REPORT | Cities of the Future

TRANSPORT HUBS AS PUBLIC SPACE

Transforming the public space surrounding Brussels-South Railway Station

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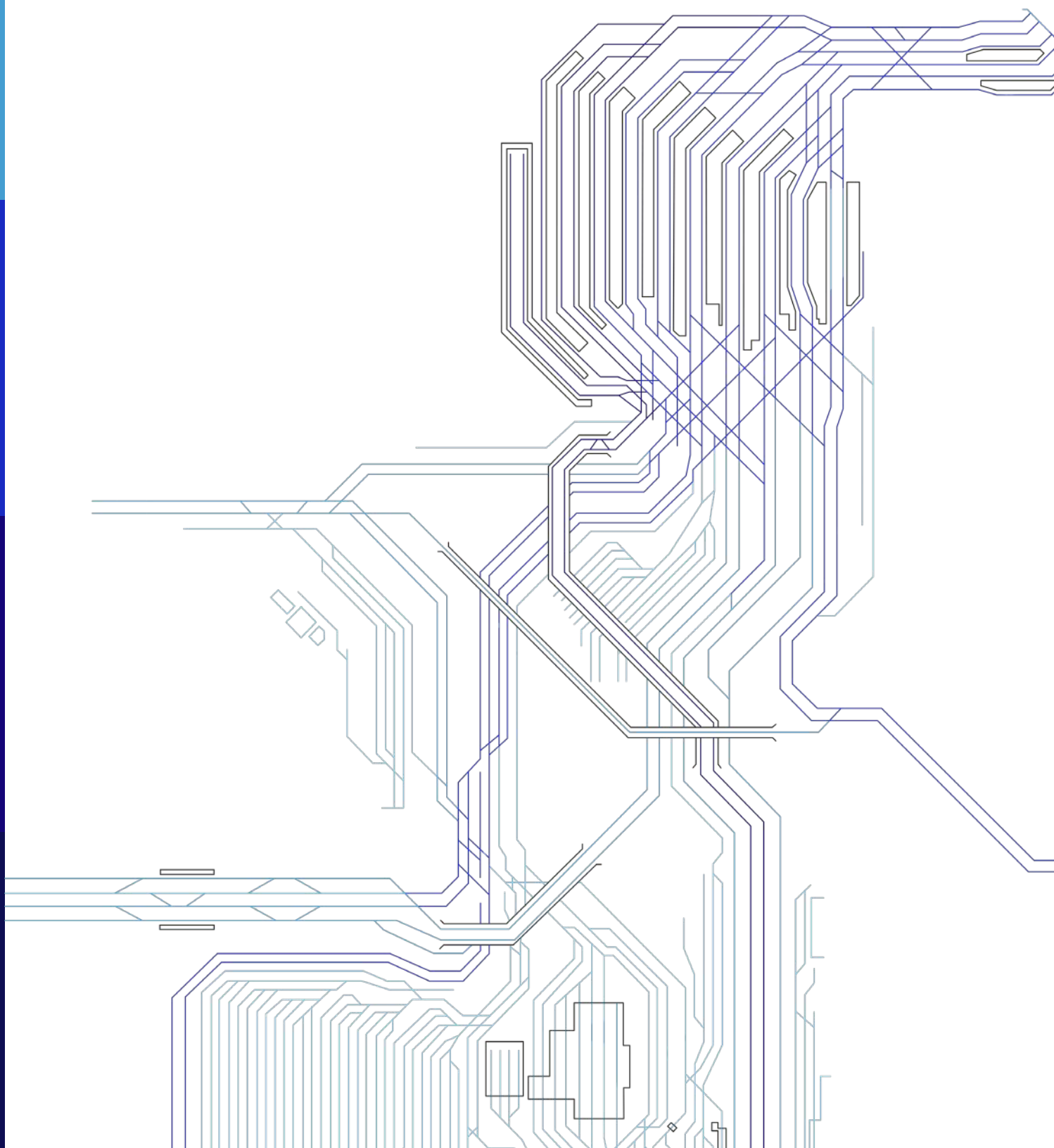

Colophon

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Transforming the public space surrounding Brussels-South Railway Station

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Delft University of Technology
Faculty of Architecture and the Build Environment

MSc Architecture
Cross Domain Graduation Studio: Cities of the Future

INTRODUCTION

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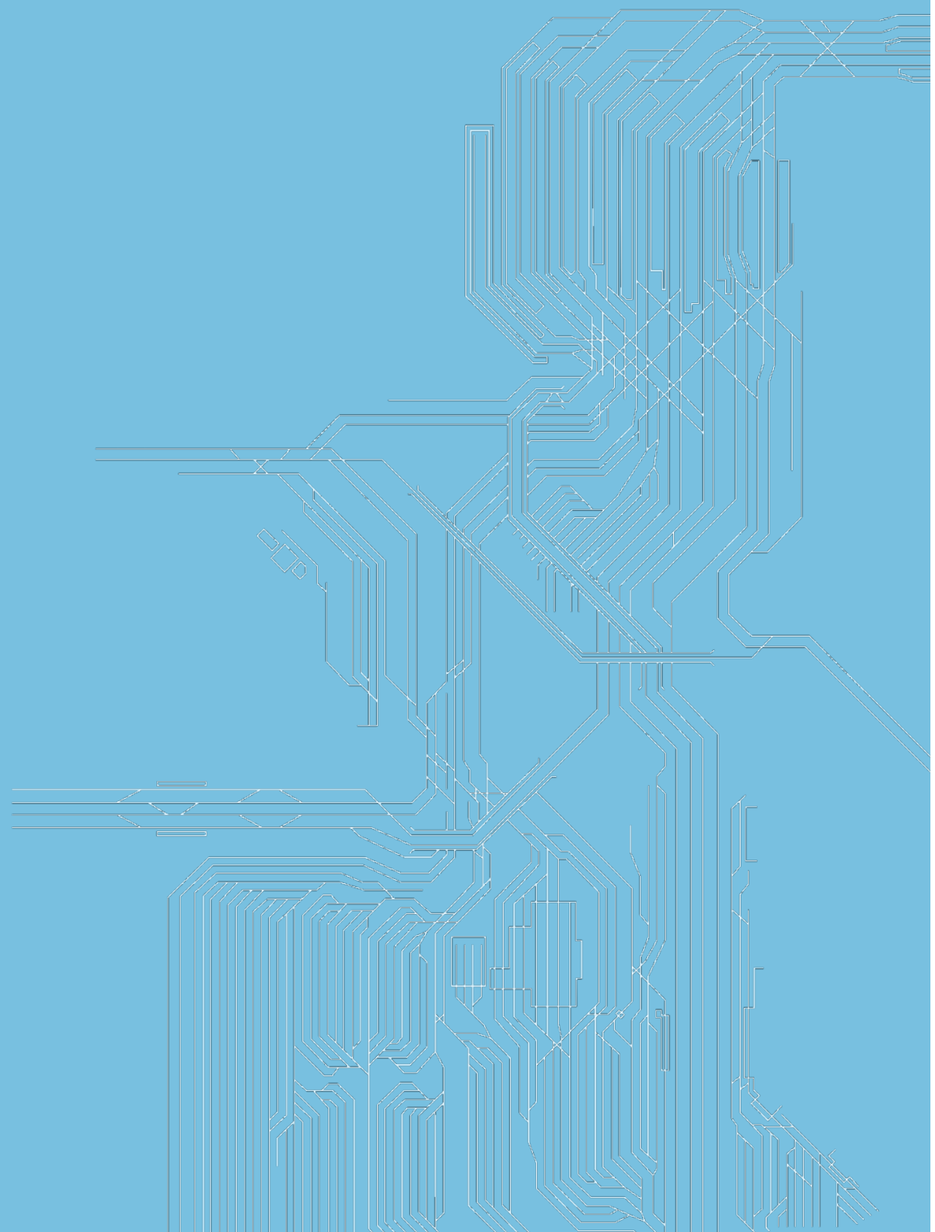

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Introduction

Introduction

TRANSPORT HUBS AS PUBLIC SPACE

1.2.1 General Introduction

The implementation of high-speed rail in transportation hubs and stations have caused a series of (re)developments in European cities. These developments however have not addressed the problems of integration and experience of the public space inside and surrounding the stations. Therefore, this research continues the studies to improve the spatial experience and integration of public space in transportation hubs, focussing specifically on the relation of public space inside intermodal transportation hubs with the current and future transport modes.

The aim of this research is to understand the relation between public space and the different transport modes inside an intermodal transport hub and how this space can be improved and integrated within the complex and the city using architectural methods and tools. The central question in this research is therefore:

Central Question:

"How can architecture contribute to the spatial layout and experience of public space in European intermodal transportation hubs of the future?

This research is developed during the master studio City of the Future of the Department of Architecture of the TU Delft. The central goal was to develop a design that would continue the written research and study. This research is therefore split into two parts. The first part focusses on a literature study and a case study analysis. The second part focusses on a redesign of the Brussels-South Railway station with the aim of improving the problematic aspects introduced in the research.

As a result of this structure, the main product of this research is a (partly) redesign of the Brussels-South Station. This booklet will therefore go into depth to the products resulting from this design.

Figure 1.1 (Right): Brussels-South Railway Station Southern Side

CONTEXT

02

INTRODUCTION

2.1.1 Problems with Transportation Hubs

Transportation hubs or stations in general are key structures in the public realm, used by local, national, or sometimes even international travellers. They serve as one of the main access points to the city and its public space and can therefore sometimes be seen as the gateway to the city. This role as gateway is becoming increasingly important since the importance of train stations and transport hubs is on the rise again. The increasing need for more environmentally friendly transport, the increasing population of urban areas, and the further implementation of high-speed rail will lead to an increasing number of travellers using transport hubs. Most often the redevelopment is considered a success, while researchers see it as a missed opportunity to rethink stations.[1] The redevelopments kept the same layout and principles, pleasing the financial stakeholders with focussing on efficiency. Other aspects like the experience of users often not prioritised.[2] Which led to the question; are we still designing transport hubs correctly?

At the same time, it is often referred to that stations and transport hubs are undergoing a functional shift, changing from a place to travel to a place to be. This has not reflected in the design in most of stations and hubs, where they are often still just a station and not a place on its own.[3] Therefore it seems confusing why aspects like experience are not prioritised, since this is essential to creating a place. Another important aspect of a place is the integration in the context, which is also missing often in train stations. There is a clear disconnect to the public space inside and the public space surrounding the station.[4]

The reasons that cause these problems are mostly grounded in the history of station and transport hub design and the relation between architecture and urbanism with these complex structures.

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[1] Marcel Hertogh, “Towards an integrated approach for stations,” in Station as Nodes, ed. Manuela Triggianese, Roberto Cavello, Nacima Baron and Joran Kuijper (Delft, TU Delft Open, 2018), 17-19.

[2] Yo Kaminagai, “Intermodal hubs as urban spaces,” in Station as Nodes (see note 1), 33-35.

[3] Yo Kaminagai, “Intermodal hubs as urban spaces,” 33-35.

[4] Ana Conceição, From City Station to Station City (Delft University of Technology, 2015), 17.

RELATION

2.2.1 The Relation between Architecture and Transportation Hubs

The relation between the cities and the train networks is complex and has changed through the years. Before the introduction of rail connections, it was difficult to travel long distances between different cities. Often, it was done using the existing waterways, which the Netherlands had quite a lot of. With the introduction of passenger rail lines in 1825 it offered the opportunity to develop the political, economic, and social aspects of different cities or towns.[5] In many places it became a crucial aspect of new developments, dictating the places where new areas or towns would rise. However, the train network would require quite a lot of infrastructure. This among other reasons is why many train stations of existing cities were placed along the edge of the city. It would often take the shape of a terminus station since it was difficult to lay tracks through the city itself. Combined with the early years having often multiple companies operating in countries it led to some cities having multiple stations on different sides of the city, something that can still be seen today in cities like London and Paris.

The area where many of these stations would be constructed was often barren, allowing for opportunity to position the station centrally and create squares surrounding it. Train travel was in this time seen as the future mode of transport which led to many of the stations having a monumental design visible from a distance. These early stations often consisted of a platform area with a large building on the side or top. This building would host ticket halls, baggage storage and more importantly waiting halls, since early trains were quite slow. This combined with the monumentality and status of the stations it often led to stations having prestigious architectural designs.[6]

As time went on, the stations surrounding the edge of the cities would be engulf by the growth of the city itself. With the function of the station itself being desirable, the areas surrounding the station would often be the first areas of the city to grow, creating a new central hub around the station. These areas evolved and became more important if the network grew, leading to other modes of transport also being added in this area. The train stations therefore often evolved to a large transport hub, with often having metro, tram or bus stations surrounding it. It could be seen as the golden years of train stations, being sometimes the most important building in the whole city.

2.2.2 The changing role of Transportation Hubs

The growth of the station and the densification of the area surrounding it was beneficial in the beginning, but also led to problems in the future. The train network improved, which led to more frequent connections to more places. While this improved the accessibility, it also made many of the waiting areas in the station building being obsolete. Together with the introduction of the car, the station buildings itself became more and more a building that was unnecessary. With the architectural philosophy form follows function getting more attention, it led to the redesign of many stations in Europe. Therefore, owners removed many of the unprofitable constructions and expensive square meters of public space.[7] The design of the station instead became more simpler, more streamlined and more focus on efficiency and profitability, something that could be seen as a negative influence on the quality of the architecture of the stations. Even then, the number of travellers using the trains was still in decline leading to more reductions in the number of features new and redesigns stations would get, creating a negative spiral.

[5] Dictaat spoorwegontwerp.pdf
[6] Van Acker
[7] Van Acker

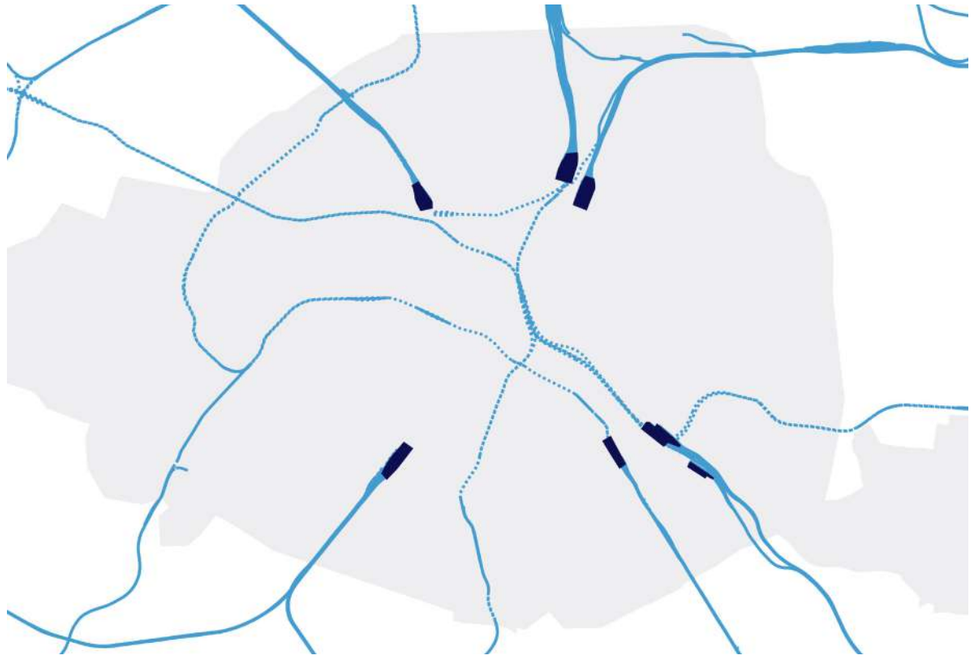


Figure 2.1: Rail routes and stations in Paris. Source: Wikimedia Commons

Figure 2.2: Waiting areas are now often placed in the main corridors

NODE VS. PLACE

2.3.1 Creating Balance

The downfall of the station was mostly related to the surrounding functions that the station or hub had. The station itself would still operate and in some aspect even get more connections. Therefore, it is important to understand the different aspects that a station has. The division of the station as a transport element and a place to visit was first introduced in the Node-Place theory from Bertolini.[8] In his report from 1999 he introduces an analytical tool to help identify the potential for public transport-orientated urban-regional development with the goal of finding and analyse ways people are interacting or could interact inside a transportation hub. The theory splits these aspects into two sections. The node section focusses on the accessibility of the node and the potential for physical interaction, following the principle: if more people can get there, the more interaction is possible. The Place section corresponds to the intensity and diversity of activities there and therefore the potential for physical human interaction, following the principle with the idea: the more activities there are, the more interaction is actually happening. The central idea is that these ideas should be in balance with each other, meaning that if the node function is large, it should have an equal number of activities.

The relation between node and place is also visible in the history. As stations originated, it was necessary to create a place surrounding it, offering mostly waiting rooms and other aspects to pass the time. When this was no longer necessary in the new developments the function as a place was greatly reduced, which also influenced the quality of the station itself. Bertolli therefore argued that stations would have to bring the place aspect back into the design of transport hubs.

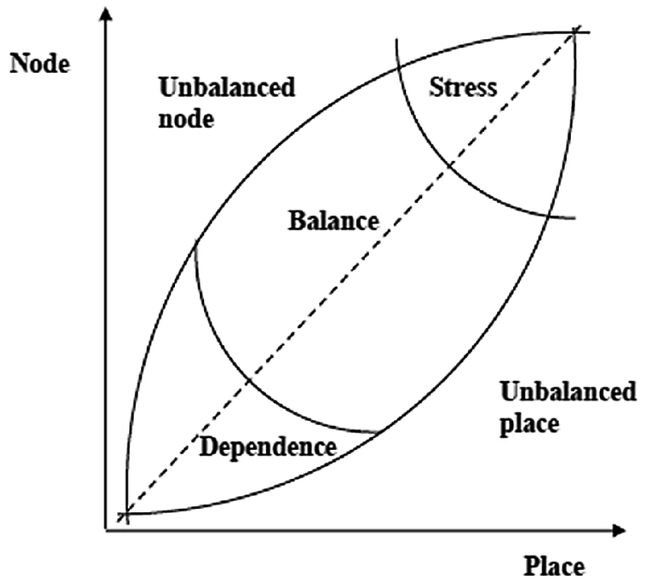


Figure 2.3: Node vs. Place Model created by Bertolini

Figure 2.4 (Left): View of the tracks connecting with the platform at Brussels-South

[8] Bertolini

THE SITUATION

2.4.1 The Introduction of High-Speed Rail

The role of the place aspect in transport hubs did end up becoming more important, mainly due to two aspects that would be introduced to transport hubs. First was the commercialisation of transport hubs. These areas would often have one of the largest collection of people inside a city. Therefore, slowly more shops would be situation around the station and eventually even infiltrate the station itself. Along the passageway these shops would be located and benefit from the large number of travellers using it. This change coincided with a larger change in the node aspect of the stations, the introduction of High-Speed Rail travel. The introduction of high-speed rail made it possible to travel between large cities in different countries in matter of a couple of hours. This made it easier for most people to travel to neighbouring countries, often being faster than the car.

The new high-speed rail was an opportunity to for cities and station owners to redevelop their stations again since it could bring an international level to the inner city. Restructuring or redesigning the whole building could make the station more attractive and could bring more revenue, which is why many of the stations connected internationally would do this. The new design would more reflect the old style of stations, with a new grand design, this time with the addition of more and a more diverse offering of non-transport functions.[9]

2.4.2 The remaining problem

However, as stated in the introduction, the user experience is still lacking inside and surrounding transport hubs. Owners and stakeholders are often still neglecting the experience and spatial performance of the hubs itself. This lack of focus on these aspects leads to unattractive public space inside the area and an disconnect between the station and the surrounding urban fabric.[10] The functional change of stations to a place to be is being implemented by designers and experts like Bureau Spoorbouwmeester who are implementing space where people can stay,[11] however this space is often still undefined, unattractive, and not prioritised. Often it also leads to the same formula of shops and cafés, not designed places itself.[12] Since the public space inside the hubs as place to be is becoming more important, the design of the transportation hub should reflect this change. Otherwise, the potential and functioning of these transportation hubs will decline and will in the future be avoided by the travellers due to the negative experience.

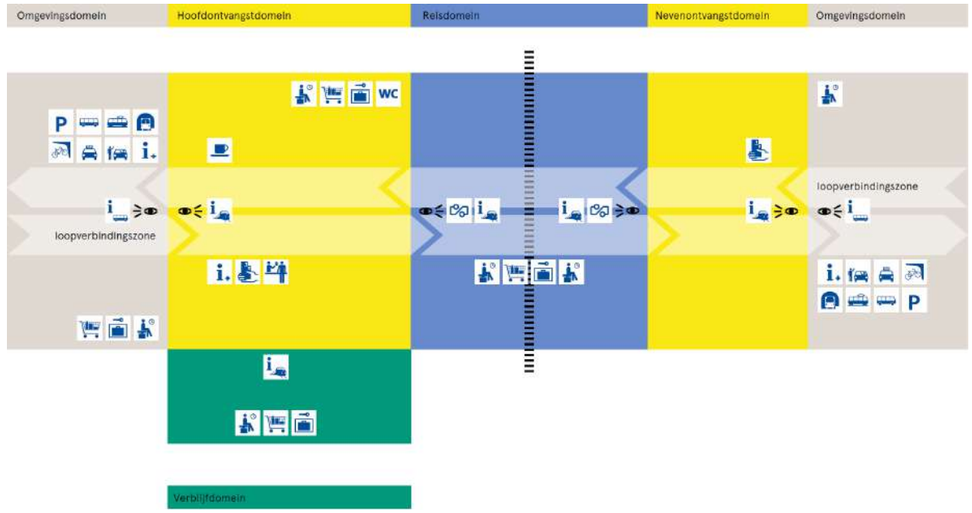


Figure 2.6: Station Design Concept created by Bureau Spoorbouwmeester

Figure 2.5 (Right): Main High-Speed Lines in Europe. Source: Wikimedia Commons

[9] Conceicao
[10] Cavello, Roberto. "The Railway and the Dutch City." OverHolland 5 (2007): 43-59.
[11] Bureau Spoorbouwmeester, Het Stationsconcept. (2011).
[12] Conceição, "From City Station to Station City," 14, 23.

RESEARCH & METHOD

03

INTRODUCTION

3.1.1 Research Framework

This chapter focusses on the research methodology and the different methods of assessments used in the research. This section introduces the framework used to determine the research locations and setup the assessments of the comparative case study analysis, while also introducing the aspects that will be used to help design the final design assignment.

As a summary of the previous chapter, transportation hubs have gone under several redevelopments and transformations, but are always neglecting the experience and spatial performance of the hubs itself. This lack of focus on these aspects leads to unattractive public space inside the area and an disconnect to the surrounding urban fabric. Since the public space inside the hubs as place to be is becoming more important, the design of the transportation hub should reflect this change. Otherwise, the potential and functioning of these transportation hubs will decline and will in the future be avoided by the travellers due to the negative experience. Therefore, a change is needed to the design of public space inside and around the hubs. This change could be implemented during the next redevelopment, integrating new transportation modes that will be implemented the near future.

The focus of this research is therefore on the design of public space inside and surrounding train stations. Since the space surrounding the station is often quite large and surrounds other transport modes, this investigation will focus on transportation hubs with at least three different types of transportation hubs. One of these modes of transportation is rail transport, since these stations are often the largest structures and have most to benefit from creating its own place inside the city and this research. Furthermore, this research will exclude transportation hubs with boat and air travel since these are not as common or require a specific solution. As with airports, they also have a different relation with the surrounding context which needs its own research or solution. Finally, this research focusses on transportation hubs located in Europe since cultures and regions can cause major differences in transportation systems and their usage.

Since rail stations often also include other transportation modes, further mentions of stations or transportation hubs will refer to these specific inter-modal transportation hubs unless mentioned otherwise.

RESEARCH QUESTIONS

3.2.1 Main Research Questions

The central goal of this research aims to investigate the spatial relationship between the different transportation mode in the transportation hub of the future, with the goal of understanding how the public space currently exists and how the function of this space can change to a place of its own. To understand how this goal can be reached, the following main research question (RQ) is formulated:

"How can architecture contribute to the spatial layout and experience of public space in European intermodal transportation hubs of the future?

To answer this main research question, four sub research questions (RsQ) are formulated. These questions are based on the several aspects that will be investigated in the research.

"What is the current role for public space in transportation hubs?

"What is the relation between different transportation modes in transportation hubs?

"How can the experience of transportation hub be improved without limiting the efficiency?"

The first two questions are set with the purpose of understanding the current situation of transport hubs, with the first question focussing on the public space itself and the second question more on the relation between the different modes of transport. These questions should give an overview how the current spatial situation is inside and surrounding the hubs. The third question was created to investigate deeper the experience the current situation gives and how this should be improved. The answers from these question function as a base of knowledge that can be used to answer the main research question.

3.2.2 Research Domain

To study and analyse the public space inside the transportation hub, this research must go beyond the scope of architecture and the traditional scope of the building. The connection with the surrounds and functioning of the stations itself will have to be considered when researching to prevent the solution only being focussed on the domain of architecture. Instead of limiting to only using the domain of architecture, this research will therefore expend the scope with theory from the domain of Urbanism and the domain of Transport, Infrastructure and Logistics (TIL).

These different domains highlight the duality in this research. This duality is most prominent in the tangibility of the different aspects of transportation hubs. The general functionality of the transportation hub is a systematic aspect; it can be analysed with numbers and other data driven analyses. However, the central subject of the research is of course the public space itself. This, however, can be considered more softer since it can be hard to define the quality and space itself. This balance will have to be managed in the research itself, but also reflects the different disciplines in the research itself.

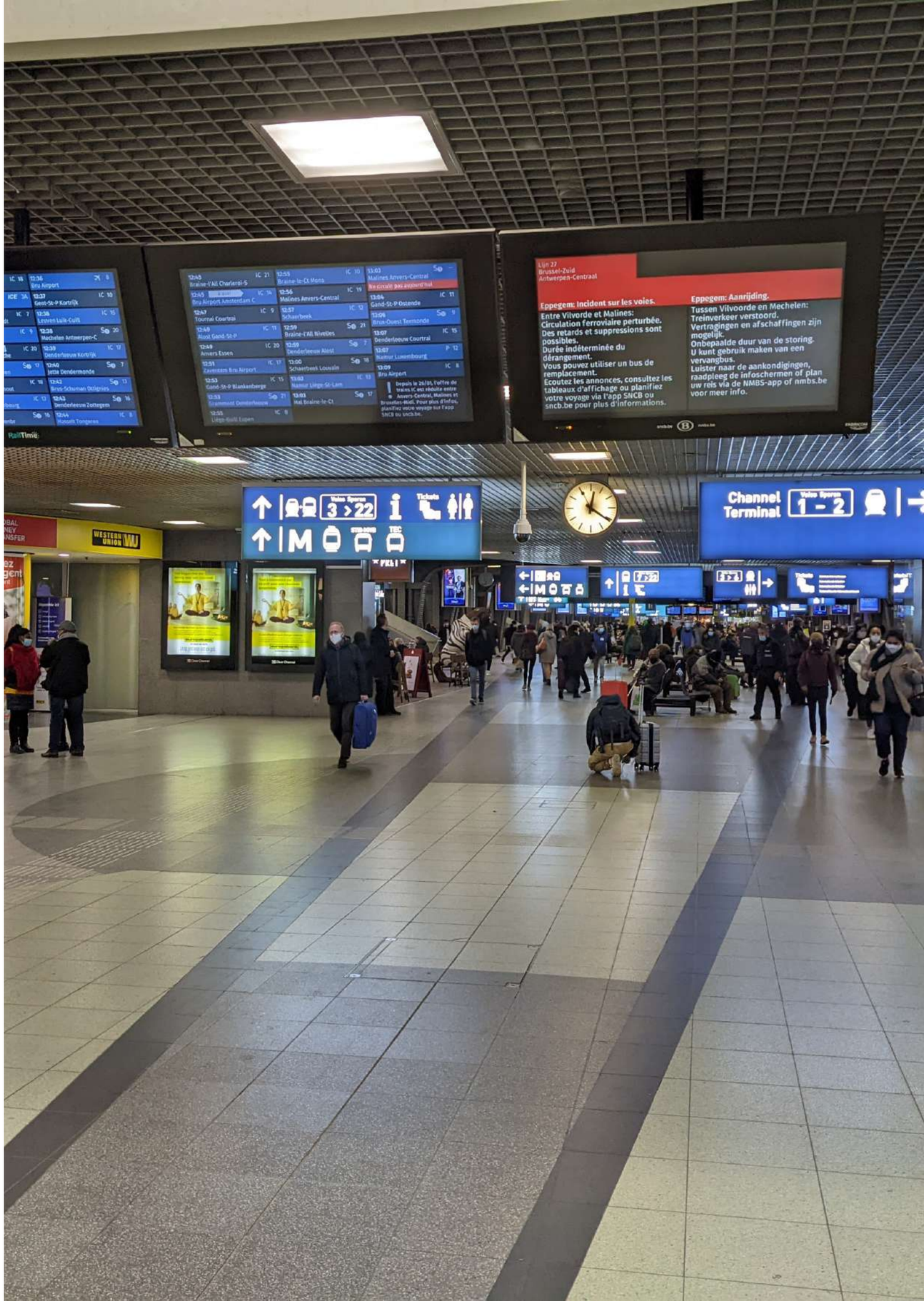


Figure 3.1 (Right): The main station hall of Brussels-South

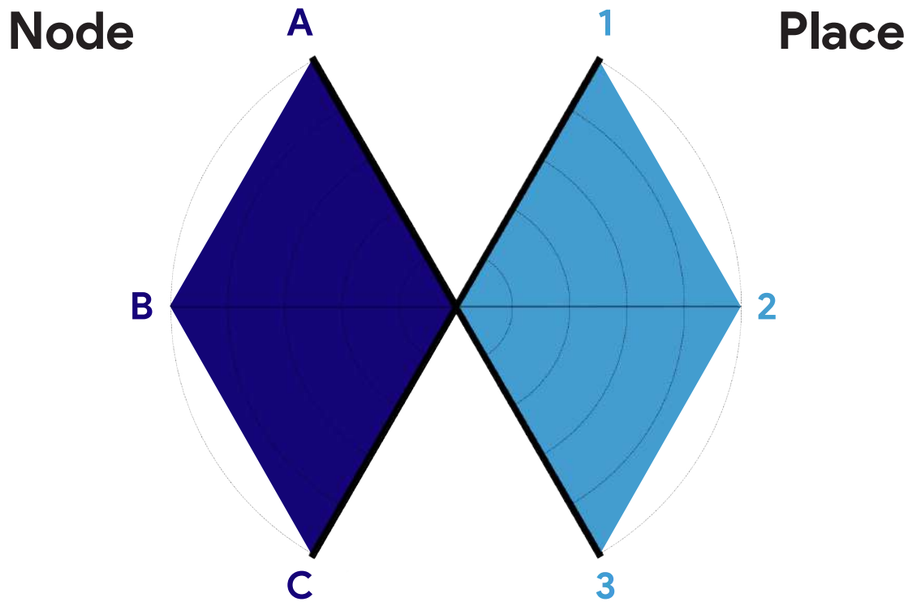


Figure 3.2: Butterfly Model. Remade, translated; Source: Vereniging Deltametropool

A. Slow Traffic

This value is based on the number of facilities available at the station including rental services. This is combined with the reach for the slow traffic, based on the direct surrounding (<300) and the total reach of a bike (3000m).

B. OV-Network

This value is calculated based on the amount of transportation modes are available in the hub and the frequency of these modes. This value is based on off-peak travel times and are scaled based on the speed of the transport modes.

C. Road Network

This value is similar as the previous one but focussed on road network. The value is calculated by the ratio between the number of road types and the number of parking places in the station. Furthermore, the number of directions for cars is added to this value.

1. Closeness

This value consists of three calculations. First is the ratio between how much activity is happening in the first 300 meters compared to the full reach of the station. This counts for 50 percent of this value. The second calculation is calculated by measuring the comfort in the station based on the facilities related to this aspect inside the station. The last part of the value is based on the quality of the area, which is determined by experts of the organisation.

2. Intensity

This value is calculated by comparing the number of residences, employees, and visitors of attractions in a certain reach from the station to the total reach of the station itself. A denser area leads to more potential travellers, facilities, and visitors.

3. Blending

This value consists of two calculations. First it calculates the ratio between the residences and workers in the area, with 100% being equal size. The other section is based on the ratio between the visitors and the percentage of different regional facilities in the area.

ANALYTICAL MODEL

3.3.1 Butterfly Model

Since this research is based on the public space, the balance between creating a node and place is important. Since the introduction of these concepts by Bertolini, several researchers and organisations have continued this concept and improve the model. One of these organisations is Vereniging Deltametropool, who created the so-called butterfly model based on the balance between node and place. The model and its characteristics are visible on the other page. The central idea is that the different aspects should be in balance with each other.

3.3.2 Evaluating the concept

The new model was created to better determine the qualities of the node and place inside the station. However, while the model has improved from the original model from Bertolini, it is in my opinion not enough to use in this research. Several aspects and calculations are lacking, leading to the public space not being represented enough. To start, a lot of the values are based on statistics, but this is not guaranteed that it will be creating the desired effect or benefits. Furthermore, quality is an underrated value in the current model. It is only represented as a quarter of one of the values. It should rather be represented as its own category.

Besides issues with content of the model, the balance itself is also flawed. While the concept is good that it can show the balance between the node and place, the aspects that are currently compared to each other differ drastically from each other. As an example: large central stations are often difficult to reach by car and therefore do not have a high score in road network. However, this does not mean that the blending aspect should be low as well to create balance, because a good blend of residences, workers and travellers is also a wanted aspect.

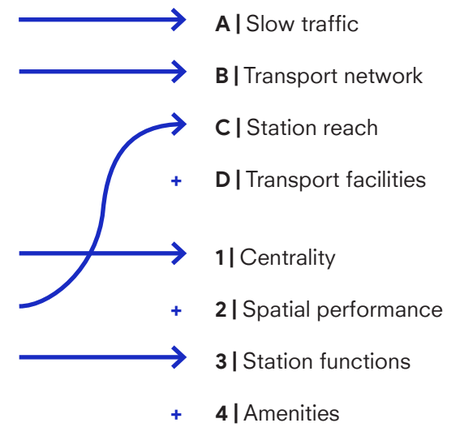
Furthermore, it could be argued that the scale of the building itself is also being undervalued, since the building itself also has properties and characteristics that can help create a place. Therefore, this model might not be useful to grade the different case studies. However, an alternative to the model can be interesting to investigate focussing more on the aspects surrounding public space.

[13] Bertolini
[14] Vereniging DeltaMetropool

ADJUSTED MODEL

3.4.1 Shifting Priorities

As a results of the faults of the butterfly model, this research will use an adjusted model based on the same principles and concept. The basic idea of balancing the node and place will be kept. The new model has been optimised to include aspects important to this research but can, and in the opinion of the author should, be used in other research as well. Details about the changes of the model are visible on the other page.



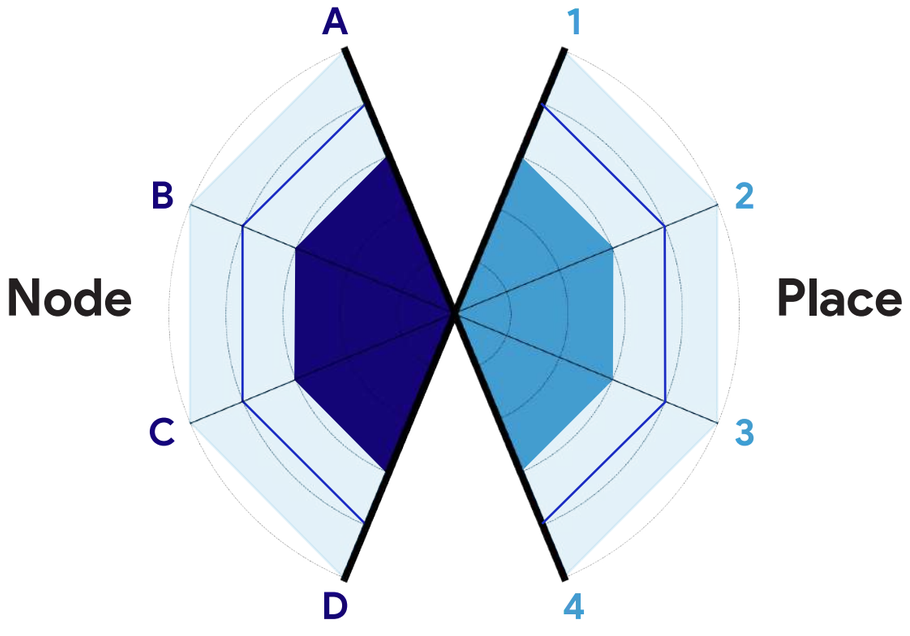


Figure 3.3: Adjusted Model

New Values:

A. Slow Traffic

This category remains the same from the original model. However, the aspects related to storage and service are transferred to another category.

B. Transport Network

This category remained the same of the original model, using the same calculation.

C. Station Reach

This category is similar to the intensity category from the original model. However, that subject focusses mostly on elements relating to the physical performance side of the station and not on creating a place, it is much more suitable for this side of the model. This category therefore focusses on the number and diversity of people living, working of visiting the station area.

D. Transport Facilities

This category includes services related to transport, like parking places and bicycle storages. These aspects help strengthen the node function, which is why these are included on this side of the model.

1. Centrality

This categories is based on the main analysis from the old closeness section. Other parts are relocated to other categories.

2. Performance

This category focusses on the spatial and social performance of the station. This includes things like wayfinding and accessibility. A large part of this section is the level of integration that the station has with the surrounding context.

3. Station Functions

This category focusses on the different functions located in and around the station and how the station is being used. This includes the 'blending' from the original model; analysing which people use the building. This is combined with analysing the balance, quality, and diversity of the functions in and around the station.

4. Amenities

This category has evolved from the old closeness section. It now focusses on the services and quality that the station provides to the area. It will analyse the following elements:

Experience: This element focusses on the experience of the transportation hub itself. This includes architecture, materiality & greenery.

Comfort: Elements that makes staying in or traversing of the transportation hub better, like Climate protection, Toilets, Services (like Wi-Fi) etc.

(social) Safety: Things that let users of the station feel safe, like open façades, clear overview, human scale, and visibility.

3.4.2 New balance

The new aspects are meant to improve the balance from the original model. This results in the following combinations:

A — 1 Both aiming to understand to close slow-moving area around the transport hub

B — 2 This section focusses on the performance of the transport network and station and the link with the area.

C — 3 Focussing on the reach and attraction of the station for the surrounding area.

D — 4 Understanding how much the station has to offer for the users and in what qualities.

Besides this balance, two other features are added to the new model. First off, a line is drawn showing the highest value between the different combinations. This is the line that the aspect should reach to create balance between the node and place aspects. Furthermore, an outline has been added which shows the expectation of the model. This is based beforehand on the size and importance of the transport hub. The goal is to highlight that even if the model is in balance, it can still fall short of what it should be.

While the model improves the aspects in opinions of the author, it is not perfect. Since this research focusses on the aspects related to public space, these values have been given more priority. It is therefore that this model can be considered limiting and partly forced. Furthermore, the higher focus on quality can make the results more subjective. Quality is hard to define and only a few sources try to determine these aspects. Still, it is given an bigger role to put more attention to this subject.

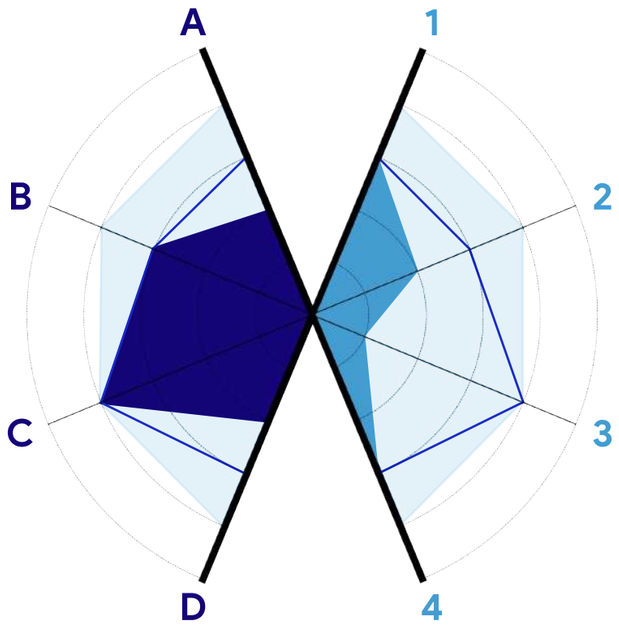


Figure 3.4: Example model

Figure 3.5 (Right): The Parking garage of Brussels-South

THEORY

04

INTRODUCTION

4.1.1 Introduction to the Theory

With the problem and methodology established, the next step is to investigate the problem and find solutions. To setup the framework for the analysis and the design, a theory essay has been written focussing on understanding the problem and related aspects. This essay is meant to be read with the knowledge of the context in mind. Therefore, it is recommended to read the previous chapters before this one.

The essay is a product of a previously made research plan for this research. The information provided in the research plan is already provided in the previous chapters. Nevertheless, the plan has been added in the abstract.

Keywords: Transportation hubs, Train stations, Public space, Integration, diversity, High-Speed rail, Spatial layout.

4.1.2 Abstract

With the introduction of High-Speed Rail, many transportation hubs have been redeveloped to include this transport. However, these stations are often neglecting important aspects related to the quality of the public space and the connection with the surrounding. To improve the quality of the space, the station needs to be adapted in several days. To start, the areas are to monotone and need to be more diverse. Furthermore, the stations are currently not integrated with the surrounded context. Integration can be split up into functional, spatial, visual, and mental integration. However, each of these aspects is currently lacking. All these aspects need to be addressed to prepare the stations for future expansion and transformation.

Theory

RESEARCH ESSAY

4.2.1 Introduction

International travel has taken centre in the recent developments of transportation hubs in Europe. The prestige of and importance of this connection is often enough to encourage stakeholders and owners to redevelop or sometimes completely redesign the transport hubs. However, with this change the experience of the user is not placed central, leading to most of the created space being formulaic and unattractive. To fulfil the functional change from a place of travel to a place to be the design process of a transport hub need to be drastically changed, placing the experience of the traveller as high as the efficiency of the hub itself. Furthermore, the transport hubs should be better integrated in the surrounding context. This essay will therefore focus on the specific problems created with the current method of designing transport hubs and investigates aspects that should help improve the current situation by doing a literature review of existing knowledge with the main goal of understanding what makes a quality "place", which will be combined with case study analysis in the main research to create design interventions.

4.2.2 International vs. Local

Starting off, the current redevelopment of transportation hubs does not attempt to create a better place. The addition of a High-Speed rail connection is a great source of getting more people to use the transportation hub. And following the theory of Bertolini,[15] more interaction can create a better place. However, the current method of designing transportation hubs does the opposite. The addition of a High-speed rail connection can indeed make the transportation hub a better node, but it often brings negative aspects with it that affect to the place side of the hub. While it is proven untrue. As an example, stations with a High-Speed rail connection are often perceived as a station relevant for the whole of Europe, leading to developers having higher expectations on the economic effects.[16] While this has been proven untrue, the stations and hubs are often still seen as special project with national importance.[17] This effect does bring more economic benefits that benefits the place side with brining more non-transport functions.[18] However, the improved accessibility that the international connection brings is often marketed to international offices, often transforming the surrounding area to an international business district. These areas are often experienced as monotonous and dull rather than lively and vibrant, creating the opposite of the desired place for the transport hubs.[19] The High-speed rail will allow this area to have an international connection, but it also brings the international style to the area. It is not that this problem can't be solved, a better selection of functions in the surrounding and a careful masterplan can help prevent it. Which leads to the second point regarding the current redevelopment of transportation hubs: the role of diversity.

Figure 4.1: The Delfse Poort and Rotterdam Central station, an example of international offices being located next to stations with international connections. Source: in de buurt

[15] Bertolini, "Spatial Development Patterns."
[16] Jan Jacob Trip, *Urban Quality in High-Speed Train Station Area Redevelopment: The Cases of Amsterdam Zuidas and Rotterdam Centraal* (Planning Practice and Research, 2008), 20.
[17] Van Acken, "Spatial Impact of Train Stations," 20.
[18] Conceição, "From City Station to Station City," 182.
[19] Trip, "Urban Quality in Train Station Area," 22.

