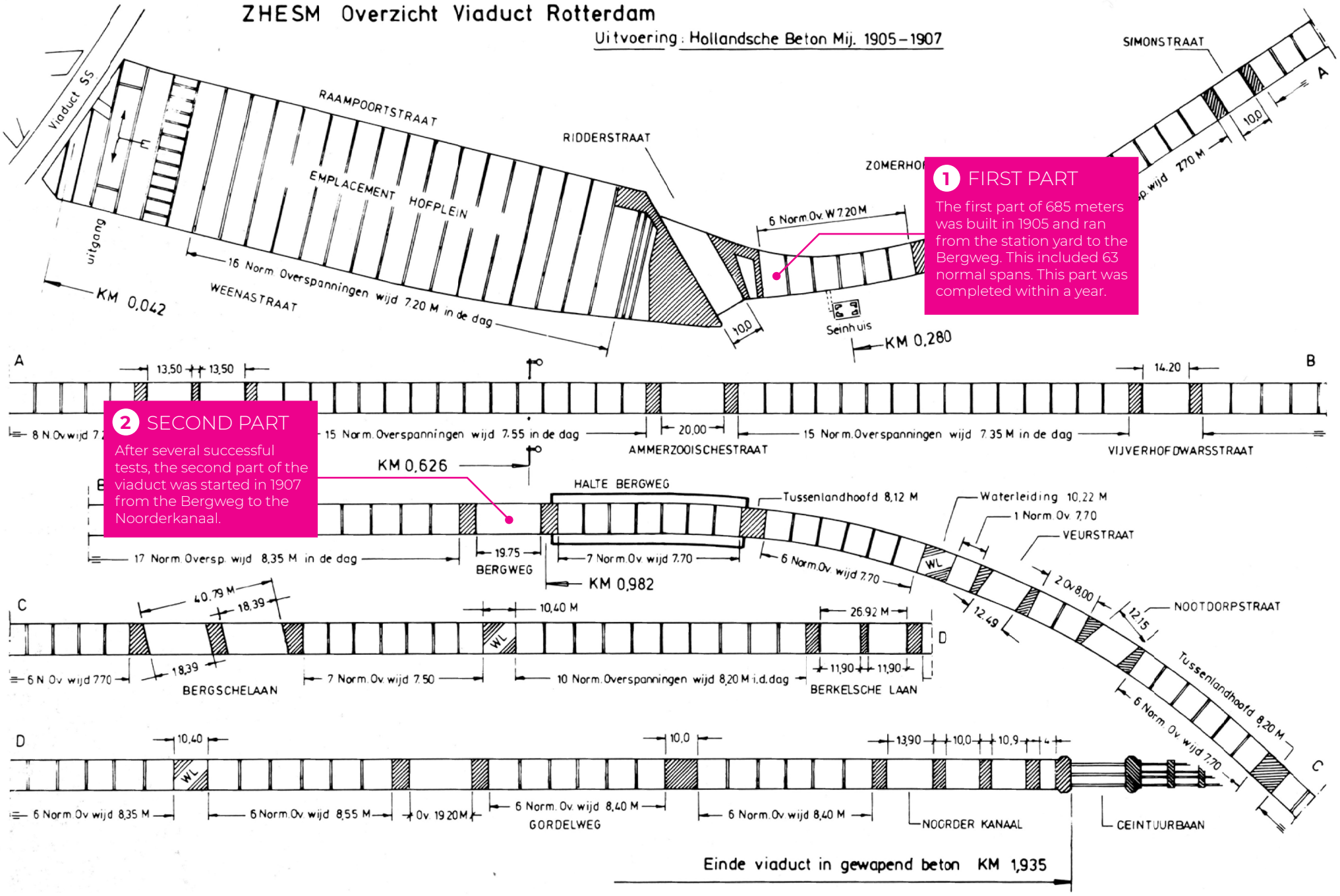

END STATION HOFPLEIN

Construction.

In addition to the fact that the Hofplein line was the first electric train in the Netherlands, the construction of the viaduct was also a first. The railroad organization at that time opted to construct the Hofplein viaduct in reinforced concrete, because this material was cheaper in comparison with the usual metal constructions, had a favorable construction height and caused less environmental nuisance. There had been spans in reinforced concrete before, but never before had an air track been built with an span of almost two kilometers. The final realization of the Hofplein viaduct marked a revolutionary breakthrough in the development of the construction of railway viaducts. Engineer Van Hemert managed to realize an extremely strong and light construction for the Hofplein viaduct. In principle, the entire construction was hollow and constructed from thin sheets of reinforced concrete that were anchored to each other via the reinforcement. The entire structure was completed in 1907 and then consisted of a total of 189 spans varying in width (between 10.50 meters and 21.60 meters), of which 14 underpasses were intended for intersecting roads.

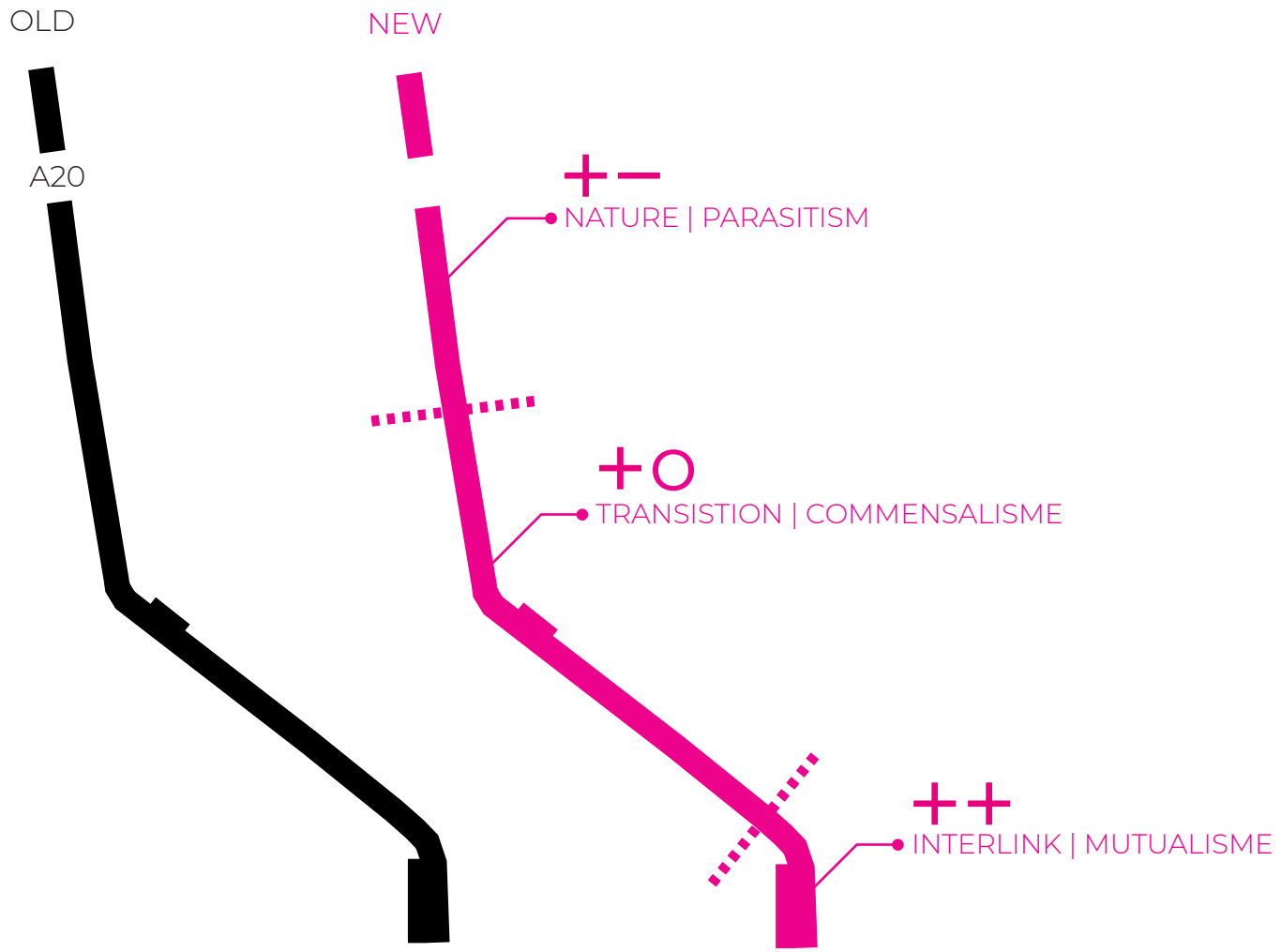


Plan.


ZHESM Overzicht Viaduct Rotterdam
Uitvoering: Hollandsche Beton Mij. 1905–1907
Viaduct SS
RAAMPOORTSTRAAT
EMPLACEMENT HOFPLEIN
RIDDERSTRAAT
SIMONSTRAAT
uitgang
16 Norm Overspanningen wijd 7.20 M in de dag
WEENASTRAAT
KM 0.042
6 Norm.Ov. W 7.20 M
10.0
Seinhuis
KM 0.280
270 M
1 FIRST PART
The first part of 685 meters was built in 1905 and ran from the station yard to the Bergweg. This included 63 normal spans. This part was completed within a year.
13.50
13.50
14.20
15 Norm.Overspanningen wijd 7.55 in de dag
20.00
15 Norm.Overspanningen wijd 7.35 M in de dag
AMMERZOOISCHESTRAAT
VIJVERHOFDWARSSTRAAT
2 SECOND PART
After several successful tests, the second part of the viaduct was started in 1907 from the Bergweg to the Noorderkanaal.
KM 0,626
HALTE BERGWEG
Tussenlandhoofd 8,12 M
Waterleiding 10,22 M
1 Norm.Ov. 7.70
VEURSTRAAT
17 Norm.Oversp. wijd 8,35 M in de dag
19.75
BERGWEG
7 Norm.Ov wijd 7.70
6 Norm.Ov wijd 7.70
KM 0,982
2 Ov.8,00
12.15
NOOTDORPSTRAAT
40.79 M
18.39
10.40 M
26.92 M
12.49
6 N Ov wijd 7.70
18.39
BERGSCHELAAN
7 Norm.Ov wijd 7.50
10 Norm.Overspanningen wijd 8,20 M i.d.dag
11.90
11.90
BERKELSCHE LAAN
Tussenlandhoofd 8,20 M
6 Norm.Ov wijd 7.70
10,40
10.0
13.90
10.0
10.9
6 Norm.Ov wijd 8,35 M
6 Norm.Ov wijd 8,55 M
Ov 19.20M
6 Norm.Ov wijd 8,40 M
GORDELWEG
6 Norm.Ov wijd 8,40 M
NOORDER KANAAL
CEINTUURBAAN
Einde viaduct in gewapend beton KM 1,935

