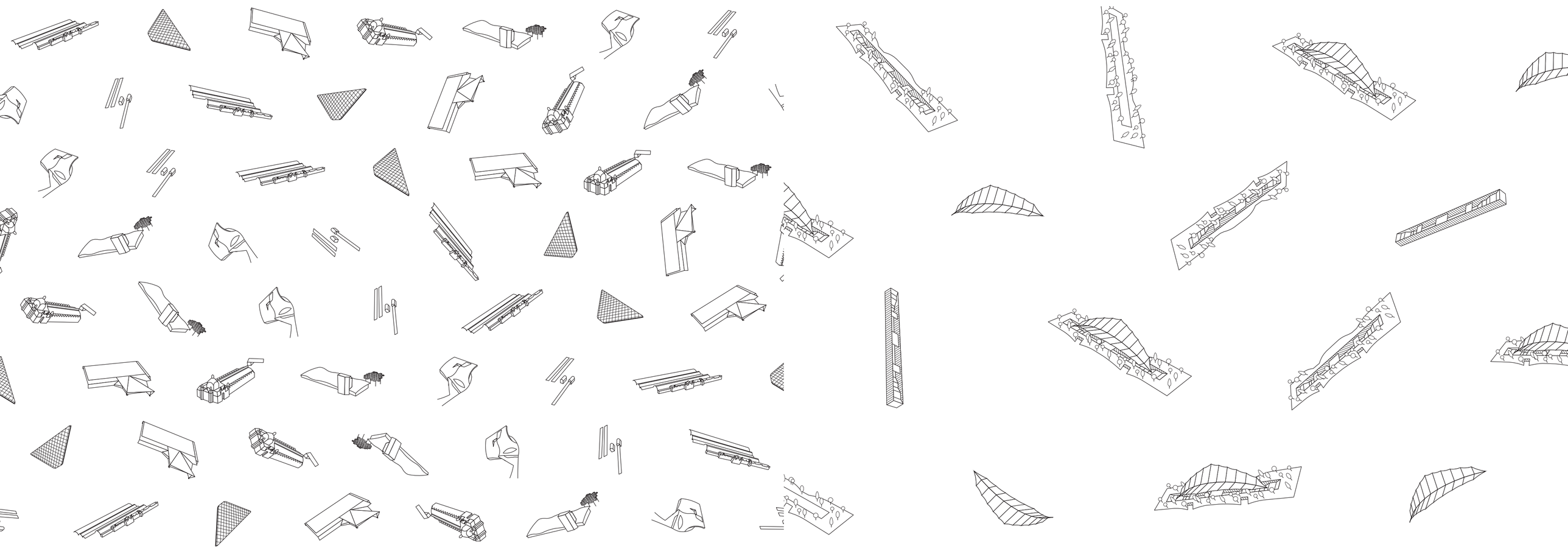


ARCHITECTURE GRADUATION

THE WHALE

DESIGN BOOKLET





PREFACE

Dear reader,

First, let me introduce myself: my name is Robin. I am a 26-year-old freshly graduated architectural student from the Master of Architecture at the TU Delft, Faculty of Architecture and the Built Environment. I have a great love for public transportation and train stations and chose to graduate on designing one.

In this portfolio, I take you on a journey through the process of my graduation design project: the new Amsterdam Zuid Hyperloop Terminal. In this project, I aim to redevelop the station of Amsterdam Zuid by implementing a hyperloop terminal and by integrating the station within its dense urban surroundings.

A central theme within this project is the combination of the nodal function and the public function. This aspect has been informed by my academic research on the integration of the station within the city, which can be found in my research booklet.

I hope you have a pleasant experience strolling through my graduation work.

Sincerely,
Robin Koelmans

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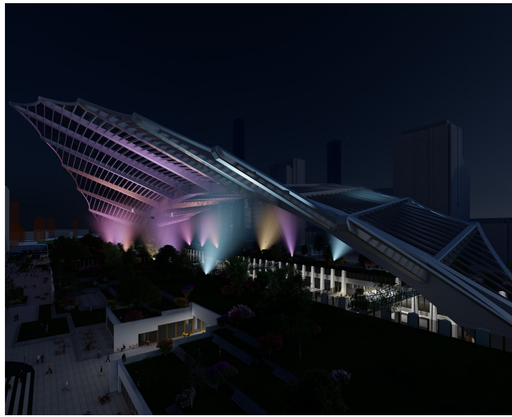
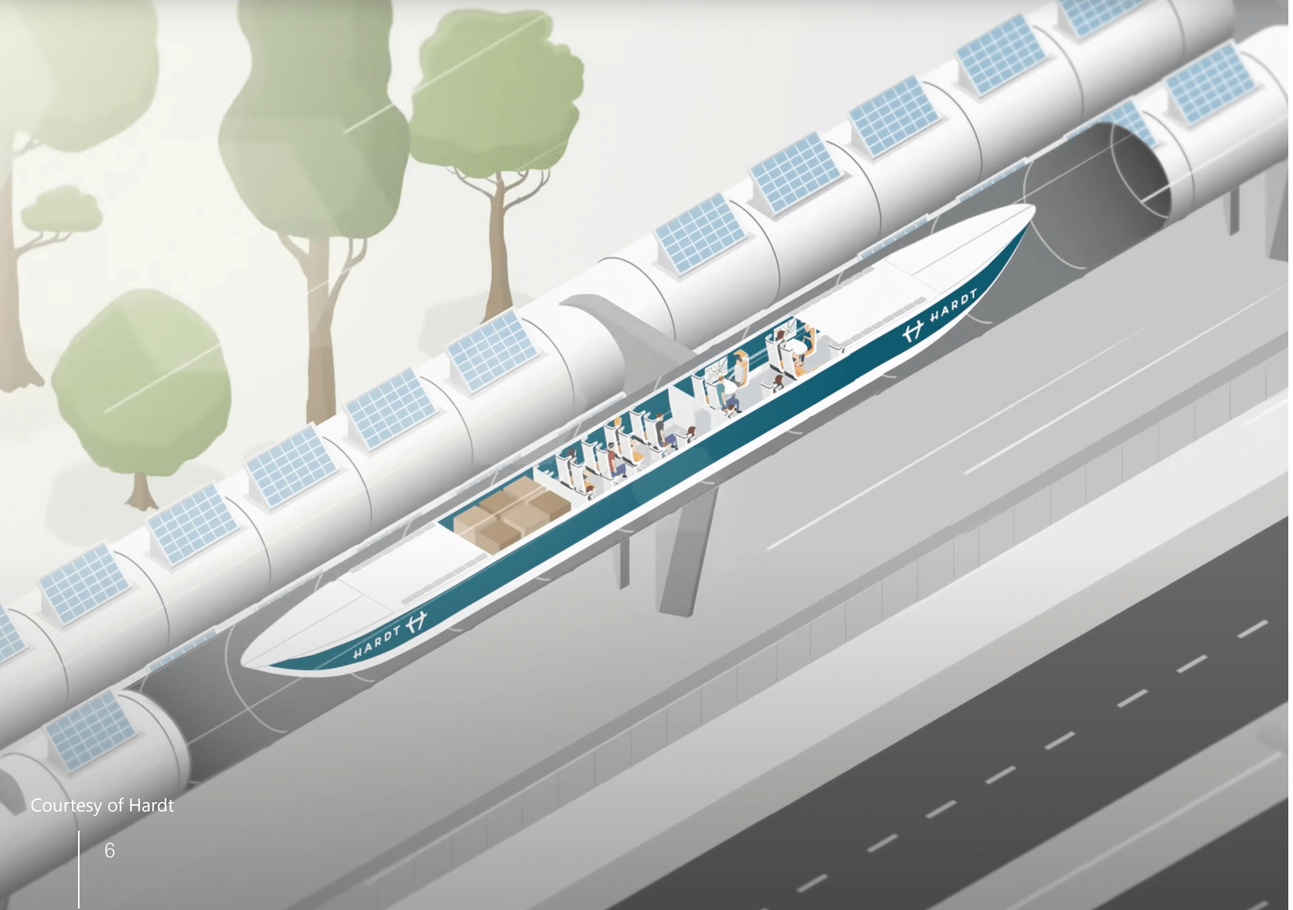




Courtesy of Hardt

HYPERLOOP
HOW DOES IT WORK?

Hyperloop | Quick Facts



Pod (automated)

Tube



20.000 passengers/hour/lane



Low-pressure environment



A pod every 10 seconds



Depressurizing pumps every 10km



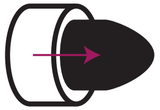
Speeds of up to a 1.000km/h



Magnetic levitation/ suspension



Powered by the electrical grid



Electromagnetic propulsion

HYPERLOOP
How does it work?

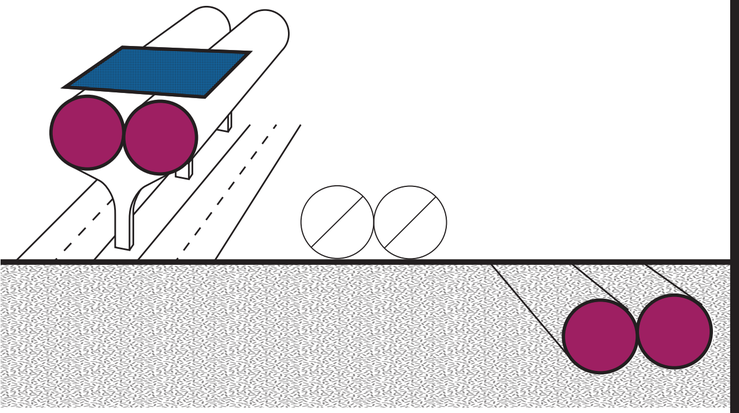
Hyperloop consists of two elements: tubes and pods. An airtight tube, made out of steel, maintains a low-pressurized environment within it in order to reduce air resistance for vehicles moving through it. These vehicles are called pods, they are similar to the cabin of an airplane or a bus.

The pods do not physically touch the tube, they are kept in place by magnets in order to reduce friction when the vehicle moves. Electromagnetic propulsion enables the movement of the pods, enabling the system to be supplied by local (green) energy sources.

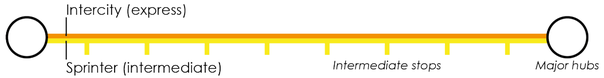
Due to its highly efficient system, hyperloop has barely any emissions but can still reach high speeds of up to a thousand kilometers per hour. As a result, hyperloop can substitue short to medium-distance aviation, which contributes to a more sustainable transportation sector. These are all good reasons for implementing hyperloop in this design project.



Courtesy of Hardt



Railway system



Hyperloop system



THE TUBES

The line infrastructure of hyperloop exists of tubes for hundreds of kilometers, stretching over land. In order to prevent the tubes from forming landscape barriers, I advocate that they should be put either underground or elevated on columns.

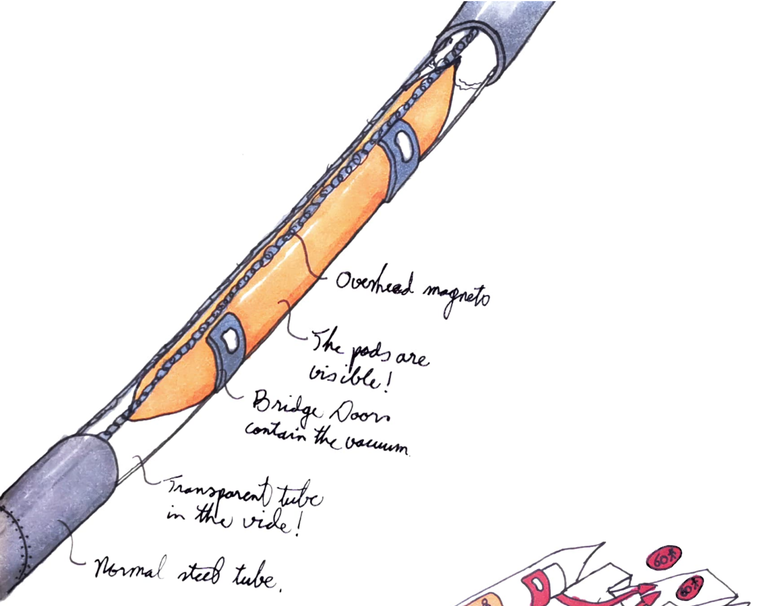
DEMAND-DRIVEN TRANSPORTATION

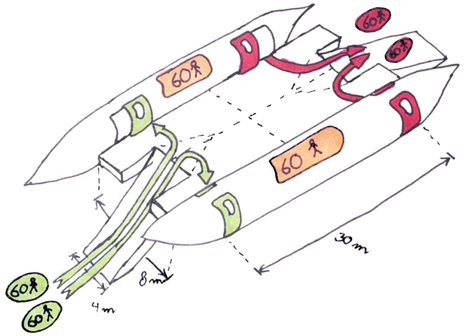
Hyperloop tubes function like a highway: they facilitate continuous flows of pods. Intermediate stations have tubes that branch off from the main tube, enabling pods to have individual routes, instead of operating on fixed schedules. Pods can operate based on demand and thus better suit the needs of future travellers.

THE NETWORK

Hyperloop has the potential to connect all of Europe's main hubs within a matter of hours via several corridors. Eliminating the need for more pollutant aviation on one hand and strengthening unity by connecting more people on the other hand. This way, I hope that hyperloop could also play a more political role in strenghtening the European Union.







HYPERLOOP
DESIGNING THE TERMINAL

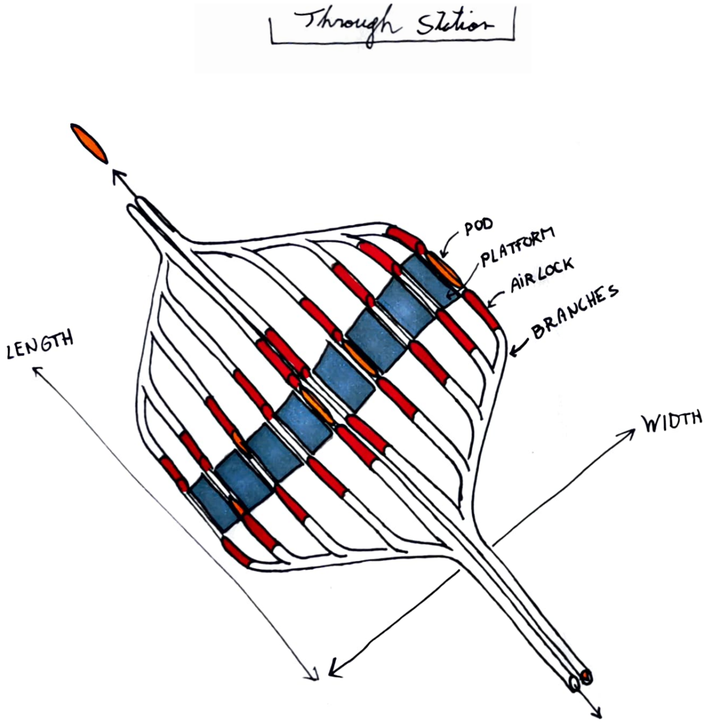
LAYOUT

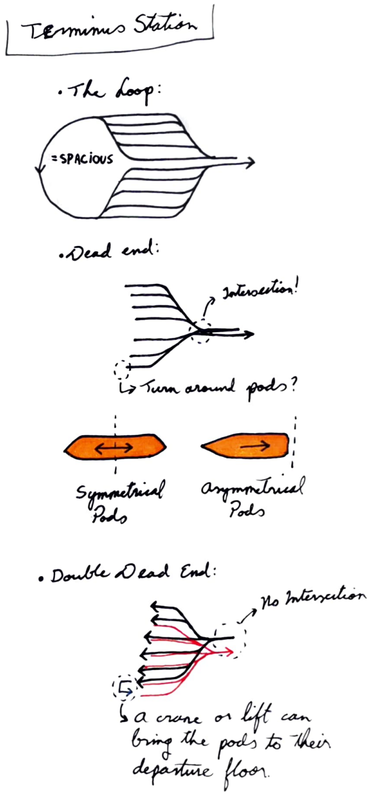
An important difference between the layout of a regular train station and a hyperloop terminal, is the difference in platform length. Train stations generally have a few long platforms, whereas hyperloop terminals have many short platforms. In accordance with the design of Hardt, I work with platforms of 36 meters long. This enables 30-meter-long pods to stop, carrying around sixty passengers.

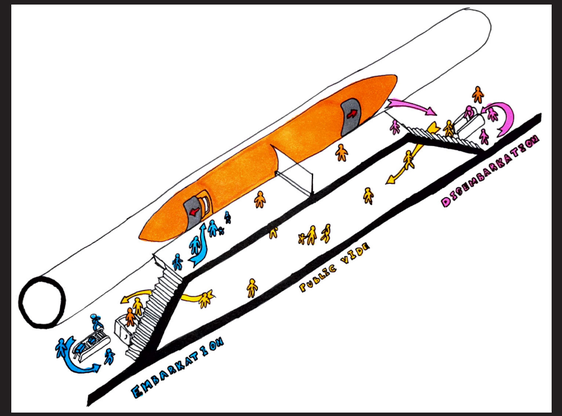
BRIDGE DOORS OR AIRLOCKS?

Apart from this, the difference in pressure is a challenge when designing a hyperloop terminal. There are two ways to solve this: creating bridge doors on both the tube and the pod that connect with each other very (air)tightly (see the image on page 7). Or creating airlocks, which are a part of the tube that can (de)pressurize the atmosphere before or after a stop (on the center right drawing).

After careful discussions with industry professionals, I decided to go for the bridge doors. They are more difficult to construct, but they save a lot of (travel) time, which is crucial when operating pods at high frequencies for a turn-up-and-go system.



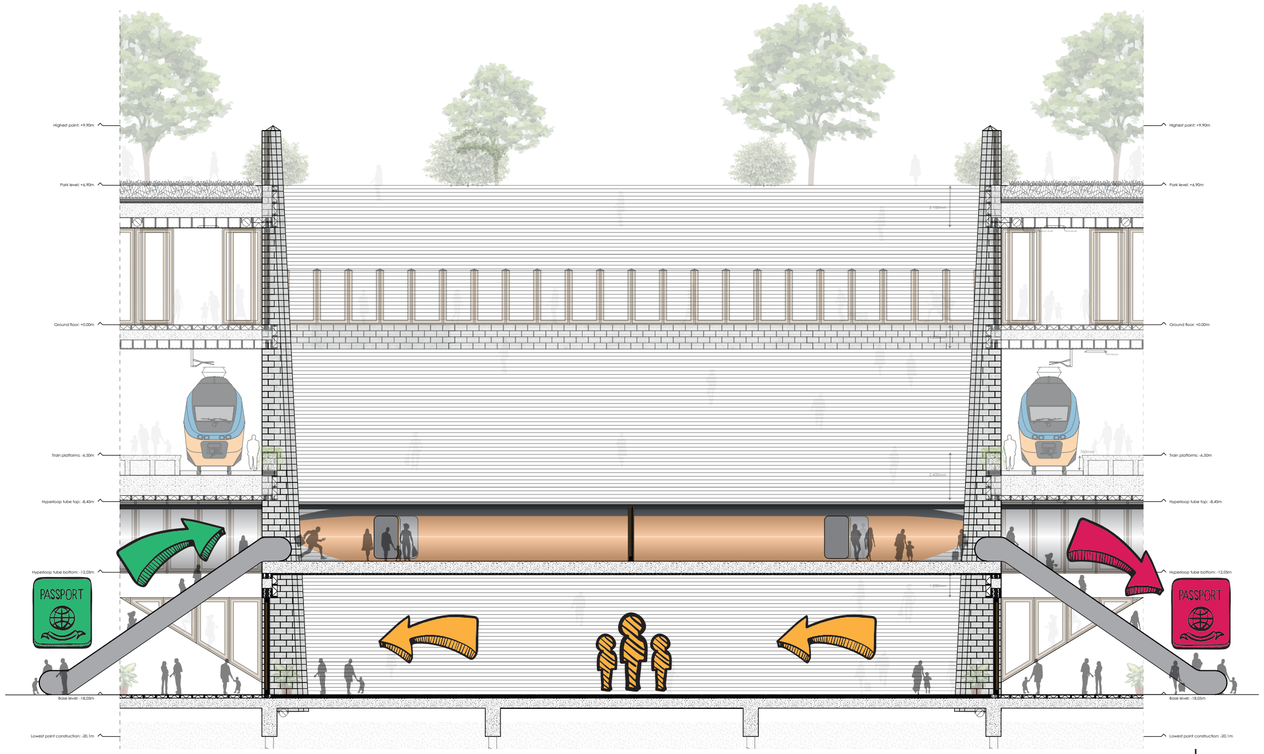




THE PLATFORMS

A third challenge for designing a hyperloop terminal is security. Because hyperloop consists of a network that supercedes the Schengen-area, customs are necessary. Customs are located at the lowest floor adjacent to the vide, being located right underneath the hyperloop tubes and platforms.

I chose to divide platforms in four parts by placing glass screens. The platform is divided by glass screens in the transversal direction in order to separate the outgoing passengers from the incoming passengers whereas another screen divides the platform longitudinally in order to separate flows if two pods stop simultaneously at either side of the platform. As a platform faces two tubes, pods in both tubes can have different directions, so passengers should be guided towards the right pod. In order to facilitate this, stewards will be present on each platform, guiding travellers and keeping everything safe and smooth.





Siebe Swart, 2013

AMSTERDAM ZUID
ABOUT THE LOCATION



IAmsterdam, 2018



Siebenwart, 2013

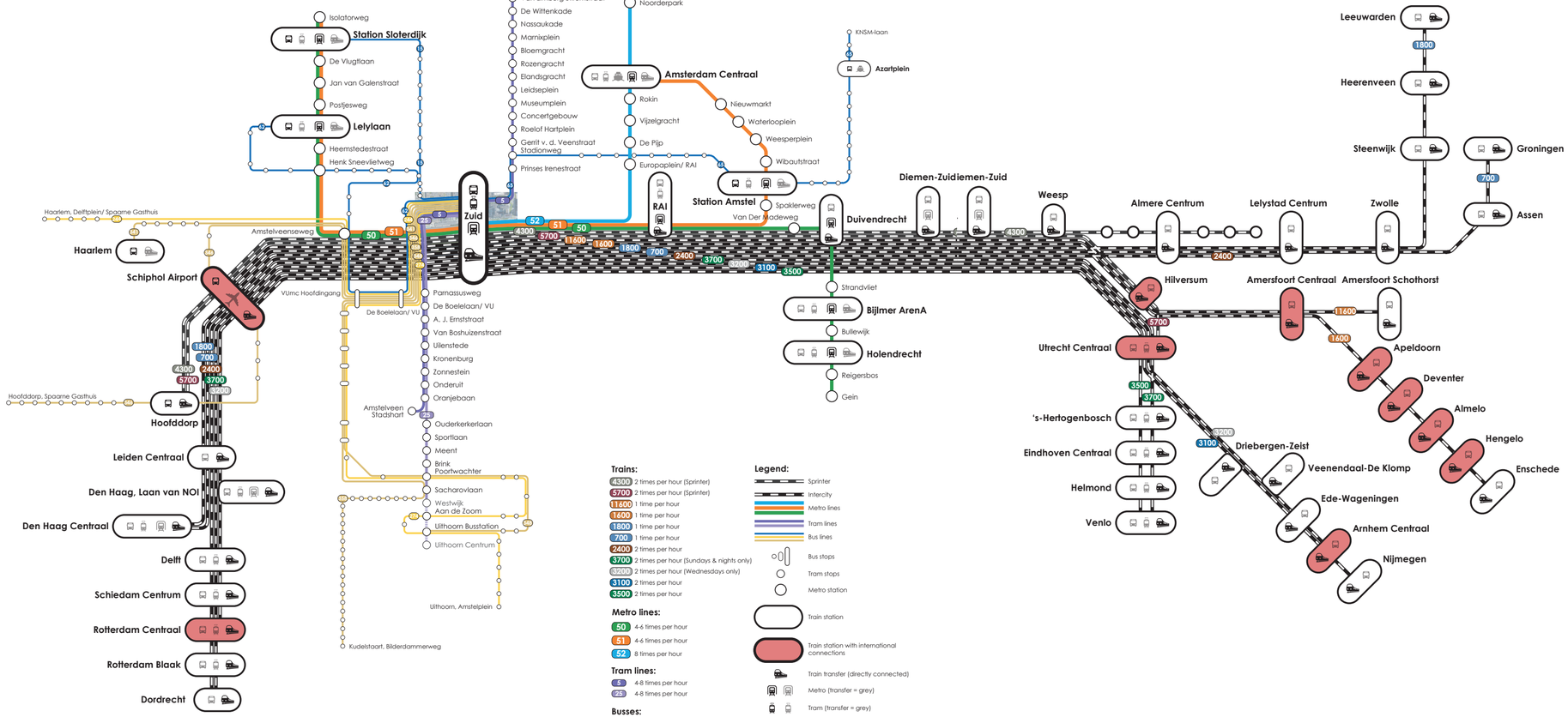
AMSTERDAM ZUID
ABOUT THE LOCATION

THE BUSINESS DISTRICT

Amsterdam Zuid is the main business district of The Netherlands. The area is characterized by office highrise that houses major banks and insurance companies. The area has been developed from 1998 on because of its strategic position between the airport and the inner city.

Right in the heart of the area, one can find Amsterdam Zuid station. An important hub that connects the district to the national and regional grid. The A10-highway runs parallel on both sides of the station. The result is two blocks of highrise intersected by an infrastructural bundle that is always in motion.





AMSTERDAM ZUID
THE NODE

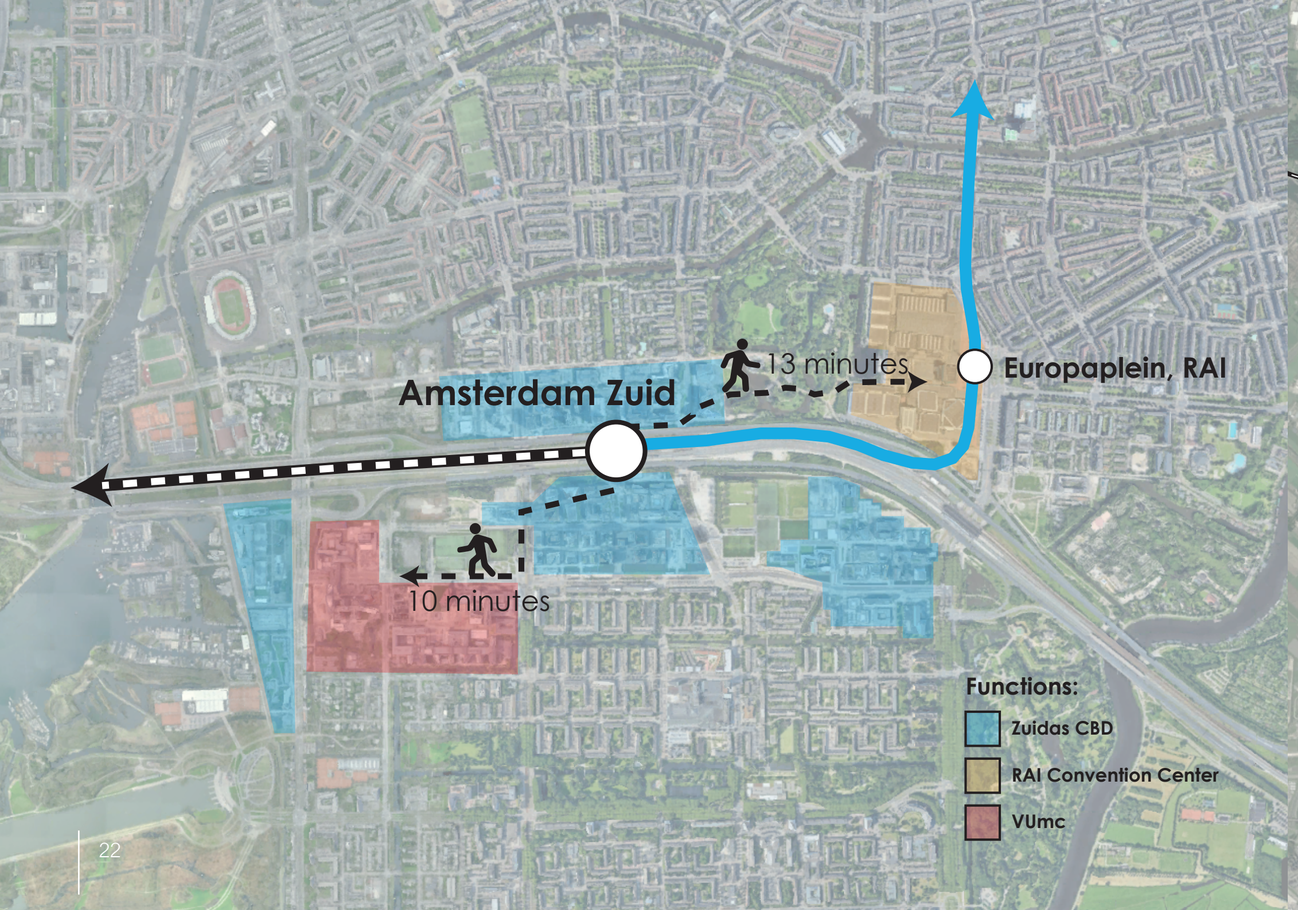
CONNECTING ON DIFFERENT SCALES

Amsterdam Zuid is an important node on different scales (see the following pages for illustrations).

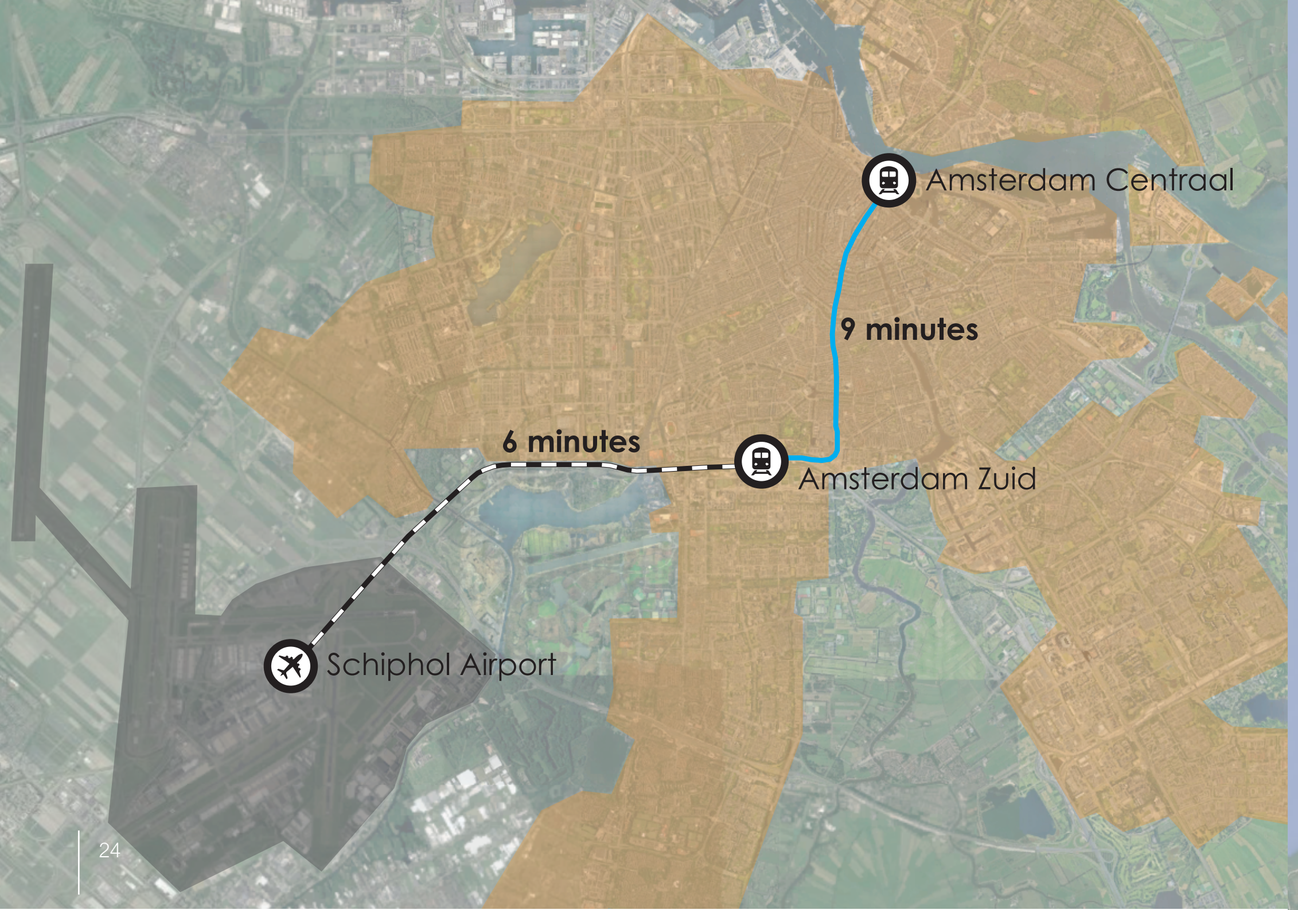
On the national scale, Amsterdam Zuid is a major hub for the Dutch Railways (NS) thanks to its central location within the Randstad and close proximity to Schiphol Airport. The station features direct connections to eleven out of twelve Dutch provinces.