4.3.3 Creating Diversity

To improve the transportation hub as a place it needs to have not only a social diversity but also a functional diversity. Social diversity can help bring people from different age groups, education, and backgrounds together. Often, this is already the case in the travellers that use the transport hub itself. Therefore, there is a big opportunity to create interactions between these different groups, something that is hard to recreate in other areas in the city. This increases with the addition of international rail travel since it also can extend to different nationalities. But the same diversity is also the case for the functions inside and surrounding the hub itself. A wider range of functions like residential between the commercial functions can help make the hub more attractive and generate more social safety which improves the experience of the travellers.[20] A residential function can also be used as a guide for the area, helping define the requirement to make the transportation hub a place to live, and therefore to be.[21]

Diversity requires not only a mixture of residential and economic functions but also a mixture of buildings of various sizes and ages for various types of businesses to prevent economic monoculture.[22] It is also why the international business district and the formulaic addition to shops to stations and transport hubs does not work in creating a place. Furthermore, these functions should also be diverse compared to the functions outside of the station, to prevent competition between each other. If all the functions can be found inside the transport hub, there is no reason to go to the surrounding area and vice versa.[23] To solve this, the functions need to be diverse, and the hub needs to be integrated in its context.

4.3.4 Integration

One of the most important aspects relating to the quality of space is the level of integration. Good integration is crucial to creating a transportation hub that is functioning within its area.[24] Currently, this is often not the case. Transport hubs are large structures, meaning that they exist and differs in its area in ownership, control, scale, and architecture. Together with the large connecting infrastructure to these hubs, it often leads to fragmentation of the area which harms the quality of the space itself. One of the levels of integration is functional integration. As stated before, the integration between the functions inside and outside is crucial to the performance of the area and place itself. The functions need to be diverse, complementary, and not competing between themselves. However, this is only possible if the functions inside and outside can be easily accessed.

Figure 4.2: Southern Side of Brussels-South with a large barrier surrounding the station created by the large road in front of the building. Source: Wikimedia commons

[20] Stefan Christiaan Van der Spek, *Connectors: The Way Beyond Transferring* (Delft University of Technology, 2003), 60.
[21] Seminar / Masterclass Bart Mispelblom Beyer
[22] Trip, "Urban Quality in Train Station Area," 78.
[23] Idem, 85, 86.
[24] Idem, 87.

2.3.5 Accessibility and Spatial Integration

The accessibility and the flow inside a transport hub is a central aspect to the experience of the user and is surprisingly often neglected in the design. Accessibility can be discussed in many forms, but without it a transport hub is nothing. Most of the space inside transportation hubs are a space of accessibility. The flow between the different modes, inside and outside, and surrounding the hubs is important for the functioning of the space as a node and as a place. It is further also crucial to create a place for social interaction, where people can come together. Poor accessibility can also lead to poor economic performance, which is why it is surprising that this aspect can be lacking in current day transport hubs. It was often one of the focus points of the renovation of transportation hubs for High-Speed Rail,[25] however it can still be lacking in these hubs. For example, the introduction of the international terminal to the Brussels-South Railway station reduced the internal walkways inside the station, which furthermore lead to the closing of one of the entrances of the station.

The reason for poor accessibility is often the complicated nature of quality in a transport hub itself. Ideally, the experience and space inside a transportation hub is great, however the transport hub itself is often something that harms the experience. As an example, the hubs are often loud, polluting and containing massive transport infrastructure like rails and roads which create borders in the area that are difficult to cross for pedestrian and cyclists.[26] To improve the experience and accessibility these aspects will have to be removed, leading to the place no longer being a transport hub. Often, the quality of the accessibility of the transport hub is already defined by the placement of the rail tracks. These are the hardest barrier to cross and cause a large chunk of the noise and other pollutions. Stations and transport hubs therefore try to hide the mechanical parts of transport modes from view,[27] sometimes harming other things in progress. Often, stations try to solve the largest problem, the creation of the barrier by the rail, first by moving the tracks above or below the ground. This aspect is the hardest aspect to change in a transport hub since it alters everything about the building. Even then, these solutions will also come with its own challenges, often the lack of daylight to the trains or access routes. Improving the accessibility of a transport hub is therefore a difficult balance between the function as a node and the creation of place.

The same can be said for the flow around a transportation hub. Interruptions to the flow with function like shops can make the hub more attractive[28] but will also impact the experience of not only the people arriving and leaving, but also the people who are transferring inside the hub. The efficiency and easiness of transferring between the different transport nodes is important to the functioning and experience of the transport hub. Transferring also plays a large part of the experience of the journey itself, often two or three times as much compared to the normal journey.[29] Therefore, interrupting this flow can greatly reduce the experience of the traveller which is why it needs to be done carefully and with valid reasons.

Lastly but not least, the quality of the place and accessibility is also determined by the way it is meant to be used by all the different users. Or in other words; How is the transportation hub experienced as someone with bad hearing, or bad eyesight. How is the transport hub experienced for someone who does not speak the language? The design of the space should be inclusive for all the users, otherwise it can still be experienced as a negative space. This should also consider the mobility skills of the different users, which can also influence the experience.[30]

[25] Van Acken, "Spatial Impact of Train Stations," 20
[26] Conceição, "From City Station to Station City," 62.
[27] Trip, "Urban Quality in Train Station Area," 86.
[28] Idem, 56.
[29] Van der Spek, "Connectors: The Way Beyond transferring," 67.
[30] Stephane Tonnelat, *The Sociology of Urban Public Spaces* (Urban Planning Overseas, 2009), 7.

Figure 4.3: The closed entrance at Brussels-South, blocked off with wooden panels

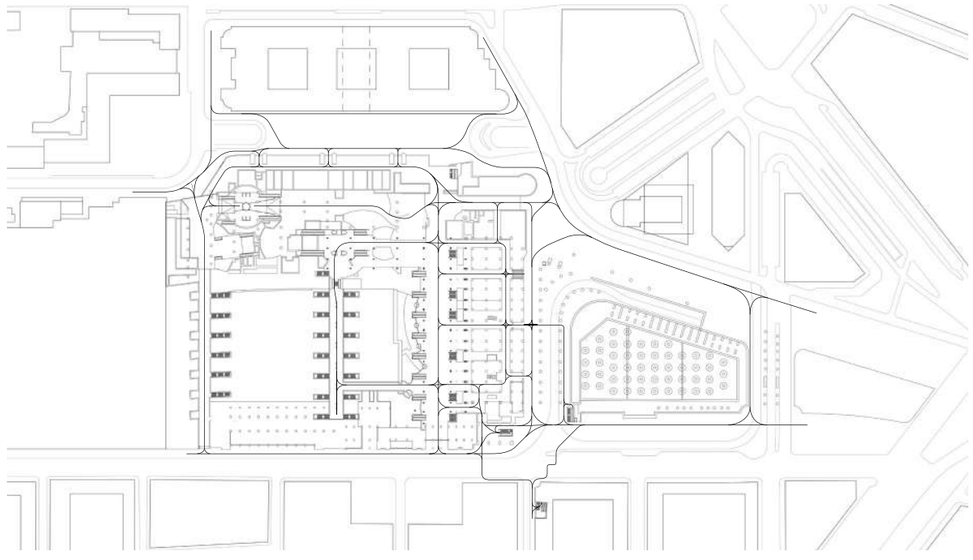


Figure 4.4: Plan of Brussels-South, showing the disconnected walkway and removed entrance

4.3.6 Visual Integration

Another important aspect is the visible integration of the transportation hub and surrounding areas. Visual integration can help improve the quality of the place if spatial integration is not possible. While most hubs try to hide the mechanical aspects of transport hubs, the visual connection would be improved if it would remain visible. A visible train immediately conveys the location of the platform to an unknown traveller. Visual axes can also be used to highlight certain areas to the different users. As an example, guidelines from Bureau Spoorbouwmeester, suggest separating the staying area from the other traffic . While this could help separate the two users, it does lead to more difficulties finding the staying area. It is therefore important that visual connections are used to guide the travellers wishing to use this area to the right location.

Visual connections are also important relating to the entrances of the hub. A clear visual entrance can help navigate the people around the transport hub and help improve the wayfinding. Unlike the other aspects talked about here in this research, there are quite a lot of stations and transportation hubs who can manage to do this fine, but it does lead to another phenomena in station design: The front and back syndrome. This means, the design of through-stations is often unequal. One side is seen as the front side, often highly decorated and articulated, while the other side is seen as the back side of the hub. This effect reduces the effectiveness and attractiveness of the backside of the transport hub and should therefore in most situations be avoided. This problem can be seen as a larger orientation problem with transport hubs, often only focussing on the main central side. To improve the integration the focus should be on more than one side of the hub. This is especially with the visual connections since these can drastically make the building more inviting.

4.3.7 Mental Integration

Lastly, mental integration is also important to the experience of the public space surrounding transportation hubs. Mental integration mostly refers to the mental image a person can create when navigating the hub and the space surrounding it. If they can create a better image in their head, they can better navigate the space inside. Therefore, this is one of the most crucial aspects relating to wayfinding of the hub. But the mental image is also the image people will leave the transport hub with. If this image is positive, it will leave a positive impact to the user traveling the station. This aspect is especially important with new travellers of the city. The image they create is often the first experience that they have with the city. Therefore, the image should reflect the city that the transportation hub is serving.

[31] Bureau Spoorbouwmeester, “Het Stationsconcept.”
[32] Conceição, “From City Station to Station City,” 23.
[33] Rahimi, Alaleh; *Public Space and Outdoor Design*, 3.

4.3.8 Conclusion

To conclude, there are many elements that influence the quality of the place and transport hub. While the addition of High-Speed Rail has caused a series of redevelopment to the current transportation hub, the method of designing the hubs is still flawed. There are many elements that are still being ignored in the current development, that should be tackled to improve the quality of the public space surrounding the transportation hubs. One of these aspects is diversity. Diversity can help stimulate the interaction between the different travellers using this station and improve the quality of the created spaces. This can be improved with better functional, spatial, visual, and mental integration. With better integration, not only the space in the station can be improved, but the whole area and the surrounding buildings as well.

Solving the problem however can be quite difficult if the problem can be called at all. The problems are deeply connected with the design and architecture of the hub itself and the spatial layout. These aspects are often hard to adjust in existing buildings and require major redevelopments. Therefore, it can take a while before these aspects can be adjusted in many of the transport hubs in Europe, since the majority just had a large renovation. This research therefore tries to start the awareness of the existing problems with the current method of designing and would suggest other researchers to continue the research in these problems. Deeper investigation into the problems and other aspects of the transportation hubs are therefore recommended as for research in other types of transportation hubs, including air or boat travel for example. With more knowledge it might be possible to adjust these aspects in the next renovation of the transportation hubs. Or, in the best-case scenario, convince the owners and stakeholders that the problems already warrant a redesign.

Since the problems are deeply baked in the design of the transportation hubs, this research will continue with an comparative case study analysis to investigate the problems in more detail

CASE STUDY SELECTION

05

INTRODUCTION

5.1.1 The List of Cases

As introduced earlier, this research will use case study analysis to understand the spatial aspects of transportation hubs and their influence on experience and functioning of the public space. Using a comparative case study analysis, different stations will be compared in their method of dealing with the public space inside and surrounding the main building. With this study, the aim is to find interventions that are done to improve or harm the quality of space. These interventions can then be investigated further to see why they work and if they might be applicable in other transportation hubs. Since the conclusion of the literature study was that the quality of public space can be subjective, this section of the research tries to understand if there are still elements that work in general.

The selection of cases for this limited case study research is important since the results can be quite influential for the results of this study. Therefore, this research features quite a large selection progress, starting with an investigation of all the possible cases.

As a reminder, this research focusses on intermodal transport hubs in Europe with at least three different types of mobility. Since this still includes many stations in Europe, the case studies are limited to only the largest stations in cities. Often this limits itself to the central and the secondary stations in the city, depending on the size of the city itself.

These selected case studies are combined in a list. This list includes the basic statistics and aspects of the station. The full list is included in the appendix of this report. From this large list, four transport hubs would be selected. This selection would be based on creating a wide representative selection of stations on two selected aspects important for public space. The result would be four stations that each have a unique but representative relation with the selected aspects. Which aspects are chosen will be explained in the next section? Alternative aspects were considered, which are also visible in the appendix.

DIVISION

5.2.1 Determining characteristics

The list of station will be further divided by the different characteristics. These characteristics will be used to create multiple categories of stations that represent the whole range of the different stations. The first characteristics that will be used to divide the list of station is the type of rail station it is. This refers to the continuation and layout of the rail tracks in the station. This results in the list of transport hubs being split into four categories: Terminal Stations, Through Stations, Cross stations, and Mix Stations. While the stations can be split into more specific types, like split stations for example, the current categories are based on the relation with the public space. While the split station has a different rail layout, the location of the platforms and public space is the same as a regular through station and is therefore included in this category. Furthermore, the mixed category are stations that use multiple types for a significant part of the station.

Through Station **Terminal Station** **Cross Station**

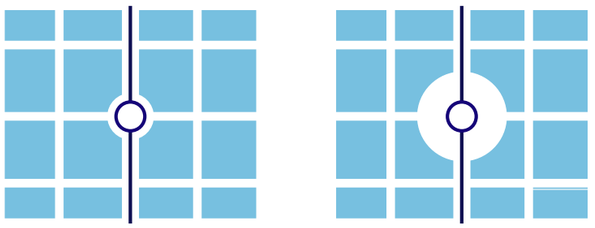
The different types of station will be further divided based on the barriers that are created in the station for the pedestrian traffic inside the station. These barriers differ based on the layout and height of the tracks. Therefore, the list of stations will be divided based on the height of the tracks compared to the ground level surrounding the station. Furthermore, the way people access the platforms from above or below changes the way the space is experienced. Each method of access will bring its own type of barrier and problems for the quality of the space, which is why the list is further split up in the way the platforms are accessed.

Access from Above **Access from Below**

These characteristics of the station and its subdivisions already divide the list into multiple categories and subcategories for further specification. The final selection should represent this whole range of categories.

5.2.2 Surroundings

The categories will be divided by another characteristic of the transportation hubs, based on the surrounding. As stated before, the relation between the public space inside and surrounding the station is important in this research and can have a large influence on the surrounding of the station. Poor accessibility, vacancy, obsolete patrimony, insufficient economic activity, lack of greenery, noise hindrance, and an uncertain real estate market can even affect the space in the station itself.[34] It is therefore that the list is further divided based on the density of the surrounding so that the different densities are represented in the final selection of cases.



Dense surrounding **Open surrounding**

5.2.3 Resulting Comparison Table

In the end, it results in a selection of fourteen categories and subcategories. The table and the filled in transportation hubs are visible in figure 4.2. With only a limited selection of transportation hubs, several categories are empty as can be seen in the figure. Furthermore, some combinations are hidden since no hubs were associated with them. As an example, it is very unlikely to find an underground station being accessed from below, which is why it is missing.

[34] Van Acken, Maarten

CASE STUDY LIST

5.3.1 Selecting the cases

The figure below shows the complete table with the transport hubs filled in. Ideally, from all the different categories a transport hub would be selected to be analysed. However, this research must limit itself to only four cases. Therefore, the selection will be narrowed down further. To reduce the selection and to optimise the selection, only stations that are going through a renovation, have one planned are being selected. This makes it possible to study the original design and the new renovation, which can be helped to understand the problems that the new design tries to solve. Furthermore, it gives the best opportunity to understand the current design methods. Therefore, the selection was narrowed to only these stations. These hubs are highlighted below in figure 5.2.

Type of Station	Terminal Stations	Through Station	
		Straight	
Height Tracks		Above Ground	
Pedestrian Access	Side	Below	Above
Open Surrounding	38. Stuttgart Hbf 51. Helsingin Päärautatieasema 52. Moscow Yaroslavsky	08. Berlin Freidreichstrasse 15. Praterstern 30. Dresden Hbf 34. Berlin Ostbahnhof	32. Hamburg Hbf 41. Chamartín
Closed Surrounding	06. Den Haag Centraal 09. Gare du Nord 10. Gare de l'est 11. Gare Lyon 13. Paris Saint-Lazare 19. Kings Cross 20. Sint Pancrass 23. Victoria 24. Charing Cross 25. Euston 26. Waterloo 27. Paddington 29. München Hbf 31. Frankfurt Hbf 47. Roma Termini 48. Milano Centrale 49. Torino Porta Nuova 50. Venice 56. Gare D'Austerlitz	01. Amsterdam CS 03. Amsterdam Zuid 04. Rotterdam CS 14. Wien Hbf 18. Brussels-South 22. London Bridge 28. Bremen Hbf 37. Hannover Hbf 39. Koln Hbf 40. Nürnberg Hbf	05. Utrecht Centraal 44. Stockholm City

5.3.2 The final Aspect

The final selection will try to cover the whole range of transportation hubs located in the hub. The final aspect that will be used to select the case studies is the position of the station in the network. Earlier in this research it was said that the role and experience of the station is changing due to the introduction of high-speed rail. This can be broadened and investigated further if the selection of case studies includes stations from different levels in the network, i.e. A central station, a supporting station, and regional station for example. This range can help understand what effect the high-speed rail has on the station and if similar changes are also present in other stations. This final factor resulted in the selection of the four case studies.

				Mix
		Cross		
Underground		2 Layers	3 Layers	Terminal + Through
Above		Below	Middle	Side
12. Châtelet-Les Halles 36. Gesundbrunnen station 43. Barcelona – Sants		33. Berlin Ostkreuz 35. Berlin Südkreuz	02. Amsterdam Sloterdijk 07. Berlin Hbf	17. Antwerp Centraal 54. Oslo sentralstasjon
16. Wien Mitte 21. Liverpool Street 44. Stockholm City 46. Bern 53. Moscow Kursky				42. Madrid Atocha 45. Zurich Hbf

Figure 5.1: List of train stations considered in this research

Case Study Selection

CASE SELECTION

5.4.1 The Selection

Below is a brief introduction to the different case studies that have been selected, which aims to introduce the special aspects of these stations. Furthermore it also highlights the reason why it has been selected compared to other stations that would still fit the demands.

Hamburg Hauptbahnhof

1

This station is the busiest station in Germany and the second busiest in Europe. It has a unique relation with the public space and the network. While the tracks are located below the main ground level, the tracks are open to the surface, so it functions more like a normal station instead of an underground station. Due to this situation the station has trouble expanding, leading to a new underground section of the station being created adjacent to the main building.

Bahnhof Berlin Ostkreuz

2

This station was a busy S-Bahn station located to the east of the centre but is currently going through a development that would allow it to receive regional trains. As the name suggest it is a cross-station making it an important interchange station in the network. The station is currently in the final phase of development focussing on the public space surrounding the station. However, numerous budget cuts could have resulted in a lower quality public space.

Gare de Paris-Austerlitz

3

This station is one of the several major terminal stations in Paris. It has recently been expanded and renovated, however there are already more plans to further expand the station to include more of the original building. These changes are done to prepare to take over some services of the TGV Atlantique and Sud-Est from the adjacent Gare de Lyon and Gare Montparnasse. Besides the main rail service it also includes an RER-Station underground that is accessed from below.

Station Brussel-Zuid / Gare de Bruxelles-Midi:

4

This station is one of the three major stations in Brussels, located to the south of the centre. It has been remodelled several times, changing from an terminal station to an elevated station with the introduction of the North-South rail line underneath the centre. It serves as the main international station in Brussels including services from the ICE, Thalys, and TGV. Furthermore, it is served by Eurostar trains, meaning that the station also includes Border Patrol areas.

Figure 5.2: Entrance to the International Terminal of Brussels-South

HAMBURG HAUPTBAHNHOF

06

Hamburg Hauptbahnhof

OVERVIEW

6.1.1 Introduction

Hamburg Hauptbahnhof is the busiest station located in Germany and the second busiest in Europe, only surpassed by Gare de Paris-Nord. With its position located in Germany it is one of the most important interchange points for the German train and ICE network. The station was constructed in 1904 as a substitute of several terminal stations in the area.

The station tracks are located underground but are still open to the surface. The tracks are currently used for the general trains and the S-Bahn running through the city. The station also has connection to the underground subway; however, these are located even lower.

The current station is limited on space since the tracks are located below. It is therefore that part of the S-Bahn platforms is in an extension to the north of the building. These platforms are closed off from the surface and are technically outside the limits of the building. With the expected rise of travellers, it is being considered to add another two platforms to the north, completely moving the S-Bahn services outside of the building. An extension to the current building is being considered to better integrate the new platforms.

Figure 6.1: Proposed plan of Hamburg Hauptbahnhof. Source: Deutsche Bahn

6.1.2 Statistics

18 Rail Tracks
10 Train
4 Metro
4 S-Bahn

4 Floors in Total
3 Having transport modes

196 Million Visitors (Annually)

1906 Origin Station
1906 Build year current station

Figure 6.3: Location of Hamburg in Germany. Source: Wikimedia commons

6.1.3 Current Building

The construction of the current building started on 1904 and the building opened in December 1906. It was designed by architects Heinrich Reinhardt and George Süssenguth. The station consists of one large roof, spanning a length of 73 meters. On either side of the roof there would be an additional smaller roof that would only span above two tracks. Both sides would get a tower next to the entrance highlighting the entrance. The station would be accessed from two pathways above the tracks: the Nordsteg (currently called Wanderhalle) and the smaller Südsteg. After the opening of the station, it has been modified and renovated several times. The two metro stations located underneath the station were constructed later, with the southern station opening in 1912 and the northern section opening in 1968. The extra S-Bahn station was added between 1969 and 1974

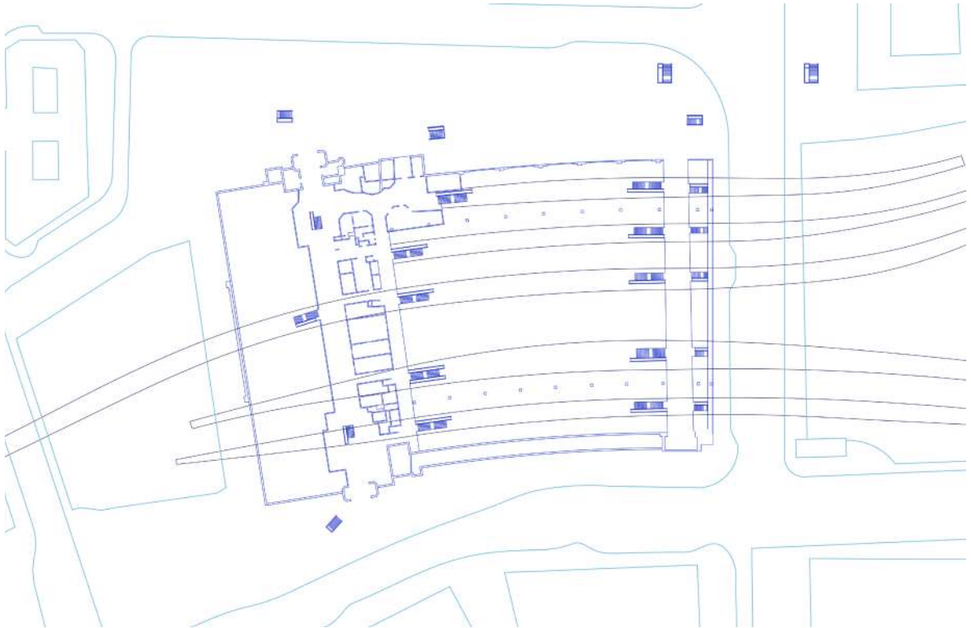


Figure 6.2: Schematic plan of Hamburg Hauptbahnhof

6.1.4 Analytical Model

With the status as busiest station in Germany it can be expected to be one of the major stations, meaning that we can expect a value of 5 in the analytical model. However, as can be seen in the figure to the side, the station does not reach its potential. It mainly falls short on the place side of the model, with the amenities being the shortest one of all. Even though that the model is currently not acceptable, a lot of the issues with the building can be relatively easy be fixed. A large number of problems come from the large commercialisation of the station with advertisement and shops everywhere, making it feel very crowded. This is amplified with the large shops located on the platforms.

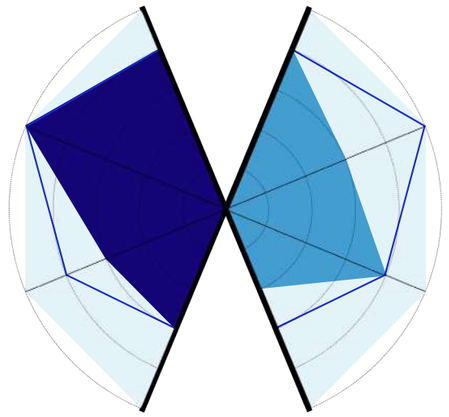


Figure 6.5: Analytical model of Hamburg Hauptbahnhof

6.1.5 Conclusion

Hamburg Hauptbahnhof has a lot of potential. Most of the problems are related to the large crowds that use the station and the small space that the station has to offer. With the large commercialisation of the building the inside of the station feels very crowded with little room to breathe. More effort should be made to creating more places to relax and spend more time without being pressured to buy something. Furthermore, the space surrounding the station is currently quite empty and lacking greenery. It is therefore positive to see that they are planning to address this in the proposed expansion of the building. While I do not expect that the new proposed building will solve all of the problems, it is already a step in a good direction.

Figure 6.4: The current status of the proposal for the expansion of the station. Source: bof architekten

HAMBURG

6.2.1 Functions

The station is located near the edge of the centre of the city. This is visible when looking at the plan of the city, with a lot of public and commercial buildings located to the west of the station. With a more residential part located to the east of the station the area is quite nice in balance between living and shopping. However, it could be argued that the area to the west of the station is a little the monotone, but that is also partly because of the simple definitions of the image.

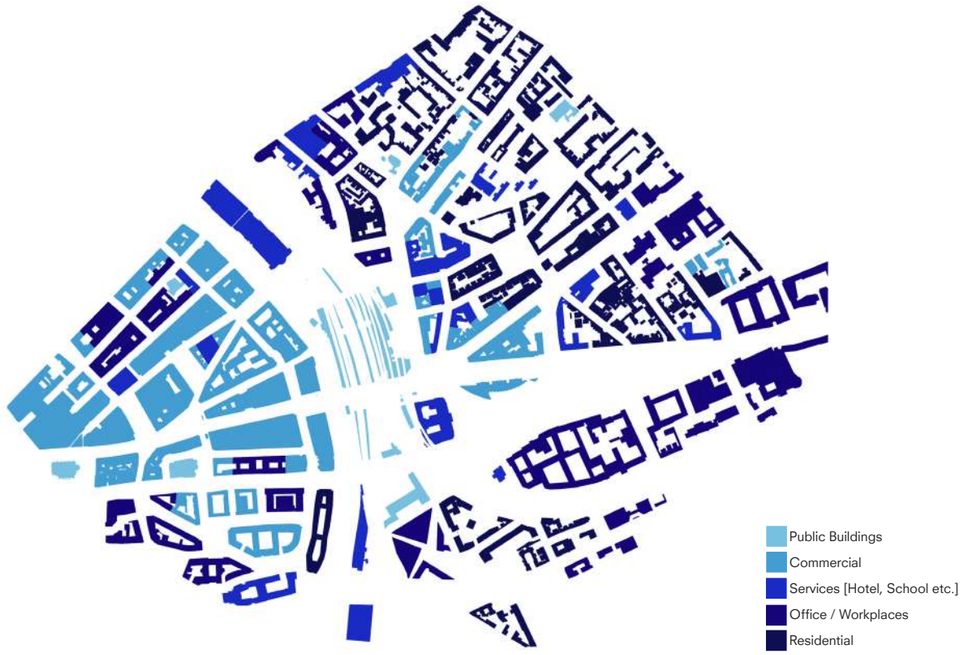


Figure 6.6: Main functions in the surrounding buildings of Hamburg

It is clear from this plan that the tracks of the station are quite a barrier between the areas of the city. Furthermore, there is quite a lot of empty area in the surrounding, mostly being taken up by large road networks. Furthermore, the large lake to the north-west of the area makes the centre have even less buildings. It is therefore good that the station is located mostly underground, otherwise it would have been a large barrier in the city.

6.2.2 Area

With the location being so close to the centre, the surrounding area is quite easily accessible. This is probably a result of the relatively late construction of the station. Since it only was created the early 1900 the designers had the opportunity to adapt more to the existing city. The old locations of the other stations are still visible in the large number of tracks spreading out to the south of the station. Most of the old stations have changed to be rail yards for the new station.

Figure 6.7: Proximity to the station

6.2.3 Conclusion

Hamburg Hauptbahnhof is located on an area with a lot of potential. The area is already quite diverse, and the station has an ideal opportunity to connect with this area. With the rails being a barrier through the area, around the station is one of the best places to cross to the other side. Most of the functions surrounding the stations have commercial functions, which can make it difficult for the station to add a function that is not already in the surrounding. Currently, the station also offers a large commercial walkway that could be competing with the surrounding area and should be made more diverse just in case.

THE STATION BUILDING

6.3.1 Introduction

This section goes more in depth to the basic analysis of the structure of Hamburg Hauptbahnhof. Detailed plans of the station were unavailable, so this plan has been reconstructed based on some available images and plans. Unfortunately, it was impossible to find plans of the underground structures. Therefore, this plan has estimated how the space is situated as much as possible.

6.3.2 Routes

Figure 6.8: Main routes around and through the station

In the figure above the main routes around the station have been identified. The station has two main access routes, the Nördsteg, or Wandelhalle. and Südsteg. The Nördsteg doubles as a commercial place and has only access to the platforms below on one side, except for one platform. This platform has been extended and has perhaps therefore an extra staircase connecting with the extended platform. The Nordsteg also has an additional floor for more commercial functions, accessed from both side of the station with a staircase in the middle of the space. The Südsteg on the other hand is much smaller but has staircases and escalators on both side of the path. Furthermore, this connection has been extended on the west side of the station, offering an connection underneath the adjacent road to provide a better connection with the centre.

6.3.3 3D Space

The exploded view shows the different layers that the station has. All the transport functions are located underneath the general surface, with the metro systems being the lowest. Both the northern and southern metro stations contain tunnel bored stations. The northern section also contains extra two tubes for expansion, but this is not planned now.

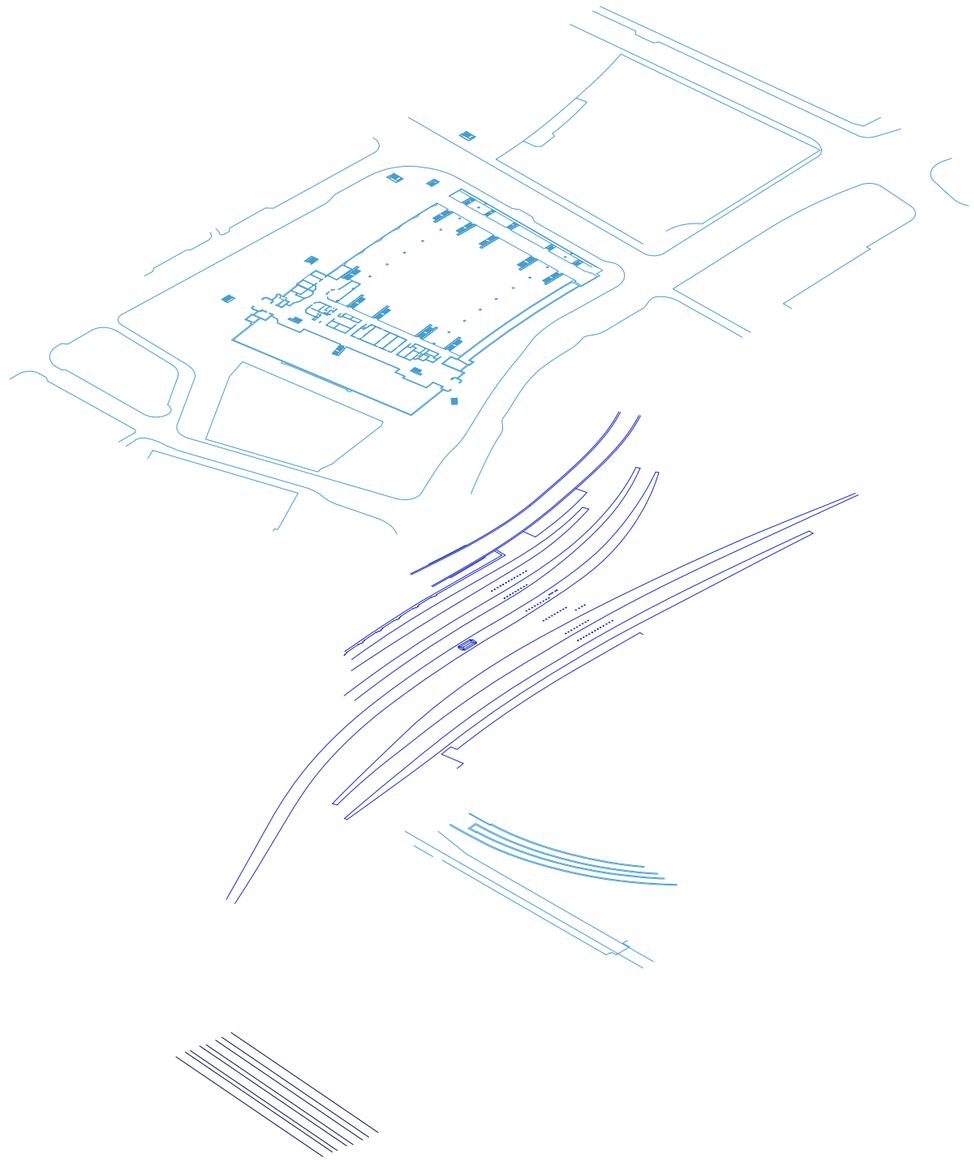


Figure 6.9: 3D axometric view of the station

6.3.4 Functions

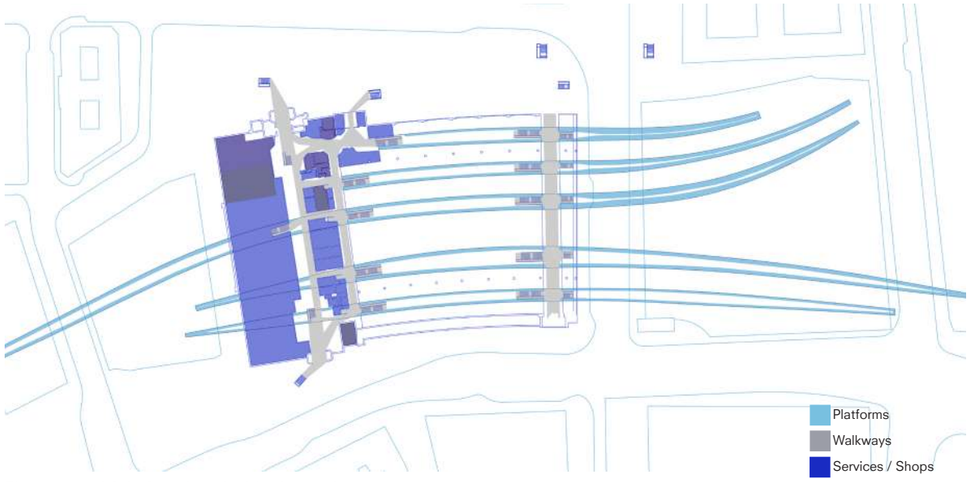


Figure 6.10: Main functions inside the station

As stated before, the clear difference between the two functions of the access routes is visible in the figure above. Besides the commercial functions the northern side of the station also contains the main service desks and other functions of the Deutsche Bahn.

6.3.5 Barriers

Besides the two walkways, there are some other bridges that help cross over the rails without entering the station. However, these are mostly large roads meant mostly for cars.

Pedestrian therefore are more likely to walk through the station, which is possible since the Deutsche Bahn does not use ticket gates at the station.

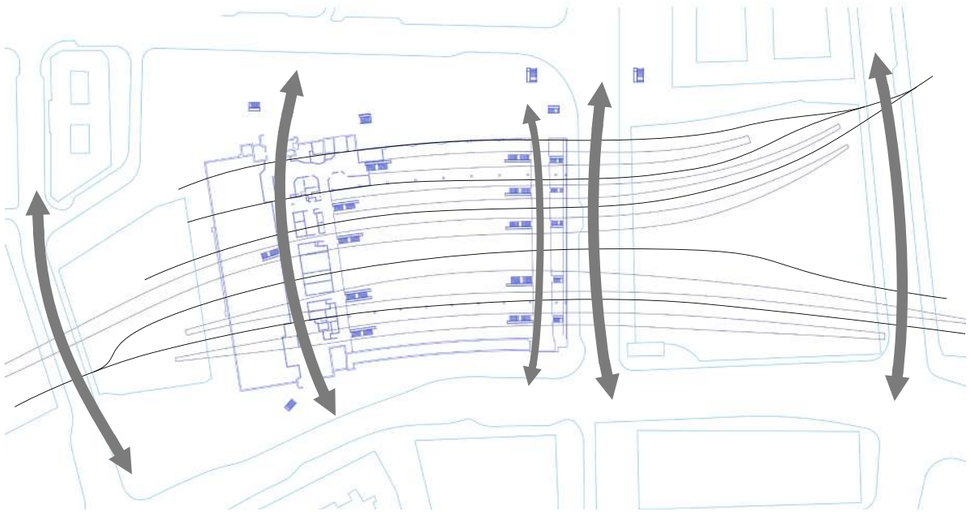


Figure 6.11: Barriers created by the station and the main areas to cross them

6.3.6 Spaces

Besides the main building, the station is much larger and is accessible from more entrances than the obvious ones. The structure of the station is located below and shows the extra spaces that are located underground. This can be summed up as the ticket halls for the metro and the platforms. The only exception is the Passage that connects with the Südsteg. This hallway also connects with a large commercial building that currently hosts the Saturn store, allowing for direct access from the station.

While the station is quite large, the structure is mostly contained around the building. The largest exception is the Southern metro station, which is located far more east than the rest of the station, connecting with the above ground bus station which is in the same eastern corner. This station used to be better connected with the Deichtorplatz underpass. However, this space was often referred to as the public toilet of Hamburg, which shows the reason for why this area was closed.

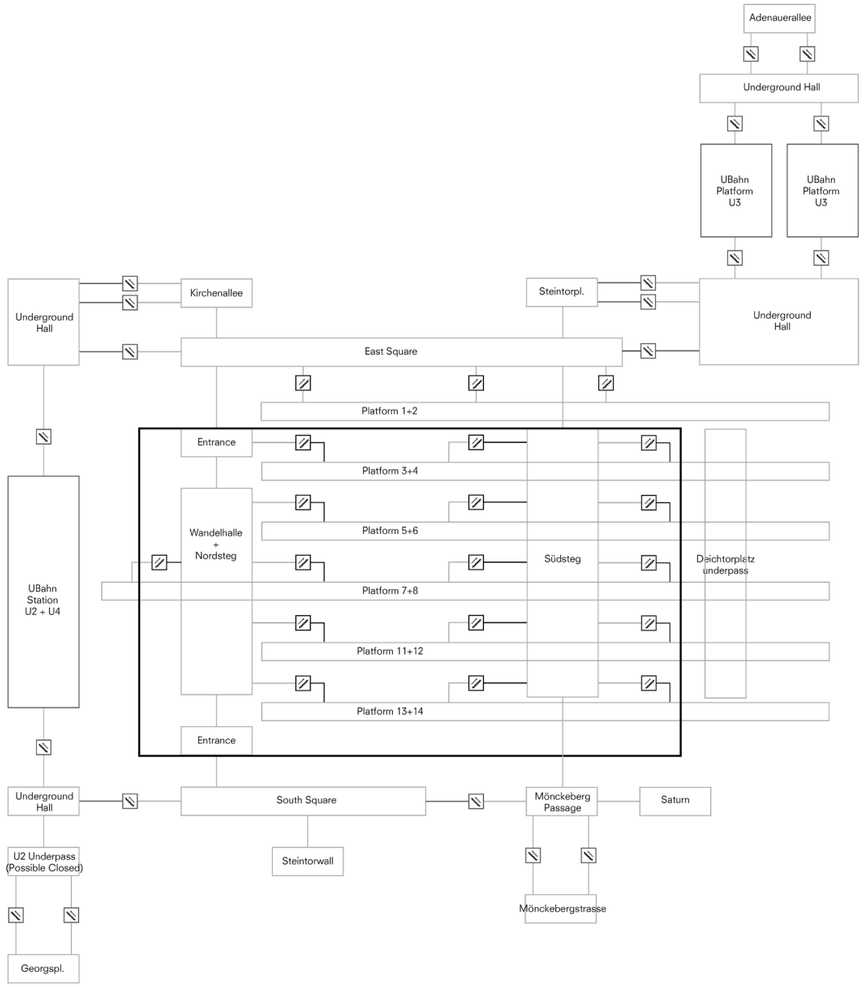


Figure 6.12: Layout of spaces in Hamburg Hauptbahnhof

FUTURE PLANS

6.4.1 Extension to the South

As with all the other case studies, the station is planning to go underneath a large renovation that will change the station drastically. The plans for Hamburg are as of writing this not finalised yet but are expected to involve expanding the station to the south.

This expansion will cover the adjacent street and will host some flexible workspaces and perhaps more. The final functions and design are not yet known, but it shows that they are already working on improving the functions and spaces in the station.

Figure 6.13: Extension of the station to the south with new office spaces. Source: Deutsche Bahn

Figure 6.14: Possible extension of the building to the east with new higher volume. Source: Deutsche Bahn

Figure 6.15: Alternative proposal to the station Source: bof architekten

BERLIN OSTKREUZ

07

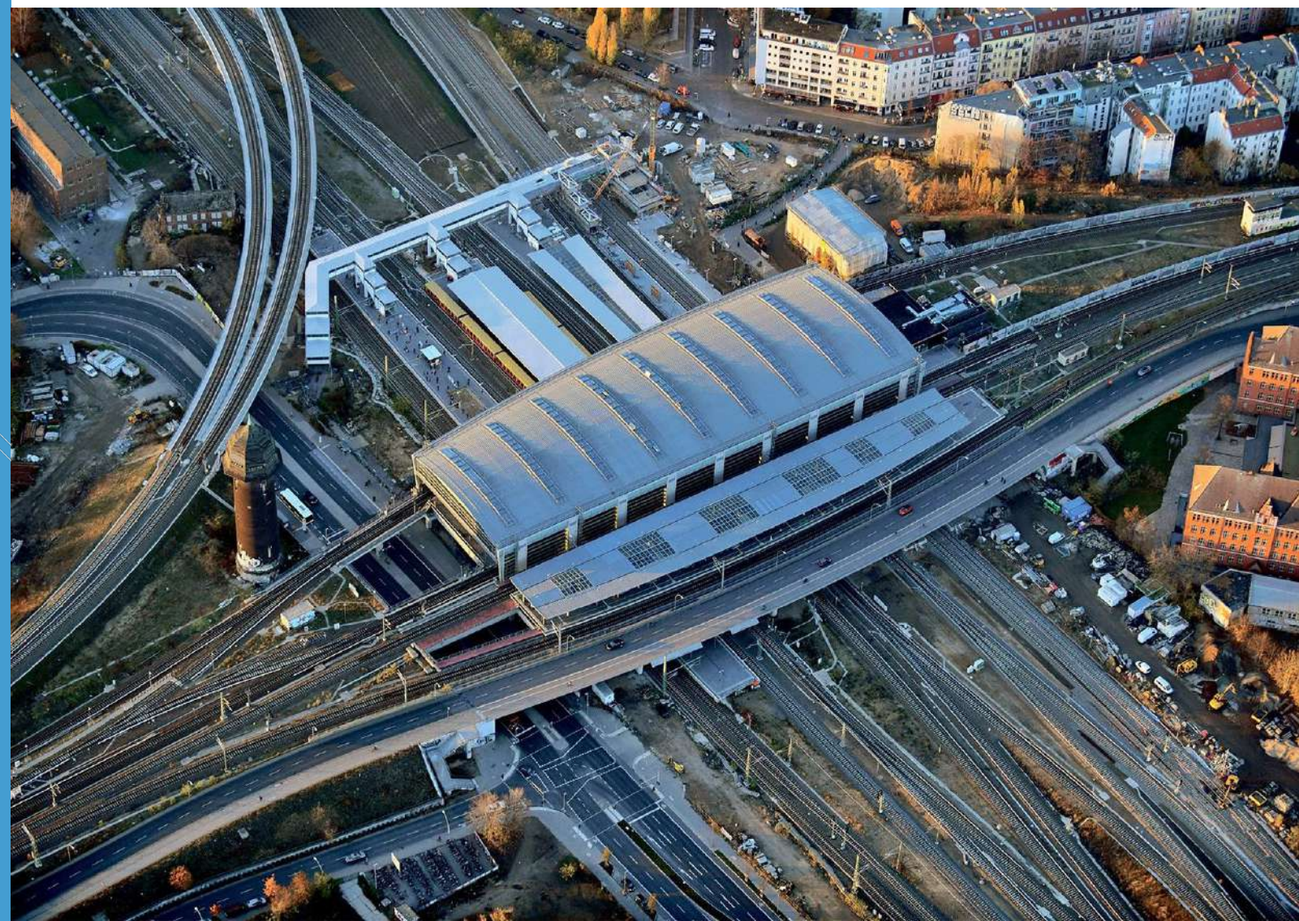
Berlin Ostkreuz

OVERVIEW

7.1.1 Interchange Station

Bahnhof Berlin Ostkreuz is one of four cross stations in Berlin. It is as the name suggest located in the east and it mainly serves it purpose as an interchange station between different S-Bahn lines. While it is not directly in the centre of the city, it is still one of the busiest stations in Berlin. The station has recently been modernised and modified to also allow regional trains to stop at the station, which could make the station even more important in the network. This remodel brought new platforms, buildings, shops and stops to the building, to make it function better and offer more services. Most of this work has already been completed, with the main building being finished in 2018. The surrounding area and the new tram stop however are still under construction.