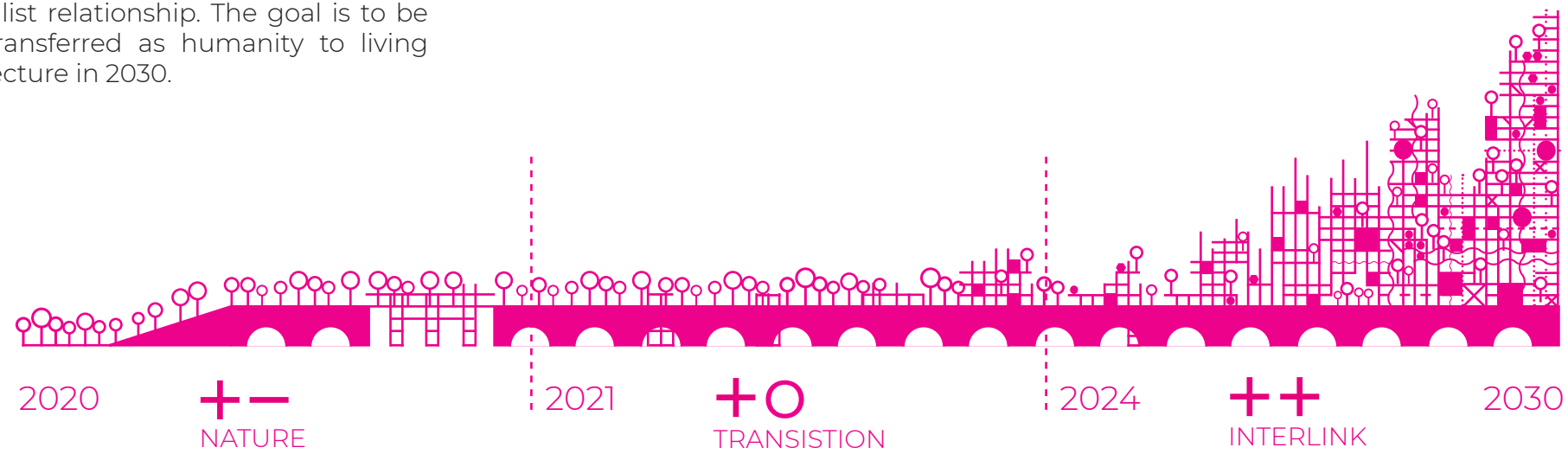
Vision.

The goal is to interlink Rotterdam with natures natural ecosystem and hereby recover the disturbed relationship between humans and their environment. For more than 100 years this track has been dominated by trains that transported humans throughout the country. Since 2010 the old train viaduct is not in use anymore a therefor an opportunity arises for a new symbiosis. On the North side of the Hofbogen, natures enters the track and slowly 'walks' into the city. In the new situation the track will be divided in 3 section that fluently flow into each other. The North side will be dominated by nature to confront people with the physical presence of wilderness in the direct environment. In the midsection (transition), humans are gently interlinked into the system which slowly evaluates in a complete symbiosis southward the end of the track.



Mision.

By breaking our current symbiosis, the relationship between man and nature must be restored. At present, humanity is a parasite. By going through various symbiosis such as parasitism, commensalism and mutualism, the relationship will slowly recover. In the first phase it is confronted, where the building has no function and it will degrade to nature. In the next phase, functions are gradually added which will increase in lifespan. This is the transition phase. In the final phase, humanity will be equal to nature by entering into a mutualist relationship. The goal is to be fully transferred as humanity to living architecture in 2030.



Through Time.

Like the train, the building is also moving. The designer initially determines the maximum lifespan of the building, whereby the user has the important task of maintaining it and thus keeping it alive. Over time, the building changes to the needs of the user. In the first phase, the mega construction is built up, after which it will be sprayed with mycelium and embrace the degradation process. Here the residents of Rotterdam are confronted with - in a first respect - useless building, which results in a parasitic relationship. The building then continues and small functions are gradually added to the megastructure, such as lookout towers, walking routes and restaurants. The transition phase is heralded in this and the lifespan of the megastructure will increase. In the coming phases, the functions in the mega structure will increase and the service life will also increase. Gradually a trail of nature forms behind the building, of already composted buildings. Here, people see the cycle of life up close and are directly confronted with the laws of nature, which in the long term must cause a fundamental change in our dealings with the environment.