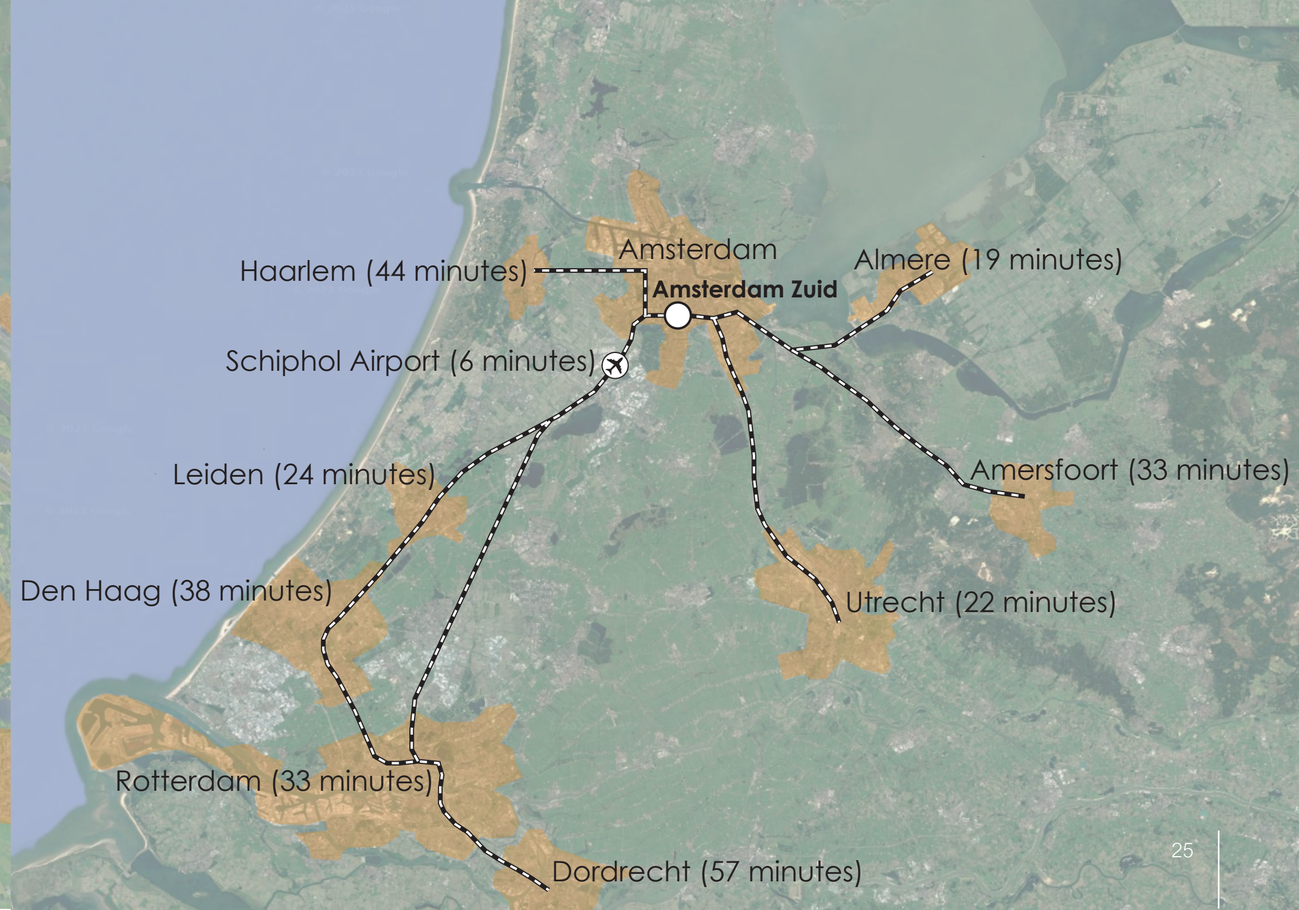
On the regional scale, Amsterdam Zuid is one of the focal points in the transportation network of the Metropolitan Area of Amsterdam. The station connects three out of five metro lines and is an important gate to the inner city since the opening of the North-South line (in blue).

Locally, Amsterdam Zuid station is an important connection between the two sides of the Zuidas (North and South from the infrastructural bundle). Due to the infrastructure, there are only a few connections present and the Minerva Concourse is the most important.


Amsterdam Zuid
13 minutes
Europaplein, RAI
10 minutes
Functions:
Zuidas CBD
RAI Convention Center
VUmc


Metro lines:
50
51
52
53
54
Amsterdam Centraal
Amsterdam Zuid
Schiphol Airport


Amsterdam Centraal
9 minutes
6 minutes
Amsterdam Zuid
Schiphol Airport


Haarlem (44 minutes)
Amsterdam
Amsterdam Zuid
Almere (19 minutes)
Schiphol Airport (6 minutes)
Leiden (24 minutes)
Amersfoort (33 minutes)
Den Haag (38 minutes)
Utrecht (22 minutes)
Rotterdam (33 minutes)
Dordrecht (57 minutes)



CROSSING BORDERS

In the near future, Amsterdam Zuid will also act on the international scale, as the international high speed train connections will shift from Amsterdam Centraal towards Amsterdam Zuid.

According to governmental policy, the competitive position of the Zuidas can be strengthened within Europe by providing international connections. As a result, the financial district will stand in direct connection with major hubs like Frankfurt, Paris and London.

Apart from high speed rail, Amsterdam Zuid already has great access to Schiphol Airport, which is only a six-minute train ride away.

By implementing hyperloop in the Zuidas, Amsterdam Zuid station and Schiphol International Airport could work together in creating two dedicated international hubs: one for European travels at Amsterdam Zuid, driven by hyperloop and high speed rail and on at Schiphol Airport for facilitating intercontinental travels through aviation.

The extension of the North-South line (in blue) towards Schiphol and Hoofddorp could improve the connection between Amsterdam Zuid and Schiphol Airport and create a more robust system.



Zuidasdok Informatiecentrum

Tot eind 2025 nog zo'n 1.700 nieuwe woningen in Zuidas

Zuidas krijgt er tot 2025 zo'n 1.700 woningen bij. En daarna nog eens circa 6.000. Daarmee komt het totaal aantal woningen op zo'n 10.000, aanzienlijk meer dan de 7.000 woningen uit de Visie Zuidas. We bouwen ze voor alle Amsterdammers.

Crossover **Pulse** **Zuidas Leeft**



AMSTERDAM ZUID
THE PLACE

A MULTIFUNCTIONAL DISTRICT

In the past years, the Zuidas has an increased focus on the development of residential zoning and facilities. This is part of the vision that the municipality of Amsterdam has for the area and is an addition to the offices and other functions such as the RAI Convention Center, the VU and the VU Medical Center that are already present.

By building about 10.000 residences (initially 7.000) in the Zuidas, the municipality hopes to tackle the shortage on the housing market whilst creating a lively district, bustling with life.

As a result, the area becomes increasingly densely used by more people that either work, live or recreate in the area. Apart from this, the station will attract more and more travellers due to the implementation of a hyperloop terminal. In order to suit all these users, it is crucial that the area is well designed and comfortable to be in.

Luckily, there are already many high-quality spaces present in the Zuidas, as you can see on the images on the right. However, this is not all there is to find at the Zuidas..





THE NICE MIXED-USE DISTRICT







CONCRETE JUNGLE

The infrastructural node that runs through the Zuidas, acts as a barrier between both sides of the area.

On one hand, the dyke that carries the A10-ringway and the ring-railroad, creates a wall through the Zuidas. The dyke acts as a physical barrier, one can only cross the dyke through a few underpasses (of which the Minerva Concourse is most used by pedestrians).

On the other hand, there is a mental barrier due to the low spatial quality of the underpasses. In the pictures you can see that the concrete underpasses create very harsh spaces, uninviting for people to pass through voluntarily.

Highways, railroads and railway station often act as barriers. The traffic that crosses through them can not be mixed with normal traffic flows and this results in grade separated junctions. When designing these junctions, cars and trains usually get the most attention at the cost of other modes.

I would advocate to put the infrastructure of the highway and the railroad underground in order to give free reign to pedestrians and cyclists above ground.

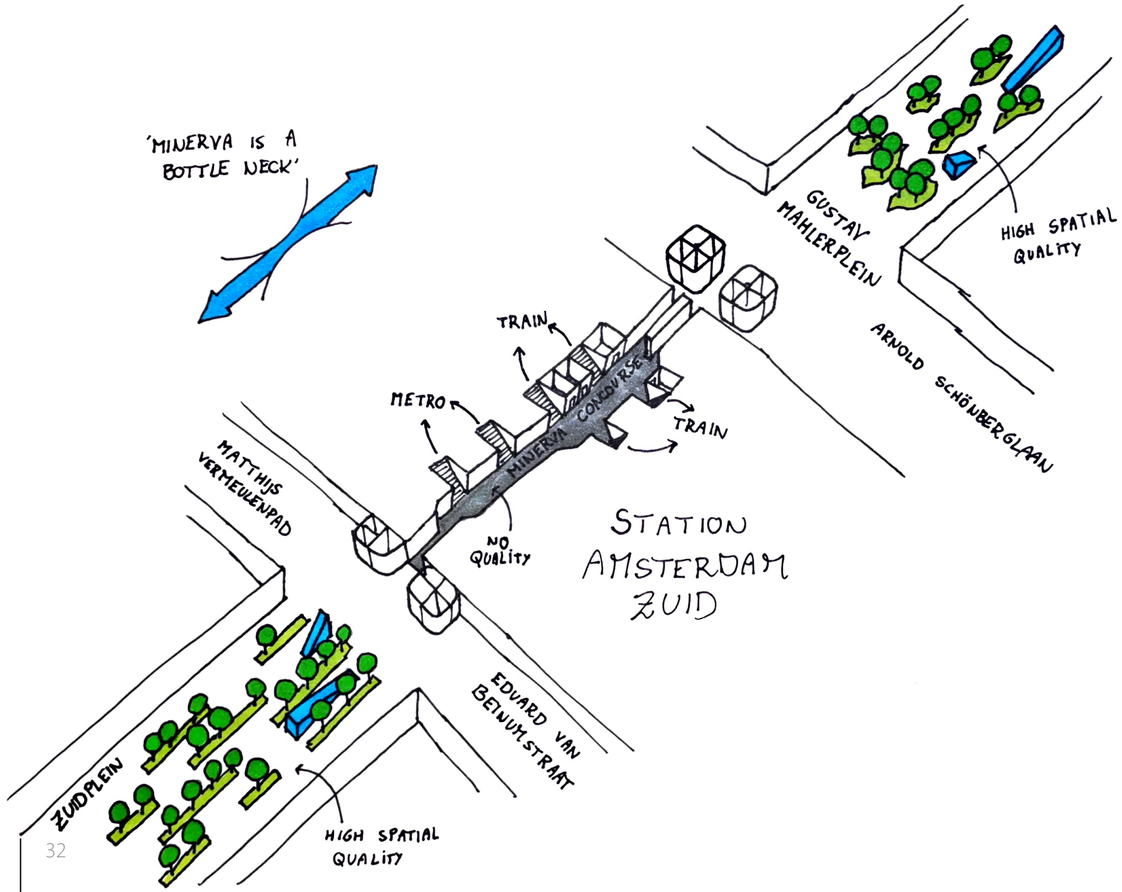




THE BAD CONCRETE DIVISION







THE MINERVA CONCOURSE

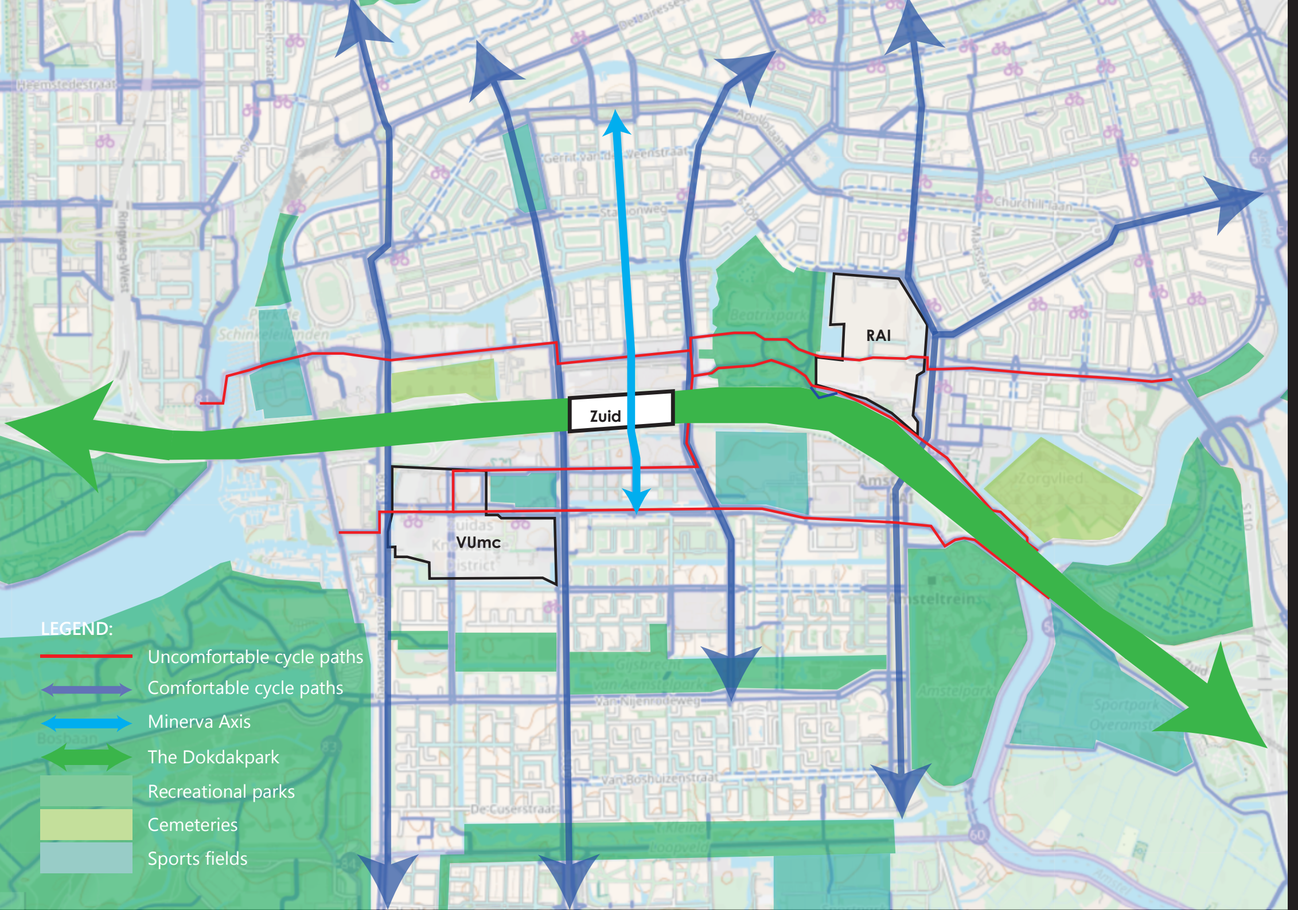
The Minerva Concourse forms the most important pedestrian connection between the Northside and the Southside of the Zuidas. The concourse lies on the Minerva Axis, a route from the inner city to the suburb that is a direct result from Berlage's 'Plan Zuid'.

Apart from this pedestrian connection, the concourse acts as the station hall of Amsterdam Zuid, this is where transfers between different trains and metros happen.

In contrast to its significance and its high profile surroundings, the concourse is actually a fatal flaw of the current station. The concourse is too narrow to support the pedestrian flows and has a very low spatial quality that creates a feeling of unsafety during the more quiet hours of the day.

In order to better suit the increasing amount of travellers and the increasingly dense neighbourhood, a new design is required. The Minerva Concourse needs to be widened and the spatial quality in and around the station needs to be improved. The new design should leave no barrier. Instead, it should lift up city life in the area.



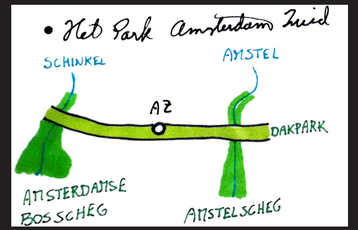


THE DOKDAKPARK

In the area of the Zuidas, most cycling routes are North-South oriented, from the suburbs to the center and vice versa. From East to West, routes are discontinuous due to the urban plan and the natural barriers from the Schinkel and The Amstel.

By putting the highway and the railway underground, space is freed up that can be used to connect major green areas such as the Amsterdamse Bosscheg and the Amstelscheg. This green infrastructure can in turn provide spatial quality to the central part of the Zuidas and can feature an important cycle and walking route oriented from East to West in addition to the existing routes perpendicular to it.

This park is based on the already existing idea for 'the Dokdakpark' that used to be a part of 'Zuidasdok'.





The Dokdakpark, Zuidas.nl, 2021



RESEARCH FINDINGS
INTEGRATING THE STATION



Catching a transfer



Catching a bite



Stad inZicht, 2006



Het Parool, 2019

RESEARCH FINDINGS
INTEGRATING THE STATION

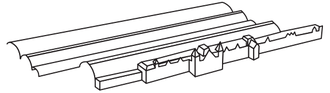
DESIGN PRINCIPLES

The integration of the Amsterdam Zuid railway station within its urban surroundings is a real challenge. In fact, stations are known for creating barriers and low-quality public spaces (or non-places, as Marc Augé calls them).

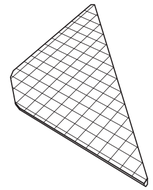
This given led me to perform an academic research into the integration of the station within the city. After performing a literary research and several interviews with industry professionals, I defined six design principles that can help with integrating the station within the city. I then tested these design principles by performing case studies on seven Dutch and Belgian train stations, of which examples depicting Amsterdam Centraal can be found on page 39.

During this proces, I gained new insights and added six design spaces, one for each design principle, in order to make the findings more practically tangible. The six design principles and design spaces can be seen on page 38. The entire research has been described in the research booklet.

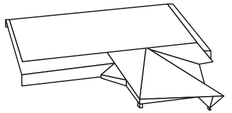
These six principles and spaces informed my design on assuring a good integration of the station within the city, as will become visible in the last chapters.



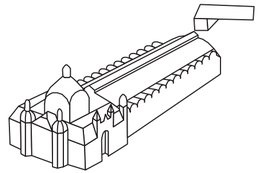
Amsterdam Centraal



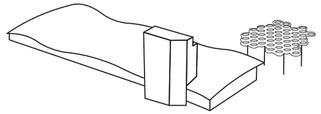
Schiphol Airport



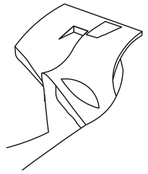
Rotterdam Centraal



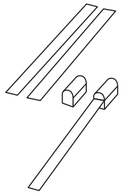
Antwerpen Centraal



Utrecht Centraal

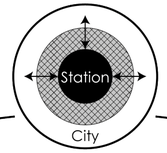


Arnhem Centraal

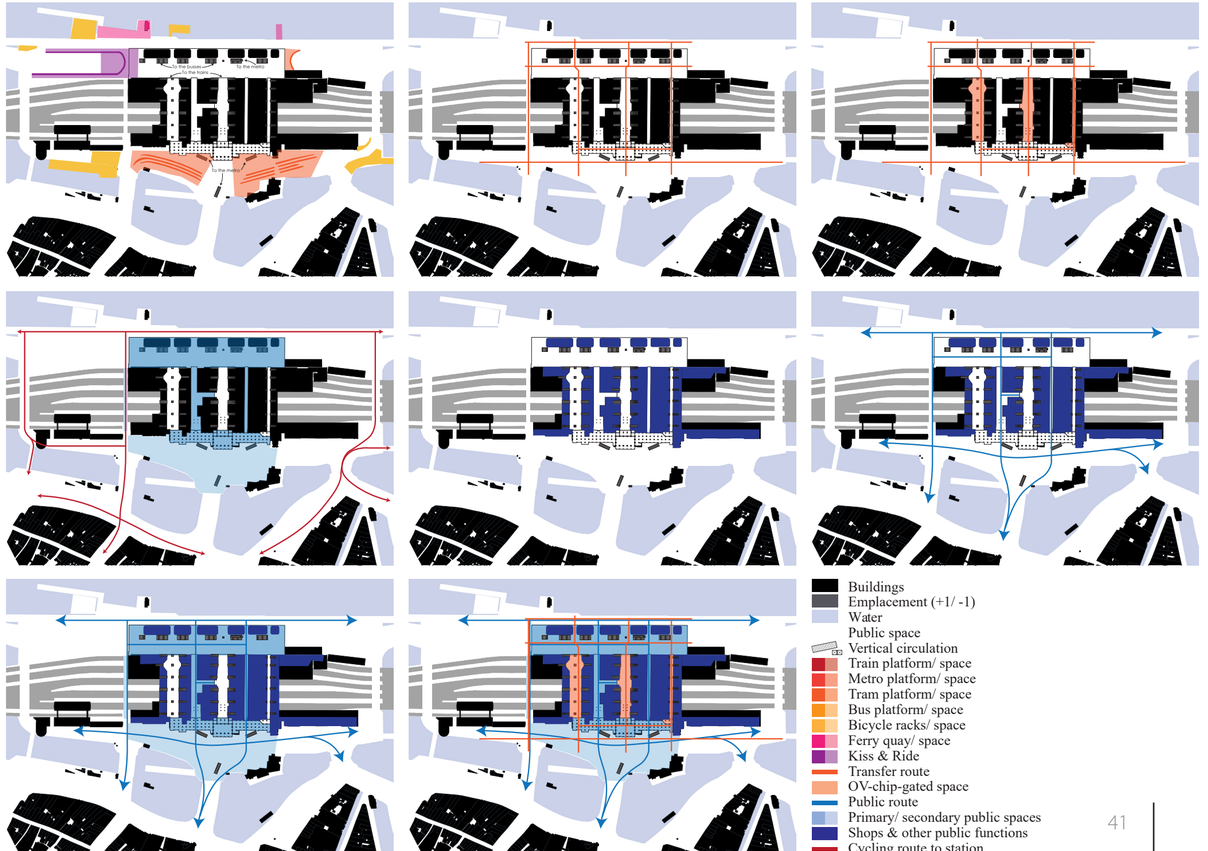


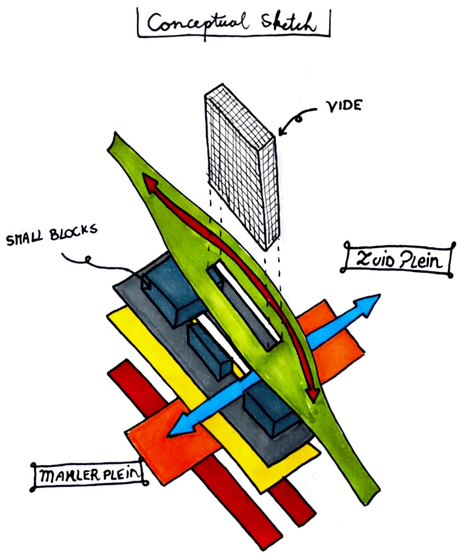
Amsterdam Zuid

How to integrate the station within the city?

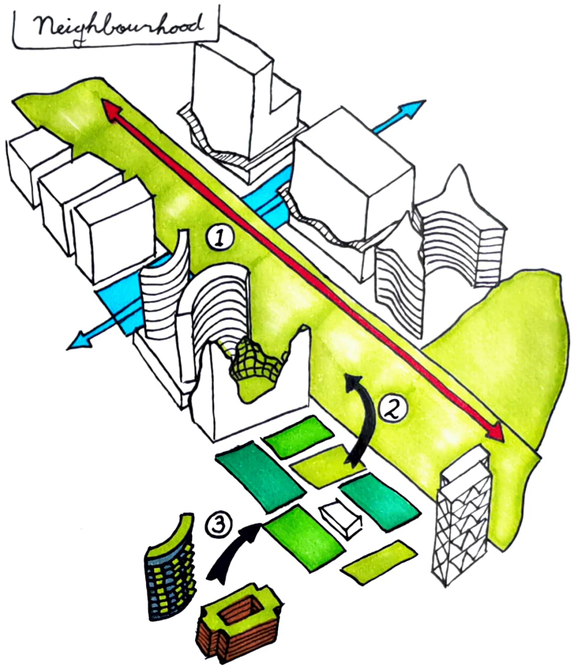


	Functionally		Spatially		Architecturally	
Principles	**Multimodality** "Offer diverse transportation services and stimulate active transportation."	**Functional mix** "A divers and public functional mix that attracts citizens 24/7."	**Connectivity** "Minimize the station's barrier effect and continue the urban grid."	**Spatial quality** "High and diverse spatial quality offers a comfortable stay, it is inviting to all."	**Visibility** "The station is clearly recognizable and creates a good orientation."	**Flexibility** "Over-dimensioning and structural flexibility enable the station to adapt."
Spaces	**Central square** "The heart of the station, everything comes together here."	**Station living room** "Comfortable, open, freely accessible for everyone, a home away from home."	**Connecting streets** "Provide plenty strong connections for active transport, walking has priority."	**Welcoming Park** "Offering green spaces, welcoming guests, improving sustainability."	**Monumental aspect** "An element that creates visibility and offers space for public activities."	**Temporary infill** "The excess space enables temporary (public) functions & cultural activities."





CONCEPT
LAYERS & DIRECTIONS



CONCEPT
LAYERS & DIRECTIONS

LAYERS

In the new situation, the station of Amsterdam Zuid and the A10-higway need to be expanded. However, the open space in-between the highrise is about 200 meters wide and this is simply not enough space for both interventions (see the next page).

It has also been described that the spatial quality in the central corridor needs to be improved. By moving the infrastructural bundle underground, space is freed up to enhance the area surrounding the station. This also enables the implementation of the Dokdakpark that has been mentioned earlier.

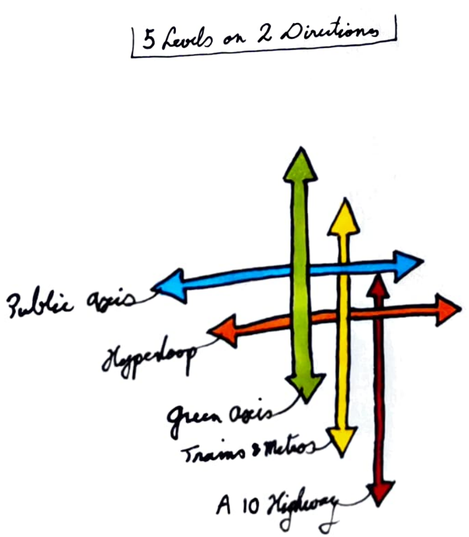
However, this does not just serve the station. On the scale of the Zuidas as a whole (see the left image), the Dokdakpark (1) can provide space for the sports functions (2) that are currently present in the area. As a result, new residential development can be planned on the former sports fields (3), strengthening the monumental layout of the Zuidas and its multifunctionality in turn.

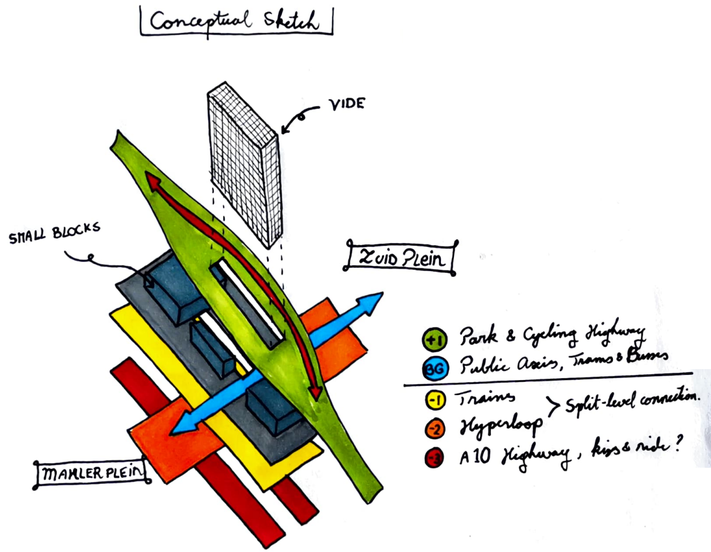
DIRECTIONS

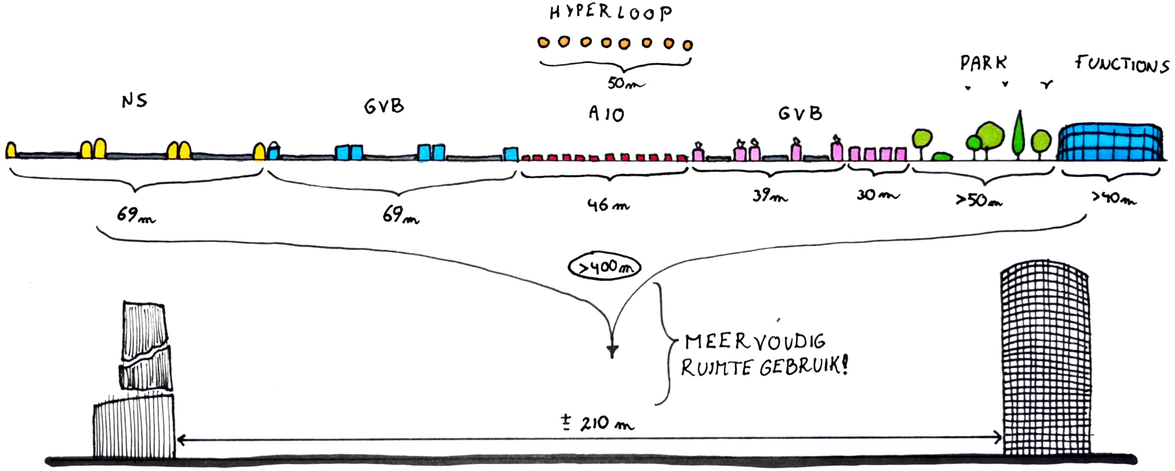
The Dokdakpark, or the Green Axis, runs from East to West and will form a crucial route for both pedestrians and cyclists in the future. The highway and railway run underground in the same direction.

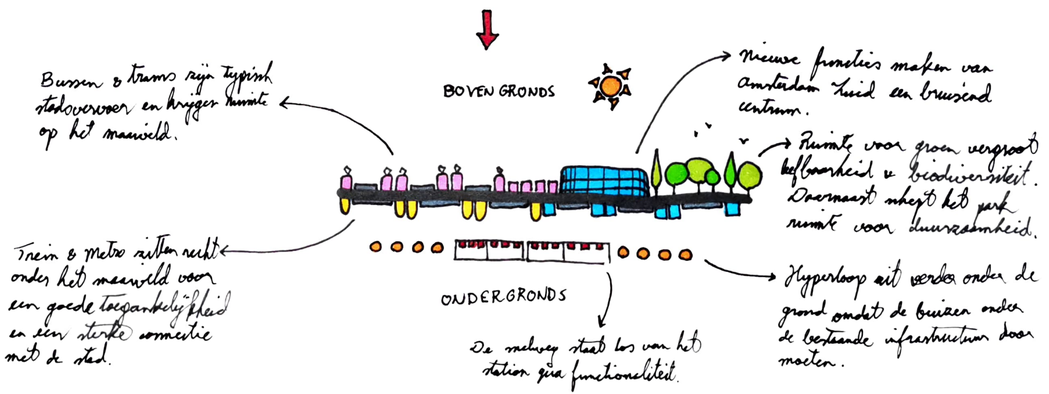
The Minerva Concourse runs from North to South (just like the subterranean hyperloop tubes) and is the main pedestrian connection between the Northside and the Southside of the Zuidas. In order to create a safe and calm situation, both axes will be on separated grades.