Figure 7.1: Current state of Berlin Ostkreuz. Source: Wikimedia commons



7.1.2 Statistics

7 Rail Tracks
7 Train
6 S-Bahn
2 Tram (Planned)

2 Floors in Total
2 Having transport modes

91.3 Million Visitors (Annually)

1882 Origin Station
2018 Build year current station

Figure 7.3: Location of Berlin in Germany. Source: Wikimedia commons

7.1.3 Current Building

The current station can be divided into two parts, the lower and upper platforms. The upper section consists of four tracks with two platforms and the lower section of seven tracks and five platforms. While all the platforms have been upgraded, the new building is only placed on the upper layer, serving simultaneously as an access route to all platforms. Due to budget cuts, only part of the upper level got a fully enclosed building spanning the whole platform and tracks, while the other only got a regular roof. The enclosed building would be filled in with several little shops and service desks between the two tracks.

Figure 7.2: Schematic plan of Berlin Ostkreuz

Berlin Ostkreuz

7.1.4 Analytical Model

As Berlin Ostkreuz is only a regional station, the expectation for the station is lower. However, due to the large amount of traffic using the station, higher expectations can also be considered. For this research, we expect a rating of three. This is because the station is still mostly a regional station and not a national station.

The station is just like the others not in balance. Unlike the others, the place side is here stronger than the node side. This is related to the recent renovation that the station has had. The model even has a score that is higher than expected. The only side that is down from expectation is the amenities, since the station is still very lacking in extra furniture besides a plain roof. This could be related to the budget cuts that the station would have had.

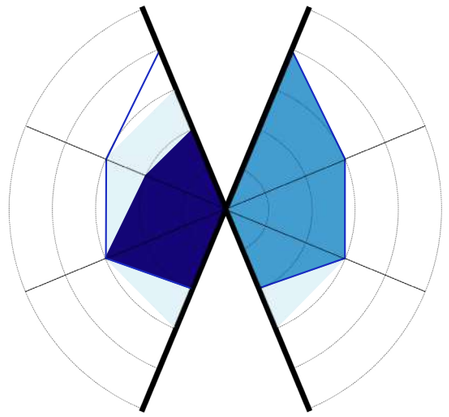


Figure 7.5: Analytical model of Ostkreuz

7.1.5 Conclusion

Ostkreuz is a station that has been improved massively in the last renovation. But still, it is a station that has a lot more potential. The station could be the central location for the four adjacent areas and create a place where they can come together. With more functions besides the simple food stalls and service desks and more places to just hang out the station can be the centre in the area, while it is now just a very busy transport node.

Figure 7.4: The lower platforms and the main central upper area. Source: Wikimedia commons

Berlin Ostkreuz

BERLIN

7.2.1 Function

The location of Berlin Ostkreuz is located some distance from the main centre of berlin. It is therefore that the station is in a more residential area of the city, visible in the figure below. At the north side of the station is a residential area. Along the main routes to the station there are some little commercial shops that try to benefit from the large crowd that walks through the streets. On the southern side is an industrial area, mainly having small companies and workspaces. The area around the station is quite spacious without functions. The area is currently mostly barren, but there are already studies looking into redeveloping the land to add more residential functions.

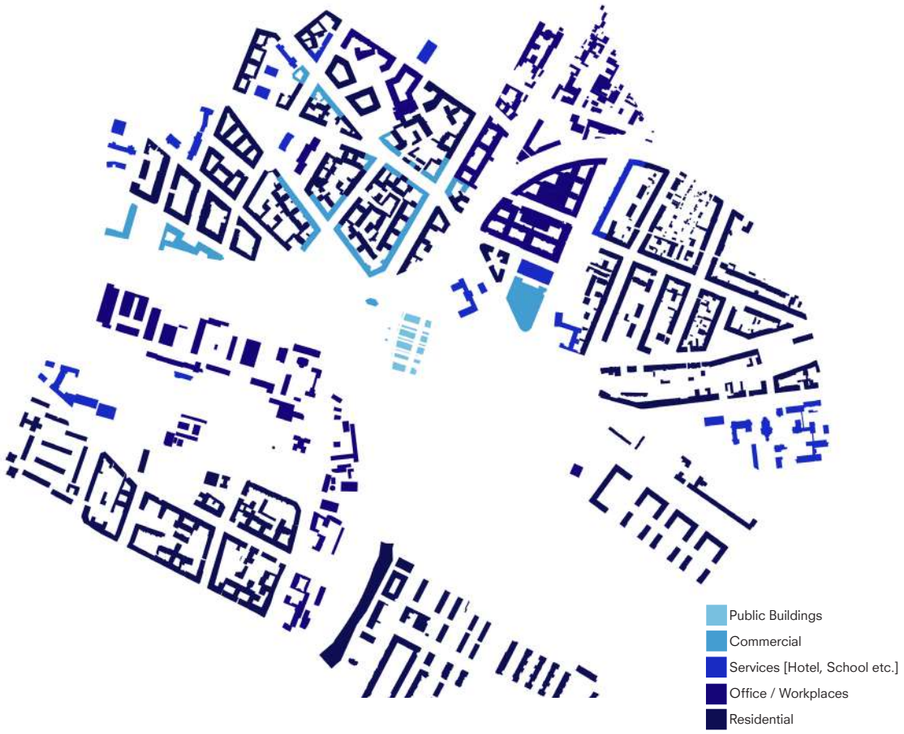


Figure 7.6: Main functions in the surrounding buildings of Ostkreuz

In the area there are few large public buildings, as is expected an outside region of a large city. This does mean that the station is one of the main public areas where people can come together in this region, however the station does not have a nice area to provide this function. This is quite a shame since it is centrally located between the different areas and could have played a key role in the area.

7.2.2 Area

With the large number of travellers, it is expected that the station serves quite a large area. And this is reflected in the image below. The surrounding area mostly consists of smaller residential buildings, creating a low-rise but high-density area. These potential people will have to travel to the station, so the existing tram routes and the planned new tram stop next to the station will help the station reach a larger amount of people. The area is further largely dominated by the larger infrastructure network. Besides the station itself the area has several train lines going through the area, dividing the area in smaller neighbourhoods.

Figure 7.7: Proximity to the station

7.2.3 Conclusion

The station is situated in a High-density area and should make optimal use of this. As it is one of the best places to cross the large infrastructural barriers in the city and it being one of the only public buildings in the area it should be a central place that would connect the areas together. Furthermore, with the expectation of another high-density residential area to the south-east it should provide enough functions to act as a central hub.

THE STATION BUILDING

7.3.1 Introduction

This section goes more in depth to the basic analysis of the structure of Bahnhof Berlin Ostkreuz. Detailed plans of the station were unavailable, so this plan has been reconstructed based on some available images and plans. Since the surrounding area of the station is still being designed, it was impossible to create a plan based on that situation. Therefore, the existing situation is used, including most (temporary) paths connecting the station.

7.3.2 Routes

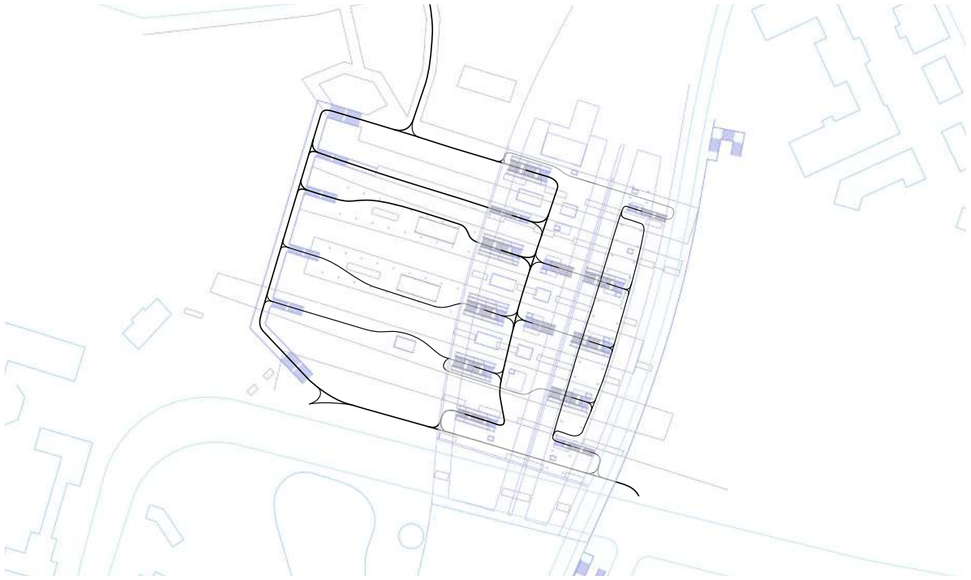


Figure 7.8: Main routes around and through the station

The station consists as stated earlier about an upper level and a lower level. The lower level is mainly used for platforms, while the upper level also is used as the main crossing between the platforms and the two sides. Besides the main crossing, there is also a walkway that serves the same purpose on the west side of this station. This walkway is however nothing more than a walkway and seems more temporary than fixed. However, there are currently no plans to change this walkway into something more definitive.

The upper level mostly consists of two parts. One central part that is fully enclosed and another section that is just an open platform. While both can be used for crossing to the other side, it is easier to cross in the main hall. The upper areas are not connected, which means that people transferring will have to use the platforms below. This makes the building more efficient, but it does mean that travellers use the platforms as walkways.

7.3.3 3D Space

The two areas of the station can be best seen in the image below, where the upper and lower level are highly visible. As the station does not have any underground platforms, the structure of the station is quite efficient. Often, spaces have multiple functions making the building smaller and feel livelier.

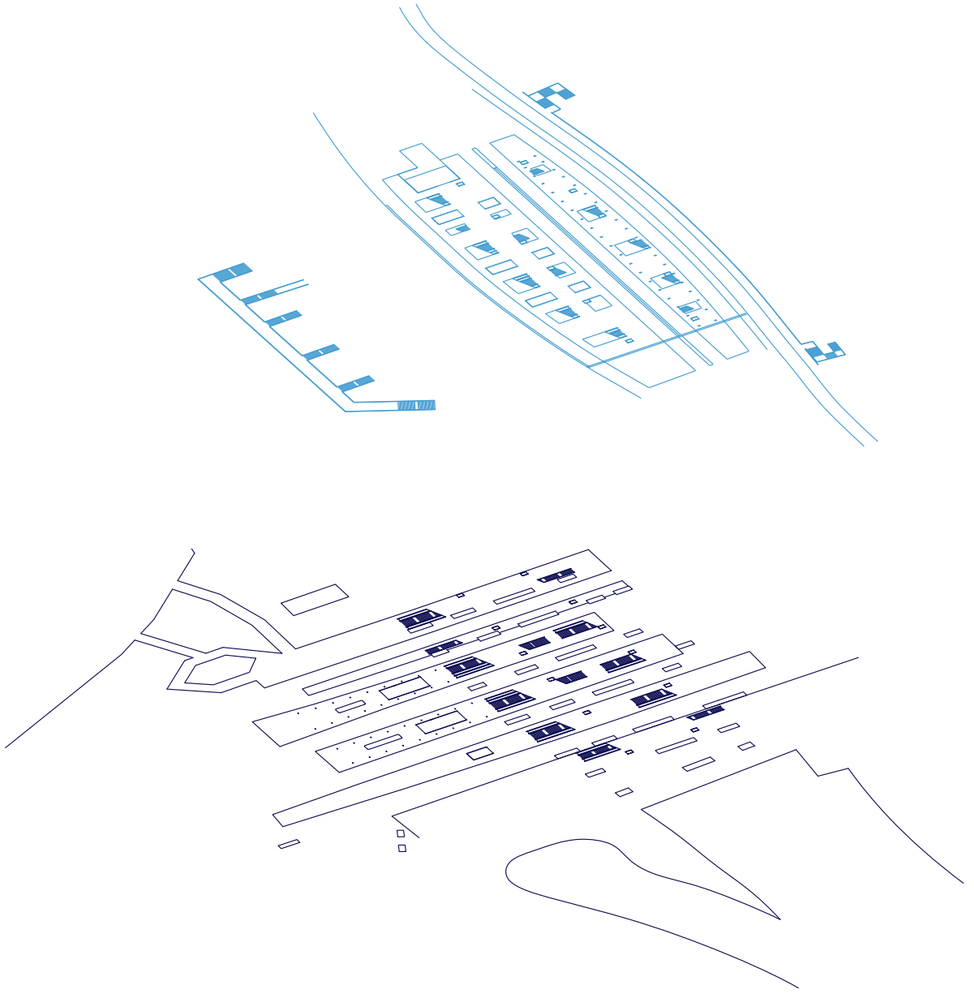


Figure 7.9: 3D axometric view of the station

Functions

7.3.4 Functions

Figure 7.10: Main functions inside the station

As stated before, the station is mostly a regional station. Therefore, there is not a large space with commercial shops and facilities in the station. These functions are placed on the platforms, in small buildings located along the main walkways in the main upper area or in the middle on the lower platforms. At the end of the main upper area there is a larger building with besides technical installations also has a McDonalds.

While the number of functions in the station is quite good for a regional station, it is however very monotone. Either it is a service desk, or it is a restaurant of one of the main commercial food brands like McDonalds. Since the station can become a central place for the four surrounding areas, it should offer more than just the basic food and service options.

7.3.5 Barriers

With the location of the station, it is important that the people can easily cross from one side to the other in the station. The two levels of railway infrastructure form quite the barrier, but the station does allow the people to walk through the building to cross to the other side. Besides the station, there is also a road located to the east of the station with staircases to the lower level, giving an option to cross to the other side without entering the station. This walkway also crosses the street on the south side, which the station itself does not do. While the station gives plenty of opportunities to cross the station, the quality of them can be improved. As a start, the walkway on the west side of the station is as stated before mostly a temporary structure. If this walkway is improved including greenery and more of a place to stay this station would already be a lot better.

Barriers

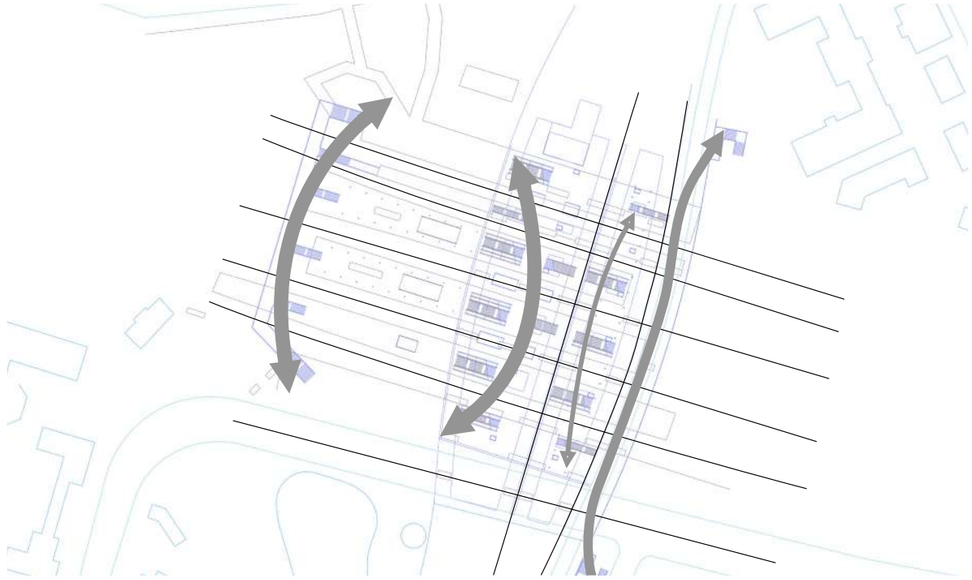


Figure 7.11: Barriers created by the infrastructure and the main areas to cross them

7.3.6 Covered Area

The station uses the platforms below as a walkway between the two upper sections. On its own, this is not a problem. However, the platforms created below are standard size, meaning that there is not much space available to change between the different areas. Furthermore, the structure of the two upper levels consists of quite large concreate columns. Together with the floor above, the area underneath the upper level can be experienced as dark and claustrophobic. The stairs and elevators could make it feel even more crammed than it already is. So, while it is a efficient method to use this space also as a walkway, other options would maybe be more preferable if they would have created a better space.

Figure 7.12: The structure and covered area created by the upper section of the station

7.3.7 Spatial Structure

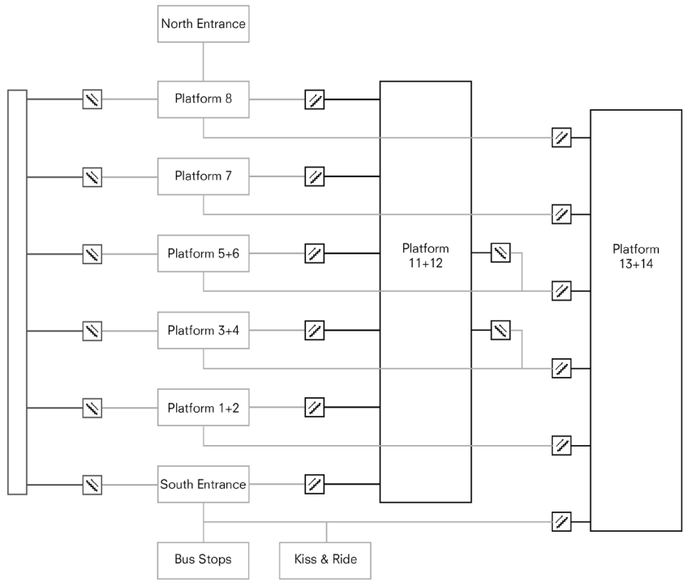


Figure 7.13: Spatial structure of the station

The spatial structure of the station is quite simple. There are no spaces underground which complicates the structure. The only aspect what is not straight forward is the lack of consistency in the extra platform connections. Platforms 3-4 and 5-6 are for the S-Bahn and are therefore more frequent. This could explain the reason why only these two platforms got an extra connection with platform 11-12, perhaps to improve the ability to change between S-Bahn lines.

FUTURE PLANS

7.4.1 Past and Future

As stated before, the station has in 2018 opened a new building, part of a plan that was in the works for a very long time. The new station improves the area in quite a large way, as shown by the image of the old platforms below. However, the surrounding area is still in design / construction. The basic principles of what this area is supposed to be is shown here below. However, since this concept is from 2013 there is a large chance that the execution will be different.

Figure 7.14: The old platforms. Source: Wikimedia commons

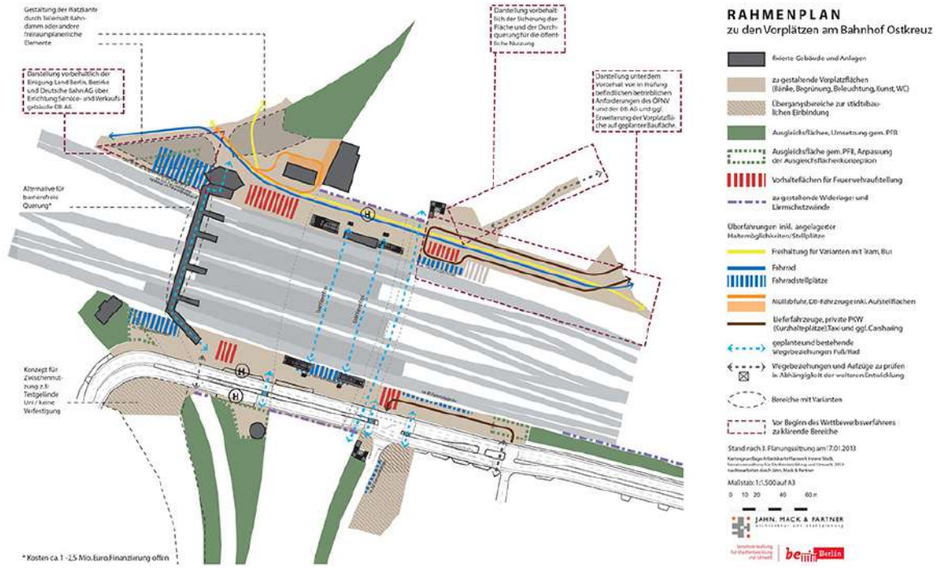


Figure 7.15: The concept for the surrounding area in 2013. Source: Jahn, Mack & Partner

GARE DE PARIS - AUSTERLITZ

GARE D'AUSTERLITZ

08

Gare D'Austerlitz

OVERVIEW

8.1.1 One of Six

Austerlitz Station in Paris is one of the six major terminal stations in Paris. The twenty-one million visitors in a year are not a lot compared to the passenger numbers of Gare du north, but it still serves as an important station within the network. The station is currently going underneath a massive overhaul, giving more space to other functions, and expending the number of platforms. With this change the station is supposed to take over some of the TGV services currently servicing Gare de Lyon and Gare Montparnasse, to help balance the load of these stations since they are already at full capacity. Gare d'Austerlitz is currently not at capacity. Together with four extra platforms the station is expected to double the number of lines connecting to this station.

The station is located to the southeast of the city, closely located to Gare de Lyon. It can therefore often be overshadowed, however it has still a crucial position in the network of transportation in Paris, having connections with the RER and the Metro network.

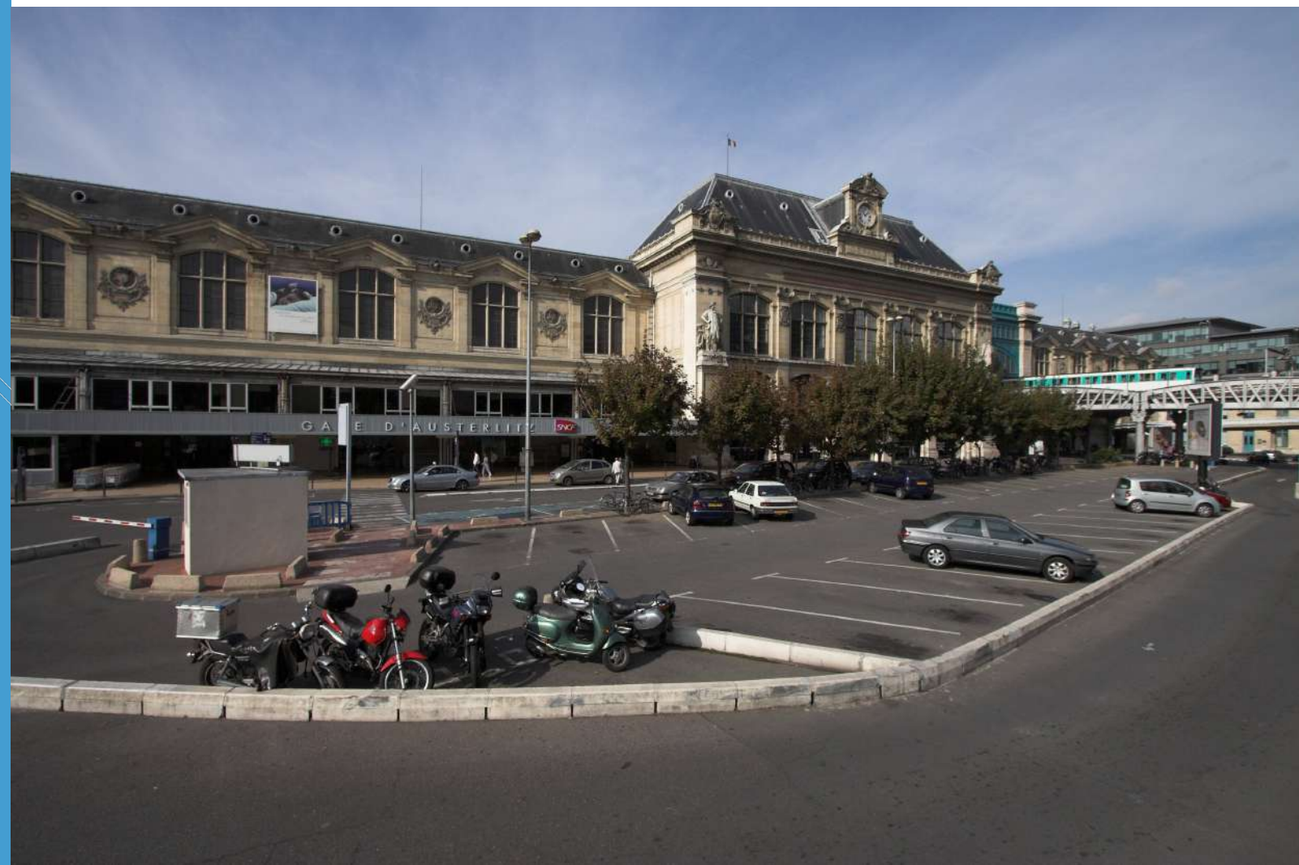


Figure 8.1: The main entrance of Paris Austerlitz. Source: Wikimedia commons

8.1.2 Statistics

29 Rail Tracks
21 Train
4 RER
4 Metro

3 Floors in Total
3 Having transport modes

21.68 Million Visitors (Annually)

1843 Origin Station
1869 Build year current station

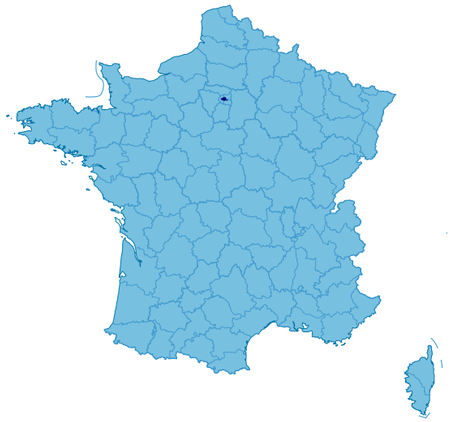


Figure 8.3: Location of Paris in France

8.1.3 Current Building

The station originated as the Gare d'Orleans station, located near the current location of the station. The station would change to its current place between 1862 and 1869, giving the station a new building with a large hall spanning 51.25 meters. The current station remains in the building that is now seen as a historical landmark. However, much of the original space inside the building is currently closed off for pedestrians. The space is currently used for parking and the RER line. This will be changed with the planned renovation in the future.

Besides the main train hall, the station also has a RER station located underneath the existing tracks. This underground station is accessed from below and connected with the underground metro station for line 10. The station also has a connection with metro line 5 that goes perpendicular through the building on the first floor.

The current building already has an extension made to the north side of the building, creating four new platforms located underneath a street and building as seen below.

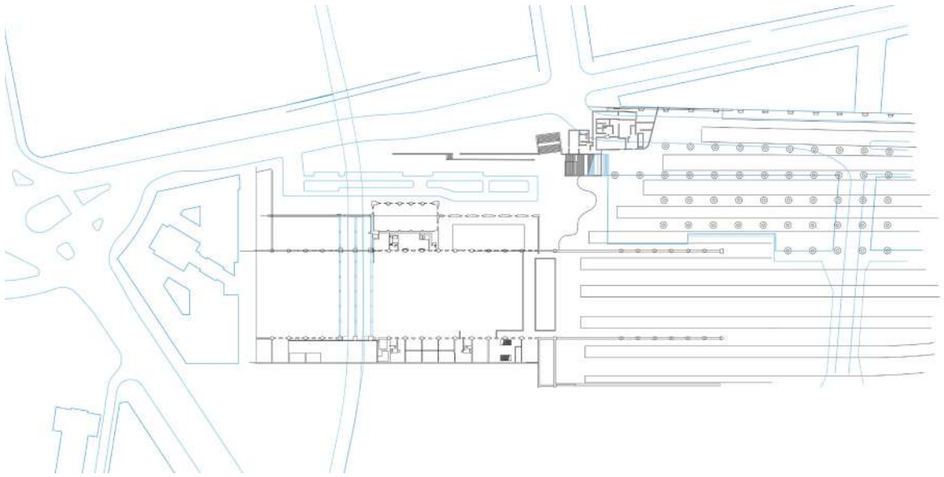


Figure 8.2: Schematic plan of the ground floor of Gare d'Austerlitz

Gare D'Austerlitz

8.1.4 Analytical Model

While the number of lines can be expected to double, the station will then still be one of the smaller terminal stations in Paris. Therefore, the analytical model goes with an expectation value of four. Still, it can be difficult to expect how the station will be operating in the future, which is why the current situation is considered. Even then, the station is well underway to reaching the expected value. The place side of the model is currently still quite lacking; however, this will be addressed in the planned renovation. For now, the quality of the space is not great due to the many building sites around the station. For the model, these sites have been ignored to estimate the value which the space would have had without the construction spaces.

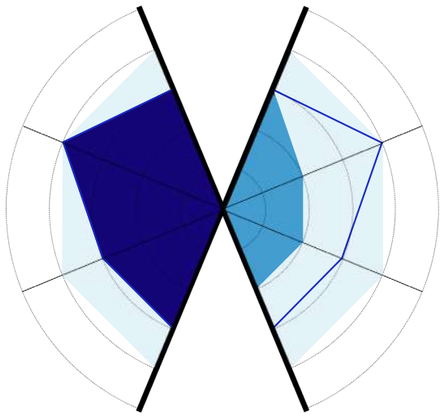


Figure 8.5: Analytical model of Gare d'Austerlitz

8.1.5 Conclusion

Gare d'Austerlitz is a station that has just like the other case studies lots of potential. Its location is good, it has a good connection on the transport network, and it has a diverse surrounding. Even then, the space is currently not used optimally, since more than halve of the building is currently closed off from the public. However, the plans that are currently in development do show a lot of promise in addressing the shortcomings of this station, addressing the most critical issues, and adding more functions to the station. Only time will tell if these plans will be realised.

Figure 8.4 An proposal to create an green area surrounding the station. Source: parisinsidersguide.com

Gare D'Austerlitz
PARIS

8.2.1 Function

The station is situated in quite a unique area. Adjacent to the north of the station is a botanic garden from the 17th century. Furthermore, located to the west of the station is the Hôpital de la Salpêtrière, one of the most important centre for psychiatric and neurologic sciences in Europe. Together with the seine to the west, the station is in quite the public area. The rest of the space is mostly filled with residential to the north west and offices to the south, making the total area quite diverse. This diversity can be a great benefit for the station. However, for a more ideal scenario the different areas would be more mixed, instead of the clear division that is currently visible.

With the diverse functions in the surrounding, it can be difficult to create a unique space for the station itself to offer to this area. A potential idea would be to create a public space sheltered from the rain, something for which the unused space underneath the large roof can be used for.

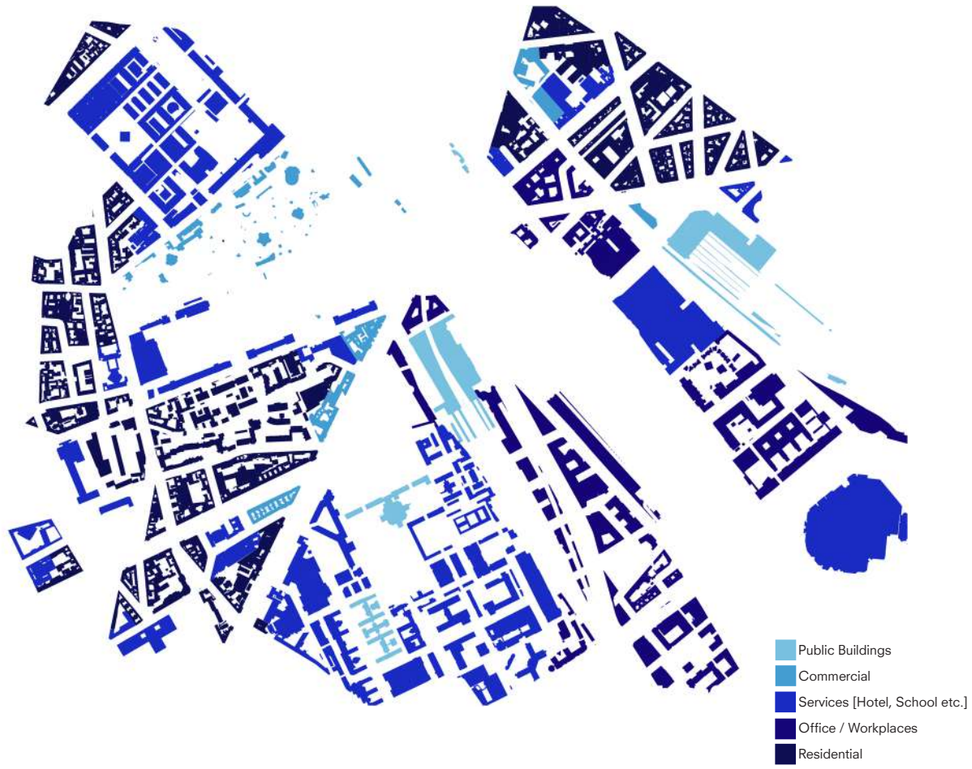


Figure 8.6: Main Functions surrounding the station

8.2.2 Area

The station is situated near the seine, located on the opposite side of Gare de Lyon. This river harms the connectivity of the station with the other side, which the metro system does help massively. This is however one of the only barriers in the area since the tracks terminate at the station. It is therefore that the station still has a good connectivity with the surrounding area.

The main area surrounding the station is similar as many other areas in Paris, a mostly low-rise high-density area. It is therefore that the station has a lot of potential travellers in the area. With the hospital located adjacent and the botanical garden it is quite surprising that the station only has twenty-one million visitors. The proximity of Gare de Lyon harms the position of the station perhaps more than initially assumed.

Figure 8.7: Proximity to the station

8.2.3 Conclusion

The station is surrounded in a nice diverse area with lots of potential functions that can be related to the station. The effectiveness of the station is however harmed by the location of Gare de Lyon close by, which is the main station for connections to the southeast of France. It is therefore a good move that the city has decided that the two stations need to work better together, with Gare d'Austerlitz planned to play a bigger supporting role after the planned expansion.

Gare D'Austerlitz

THE STATION BUILDING

8.3.1 Introduction analysis

This section goes more in depth to the basic analysis of the structure of Gare de Paris-Austerlitz. Detailed plans of the station were unavailable, so this plan has been reconstructed based on some available images and plans. For the main building only plans of the new situation were available. The analysis is based on the current station, and therefore an estimation was made to the space inside based on pictures. While the plan is therefore not 100 % accurate, it can be used for the basic analysis that is being done here.

8.3.2 Routes

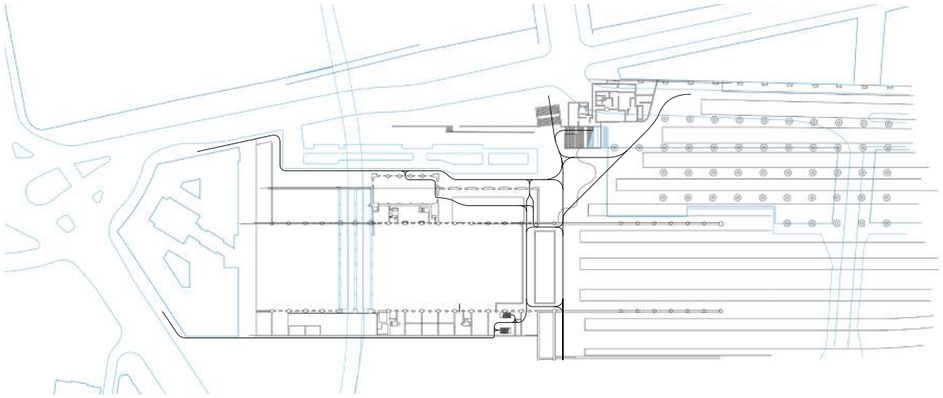


Figure 8.8: Main routes through the station

The main routes in the station are quite complex. While the ground floor is quite simple with a straight connection at the end of the platforms and some side buildings, the situation underground is harder to understand. The RER station is located directly underneath the platforms but has no direct connection with the platforms above.

The underground station is accessed from below, which means that the route to this station is quite complicated. Furthermore, the underground metro station is located to the north of the station, meaning that an underground walkway is traversed for people who travel between these two stations.

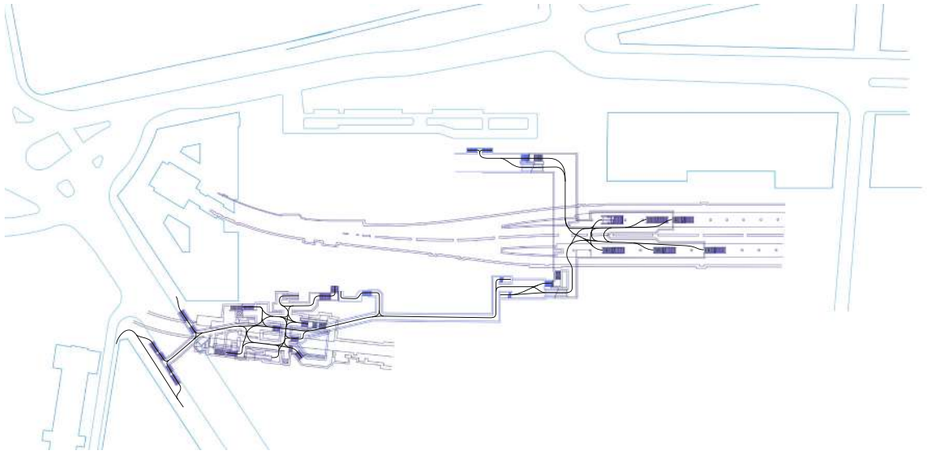


Figure 8.9: Main routes underground

8.3.3 3D Space

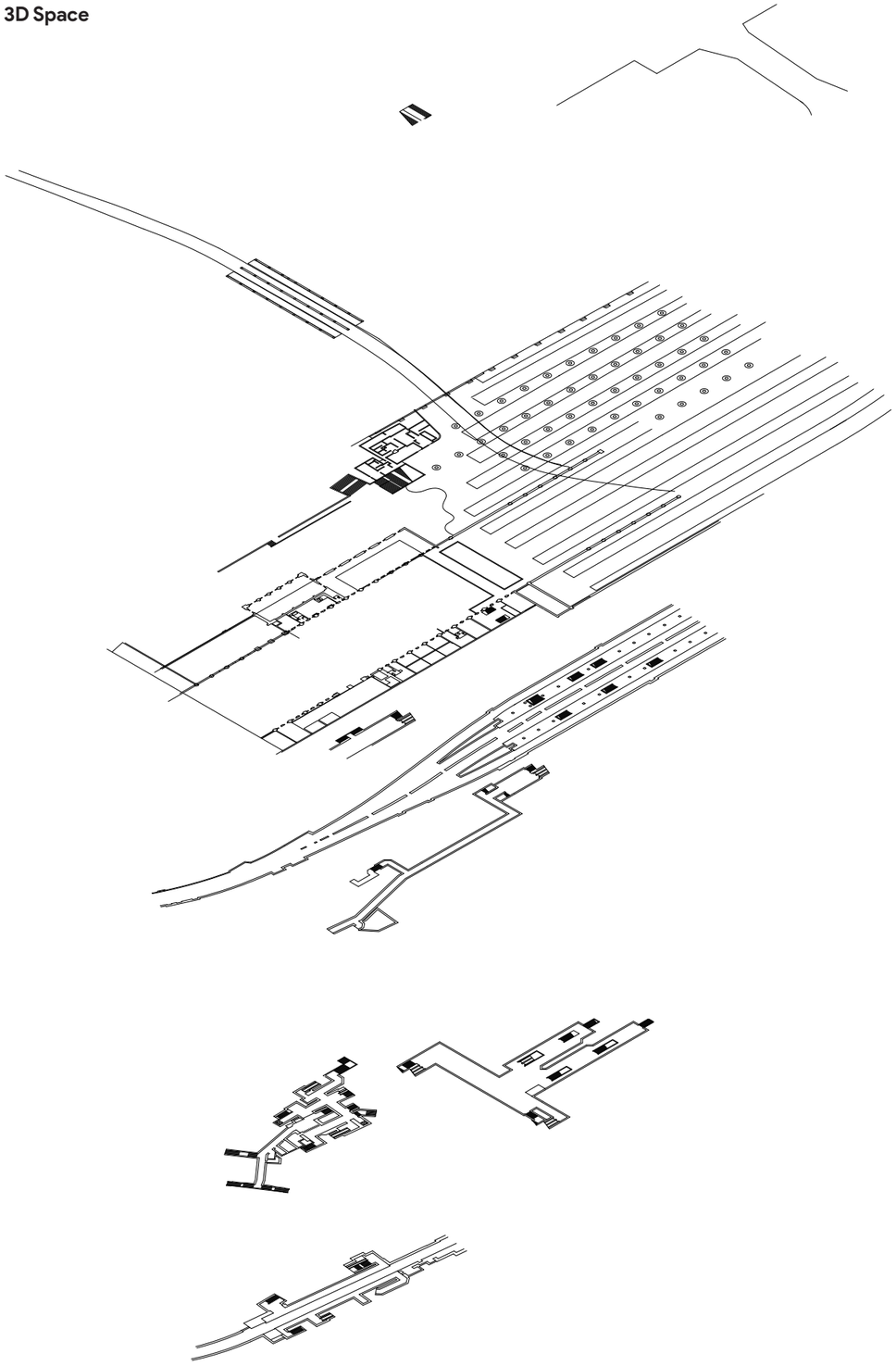


Figure 8.10: 3D exploded view

Figure 8.10 on the previous page shows the complicated structure of the station, covering in total four levels, with some of them intersecting. This exploded view highlights the complicated access method for the RER station and the complexity of the underground metro system, which itself also consists of two levels. Besides the main walkway, the metro station also has its own connection with the ground above. Furthermore, it also shows the position of the upper metro station, located almost separate from all the other transport modes.

8.3.4 Functions

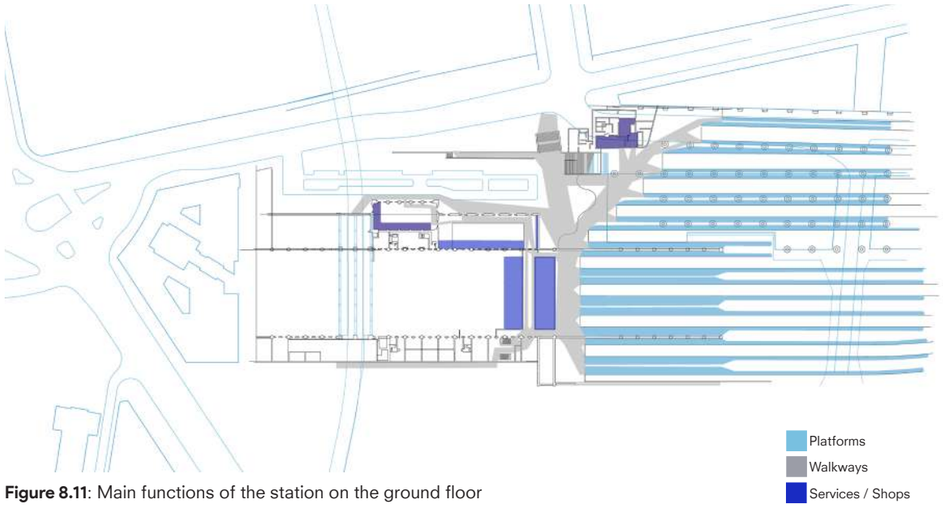


Figure 8.11: Main functions of the station on the ground floor

The station is separated in transport functions and other functions. The platforms are located to the southeast, while the shops and services are in the main building on the top side of the station. The main access routes however do not interact with these shops, instead going directly outside and skipping most functions. Creating a clear separation of the two sides.

Underground the space is mostly used for movement, except for two spaces at the RER ticket hall. These have little information services and some small shops for the fast traveller. The metro station on the other side has no additional functions besides the placed ticket machines. The connection between the two underground section is also barren, filled only with a large amount of advertisement banners on the walls.