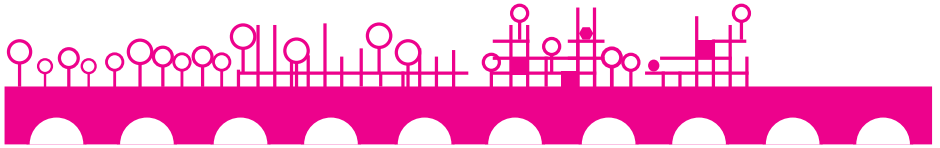
Phase 0



Phase 1



Phase 2



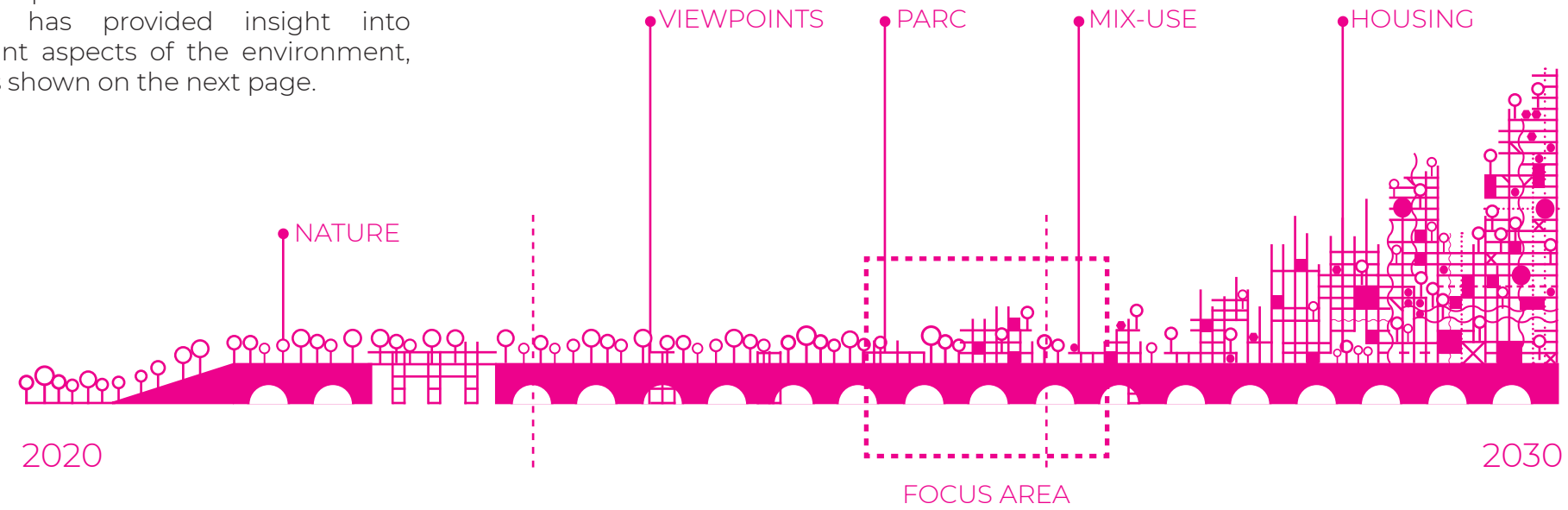
Phase 3



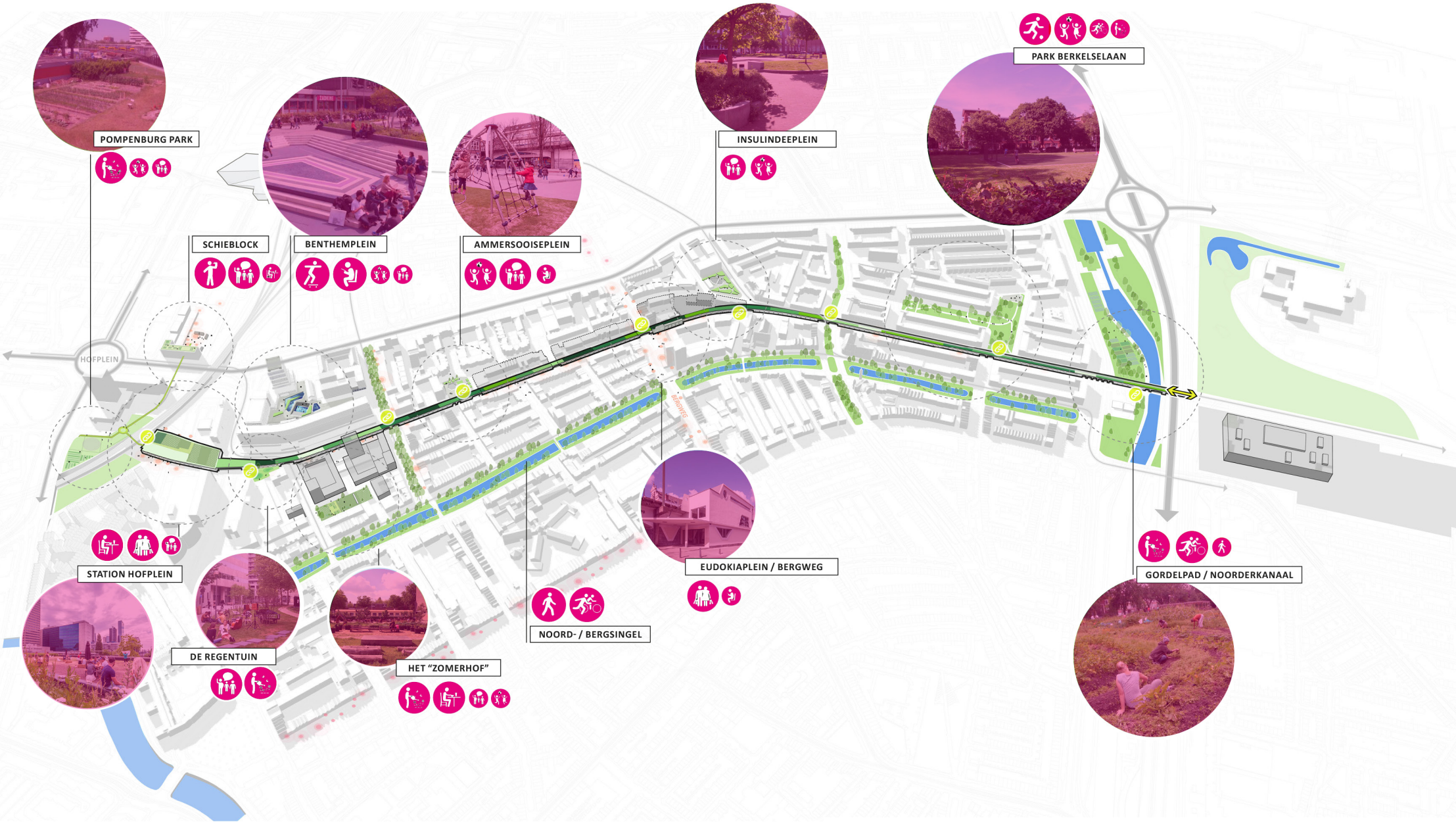
Phase 4

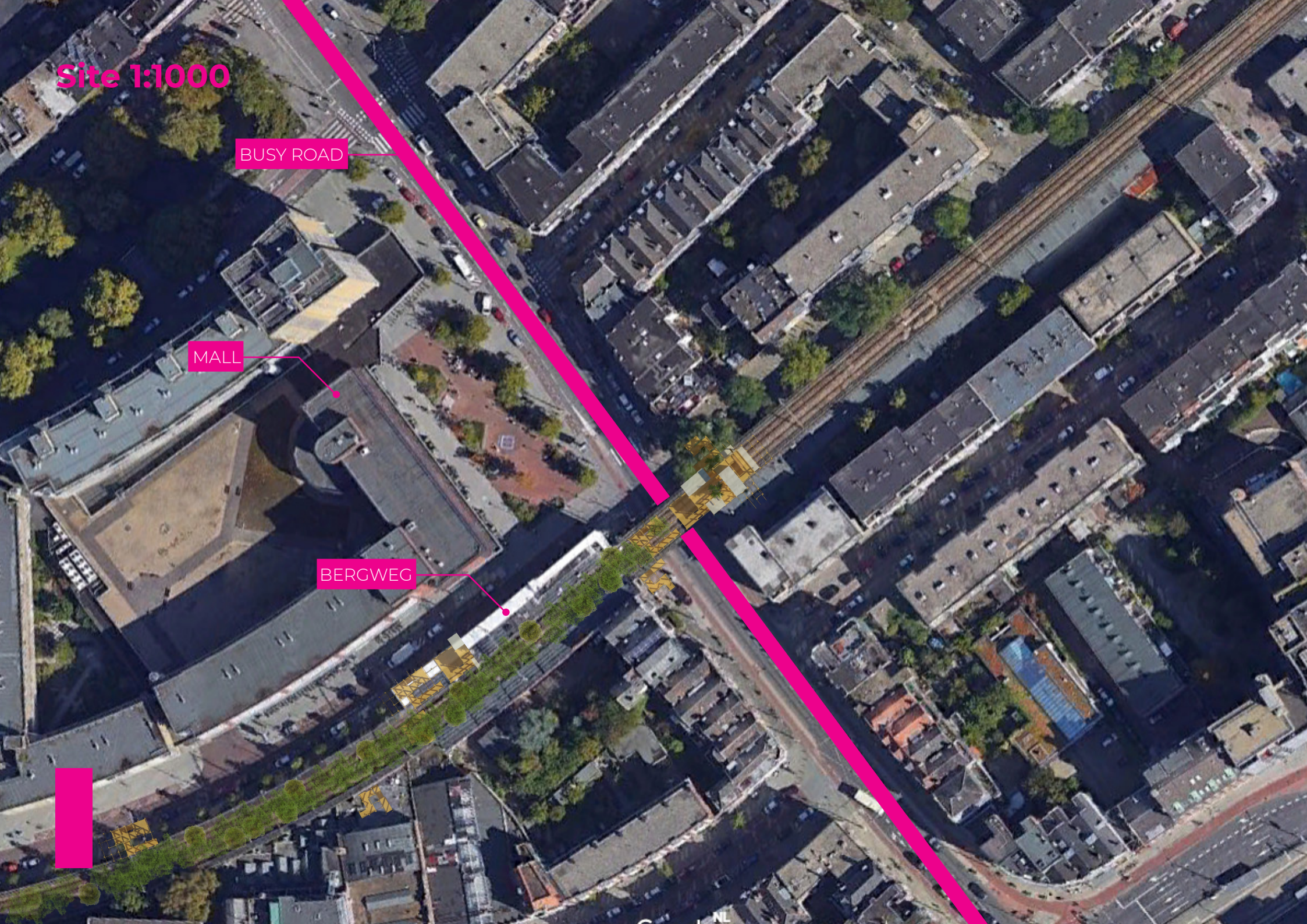
Pilot.

Within the case study, the focus will be on the year 2021, when the building has just arrived at Bergweg Station and the transition is slowly moving towards the mutualist phase. In this phase, multiple pods will be added for the first time in the megastructure with a mixed purpose. During the train process, the structure responds to the environment, whereby they enter into an equal and respectful relationship with each other. A contextual analysis has provided insight into important aspects of the environment, which is shown on the next page.



Context.


POMPENBURG PARK
SCHIEBLOCK
BENTHEMPLEIN
AMMERSOOISEPLEIN
INSULINDEEPLEIN
PARK BERKELSELAAN
HOFPLEIN
STATION HOFPLEIN
DE REGENTUIN
HET "ZOMERHOF"
NOORD- / BERGSINGEL
EUDOKIAPLEIN / BERGWEG
GORDELPAD / NOORDERKANAAL


Site 1:1000
BUSY ROAD
MALL
BERGWEG

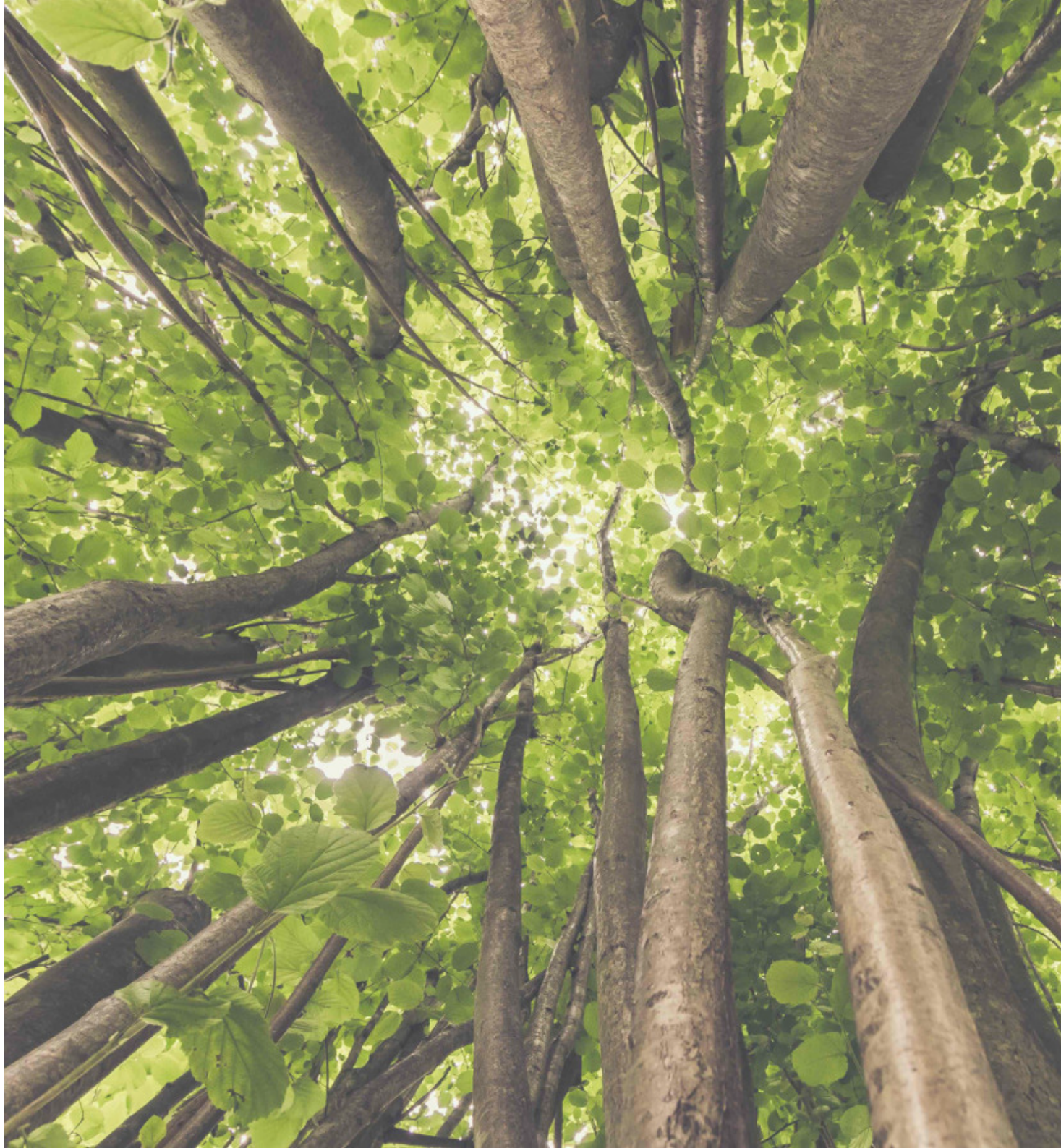
Station Bergweg.

Looking at the environment of the focus area, it is striking that there is a high dynamic. Not only is there a busy road at the mountain road station, but also a number of restaurants, concept stores, retail stores and even a shopping center. The most striking building in this area is the Bergweg Station (1960). This station was the last station in a series of many that architect Van Ravesteyn designed in Rotterdam. Given the limited number of travelers, the new station was just as modest in size as the pre-war station. Van Ravesteyn designed a simple but very subtle entrance building, the entrance of which he projected on the corner of the street span due to lack of space. The entrance was marked by a triangular overhang that provided some shelter despite the limited space. Despite the fact that Bergweg Station was created with minimal, especially graphic interventions, there are beautiful and subtle architectural details that betray the hand of Van Ravesteyn. Examples of this are visible in the facade of the station on the Voorburgstraat. This is plastered white and interspersed with an elongated strip window, trapezoidal windows and round windows.