The Dokdakpark will be elevated to +1, freeing up space on the ground floor for the connections to the station underneath and a public plinth with functions and amenities for both the station and the neighbourhood, consisting of small blocks.

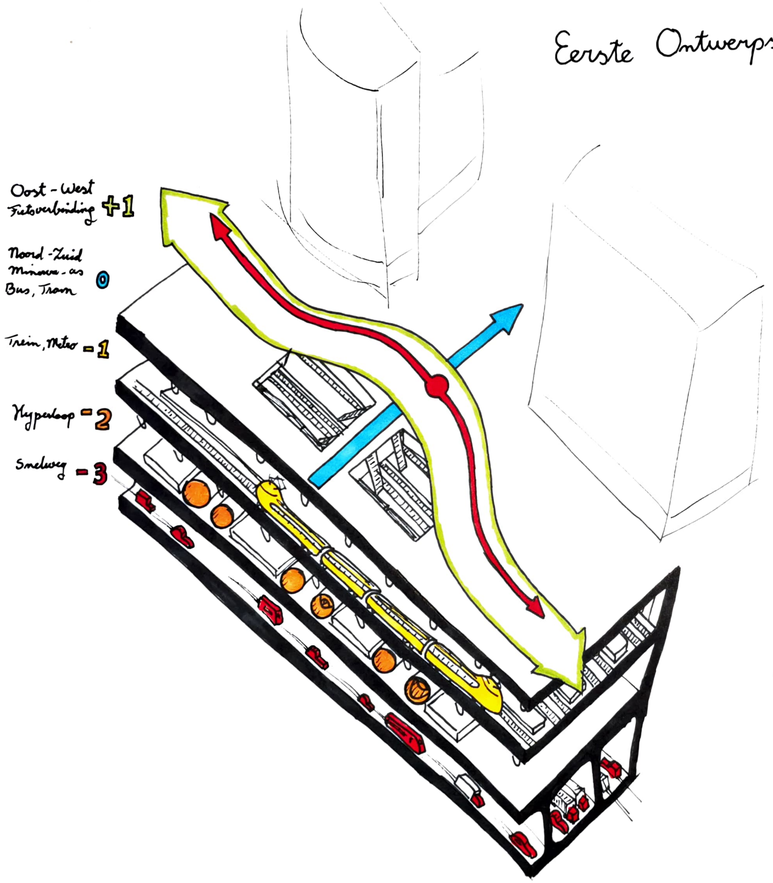




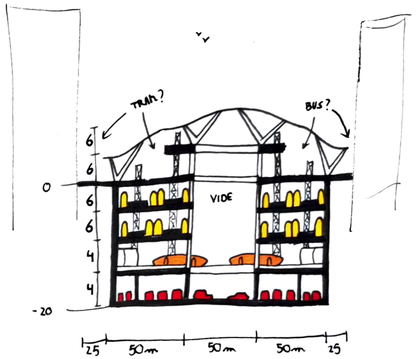




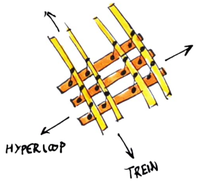
Eerste Ontwerpschets



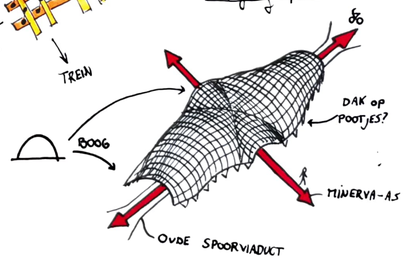
Verticaliteit:

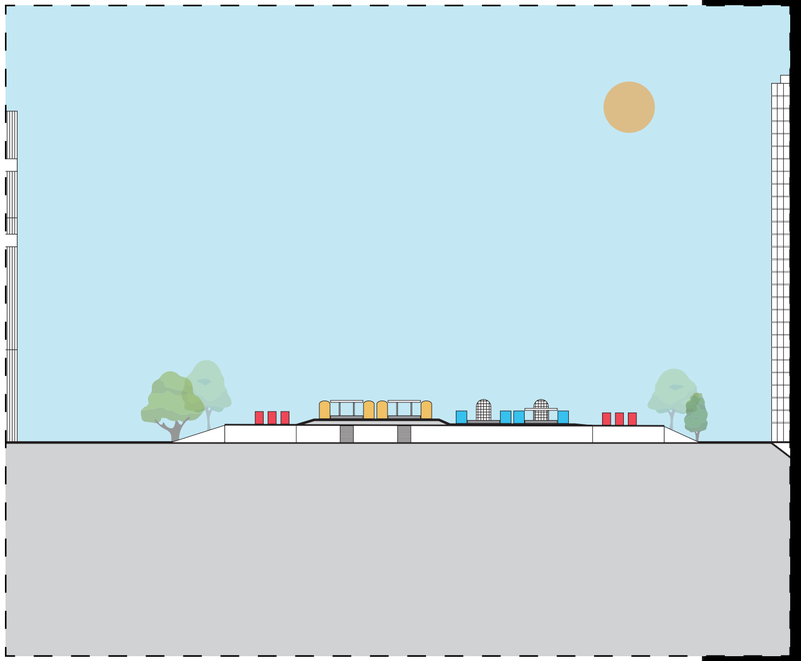


Kruisstation:



Alzijdig open:





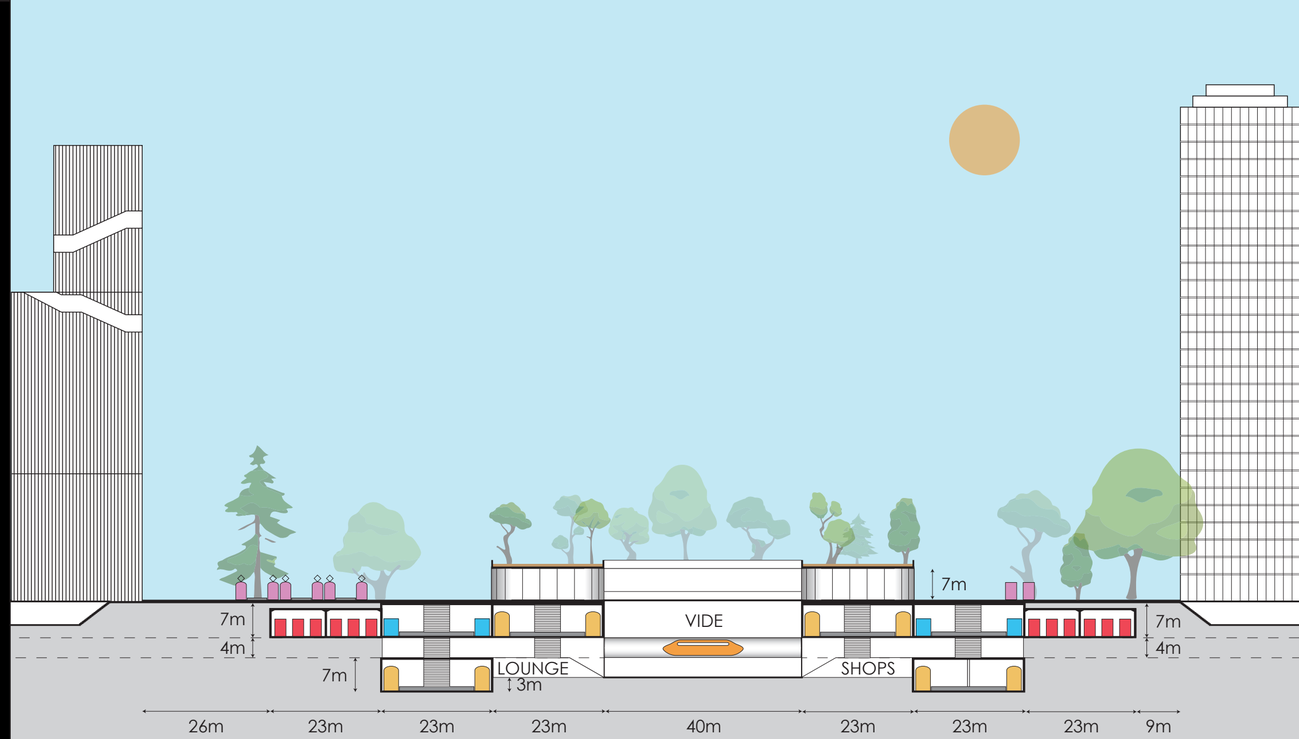
LEAPFROG

Stations always have to be operational, which makes redesigning a station a difficult task. The new station has to be designed around or next to the existing station, without interrupting its services.

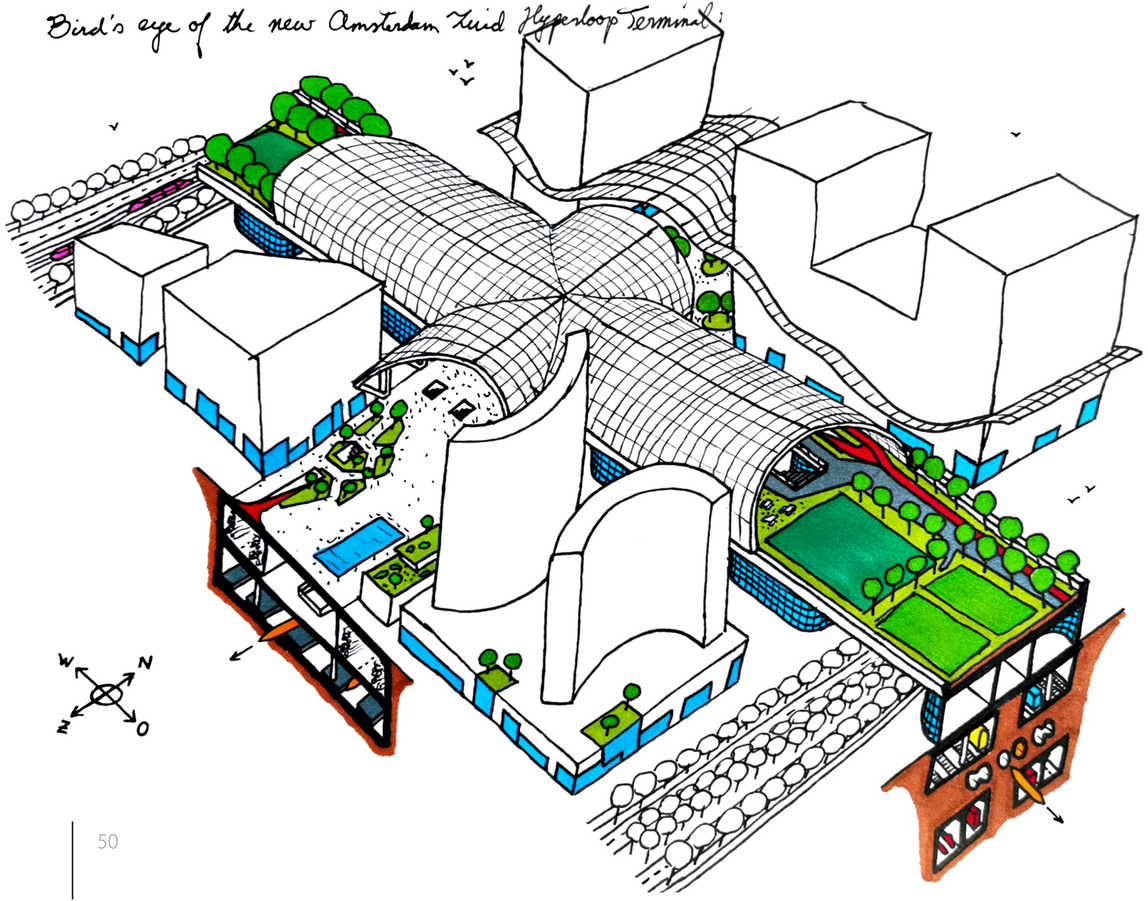
In this case, the new station will be built gradually besides the existing station. Everytime a new part of the new station has been constructed, the corresponding part of the old station can be demolished, freeing up space for the next part.

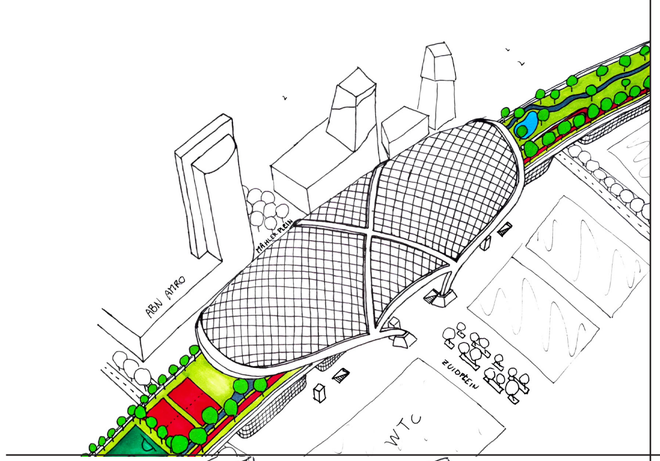
This way of constructing has defined the exact location of the station and its distance from the existing highrise. The starting point has been the placement of the tunnel for the A10-highway besides the existing highway by clearing out the green strip. In-between the highway tunnels, the new station will be constructed.

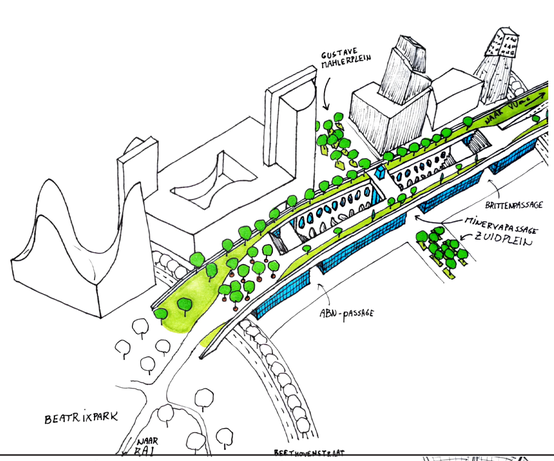
The vide is the last part of the design. On top of the vide, the station remains to be functional until the subterranean tracks and platforms have been constructed. Once the old platforms can be removed, the vide will be excavated, marking the end of the construction phase at the station. Only the arched roof will be constructed after this.

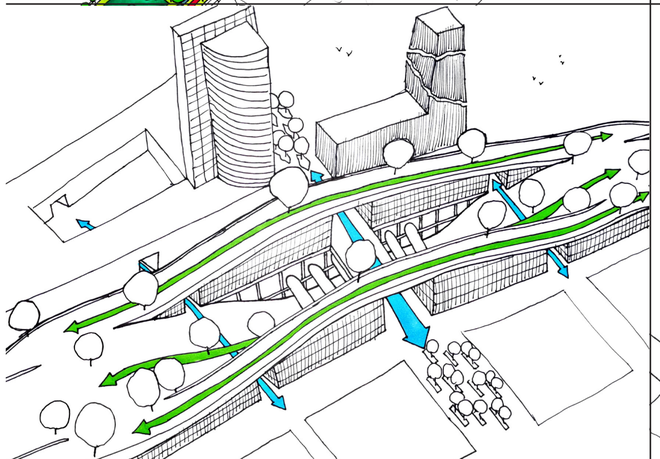


Bird's eye of the new Amsterdam Zuid Hyperloop Terminal



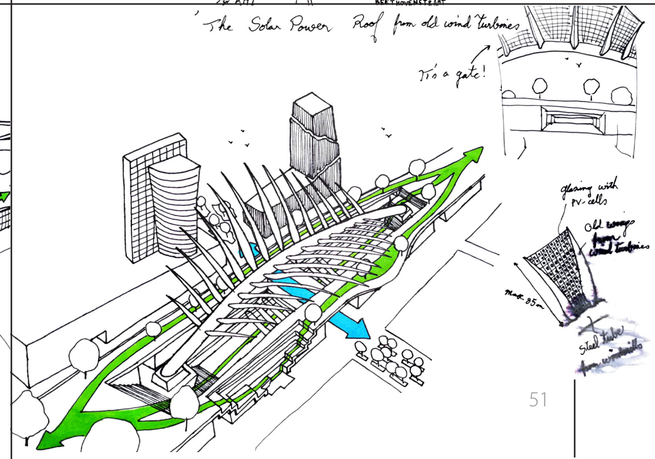


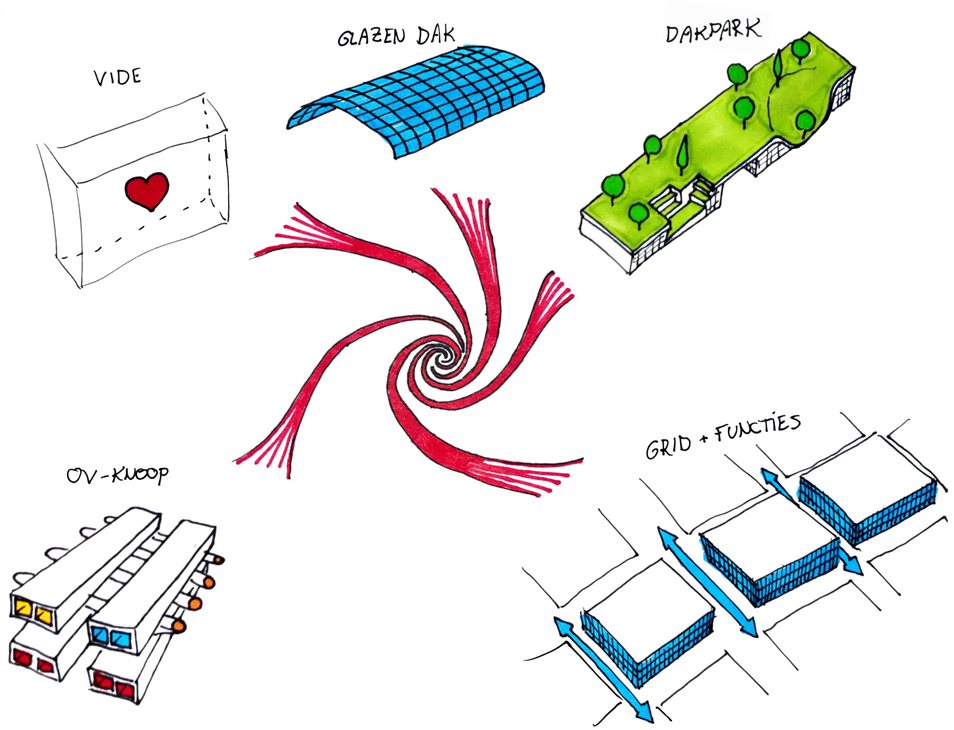




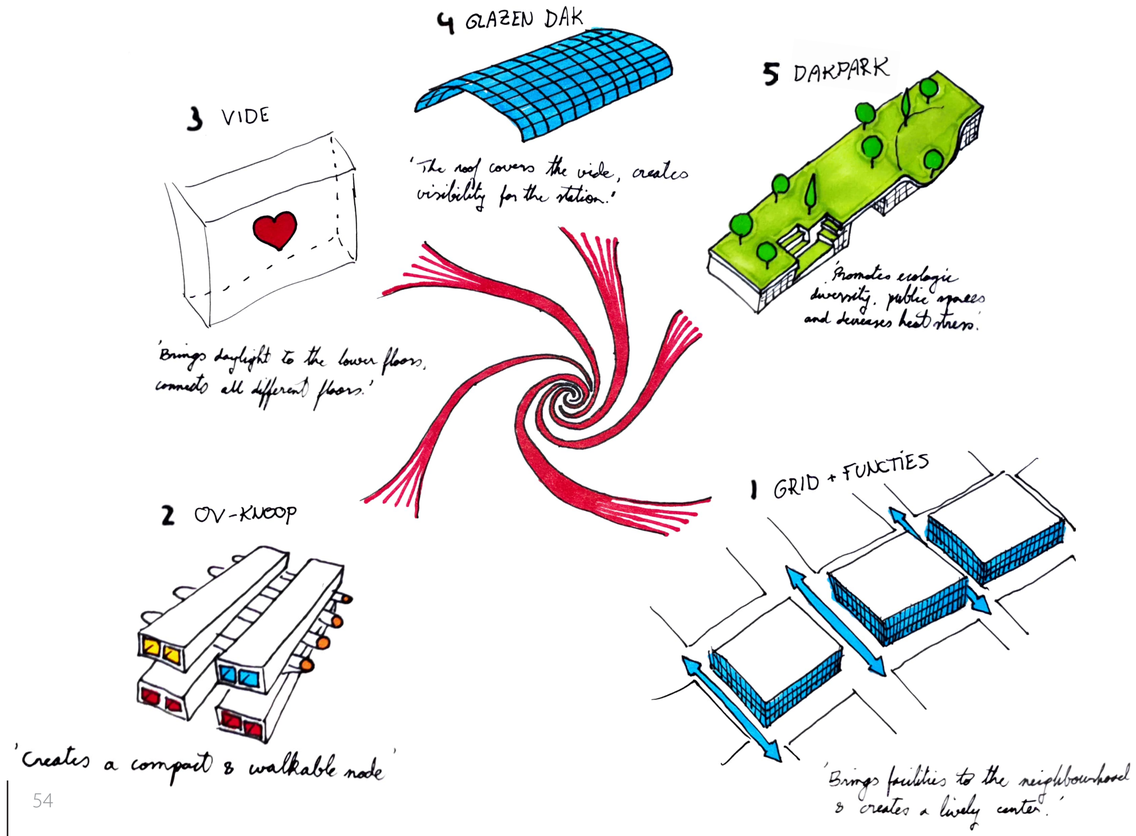
The Solar Power Roof from old wind turbines

It's a gate!





ALL FOR ONE
THE 5 DESIGN ELEMENTS

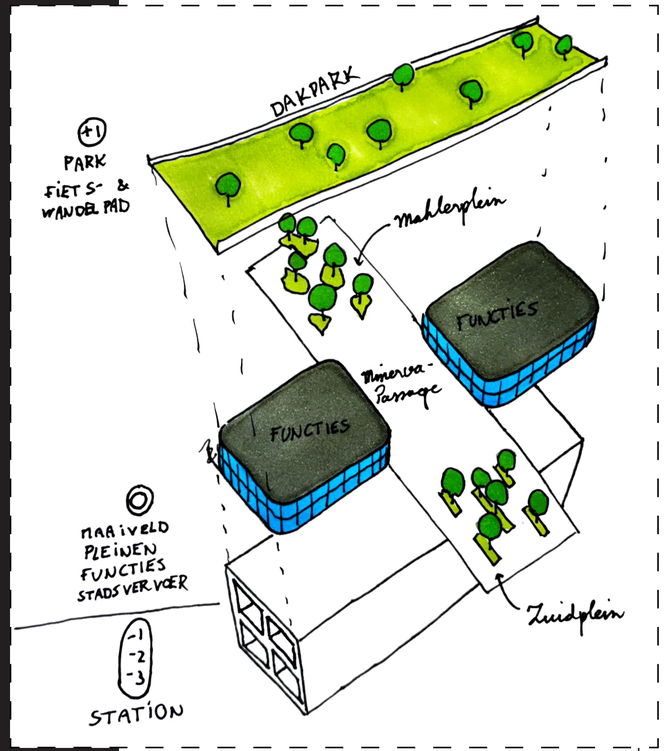


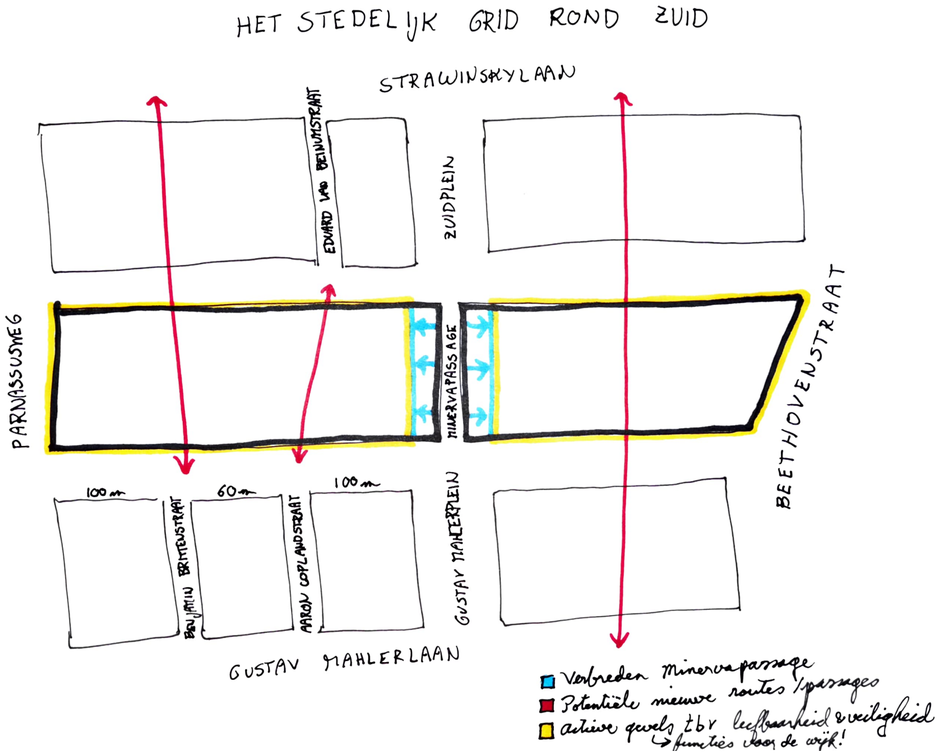
ALL FOR ONE
THE 5 DESIGN ELEMENTS

ABOUT THE 5 DESIGN ELEMENTS

The sketch design has been informed by three different exercises. Firstly, the design has been informed by the site analysis, that showed that a vertically stacked station complex is inevitable. Secondly, the design has been informed by several preliminary sketch sessions, of which some drawings have been included on pages 48 & 49. Thirdly, the sketch design has been informed by the research findings, advocating for a comfortable multimodal hub that is fully integrated within the city; a hub that combines the nodal and the public function of the station.

These three different exercises led to the formulation of five different design aspects that form the basis of the design. At ground floor level, the city's grid is being continued, accompanied by public functions and other amenities (1). This diminishes the barrier-effect of the station and creates a liveable and safe public realm. The combination of multiple modalities and the need to put these underground, ask for a well-designed compact hub (2). By putting the infrastructure underground, a vide (3) has been designed in order to connect the different layers via the station living room and bring daylight to every part of the complex. Covering the vide should be a transparant roof that also creates visibility for the complex (4). At first floor level, a park (5) ensures the proximity of greenery and a comfortable route for active transportation for everyone.



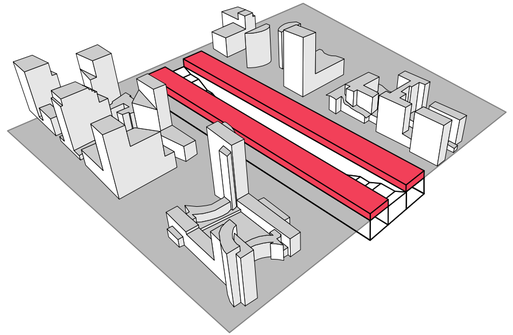


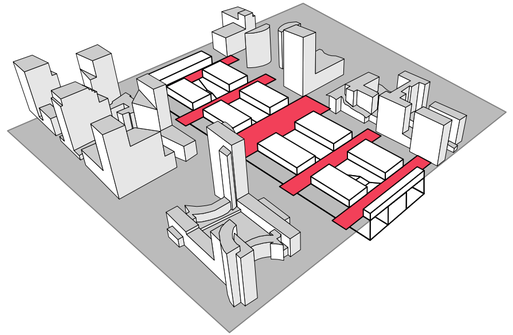
1. GRID + FUNCTIONS

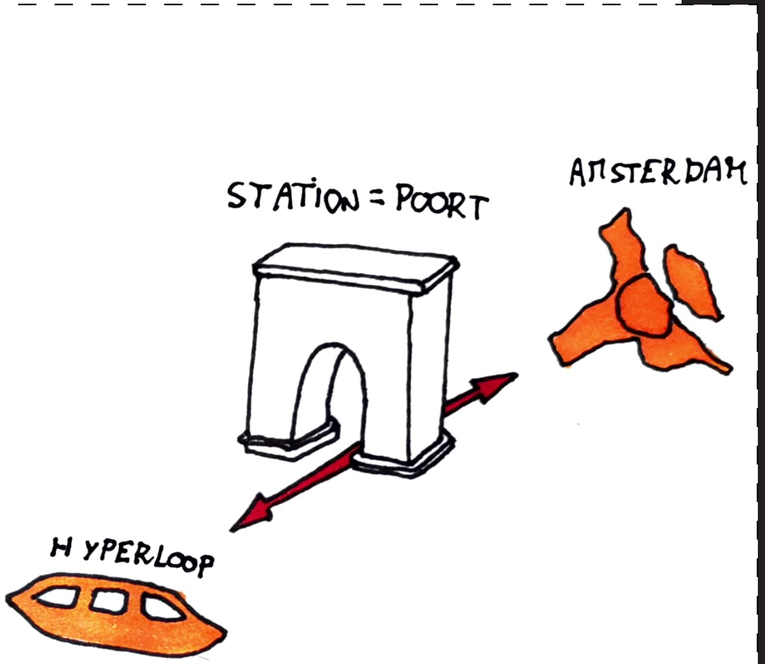
In order to minimize the barrier-effect that the station of Amsterdam Zuid imposes on its surroundings, the urban grid will be uninterrupted by placing the infrastructure and the station underground. The aim is to continue and reconnect the surrounding urban grid of Amsterdam Zuid by adding new concourses/ walkways and by broadening the Minerva Concourse in order to better suit the Minerva Axis.

The space in between these routes and the vide, will be filled with public functions and amenities. In contrast to the widely used retail mix at stations, the functions at Amsterdam Zuid will be not just directed towards the traveller, but towards the people that work, live and recreate at Zuid as well. Whether they use the transportation or not.

Expect a supermarket, a hairdresser, a laundry service or an art shop in addition to the usual Smullers, AH To Go & the florist. The station will grow out to be the bustling heart of Amsterdam Zuid.





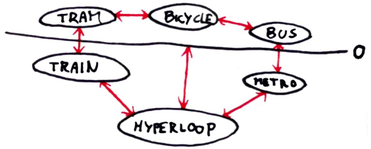


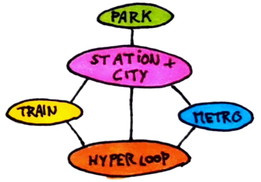
2. VISIBILITY & COMPACT NODE

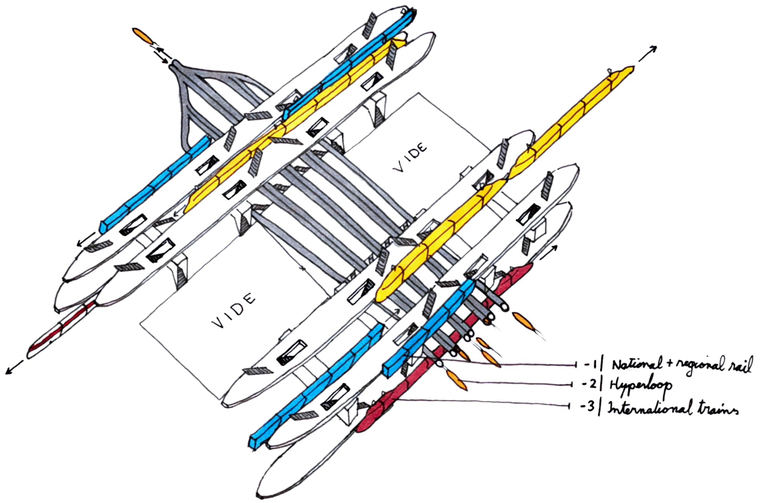
Stations have a crucial role in modern society by being the interface between mobility and society. Station design has a direct relation with travel experiences and therefore a well-designed station can stimulate patronage of transportation.