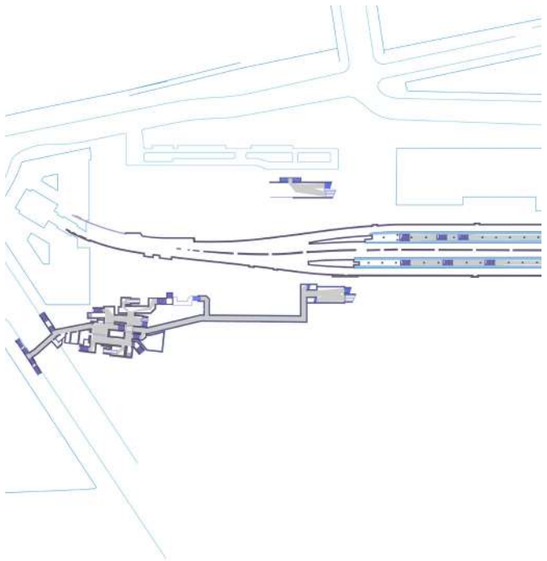


Figure 8.12: Main functions of the station underground

8.3.5 Barriers and Covered Space

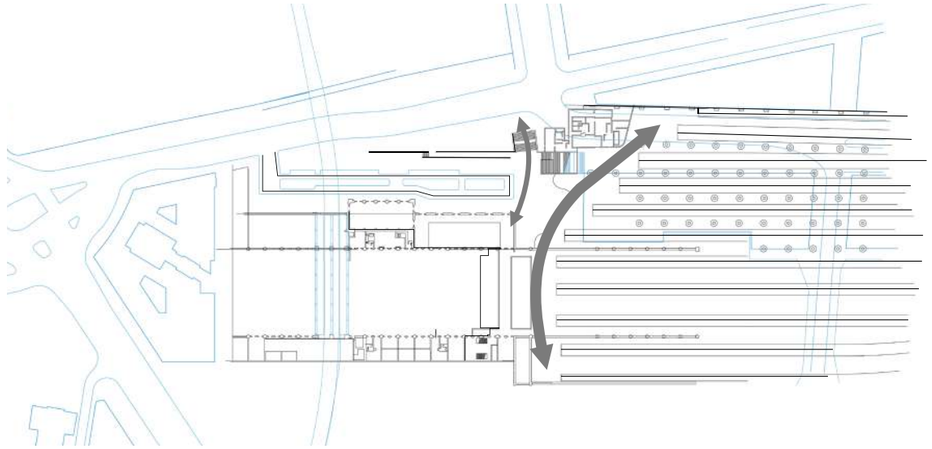


Figure 8.13: Main routes underground

The barriers created by the transport infrastructure are minimal. Due to the nature of a terminal station, they can more easily be avoided since the main barriers are ending. With the kiss and ride located to the east of the station, a central access corridor is created that avoid the main barriers. Even then, the space still is quite open for the pedestrian.

This is not the same for the roof, since a large part of the station is covered. While the large roof spanning the main platforms has some skylights, the new additional platforms are located fully underneath a building. This space could therefore create a dark environment. However, since the space has just recently opened, it is yet unclear what effect this has on the experience.

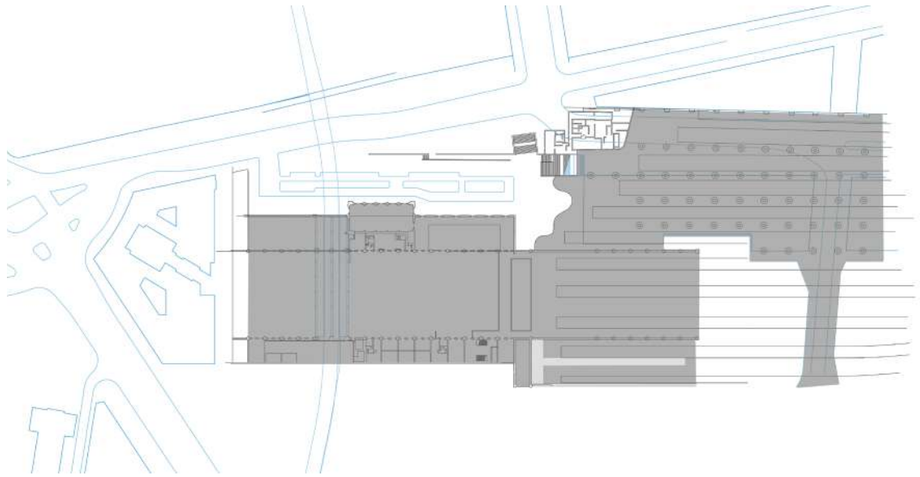


Figure 8.14: Main routes underground

Gare D'Austerlitz

8.3.6 Spaces

The spatial structure of the station is quite complex since it features multiple underground sections. Most of the spaces between the different transport modes are created due to the height differences between these modes. As an example, since the RER station is accessed from below, it creates multiple spaces in the route to go underneath the station and the access routes above.

Furthermore, both metro systems are not well integrated, and are only connected via walkways. The stations itself are completely on its own, while there is much opportunity to let these different modes interact. Metro Line 5 goes through the building, above the RER lines and yet it is completely disconnected from the other spaces.

Figure 8.16: Upper Metro Station. Source: Wikimedia commons

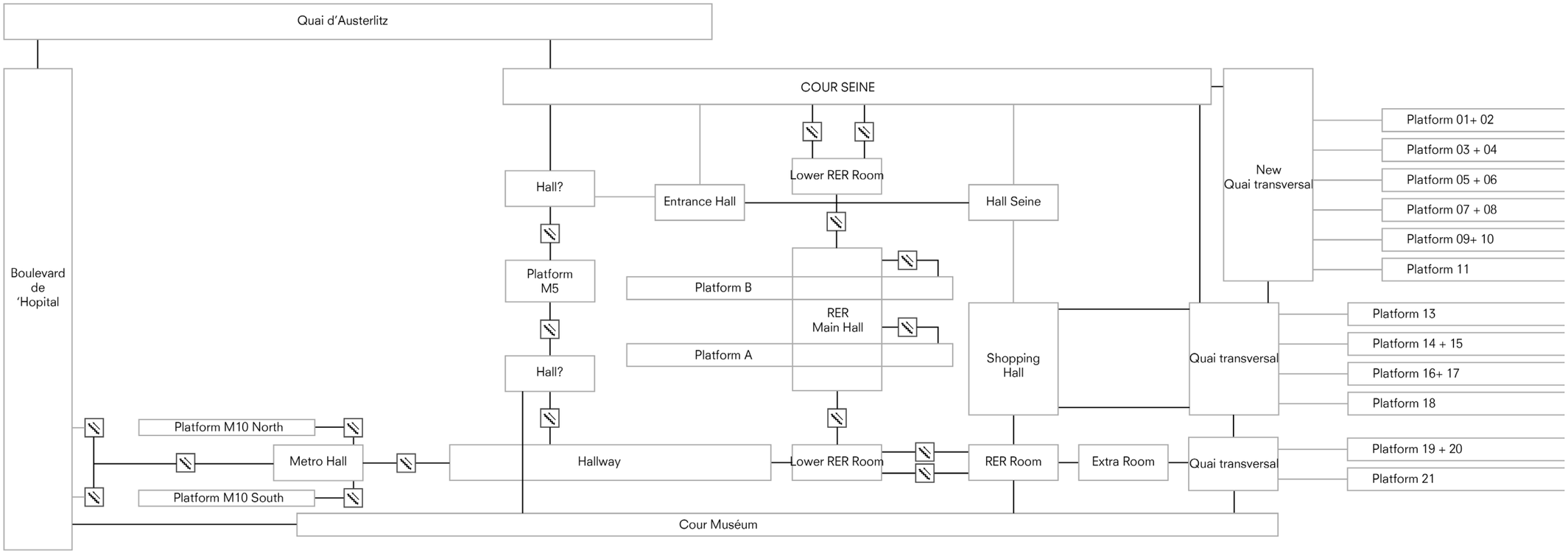


Figure 8.15: Main spaces around the station

Gare d'Austerlitz

FUTURE PLANS

8.4.1 Extension to the South

Besides the additional platforms, another redevelopment is planned to the inside of old building. The currently unused space will be transformed in a lively area with shops and flexible working spaces, while also improving the access to the underground spaces. This renovation will again allow the old building to be central in the building.

Furthermore, a mixed residential block is planned to be constructed to the west of the station, interacting with the above ground metro line and simultaneously expand the underground connection between the metro and the RER station, by integrating that walkway into the building and adding more commercial functions. This space is still work in progress, so the final design could step away from some of these aspects.

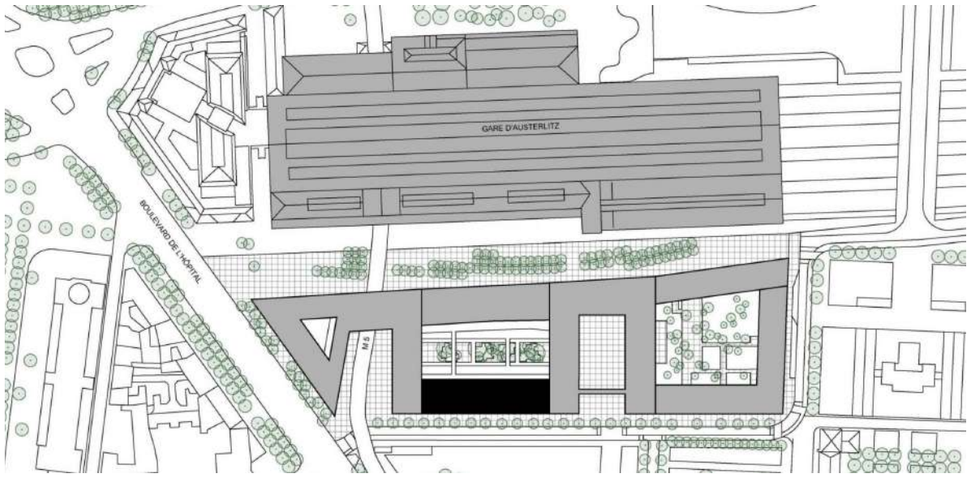


Figure 8.17: Possible new volume located adjacent to the station. Source: AZC

Figure 8.18: Possible renovation and interaction of the new building with the underground pathway. Source: AZC

Figure 8.19: Proposal for the inside of the station. Source: AZC

STATION BRUSSEL-ZUID / GARE DE BRUXELLES-MIDI

ZUIDSTATION / GARE DU MIDI

09

Brussels-South

OVERVIEW

9.1.1 Introduction

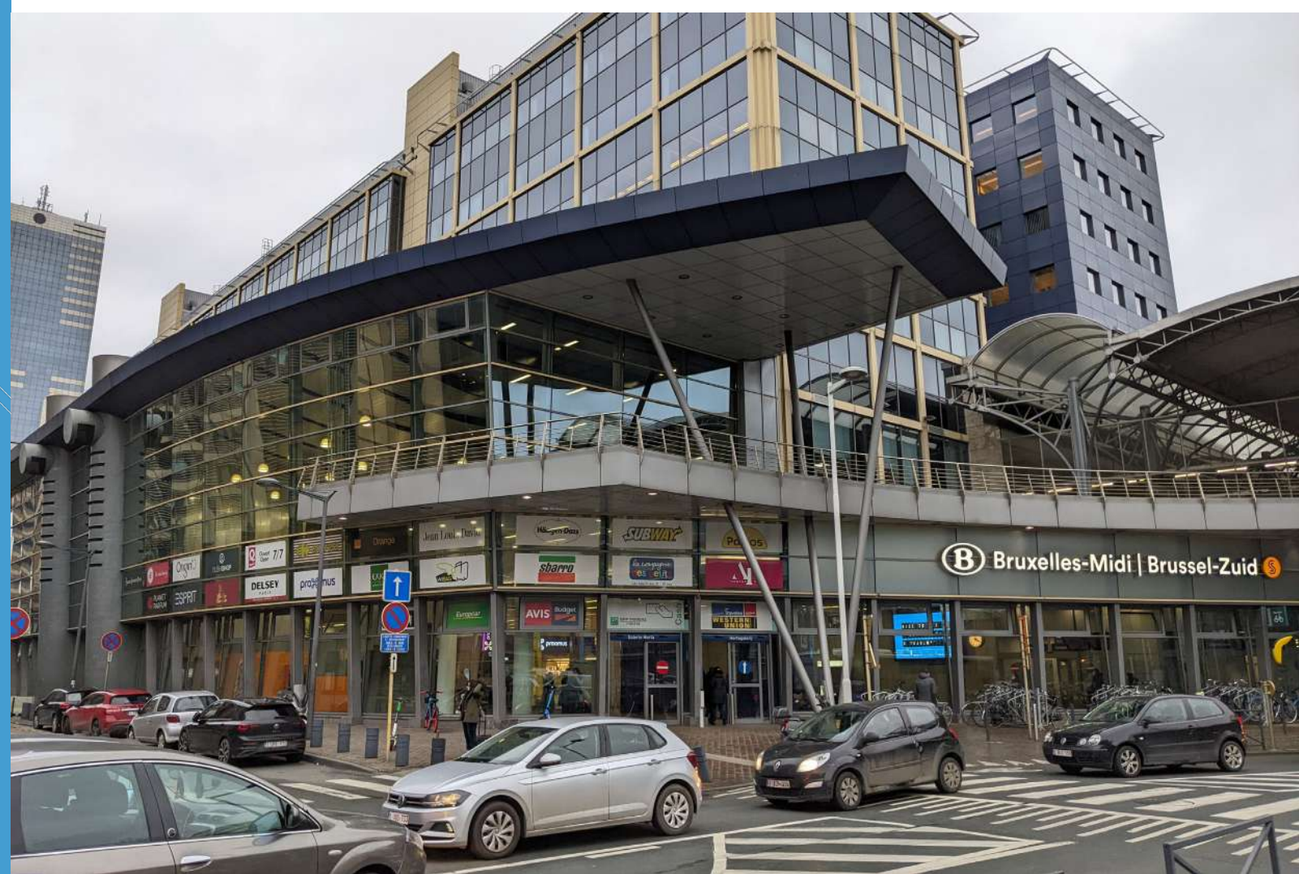
Station Brussel-Zuid, Gare de Bruxelles-Midi and metro station Zuidstation / Gare du Midi, further referred to as Brussels-South, is one of the three large train stations located in Brussels, Belgium. The station serves as the main international station in Brussels, with connections to the Netherlands, Germany, France, and the UK. Because of this, the station has a large section dedicated to international travel, making use of the centrally located position of Brussels in Europe. Furthermore, the connection with the UK means that the station also has its own border patrol located in the building.

The station started off as a terminal station, mainly for the people living to the south of Brussels. With the introduction of the north-south tunnel through the centre of Brussels it changed to and through station. This change came with a complete remodel of the station. While a lot of the station design remains today, a new terminal was added to one side of the station with the introduction of international trains to the UK, with the addition of the border patrol.

Besides the main railway platforms, the station also has an underground section. This section is located underneath the so-called Covered Street, and contains a ticket hall, metro station and a pre-metro station. This last station is a tram station that can relatively easily be converted to a regular metro station.

With the dual language used in Brussels, it has a complicated name. The official name of the station is Station Brussel-Zuid / Gare de Bruxelles-Midi, depending on the language used. This is often shortened to Zuidstation or Gare du Midi, the names given to the metro station underneath

Figure 9.1: One of the entrances in the newer international terminal.



9.1.2 Statistics

28 Rail Tracks
22 Train
2 Metro
2 Pre-Metro
2 Tram

5 Floors in Total
4 Having transport modes

23.2 Million Visitors (Annually)

1840 Origin Station
1952 Build year current station

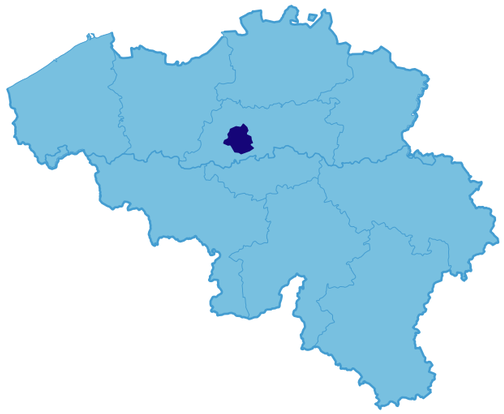


Figure 9.3: Location of Brussels inside Belgium. Source: Wikimedia commons

9.1.3 Current Building

The current building was constructed between 1939 and 1954, in post-war functionalist style. The building was mostly recognised by its large post office located to the southern side of the station. With the length of the building spanning beyond the station, it is one of the longest stations in Belgium. With the introduction of this building the tracks were raised to six meters above the ground, allowing the space underneath to be used for logistics and a shopping corridor.

With the introduction of connections to the UK the northern side of the station was renovated, and a new international terminal was added. Due to the success of this terminal, the orientation of the station slowly turned away from the post office building to the northern side, which is currently the main side of the station. The post office building currently is empty and in a bad state.

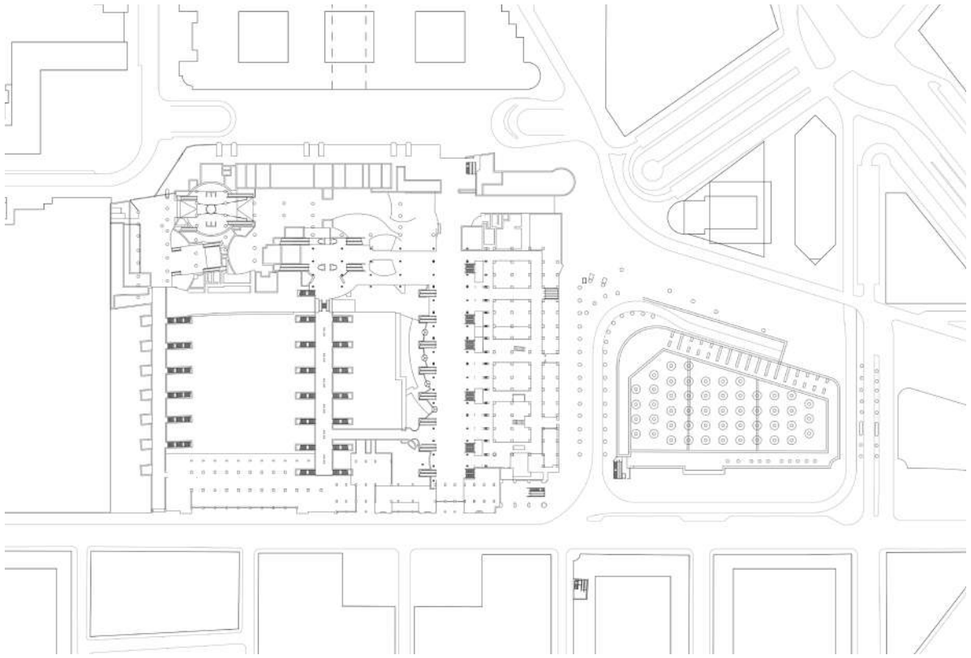


Figure 9.2: Schematic plan of the ground floor of Brussels-South

9.1.4 Butterfly Model

While the passenger numbers of Brussels-South are not as high as some of the other stations in this research, it is still a major international hub. Therefore, the expected value of the aspects in the analytical model is five. However, as seen in the model here, this is not the case for most of the aspects. Both sides of the station need to be improved to match the quality of what a major international hub needs to offer. Still, the place side is the side that needs most attention since it falls short on all aspects.

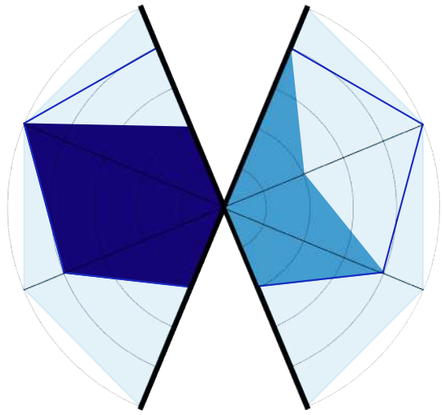


Figure 9.5: Analytical model of Brussels-South

9.1.5 Conclusion

Brussels-South is a large and complicated station. The position of the station in the European high-speed network makes it an ideal interchange point, but the quality of the station is not up to this task. A large amount of the space is unattractive and empty. With the new expansion by OMA some of the areas of the station will be addressed, but these will not be enough to fix the more fundamental problems with the structure of the design.

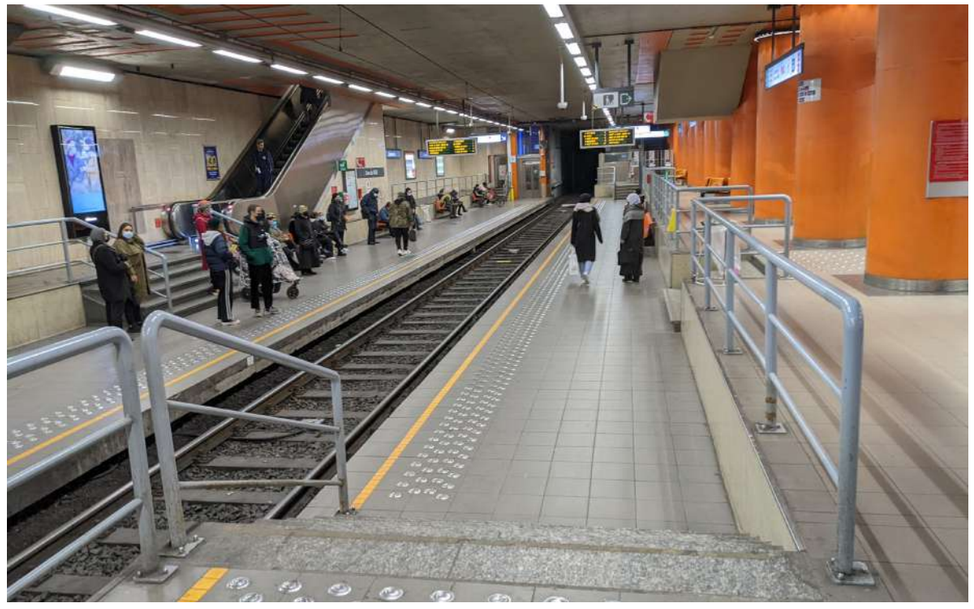


Figure 9.4: The current pre-metro plaftform underground.

BRUSSELS

9.2.1 Function

The functions surrounding the station are mostly residential, except for the northeast section. This section is mostly filled with shops and some restaurants along the road towards the centre of Brussels. The station here is clearly the main attraction for the neighbourhood.

Figure 9.6: Functions surrounding Brussels-South

The same division can be seen in the transport network of the area. The main transport functions are located on the same place as the commercial area. Furthermore, the system could be lacking to the west side of the station, with a lot of residences needing to use a bike or walk to the station to travel. This means that the station should also focus on the local travellers in the area to make sure their needs are met.

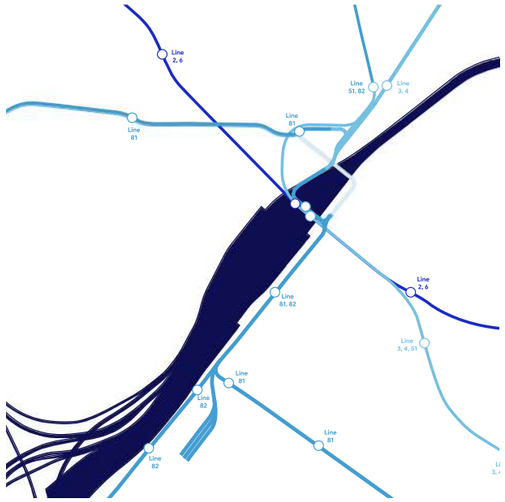


Figure 9.7: Main network of Brussels-South

9.2.2 Area

The station is situated on the side of the city centre. In the street pattern visible in figure 8.7 the rail yards located to the south are highly visible. This is not the case for the north, a result from the old function as terminal station on the south of Brussels. The station has quite a lot of reach in the area, with most of the surrounding consisting of small buildings and small streets, with leads to quite a high density in the area. Also visible is that the station is located between different municipalities, since there is not a clear structure that is similar between the areas to the east and west.

Figure 9.8: Proximity to the station

9.2.3 Conclusion

The functions surrounding the station are mostly residential, except for two sections. The northeast section is mostly filled with shops and some restaurants along the road towards the centre of Brussels. The southern side of the station is connected to several office spaces. Overall, the area is quite monotone which should be improved. The station is clearly one of the most important buildings in the area, but it feels like the station has very little connection with the area itself.

THE STATION BUILDING

9.3.1 Introduction

This section goes more in depth to the basic analysis of the structure of Brussels-South Railway Stations. Detailed plans of the station were unavailable, so this plan has been reconstructed based on some available images and plans. Sadly, images and plans for the upper levels of the station and the post building were not available. These are therefore estimated based on the little information available.

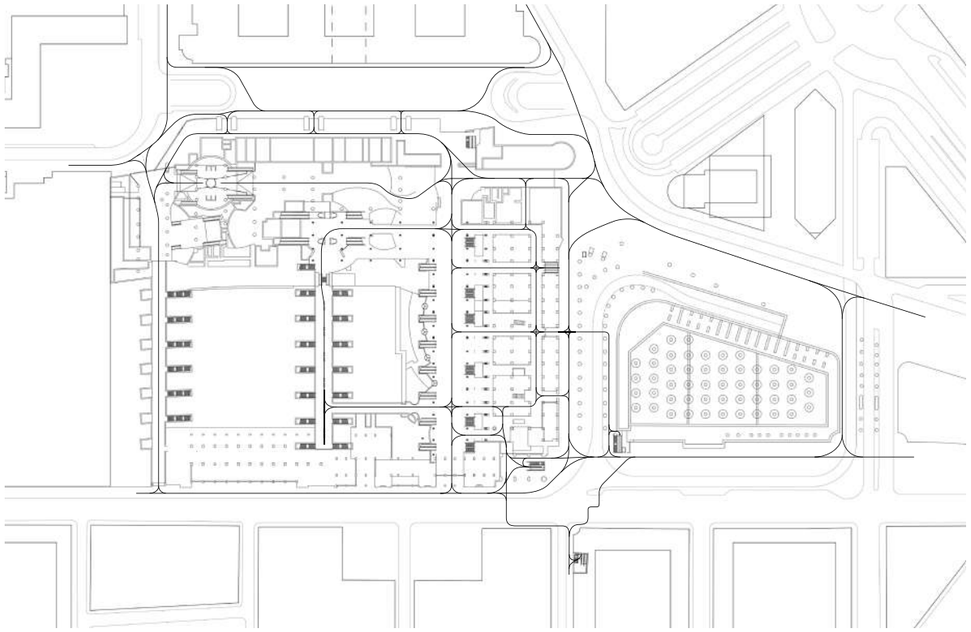


Figure 9.9: Main routes on the ground floor

9.3.2 Routes

Like the previous stations, the possible route through the building is quite complex. These complications are mainly due the illogical structure of the station itself. As can be seen in the image above, the middle walkway is disconnected from the southern walkway and the outside. Furthermore, the international border patrol forms a large blockage in the routes in the station. The underground section is mostly accessed from outside the station, with only one connection with the inside of the station.

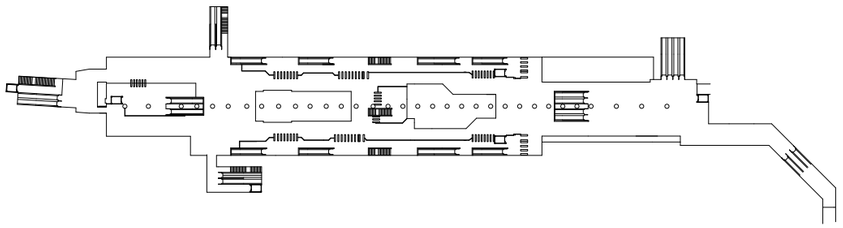


Figure 9.10: Layout of the Ticket hall of Brussels-South

9.3.3 Space

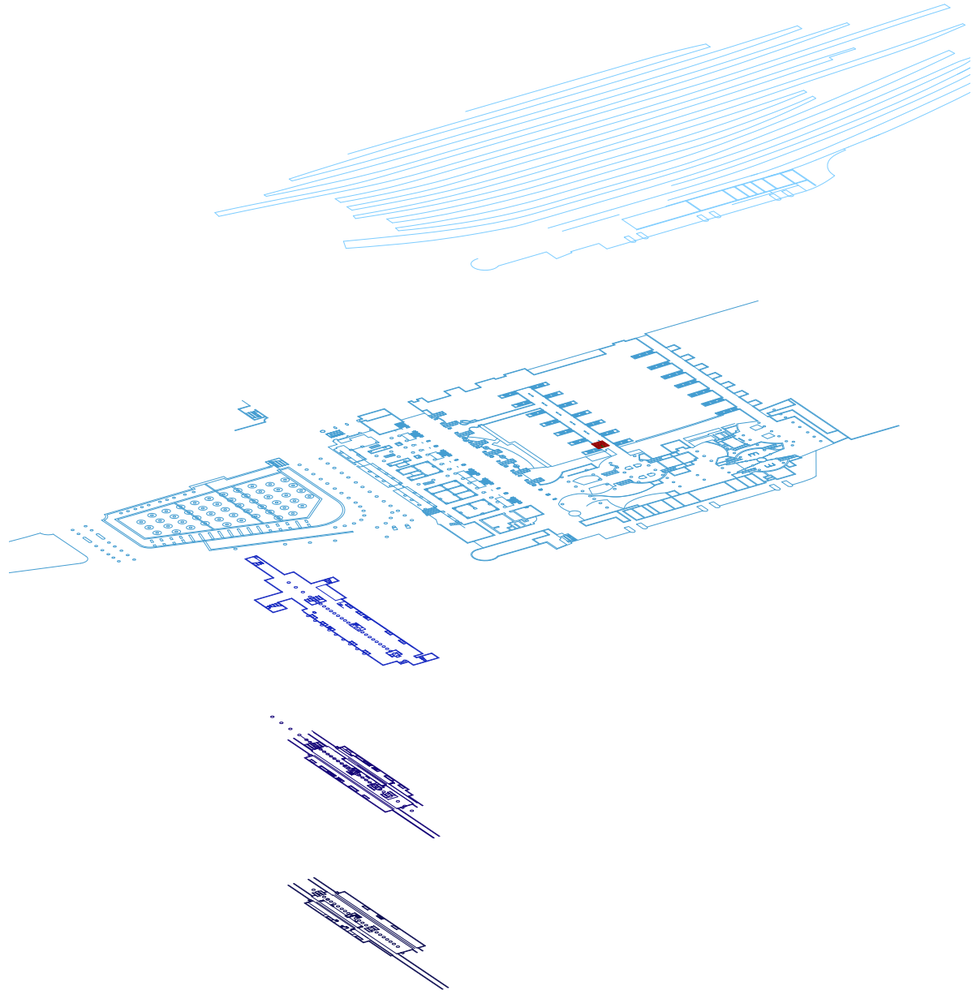


Figure 9.11: Isometric view of Brussels-South

The isometric view shows the complicated structure of the station. The main highlight is the complicated underground section of the station, located underneath the Covered Street. The metro station consists of three levels in total, giving the station a total of five layers. The upper layer of the metro is a ticket hall with two platform levels below it. The platforms are build following the Spanish principle; meaning that the track has two platforms, one for unloading and one for loading. The outer platforms here are used for loading and the middle platforms for unloading. Each platform level has direct access to the ticket hall

9.3.4 Function

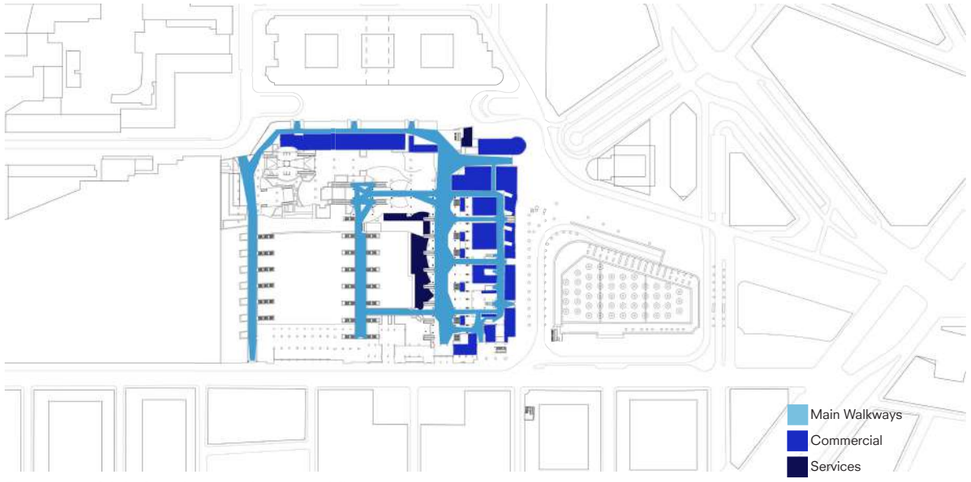


Figure 9.12: Main functions on the ground floor

The function of the station can be mostly split based on the different levels. The platforms above are only used for transportation, while the ground floor hosts all the other functions. The main service points and shops are located adjacent to the main walkway in the station. The other two walkways have very little functions associated with them. Further shops are also located along the eastern side of the station, located next to the Eurostar terminal. This section also has an upper level; however, this space is mostly empty.

Figure 9.13: Main functions in the surrounding buildings

The station has a large section of commercial space. Looking at the surroundings confirms that this are the only major commercial areas in the immediate surrounding. We can see that some of the buildings are reacting to the presence of the station, however this is in limiting amount.

The station also has an entrance and connection underground to that goes underneath the busy Avenue Fonsny in an surrounding building. However, this entrance does not interact with the functions surrounding it.

Brussels-South

9.3.5 Public Space

The public space in the station is quite large, with most of the area focussed on the east and northern side of the station. A large part of the eastern side of the station is however blocked due to the customs required for the Eurostar trains. Furthermore, a large band of space connects this side with the centre. This space is empty but is often used for a market on select days. From this image the orientation of the station seems to be the northern and eastern side. However, with the current state of the covered street this can not be considered as a main entrance area.

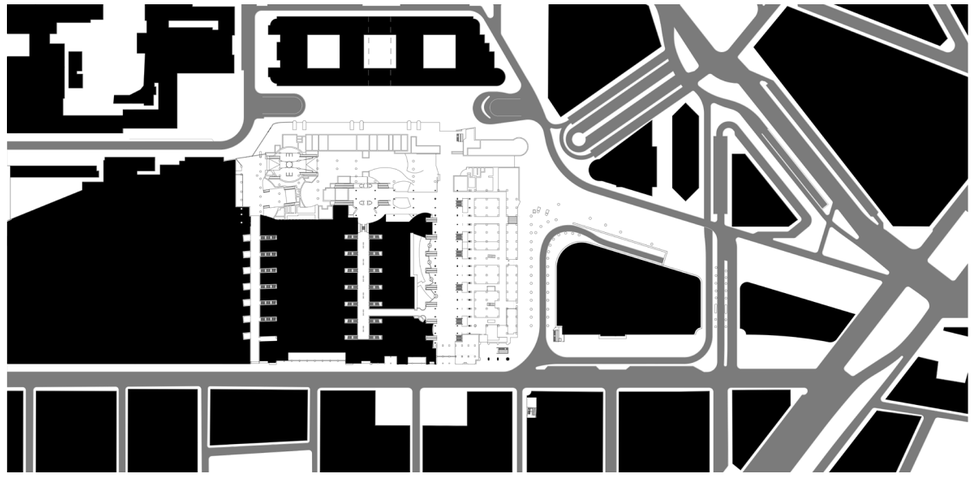


Figure 9.14: Public area surrounding and inside the station

While there is much public space surrounding the station, there is still a large disconnect between the inner public space and the outer public space. There is a large amount of potential to improve this connection. One major area which can improve the whole area is the so called *vierhoek*, the space located underneath the train tracks to the northeast of the station. This area underneath the train station is currently unused but can be accessed from all the sides of the public realm. The current plan of the municipality is start using these spaces again, so attempts are being made.

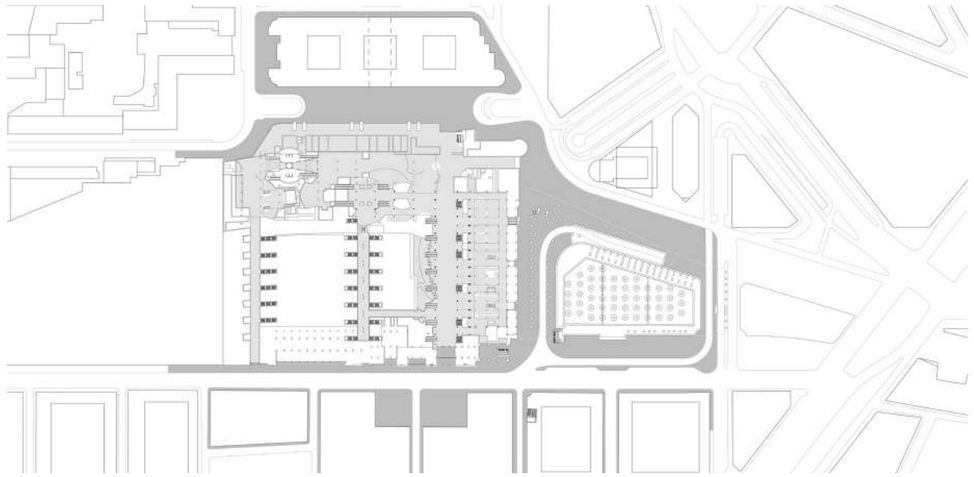


Figure 9.15: Inside and outside public space

9.3.6 Network

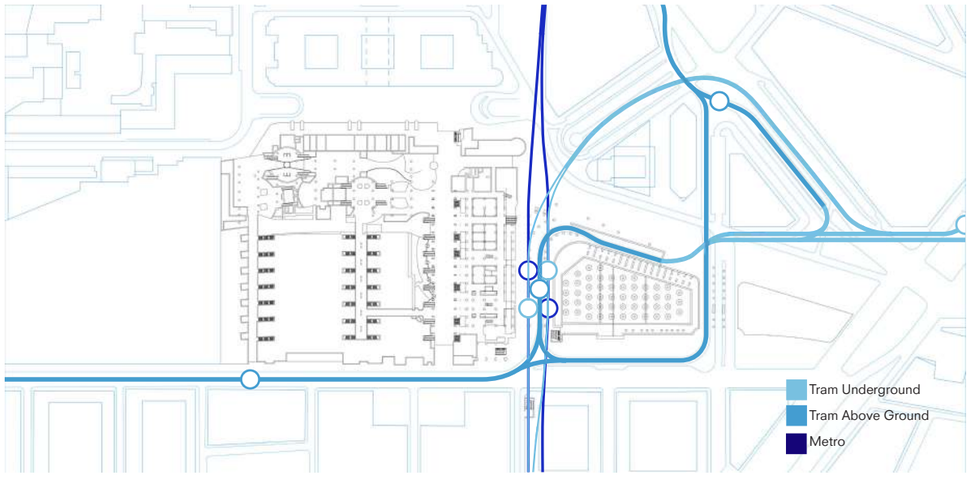


Figure 9.16: Network of the Tram and Bus in Brussels-South.

Important to large transportation hubs are the connections between the transport modes. The situation around Brussels-South is also quite complicated. For the traveller, the Pre-metro, metro, and tram all stop on top of each other. The routes that the trams take is however quite complicated, which can still affect the directional awareness of the travellers in the station. Good signage is therefore important in the area to understand where the transports are going to. With the current transformation of the pre-metro line to a normal metro line this system will change.

Brussels-South

9.3.7 Layout

The layout of the station is complex. With the border patrol and the three walkways this is the most complicated station of the four case studies. This is also the only station that has more than two walkways connecting the platform, making it the most efficient of them all. This would be the case if the middle hallway was a proper hallway connected with the outside.

This text will be expanded when the metro system is added. I forgot that I still had to do this.

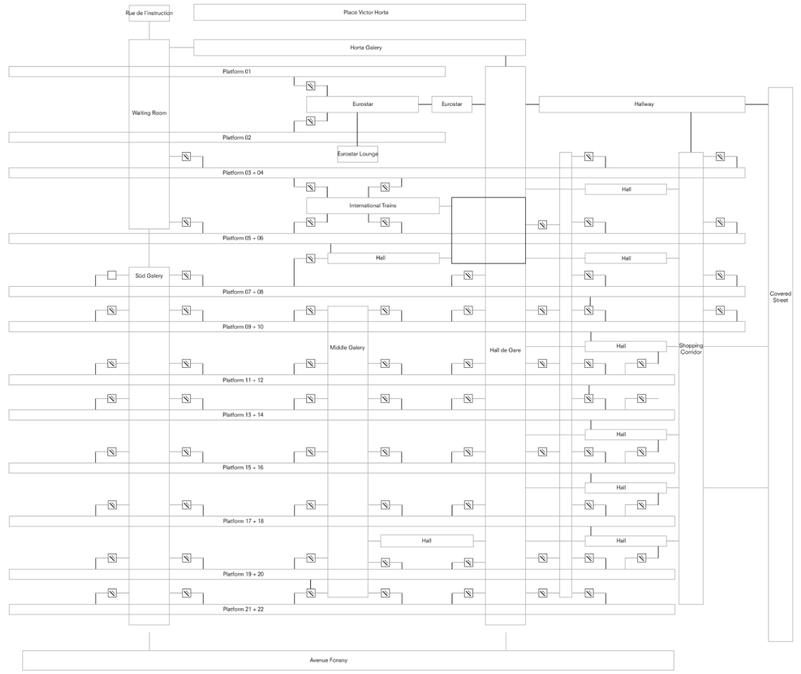


Figure 9.17: Spaces on the ground floor of Brussels-South

FUTURE PLANS

9.4.1 Metro Line 3

As stated already before, the station is currently going through the upgrade of pre-metro line 3/4 to a fully fetched metro line. This means that the lower platforms in the stations will have to be raised and lengthened. This change means that line 51 can no longer make use of the underground station. Therefore, this line will be split up into two different lines. Furthermore, a new station and tunnel will be added around the station, which could help with the throughput of the metro system in the station itself.

9.4.2 New SNCB Office

As part of a reunification of the different NMBS / SNCB offices (the company that runs most of the trains in Belgium) the existing post office building will be renovated to create one general office. Besides the renovation, the building will be expended with more office space designed by OMA. With this expansion, they are connecting the middle galery that runs through the station with the outside. Furthermore, as part of the new masterplan in this area, the road will be restructured to improve the ability to cross the road.

This expansion of the building is part of a larger masterplan to densify the whole area. While this building only focusses on offices for the rail company, other parts try to add more residential to the area and making it livelier. The plan also tries to reduce the amount of traffic in the area, by making some roads one-way and transform others into pedestrian only roads.

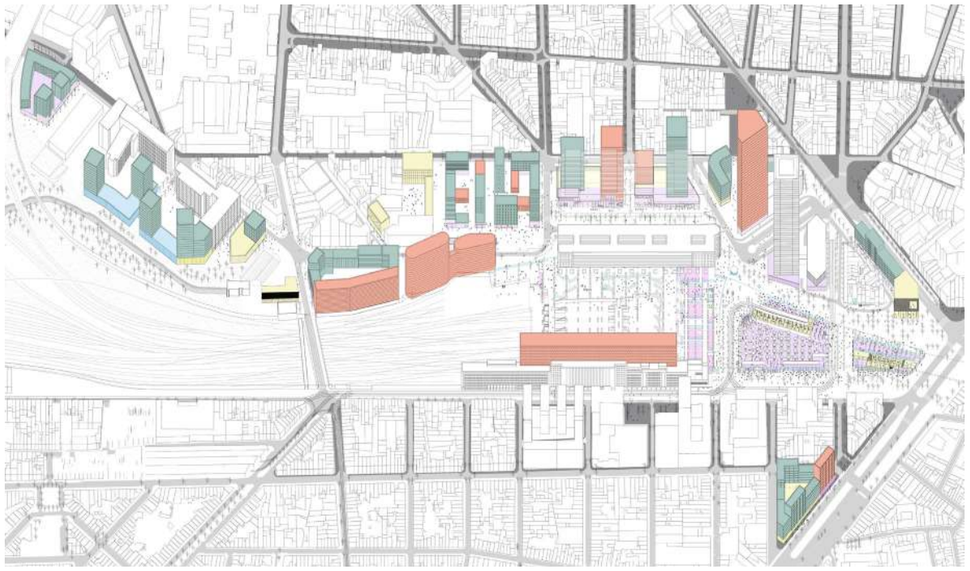


Figure 9.18: Masterplan of the Area. Source: perspective.brussels

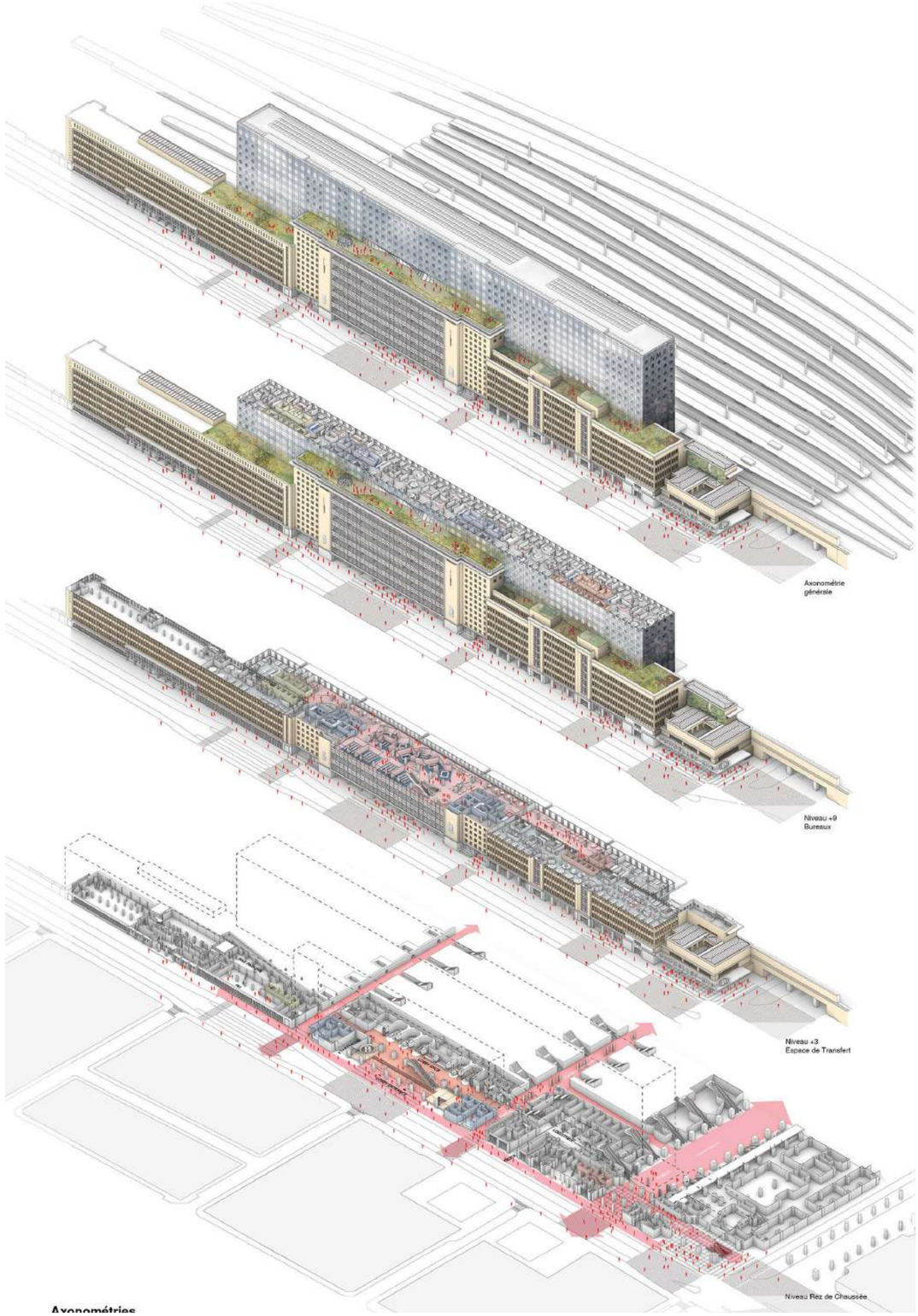


Figure 9.19 Plan by OMA to renovate and extent the current building. Source: OMA

RESULTS

10

LESSONS FOR THE DESIGN

10.1.1 Introduction

This section aims to give an overview of the learned research to prepare for the design assignment that will be formulated based on the learned information. The goal is to create a design that uses this knowledge to create a design for a station with an improved quality of public space inside and surrounding the station. Therefore, this section will create a series of Design aspects based on the learned knowledge that will help guide the design towards creating better spaces. These will mostly consist of lessons of what to do and what not to do. Before this, the design location needs to be created. This is what the other section of this chapter is about.