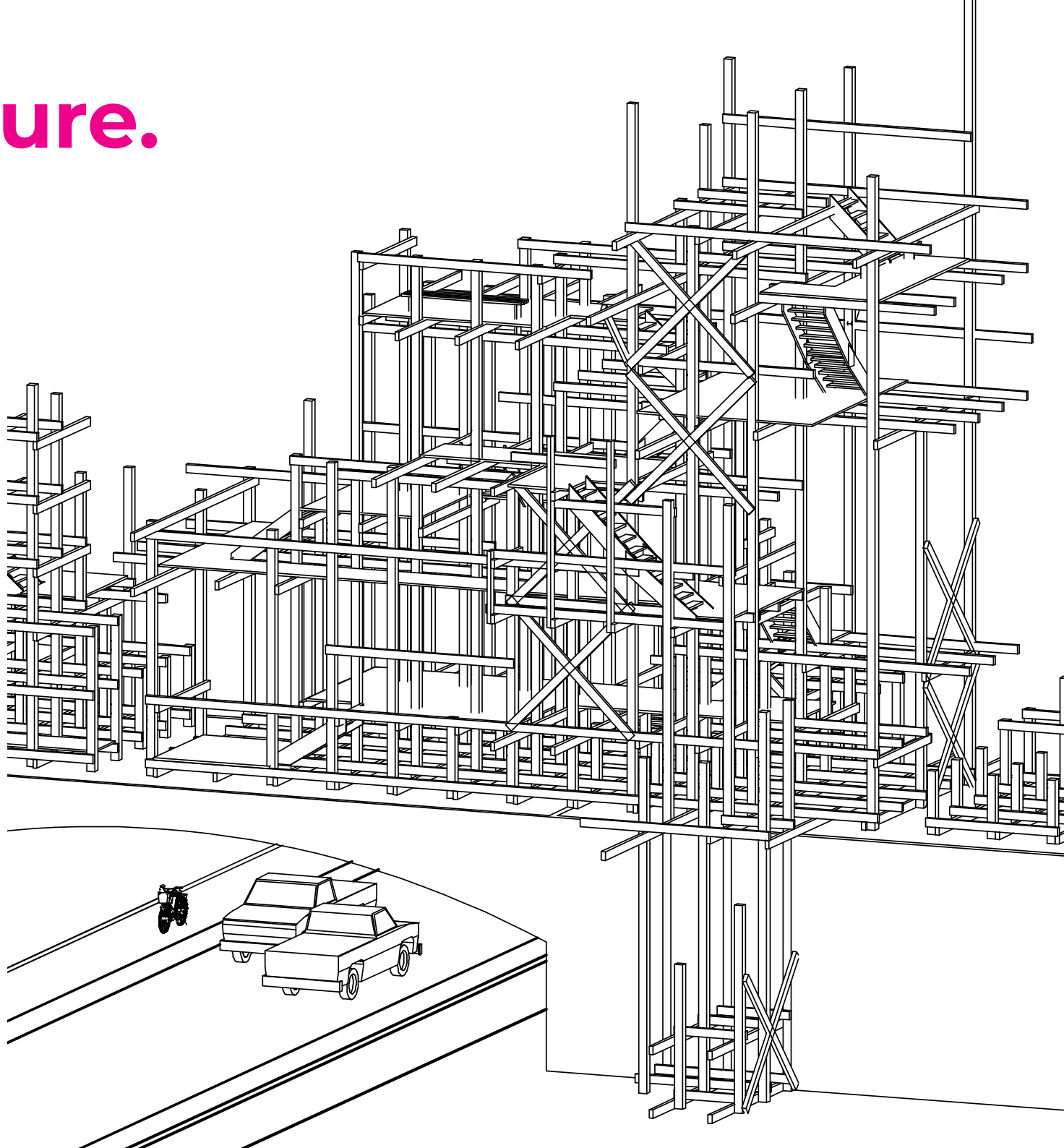
Goal.

From the perspective of the street, humans are invited to enter the new building system. The system welcomes you with open arms due to warm natural colors and a lot of vegetation. The goal is to introduce humanity to the new way of building. Slow but steady visitors will get acquainted to the new standard of living, which has a ratio of 50% human and 50% vegetation. This is an invitation towards a forest inside a city. On every corner a new perspective waits. Via the height difference and multiple walking routs a dynamic stay is achieved in any way. Within the booming high dynamic city this is a place for consciousness, reflection and silence. This urban oases brings together humanity and biodiversity in one building. Striving for a common habitat instead of a separate life.



Megastructure.

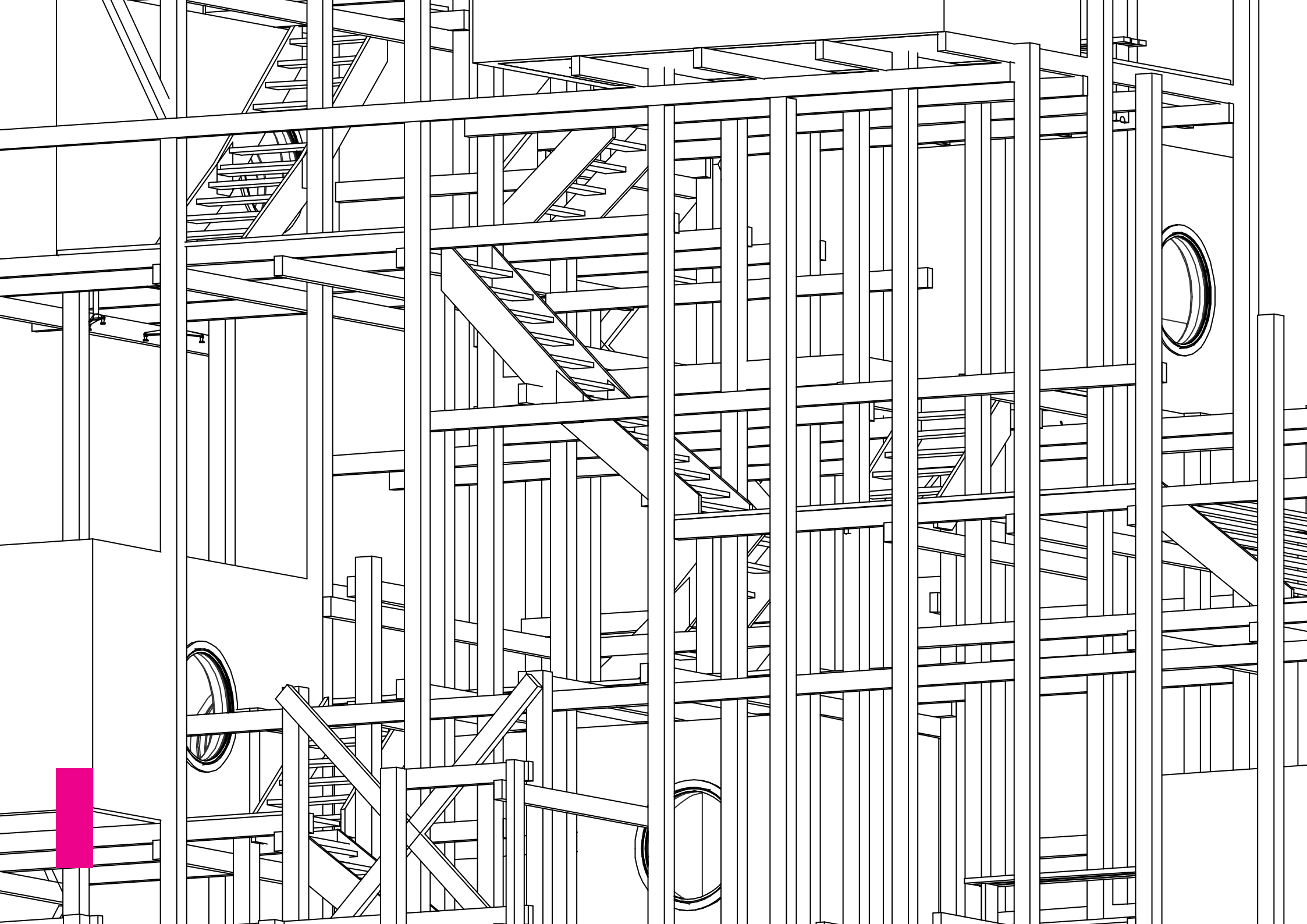
The mega structure for the Hofbogen Case Study is made from poplar wood. Not only is this a locally available and already available wood type, it also has a lifespan of 1-4 years, which is in line with the building vision in the transition phase towards full occupation. The grid rises exponentially as does the mycelium growth, whereby the sizes 0.75 - 1.5 - 3 - 6 meters are used. The beams and beams are attached to the wooden columns by means of a dry wood connection. The mega structure has an orthagonal grid because it is in the transition phase. Hereby it is important for people to be able to link certain facets of this new building method to the current building method, namely that of right angles and a vertical and horizontal line game. It is also intended to focus full attention on the mycelium pods that will grow between this line game. In this way, humanity is gradually being introduced to living architecture.



Piranesi.

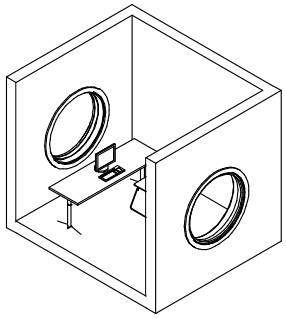
The megastructure is inspired by Piranesi. He was an Italian artist famous for his etchings of Rome and of fictitious and atmospheric "prisons". The influence of piranesi can be seen in the design of the mega structure. In the wooden line game, different levels have been raised that are connected to each other, but also have an individual character. These places are connected by linear staircases and floor sections. Looking at piranesi's work 'The Drawbridge' we see fantastic labyrinthine structures, epic in volume. They are capricci, whimsical aggregates or monumental architecture and ruins. Walking through the building, the user experiences new perspectives, whereby the user is constantly aware of his place in the building. This stimulates the senses, which increases awareness among the user. Searching through the complex architecture, the user is in a state of being. The building ensures that visitors are pulled out of the routine of their daily lives and can focus on the basis of every human being, namely the senses.



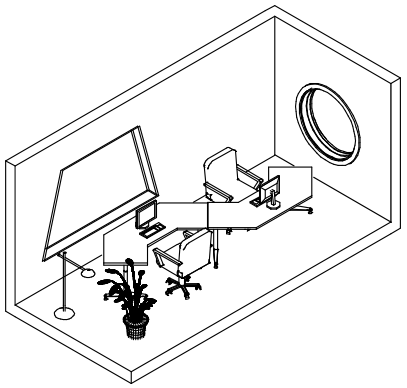


Pods.

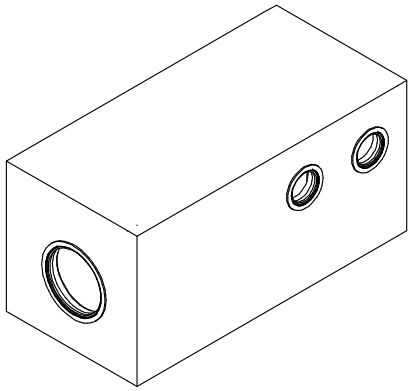
The pods for the showcase are carefully selected on the parameters of lifespan, climate and context. The mycelium-based pods are made with the fungi strain of the ganoderma lucidem, which is a fungi type that is readily available from local farmers (CNC Exotics). The pods are prefab grown in the lab including all wall openings such as windows and doors. In this case the window is also used as door to undermine the visitor and force respect. Due to the lifespan of 1-4 years and the transition phase, the pods are used for short stay activities. Similar to visiting a park the pods provide sufficient comfort and facilities for stays no longer than 12 hours. The pods each have their own unique character due to their correlating context, which is the old Bergweg station. The pods have various function which are based on the environmental vision of the city Rotterdam. The meditation pods on the first floors relieve emotion from visitors due to the focus on specific sense. One pod is oriented on the decay of the past buildings, one is silent and focused on the sky and one is almost completely dark and heavenly isolated in which you are able to let out your deepest emotions via voice.