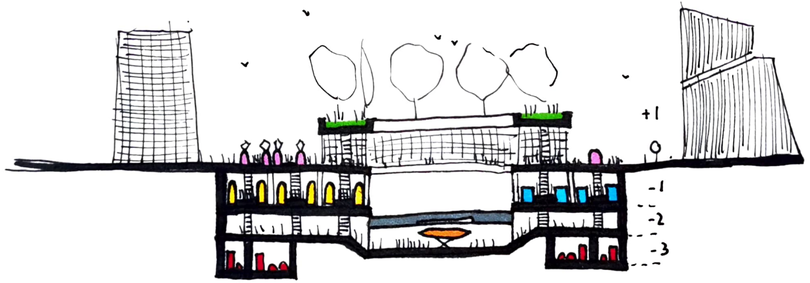
Especially in the case of a hyperloop terminal, the station's design is pivotal. By bringing a completely new way of travelling, travellers need to be assured of the safety and the comfort that the hyperloop ensures. By placing the hyperloop tubes perpendicular to the vide, their floating platforms and tubes cross the vide. In order to maximize visibility of the pods, the tubes will be made from transparent curved acrylic sheets.

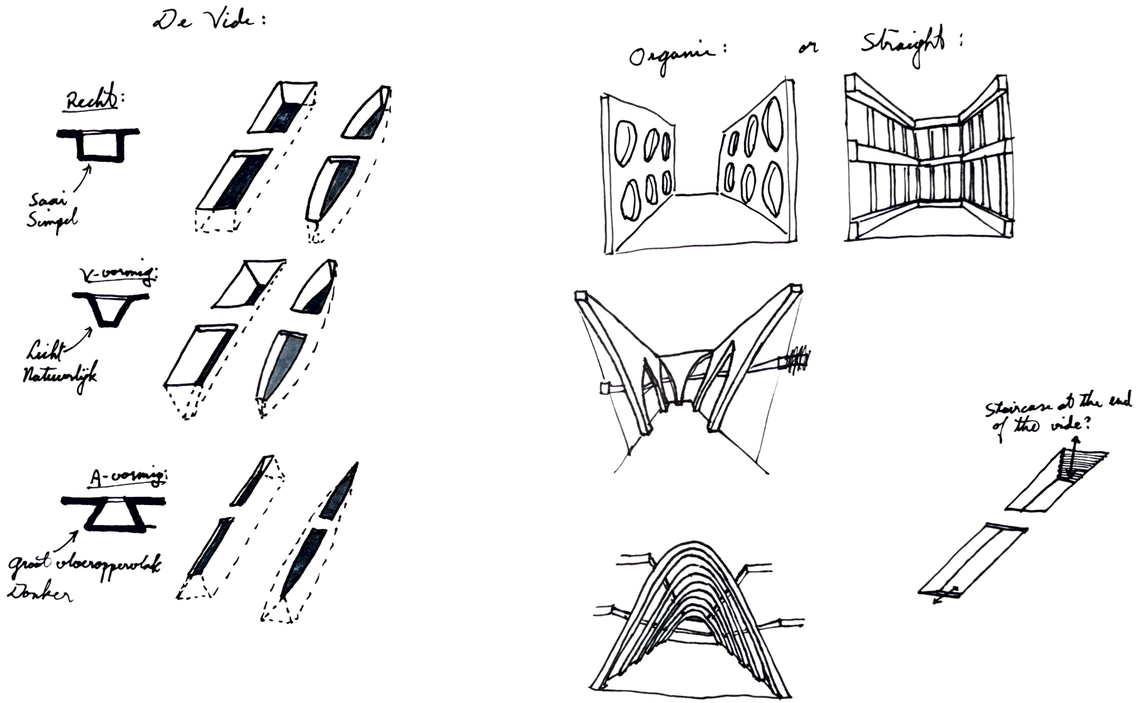
This perpendicular placement brings about another advantage, because it saves the need for an intermediate floor. In-between the hyperloop tubes, concourses are placed that connect the station platforms at -1 with the bottom of the vide, where the entrance to the hyperloop customs are located as well. Train and metro connections are situated at -1 in close proximity to both the city and the hyperloop for an easy transfer. The result is a highly compact node that brings together a multitude of modalities.











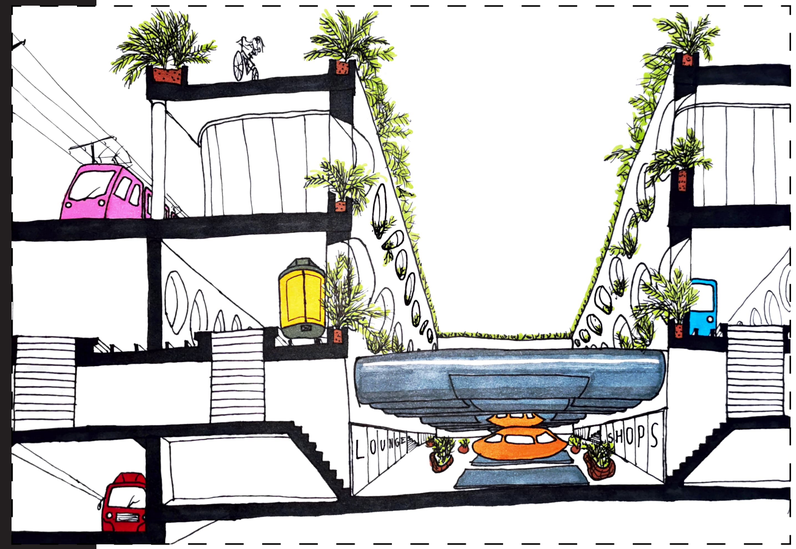
3. THE VIDE

The Vide is the heart of the station complex. It is a monumental urban canyon that brings daylight and fresh air deep into the station complex.

All different spaces and functions of the station complex are situated around the vide. Wherever you are in the complex and large station, you can see the vide with its abundant light. This gives travellers and passers-by a sense of place: the vide always provides the necessary orientation.

From the vide, all different modalities and spaces are easily found and reached. The trains and metros are situated in-between ground floor level and the vide so that they are also fully accessible from the street. However, all international travel (hyperloop at -2 & international trains at -3) is to be accessed through the vide and the adjacent customs.

At the bottom of the vide, retail fills up the plinths that are not used for customs. Terraces and planters fill up the space and create a 'station living room' where anyone can feel at ease and relax. Whether one is waiting for a transfer, or meeting up with a friend.



THE GROUND FLOOR

The ground floor shows how the previous three design elements combine.

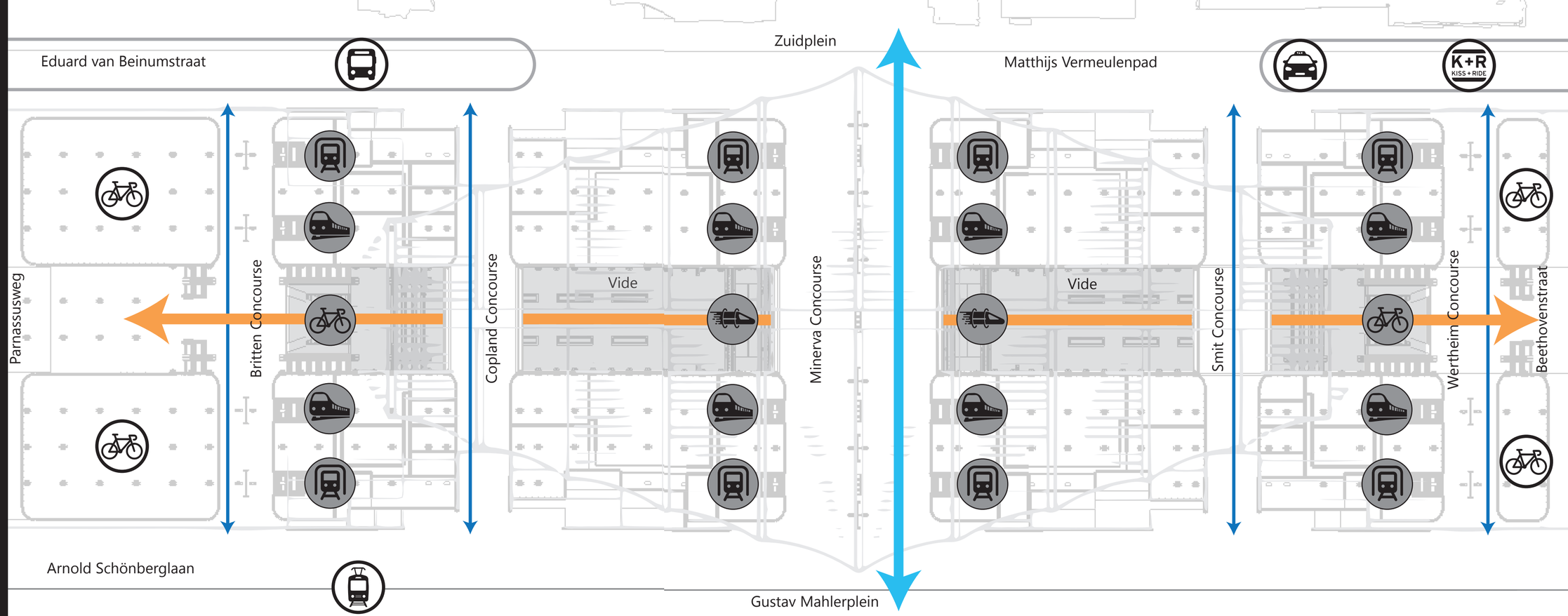
THE CITY'S GRID

The five concourses and the retail blocks form a continuation of the surrounding urban grid. On top of this, the vide creates a brand new urban space: an urban canyon.

THE INTERFACE

The ground floor and the vide form the interface between the city and the station. Stairs and elevators are situated in the Britten, Minerva and Wertheim Concourse and bring travellers towards their departure platform.

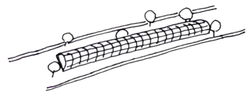
- The Minerva Concourse
- The vide
- Newly added concourses
- Modality on ground floor
- Subterranean modality



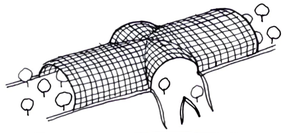
1:1000

Verschillende daken

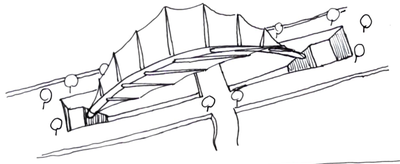
1. Het zwembaddak



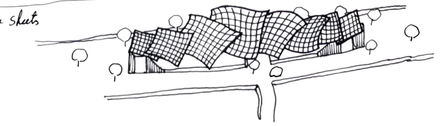
2. Kunststofgewelf



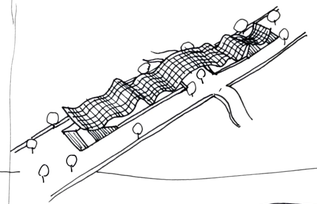
3. The Whale



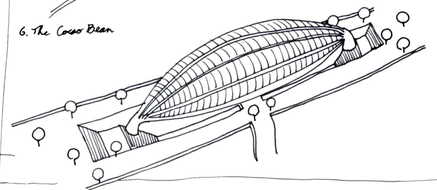
4. The Sheets



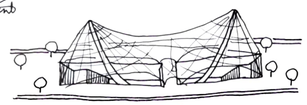
5. The Wave



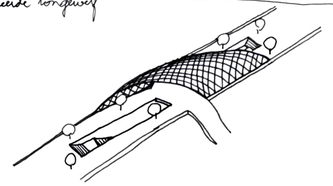
6. The Cocoa Bean



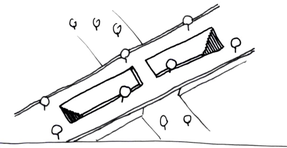
7. De Overstek



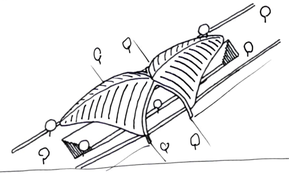
8. Het getordeerde tongewelf



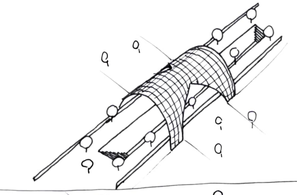
1. Green Roof



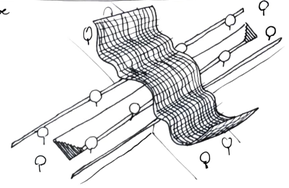
2. De Vlinder



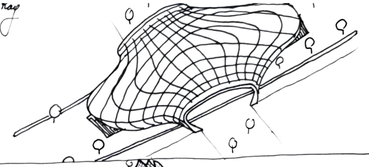
3. De open ton



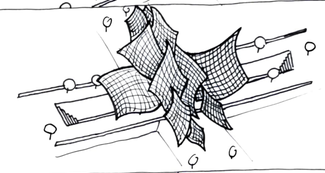
4. The Wave



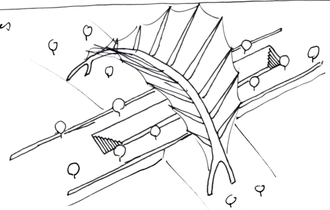
5. De Mantel Roof



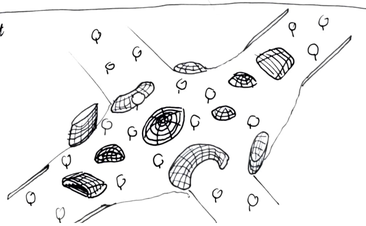
6. The Shades

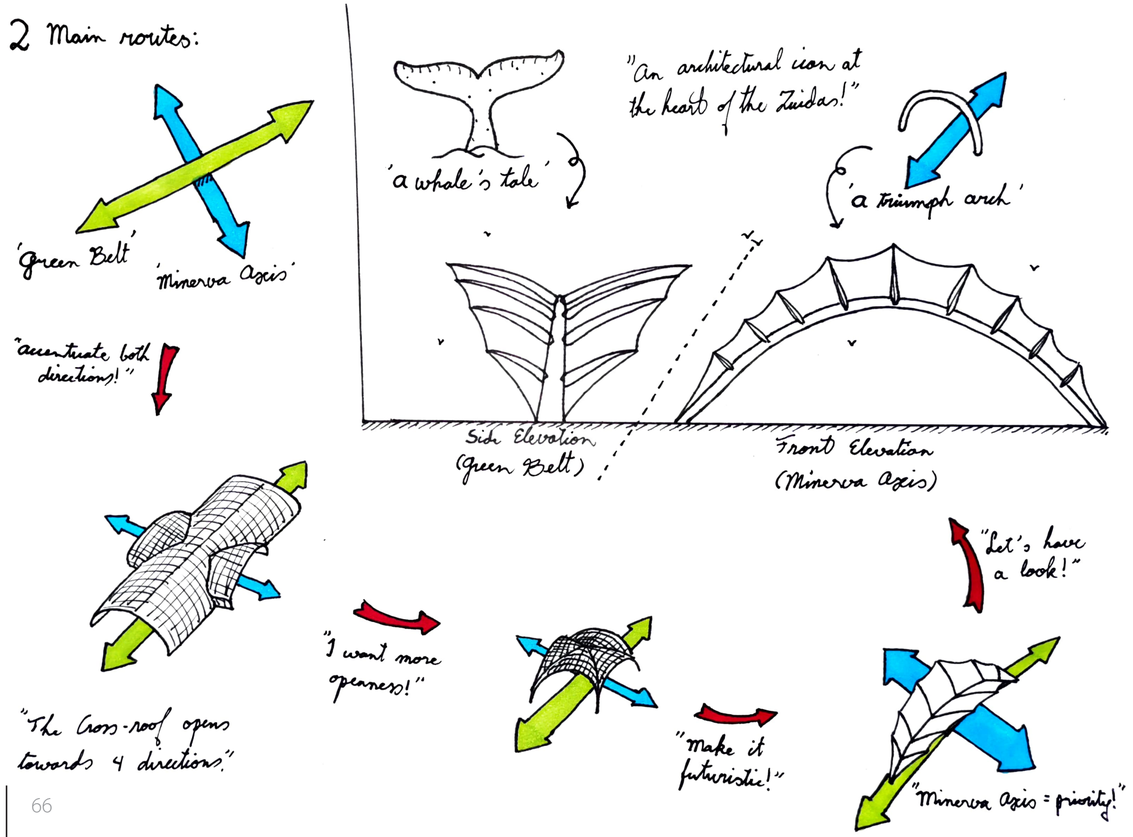


7. The Spikes



8. The Rabbit





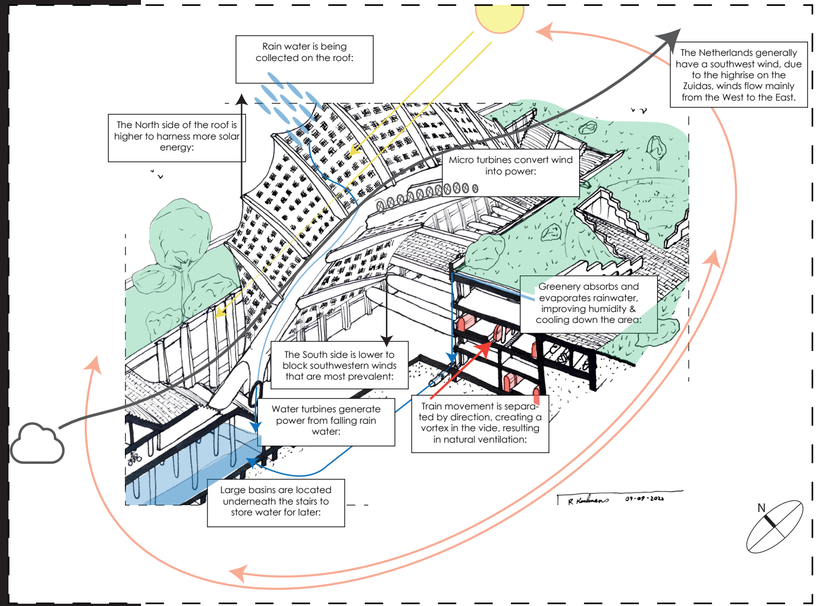
4. THE ROOF

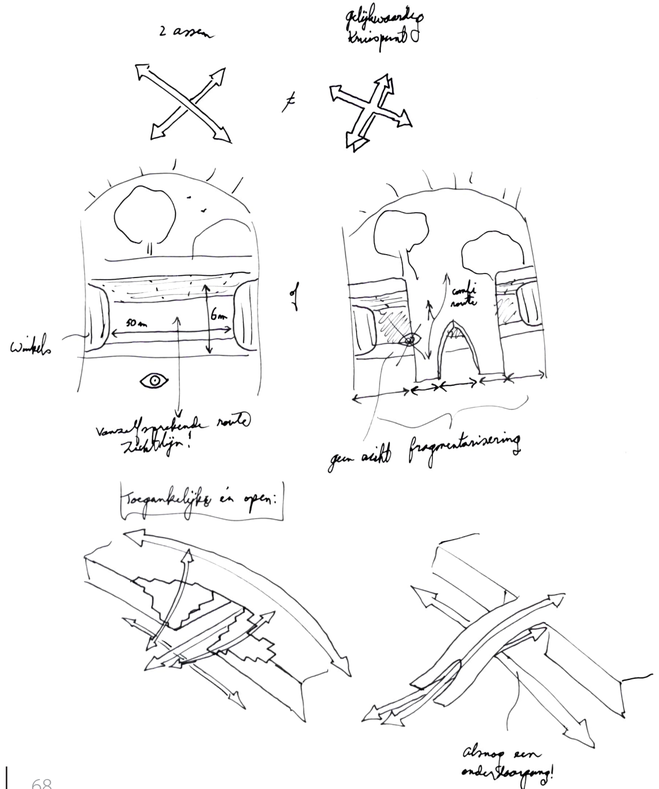
Initially, I designed the roof as a classical shed roof constructed with glass and steel. This type of roof can be found on stations all over the world and hence has a strong definition of place regarding stations.

Eventually, I questioned whether this would be the right roof for this situation. Because of its curved shape, the roof encloses the space underneath it entirely. The roof would divide interior and exterior, whereas I wanted to create one continuous space.

I started sketching a multitude of different roofs, see the previous pages. What struck me about the 'whale' is that it works in two directions in a completely different way. Walking over the Minerva Axis, the roof acts as a triumph arch, celebrating a new era of travel. Whereas on the East-West axis, the roof acts as a guide. In the distance the roof can already be seen and is some sort of beacon. When approaching the arch, it comes up from the ground to eventually come back down. Spreading its wings over everyone passing by it. It must be quite the experience to pass by this landmark.

But this is not all there is to the roof. After choosing the shape, the roof has been optimized regarding its climatological properties, see the right image.





5. THE PARK

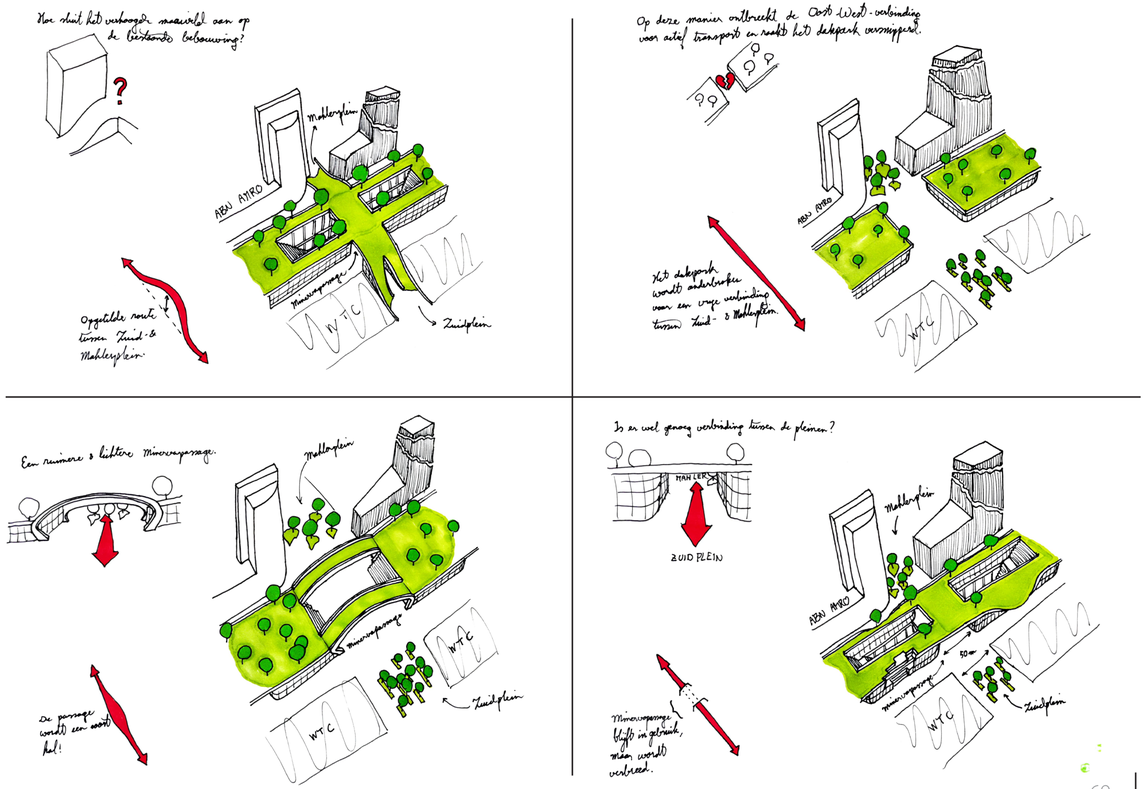
The park is a real novelty in the station quarter. It brings a completely new type of public space to the station, ensuring a wide range of comfortable places to stay for its users.

Apart from this, the park plays a pivotal role in creating a nice and comfortable climate. The greenery helps with diminshing the urban heat island effect, that is otherwise so prevalent around stations and in dense urban areas in general.

Due to the public functions that are located at the ground floor, the park is located at the first floor. The park ensures a nice getaway from the buzz around the station.

Creating smooth connections between the ground floor and the first floor was a challenge. Vertical distances are usually more difficult to overcome than horizontal distances. By creating slopes and stepped landscapes, I aim to create a fluent landscape that continues over multiple levels.

In the end, I decided to go with the bottom right option on the next page, in order to enable a smooth flow of cyclists from East to West at +1 whilst maintaning a pedestrian oriencted ground floor with the Minerva axis.





FINAL DESIGN
THE WHALE

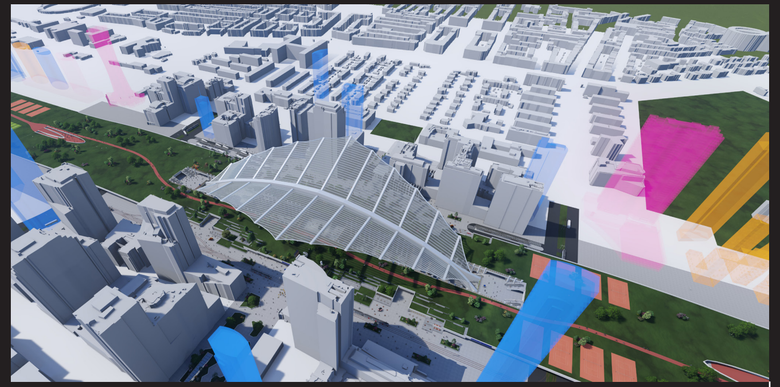
FINAL DESIGN
THE WHALE

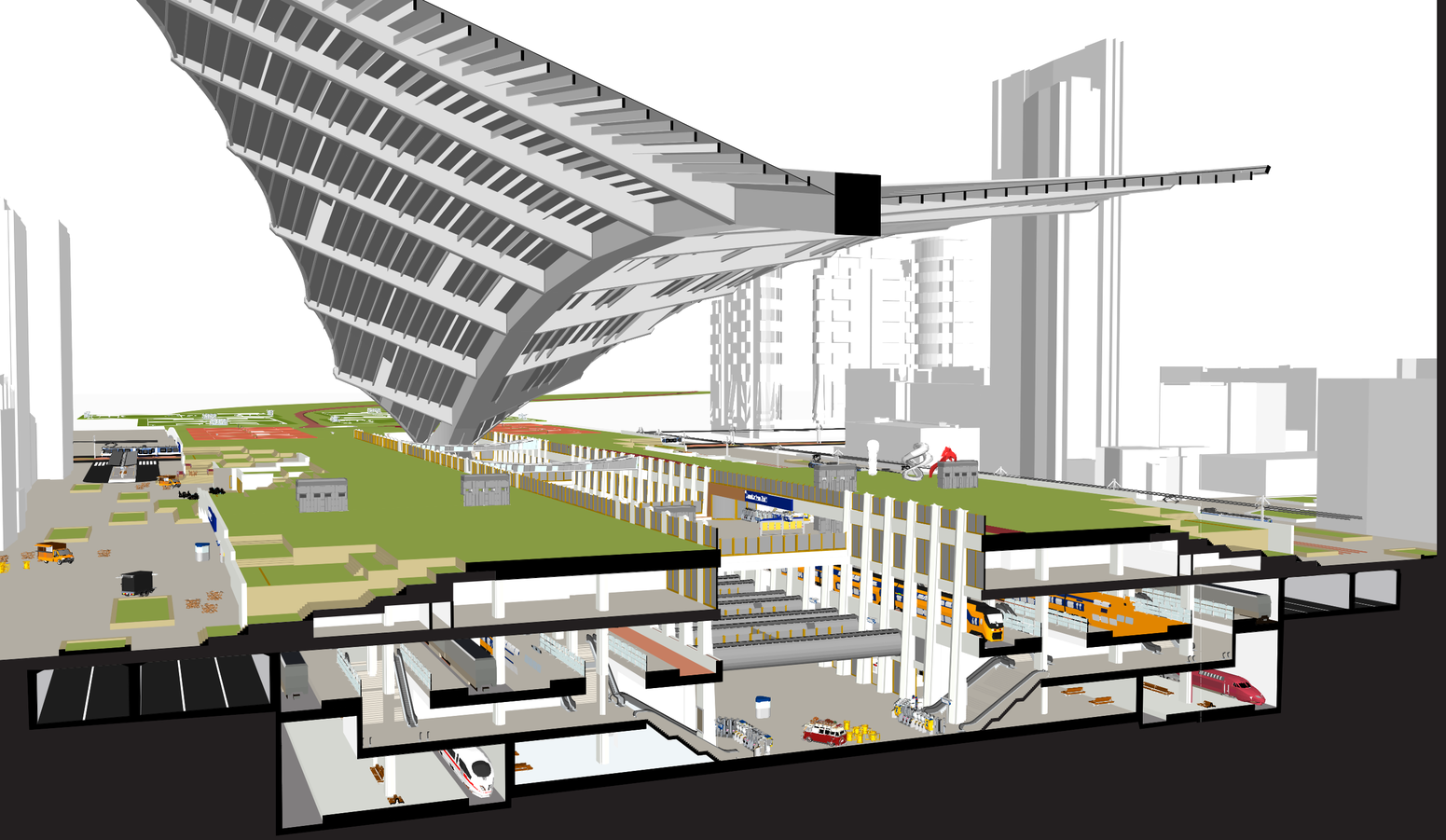
ABOUT THE PROJECT

Emergence of hyperloop on one hand and better integrating the station of Amsterdam Zuid within its surroundings on the other hand, created the need for a new design. After a year of doing academic research on the integration of the station within the city and designing this complex multimodal urban station, I can be proud of the final design that is presented in this chapter.

ABOUT THE WHALE

The station consists of two parts: the roof and the vide. The vide is the heart of the station and has a highly rhythmic facade that refers to the banks and insurance companies on the Zuidas. Whereas the arched roof refers to the future, a future where Amsterdam Zuid becomes The Netherlands' most sustainable international hub, right at the heart of the Zuidas.





THE WHALE
AN INTEGRATED MULTIMODAL HUB AT ZUID

THE NODE

Seen from the street, the new Amsterdam Zuid train and hyperloop station has only one layer: the ground floor. However, seen from the vide the complex has three extra floors located just under ground floor level. These three floors create a complex and compact mobility hub where hyperloop, (inter)national train services and regional transportation are connected seamlessly.

National train services and regional metro services are located at -1 in order to be accessible from both ground level and the lower floors. Hyperloop is located at -2 and is placed perpendicular to the train services, parallel to the subterranean concourses that connect the different platforms efficiently to the vide. At -3, international trains such as the Thalys, Eurostar & ICE can be found. International services can only be reached from the vide, after passing through security in case of leaving the Schengen area.

Standing in the vide, one can really immerse in the bustling scene of the station. Hyperloop pods, trains, metros and people pass by, bringing the whole station in a constant flux & celebrating a new era of travel.

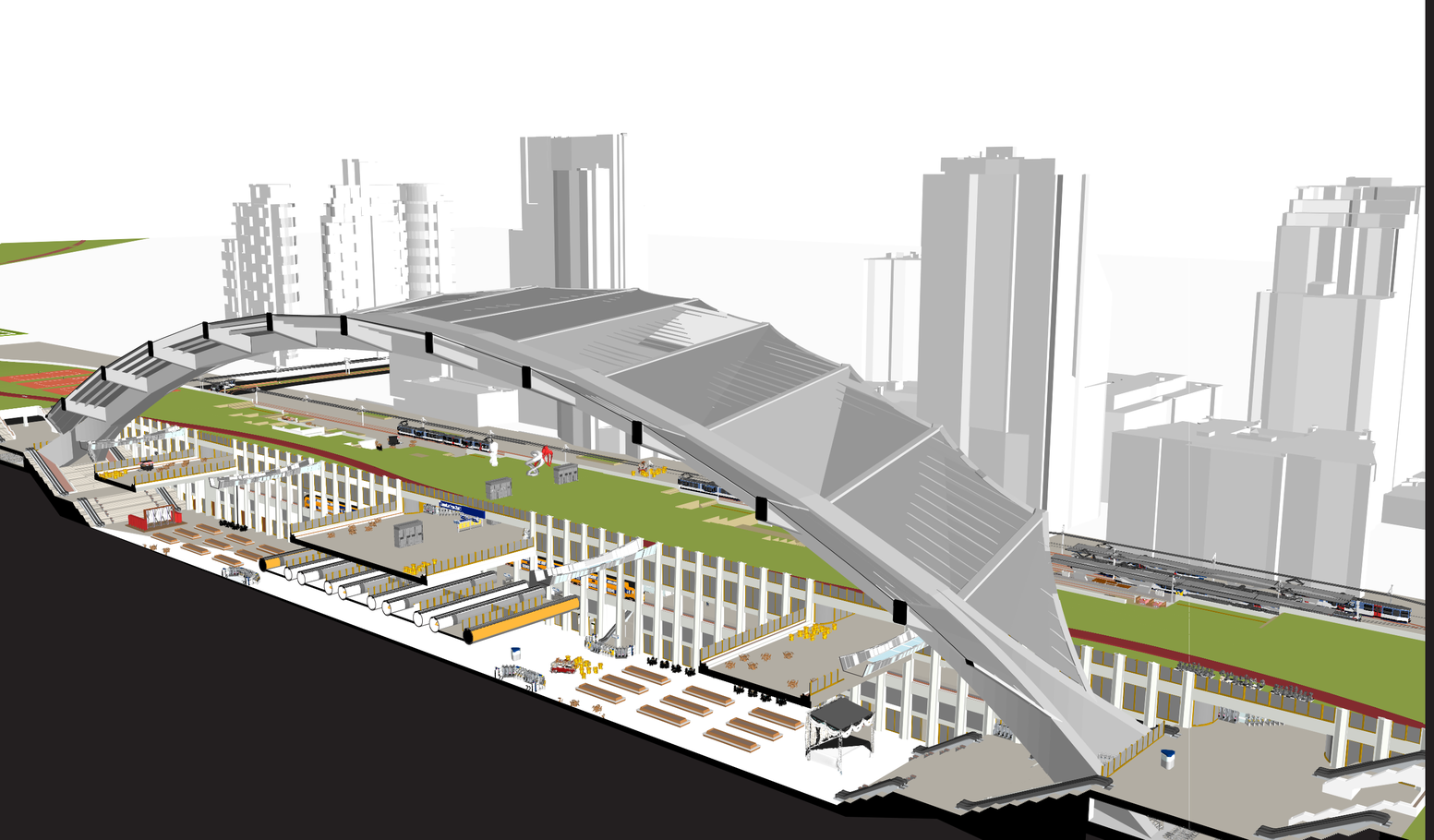
THE PLACE

Because all large infrastructure is placed underground, the ground floor could be designed freely. It now follows the grid of the surrounding cityscape. Four new concourses connect to previously dead-end streets in the area and improve permeability of the station area.