10.1.2 Lessons from the Research

From the literature and case study analysis, several lessons have been learned that need to be addressed in the new design. These have been summarised in four main principles:

A. The Public area is often nothing more than an area

The spaces need to handle large amount of traffic, so often it is only a place of throughput. This is even the case for the station square, which is often empty as a result. This needs to be addressed if the place side of the station need to be improved so it can feel like a place where you want to go.

B. The connections between different modes are often the places that lack the most quality, but they should be prioritised.

The large transportation hubs serve as the name suggest as a hub, where most of the travellers switch from one mode of transport to the other. Therefore, the connections between the different modes are often the most used routes but are often not designed. This is also the case for the elevation changes which are often executed poorly.

C. Public Space is more than the main public area.

Extra functions besides the usual shopping help diversify the areas and integrate it more in the functioning of the general area. This function can also be used to create a better area for waiting.

D. Transport hubs should be more than a transport hub and shopping centre.

Often, the most designed public areas are the main halls with the combined shopping area. However, the other places like the platforms where most people wait is often undesigned and sometimes even unfurnished.

10.1.3 Central Themes

Besides general lessons, several aspects were identified in the literature research and the analysis that can influence the quality of the public space. The most central aspects are Integration and Diversity. These aspects are closely interlinked and should be addressed in the new design. These aspects are therefore two of five central themes that will be used to help create a new design. The other central themes are also established using the existing research and the case studies. This leads the following five themes:

I Integration

II Diversity

III Wayfinding

IV Greenery

V Placemaking

Each of these aspects will need to be addressed to improve the public space around the station. It is therefore that they will serve as a guideline for the new (re-) design.

DESIGN LOCATION

10.2.1 Choosing an site

Following the research and the found lessons and themes, a location needs to be chosen where the final design will be created. This final location would be selected from the stations that were eligible for the case study analysis. As a result, the choice was made to take Brussels-South railway station as the main location for the research. This station suffers from most of the established problems, has a high-speed rail connection, and has a complicated scenario with the border patrol located in the building which makes the public space even more confusing. Furthermore, the quality of the space inside the covered street is one of the worst places that has been found so far in this research, which can be the perfect area for a redesign. The station is therefore ideal to try to improve the situation of the public space inside and surrounding the station.

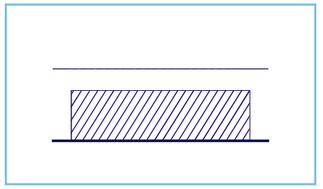
Furthermore, the proposed changes to the station are not solving the current problems. While they do address some of the issues, they are ignoring the bigger problems and are in some areas even making the situation worse.

Figure 10.1 Brussels-South Railway Station

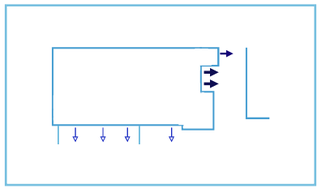
DESIGN ASPECTS

10.3.1 Aspects Related to the Building

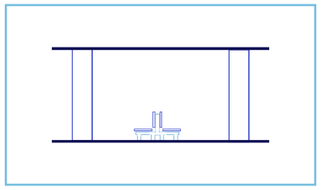
As a result of the research so far, several design aspects have been created to help improve the building. These are all based on different section. This section focusses on the aspects related to the current building of Brussels-South.



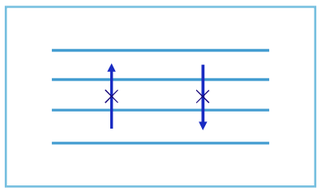
Dark / Hidden Areas
Part of the station, the so called Covered Street, is very dark from the outside, which can be seen as unattractive and dangerous area.



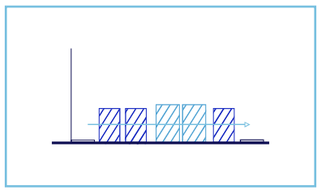
Wrong Priority
The Stations main entrance is aimed towards an square. However, this square is located away from the main flows around the station. The main flow towards the station therefore only has a small station underneath an hotel.



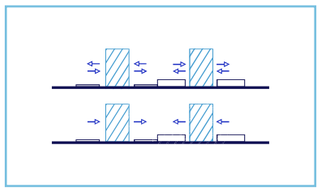
Under-designed Waiting Areas
Often the negative experience is related to external climate effects, like wind and temperature. Therefore, the main waiting areas should have protection for these elements to provide an better experience.



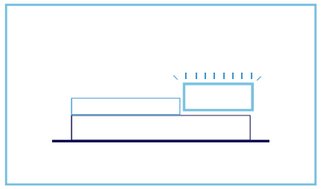
Bad Connected Levels
While some floors are located on top of each other, the connection between them can sometimes be complicated or limited. Therefore, better connection to all the levels should be implemented.



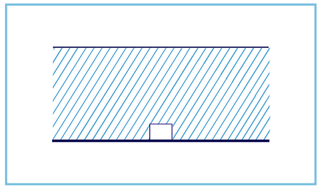
Traffic Barriers
On several sides of the station high traffic roads are located, leading to barriers for the slow traffic around the stations. Because of this, the station feels very isolated from the perspective of the pedestrian.



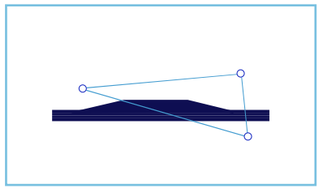
Flauwed Principles
The pre-metro and metro underneath the station use an multi platform station following the Spanish solution, as seen besides here. This system is however not utilised properly, leading to an less efficient system.



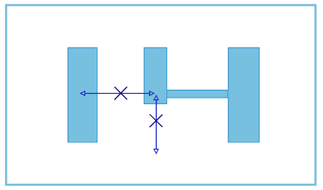
Unbalanced Design
The International Trains stop on platforms that have been redeveloped more recently compared to the other platforms, leading to an massive gap in quality between the different parts of the station.



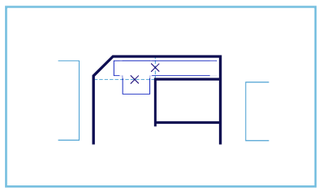
Unclear Entrances
Besides the main entrances, many of the stations are small and unclear. This is often combined with other functions surrounding it with better visibility. This is an clear symbol of the front-back syndrome found in many stations.



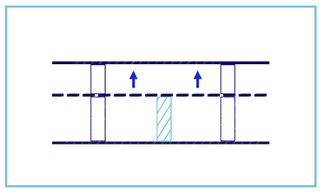
Split-up Design
Some parts of the station, like the buses, are split up around the station, which could be difficult to navigate.



Unfinished System
While the station has an central corridor, this corridor is not accessible from the outer border of the station or from the south corridor, which causes it to feel like the station's layout unfinished.



Border Barrier
The border patrol for the Eurostar is located on the east side of the station. The shape makes it impossible for other travellers to reach the south corridor without going around.



Low Ceiling
On several sections of the station the ceiling is quite low, which should be improved or the experience of the user. Secondly, some sections have an high density of columns which should be reduced to improve the flow and way-finding.

Results

The problems mentioned on the previous page can be site specific, and therefore the main area where these problems are located can be seen here

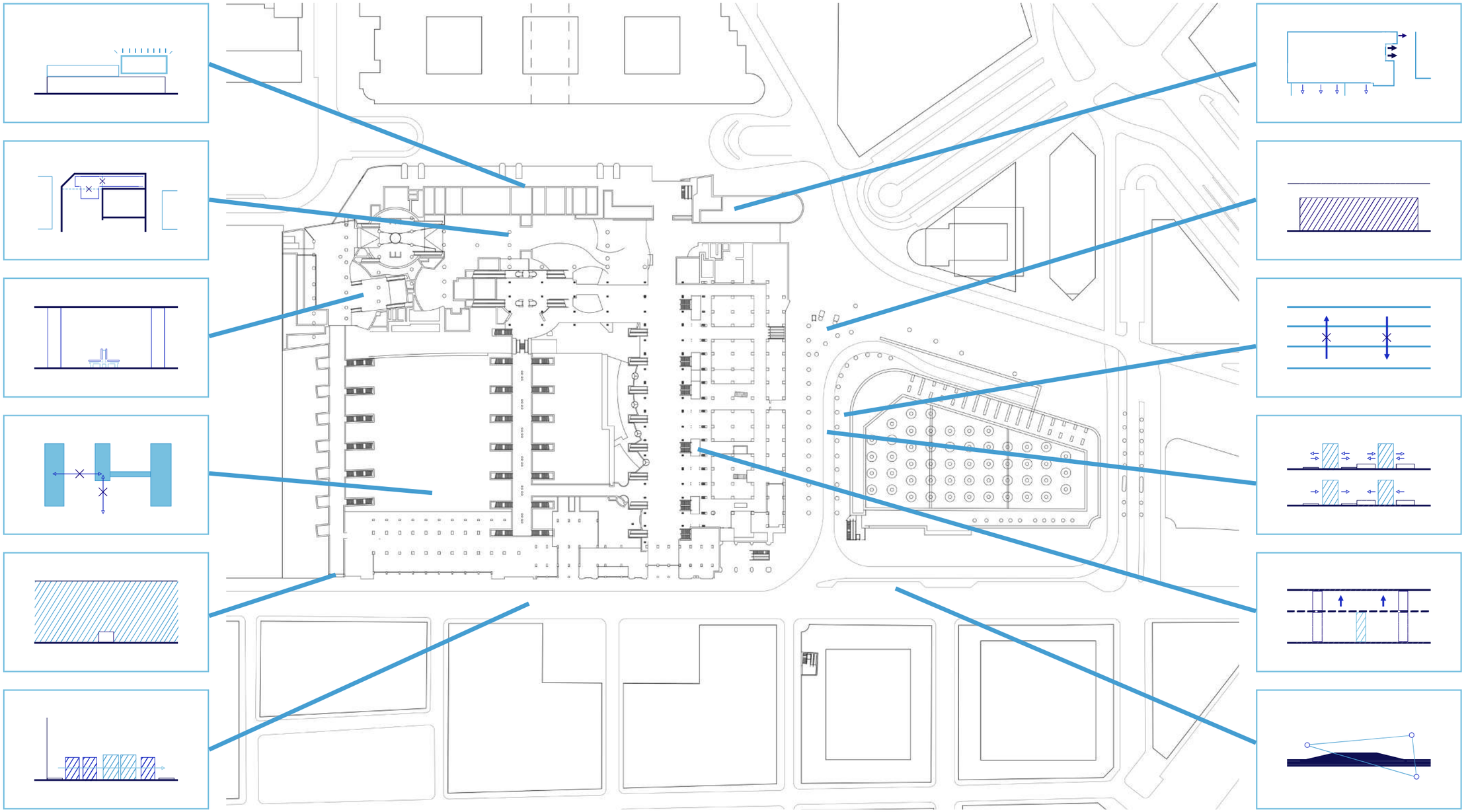
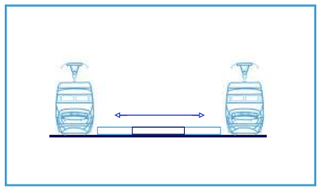


Figure 10.2 Layout of Brussels-South

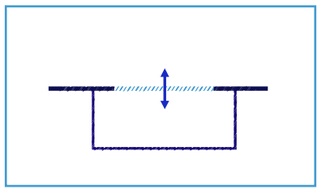
Results

10.3.2 Aspects Related to Literature

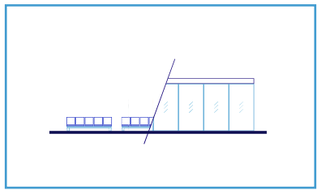
The information learned from the theory has to be applied to the redesign of the chosen station. The information is therefore processed into several aspects that are translated into simpler objectives that the station should strive to reach or create. How this should be done will be investigated in the next chapter during the remodel of the station.



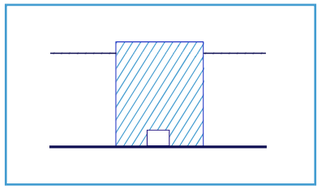
Increase size of the Platform
The space on the platform can be used for other functions to improve the experience of the station. This is however only possible if the space is wide enough, otherwise it will harm the experience.



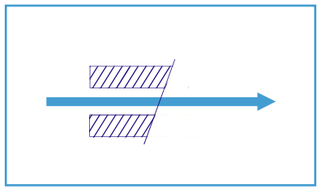
Breaking through the Underground Areas
The underground areas in transportation hubs are experienced more negatively due to lack of daylight and generally low ceilings. Therefore, the design should break these area's (partly) open to connect the underground space with the above areas. This is also the case for areas above ground that are still covered.



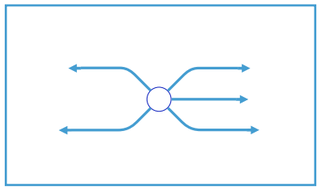
Climate Controlled Waiting areas
Often the negative experience is related to external climate effects, like wind and temperature. Therefore, the main waiting areas should have protection for these elements to provide an better experience.



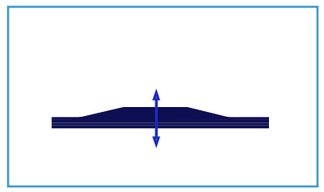
Highlighted Entrances
While often the case for the main entrance of the transportation hub, the entrances should be highlighted clearly to improve the way-finding of the station. Materiality should play an role here in identifying the entrances to the station.



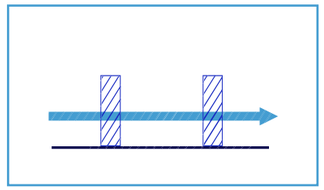
Clear Interruptions
While functions like shops and cafés are crucial for an modern station, they often interrupt the main routes to increase traffic. Stations should offer an alternative route with limited interruptions for the frequent traveller.



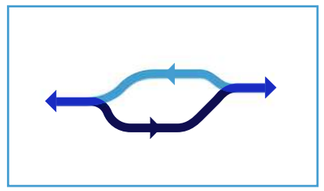
Central Meeting Area
The role of the station as an place to be and meeting area will increase, which should be reflected in the layout of the station. Therefore, there should be an central meeting point in the building with easy access. However, it should still be possible to skip this area for frequent travellers



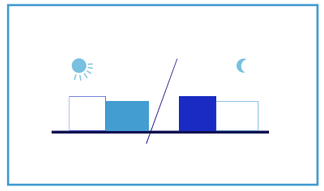
Clear Passageways
Stations are often barriers for people travelling through the area. Therefore, the station should have clear passageways through the station to connect both side of the station.



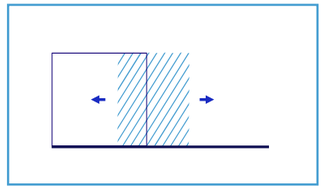
Reduction of Barriers
More efforts should be put into the reduction of the barriers that the traffic around stations are created for the slow traffic.



One Way Systems
One-way systems can help improve the flow and traffic inside an transportation hub, so the addition of these systems can help improve the station. However, these options can also harm the station if not implemented correctly.



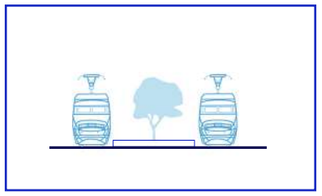
Increasing the operating window
The functions in the station should reflect the activity of the station itself. Which means that the station should have functions that operate in the morning, afternoon, evening and possibly night.



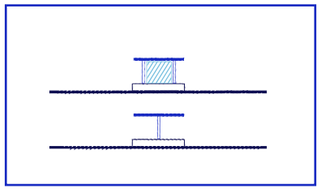
Increasing the Buffer Zone
To improve the integration of the station, the barrier between the station and outside should be reduced. This means that the zone of the public space inside and outside should be mixed with each other.

10.3.3 Aspects Related to Case Studies

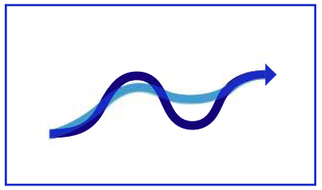
From the case studies several additional objectives can be determined. The reason behind these aspects can be found in the case study analysis in the previous section, but this section will give an brief overview to the elements.



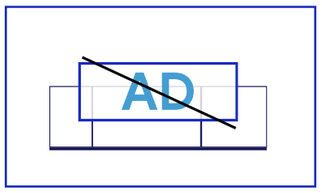
The Addition of Greenery
Greenery can change the experience of a station drastic. Therefore, the addition of green elements to the station can help create a more relaxed and .. experience. This greenery could even be extended to the platforms itself.



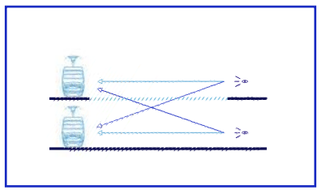
Thoughtful creation of Space
The supports on the platform help define the space on the platform. The method that is used can help create extra space that can be good or bad depending on how this space is defined. Sometimes not defining this space can make this space useless.



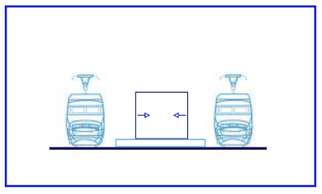
Simplifying the Flow
Efforts should be made into improving the flow and reducing the complexity of the flow around the transport hub. This reduction should help improve the way-finding of the station.



Ads
Large and overwhelming amount of adds can greatly affect the experience of the station. Therefore, while completely removing adds would be preferable, ads should be kept to a minimal.



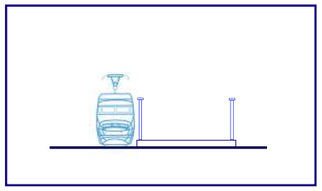
Visibility
The visibility to the transport modes is very important for the way-finding of the station, which means that the modes should not be hidden from view, something that is done often.



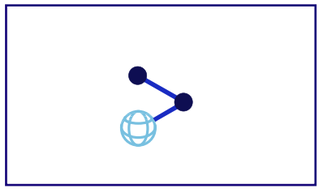
Reducing elements on Platform
While elements like shops can be very nice on the platforms, it should not overtake the priority of the boarding areas.

10.3.4 Aspects Related to the Future

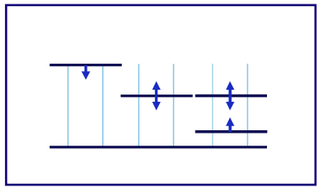
There are several elements that will change in the future, for which the transport hub has to be improved or adapted as seen before. Below are a couple of aspects resulting from the research earlier.



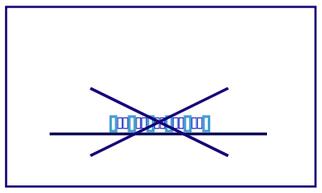
Platform Barriers
To improve operations, many subway systems are implementing platform barriers, which has the additional benefits of improving safety. These platforms could perhaps be implemented for trains.



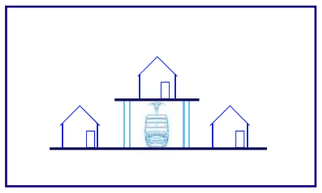
Data and Internet
More systems will connect with the internet and share information, which could help improve operations and perhaps give the travellers more information.



Flexible Space
Stations of the future are expected to have more flexible space, which could take the shape of flexible workspaces, rooms or even walls. The precise method will be determined during the design itself.



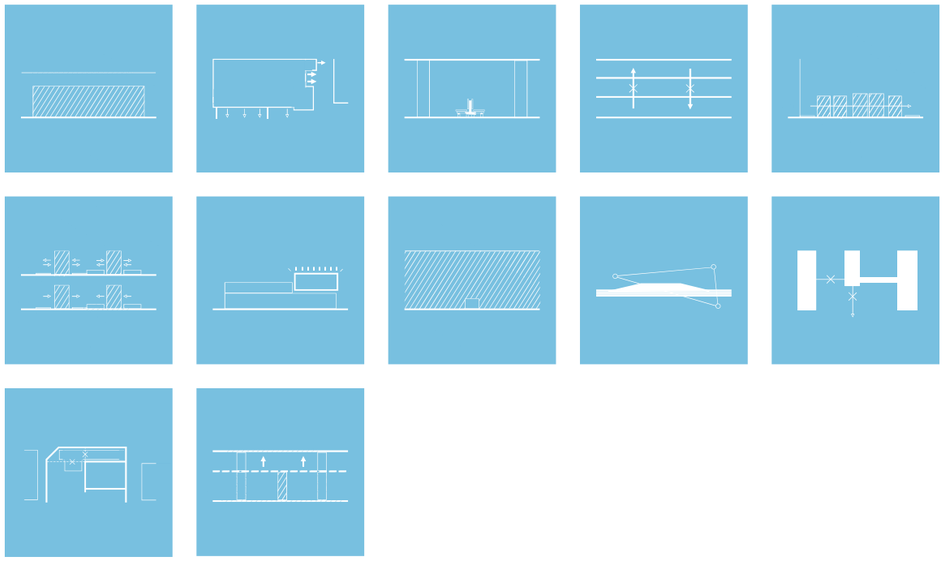
Highlighted Entrances
While often the case for the main entrance of the transportation hub, the entrances should be highlighted clearly to improve the way-finding of the station. Materiality should play an role here in identifying the entrances to the station.



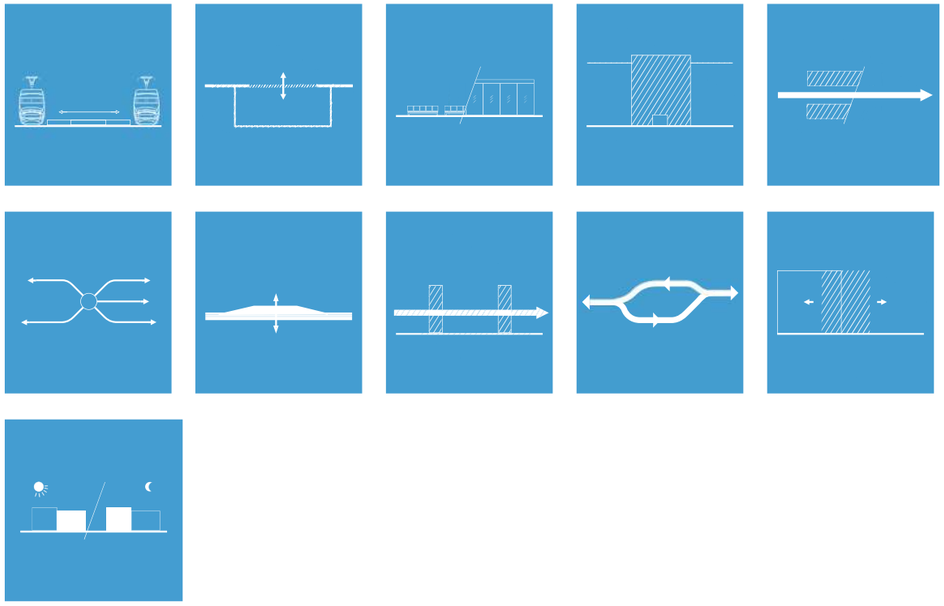
Increase Density Area
-In the future there is an need for more housing and areas like stationareas are attractive spaces for this new housing. Therefore, it is expected that the station will have to add housing to the building

10.3.5 Overview of all the different aspects

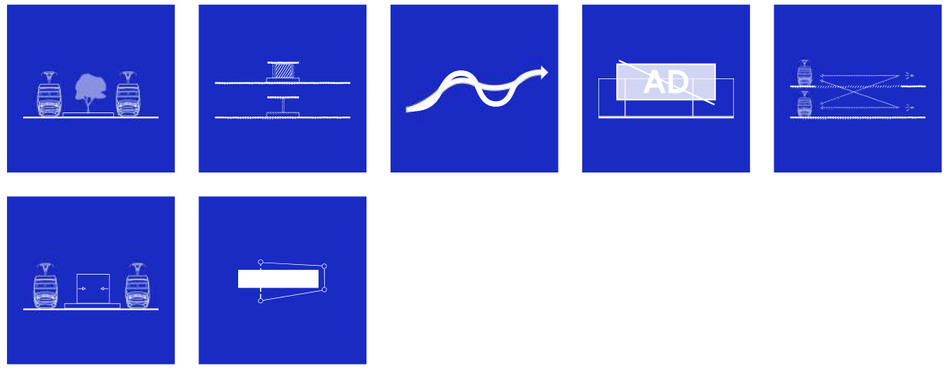
From the Building:



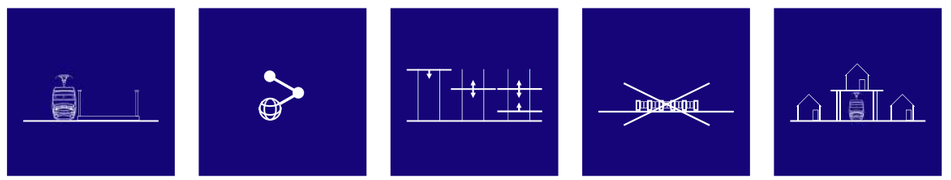
From the Literature:



From Case Studies:



From Future Challenges:



DEEPER INVESTIGATION

11

INTRODUCTION

11.1.1 Introduction

Before a new design can be made, the station needs to be investigated deeper to understand the needs and to understand the most problematic areas inside and surrounding the station. This section focusses on understanding the main areas around the station and decide which area needs to be addressed to make to benefit the quality and experience of the public space the most. Furthermore, this section also investigates what exactly needs to change in the problematic areas.

11.1.2 Main Spaces around the Station

The station is surrounded by different areas, each having their own seperate function and role in the surrounding area. These different areas are not physicly seperated, but there is also not much that connect these different areas together.

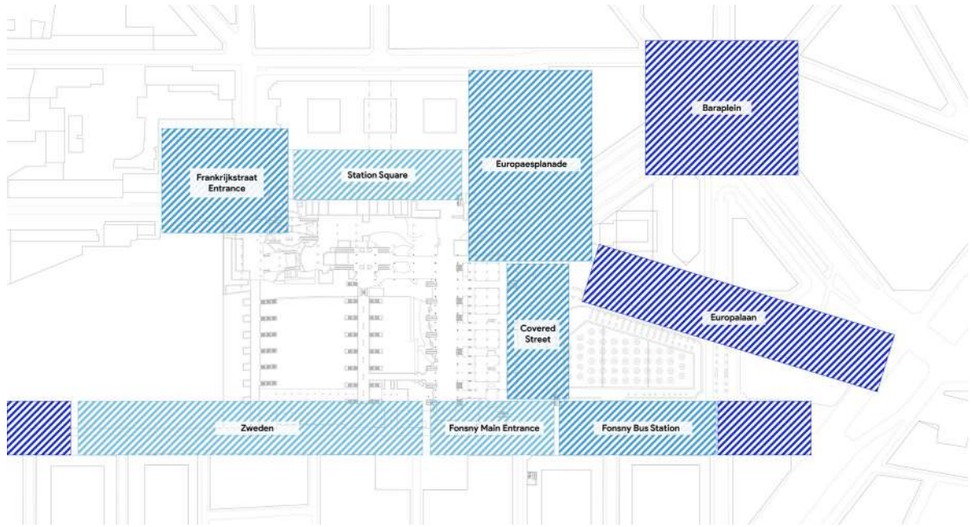


Figure 11.1: Main areas surrounding the station

PROBLEMATIC AREAS

11.2.1 Orientation

To understand the spaces deeper, it is important to understand the orientation of the station towards this area and the orientation of the building in general.

From the analysis done in the previous chapters it is understood that station is mainly orientated to the east and northern side with the international terminal being the main building. This was not always the case of this station. Before this, the building was orientated to the Avenue Fonsny, with the post office being the central image for the station. It is therefore that the post office has quite a monumental design. The northern side where currently the international terminal was back then a large and busy road and suffered from the same problems as Avenue Fonsny suffers from now.

With the introduction of the international terminal this changed. The surrounding area was redeveloped, and a new square and terminal building was added to the North-west of the station. With the international platforms located on this side the orientation of the station shifted slowly to this side as international travel became more important. This accelerated with the abandoned of the Post office building, which slowly deteriorated and even let to the closure of the entrance to the middle gallery on Avenue Fonsny.

The renovation of the Post Office and the addition will bring some much-needed life to this side of the station and could potentially make the station more orientated towards both sides. However, no major changes have been planned to the poorly visible entrances so there is still room for improvement.

11.2.2 New Approach

To create a higher quality public space, the current orientation needs to change. More emphasis needs to be placed on the main routes to the city centre of Brussels while the front and back side orientation needs to be changed.

As a solution, a multidirectional orientation is proposed, each with their own orientation towards a different target group as can be seen below. The international terminal remains orientated towards the Horta square as it is currently. The shopping corridor will be orientated towards the covered street with the aim of providing a stop between the local and regional transport options. The Avenue Fonsny will be dedicated towards the recreational travellers, aiming to create a slower and less stressful experience. This new U-shape orientation can also be combined with the revitalisation of the space, often referred to as “Grote vierhoek”, below the tracks on the north-east side of the station.

In this new orientation, the crossing of the different sides will combine to two central areas which can be the new main entrances to the station.

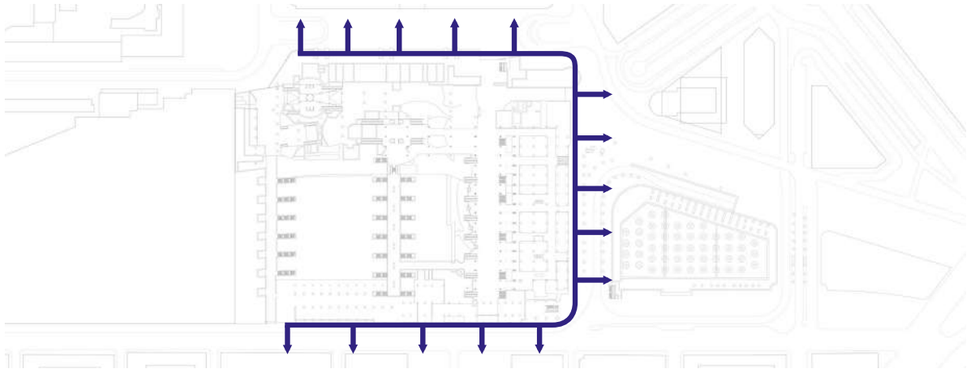


Figure 11.2: New Orientation

11.2.3 Five Main Areas

Using the new orientation and the analysis of the station in the earlier case study analysis, five main problematic areas were identified that need to be addressed.

Area 1: The Platforms
The regular platforms are currently in a very bad shape. Furthermore, the furniture and ammenities are lacking and the platforms small.

Area 2: Avenue Fonsny
The current street is a high-traffic area with different transport modes. The current plinth of the station is mostly closed off and disconnected of the station.

Area 3: Border Patrol
The large complicated border patrol situation in the building harms the layout and wayfinding of the station.

Area 4: Horta Square
The main square infront of the station is mostly empty and unattractive and disconnected from the functions inside the station.

Area 5: Covered Street
The current situation mostly feels like a sewer, a dark and unattractive area filled with multiple modes of transport.

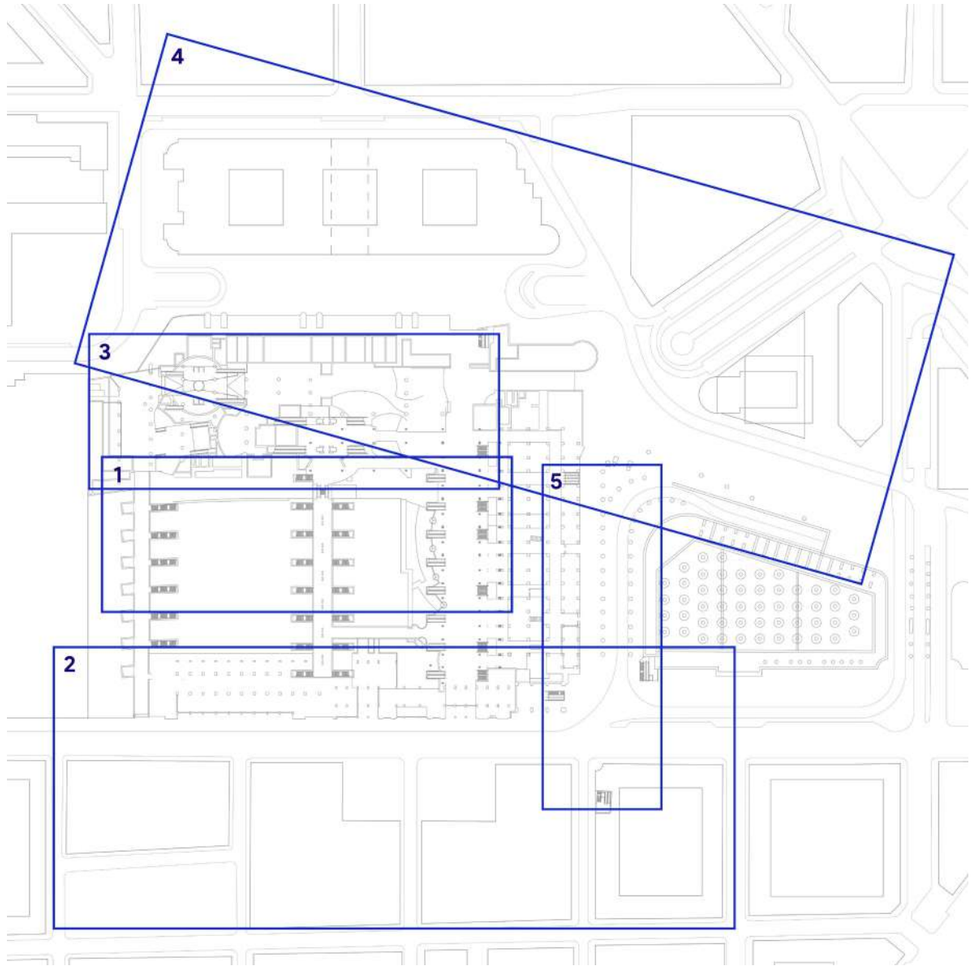


Figure 11.3: The five main problematic areas

INTERVENTION AREA

11.3.1 Limiting the Research

While al the five different areas need to be addressed to improve the public space inside and surrounding the station, this study sadly only can focus on a limited selection due to the limited time. Therefore, the intervention area for the design will be on the most problematic areas of the station.

This research will therefore focus on Avenue Fonsny and the Covered Street. These areas currently have the biggest barriers for pedestrian and other slow traffic and have the most potential for a higher quality space. This area also suffers from most of the problems identified in the literature research and is therefore ideal to address the five central themes established earlier. Furthermore, these areas suffer from problems that are also found in the other areas and could therefore serve as a representative part of the station for a full redesign. Methods applied to these areas can serve as an example how the other areas of the station can be designed.

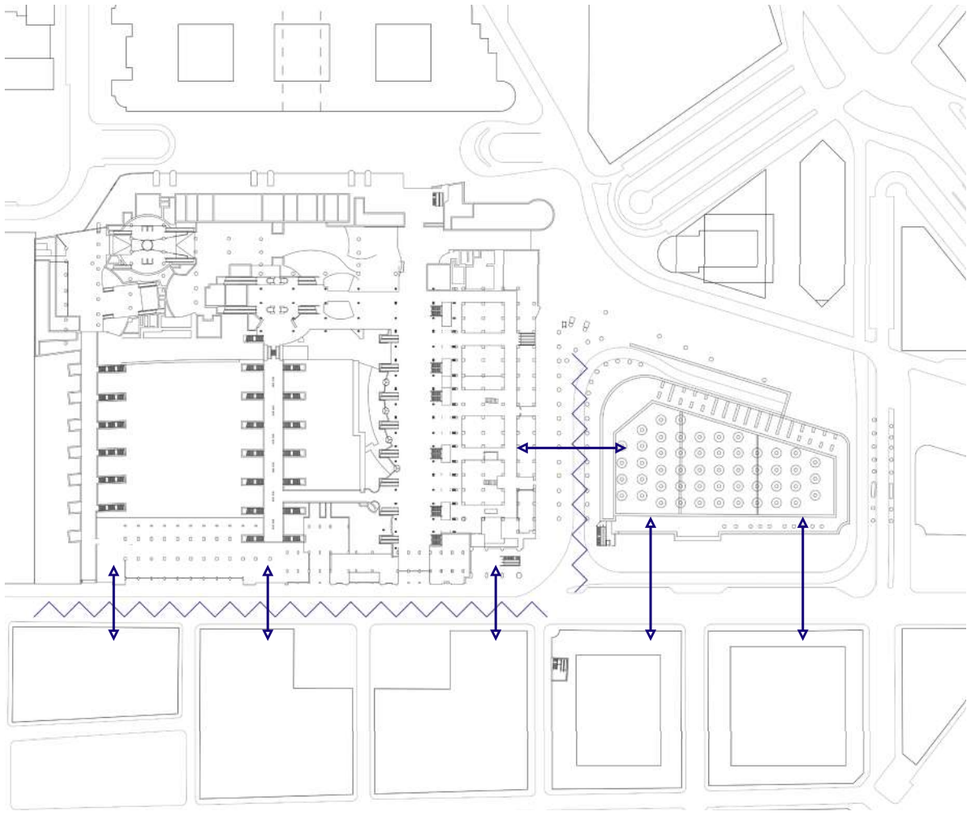


Figure 11.4: Created Barriers in Covered Street and Avenue Fonsny

11.3.2 Spaces

To be able to understand how these two areas need to be changed, an deeper investigation to the spaces must be made. Therefore, this section will dive deeper into the spaces established earlier in figure 11.1 within the two areas and how they need to change.

11.3.3 Avenue Fonsny: Bus Station

Current Situation

This area feels mostly as an extended road. While it does contain several places where buses can stop, it is not the main area. Therefore, it feels more like a normal road. While there is quite some space that looks to be only for pedestrians, it is often used for car parking. Therefore, it feels more that there is not a clear route to the centre of Brussels from this side. Besides the buses it also includes a currently unused tram stop, however the tracks itself are currently still in use by taxis.

Needed Changes

Since it is confusing that there are so many bus stops around the station, it is probably for the best to remove the small amount of stops from this location. With the unused tram stop and the removal of the buses this area can be opened a lot more for pedestrians. However, this also effects the large interchanges that are located to the northeast of the station, since these are also not nice experiences for the pedestrians. Changing the road to this interchange to be more pedestrian friendly also means that this interchange must be changed. With opening up this area, it can possible also be linked with the Europastraat.

Figure 11.5: Avenue Fonsny Bus Station

11.3.4 Avenue Fonsny: Covered Street Entrance

Current Situation

This area feels like a major interchange instead of a major entrance to the biggest station in Belgium. The area is dominated by the car and tram infrastructure. For the pedestrian it is not easy to cross the street. While they get priority over cars, they still need to yield to trams. The sidewalk beside the road is the same as other streets, which could cause issues with the larger amount of traffic that walks through here. The second major issue is the lack of connection with the areas inside the station itself. This is also visible in the entrances itself, who are also not highlighted. The secondary entrance also hosts an entrance to the metro. However, much of this path is blocked by bike storages, which can't handle the number of bikes that are currently there.

Needed Changes

The amount of vehicle traffic in this area needs to be reduced, and a proper connection with the inside of the station must be made. Furthermore, the bicycle infrastructure must be improved, with adding a proper storage area so that the station entrances aren't covered with bicycles. The priority of the area should be placed on the pedestrian and bicycle. However, I can understand that the tram might need to get priority, to make sure that they are running on time. This does not mean that there aren't interventions that can be made to improve the safety.

Figure 11.6: Avenue Fonsny Covered Street Entrance

Deeper Investigation

11.3.5 Avenue Fonsny: "Zweden"

Current Situation

This area feels mostly like a busy road. Because of the large and visible tracks to the side of the station building, you know that you are walking besides a station, however, this is not reflected in the building itself. The second entrance, the one to the south-gallery, is barely highlighted just like the other entrances to this street. Located before this entrance is an additional bus/tram stop, however it feels just like a stop on a normal road. The sidewalks besides the road are just like the other areas on the Fonsny street narrow. The walls on the side of the station are covered with tons of graffiti or are covered with a temporary wooden structure. Therefore, it feels like the building is abandoned (which, to be fair, it mostly was).

Needed Changes

While better maintenance can already help the image of the street, the street needs to be reduced in amount of traffic. Therefore, it can be better optimised for slow traffic. While it currently has a bicycle lane, I would not be comfortable riding there on such a busy street.

Figure 11.7: Avenue Fonsny "Zweden" Tram and Bus Station

11.3.6 Covered Street

Current Situation

The covered street is perhaps the most problematic area of them all. The space currently feels more like a sewer than a normal street. While the street can be accessed from both sides, the dark nature of this area makes it uninviting. The street also has multiple entrances to the shopping corridor of the station, but these shops are not opened to the street itself. The street functions mostly as a stop for the tram, bus, and taxi's that are allowed here. While the connection is great, these vehicles make the space feel more unpleasant due to the emission, noise, and barrier that they create. Furthermore, the unused space to the other side of the covered street makes this space feel isolated from the other spaces around it.

Needed Changes

The area needs a large overhaul, mainly reducing the number of vehicles using this space. This will make the space feel less crowded and will reduce the amount of hindrance. Furthermore, connecting the functions surrounding the station with the space inside will make the space more inviting and more connected while also increasing the social safety of the area. The largest change, however, would be creating lighter inside the area. With the train tracks and platforms located above it this will be difficult to archive.