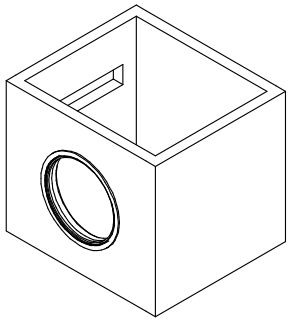
Private workspace



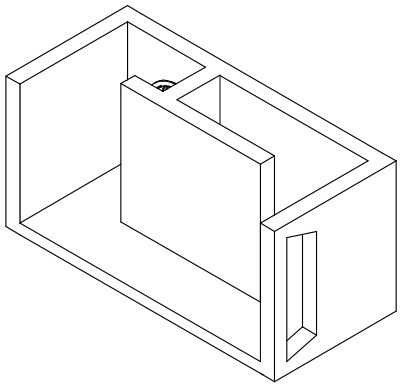
Co-working space



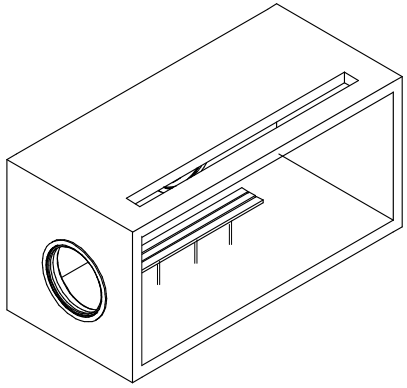
Brainstorm space



Discussion



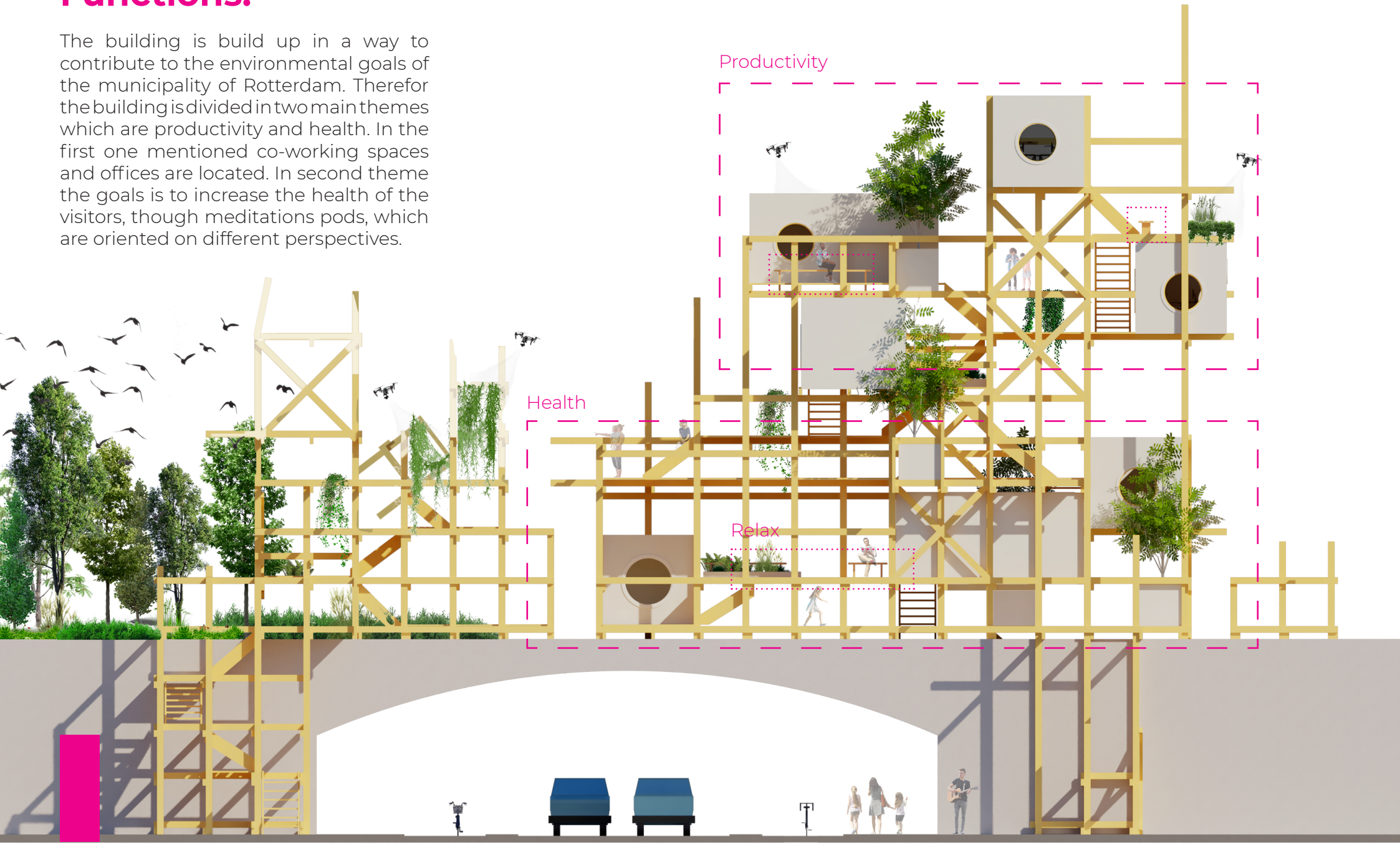
Scream



Silent

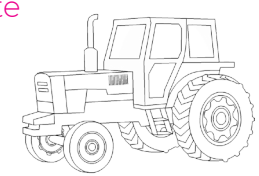
Functions.

The building is build up in a way to contribute to the environmental goals of the municipality of Rotterdam. Therefor the building is divided in two main themes which are productivity and health. In the first one mentioned co-working spaces and offices are located. In second theme the goals is to increase the health of the visitors, though meditations pods, which are oriented on different perspectives.



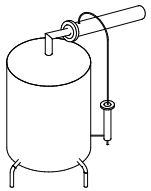
Production

Substrate



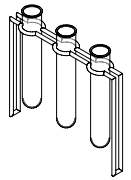
The production process starts with the harvesting of an organic material, in this case hemp. This forms the base of the biobased building method.

Steralize



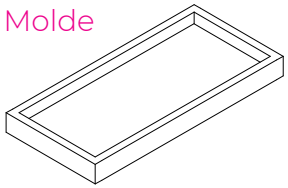
The hemp must be sterilized (3-5 min in autoclave at 134 °C and 300 kPa) to kill all other fungi & bacteria so that fungi of choise is able to flourish.

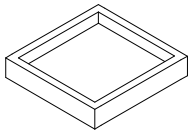
Innoculate



After steralization the hemp is innoculated in a sealed bag with a fungi of choice. Within 7 days the fungi is fully grown and ready to use.

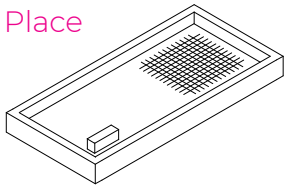
Molde

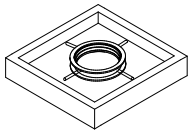




The next step is to prepare the molds for the material. The molds determine the final shape of the mycelium based composite.

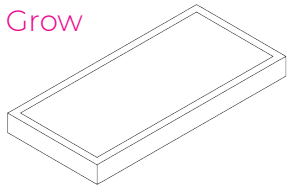
Place

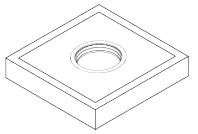




Various items of choice can be placed within the mold that will grow alongside the mycelium and hereby attach themselves.

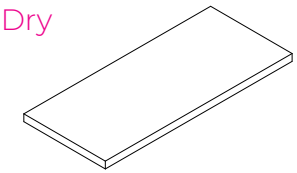
Grow

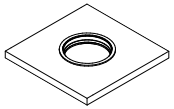




Once the sealed bags are fully grown, the material is placed in the molds. In order to elimnate contamination, sterile working is recommended.

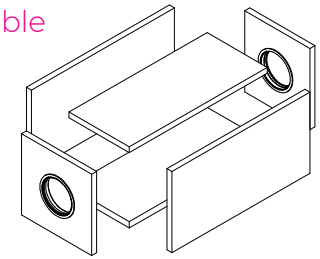
Dry





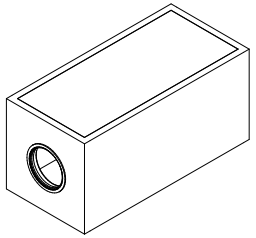
After 7 days the mycelium can be relaesd from the mold. It will dry for one day to reduce the weight and stimulate exteriru growth.

Assemble



The various parts can now be assembled together to form the final shape. The material 'glues' itself together in 1 day.

Pod



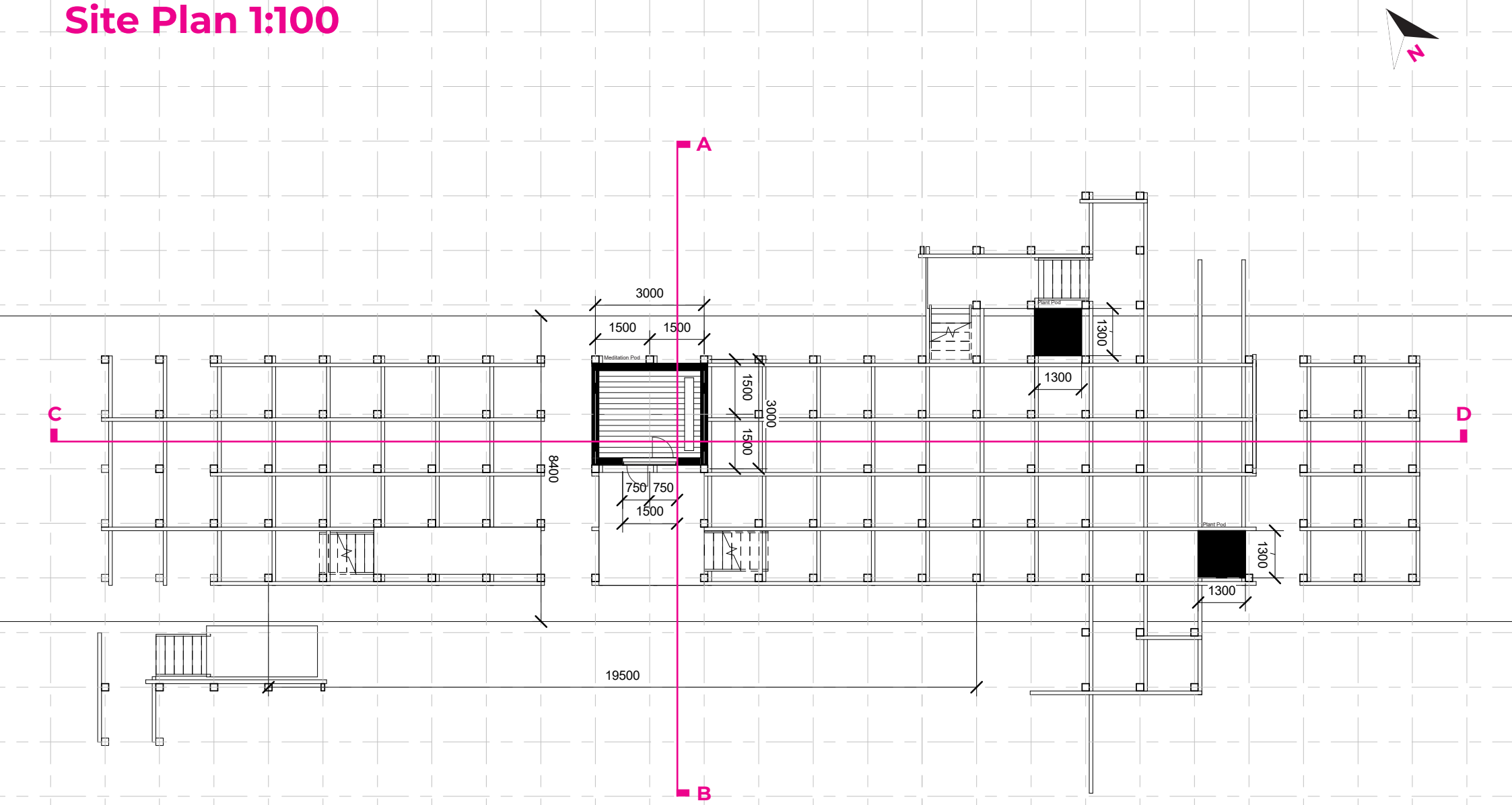
20 Days

After finishing the pod can be trasfered to the final location where it will grow in its final position and is ready to use!