Retail and other public functions create a vivid center for the area, whilst maintaining a high degree of social security. They stimulate encounters between different groups of society thanks to a divers functional mix. Apart from this, the large vide can host large public events and gatherings.

All is covered by a nice and welcoming park at +1. The park creates a healthy and comfortable environment for the surrounding neighbourhood and stimulates a comfortable local climate. The park connects to the ground floor by several stepped landscapes around the entrances of the concourses.

Glass walkways span over the vide in order to create new routes. Passers-by crossing the station complex can choose if they walk via the ground floor concourses or whether they prefer the more adventurous routes through the park.



THE URBAN CANYON
THE NEW HOTSPOT FOR ZUID

THE VIDE

The vide spans the entire length of the station. The vide is essentially a 36-meter-wide and 450-meter-long sunken plaza with large staircases at either end. The vide is framed by the inner facade of the station that stresses its sheer length thanks to the almost infinite row of columns.

As described before, the vide plays a pivotal role in connecting the station's different modalities together. But the vide is more than that: it is an inspiring place that currently sees no equivalent in the Netherlands. It is an urban canyon in the middle of one of the most up and coming Dutch financial districts/ neighbourhoods and it offers comfortable places to meet, recreate and engage in cultural activities.

The vide imposes no restrictions on its visitors: everyone can enter it. It was crucial for me that there would be no OV-chip gates that seal the vide off from the urban realm in order to keep the space accessible. Instead, OV-chip gates are situated around the entrances to the concourses that lead to the platforms.

Excited to see more of the vide? Check out the VR-rendered model on my website ;)

THE ROOF

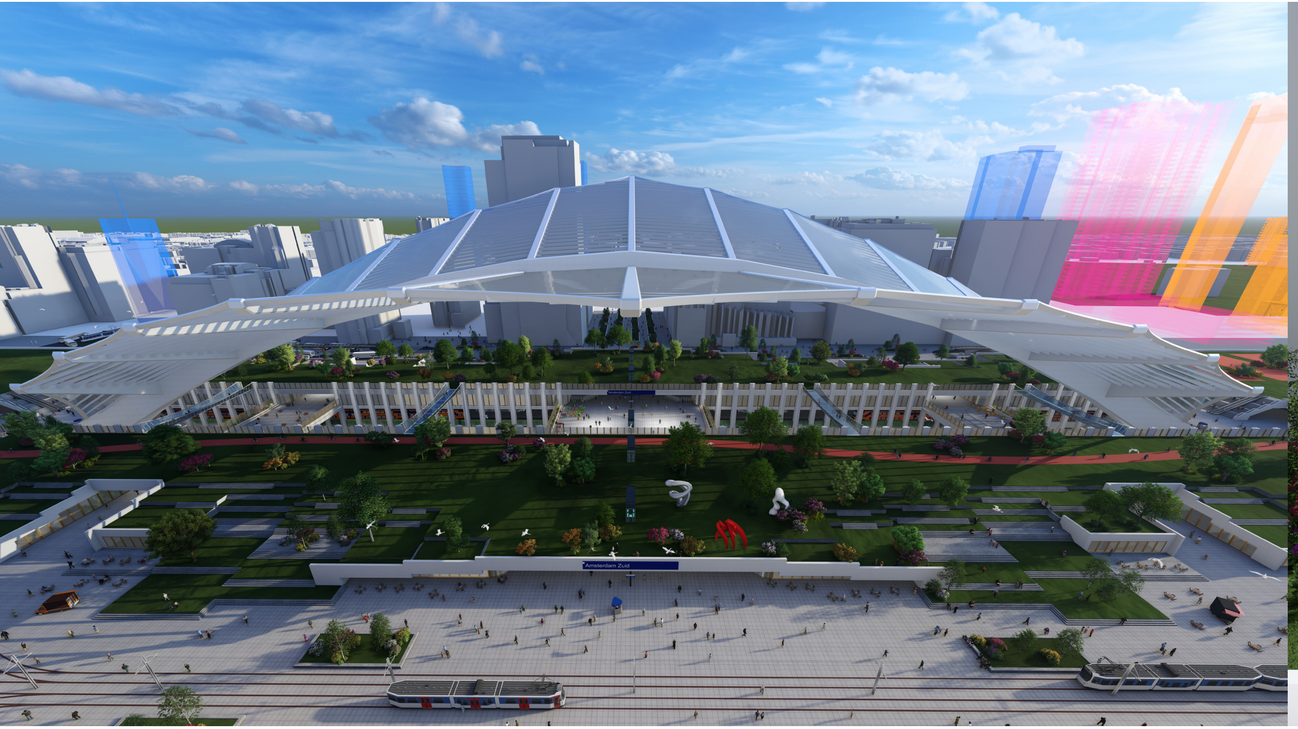
Probable the most notable feature of my station complex is the roof: a large winged sculpture that rises up 85 meters from the ground over a distance of 375 meters before disappearing again in the ground.

The roof was designed primarily in order to shelter the vide from the weather. Thanks to the large wings, the vide is sheltered from rainfall and intense sun radiation, leaving a very comfortable atmosphere in this inspiring urban place.

On top of this, the roof generates visibility for the station complex and it generates a sense of place, an identity for the Zuidas. Especially because all infrastructure is subterranean, the station can get lost out of sight, but the roof makes sure that everyone can easily navigate towards the station.

Lastly, the roof functions as an energy-generator and water-manager for the neighbourhood. The large wings can capture big amounts of rainfall during rainy days and can generate large sums of electricity thanks to the PV-cells during sunny days. Moreover, the roof is covered with tiny wind turbines that make use of the strong West winds at the location.

The arched roof and the Minerva Concourse in the middle



Gustav Mahlerplein and the Minerva Concourse



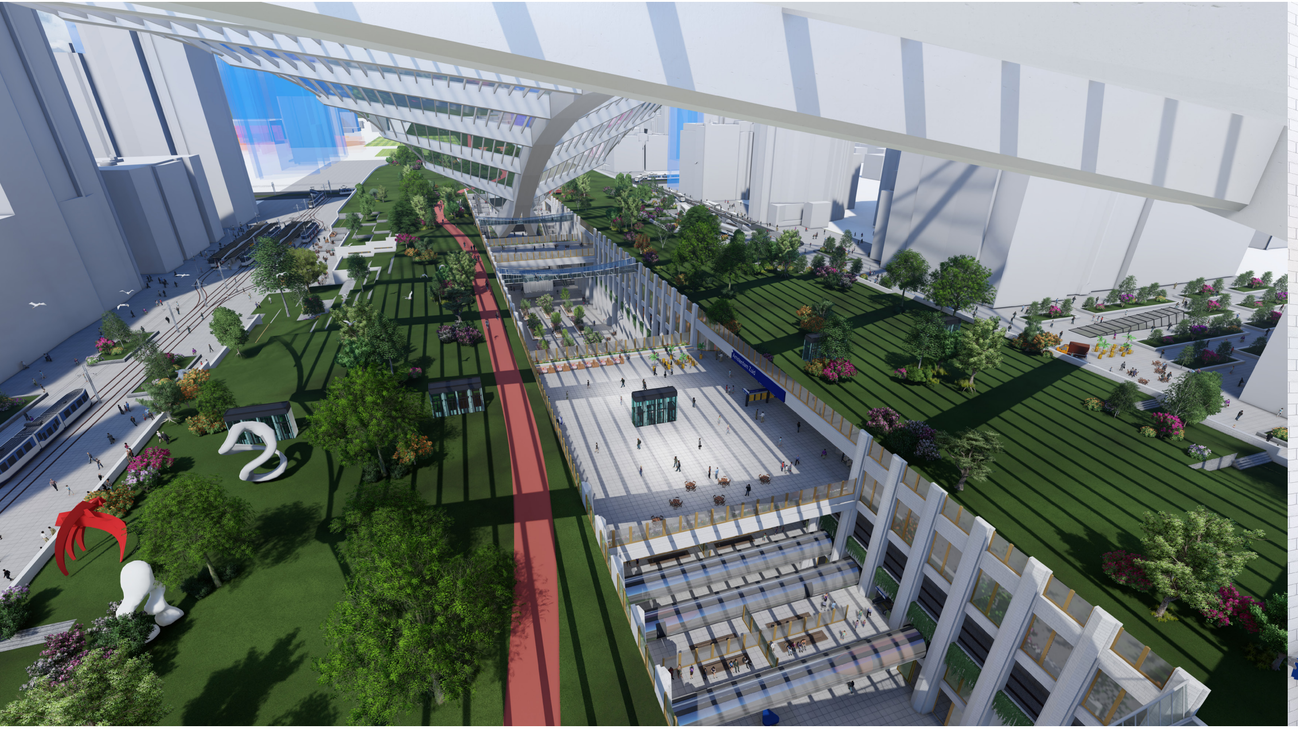
The Minerva Concourse, seen from Gustav Mahlerplein



The Minerva Concourse at the Vide



The vide & Dokdakpark seen from the roof



The vide

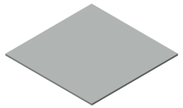


Flooring, pavement:

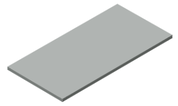


SALT & PEPPER, biobased tiles (Stonecycling.com)

These biobased tiles are made from secondary flows of material combined with biocement resulting from organic processes similar to the formation of coral. The process emits 95% less CO2 than normal regular production. These sustainable and durable tiles create a neat-looking pavement throughout the complex.



600 x 600 x10



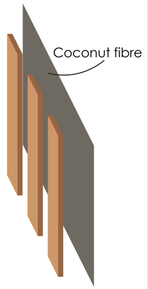
600 x 300 x10

Ceilings:

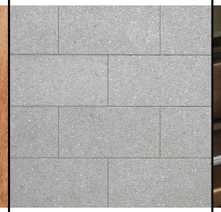


Wooden strips + acoustic insulation sheets

Wooden strips are used to cover ceilings, this provides a comfortable atmosphere and enables installations to be kept out of sight. Together with acoustic insulation (coconut fibre sheets) the ceilings absorb noise.

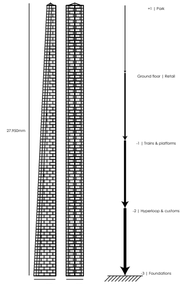


Columns and walls:



White biobased tiles (Stonecycling.com)

These biobased tiles are made from secondary flows of material combined with biocement resulting from organic processes similar to the formation of coral. The process emits 95% less CO2 than normal regular production. These sustainable and durable tiles create a neat-looking pavement throughout the complex.

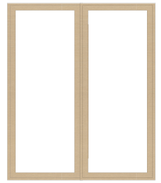


Window frames:



Brass window frames (Aluser.com)

Brass window frames are more sustainable than steel and have a golden brown look that matches well with the wooden details in the ceilings. Together with the wood, the brass frames create a warm and cosy climate within the station.



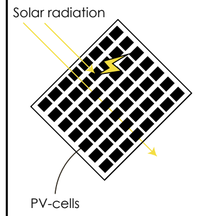
Roofing:



PV-cells on ETFE foil

The spans in the grand arch will be materialized with ETFE, supported by secondary girders running parallel to the arch. ETFE is a light-weight and sustainable alternative for glass.

PV-cells will be integrated in order to harness energy and in order to shade the station underneath for a cooler atmosphere. Also, this creates an interesting game of light. The roof plays an important role in the energy production for the station and its surroundings.

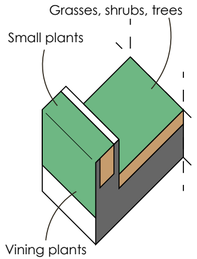


Greenery:



Hedera and other vining plants

Throughout the station complex, greeery is always present. Vining plants hang downwards from the floor above and tiny forests are planted in planters throughout the vide. The rooftop park is also an example of this. Together with the wooden ceilings, the plants create a natural feeling, help in absorbing noises and help in maintaining a pleasant humidity.



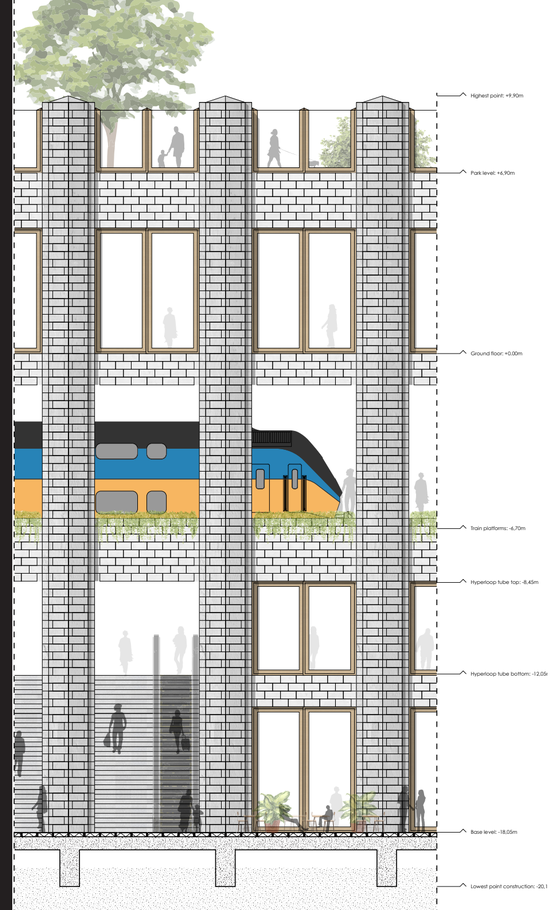
MATERIALIZATION

One of the main goals when choosing the materials, has been to create a homelike feeling. I wanted both travellers and people that reside, work and recreate at the Zuidas, to feel like coming home when entering the station area.

The use of warm materials such as wood for the ceilings and interior floors and brass for the window frames, really helped in creating this warm and cosy atmosphere. The implementation of greenery also contributed to this and helped improving acoustic properties together with the fiber sheets behind the wooden slats in the ceiling.

The grey tiles that are used in this design generate a very steady grid, which is a continuation of the rhythmicity that the columns and floors in the facade of the vide generate. This is important in order to calm the senses for the user, as a building as complex as this station already generates enough impulses.

Photovoltaic cells in the roof help in reducing heat stress in summer and generate a playful pattern of shades when the sun shines.



The hyperloop tubes and walkways intersect the vide



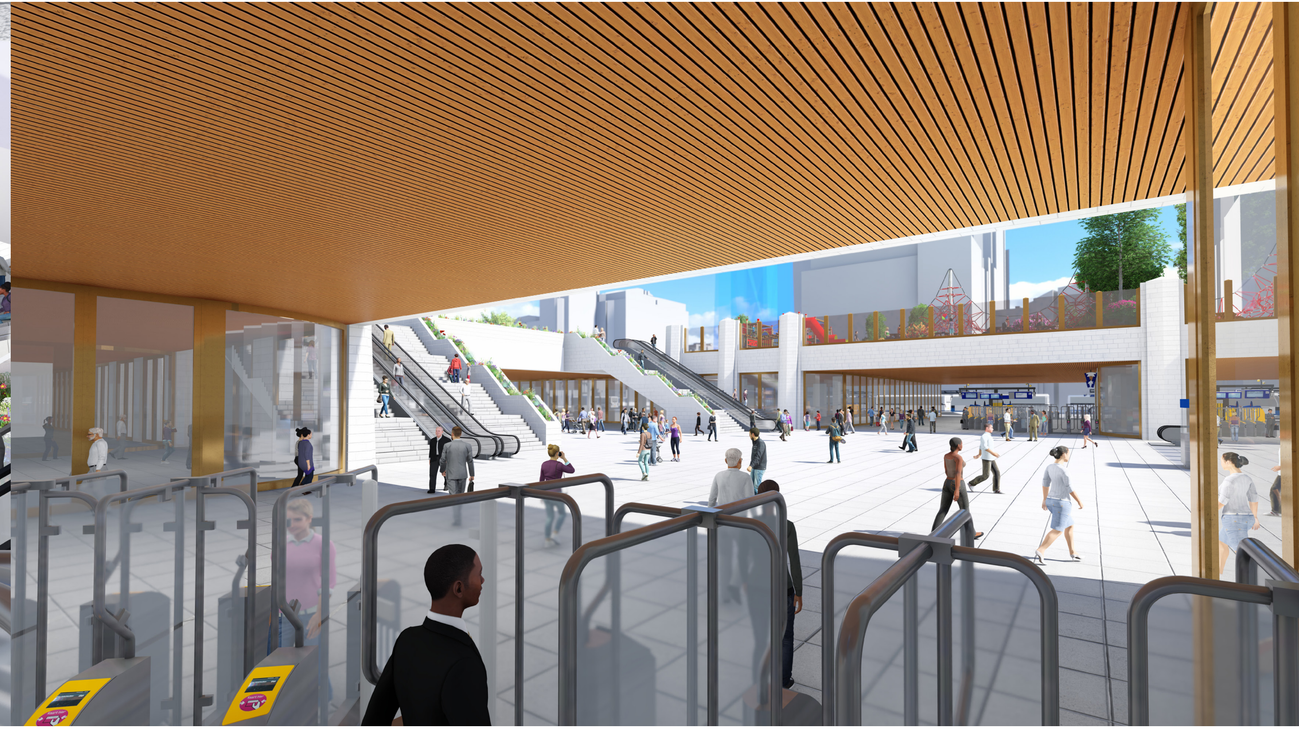
Hyperloop customs and lounge area next to the vide



Subterranean concourse towards the trains



The Britten Concourse

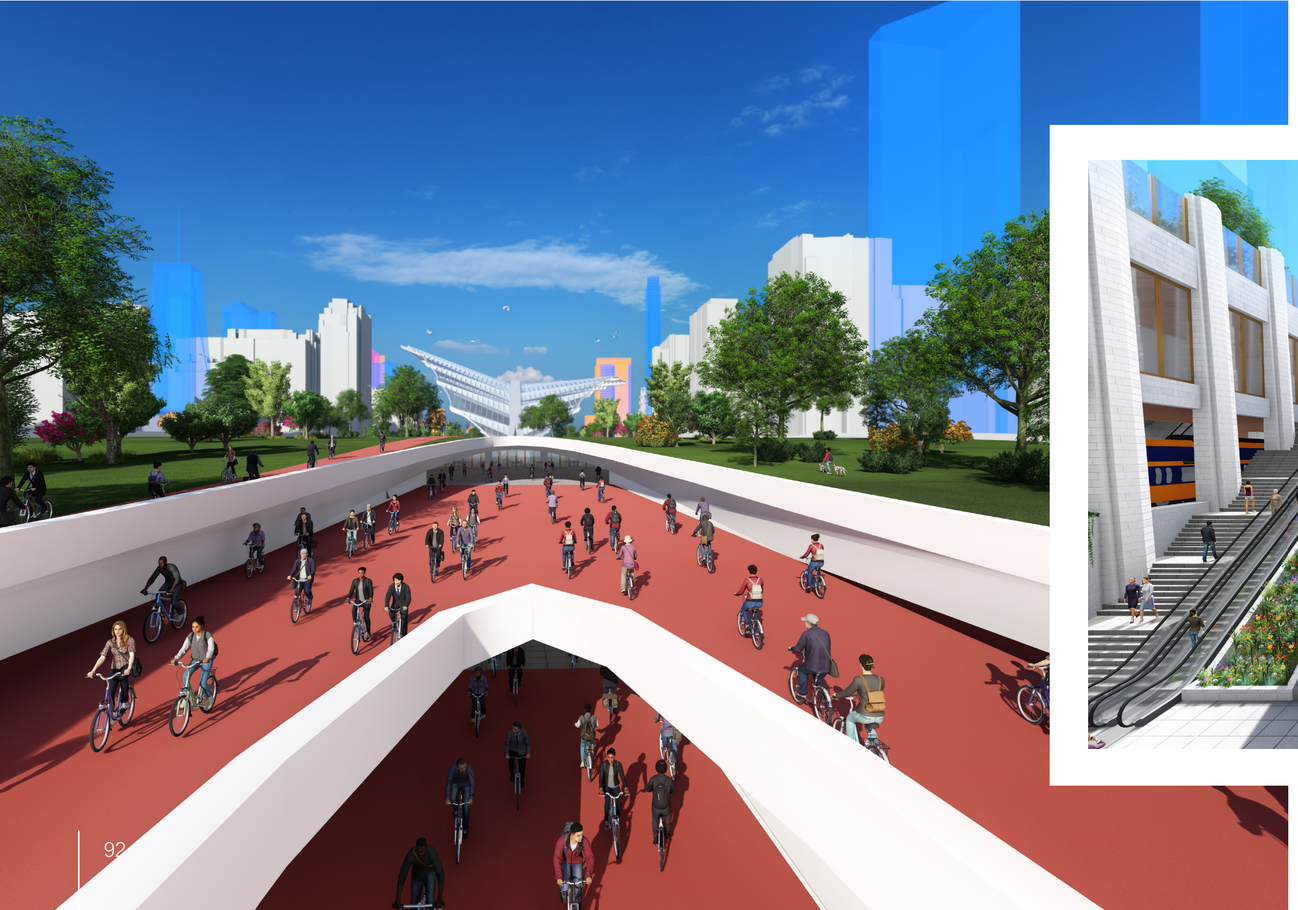


Traveller's domain at the Minerva Concourse



National train platform







BICYCLE PARKING AT THE WHALE

Amsterdam is a real bicyle city. In order to facilitate and stimulate this healthy and clean way of transportation to and from the station area, bicycle parking facilities have been integrated within the complex.

Around half of the train travellers in The Netherlands arrive at the station by bicycle. Hence, A smooth connection between bicycle and other modes is crucial.

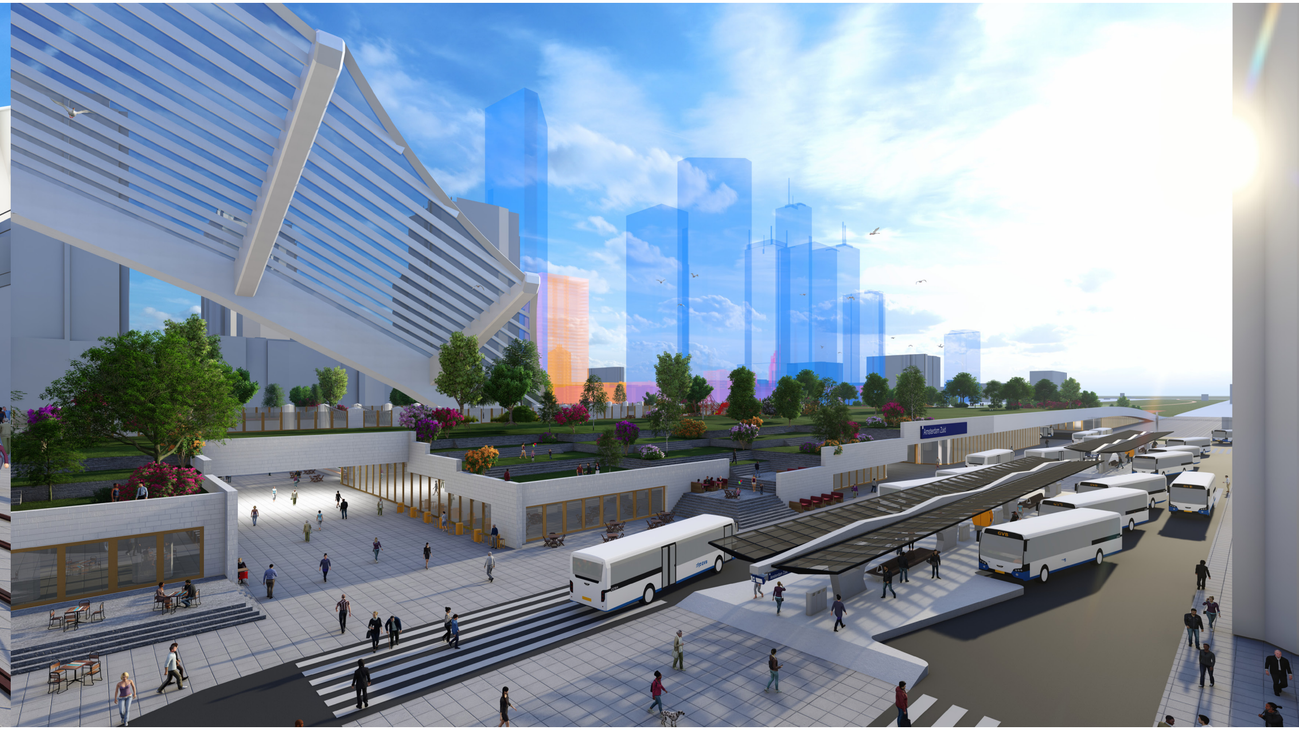
Existing parking facilities underneath Gustav Mahler- and Zuidplein will be maintained, whereas the new facilities will be placed at either end of the vide. A ramp leads cyclists directly from the Dokdakpark into the parking. After finding a spot, cyclists can walk directly into the vide, which opens up dramatically towards the traveller. From the vide, all other modalities can easily be reached.



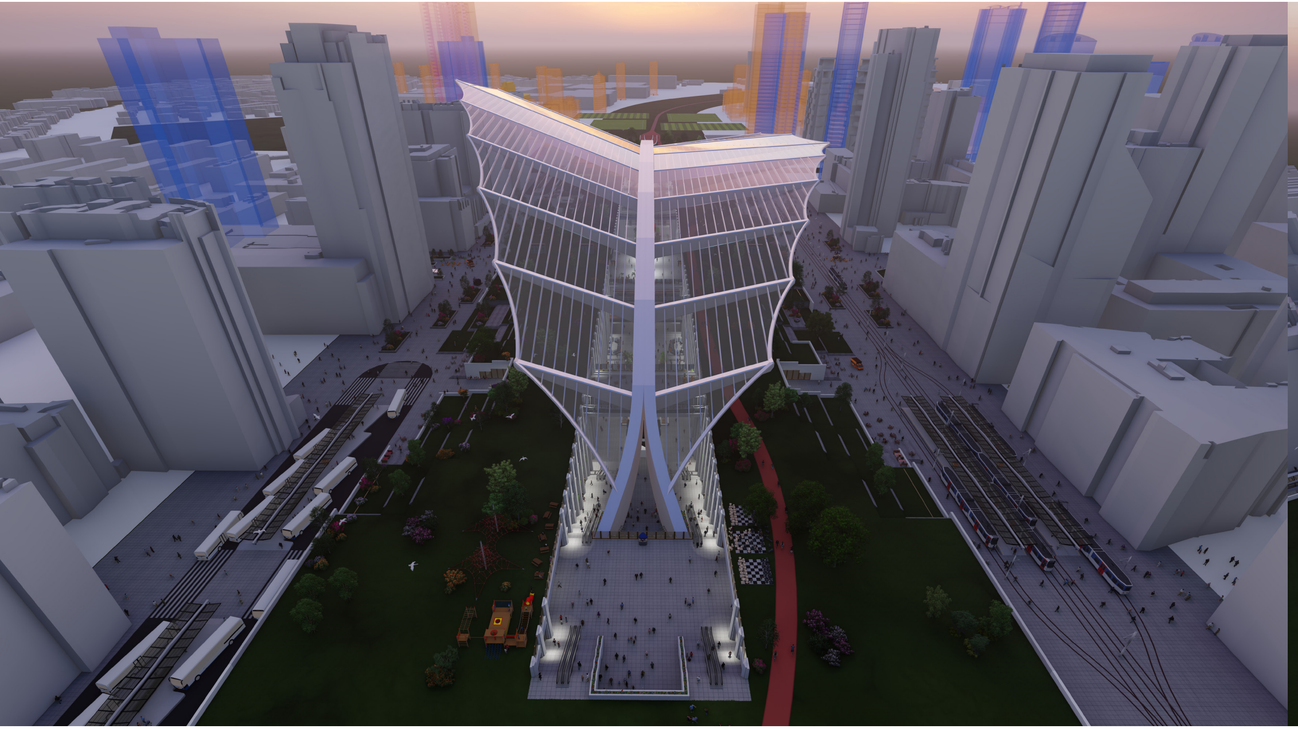
The terraced landscape connects Dokdakpark to the ground floor level



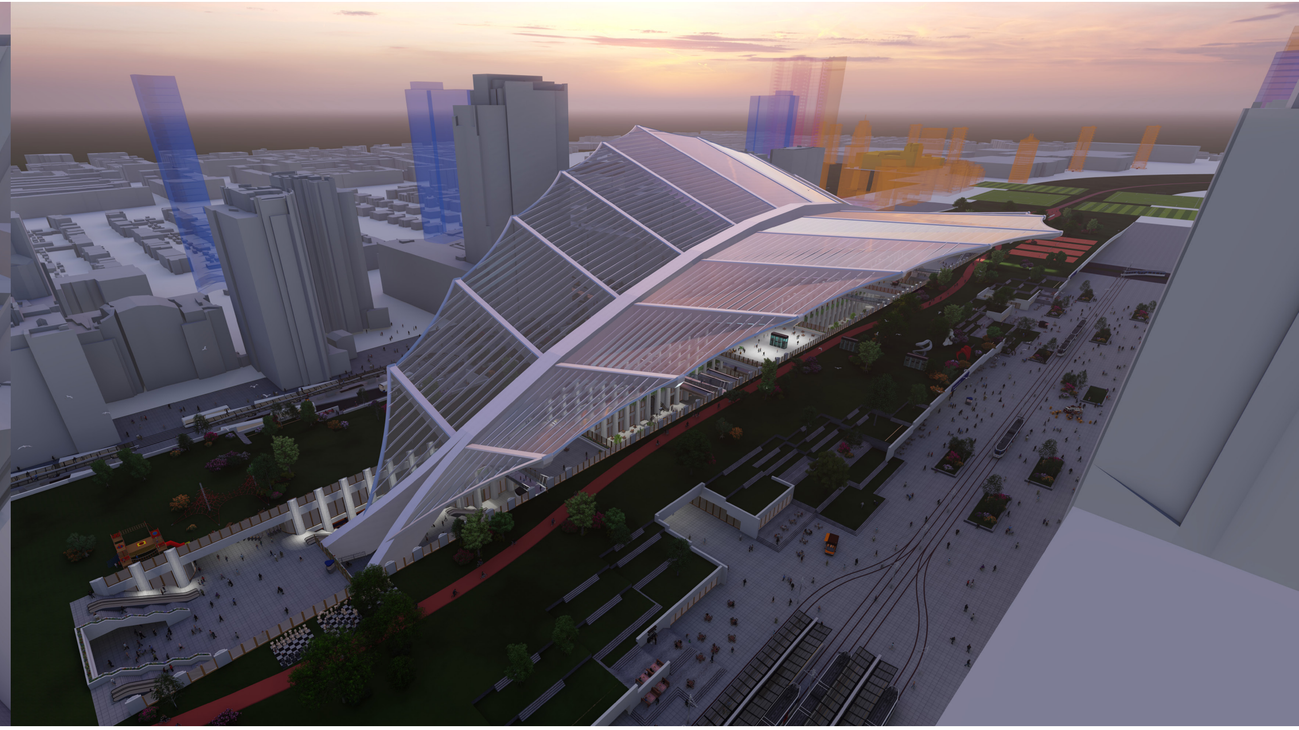
The Britten Concourse and the bus station