Figure 11.8: Avenue Fonsny Covered Street Entrance

Deeper Investigation

11.3.7 Covered Street: Underground

Current Situation

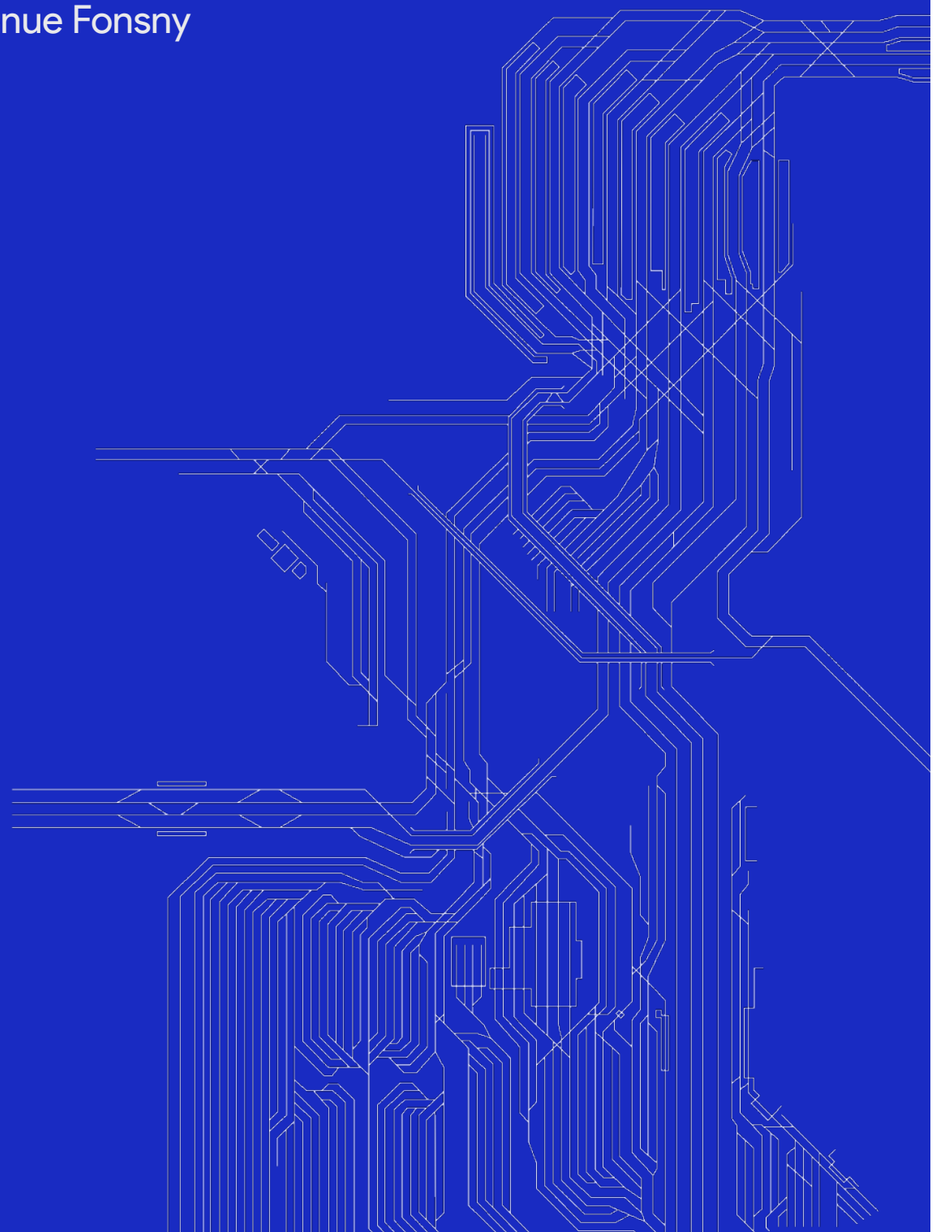
The covered street is an interesting situation since it is located below the rail tracks, but above the three levelled metro station. The level directly underneath functions as the central ticket hall for the system. While this area is as wide as the whole station combined, it feels very closed off due to the large number of fences and ticket gates dividing the area in multiple closed off section. This makes the area feel quite complicated, for what is essentially a simple room. The station makes use of the Spanish method, which means that trains have platforms on both sides, one for loading and the other for unloading. While this is the main cause for the large number of barriers in the ticket hall, it is unclear for new people how to use the system.

Needed Changes

As a start, the large amount of ticket barriers can potentially be reduced when new technology makes it possible for cameras to detect them. While this is still unsure if these systems can work, the number of barriers can still be reduced. The station makes use of the Spanish method, which means that trains have platforms on both sides, one for loading and the other for unloading. While this is the main cause for the large number of barriers in the ticket hall, it is unclear for new people how to use the system. The replacement of this system will make the waiting times for the metro longer, but it will make the wayfinding for the travellers better. And just as the street above, the area below could make use of a connection to the other areas to improve the wayfinding even more. This however can be quite the challenge.

Figure 11.9: Underground Ticket Hall

IMPROVING THE NODE



12

INTRODUCTION

12.1.1 The station as a Node

As introduced earlier in this research, the balance between the station as a node and the station as a place is important to the functioning and quality of the public space. This chapter will focus on the improvements made to the node side of the station. While the station is quite good in this aspect, there are still some areas that the station can be improved. Furthermore, changes to the node side of the station can help create opportunity to improve the place side of the station. Since the functioning of the station is still the most important aspect of a station, the node side is investigated first.

12.1.2 Main Objective

The main area in which the station falls short on is on the amount of transport facilities the station has to offer. For example, currently the station has no dedicated bicycle storage. Most of the bikes are parked against a railing at the entrance, sometimes blocking the main walking paths around the station. However, the station is looking into repurposing some of the unused area in the station for a new bicycle storage. This area is in the “Grote Vierhoek” area located adjacent to the covered street. This does mean that people using this storage will be hindered by the barriers created by the tram, taxi, and busses. This will make the quality of this space even more important.

Therefore, the covered street needs to change. The main objective for changes to the node side is therefore not highly related to the efficiency of the node functions, but to create opportunity to make the covered street a better place.

EXPLORING OPTIONS

12.2.1 The Problem

One of the most problematic aspects of the covered street is the lack of daylight. This is a result of the platforms and tracks located above the street that hinder the opportunity to make skylights to the street below. However, the platforms above are also in a bad shape; Apart from the international platforms they are made from stone tiles, which have been neglected so that the main platform is quite currently bumpy, skewed and small. Changes to the current platforms can provide opportunity to not only improve these areas but also allow for skylights to the covered street. Established in the design aspects, one of the main improvements that can be made is the extension of the platforms itself. For this, three main options were studied. These were as followed:

Option 1: *Extending the main station building to the South-west*

Option 2: *Adding an extra level above the current platforms*

Option 3: *Adding an extra level below the current platforms*

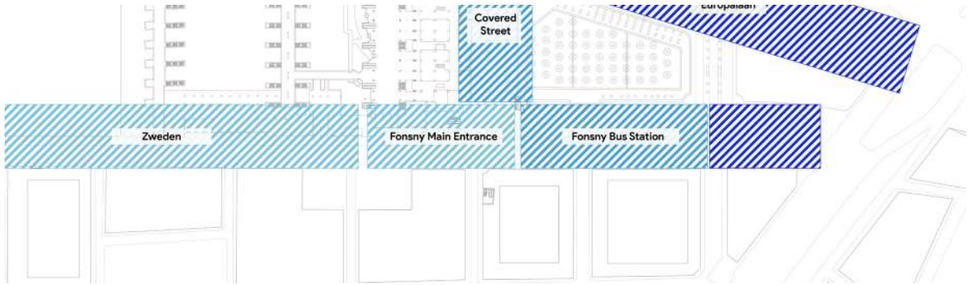


Figure 12.1: Area of extension mentioned in Option 1

12.2.2 Option 1

The first idea was giving the platforms more space by extending the station to either of the sides. The north-west side of the station offers most room for extension, while the south-east side of the station is the more logical place based on the position of the tracks and arrangement of the station. However, this would expand above the Avenue Fonsny. Since this street need to be addressed anyhow this could provide opportunity to improve both spaces, but it could also potentially create a second covered street.

Problems arise however with the old Post-office located at the edge of the station. This Building would block expansion on this side, so either the trains must be constructed inside the building or on the other side. The first option would require heavy modification to the facade and the structure of the station. The other option would split the station into two, which could cause an issue if not dealt with properly. With all these issues this would not be the most ideal option to expand the platforms.

12.2.3 Splitting the station

Other options to expand the platforms are limiting unless the station is split into multiple parts. This can be done, but it needs to be done properly otherwise it will greatly harm the wayfinding and experience of the station. Any split of the station therefore needs to be made based on the different train types that use the station. The first option would be to split the international and national trains, which is already semi-applied in the building. However, moving the international trains would require the extra infrastructure of these trains to move with them. This would mean that half of the whole building would have to be changed with would be too costly.

The second option would be to split the S-trains from the mainline trains. This is often done with similar transport modes like the German S-Bahn and the RER of Paris for example. Separating this system can also allow for easier navigation and improved operations, since the platforms can be designed specifically for these trains in mind.

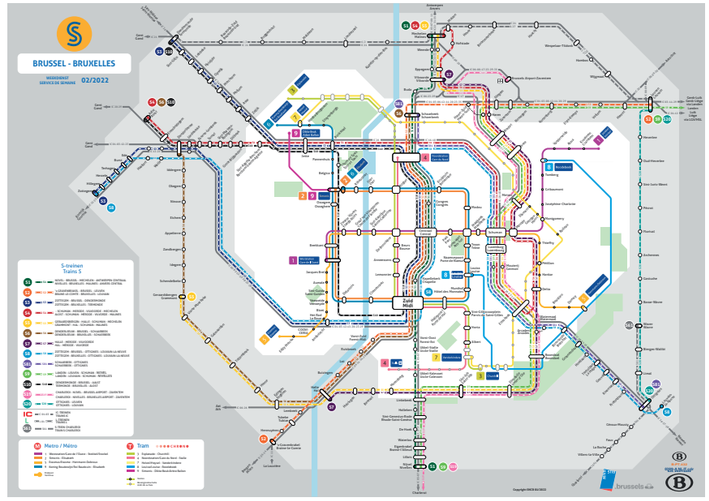


Figure 12.2: S-Train Network of Brussels. Source: MIVB / STIB

12.2.4 Bottleneck

If the S-Trains are separated from the main trains, the safety and other systems can be built specifically with these trains in mind. The throughput of trains in the station can then be greatly increased. However, this might not be useful since the station is currently limited by the north-south connection, which is a 6-Track wide tunnel that connects Brussels-South with the other main stations in Brussels. This track currently can handle 96 trains per hour, with a total of 1200 per day. This tunnel runs currently almost all day at capacity and is therefore already a limiting factor of the current throughput. The need for expansion is currently already there, but due to problems with the build of the original tunnel it is a controversial topic to talk about. However, the original tunnel was constructed around the year 1900 and technology has greatly improved, which means that the call to improve the tunnel and expand it is growing.

The current build of the new station for metro line 3 could be used to give the residences of Brussels more confidence in the expansion of the tunnel. With the increasing amount of train travel, it is expected that the tunnel will be expanded in the future. The question is more when and how. For the how, it comes to two options:

- Building an additional tunnel next to the current existing tunnels.

- Building underneath the current tunnels.

These options can influence the network, but this is outside the scope of this research. For this research we assume that one of these options will be executed in the future.

12.2.5 The Network

With the increase capacity of the tunnel, the option of splitting the S-trains from the rest of the station seems the best option. However, how this can be done is mainly based on the existing network. The current network of trains is quite complex, and alterations can be difficult to make. A further investigation to the possible opportunities to split the S-trains from the main network had to be done.

Currently, the six different S-trains using the station branch of in four different directions after stopping in Brussels-South. However, most of these lines connect to the east side of the station with the exception being S10 as can be seen below and in the image on the right. Small changes to the network could make it so that the other lines can arrive on the same four tracks, which would make it ideal to split these off from the rest of the

Figure 12.3: Current routes of the S-Trains entering the station and the space available for changes

station. This is sadly not possible for line 10 unless extra tunnels or overpasses are being constructed. Still, there is some space to create these interventions. The calculations of the ramp required are visible in Appendix 4.

The question then remains which of the options is the best to use. As a reminder, option two would be to split a part of the station to create a new level above the current tracks and option three would be to create a new part of the station below the current station.

Based on the existing network, each of the lines has enough space to rise and lower to the required level for both options except for the tracks used by S10. These tracks are passing below an overpass, meaning that there is not enough space to create the desired run without removing the overpass. Furthermore, this option would also require extensive remodelling on the other side of the station. Therefore, the best option to presume seems to be option 3.

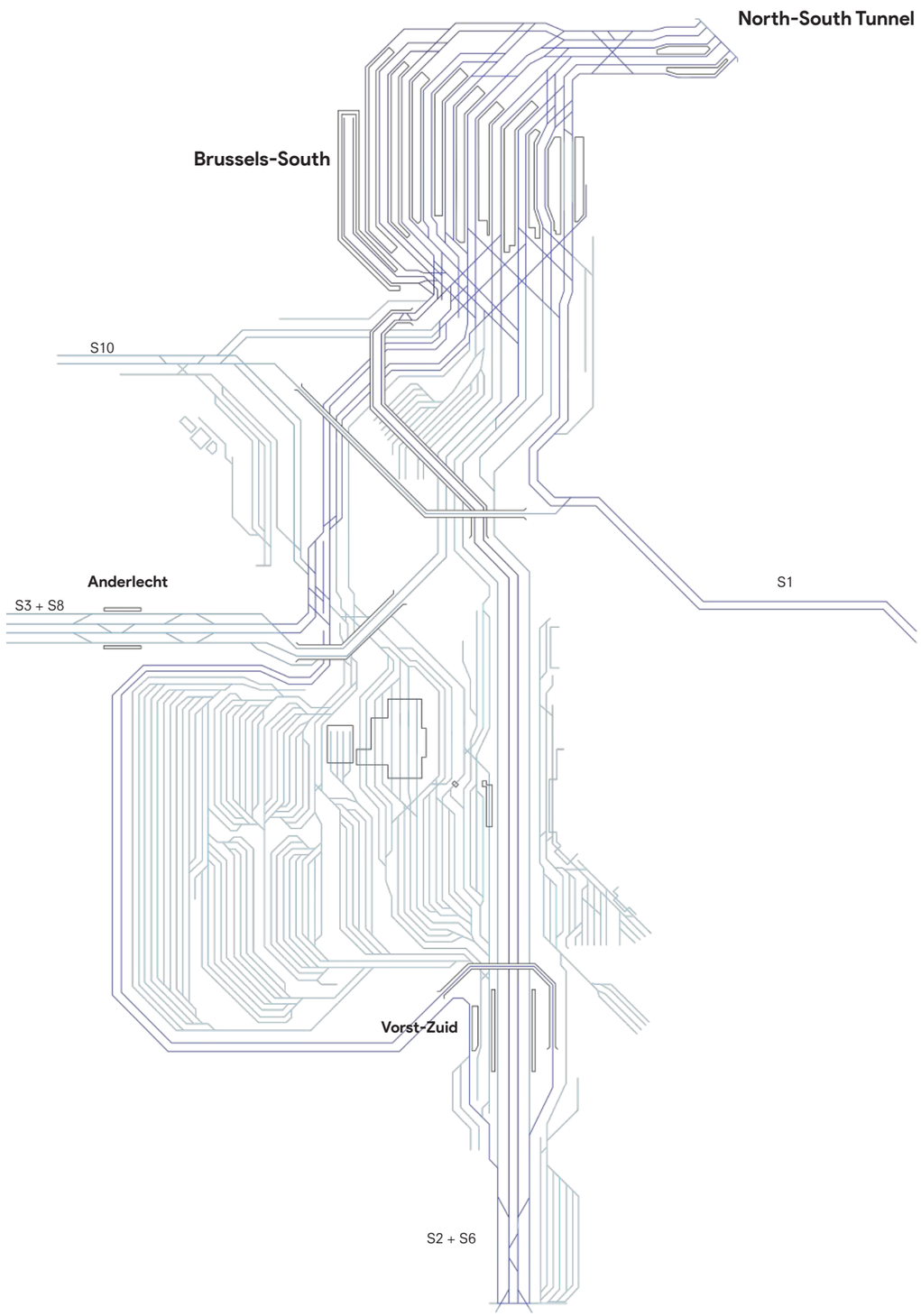


Figure 12.4: Main train network to the Southern side of the station

12.2.6 Three underground options

If option three is presumed, the question then remains where the station needs to be located. Three options were identified based on the idea of an underground station for the S-trains. Each option has its own benefits and negatives but should all be possible.

In the end, the only thing that is defining is the connection to the north-south tunnel. The tracks of the new station should be able to connect with the other tracks. While it is in theory possible to construct underneath the existing buildings, it will make the project a lot more expensive and could create a large amount of public backlash due to the history with the original north south tunnel. The best option is therefore to avoid the existing buildings for the connection with the North-South Tunnel.

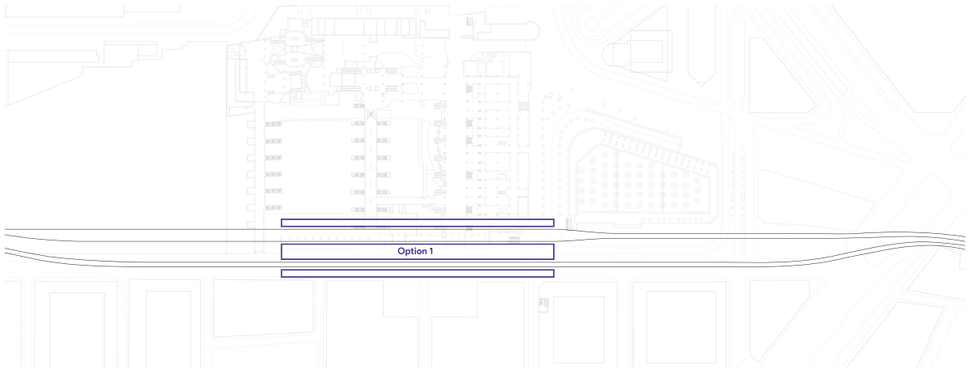


Figure 12.5A: Option 1 for the new S-Station

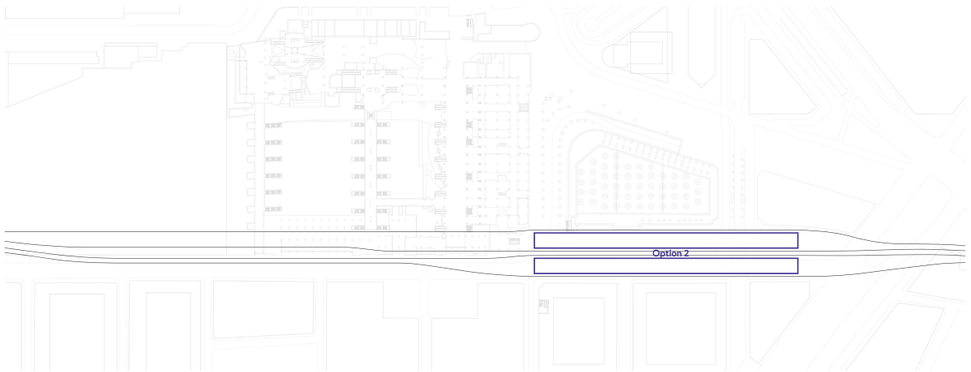


Figure 12.5B: Option 2 for the new S-Station

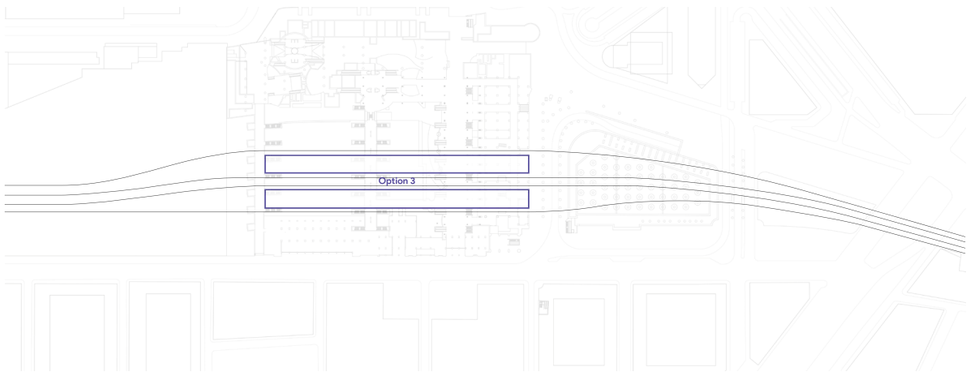


Figure 12.5C: Option 3 for the new S-Station

The remaining solutions are limiting. The best option is building underneath one of the streets , connecting further on with the existing North-South tunnel. The street however is only eight meters wide, which is not wide enough to fit two tracks side by side without potentially intervening with existing construction. It is possible to fit two tracks on top of each other through the street, but this requires space for trains to decent to this level. This means that option 2 is not possible, but the other should still be doable. The calculation for these slopes is again available in Appendix 4. Furthermore, this does limit the number of tracks that the station can have to only two tracks, since there is not enough space to create a switch and a ramp descending to the right level.

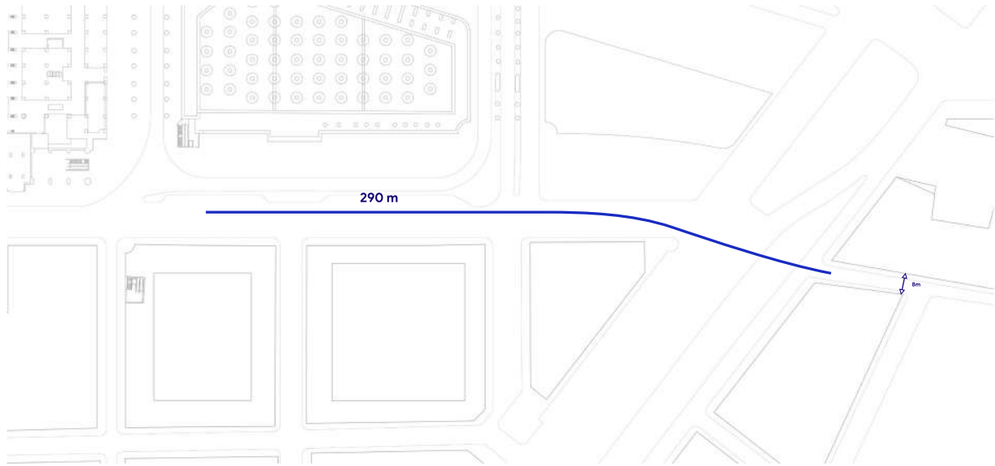


Figure 12.6: Possible Route and area for an slope in option 2

12.2.7 The final location

This limitation is not the end, since the optimisation of the safety system and the platforms for the S-trains can allow the trains to run faster after each other, which makes two platforms enough for all the existing S-trains using the station with a little room to spare. This limitation also makes it possible to construct the station underneath Avenue Fonsny without interfering with the existing construction of the Station Building. The station should be located directly underneath the street to avoid clashing with the existing metro tracks. This proximity closely to the metro could improve the connection between the local S-trains and the local metro systems.

Both option 1 and option 3 could be possible for this station. However, since it is possible to create additional platforms without interfering with existing foundations option three is the best and most logical choice for the station.

Improving the Node

PLATFORMS

12.3.1 Optimisation of the platform

With the removal of the S-trains from the regular platforms, the leftover trains can be divided along the other tracks to potentially create space for a skylight to the covered street. With the current capacity of trains through the north south tunnel of 96 trains per hour it is almost possible to put the remaining trains on only use four tracks of the six inside the tunnel. The others can be used then for the S-trains. With only four tracks connected to the station, a simple estimation can be done to calculate the number of platforms needed for the mainline and international trains. The general estimation is based on two platforms per track. This would mean that the number of platforms could be reduced further to only 8. Further calculations, seen in Appendix 5, would optimise the number of platforms based to 10 through platforms and two terminating platforms. This would mean that a large sum of platforms from the current station can be removed. This makes it possible to close every other track, as seen in the image below.

The new space can be used to connect the two platforms into one larger, or to use this space for a skylight. Furthermore, this new space on the platform can be used to place more amenities and other interventions that can help create a better space.

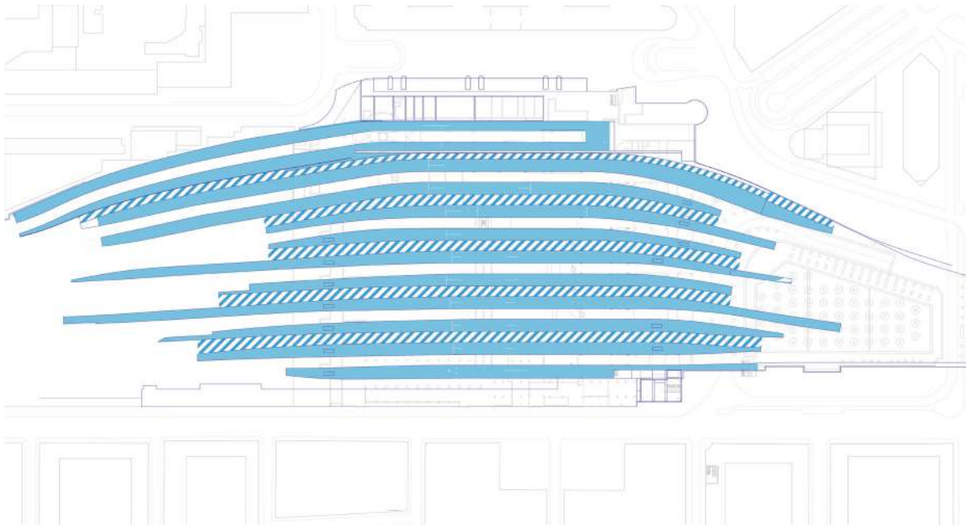


Figure 12.7: The reduction of the amount of platforms

Improving the Node

TRAM NETWORK

12.4.1 Creating more space

With the reduction of the number of platforms for the trains it is possible for a skylight to be created to the covered street. This will make the space lighter and would already improve the current space. However, this would not solve the issue of the large barrier created by the existing tram, busses, and taxis. These would have to be reduced to make this space even better.

To start, the current system of busses and taxi stands is quite confusing since they are located all around the station. While there are still busses that stop inside the covered street, most of the busses are using a bus station located to the north-west of the station. It is therefore more logical and better for the quality of the space to reroute the remaining busses to also make use of the existing bus station. The same can be done for taxi stands, which can be merged with the existing location located next to the bus station. Sadly, the situation for the tram is more complicated. While the situation would already be greatly improved if only the tram remained, the tram is still a large hinder to the experience. This is largely because of the tight curve that the tram takes through the street which cause a large amount of noise. Furthermore, the existing route that the tram takes is quite complicated which is harmful for the wayfinding of the travellers.

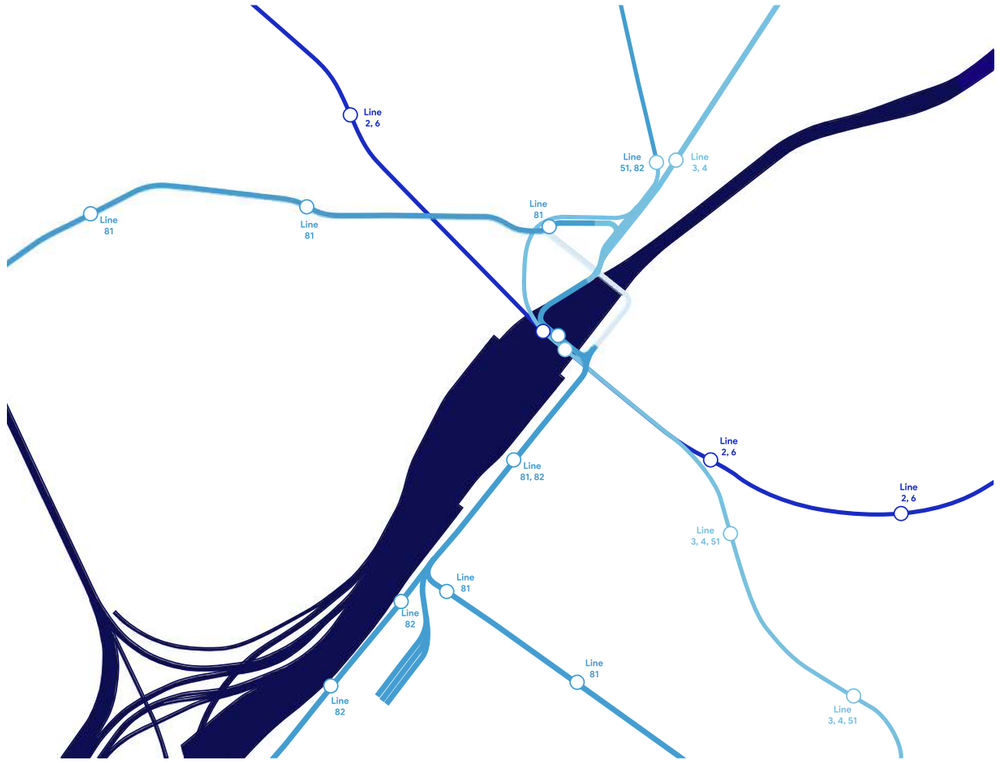


Figure 12.8: Current network of transport modes around Brussels-South

12.4.2 Understanding the current system

The current route of the tram is based on the connection with the pre-metro that also serves the station. The current space, visible in the image blow, allows trams from other lines to enter the pre-metro network or the other way around. However, this will become mostly obsolete with the change of the pre-metro lines to a fully fledge metro line. Since the metro can't cross with the other trams and can't use the existing Lemonnier station, a new station will be constructed to the side with a new connection to the existing tunnels leading to the Brussels-South metro station. In the end, the result is that the trams still take a large detour that mostly serve no purpose anymore.

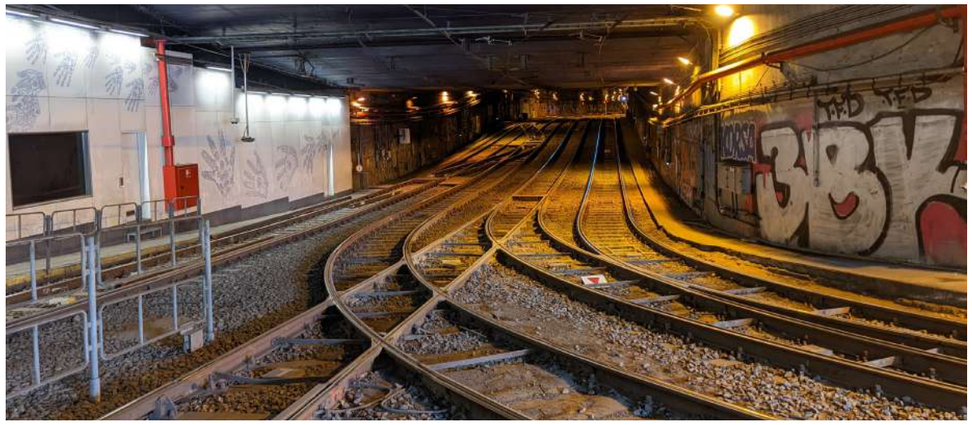


Figure 12.9: Intersection between the Pre-Metro Tram tracks and the other Tram tracks underneath the street

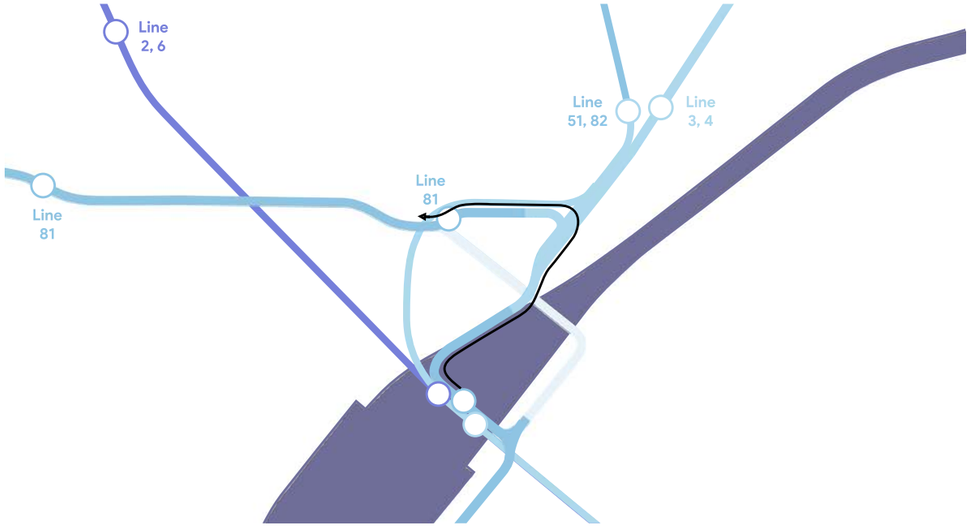


Figure 12.10: The complicated route trams currently take underneath the station

12.4.3 Creating a new Solution

To solve this problem, the proposal is to reroute some of the lines and making use of an already existing alterative route and a new tunnel that makes use of an existing but unused tunnel. As seen in the images below this new tunnel connects with the existing tram tunnel and would allow the possibility to remove all the trams from the covered street.

Overall, the new route of the tram and the reduction of the platforms should create a more streamlined station, with more capacity and improving the wayfinding. Furthermore, new S-Train station improves the connection of the S-train network with the local Metro systems while the changes give more opportunity to create a better place.

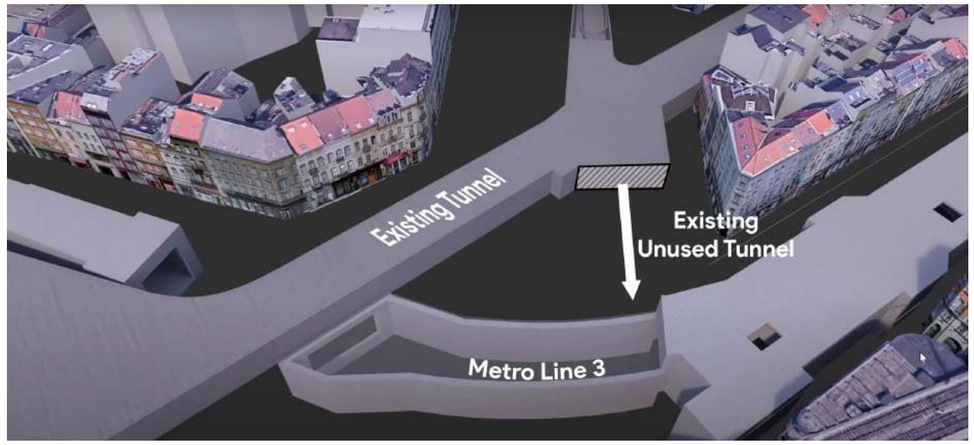


Figure 12.11: The location of the new underground tunnel and station for metro line 3 and the old tunnel

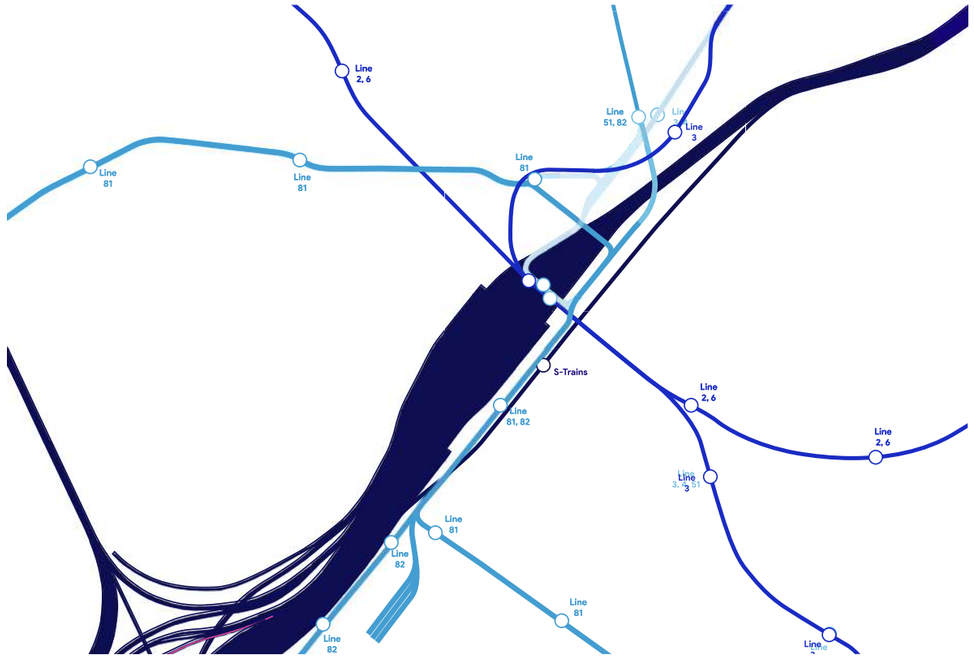


Figure 12.12: The new network map

AVENUE FONSNY

12.5.1 Restructuring the Street

The last area that needs to be discussed related to the node function is the Avenue Fonsny. This street is currently a busy car, bus, and tram street. With this street being so close located towards the station building it is a major barrier for the pedestrian using the station. The current masterplan does plan to reduce this barrier. The current plan is to reduce the amount of space taken up by the large road, so that there is a little more space for the pedestrian.

However, this is not enough to improve the space massively. Therefore, the proposal is to limit as much traffic from this street as possible. This starts with the cars. The current street experiences a relatively high amount of traffic. This traffic however is mostly through traffic, not going to one of the buildings along this street. The proposal is therefore to move the regular traffic to the parallel road to the southeast. This street is currently almost empty, but there is enough space to fit the current amount of traffic. This would allow the through traffic to still move through the area while freeing up the space on Avenue Fonsny. This would mean a restructuring of the road network. Furthermore, this would also move the connection of Avenue Fonsny with the Zuidlaan more to the south. This would create more needed distance between this intersection and the other large intersection of the Jamarlaan and the Zuidlaan, allowing that area to be transformed to a more pedestrian friendly intersection instead of the massive traffic node that it currently is.

The removal of the cars also allows more space for the tram tunnel. While the existing tunnel does exist, it is expected that the slope to the surface needs to be redone due to the addition of the S-Train tunnel underneath the street. The removal from the cars makes it possible to add this tunnel without removing a lot of space for the pedestrians in this area. The calculation of the slope for the tram tunnel can be found in Appendix X.

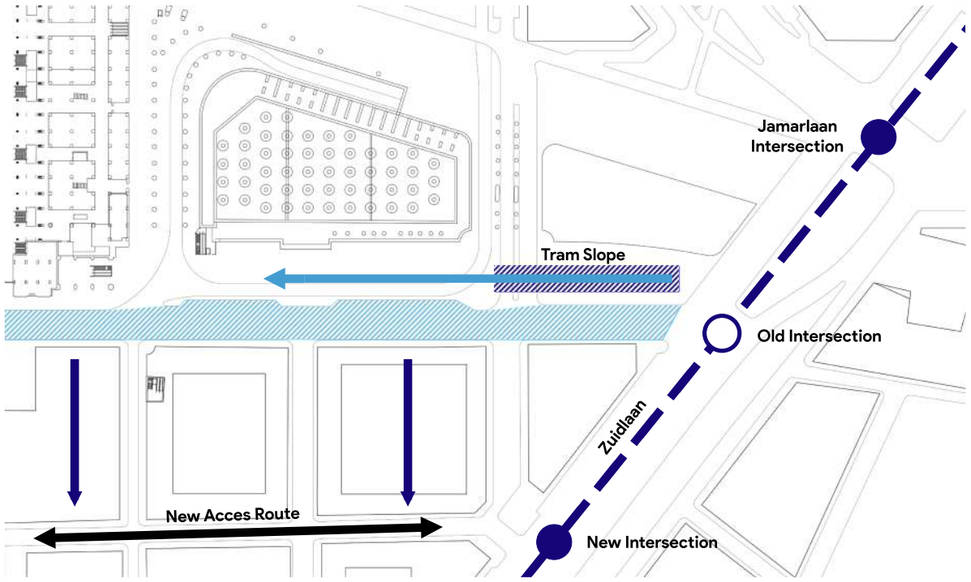


Figure 12.13: Proposed changes to the road system

With the cars removed from the street only the busses and tram remain. With the bus stops on this side of the station being moved to the central bus station, it can be expected that the busses can be rerouted to no longer make use of Avenue Fonsny. For the tram however, it would require to many changes to the network to remove these from the street. Furthermore, it is still essential to have a transport mode connect with this side of the station which the tram can serve.

Therefore, the current proposal is to transform the street to a shared space. The Pedestrian and cycle traffic would be the main users of this space, with the tram being a guest. The tram would travel through this area on a slower speed. Furthermore, the space that the tram uses could be used by delivery vehicles on select quiet times. While the idea of creating this shared space can sound problematic, similar approaches in other areas have been proven successful. Examples include the Leidsestraat and the area behind Amsterdam Central Station in Amsterdam.

Figure 12.14: The Leidsestraat in Amsterdam, Netherlands. Source: Wikimedia commons

CREATION OF A PLACE

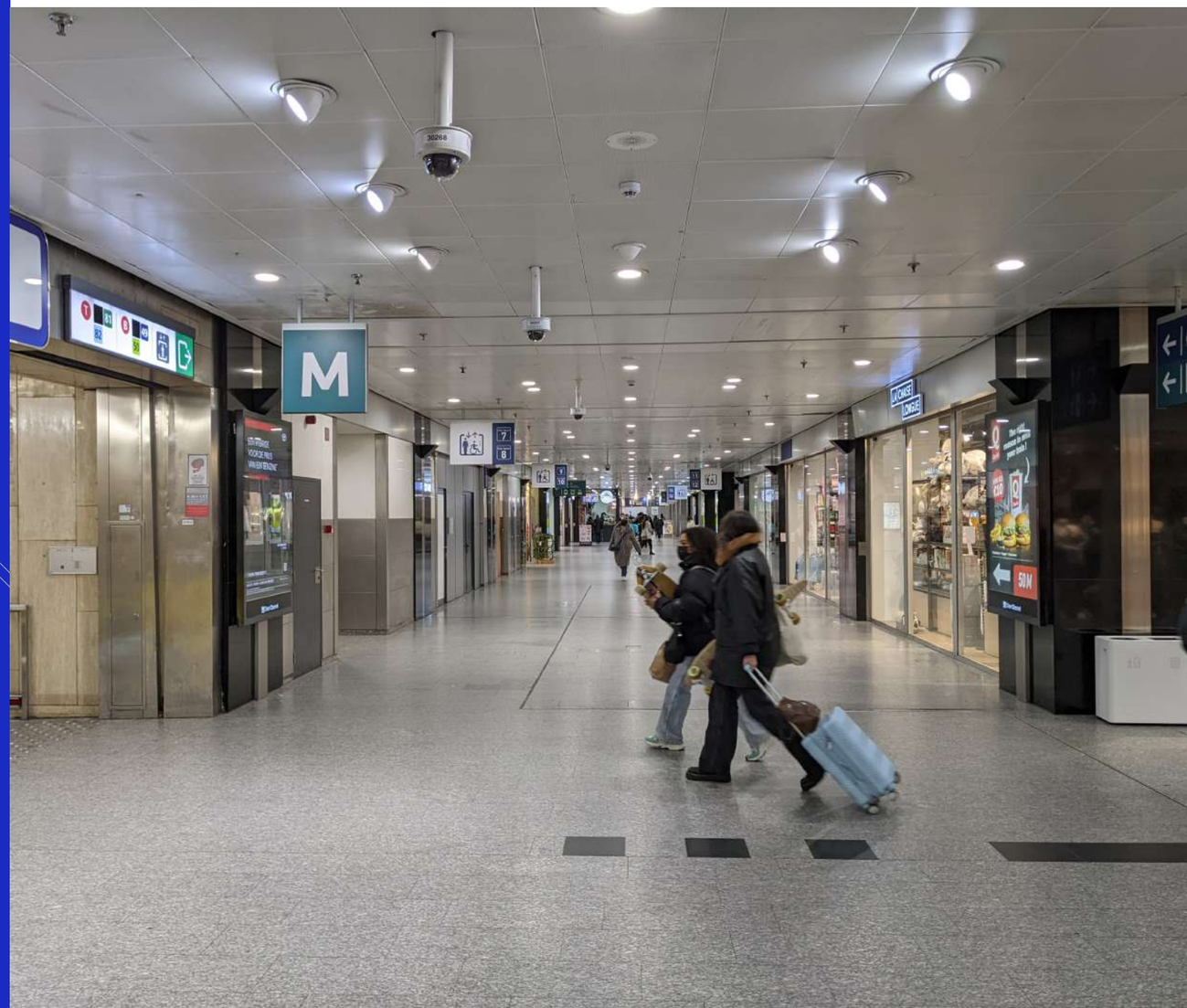
13

INTRODUCTION

13.1.1 The station as a Place

With the changes made to the Node side of the station, changes can be made to create a better place. This is a bit more complicated since quality and place are more subjective than efficiency. Nevertheless, the spaces can still be improved using the lessons, themes and design aspects established earlier. Before this can be done a further study needs to be done to establish a goal for the area and understand what this area needs. This section of the research therefore focusses on the wishes for the different areas that will be transformed. The focus will be on the function that these spaces need and how they could work in relation to the station.

Figure 13.1: The shopping corridor inside the station



THE PLATFORMS

13.2.1 Wishes

To start, first it must be established what the spaces should offer. The current public space is lacking in several ways which will need to be understood. This starts with an investigation to the wishes for the platforms. While not directly the area of intervention, it still has a large influence on the possibilities for the covered street. Furthermore, this investigation can help with the design of the platform of the new S-Train station.