Plan 1:500

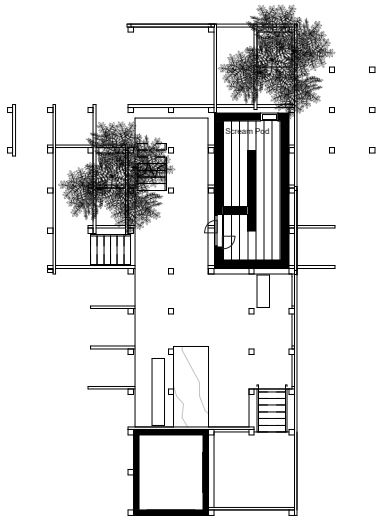


Site Plan 1:100

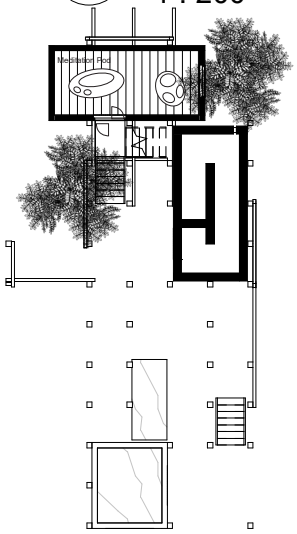


Plans 1:200

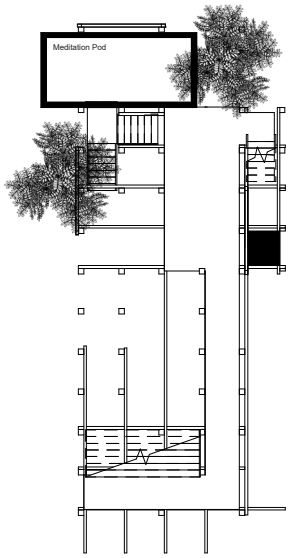
1 Level 10
1 : 200



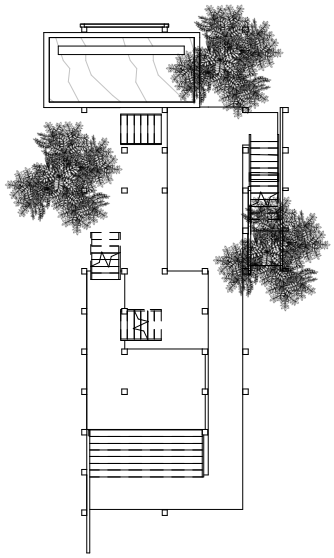
2 Level 11
1 : 200



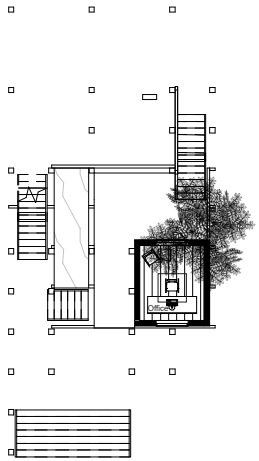
3 Level 12
1 : 200



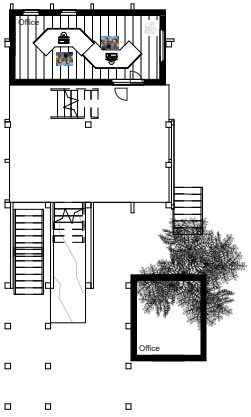
4 Level 13
1 : 200



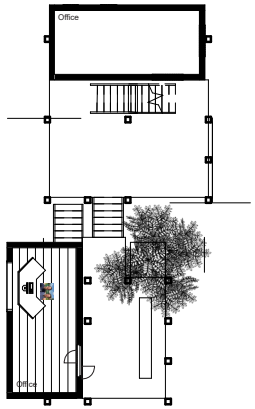
5 Level 14
1 : 200



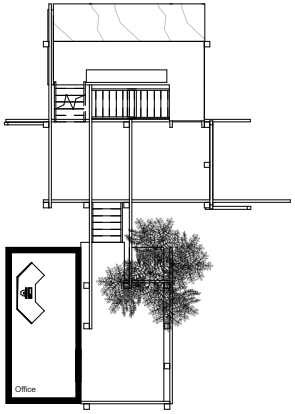
6 Level 15
1 : 200



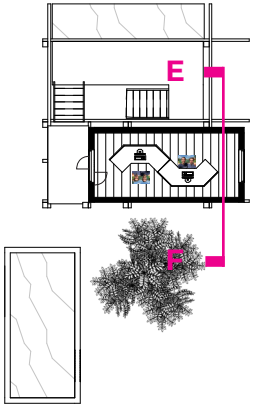
7 Level 16
1 : 200



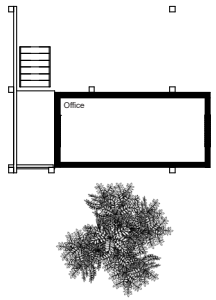
8 Level 17
1 : 200



9 Level 18
1 : 200

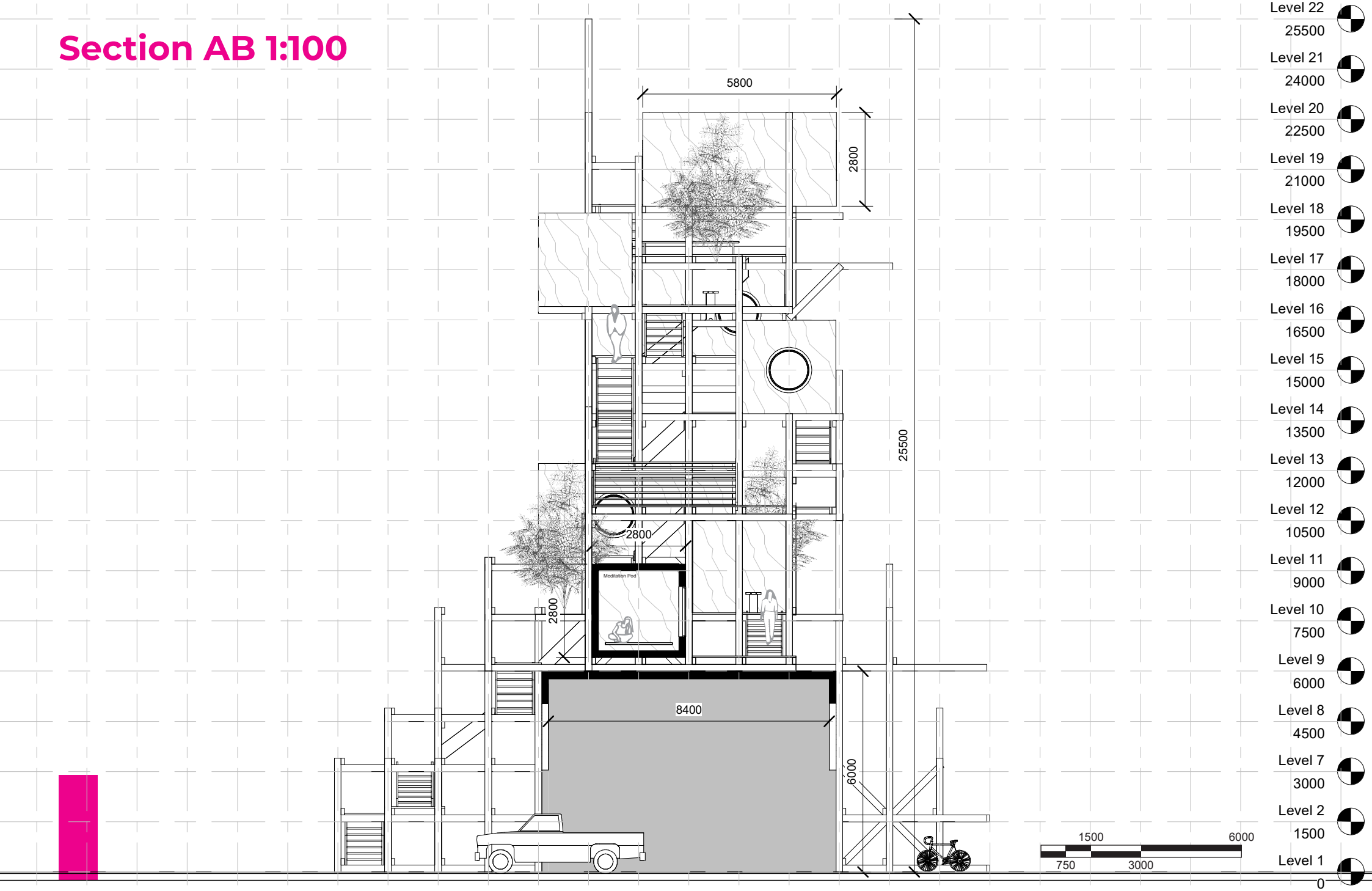


10 Level 19
1 : 200