Buses on the left and streetcars on the right of the Britten Concourse



Sunset hits the imposant roof

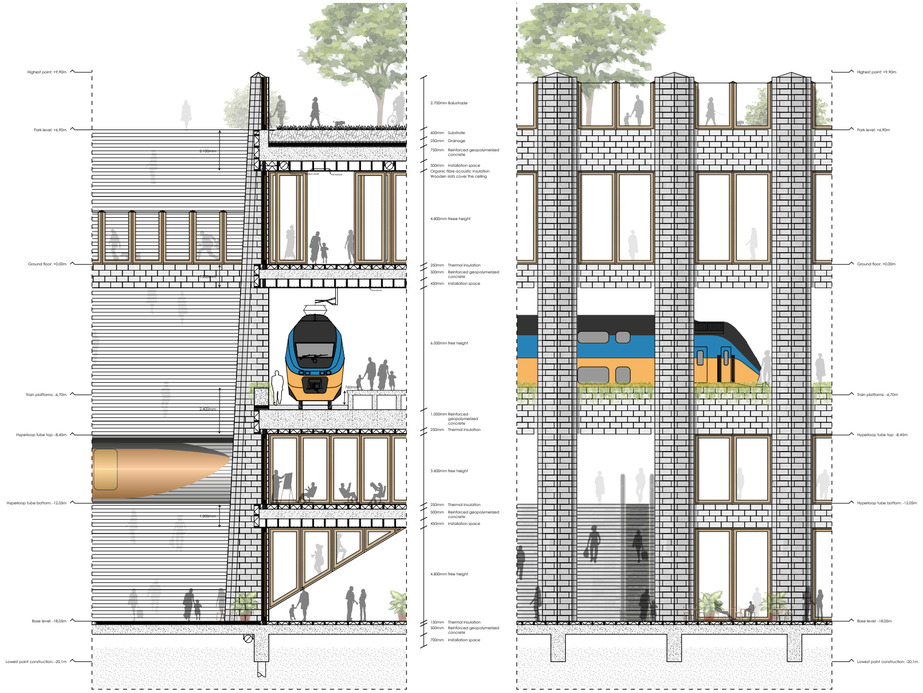


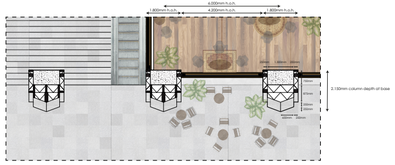
The Britten Concourse at night



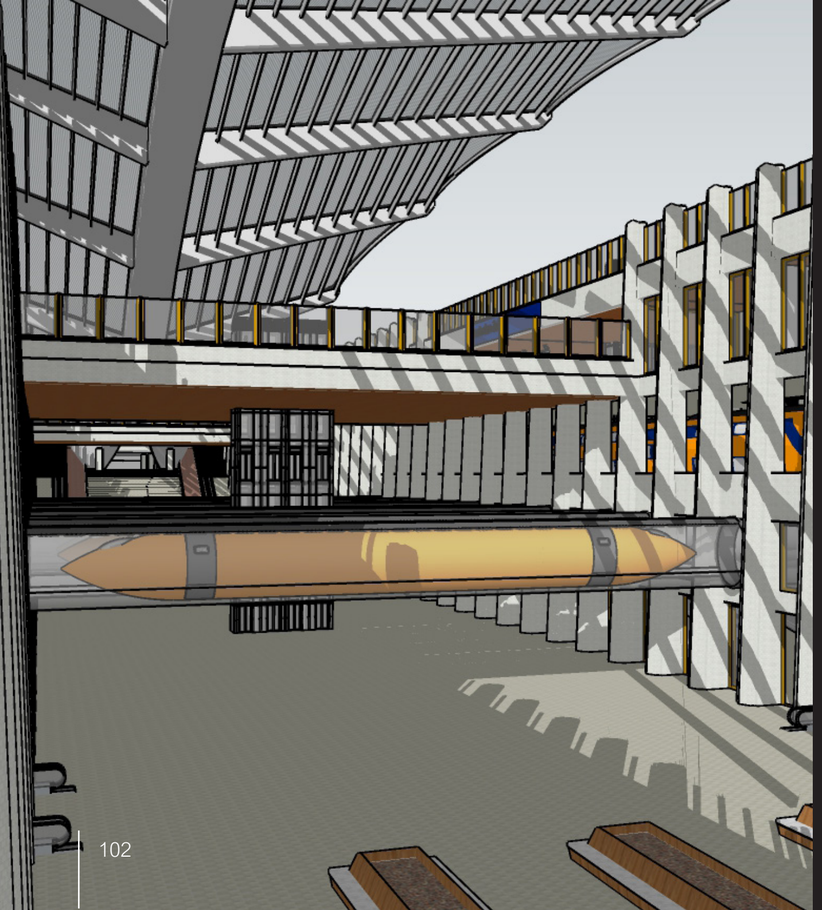
The station complex can host public gatherings and entertainment







TECHNICAL DESIGN
PLANS, ELEVATIONS & DETAILS



TECHNICAL DESIGN
PRINCIPLES

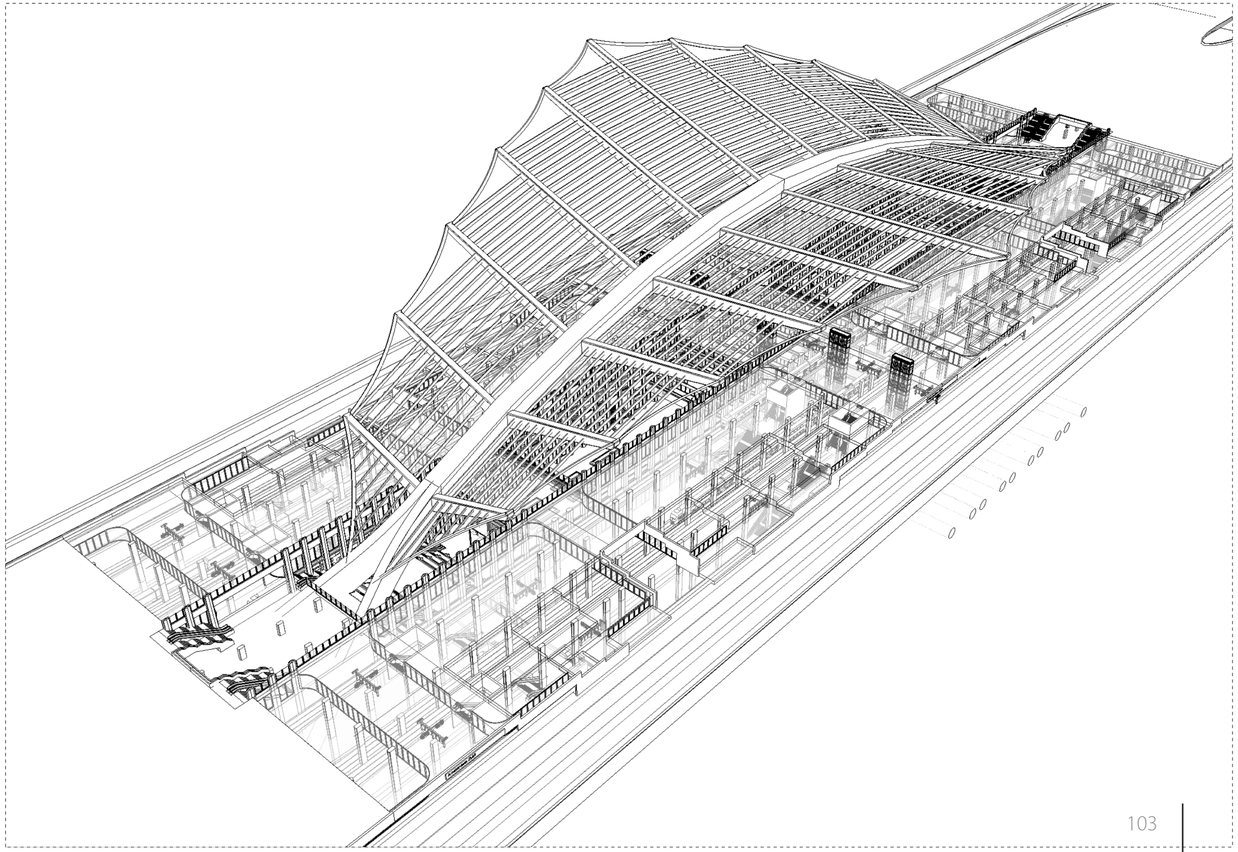
INTRODUCTION

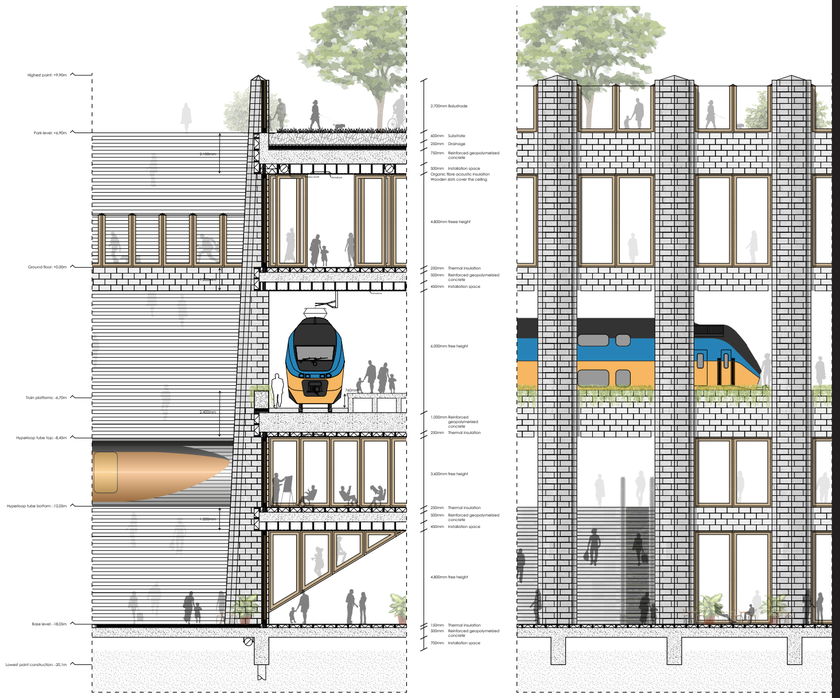
In this last chapter, the technical design will be elaborated. Firstly, the starting point for this construction will be described: two separate load-bearing structures with individual properties and appearances. After this, the floor plans, elevations and sections will be shown. This chapter will conclude by zooming in to the smallest scale of the project: the detailing.

TWO SEPARATE STRUCTURES

The arched roof and the ground structure are two separate structures. Whereas the arch is constructed with steel as a sort of bridge, the ground structure is constructed with cast-in-place geopolymerized concrete.

The steel bridgelike design of the arched roof enables a more post-modern and organic appearance, whereas the concrete construction of the ground structure helps in achieving a more modernistic and rhythmic appearance.







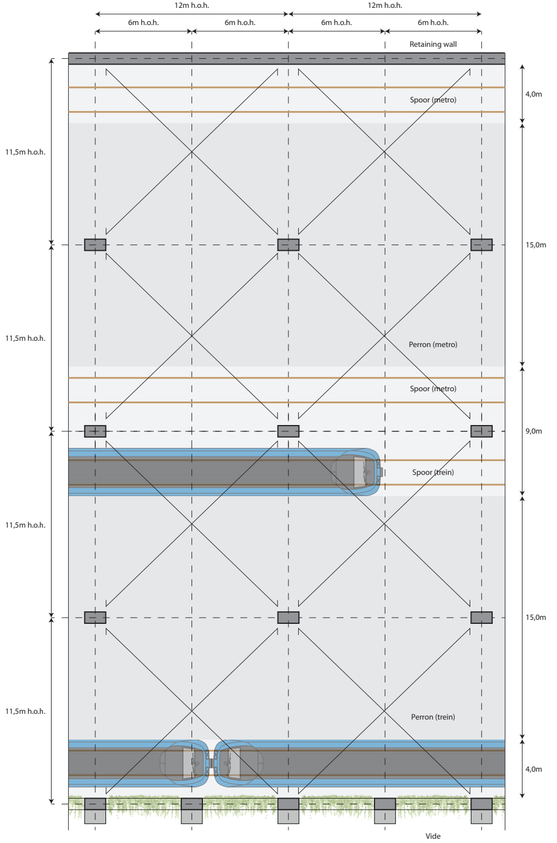
THE GROUND STRUCTURE

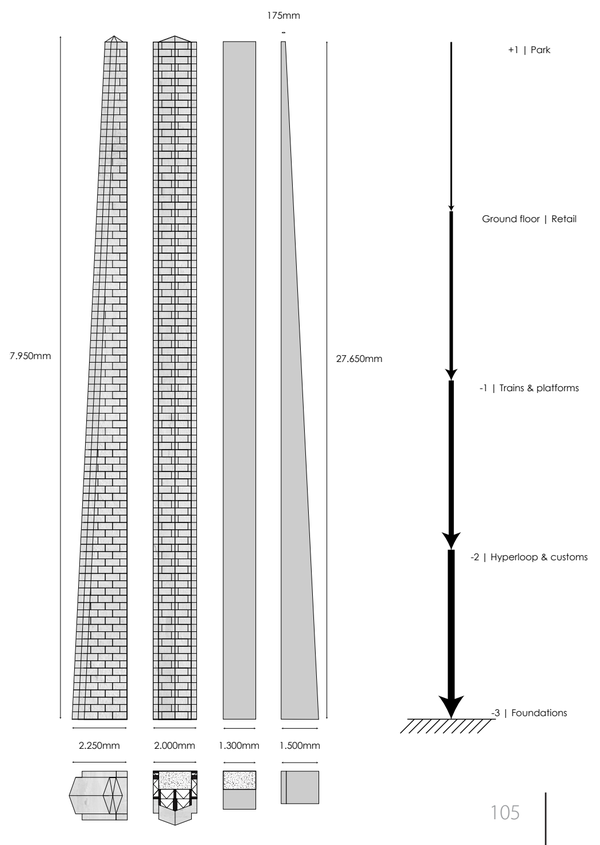
The concrete forms three different load-bearing elements: retaining walls, columns and slabs. The retaining walls form the perimeter of the building, retain the ground and the ground water and create stability for the ground structure.

The slabs and the columns create a rhythmic grid that defines the facades of the vide. Every six meters, a column is placed, whereas floors are four to six meters apart.

The load-bearing structure is designed around a twelve-by-twelve-meter grid. I started out with a twelve-by-twentyfour-meter grid in order to free the platform from any load-bearing elements, but decided to reduce spans in order to minimize material usage and create a more sustainable structure.

In order to further reduce the use of excessive concrete, columns become more slender towards their top. This corresponds with the forces in the column, as the highest parts of the columns only have to bear one floor. Whereas the bottom of the column bears all floors and therefore needs to be stronger i.e. thicker.

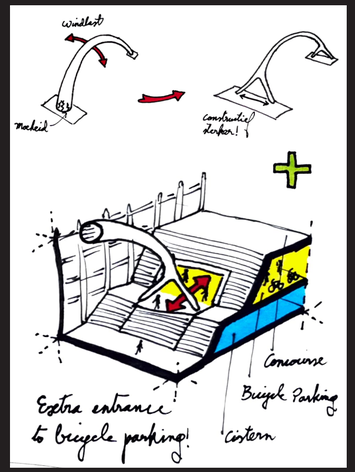


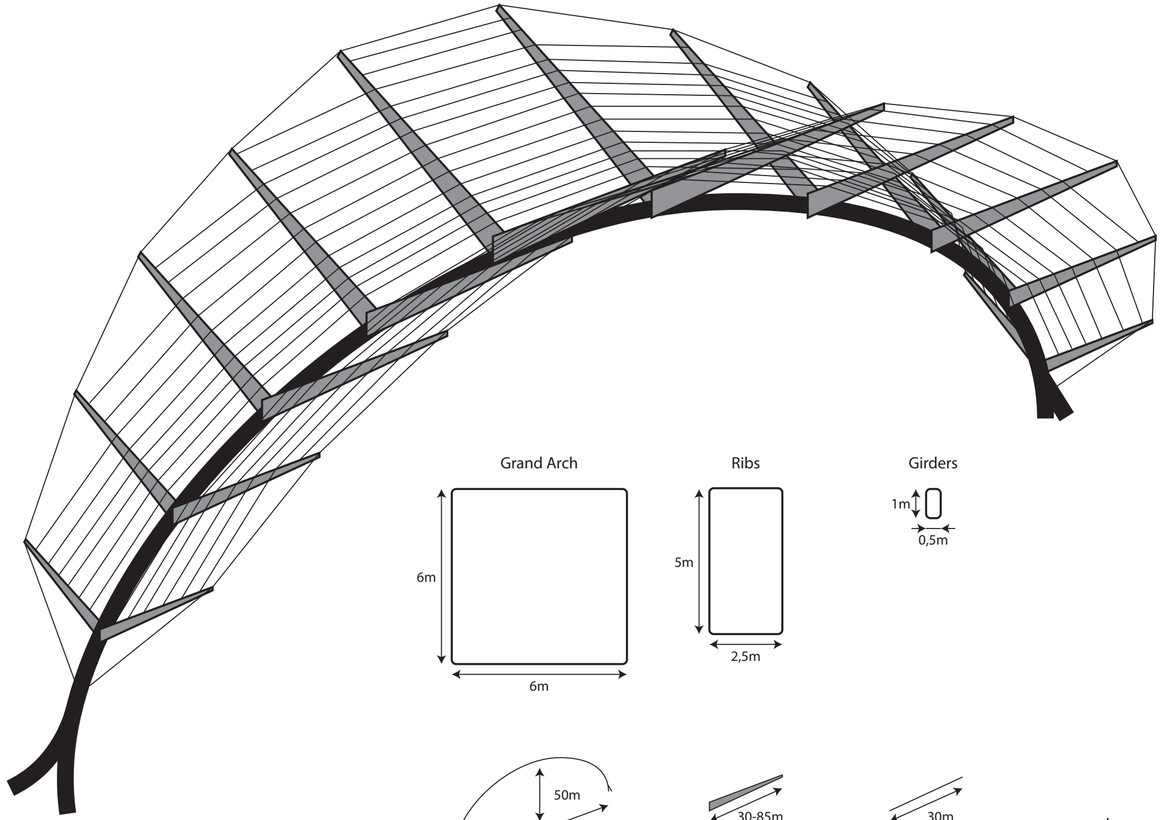


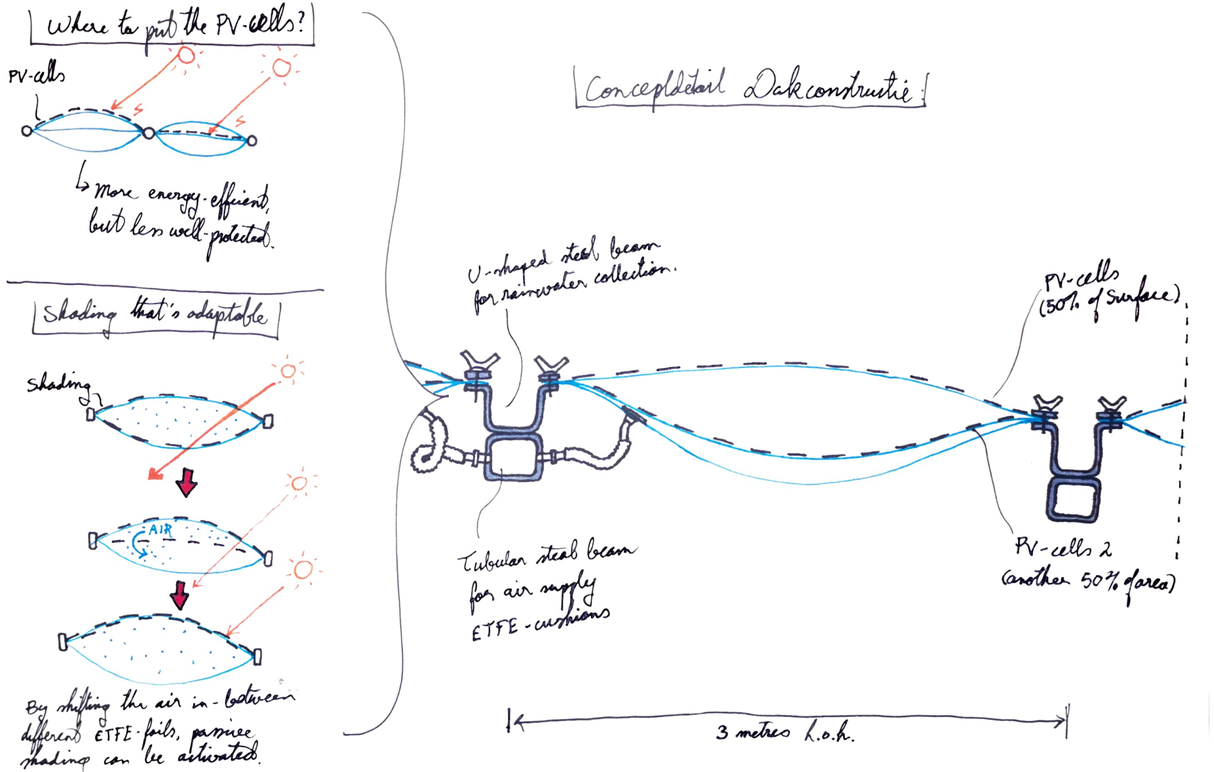


THE ARCHED ROOF

The arch is constructed similar to the deck of a bridge, consisting of a primary box beam, eleven pairs of ribs and girders. The ribs are placed thirty meters apart, whereas girders are placed perpendicular to the ribs every three meters. In order to improve stability of the arch, legs have been added to support the arch, creating a passage to the subterranean bicycle parking.







ETFE-CUSHIONS

In-between the girders, ETFE-cushions are placed. These cushions provide protection against the weather for the spaces underneath the roof. ETFE is water tight and shelters the space underneath from rain water. ETFE has very favourable properties and is ideal for this specific situation thanks to its light weight, durability and ease of use. On top of this, ETFE is much safer than glass in the event of calamities, because it will not form harmful debris.

Thanks to the use of three layers ETFE, enclosing two air chambers, air can be relocated from one chamber to the other. By putting PV-cells on the two top layers, electricity can be generated while simultaneously providing shade for the station area. Depending on the amount of air in each chamber, the sun is either partly blocked, or entirely blocked. This way, the roof is able to control the climate underneath in an active way, creating a comfortable climate at the heart of the Zuidas.



Pfeifer Structures, 2022



Tensinet, 2022

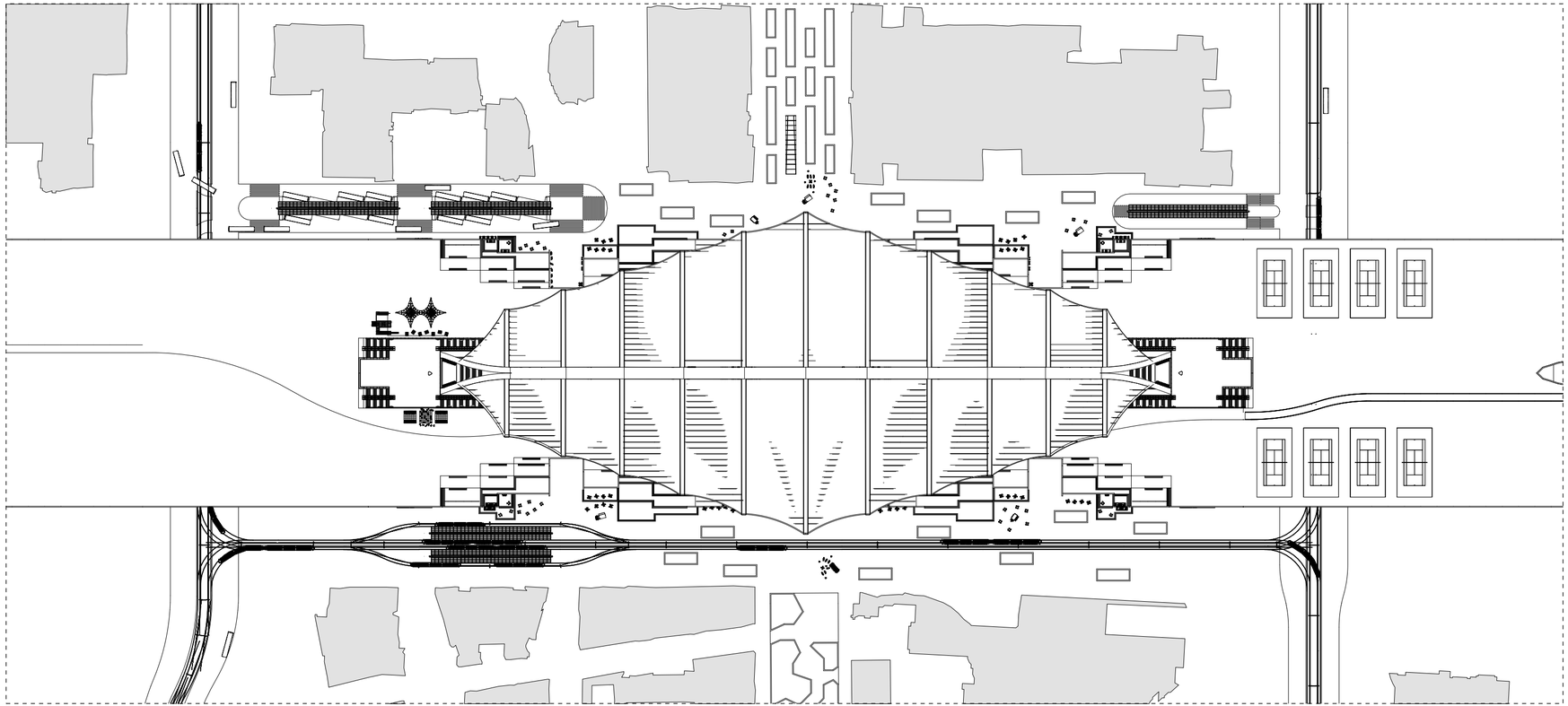
TECHNICAL DESIGN
FLOOR PLANS

TOP VIEW/ +1 FLOOR

Seen from the top, the shape of the roof is clearly visible. The roof covers a part of the park and most of the vide.

At +1, the park is located. Creating a high quality connection for cyclists and pedestrians going from the East to the West and vice versa. This connection directly links the station to the Amsterdamse Bosscheg and the Amstelscheg, linking major green areas within the MRA.

The terraced landscaping around the concourses helps interlinking the ground floor and the first floor.



1:2000

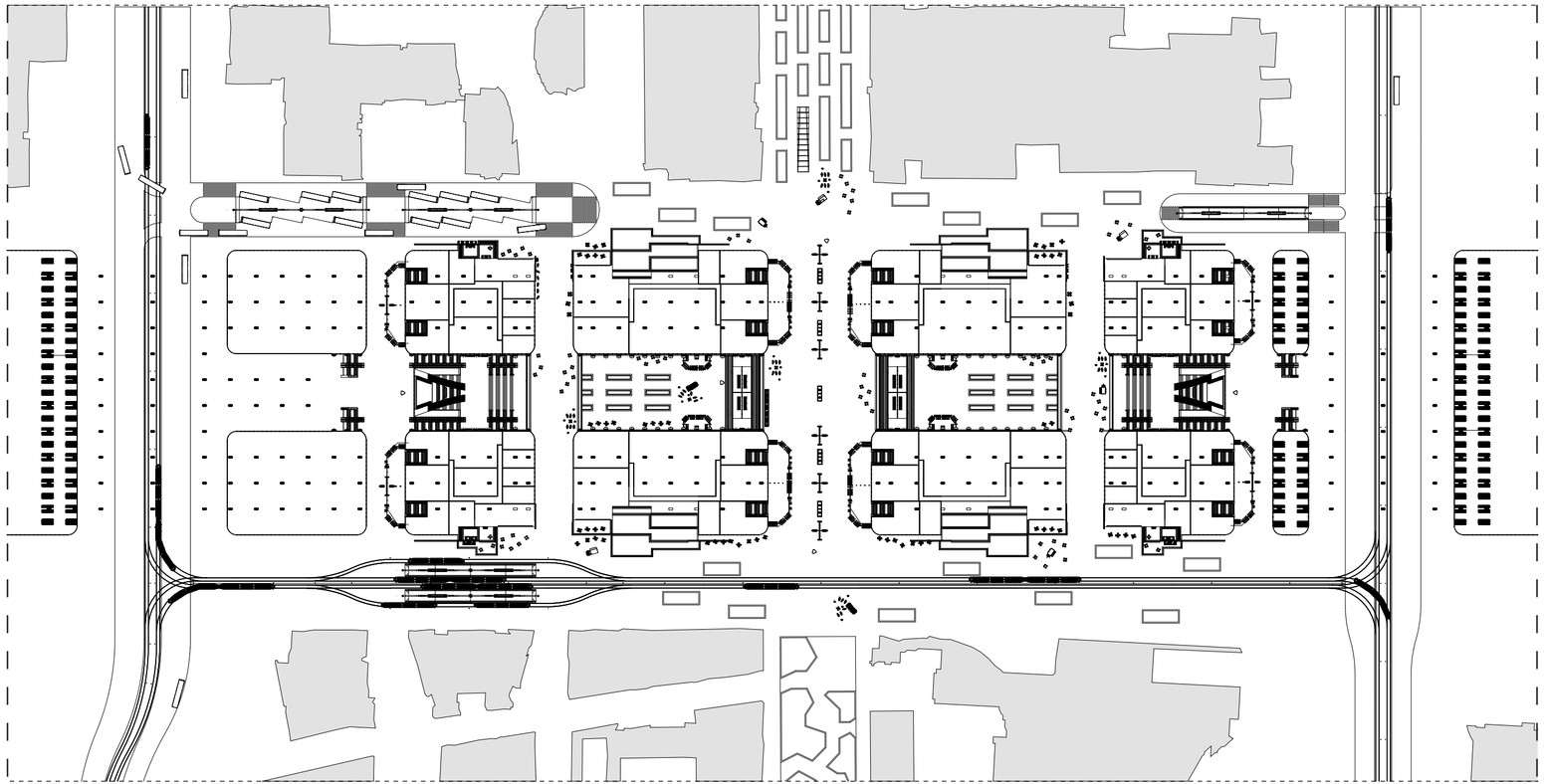
GROUND FLOOR

The ground floor is being dominated by the many different connections between both parts of the Zuidas and the public functions and amenities that are placed in-between.

Four new connections will be added. Resulting in a total of five concourses, with the Minerva Concourse in the middle.

The space in-between the concourses and the vide has been designed to house retail units that are placed in small blocks, similar to the blocks that are usually found in classical inner cities.

Thanks to the retail in each block, large glass facades provide active plinths around the different walkways, which generate a high degree of social control and thus safety. The layout of this floorplan resembles that of a shopping mall due to the large amount of retail units. In the middle of each block, a dedicated space is located for installations and storage.