13.2.2 The Rail Platforms

Established earlier in the research is that the platforms in stations are often lacking in quality and Brussels-South is not different. With the proposed alteration to the network there is much more space on the platform to do something about it. For the platform, the following things are important to create:

- Quality waiting areas
- Light connecting to areas below
- Highly visible elevators / escalators
- Greenery
- Climate Protection

Another topic on the platform is commercial functions. These functions can be beneficial to the platform, however it could also harm the main transport function. Simple commercial functions like a stall can easily be placed, however more longer staying functions like a cafe can often cause more harm. However, they could be suitable for the international platforms since passengers are generally waiting longer for their train to leave. Even then, the area should not be closed off to prevent separation. This could cause issue with payments with potential non-paying customers from fleeing with a departing train.

Staying functions can still be considered located close to the platform, perhaps below. These functions can be ideal for people who must wait for a delay or cancelled train or in general for the international trains. These staying areas can also take shape of a quality waiting area.

Figure 13.2: Current state of the mainline platforms

In other words; an area protected from external climate effects and offers more services than just a simple bench. While it is ideal that these areas are located on the platform, they can also be located below next to the access stairs and escalators to the platform. Ideally, it should still be possible to see the train arriving tot the station.

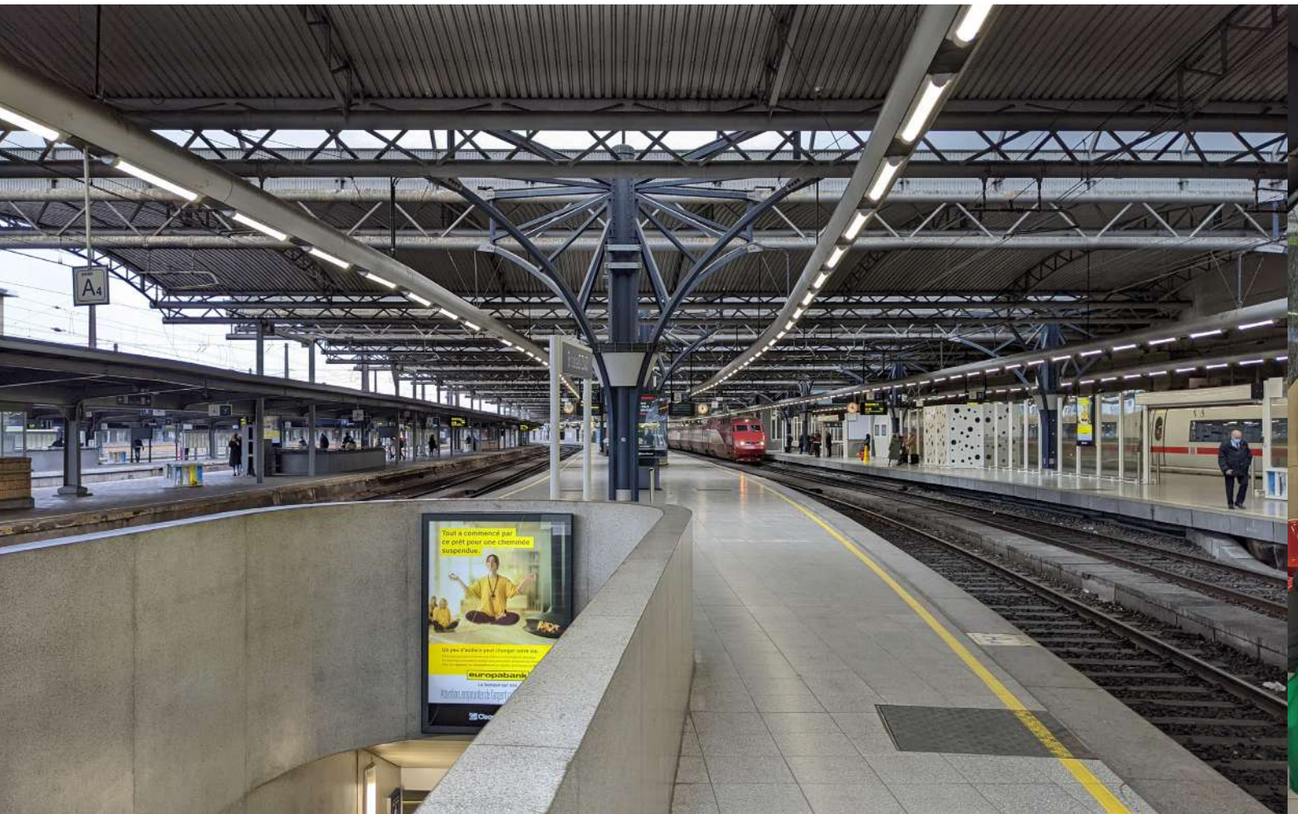
A crucial element to the platform is the relation with the roof. A low roof can make the space seem wider, but when a train stops at the platform it will close of views to the other areas of the station. Combined with the increase in passenger numbers can make the space feel crowded and small. Playing with a difference in height can also direct people since people are more likely to walk towards a higher and more open area. The roofs for platforms are often supported by one or two columns in the width of the platforms. The layout of these can influence what kind of spaces are created. If two columns are placed on the platforms, it can create an extra space in-between. This can separate the platform into two main boarding areas whiles the middle space can have its own purpose. This can only be done if the platform is wide enough and that the space is used. Otherwise, the supports can feel more obstructing.

These aspects relating to the platform is mostly based on platforms for trains. Platform for metro works a little different. Since these are traveling more often and with more capacity, a dedicated waiting area is less important. This does not mean that it can not be added, it can still help create a nice space if treated correctly. For the design itself, the width of the platform will allow most of these changes made. For the train platforms the aim is to create a wide platform with a variating ceiling, with high areas near access points of the platform.

The space that used to be other sets of platforms can be converted to the waiting spaces, voids and possible some commercial areas. While the aim is to make the space on the platforms as nice as possible, it still should remain a platform. This means that people should not come to the platform without having the intention to board a train. Otherwise, they could make the spaces unnecessarily busy

To conclude, the overall goal is to create a green uncluttered platform with quality seating, where waiting feels not so bad. It should be a area protected from climate while still having access to daylight.

Figure 13.3: Current International Platforms



THE COVERED STREET

13.3.1 The Metro Platforms

For the metro platforms the general approach is similar. Due to the limited space, it is not possible to make these platforms wider than they currently are without remaking the whole underground station. Therefore, there are two approaches that can be done with the station.

These options are depended on the boarding system. The current station uses the Spanish Method. This means that each track has two platforms, one for loading and the other for unloading. While this system can be more efficient, the current execution is lacking. Since the station has two platforms located above each other, it is not possible to change between levels without standing on the wrong platform. The only alternative is to go up to the ticket hall to change sides and to go back down.

Changing the system can allow for a lot of opportunity, but it will require large changes. First off, one of the platforms can be removed. This can create space for a visual connection to the other layers or for other things to make the space more attractive. This does mean that the current escalators need to be adjusted to work with only one platform. Furthermore, it is also likely that the platforms will be more crowded. This can be prevented with widening the platforms, which would require to more the tracks. This is in theory possible since the metro tracks are inside one wide tunnel. Moving the tracks closer to each other would open space for extending the platform, but it would be costly. The other option would be to keep the Spanish method, but to solving the current issues would be difficult in the limited space.

To understand which option should be chosen depends on the wanted function of this area. The area is currently one of the darkest and closest area of the station. Allowing more natural light to this area can improve the space drastically and help with the wayfinding. Furthermore, opening up the space can help ventilate the often-warm metro systems.

Figure 13.4: Current Metro Platforms

13.3.2 The Ticket Hall

Another thing that can influence the choice is the approach to the ticket hall and the covered street above it. Since the changes to the node side of the station allows for the creation of skylights, it could be interesting to continue this trend to the levels below. Therefore, the wanted function for these two areas need to be established first.

The function of the ticket hall is currently mostly a space of traveling. While it does have a large section dedicated to selling tickets, most of the hall is purely for access to the two metro levels. If the Spanish method is removed, a large amount of this space will become unnecessary. This would create the space required to make a visual connection to the platforms below. The space of the ticket hall is also used for some commercial functions. These spaces are still welcome, but they are disconnected from the other shops located above. It could be interesting to establish a connection between these different levels and allow them to function as one.

This area could also be interesting to introduce a new function. Metro stations around the world are often used to display artworks and other elements connected to the area. Since Brussels-South does not have this, it could be interesting to create an area that is dedicated to displaying artwork from the local area. The large amount of traffic is ideal to create this expo area. This area can be designed in such a way that it will not harm the navigation and flow of the space for the regular traffic. This space can have a double function, as it can also be used as a space for people to meet and wait. While waiting is not technically needed for a metro system, it can still be useful for meeting people or waiting on other travellers.

Figure 13.5: The Current Ticket Hall

Creation of a Place

13.3.3 The Upper Level

The upper area of the covered street is mostly a place for transportation. But with the proposed changes to this area this means that this function will be removed. The leftovers pace is then mostly a space of travel, without any other functions. Without introducing another function this will still not become a pleasant and attractive space. Most functions that would fit inside this area could also work in the ticket hall below. Because of this, there are two approaches towards this area

The first option is splitting these functions across these two areas. Both areas then function as an extension of one other. The leftover space could be used to create more stairs and escalators between these different areas. Furthermore, more voids can be created to allow natural light to go all the way down to the lowest level of this complex street thanks to the addition of the skylights on the train platforms.

The second option is to combine the two floors as one. This is a more dramatic intervention but could open the space to improve the wayfinding and allow even more light inside the underground parts. This option would work the best if the floor on street level is removed, since the level of the ticket hall is too essential to the functioning of the space. This option would harm the ability to walk around on this level, but with properly placed bridges this can be prevented.

While all the options for the metro station and the levels above could work, for this design the choice will be on the more dramatic approaches. This research is meant to show the potential in the creation of quality space inside and around train stations. It is therefore that the option for the best space is chosen, even if it is the more expensive option. This would mean the removal of the Spanish Metro, the creation of voids and the removal of the street level in the covered street.

Figure 13.6: The Current Covered Street

Creation of a Place

AVENUE FONSNY

13.4.1 Creating a better space

Another problematic area is the street located to the southeast of the station. This street, Avenue Fonsny, is currently dominated by the cars, trucks, buses, and trams. This creates a large barrier for the slower traffic using this area. With the proposed S-Train station underneath this street, it is the perfect opportunity to remodel the space above it as well.

13.4.2 Establishing a Connection

One of the central problems with this street is the lack of connection between the inside of the station and the outside. The currently planned renovation of the building does not entirely address this problem. Extra connections are added between the inside and outside, but these still suffer from the problem of recognisability. With the addition of the new entrance tot the office, more confusion can be caused with which entrance leads to which area. As a solution, the main entrances to the station need to be highlighted better. This can for example be done by extending the building on the ground floor and letting the functions of the inside spill over to the outside. This extension could then highlight the entrances of the station more clearly.

Another area that this street needs to do is to connect the existing building to the new underground station. This station will be accessed from this street since other routes are not without building underneath the foundation of the existing buildings. It is therefore that an intervention is required to connect this new station with the existing building and allow for a connection between them that is protected from rain and heavy winds. An intervention like the extension of the plinth in a new building could be the solution, but this also has downsides. Extending the building would mean that the street will become smaller. Since the tram will remain in the street, it is necessary to keep enough space for the tram without making the space uncomfortable.

A possible solution would be a hybrid space. Space that could be considered part of the station while still being mostly outside. This space could connect the existing building with the surrounding buildings, while protecting the street from most external climate effects. This option would extend the station without removing much of the space in the street, allowing for the creation of a wide shared space with some much-needed room for greenery.

This hybrid space alone is not enough to improve the integration between the different the station and the surrounding area. Ideally the space should also offer additional functions and the activation of the plinths to create the desired effect. A deeper study to the possible new functions is therefore required.

Figure 13.7 (Right): Avenue Fonsny and the many lanes of traffic

13.4.3 Establishing the functions

The new proposed hybrid space is the ideal place to add a function that helps make the transport hub more than just a transit hub. To create a better space, this new space should have diverse functions that should not be in the surrounding buildings and to help prevent the monoculture that the surrounding buildings currently create. To understand which functions are needed, the current functions of the surrounding building and the Post Office building need to be identified.

Starting off with the Post Office building, the building has been mostly been abandoned since the acquisition of the le-post building by SNCB / NMBS in 1997. While the new renovation and expansion of the building by OMA will change this, the long-time abandoning of the building was seen as a negative thing for the surrounding area. Initiated by the Municipality, an organisation started with a temporary occupation to offer functions for the community. This organisation, called Le Tri Postal, claimed that there is a need for functions in the associative, cultural, and social sections. In beginning of 2022, before the construction of the new office, the space hosts the following features:

- A Multi-purpose space dedicated to body practices
- A bicycle delivery cooperative
- The Spanish Inn, an incubator that helps support social, circular or solidarity economy project
- An Artist Studio
- A Large multi-purpose room + Bar

These functions will sadly be removed when the NMBS / SNCB will move their offices to the renovated building. And while the new building will get a new public floor, most of the functions mentions above will disappear. Since these functions were organised and created by the community of this area, it can be said that the need for these functions is still here. Since these functions have no alternative location, it would be ideal for the building to create a new place for these functions. Some of these functions can be repurposed for the new hybrid space suggested for Avenue Fonsny, but others would require their own dedicated space. Ideally, they would be located at the street, but the space around it is limited. Therefore, an alternative location was found which will be addressed in the next section.

Besides the wanted function, the desired feeling for the street is also important. The aim based on the wanted orientation is to create an area that would contrast the busy inside area and create a more relaxed and calm feeling. This needs to be done without blocking the large number of entrances that are in the street. It is therefore that the street needs to be transformed to a large semi-open space, with different functions for different sections. The main purpose is to create a green place where people can wait and meet each other in between central areas for walking. This method would allow the entrances of the building and S-Train Station to still function. The quieter areas in between would be stimulated by functions in the plinths of the surrounding buildings. As an example, the bar function that was in the old Post Office would be a perfect function to be reused here since it can also bring activity later in the evening.

The final design will therefore need to be a hybrid area, that would function as the central access point on this side of the station while also offering quieter green spaces in between the busy entrances. The proposal is therefore to create a lightweight roof structure consisting of mostly glass, to allow a dry and protected passage through the street while remaining mostly outdoors and without obstructing the view to the renovated Post-Office.

Figure 13.8 (Left): The old abandoned Post Office Building

THE INTERCHANGE

13.5.1 A new entrance

The last area that needs to be addressed is the interchange between the covered street and Avenue Fonsny. On this location a new central entrance is proposed that would function as a parallel to the entrance on the other side of the covered street.

This new entrance needs to be clearly visible and would function as an entrance for the main station, the shopping area, and the main entrance to the covered street. This section would therefore be one of the busiest places on this side of the station. It is therefore that this location is the ideal place for some of the old community functions that were in the Post Office building. This would allow travellers to interact with the community of the area while also placing the needs of the community in a central accessible location. The functions however do require a dedicated space, something that is currently not there on the location. The new entrance building should therefore be created large enough to offer these functions.

While this area will serve as the main entrance, the space in front can serve more functions beside a space for travel. This area could be the first opportunity a traveller can get from the city. It is therefore important to create a central area that can provide information and experience that represent the city and the area. The proposal is therefore to create a multi-purpose space that can be used by the community and act as a central meeting area. This space can be filled in differently depended on the time and needs at that moment. This can include exhibitions, small shows, or celebrations. It is therefore that the space needs some space that can be transformed to a podium, preferably with seating. The exact proposal will be decided during the design phase of this project.

Figure 13.9 (Right): The Current entrance to the Covered Street and Metro

MOVEMENT

14.1 | Accessibility

14.2 | Travel Speed

14

ACCESSIBILITY

14.1.1 Introduction

Central to both the node and the place side of the station is the navigation and routing. How spaces are accessed and how these routes are experienced is important for the redesign of the station. This chapter will dive deeper into how the current problems related to movement are solved and how the experience is improved.

14.1.2 Access to the Rail Platforms

While most improvements can be made to other places, the most important access route is the route to the platforms, both the trains, S-trains, and Metro. The current method used by Brussels-South is quite good, but with large changes to the node there are some areas that need to be changed.

The rail platforms in the station make use of a three-corridor structure. These corridors, referred to as gallery's, are located below the main tracks on the ground level and have stairs and/or escalators to the platforms above. While this system is quite extensive, the large disconnects between the corridors and the outside spaces harms the system massively. It is therefore that this is the first aspect that will be changed. Breaking through the middle corridor to the outside and adding extra connecting hallways between the corridors will make the system easier to navigate and more effective.

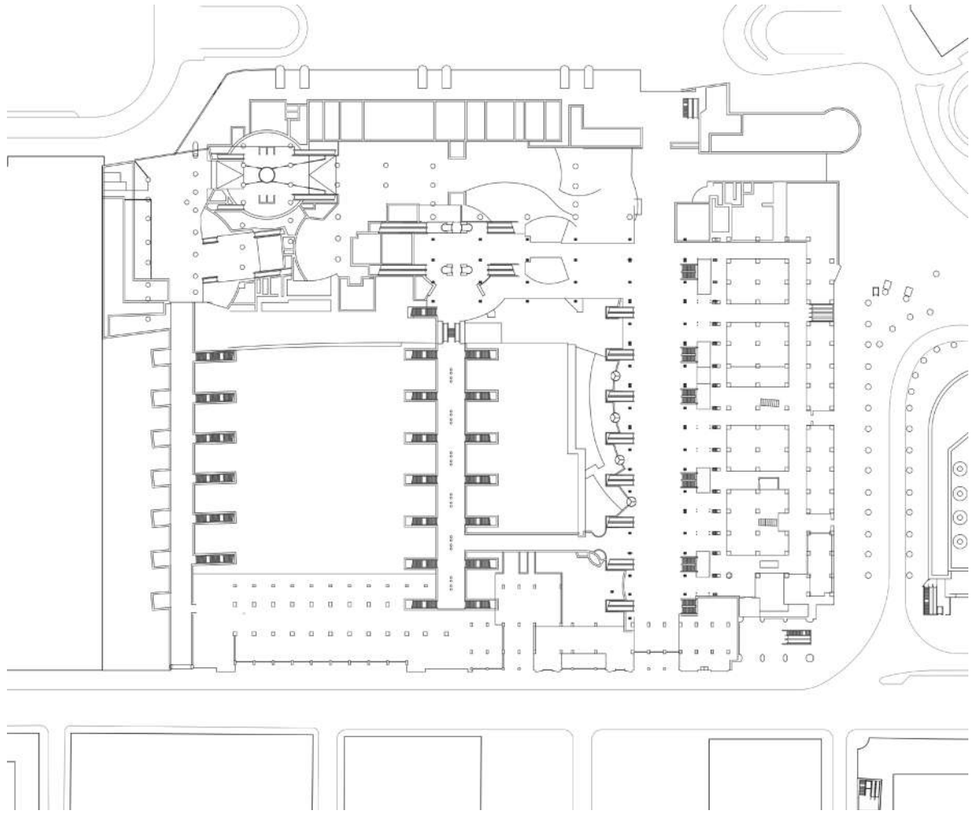


Figure 14.1: The three main corridors of Brussels-South

The access to the platforms will also change with the restructuring of the platforms. Combining the platforms means that most platforms have two places of accessing the platform side by side. While this is not a problem, the space can be rearranged more efficiently. It is therefore that on the place of the removed tracks a new void will be created, where the escalators and stairs will be moved to. The void helps create a connection between the platforms and the space below and combined with natural light can make the stairs and escalators stand out, which will help with the navigation and wayfinding of the station. Furthermore, this rearrangement allows for more space between the escalators and the trains on the platform to prevent possible bottlenecks.

While the method for accesses for these platforms remains similar, the new station for the S-trains will require a new access method. Since the station is located outside the boundaries of the current station, it is important to keep the connection between the new platforms and the regular platforms. As discussed in the previous chapter, a hybrid space can be the ideal solution to keep this area outside while still protecting it from weather. Furthermore, to keep the connection of the platforms it was decided to place the escalators and stairs in the same line as the stairs for the regular platforms, as long as they don't interfere with major entrances of the building. The new stairs and escalators would connect directly to the platforms since there is no space to create a separate ticket hall. This does mean that the platform needs to allocate space for ticket machines however the platform should be wide enough to allow for this.

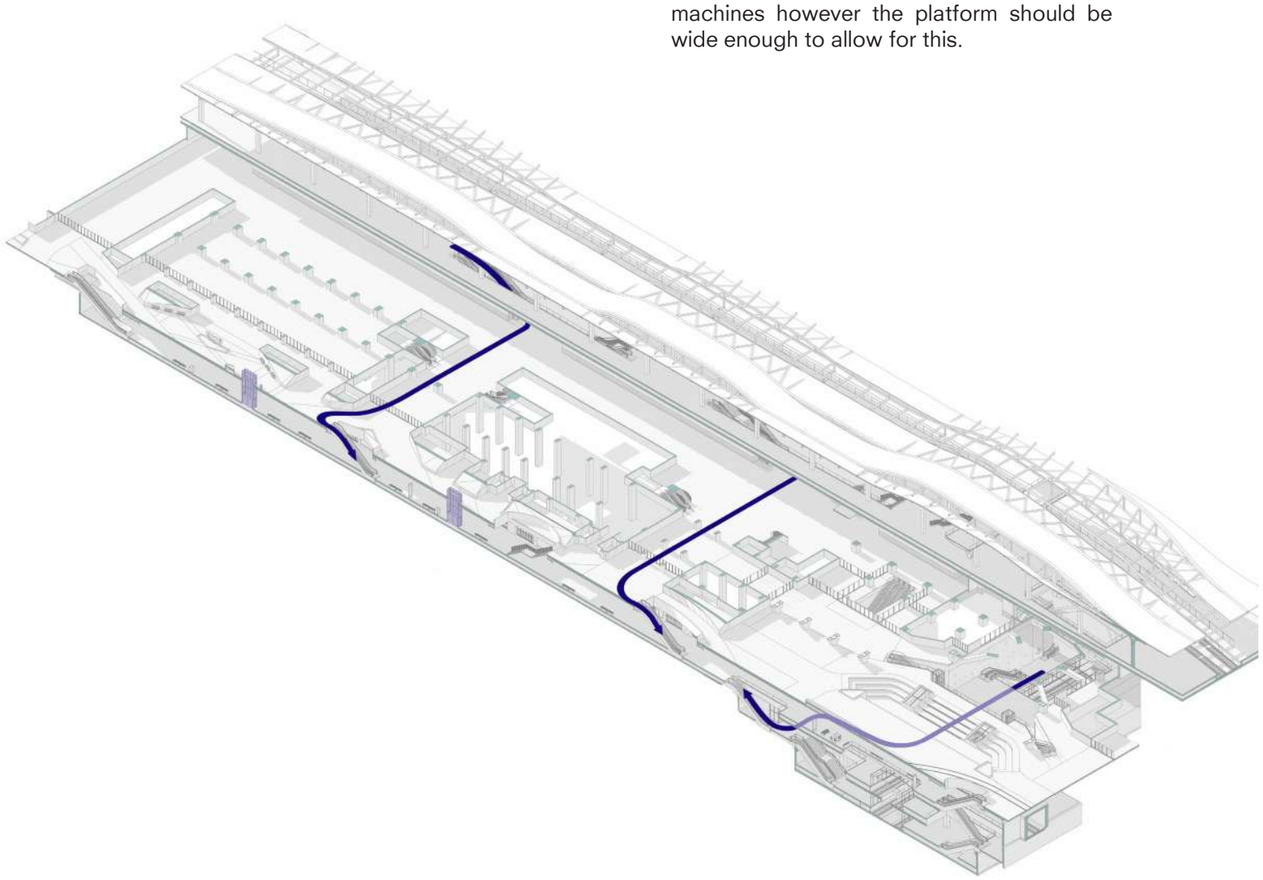


Figure 14.2: Accessfrom the three main corridors to the S-Train Station

14.1.3 Metro Station

For the metro the situation is more complex. The proposed changes to the station would make the current method of accessing the platforms and station no longer function correctly. It is therefore that massive changes will be made.

To start, the removal of the Spanish method on the platforms means that there need to be more escalators going both directions on the leftover platforms. With the proposed method, there should be enough space to place two escalators side by side, which should help solve most of the problems.

Furthermore, the central ticket hall remains and keeps the same function as hub. New escalators will be added connecting directly from the covered street above to this level to make a better connection to the surrounding shops above. Other additional escalators will be placed at the location where the metro platform connects with the new S-train station, allowing for immediate interchange between these two modes of transportation. These escalators can also be used to change between the different levels of the metro stations to allow for better connection between these two platforms. Adjacent to this area a new escalator will be added to create a direct connection to the new entrance area on the ground floor to improve flow and connectivity.

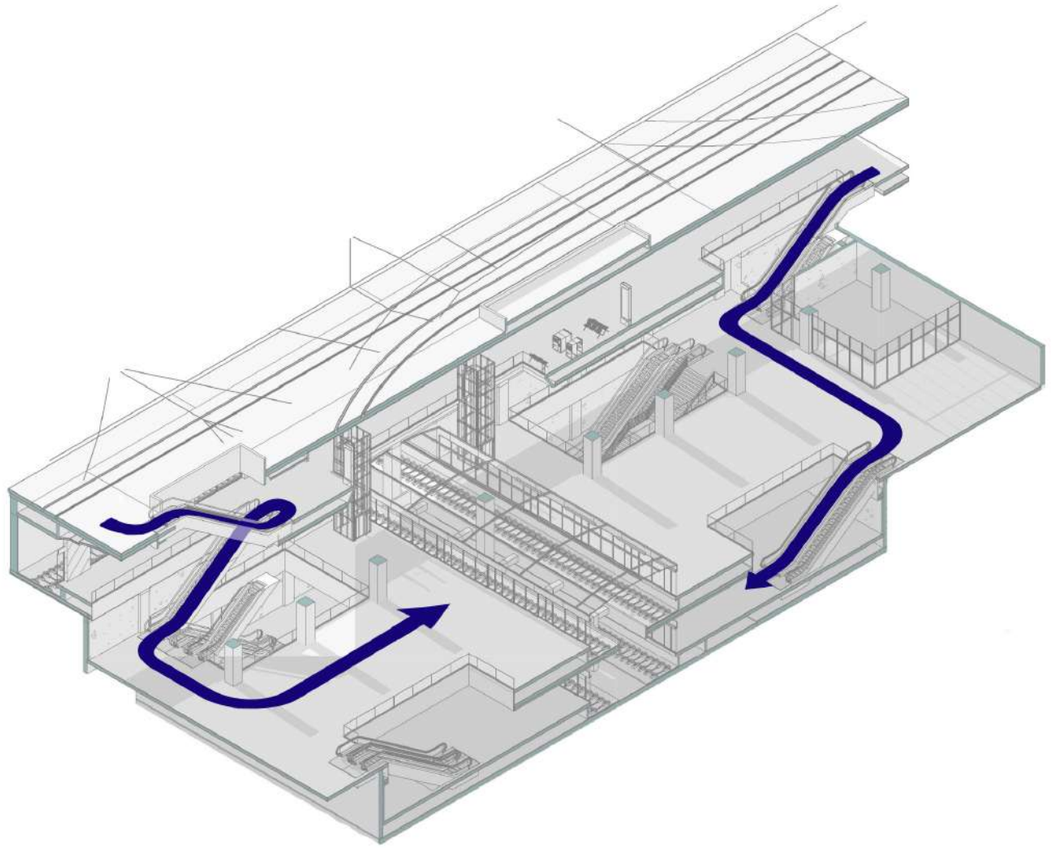


Figure 14.3: Access to the Metro Platforms and S-train Platforms

14.1.4 Elevators

Besides new escalators the metro station will also receive additional elevators. These elevators will be placed on the connection between the S-Train station and the metro station. Furthermore, the elevators located around the main entrance area will be replaced by new elevators that allows for a direct connection with the ground floor. These escalators will be highly visible from street and will serve as the main elevators for the station. Furthermore, these elevators are visible from almost anywhere in the metro station which should help improve the wayfinding of the station.

For the S-train station the situation with elevators is a little more complicated. While the structure inside places escalators adjacent to the path just like the escalators, this is not possible for the S-train station. This is because there is not enough space to place elevators besides the escalators and on the other locations, they are often blocking the main paths of the street. It is therefore that the escalators are placed between the different entrances and outside of the main crowded areas.

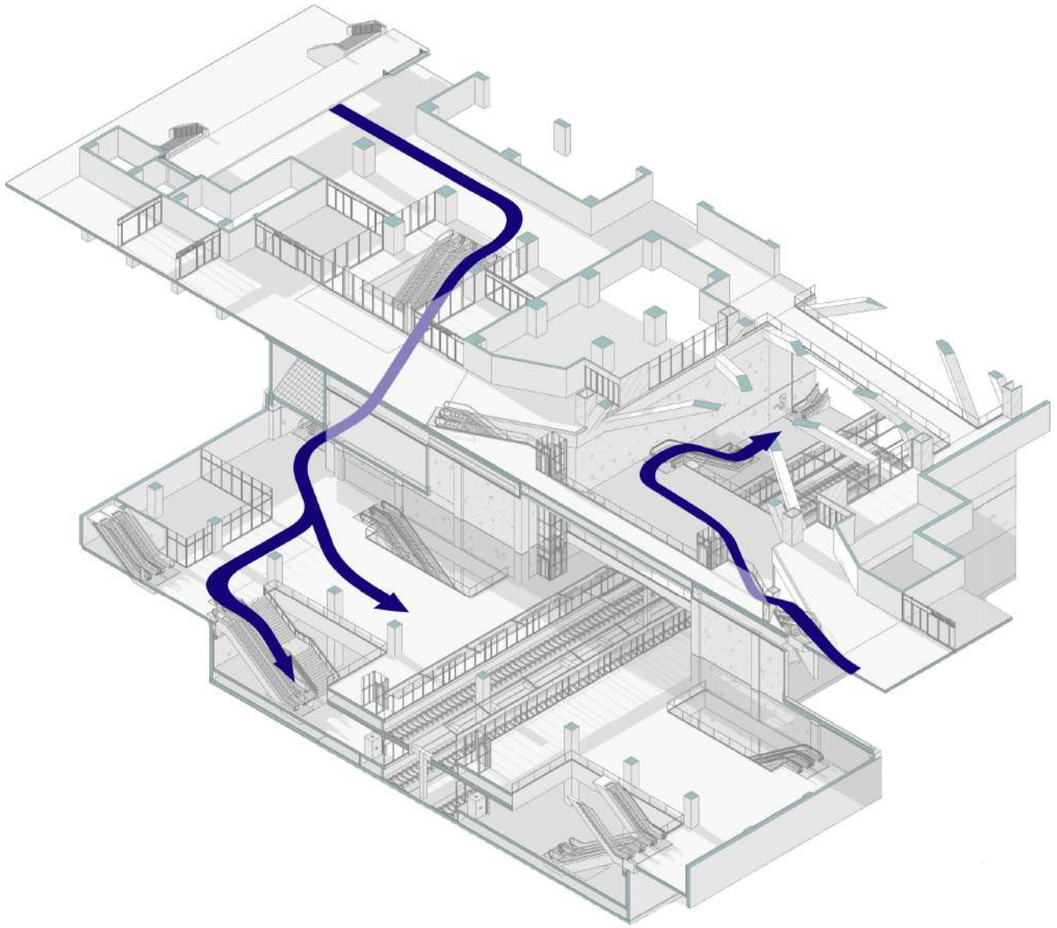


Figure 14.4: Access from the main entrance to the Metro Station

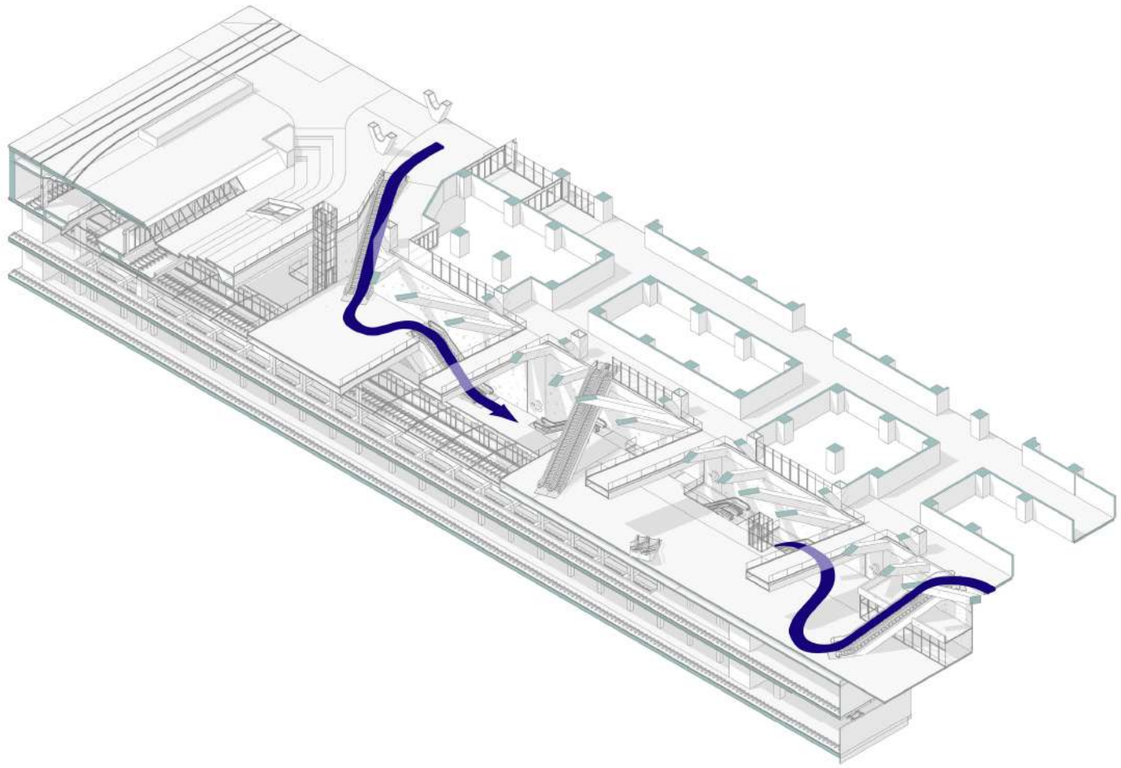


Figure 14.5: Access from the Covered Street to the Metro Station and Ticket Platform

TRAVEL SPEED

14.2.1 The experience of speed

Movement around the station is quite varying based on the type of transport and space. The large entrance areas are often busy with fast people walking in and out, while the platforms switches between an area of movement and waiting. The new spaces surrounding the station will also be used in varying speeds and flow, which is why this aspect will be used to design the spaces itself.

Starting off with Avenue Fonsny, the goal is to create a slower area, where people can enjoy the greenery and sun while waiting for their train to arrive. It is meant as a contrast to the inside of the station which will naturally be quite fast. It is therefore that the main flow around the station is not straight, and several elements are placed to let the main flow meander like a river though the street. These elements variate from seating elements, planters, and entrances. While the central goal is to create an area with the speed quite slow, this is not overall possible due to the large number of entrances on this street and the S-train station located below the station. It is therefore that the slowest speed is only possible where there is enough space. In general, the area is therefore divided in a slower wider section called Fonsny Square and the faster street itself.

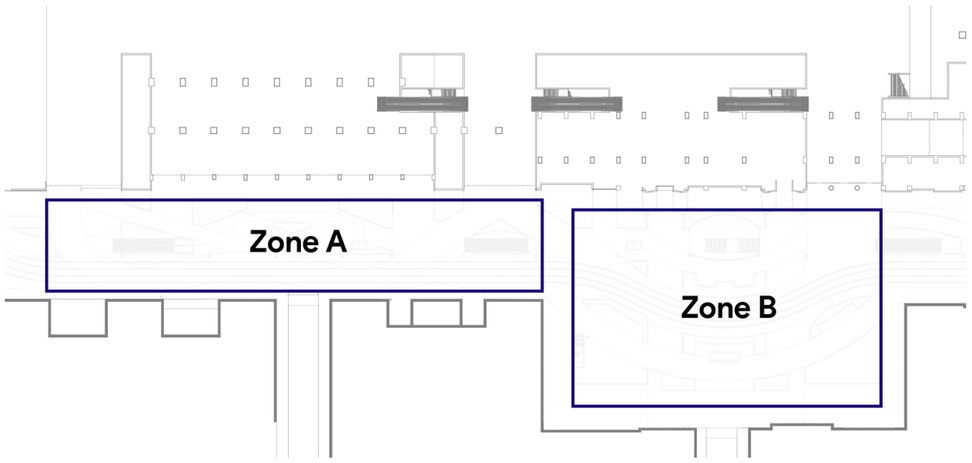
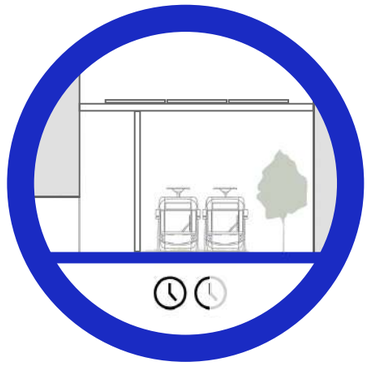


Figure 14.6: The two central areas inside Avenue Fonsny



Zone A: Avenue Fonsny

Zone B: Fonsny Square

For the entrance area the situation is a little more complicated. It is more difficult to create a slower area here since it is expected to handle a lot more traffic than Avenue Fonsny itself. This area features the new central entrance to the station on this side while also getting a new improved entrance to the metro system. It is therefore that it is important that any intervention made on this location is done without interfering with the central routes through this area. As discussed in the last chapter, the idea is to create an area for the community on this space. This space should be connected to the main routes through the area but nevertheless not interfere with the main central flows. The main flows around this area were therefore mapped and the result is visible in figure 14.x

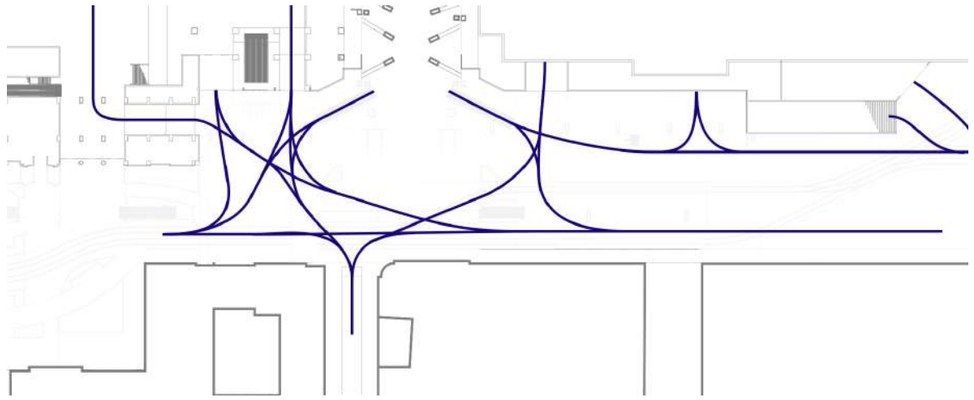


Figure 14.7: The three main areas surrounding the entrance

The result is an area split up into three sections. The first section is the main entrance with a high speed. This area surrounds a secondary smaller section that will be used as the meeting / community space. The idea is that this section will have a slower speed than the main entrance, which would only be possible if the area is bordered off. However, this border needs to be subtle and easily transferable, otherwise the area will act as a barrier. The third area will be based around the new tram stop on this street. Since this area would have waiting people and traveling people, this area will be a semi-fast area. Ideally this area would also express a slower speed, but the limited space makes this impossible.

Combined, this area will still have a relatively high speed compared to the rest of Avenue Fonsny. The area should therefore provide clear connections to the other slower areas, to steer the people who want to make use of these extended waiting areas.

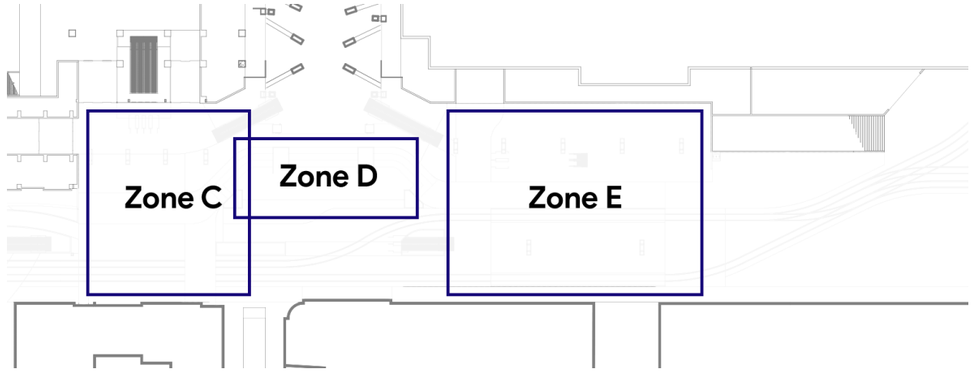
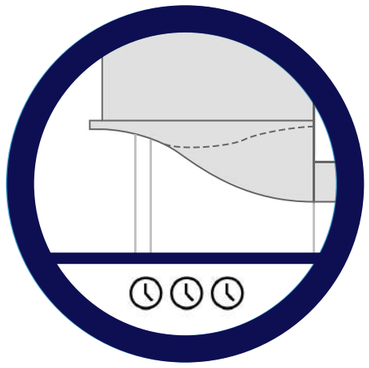


Figure 14.8: The three main areas surrounding the entrance

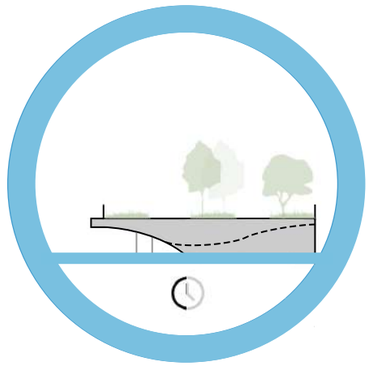
14.2.2 Contrasting Area

With the extension of the building with many community functions, it would be ideal to connect these functions with the network of slower places. It is therefore that an additional area around the entrance is proposed, located above the ground level. This level would be the area for slower traffic with many greenery and waiting areas. This area would offset the busy area below and would provide the slower speed around the main station. By creating this highly visible slower area, travellers are invited to explore this space and the community functions around the building if they want. Furthermore, this area can also be used to meet people since it provides a good overview on the level below.

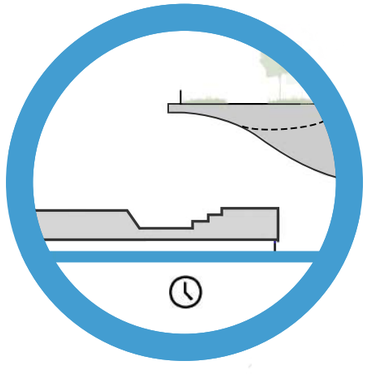
The connection with this area is important, since it needs to be clear how to get to this area while simultaneously not being too intuitive, since these spaces are not meant for the main flow. It is therefore that the main access paths to this area are located to the sides and inside the building. With proper signage it would still guide people to the right areas while not interrupting the faster traffic. Furthermore, the access on the side of the area would still be highly visible to guide people in the right direction, including a highly visible elevator.



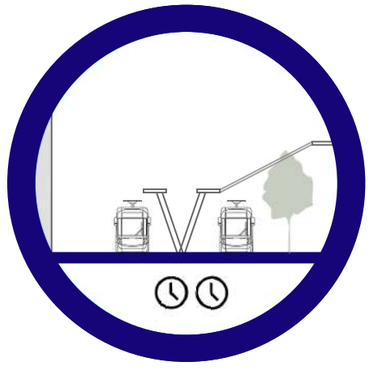
Zone C: Main Entrance



Zone F: Fonsny Area Roof



Zone D: Community Area

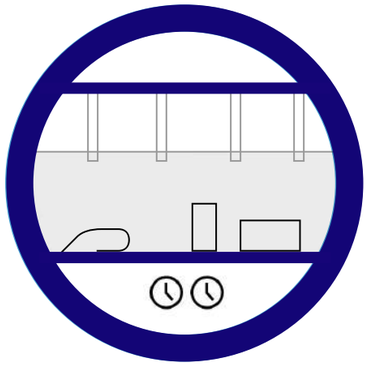


Zone E: Fonsny Tram Station

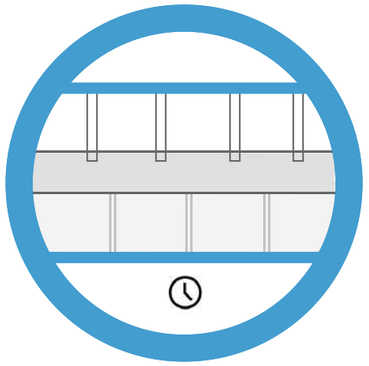
14.2.3 Covered Street

In the covered street the general travel speed is currently high and that is understandable given the current condition of the area. Even underground in the ticket hall the general speed remains high. There are no places to sit or to wait and most of the shops do not have any seating. They are orientated to serve as a quick stop for the traveller. With the large changes to the transport network there is opportunity to change this.