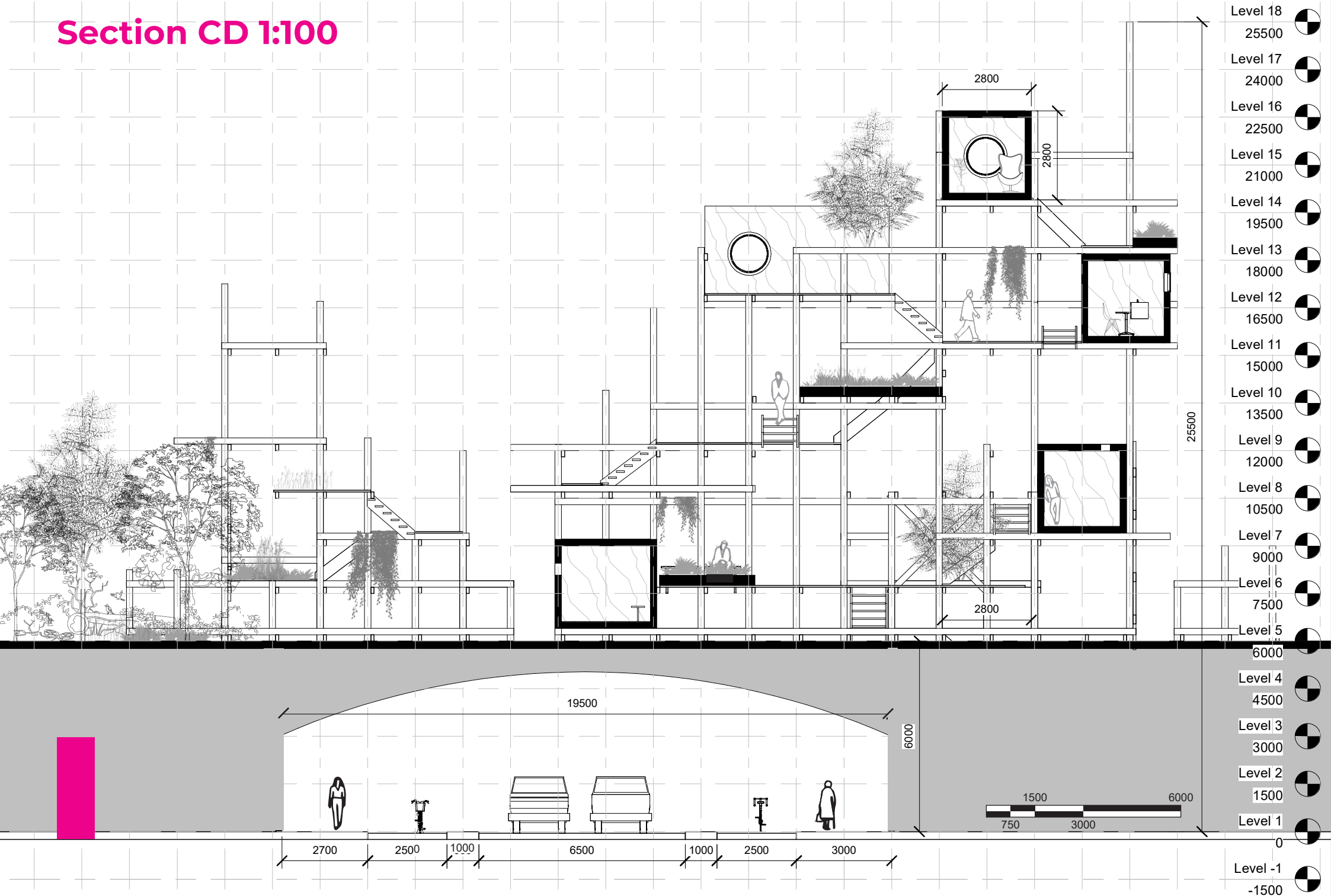




Section AB 1:100



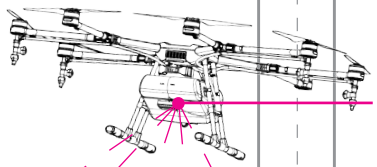
Section CD 1:100



Fragment EF 1:50



Pod Detail 1:20



DJI MG-1S - Agricultural Wonder Drone ™

10%

Humidity, CO2 & Temperature Sensors
Living Light ™ (Plant E Microbial Fuel Cell)

10MM Terminated Ecovative MycoComposite™
80MM Living Ecovative MycoComposite™
20MM Vector Net Reinforcement
90MM Living Ecovative MycoComposite™ (U= 0.035 (W/mK)
200MM x 200MM Poplar Wood Column

90 20 80 10

200MM

2800M

Physee PowerWindow™ with integrated
sun-blinds, ventilation systems and sensors.
LiFePO4 batteries

20MM Poplar Wood Floor

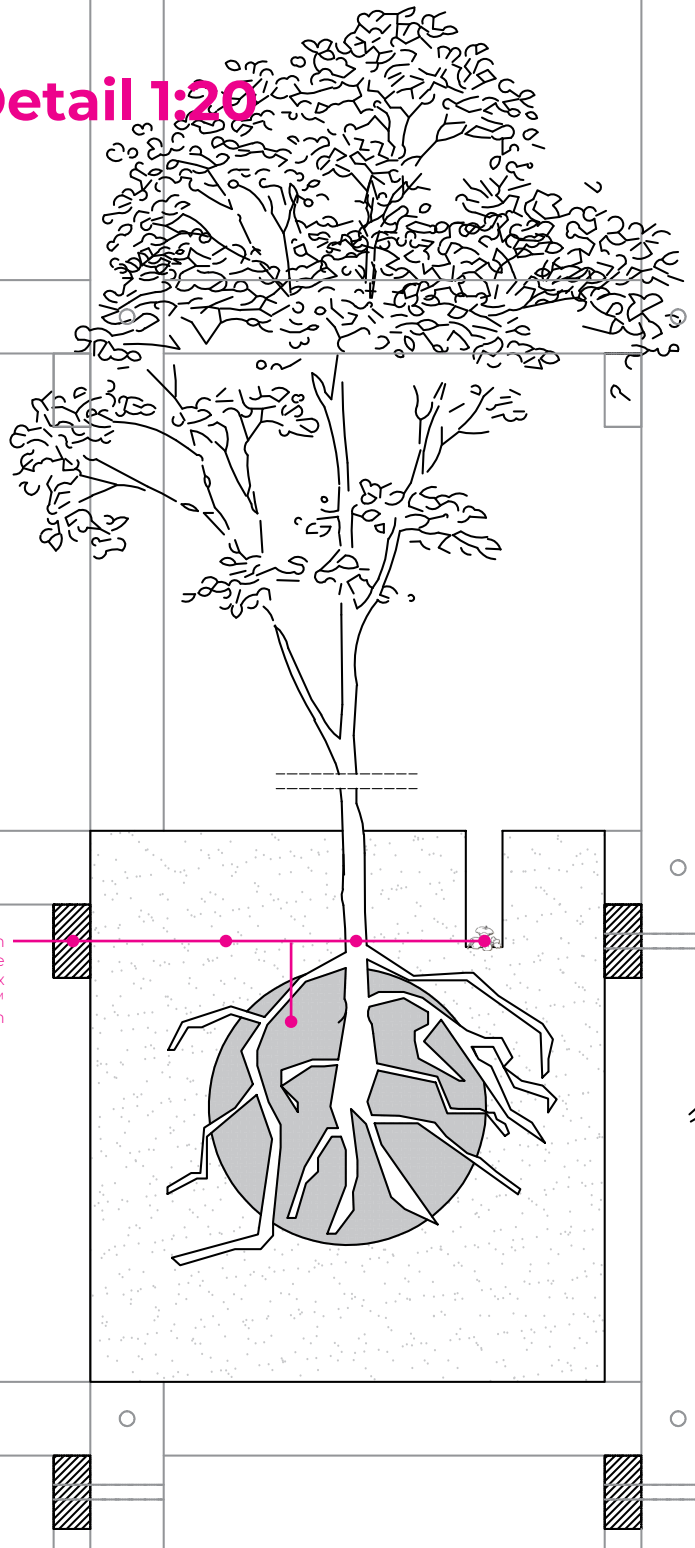
200MM x 50MM Poplar Wood Beam
Mycelium Self Assembly