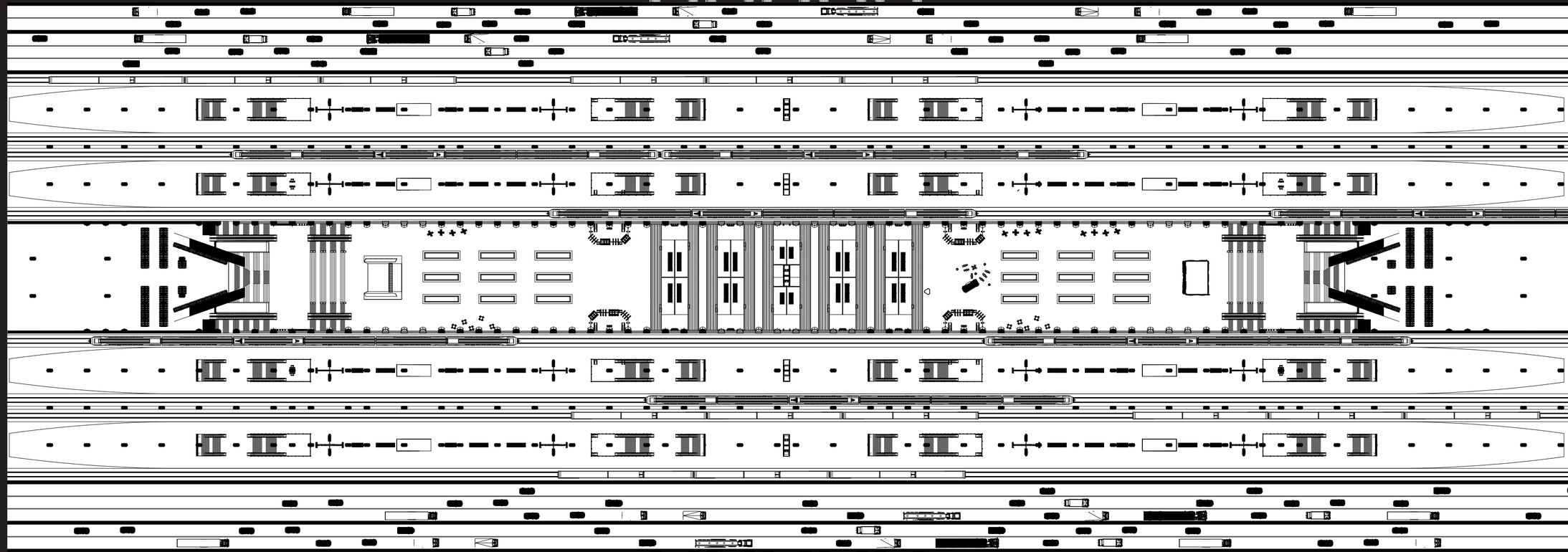
-1 FLOOR

The first subterranean level is being dominated by the station. Four island platforms are divided over four national train tracks and regional metro tracks.

By placing the national trains and regional metros at -1, a strong connection can be maintained between the city at ground floor level and these modes.

Concourses at the ground floor and -2 link the platforms to one another and to the city above and the vide underneath.

At either side of the vide, trains and metros are bundled that go in the same direction in order to stimulate cross platform transfers. This reducing the time needed for a big part of the transfers.



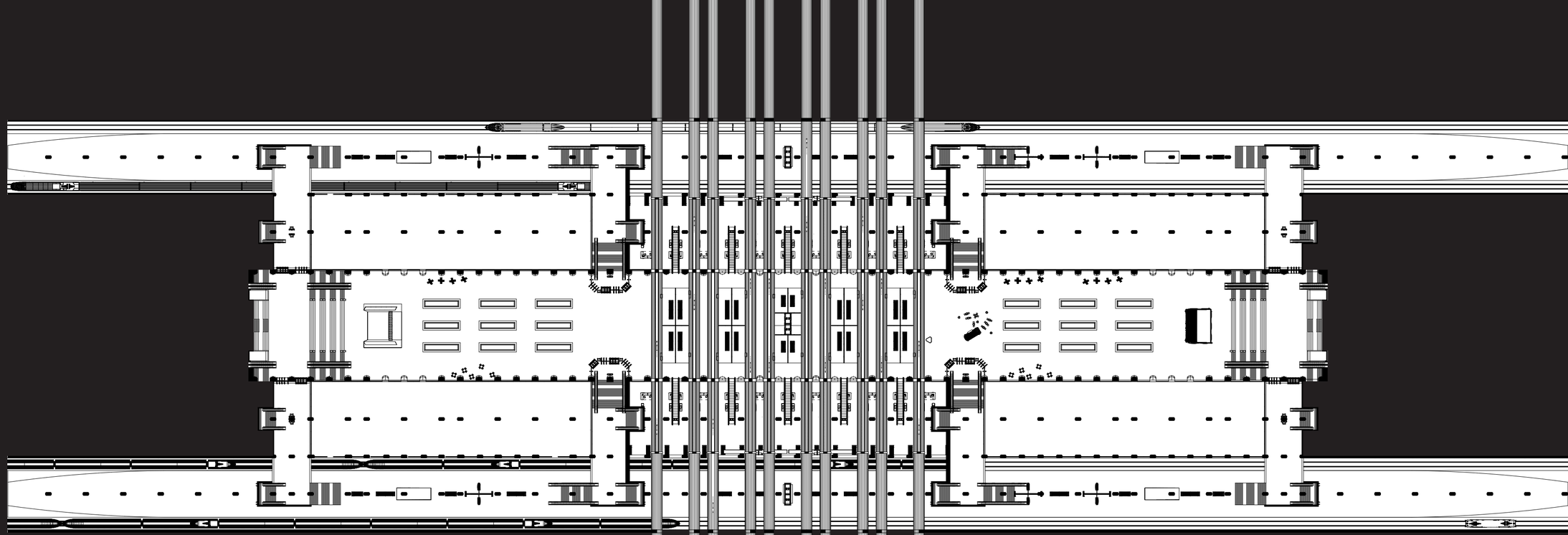
1:1000

-2 FLOOR

At the second subterranean floor, the hyperloop terminal can be found, together with the concourses and the customs & lounge for the international trains at -3.

The hyperloop tubes are placed perpendicular to the train tracks and the vide and fit neatly within the grid of the complex.

In the current situation, ten tubes have been accounted for: five in each direction. In the future, the amount of tubes could be increased by eight in each direction opposite of the subterranean concourses. This would more than double the capacity of the terminal.



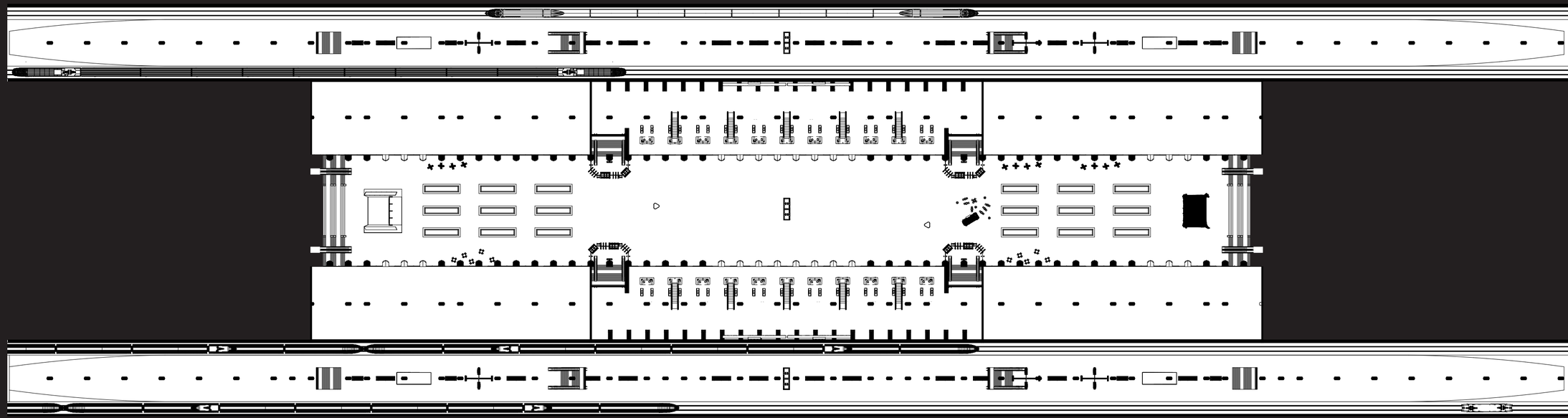
1:1000

-3 FLOOR

At the third subterranean floor, the two international train platforms and the bottom of the vide are located. In-between the vide and the platforms are retail spaces and customs checks for the hyperloop travellers.

The bottom of the vide is a crucial part of the complex, as it provides a large central space from where all different modalities can be reached. Besides this, the space is characterized by lots of free seating and greenery, in order to create a pleasant place to stay for travellers and passers-by.

The vide is the embodiment of the station living room, the most public place within the station. Where people can stay without any obligations. The vide also offers space for public gatherings. Especially the large stairs at either end of the vide can function as theater seats in front of which any cultural activity can be observed by spectators.



1:1000

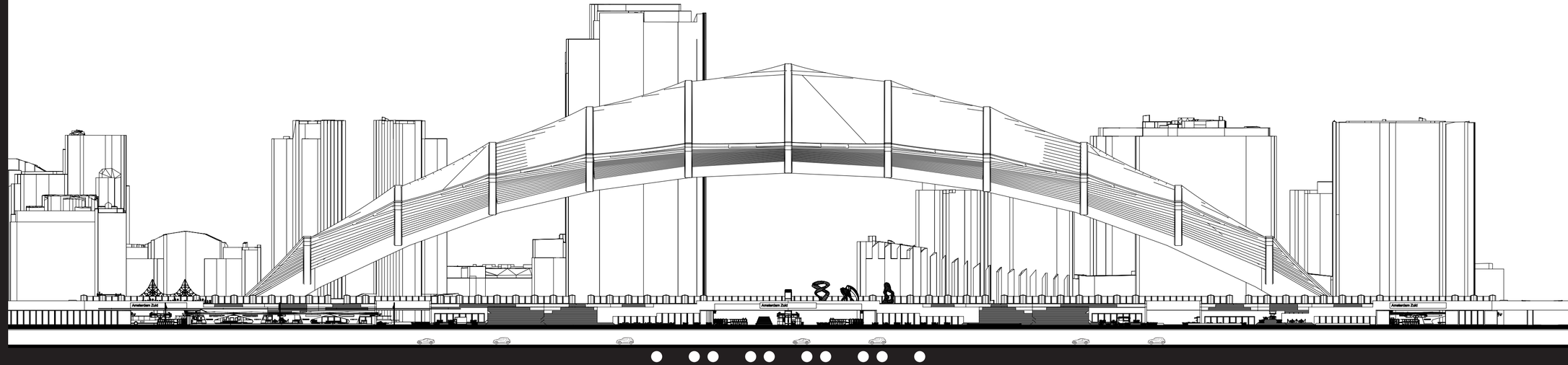
TECHNICAL DESIGN
ELEVATIONS & SECTIONS

SOUTH ELEVATION

The facade of the complex is being characterized by a white eave with the rooftop park on top of it and the glass shop windows of the retail units underneath. The eave has steps where the rooftop park has terraces in order to connect it to the ground floor. The facade is very long and narrow, being only seven meters high and over five hundred meters long.

However, the most notable feature of the station is of course the arched roof. It allows the station to control its climate and it creates a landmark for the area, stimulating placemaking.

The A10-highway is situated underground in front of the facade. The hyperloop tubes are also notable, coming out of the sheet in the center of the drawing. Although they float through the vide, they are located underground.



1:1000

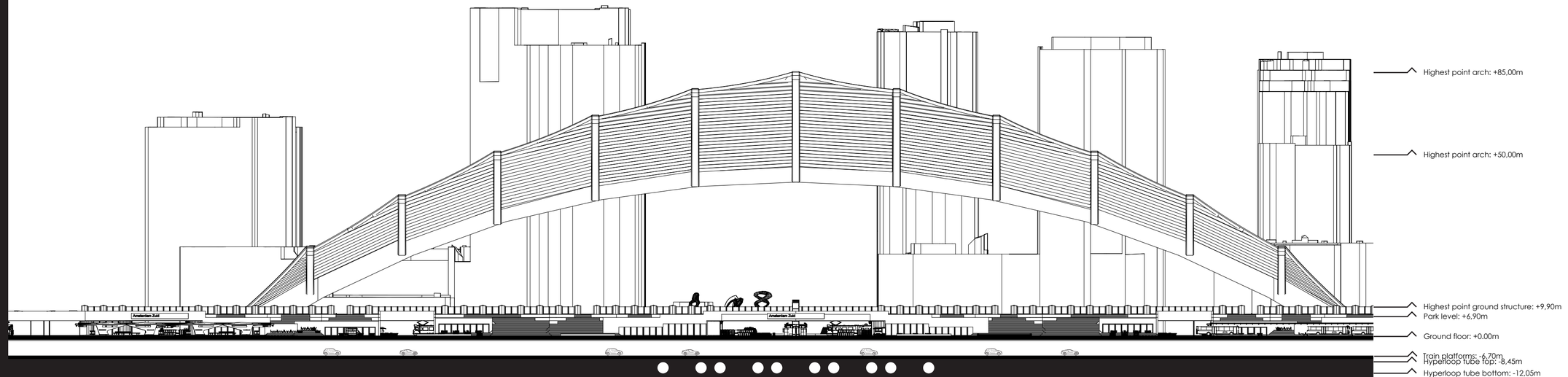
North Elevation

Characteristic for the North Elevation is the lower wedge of the arched roof. The southern wedge is lower in order to improve rain protection for the spaces underneath.

In The Netherlands, winds generally come from the Southwest orientation. At the location, building patterns with highrise on two sides and large empty spaces in the middle, stimulate the winds to come from the West. In this direction, the roof shelters well due to its closed shape.

In case the wind still comes from the South (in case of relatively strong winds), the lowered roof will prevent more rain from falling into the vide. However, due to the openness of the construction, it is possible for heavy winds to blow rain into the vide.

The Northern wedge of the roof is higher in order to optimize efficiency for the solar panels located on this wedge.

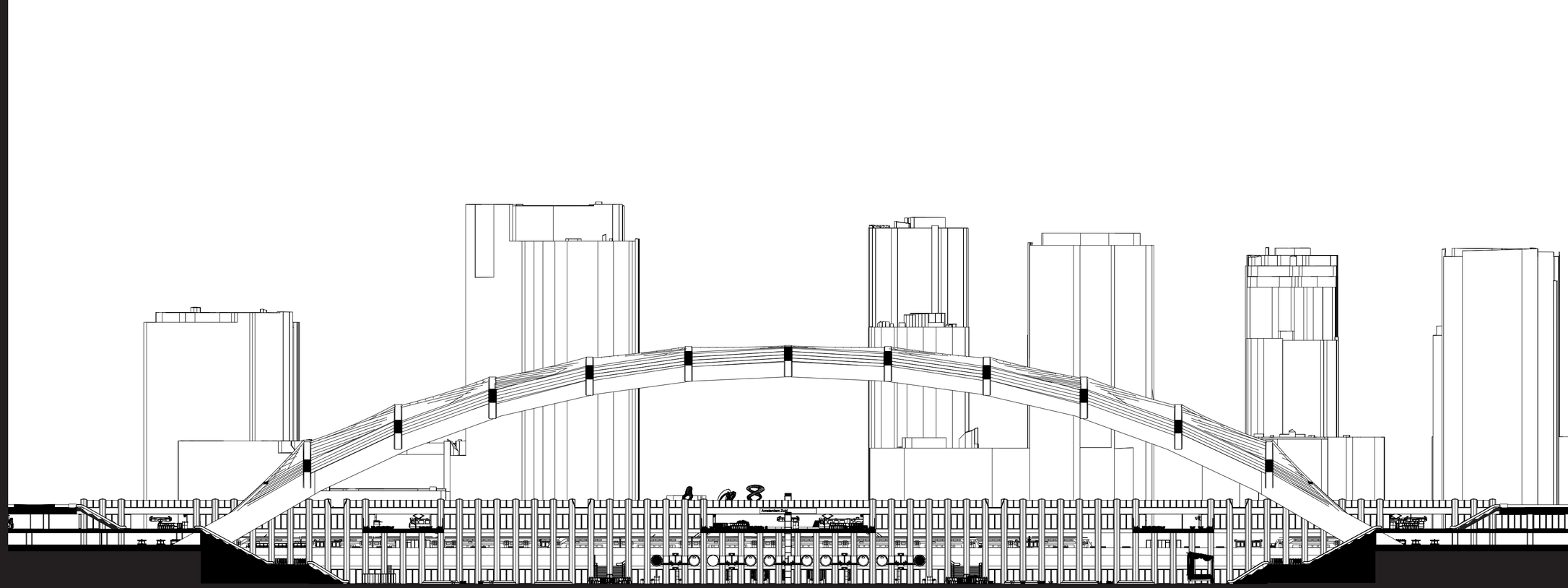


SECTION THROUGH VIDE

The vide actually features the main facade of the ground structure. Within the enclosed space of the vide, a highly rhythmic facade stretches around four hundred meters. The rhythmic and logic facade stands in contrast to the more organic and impressive arched roof.

The vide refers to the banks and insurance companies on the Zuidas and their modernist skyscrapers, whereas the roof refers to the dawn of a new era of development and transportation at the Zuidas, sprung by the emergence of a hyperloop terminal at this extraordinary location.

Walkway-bridges and the tubes and platforms of the hyperloop terminal are the only elements that cross the vide, providing impressive views and a dramatic experience as pedestrians cross them.



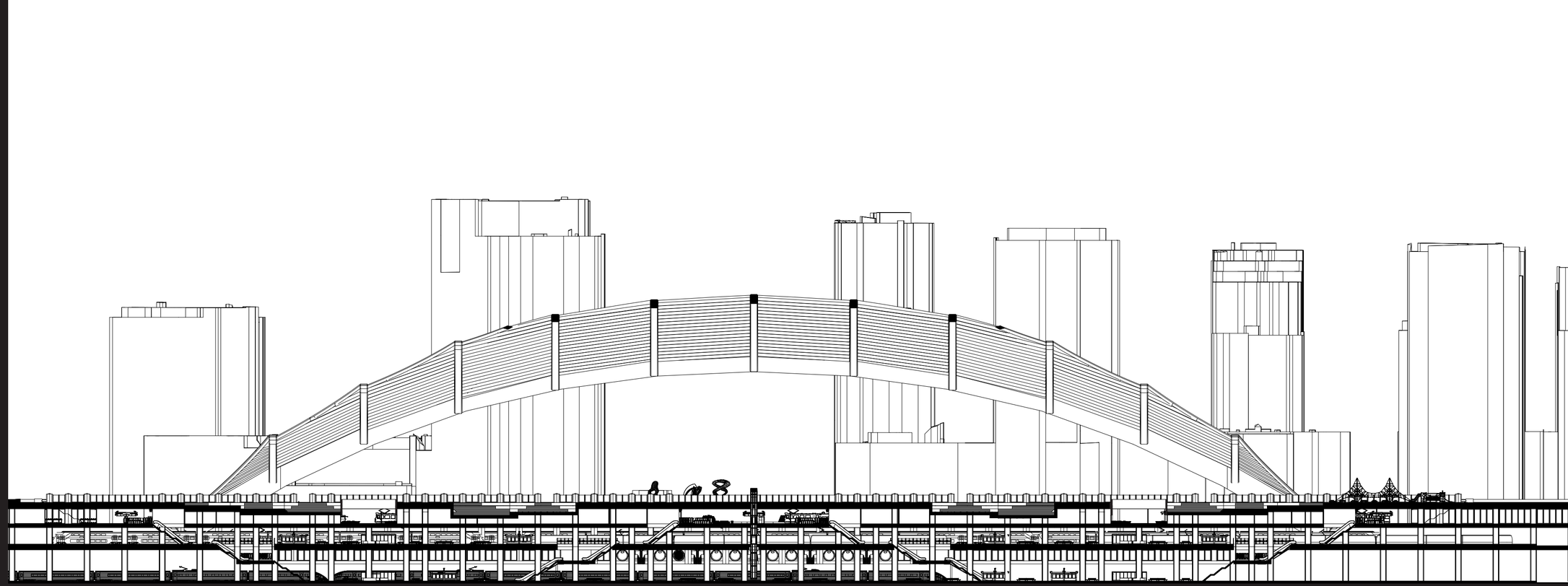
1:1000

SECTION THROUGH PLATFORM

This section cuts through the platforms and the stairwells of the complex. Most notable in this image are the sequences of stairs that link together the four different floor levels and perpendicular concourses on either the ground floor and -2 floor.

Every staircase is accompanied by escalators in both directions for those that have difficulty climbing stairs. At the heart of the station, in the Minerva Concourse, a row of elevators brings passengers and visitors to all different levels and platforms of the complex.

The international platforms at the third subterranean floor have a double height in order to create a more spaceous atmosphere as compensation for the lack of natural daylight.



1:1000

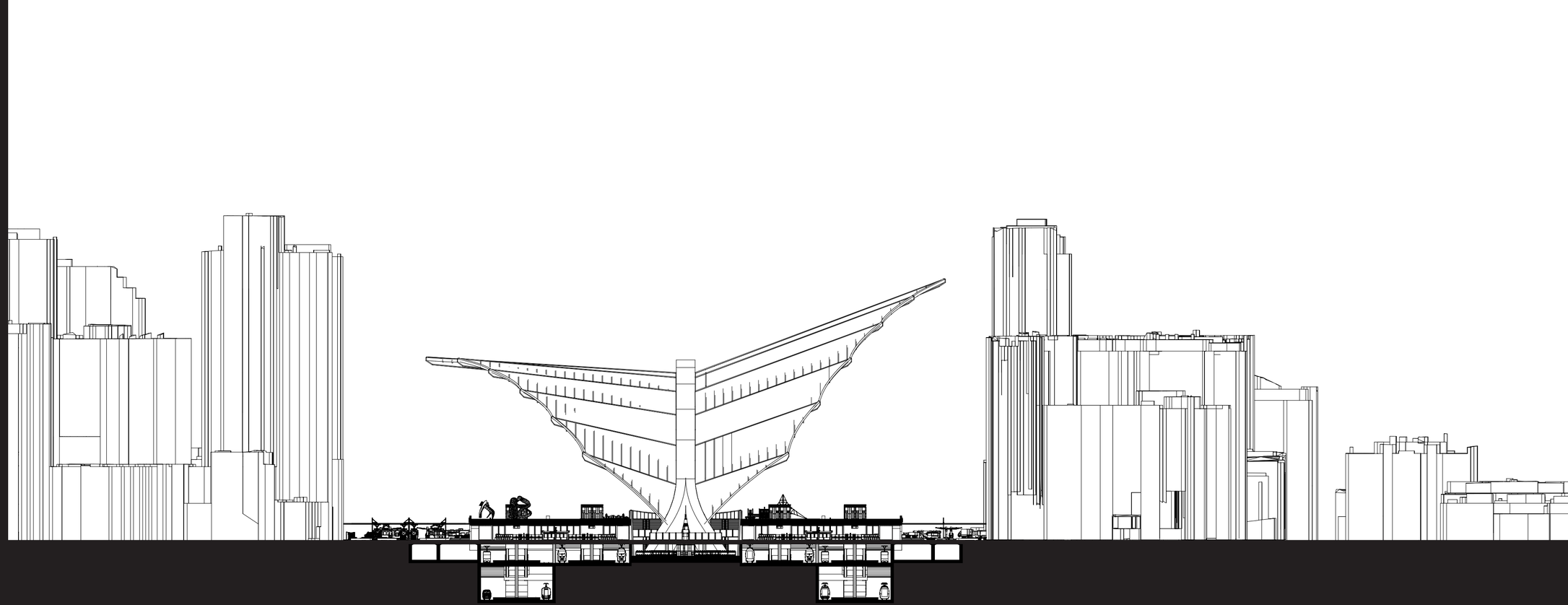
EAST ELEVATION

Coming from both the East or the West, the roof rises up from the ground and spreads its wings as a majestic bird. Underneath this large structure, the rooftop park can be found. Apart from trees and schrubs, elevators pop up on the roof where it covers the Minerva Concourse, making the park accessible to all.

The semicircular opening in the center, is the entrance to the bicycle parking facility. Coming from the green axis, cyclists can easily drive in the facility and look for a vacant bike rack.

The ease of this process has been a priority in order to stimulate the use of active transportation over the use of more pollutant and space-consuming private and public transportation.

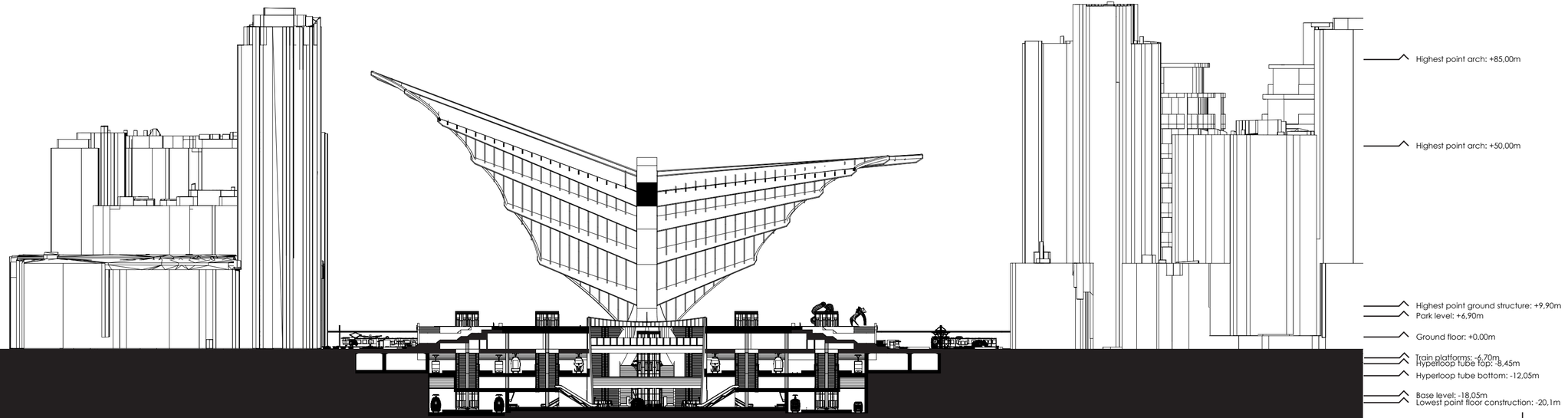
When walking through the parking facility at the first subterranean level, one enters the vide though the legs of the grand arch.



1:1000

CROSS SECTION

Cutting through the complex just in front of the arch, gives a better understanding of proportions. Suddenly, the ground structure has four layers of which three underground. This brings the proportions of the ground structure and the arch closer together than when looking at the elevations, where only the ground floor level is visible.

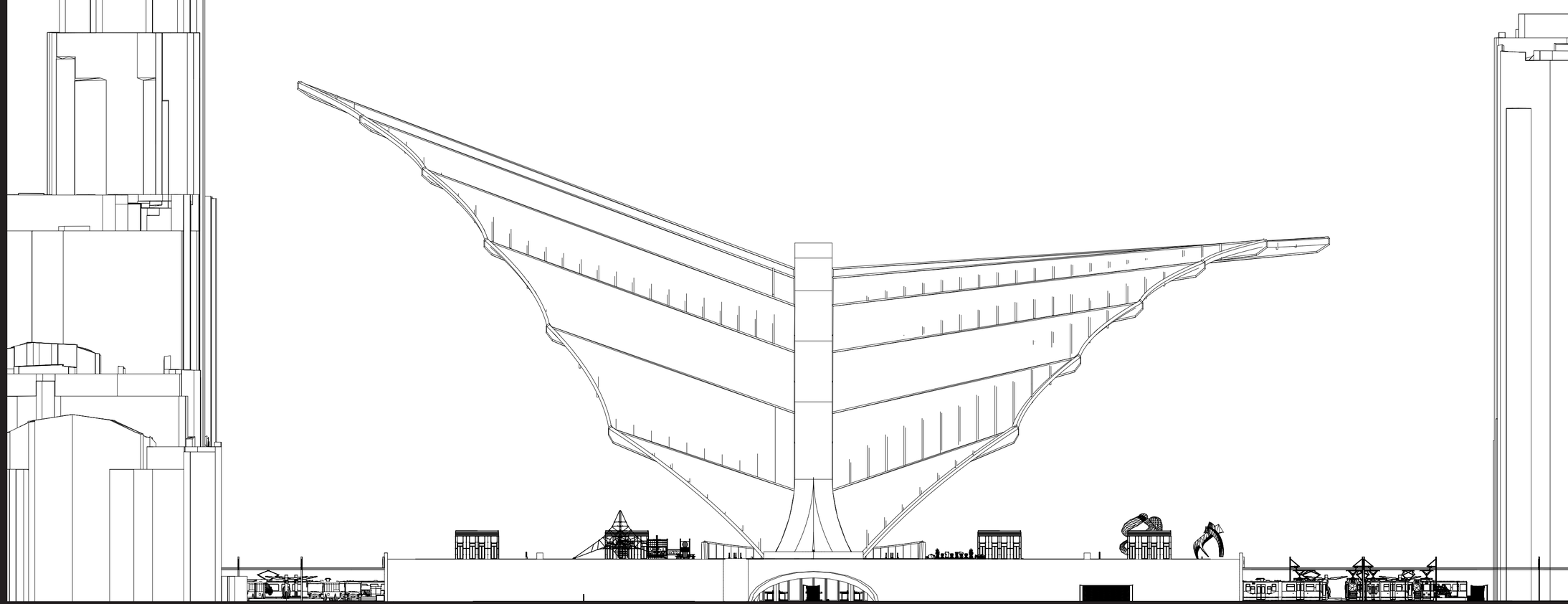


1:1000

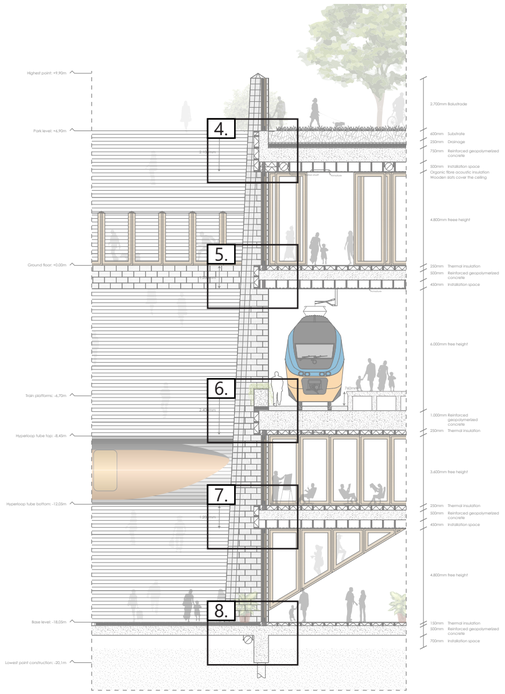
WEST ELEVATION

Seen from the East, the roof suddenly rises towards the other side. The roof rises up towards the North and reaches its highest point of no less than 85 meters.

The Northern wedge has an optimized orientation towards the sun in order to maximize solar energy gains.



1:500



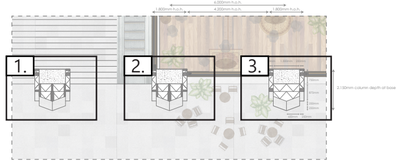
TECHNICAL DESIGN
DETAILS

ABOUT THE DETAILS

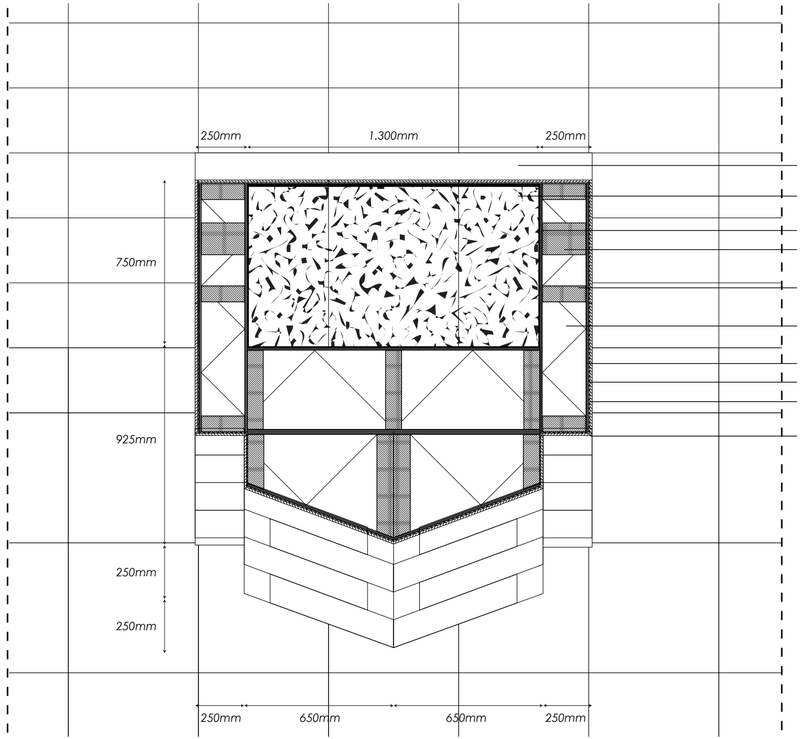
On the next pages, the technical design will be clarified on the smallest scale: 1:5-details. The details have been scaled to 1:20 in order to fit on the pages.

The challenge of detailling the project laid in the material of the facade. Ceramic tiles from StoneCycling (constructed out of sand and micro-organisms) enabled me to create a highly sustainable and durable facade, but the dimension of the tiles (thirty by sixty centimeters) forced me to rethink the dimensions of my entire design.

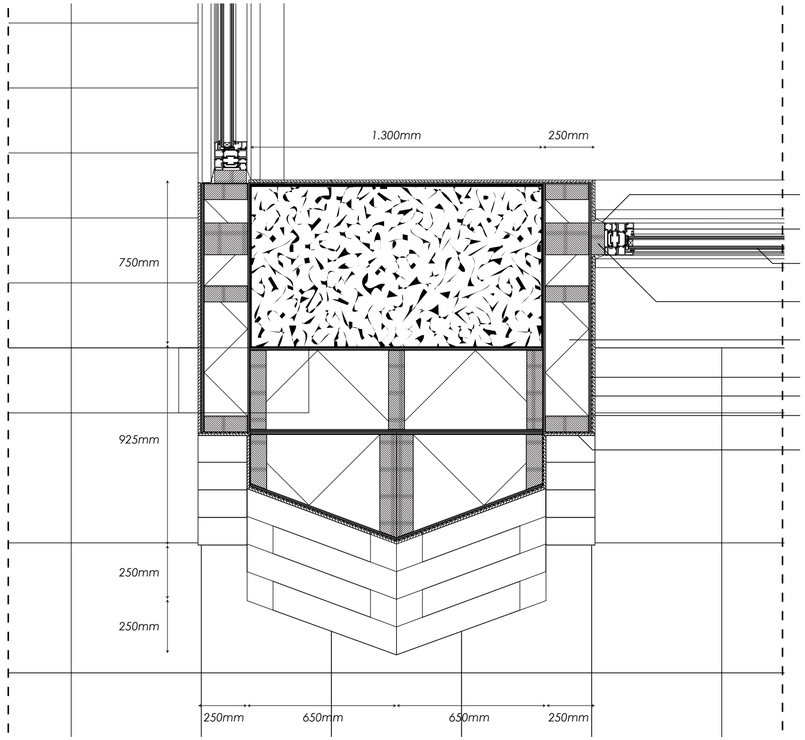
By designing my 1:5-details, I was able to ensure good connections between the different materials and the tiling. It also enabled me to create a robust design, with future adaptations in mind. This is illustrated by the construction of the columns in the facade, insulation has been placed on three sides of the column, so that future changes in layout can easily be executed with sustainability in mind.



1. | 1:20-DETAIL, FREE-STANDING COLUMN AT ITS BASE



2. | 1:20-DETAIL, EDGE-COLUMN AT ITS BASE



Concrete column (cast-in-place)
750x1.300mm

Brass window frame
130x150mm

Glass
16mm - 28mm - 16mm

Vertical wooden battens
(60x150mm)

Hempflex insulation
(200mm, Rd-value = 5)

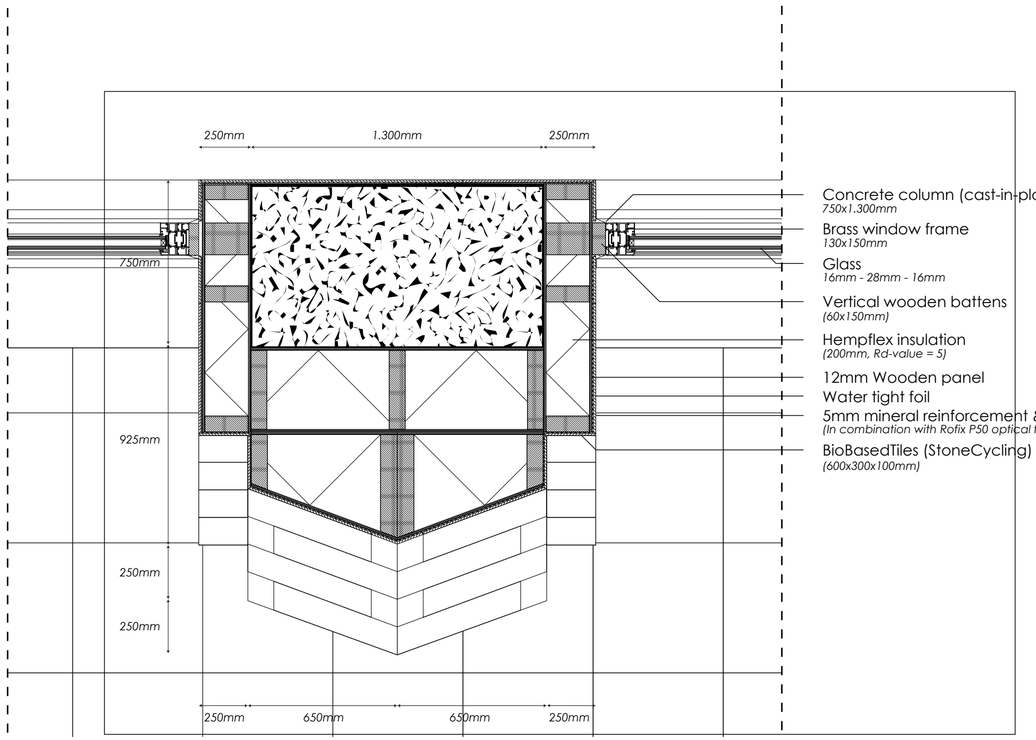
12mm Wooden panel

Water tight foil

5mm mineral reinforcement & adhesive mortar
(In combination with Rofix P50 optical fiber reinforced fabric)

BioBasedTiles (StoneCycling)
(600x300x100mm)

3. | 1:20-DETAIL, COLUMN AT ITS BASE



Concrete column (cast-in-place)
750x1.300mm

Brass window frame
130x150mm

Glass
16mm - 28mm - 16mm

Vertical wooden battens
(60x150mm)

Hempflex insulation
(200mm, Rd-value = 5)

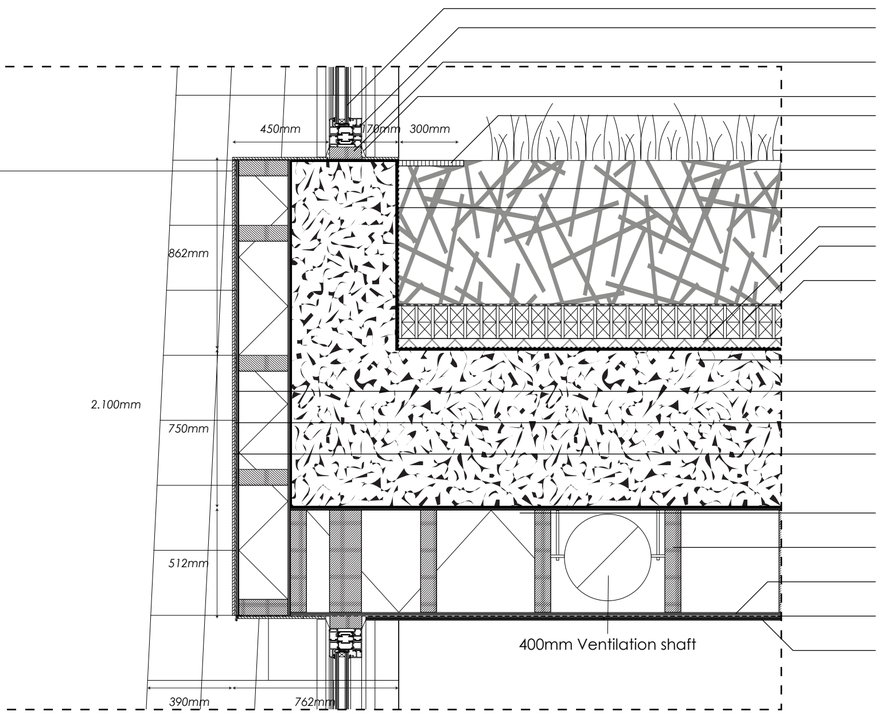
12mm Wooden panel

Water tight foil

5mm mineral reinforcement & adhesive mortar
(In combination with Rofix P50 optical fiber reinforced fabric)

BioBasedTiles (StoneCycling)
(600x300x100mm)

4. | 1:20-DETAIL, FACADE & +1 FLOOR, PARK & CYCLE PATH

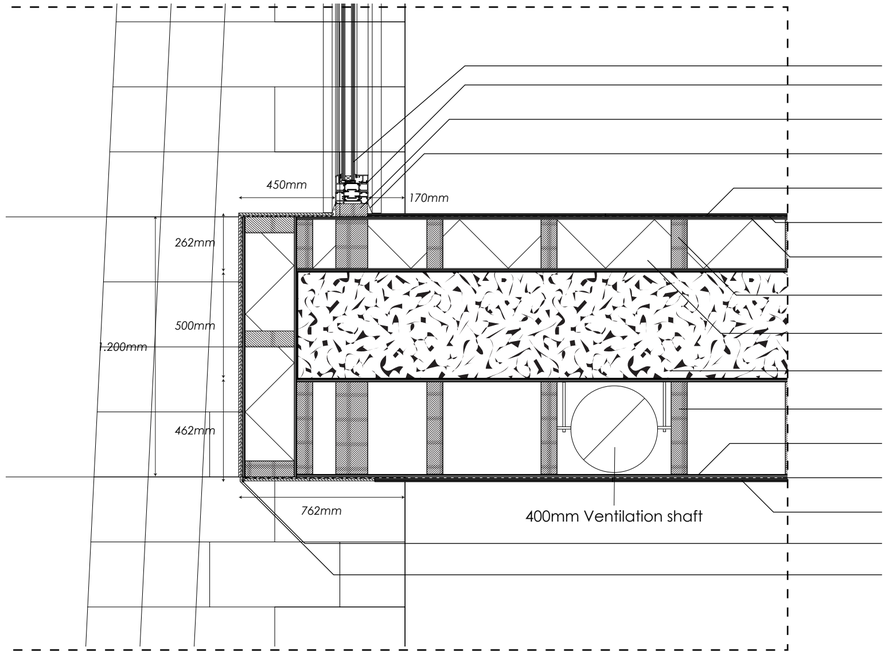


Glass
Brass window frame
(130x150mm)
Horizontal wooden battens
(60x150mm, Red Oak hardwood)
Brass Z-profile
BioBasedTiles (StoneCycling)
(300x600x100mm)
Vegetation
Organic well-draining substrate
Bitumen (water-resistant)
Bitumen (root-resistant)
Special root and water resistance
Water retention crates
(150mm, Aquacell Lite PP Inf. Unit 200L ZW)
Filter mat
(12mm AquaForte Filtervlies BioFleece 300 / 20gram rol)

Concrete slab
(500mm, geopolymerized, cast-in-place)
Water-resistant foil
(Meuwissen Miofol 125G – water-resistant, vapour-permeable foil)
5mm mineral reinforcement & adhesive mortar
(In combination with Rofix P50 optical fiber reinforced fabric)
BioBasedTiles (StoneCycling)
(300x600x100mm)

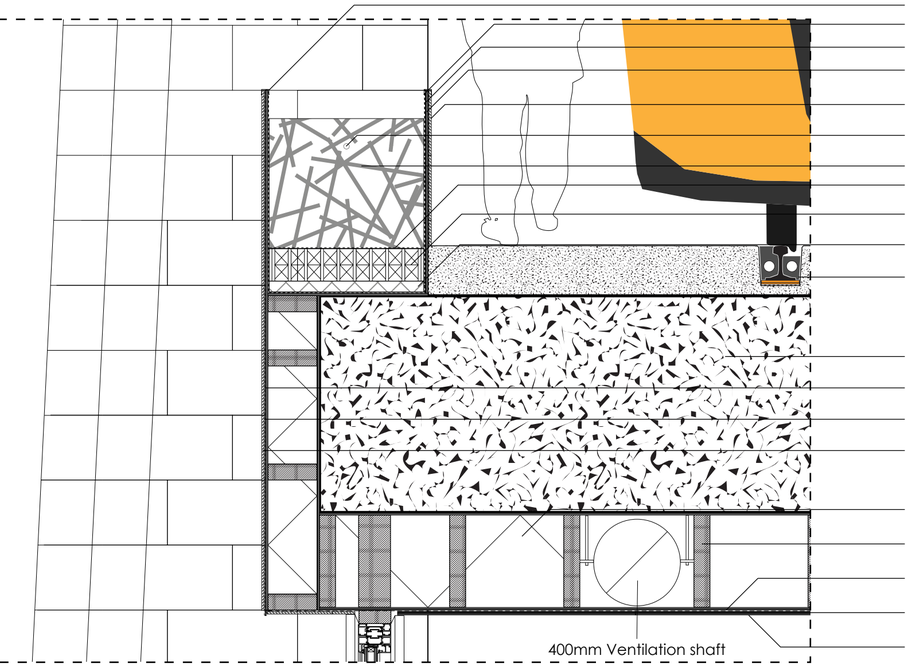
Hempflex insulation
(400mm, Rd-value = 10)
Horizontal wooden battens
(60x475mm, Red Oak hardwood)
Wooden panel
(12mm, Red Oak hardwood)
Sound absorption fiber sheet
(12mm High Density Light Grey Sound Absorption PET)
Wooden ceiling
12mm, Red Oak hardwood, lacquered

5. | 1:20-DETAIL, FACADE & GROUND FLOOR, PUBLIC FUNCTIONS



Glass
Brass window frame
130x150mm
Horizontal wooden battens
(60x150mm, Red Oak hardwood)
Brass window frame
130x150mm
Wooden flooring
12mm, Red Oak hardwood, lacquered
Sound absorption fiber sheet
(12mm High Density Light Grey Sound Absorption PET)
Wooden panel
(12mm, Red Oak hardwood)
Horizontal wooden battens
(60x225mm, Red Oak hardwood)
Hempflex insulation
(200mm, Rd-value = 5)
Concrete slab
(500mm, geopolymerized, cast-in-place)
Horizontal wooden battens
(60x425mm, Red Oak hardwood)
Wooden panel
(12mm, Red Oak hardwood)
Sound absorption fiber sheet
(12mm High Density Light Grey Sound Absorption PET)
Wooden ceiling
12mm, Red Oak hardwood, lacquered
5mm mineral reinforcement & adhesive mortar
(In combination with Rofix P50 optical fiber reinforced fabric)
BioBasedTiles (StoneCycling)
(300x600x100mm)

6. | 1:20-DETAIL, FACADE & -1 FLOOR, NATIONAL TRAINS & METROS



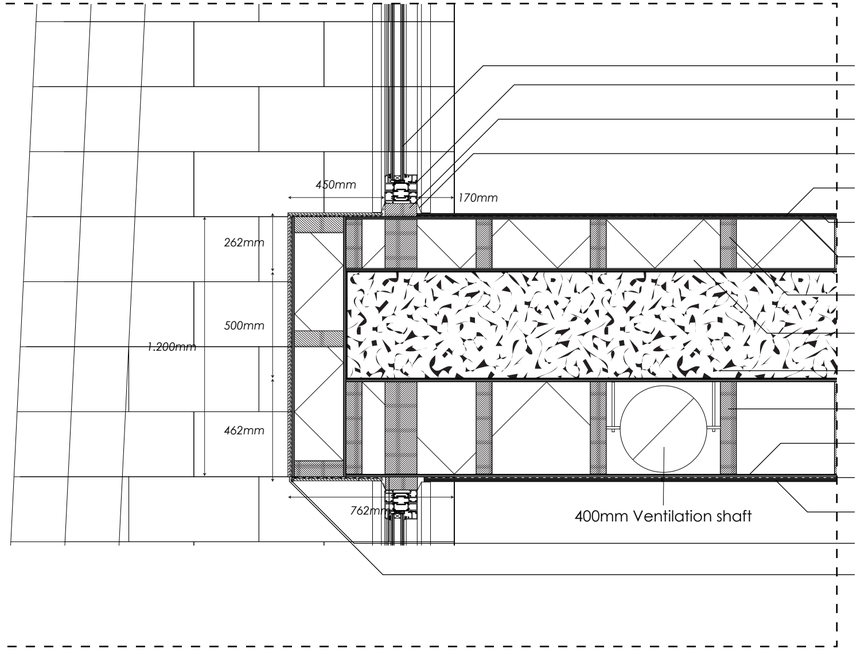
Stainless steel U-profile
Bitumen (water-resistant)
Bitumen (Root-resistant)
Wooden panel
(12mm, Red Oak hardwood)
BioBasedTiles (StoneCycling)
(300x600x100mm)
Irrigation tube
(5mm diameter)
Organic well-draining substrate
Filter mat
(12mm AquaForte Filtervlies BioFleece 300 / 20gram rol)
Water retention crates
(150mm, Aquacell Lite PP Inf. Unit 200L ZW)
Special root and water resistance

1:1-detail of the track system has ben included

Concrete slab
(1.000mm, geopolymerized, cast-in-place)
Water-resistant foil
(Meuwissen Miofol 125G – water-resistant, vapour-permeable foil)
5mm mineral reinforcement & adhesive mortar
(In combination with Rofix P50 optical fiber reinforced fabric)
BioBasedTiles (StoneCycling)
(300x600x100mm)

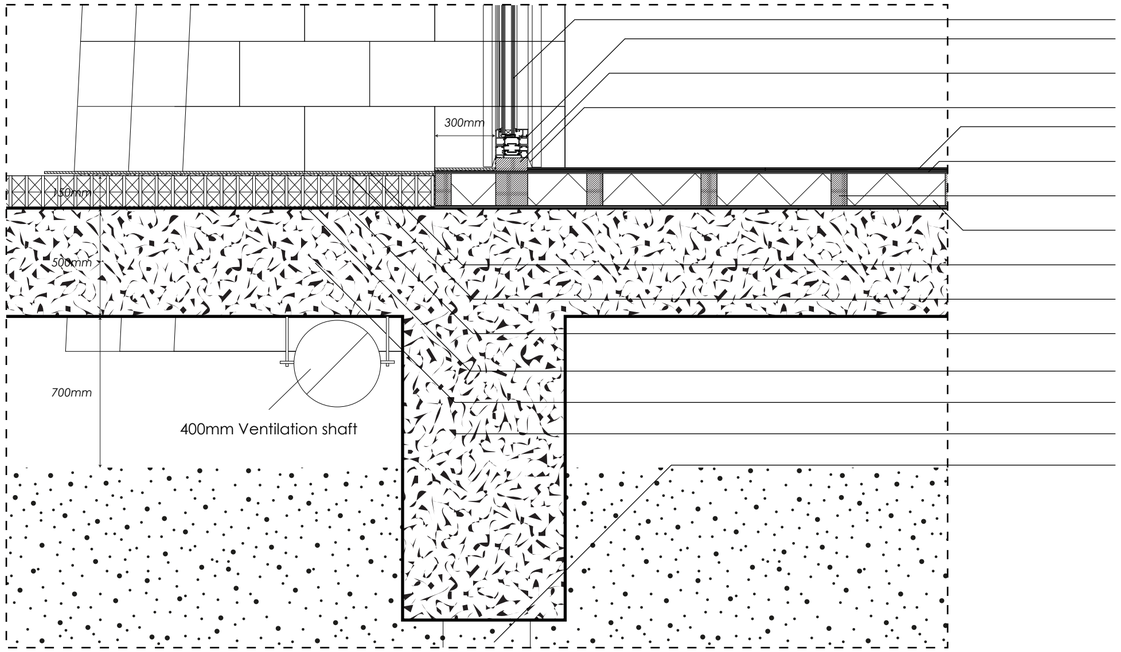
Hempflex insulation
(200mm, Rd-value = 5)
Horizontal wooden battens
(60x475mm, Red Oak hardwood)
Wooden panel
(12mm, Red Oak hardwood)
Sound absorption fiber sheet
(12mm High Density Light Grey Sound Absorption PET)
Wooden ceiling
(12mm, Red Oak hardwood, lacquered)

7. | 1:20-DETAIL, FACADE & -2 FLOOR, HYPERLOOP & FLEX OFFICES



Glass
Brass window frame
130x150mm
Horizontal wooden battens
(60x150mm, Red Oak hardwood)
Brass window frame
130x150mm
Wooden flooring
12mm, Red Oak hardwood, lacquered
Sound absorption fiber sheet
(12mm High Density Light Grey Sound Absorption PET)
Wooden panel
(12mm, Red Oak hardwood)
Horizontal wooden battens
(60x225mm, Red Oak hardwood)
Hempflex insulation
(200mm, Rd-value = 5)
Concrete slab
(500mm, geopolymerized, cast-in-place)
Horizontal wooden battens
(60x425mm, Red Oak hardwood)
Wooden panel
(12mm, Red Oak hardwood)
Sound absorption fiber sheet
(12mm High Density Light Grey Sound Absorption PET)
Wooden ceiling
12mm, Red Oak hardwood, lacquered
5mm mineral reinforcement & adhesive mortar
(In combination with Rofix P50 optical fiber reinforced fabric)
BioBasedTiles (StoneCycling)
(300x600x100mm)

8. | 1:20-DETAIL, FACADE & -3 FLOOR, PUBLIC FUNCTIONS



Glass

Brass window frame
(130x150mm)

Horizontal wooden battens
(60x150mm, Red Oak hardwood)

Brass Z-profile

Wooden flooring
(12mm, Red Oak hardwood, lacquered)

Wooden panel
(12mm, Red Oak hardwood)

Horizontal wooden battens
(12mm, Red Oak hardwood)

Hempflex insulation
(140mm, Rd-value = 3,5)

BioBasedTiles (StoneCycling)
(300x600x100mm)

Filter mat
(12mm AquaForte Filtervlies BioFleece 300 / 20gram rol)

Water retention crates
(150mm, Aquacell Lite PP Inf. Unit 200L ZW)

Water-resistant foil
(Meuwissen Miofol 125G – water-resistant, vapour-permeable foil)

Concrete slab
(500mm, geopolymerized, cast-in-place)

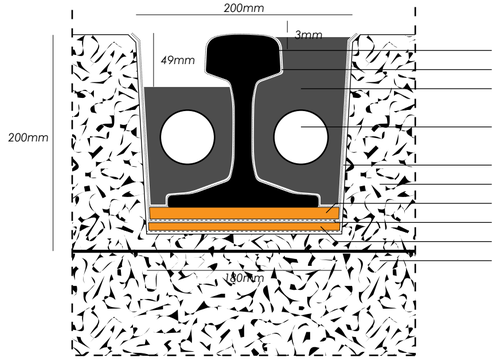
Concrete foundation beam
(750x1.400mm, geopolymerized, cast-in-place)

Concrete foundation pile
(400mm diameter, geopolymerized, cast-in-place)

INTEGRATED PLANTERS

On the previous page, the detail of floor -1 shows that greenery has been integrated next to the railway tracks. On one hand, this enables vining plants to grow in the light and spacious vide, creating a pleasant atmosphere.

On the other hand, the integrated planters and the vines themself improve acoustic properties of the space by absorbing noise from the braking and accelerating train wheels besides them. On top of this, pollution is being absorbed by the plants, improving air quality in the vide and around the tracks.



Rail beam
Protective coating
Elastic cork rubber polymere
(EdilonSedra Corkelast)
Hollow PVC-tube
(50mm diameter)
Coating
Concrete (cast-in-place)
11mm Elastic rubber for positioning rail beam
Foil
7mm Elastic rubber railpad
Main load-bearing structure

1:4

ELASTICALLY EMBEDDED RAIL

Because the railway runs right through a very complex context with many different places and functions, dimishing noise and vibrations was of high importance in order to maintain a comfortable climate for the users. Compared to traditional trackbeds using ballast or embedded block systems, elastically embedded rail has superior properties regarding the insulation of noise and vibrations thanks to the rubber that is positioned between the concrete load-bearing structure and the railway tracks. On top of this, embedded rail enables maintenance and surveillance cars to pass over the tracks if needed and reduces the height needed for the construction drastically. I chose Edilon)(Sedra's elastically embedded rail as a reference for the detail on the left.

edilon)(sedra



Technobeton, 2022



EPILOGUE
SPECIAL THANKS

EPILOGUE

As long as I can remember, I have had a great love for trains and public transportation. From when I got my first Märklin locomotive at the age of four, up until now, graduating on a station design.

This graduation project brought me a highly inspiring new journey where I got to learn a great amount of knowledge regarding station design and hyperloop. This was both a blessing and a curse, as I had to pioneer myself through the field of station design throughout the already challenging process of graduating. Besides this, I combined my graduation project with a parttime internship at Arcadis Stations & Architecture in order to fully immerse myself in the world of station architecture.

Although I really enjoyed studying architecture, I am looking forward to start out my career as a junior architect. Continuing working on station designs is something that really attracts me, although I must admit that I enjoy designing virtually every type of building. I am thrilled to see what the future brings me.

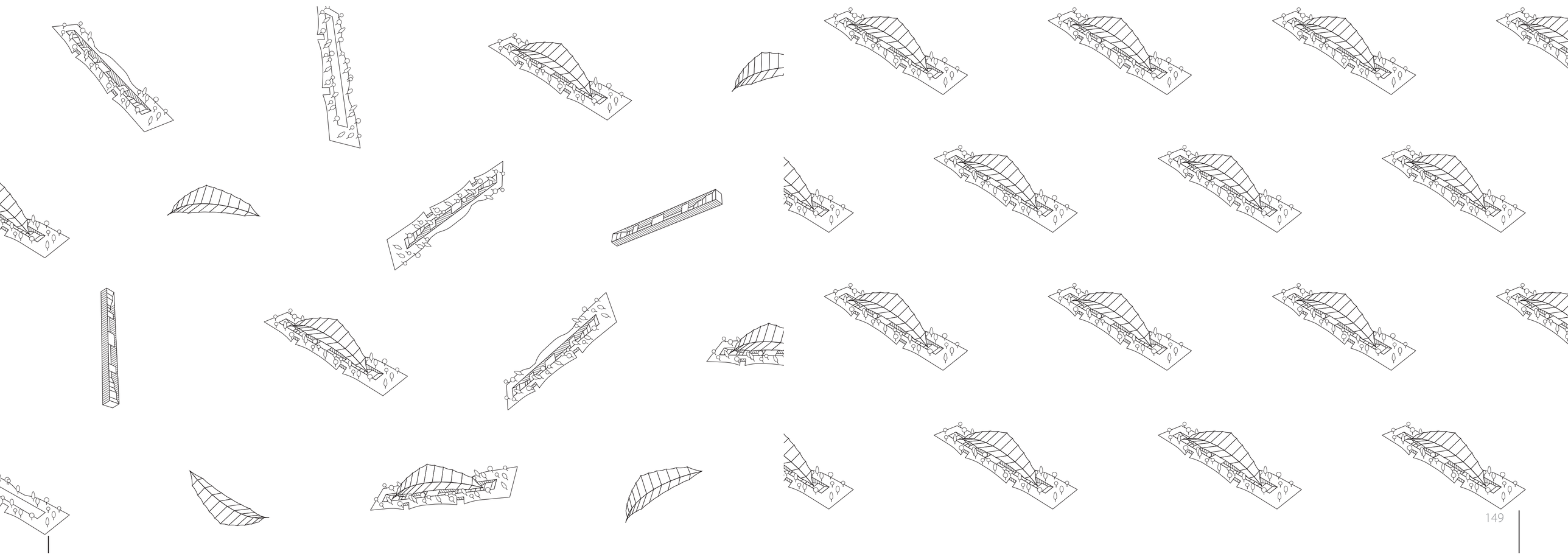
SPECIAL THANKS

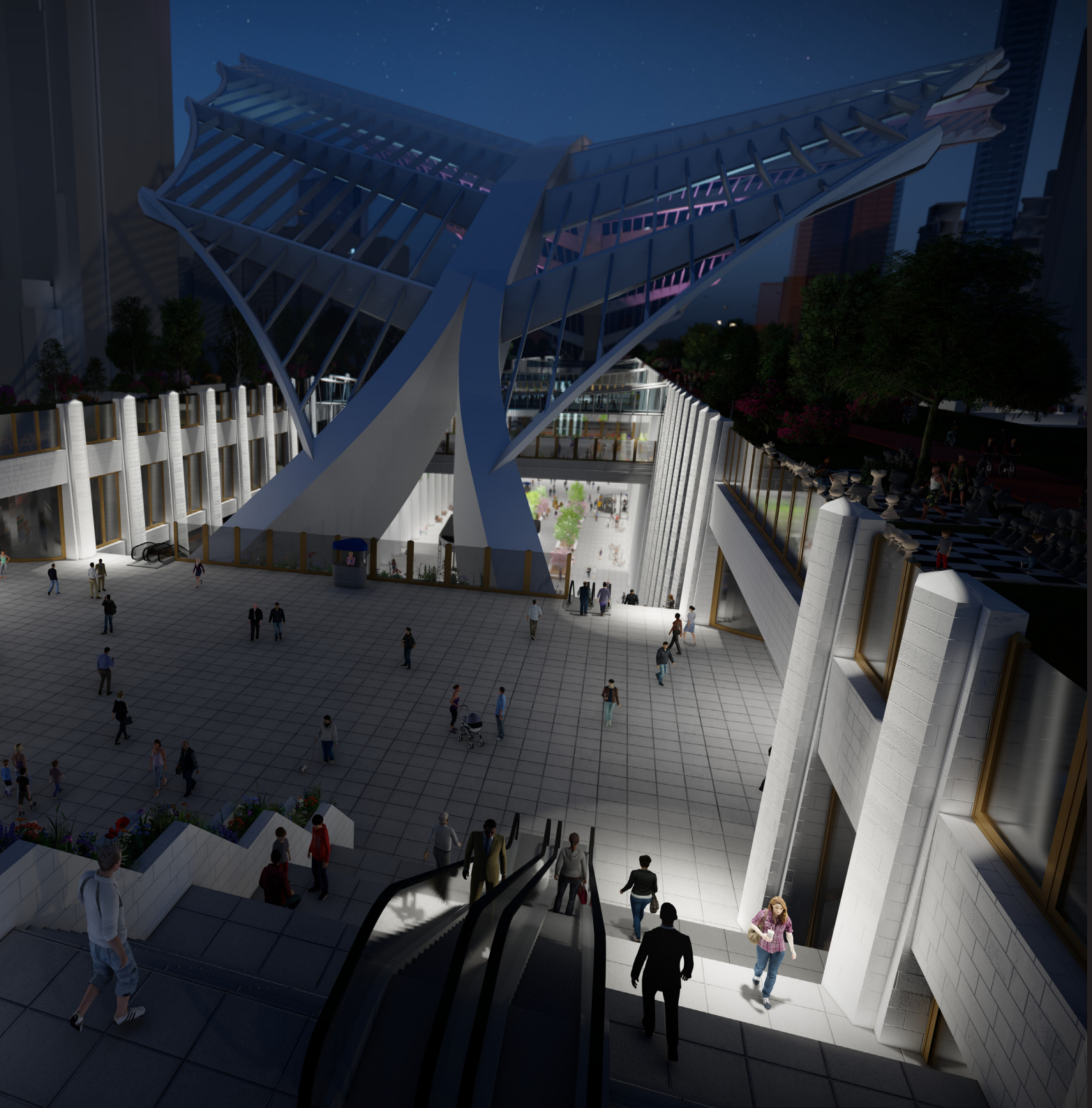
I would like to start by thanking my dad for giving me my first locomotive and my grandmother for taking me on my first ever train trip from Ermelo to Putten.

A big thank you to my tutors: Olindo Caso, Kjai Tjokrokoesoemo, Hubert van der Meel and Mariette Overschie, for your patience, critical remarks and your inspiring words throughout the process.

A shoutout to my colleagues at Arcadis, it was amazing that I could always stop by for questions. I would especially like to thank Marianne van Lochem for being my vital source of enthusiasm and inspiration this past year. I would like to thank Luc Veeger, Jeroen Eulderink, Rianne van Wijngaarden, Maayan Daniel, Marijn Heijnis, Tom Kramer, Roline Den Hartog, Jeroen Sikkenk, Janet André, Gerard van Veelen, Remco van der Wal, Franklin Besseling, Wouter Veugelers, Toine Fokkens, André Beverdam and the rest of the team for helping me this year.

Lastly, I would like to thank Joline Rimmelzwaan, Marlous Heikamp, Roséane Singotani and Nathalie van Wees for helping me out in times of need and Luuk Bom for being so incredibly supportive to me.





STAY IN TOUCH
CONTACT INFO

First of all, I would like to express my appreciation for you taking the time to review my work. I really hope that you liked the project.

In case you have any inquiries regarding my work or if you are looking for a highly motivated junior architect specialized in station design, please get in touch.

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