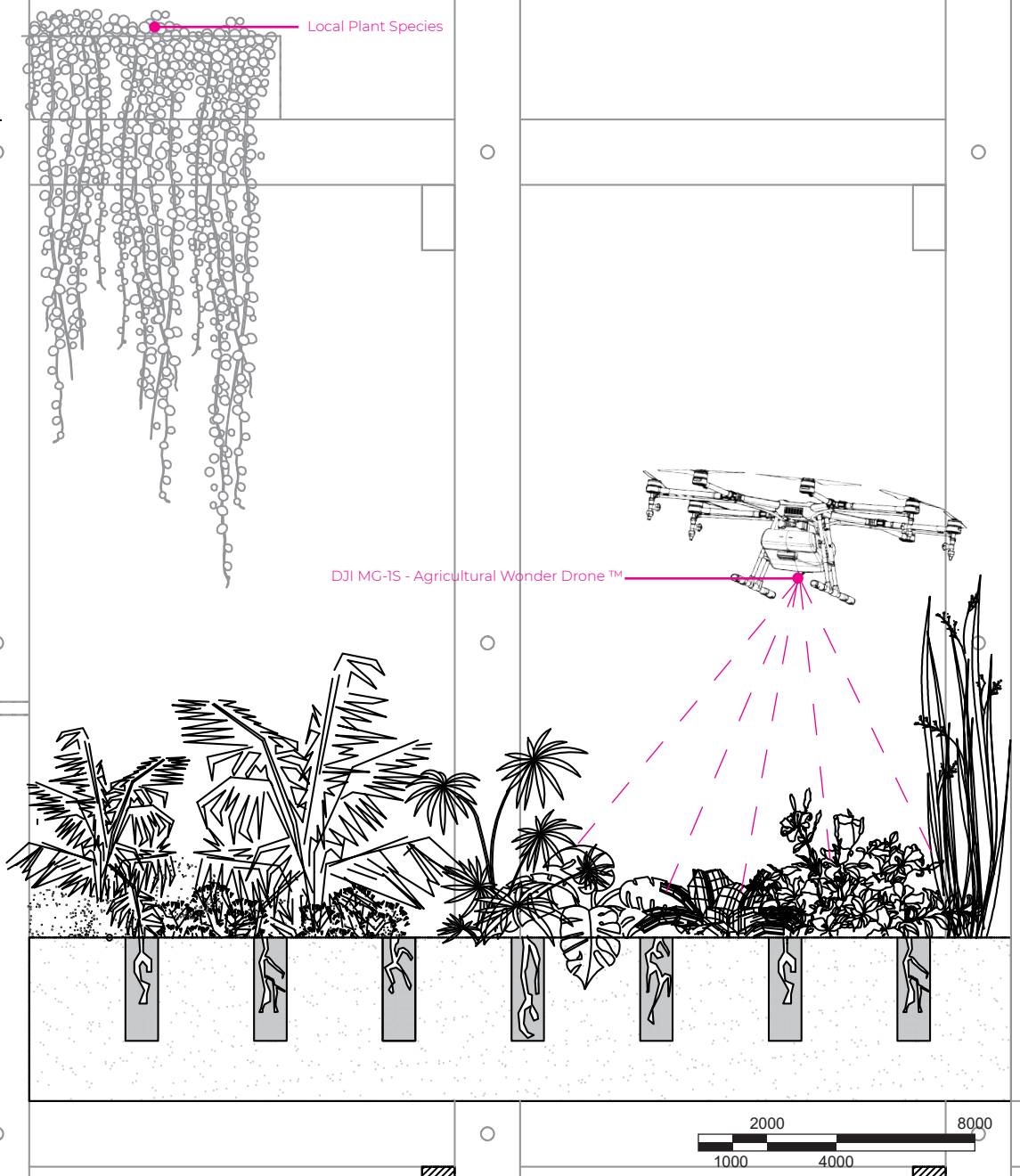
3000MM

2000 8000
1000 4000

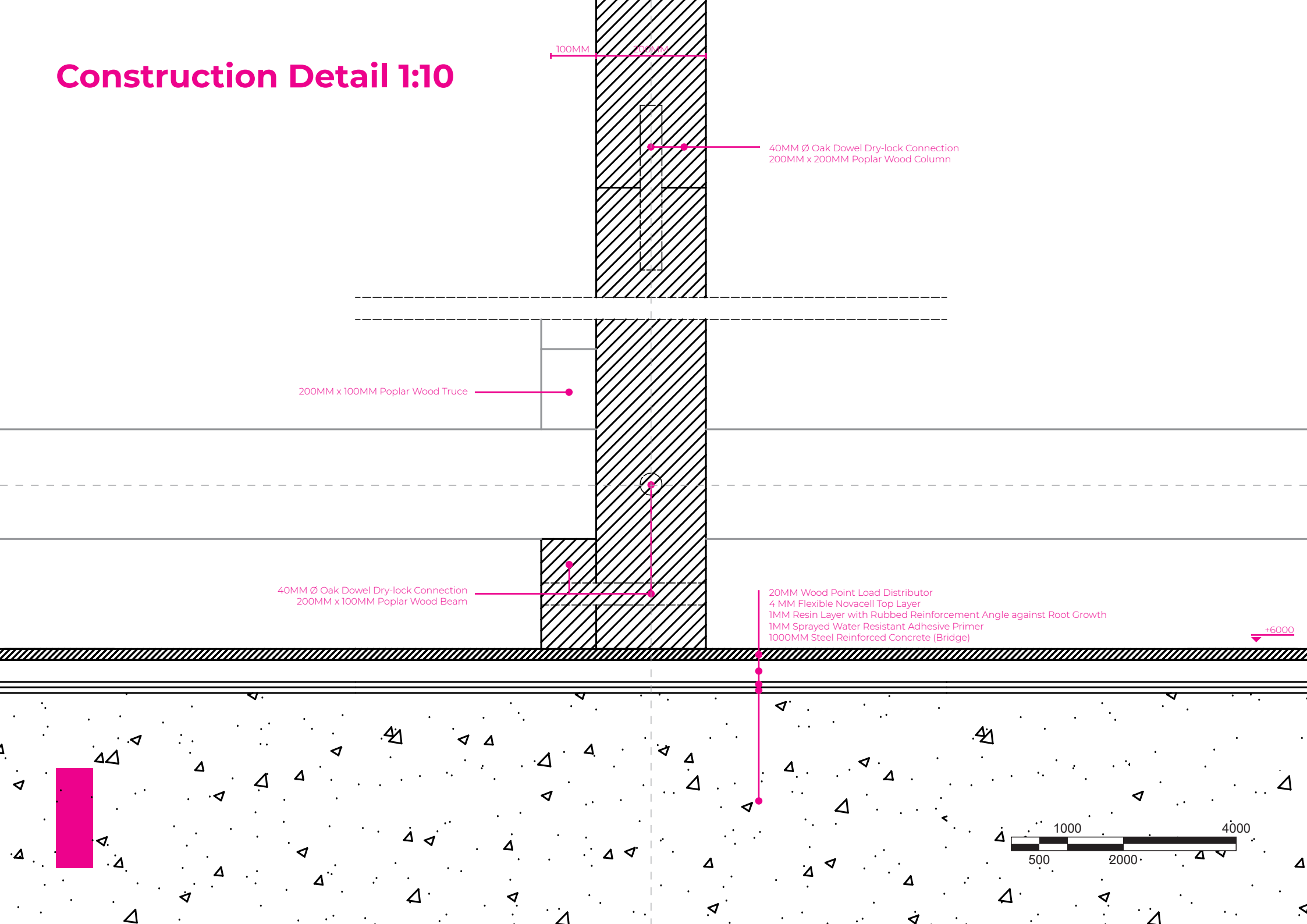
200MM x 100MM Poplar Wood Beam
40MM Ø Dowel Dry-lock Connection Oak Wood

Nature Detail 1:20





Construction Detail 1:10



North 1:100



East 1:100



South 1:100



West 1:100



Fase 1: 2021



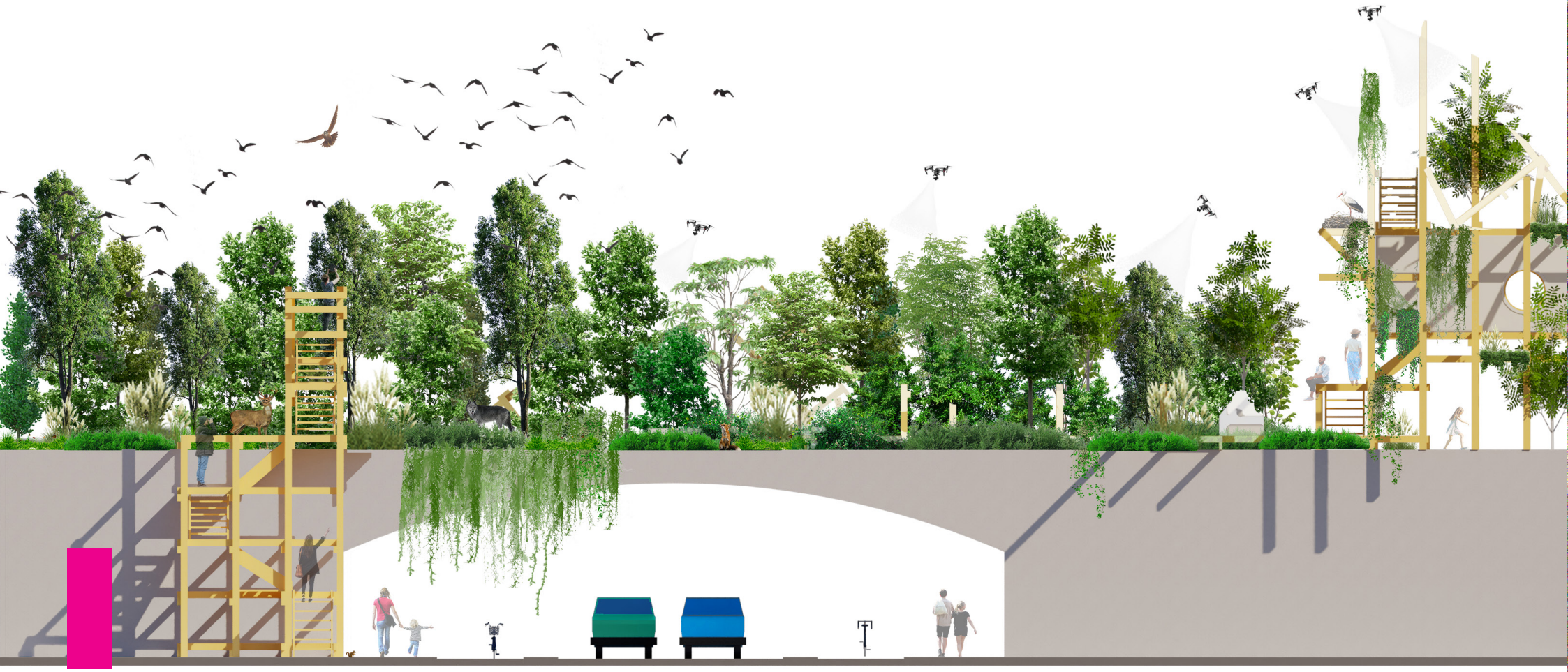
Fase 2: 2022



Fase 3: 2023



Fase 4: 2024




01-VBB-1



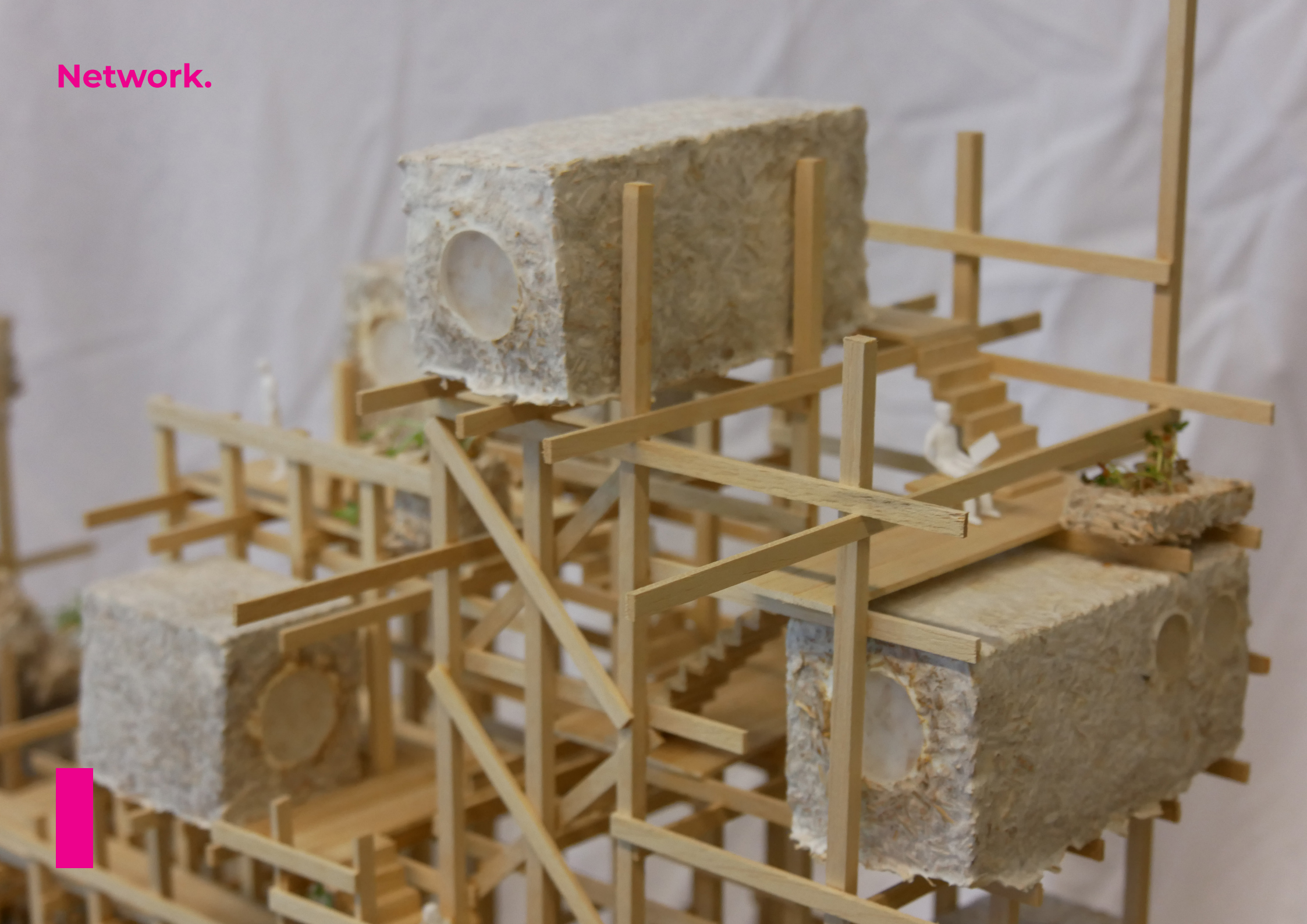

STOP






The first time.

Network.



Perspectives.




Nature.

Decay.



Pod.



Interior.



Interior.




Detail.