However, there is still not enough room to make drastic changes to the speed in this area. The proposed Expo Section on the ticket hall level will reduce the travel speed a little, but it will remain high. And for this area this is not really a problem since the focus of this area needs to remain traveling. But with additional escalators the travel speed can be reduced for the shopping section of the area, which can help create a better area.

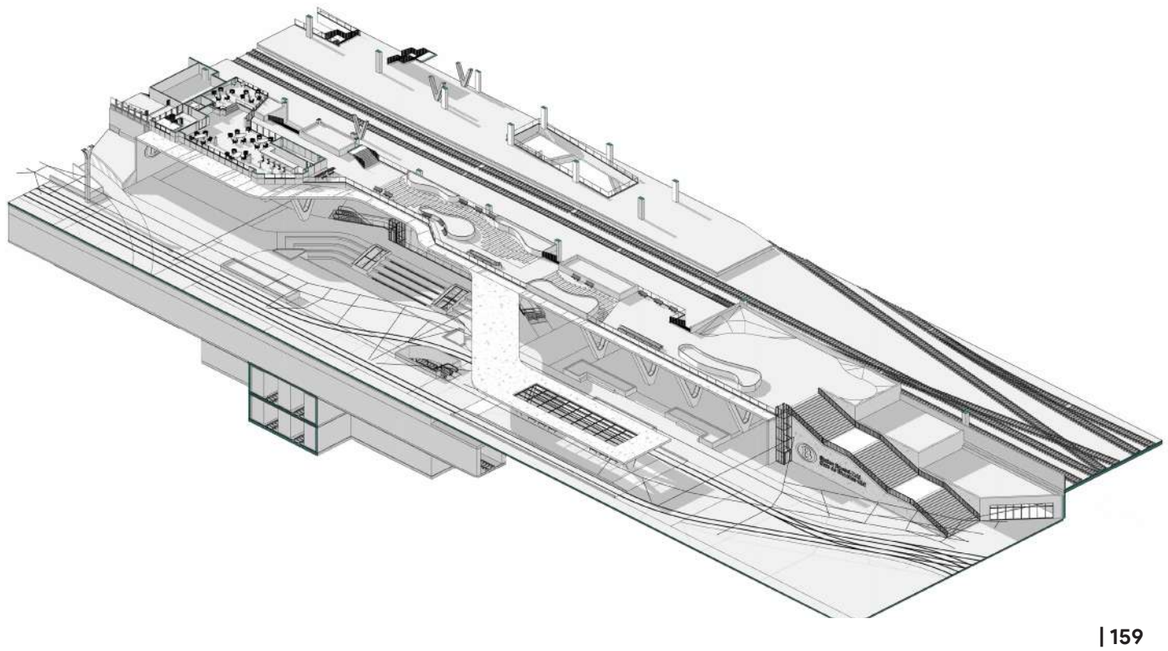


Zone G: Metro Station Expo



Zone H: Metro Station Shops

Figure 14.9: The Entrance Area



COVERED STREET

15

INTRODUCTION

15.1.1 The Design

With the goals of the different areas established and the changes to the transport network it is now possible to redesign the different spaces. The first area is the covered street, perhaps the most problematic area and the area that will change the most.

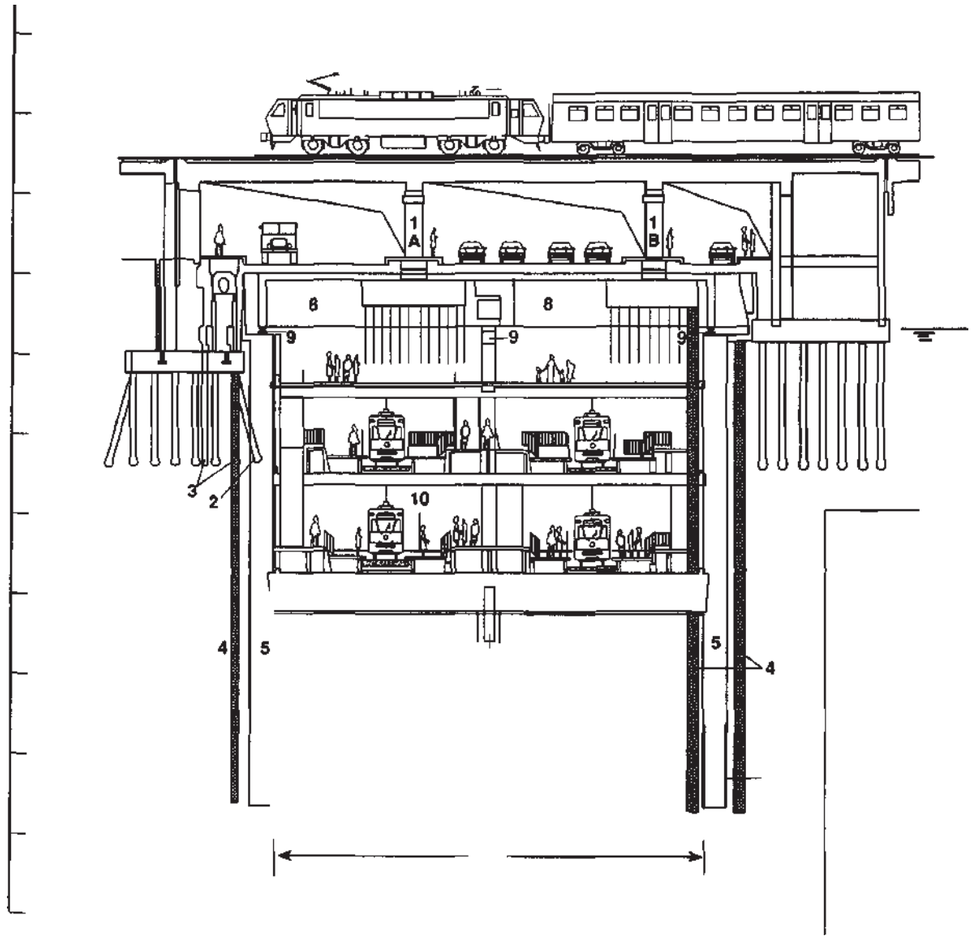


Figure 15.1: Drawing of the current construction of the Covered Street. Source: Earth Shelter and Architecture Journal.

THE STRUCTURE

15.2.1 The Current System

The central goal established earlier was to open the area and create an area with a large amount of natural light going down to the lower levels. While the transport network no longer blocks this, the structure would still require a couple of large changes. It is therefore that a deeper investigation to the structure was done to understand how the current system works and which floors can be removed.

The current system is best explained looking at the historic development of this street. This area started out as a simple road. With the addition of the North-South tunnel this area became covered by a large bridge carrying the new train tracks. The bridge is supported by two series of columns with their own foundations. This changed with the addition of the metro station below the street. There was limited space around the station to place the station and the end location became therefore below the covered street. This would mean that the foundation of the bridge needs to change.

Figure 15.2: The Foundation pillar of the existing rail bridge.

The structure of the station starts with two large retaining walls on the side of the station. These walls act as the main barrier for the three levels of the metro station. These two walls would also become the central elements carrying the vertical loads of the rail bridge. To connect retaining walls with the columns, the pillars of the foundation of the columns were cut off leaving only the foundation slab. This slab would then be supported by a large system of beams transferring the loads to the new retaining walls. This system is still visible today in the main ceiling of the ticket hall, visible in figure 15.2. The metro station itself would be supported by the retaining walls and a central row of columns in the middle. These columns would also carry partly the load of the rail bridge but would be located on a different place than the columns of the rail bridge. The final structure is visible in a diagram in figure 15.1.

Due to the nature of the large beam constructing transferring the load to the retaining wall, it is impossible to create a large void without removing this structure. While the reduction of the number of tracks does provide some leeway to experiment with the structure, it is almost certain that it would still be obstructive. It is therefore that the new design proposes a new structure, creating opportunity to make voids while simultaneously simplifying the structure.

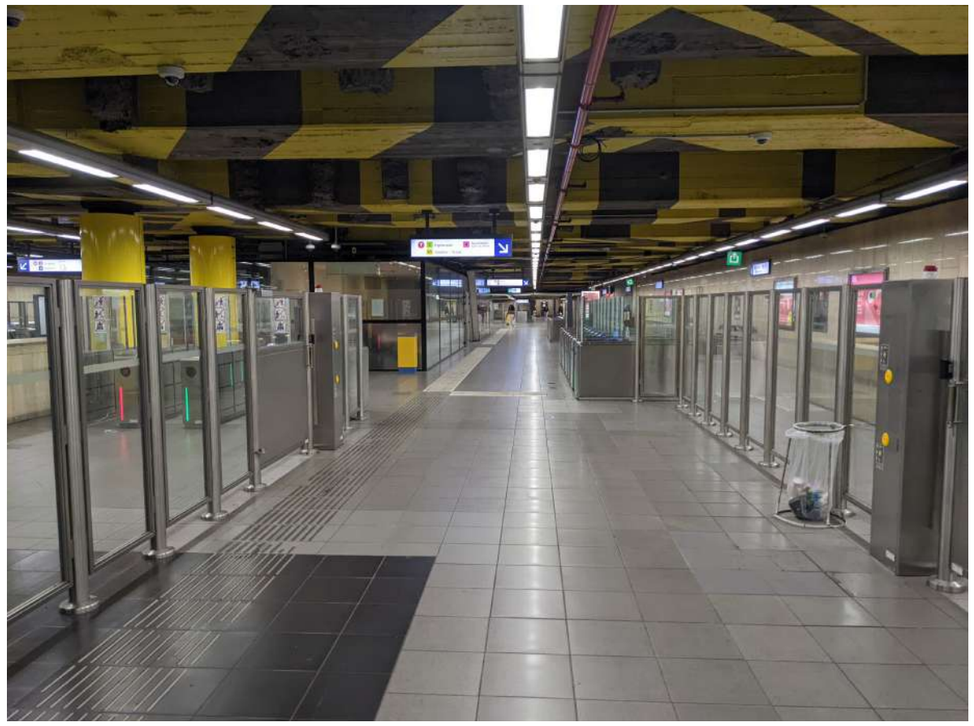


Figure 15.3: Overview of the large amount of beams across the whole ticket hall

15.2.2 A New Structure

The new structure would be based on same idea, transferring the load from the rail bridge to the retaining walls on the side of the metro station. But instead of transferring the load via the current construction, it would be directly transferred in a slanted column. This column would therefore also transfer a section of the horizontal load of the breaking and accelerating trains. This load would be transferred to the foundation slab of the surrounding buildings as seen in figure.15.4, allowing the horizontal load to be transferred to the foundation slab and the vertical load to the retaining wall. This new structure would allow the floor to be opened, while simultaneously remove the need for a column in the middle of the metro station for the rail bridge.

This new structure would replace the columns of the current rail bridge and would connect to the existing rail bridge slab. However, the structure would connect on different areas than the current column since the new structure is centred around the metro station. It is unclear if the current slab can provide enough strength to transfer the load to the new column positions. It is therefore that a new metal substructure is added with a false ceiling to help transfer the load to the connection points. This structure consists mostly as a 3D spaceframe and is visible in figure 15.5 furthermore, the new structure uses a smaller number of columns. However, this is neglectable since the number of tracks is halved.

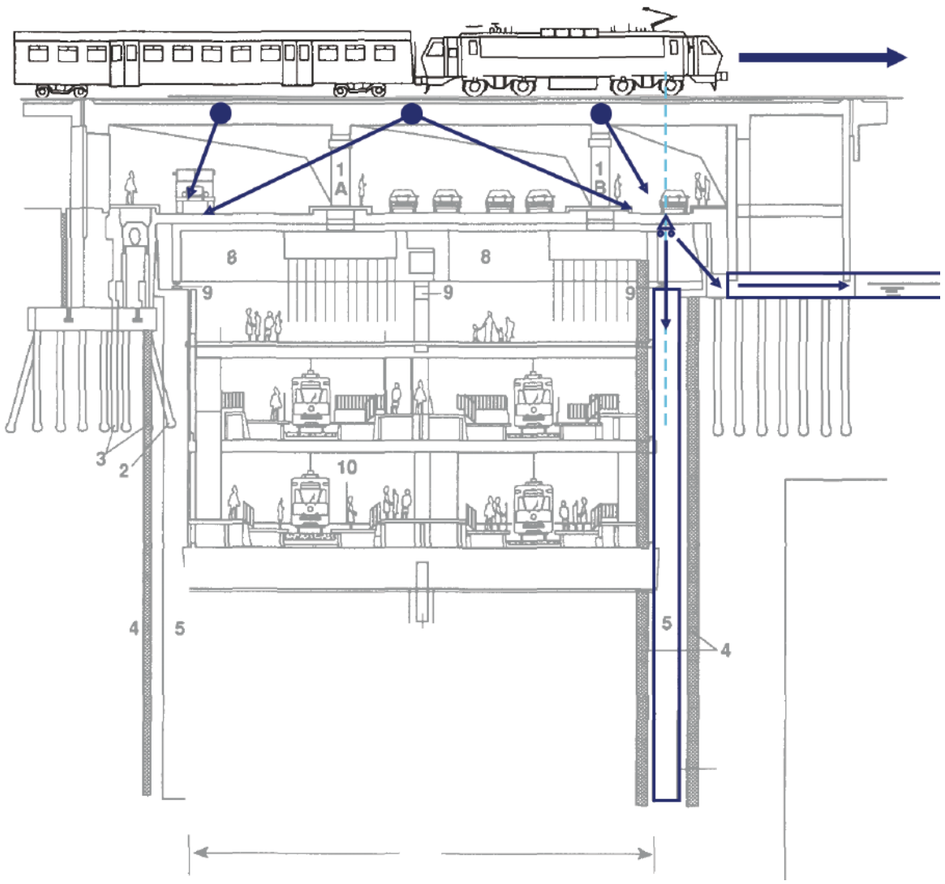


Figure 15.4: Principle behind the new structure

Overall, the new structure should in theory be enough to carry the load of the train bridge. However detailed calculations are needed by an expert for the dimensions and specific connection details.

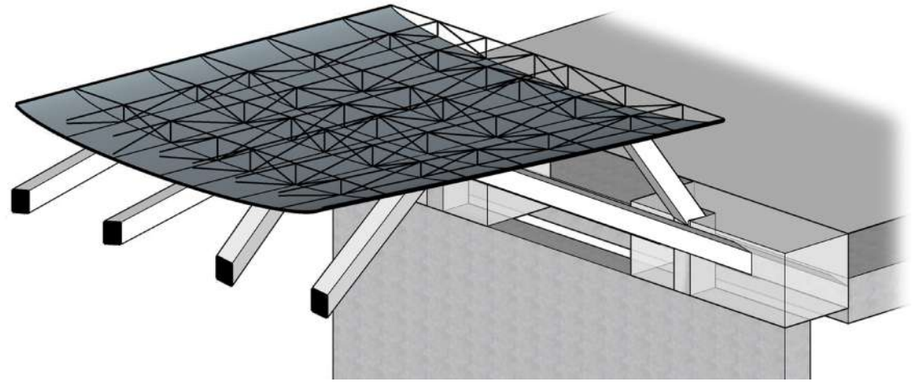


Figure 15.5: 3D Schematic drawing of the structure

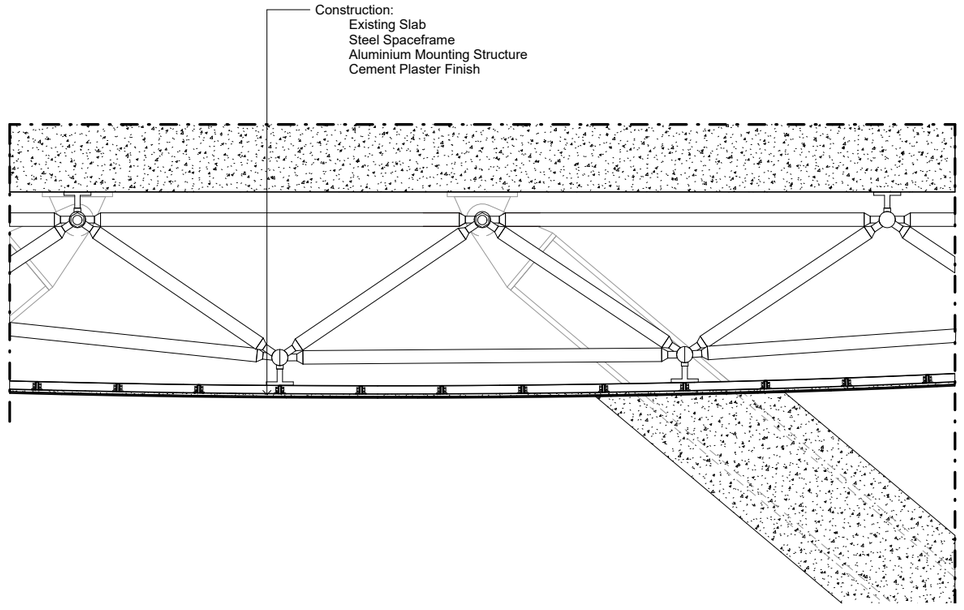


Figure 15.6: Detail Drawing of the connection of the new structure with the existing slab

VISUAL CONNECTIONS

15.3.1 Contrasting Area

With the new structure it should be possible to create an open space with large amount of natural light. It is therefore that the ground floor and a section of the ticket hall will be removed to create this open space. This open space will be used to create a series of visual connections that help navigation and light in the area.

As a start, the large voids created in the platform above serve as the main connection between the two transport modes. This allows people from the rail platforms to look down five levels to the bottom level of the metro station. This void is also the main source of natural light for the metro station. It is therefore important that the roof allows enough light to go down this area while protecting the void from rain. It is therefore that the roof, platform, and the bridges on the ground level are placed in an alternating pattern. This does not allow for a vertical connection between the different areas, but a slanted connection. Since it is more likely that people will not look straight up or down this is the preferable connection while also providing a nice, arranged space with clear connections.

Another visual connection is made between the shops on the ground level and the space inside the metro hall by creating large windows to the space inside. This protects the shops from the sound inside the station while keeping the main connection of the adjacent areas. This also helps with the wayfinding of the people in the shopping area since they can orientate themselves based on the large hole.

Figure 15.7: New central entrance to the metrostation

Figure 15.8: View from the ticket hall level

Figure 15.9: View from Platform

Covered Street

DESIGN

15.4.1 References

As for the central design of the building, much of the old station will be removed. The current station is very dated and in poor quality. The station is therefore redesigned to fit better with the current times and the metro system itself. With the transformation of the Pre-Metro line 3 to a regular metro system, several stations have been transformed and modernised. These stations have been taken as a reference to create a new design for the metro station that fits with the new modernised style.

This new style is mainly visible in the new materials for the station. The station mostly uses a combination of the existing concrete and metals for the materials. The remaining concrete walls will be polished up and protected with new protective coatings. As central accent material the new station uses metal panels. The colour of these panels is based on the design philosophy of the transport company. They associate each transport mode with their own metal colour. It is therefore that the metro station will mostly have bronze panels, representing the colour of the metro.

Figure 15.10: Design of the new Metro Line 3

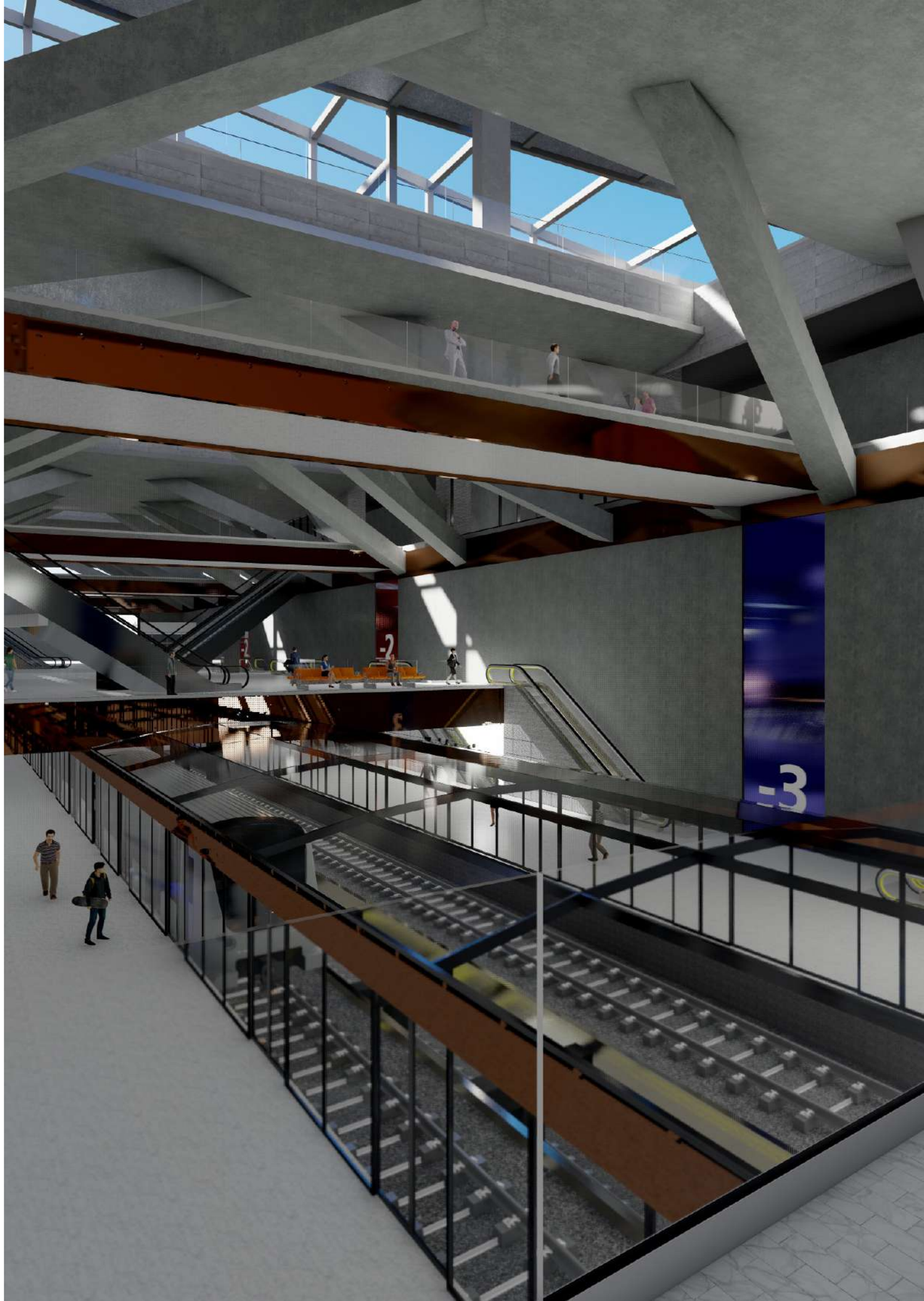


Figure 15.11 (Right): New design for the Metro Station

15.4.2 New Design

This does not mean that this station will be the same as most other metro stations on the line. Central in the room is the new structure of the roof, which also acts as decoration. Furthermore, to improve the wayfinding of the station several access methods including the elevators have been placed highly visible from most sides of the station. New escalators have therefore been added going from the ground floor to the ticket hall. These are placed between the new structure of the station mirroring the structure by going downwards. These escalators combined with the structure therefore aim to be the main highlight of the space.

The current station uses colour as a method to separate the different floors between each other. This idea will be repurposed for the new design, but instead of colouring the columns the side walls will feature coloured metal panelling based on the level they are located.

Finally, the new metro system will be upgraded with a platform door system. This system will be a full-sized system and closed off from the platforms. This allows the area inside to function on its own climate systems and should help improve the climate on the main platform and the inside area. This system will also feature several TV panels which should give information about the arriving metros

Figure 15.12 (Left): View from the Metro Ticket hall to the S-train Station

AVENUE FONSNY

16

DESIGN PRINCIPLES

16.1.1 Defining Boundries

Avenue Fonsny is besides the covered street the most important area in this design. The changes to the node side of the station allows this area to transform to make a space for the users of the station. There is a lot of opportunity in this street which needs to be extracted.

As stated before, this area will be split into two main spaces. Since they are similar in function but still different in speed it is important to create a similar style for both spaces while accommodating the different travel speed. Furthermore, the access to the large number of entrances to this street should remain.

Important to the design of this street is the tram that will remain in this street. This part of the street will be a shared space, meaning that the tram shares the same space as the pedestrian and other traffic. This area will cross the entire length of the street. While these shared spaces are often highlighted in the design of the street, this will not be the case here. Often, this will lead to the separation of these spaces inside the street. People could therefore assume that this space is for the tram only and not for them. To make it feel and act as one area, the shared space is therefore not highlighted in this design.

Figure 16.1: Avenue Fonsny Shared Space

THE DESIGN

15.2.1 Greenery

The design of the area therefore reflects the main philosophy of this area. A pattern consisting of three different pavements highlight the main meandering flow through the area while others highlight quieter areas. Between these different spaces a variety of green areas will be located. This greenery can help create a nicer feeling to the street while reducing some of the urban heat island effect. The exact plants and bushes will need to be determined with an expert.

In general, it will consist of bushes and small to middle height threes on places where it is possible. Greenery will also be used to provide a barrier between the building and the street itself. Currently, the plinth of the building is in a very bad shape and is unattractive to look at. With the renovation of the building the main areas of the station will be upgraded to make it more attractive. However, they do not change most of the logistical functions on the ground floor. This would mean that there is still a large amount of dead façade along the street. Greenery will therefore be planted against these blind façades to make the area still feel attractive. This will be done without blocking the entrances.

Figure 16.2: Example of the large amount of entrances in the plinth

Figure 16.3 (Right): New Design for Avenue Fonsny

16.2.2 The S-Train Station

Central in the design are the entrances to the S-train station below. While these entrances could be made quite small, they are made wider to allow more natural light going down to this station. Furthermore, these entrances consist of voids in the ground with escalators going down. There is no structure surrounding the entrances since these would fill up the space inside the street. This will harm the visibility of the entrances, but the large number of entrances and the positioning of the entrances should prevent people from getting lost. The exception of this are the elevators to the S-Train Platforms. These are still highly visible above ground.

Figure 16.5: Avenue Fonsny Shared Space

Figure 16.4 (Right): Avenue Fonsny with the Access to the S-train station integrated in the design

16.2.3 Fonsny Square

The other central element of the street is the Avenue Fonsny Square, the square that is located near the main entrance of the station hall. This area will be designed to create a slower travel speed in the street. As a start, the tram line through this area will curve through the area, lowering the speed of the trams. This movement breaks up the sightlines of the street, highlighting that there is something in this area. Greenery is placed in the central gap that is created, to highlight the amount of green when looking down the street.

Furthermore, this area will also have additional functions. This starts with a café/bakery located in a new building on this square. This building is in the area with the least sun where limited greenery was possible. It will feature a rooftop terrace where people can sit while eating or wait on the train. Besides this café a new restaurant will be in this area. It will be placed on the first floor of the current station building but will feature a new outdoor terrace which provides nice views on the square. Further additional functions would be in the plinths of the current surrounding buildings. These plinths are currently empty but could be further developed with help of the real estate owners. The renewed activity in the street provides excellent opportunity to add an extra function on the plinth, creating more activity in the street while increasing the value of the buildings. This would also reduce the monoculture that is starting to be developed here.

Figure 16.6: Avenue Fonsny Shared Space

Figure 16.7 (Right): Terrace within Fonsny Square

THE ROOF

15.3.1 Greenery

As stated before, the idea of this street is to create a hybrid space. The area would be partly a quiet area while also being an area of travel. This conflict between functions creates a problem in the design of this street. While the quiet space with greenery would be ideally located outside, the travellers would like to have a dry and protected passage between the different modes of transport. As a solution, a central canopy will be created inside this street, consisting of mostly a glass roof with translucent solar panels. This roof would give the travellers a dry passage between the different entrances, while simultaneously have gaps in the roof which would allow rain to pass through on the greenery. Furthermore, the sides of this structure would still be open, allowing for easy access to the building and to ventilate this area. This open structure would also mean that most of the façade of the building would still be visible.

This roof would be designed to connect with the main station building and the surrounding buildings. This would cover the whole width on the smaller sections of the street. This was done to prevent separation in the area below. If the roof would only span halfway across the street, the area would be divided into two. While the main pillars of the roof would still create a little separation, it is negligible.

Figure 16.8: The roof above Avenue Fonsny

16.3.2 Climate System

While this roof is mainly to protect the area below from rain, it will also function as a part of the climate system of the station. As stated before, the structure will mostly have glass panels with translucent solar panels. These panels help generate electricity for the buildings while still allowing for maximum light below. These panels will be placed on small sections of the roof where the sun shines the most. Other areas do not get enough sun to make them profitable since the building is surrounded by high structures. Furthermore, the roof will also be used to collect rainwater for the plants below. While there are sections that will be open and give the water directly, the closed sections will collect the water and transport it to a storage tank underground. This water can then later be used to water the greenery on dryer days.

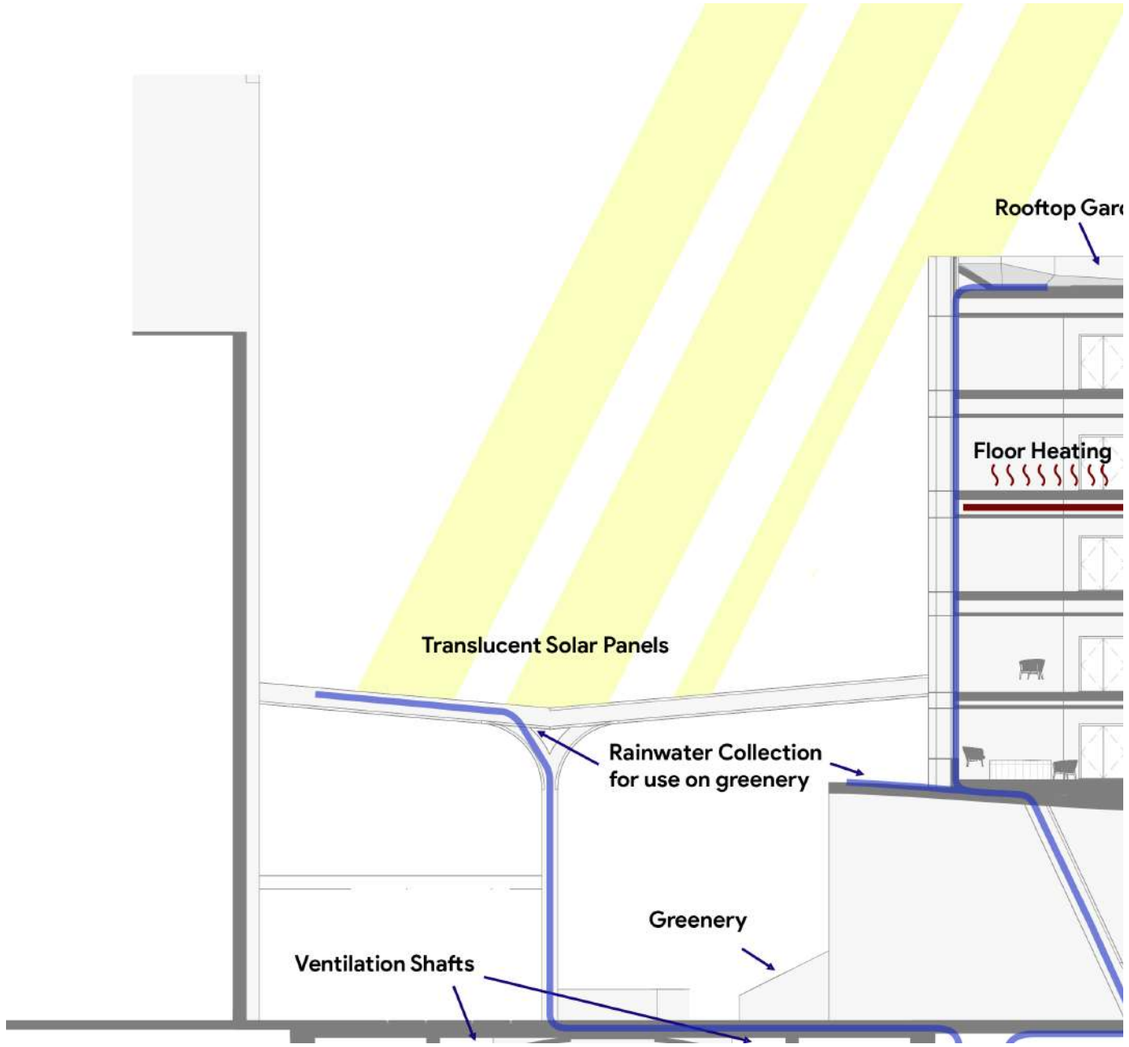


Figure 16.9: Climate Functions of the Roof Structure

DESIGN PRINCIPLES

16.4.1 Defining Boundries

Another important section to the design of this street is the S-train platform located below. The station will be based on the same style of materials as the metro station described earlier. This would mean that it just like the metro has one central metal material that will be the main highlight material in this area. For the case of the S-trains this material has not been established yet since it is not part of the local transport operator. But to keep the design similar, a new metal material is chosen for the S-trains. However, to not make this service to like the local networks the metal will diver from the orange and red tints. As a result, Cobalt was chosen and represented with blue metallic colours.

As an island platform, the general division of this space is simple. The edges of the platform are used for boarding while the middle is used for ticket machines, seating, and access points. The station features platform doors just like the metro system to improve safety and efficiency. The system is not closed off however due to the limited space for ventilation. It is therefore that the station and the platform use the same system. The platform features therefore a higher roof than the area where the trains arrive, guiding the hotter air to the middle where ventilation panels are located. These are located along the entire length of the platform except for around the access methods. There, the roof is interrupted by a green ceiling that hides the mechanism of closing off the station while improving the wayfinding.

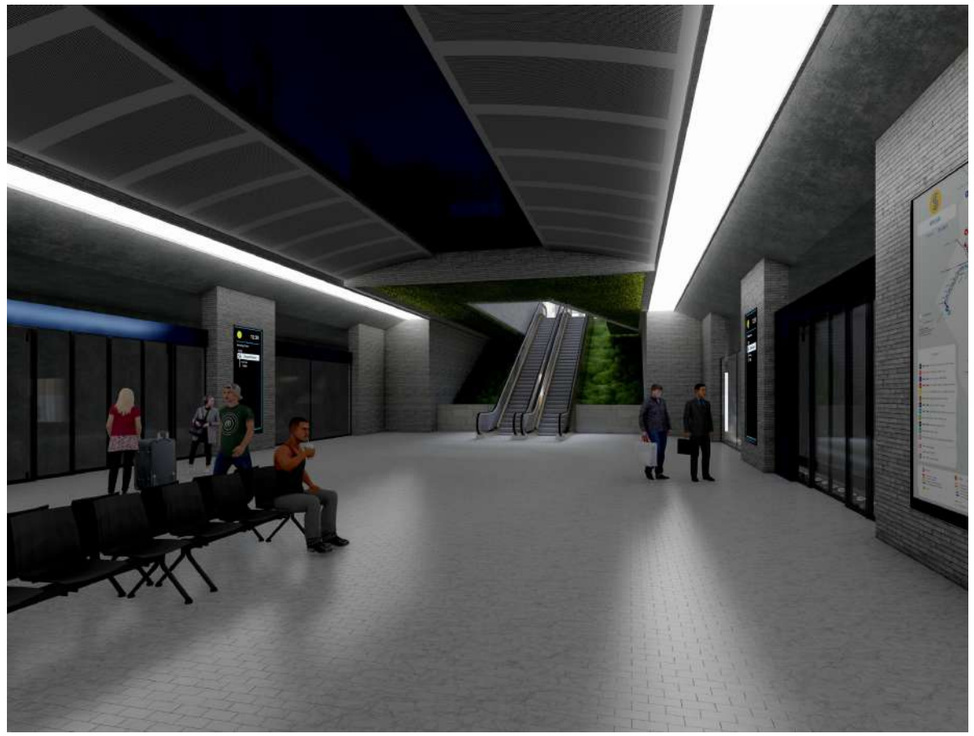


Figure 16.11: The end of the S-train Station

Figure 16.10 (Right): Central Entrance to the S-train Station

ENTRANCE

17

Entrance

THE NEW CENTRE

17.1.1 Introduction

Continuing along the Avenue Fonsny, the entrance area will become the new main area of the street. While the square on the street itself will become the area for slower travel, this area will be mainly be designed as a faster travel.

Figure 17.1: The new central area

17.1.2 The Community Area

Central in the design of the area is the Meeting and community area. This area will be an area with slower speed with the aim to create a multi-purpose area that can be used by the community. As a result, the area has been designed as a staircase and a platform. To start, the area is bound by the main central flows through this area as discussed in the previous chapter. The area is built up with the back towards the metro station with a higher and lower section. From the back of the area a staircase goes down to the lower section. This staircase is built with gaps between the stairs to allow natural light and a visual connection to the metro station below. This staircase is built in a shallow U form, build up like a stadium and can be used for seating. The area can therefore be used for an exposition and a small performance. The other half of the area is the higher section which can be used for exposition. Temporary structures can be added to this space depending on the current trends. The barrier between the lower and higher sections is executed as a window to the underground S-train and Metro station. This window shows the complexity happening below the streets and can help with orientation.

The initial idea of this area was to create more of a design. This was however scrapped due to the function of the community area. This section has therefore been left barren with the aim that the community would provide infill of this area.

Figure 17.2: The community area in the centre of the entrance

Figure 17.3 (Right): The new community area

Entrance

THE CANOPY

17.2.1 A new central Element

Besides the central meeting and community area, this area will also be the new central entrance for this side of the station. It features connections to the central station hall, shopping corridor and the metro station. The design for this new area should therefore reflect the importance of this area.

As a result, a new central canopy will be added to this area. This canopy will be in the shape of a slope and uses that to guide and invite people inside the building. This canopy will also be the basis of the Extension of the building and the other slower area, which will be located above this canopy. This canopy also needs to address the central issue that the current situation has. Currently, the station is very closed off on this side of the station, mainly having a large uninteresting wall as a façade. As a replacement, the new canopy will feature gaps to the rail platforms, allowing for a visual connection between the entrance area and the rail platforms.

This new canopy will be created as one central element with flowing curves. The material of this element would need to reflect this nature of this large central element. Since the original entrance on this side was so closed off, the inspiration for this area was a concrete bunker. Creating this large canopy out of concrete would fit with the central idea and it would fit well with the large amount of concrete in the original building. However, since this element is so large, it would be unsustainable to create this out of concrete slabs. A more climate friendly option would be to create a lower panel structure, which would be plastered off with cement plaster to create the same look and feel.

The new canopy would stretch beyond the main area and go on alongside the so called “Grote vierhoek”. This area, which will become a shopping / commercial area in the future, will therefore have the same style of entrance as the rest of the building. This should help connect this area to the rest of the station and bring more activity alongside this entrance.

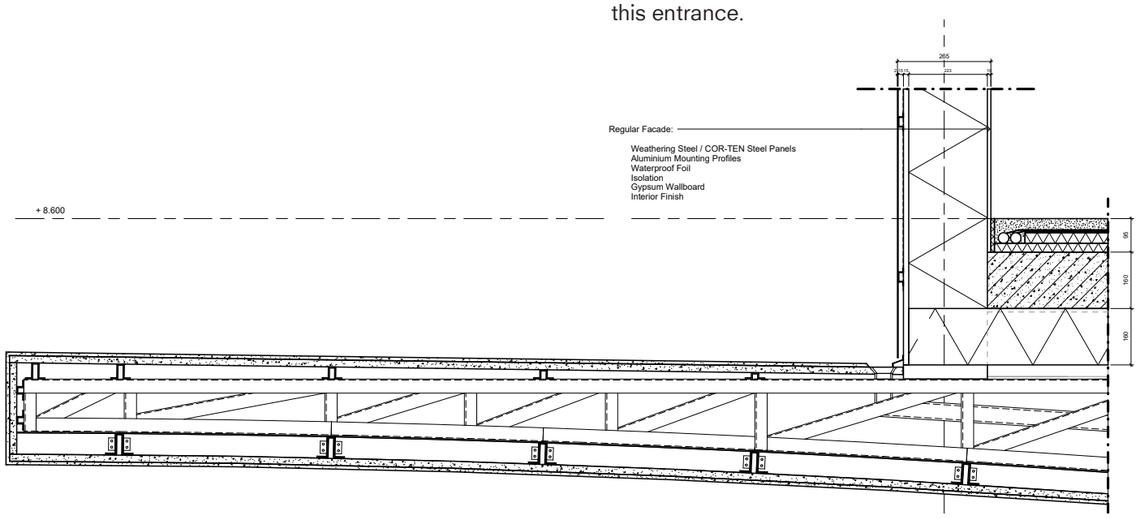


Figure 17.4: Edge Detail of the new Canopy

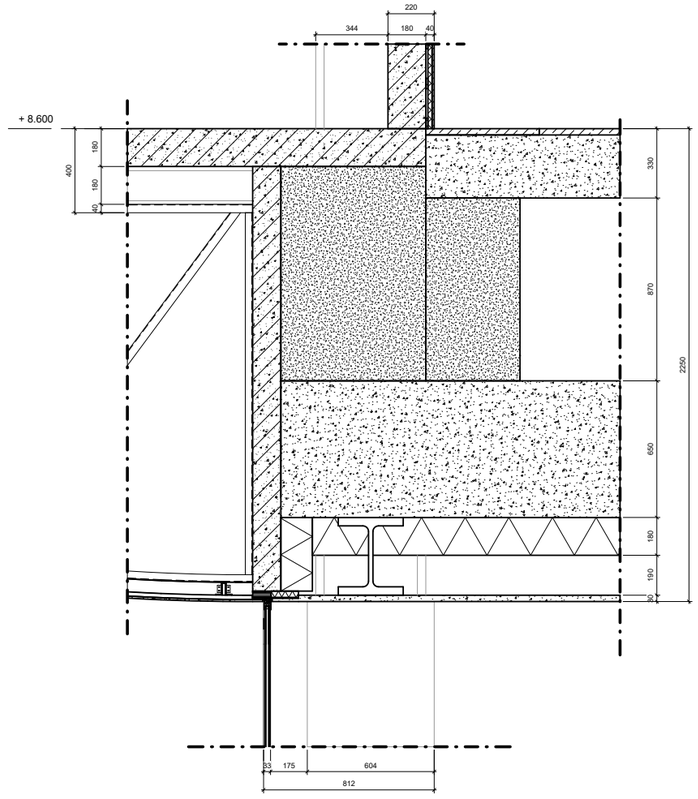


Figure 17.5: Connection of the new canopy with the existing building

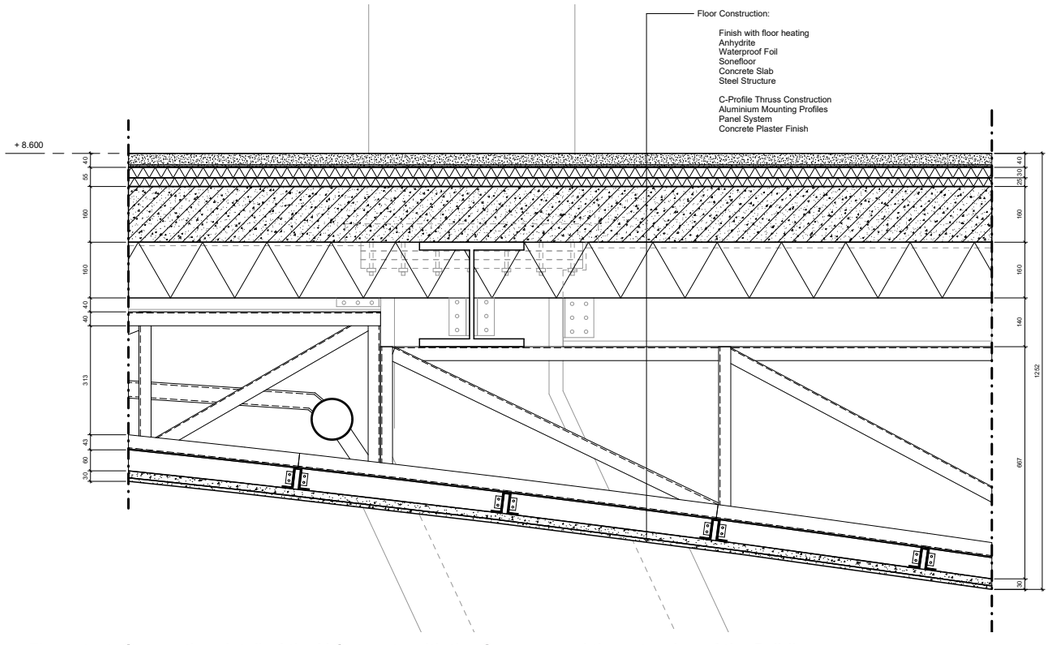


Figure 17.6: Connection detail of the V-Supports with the Cannopy and the extension of the Building

17.2.2 The Tram Station

The new tram station located in Avenue Fonsny will be created parallel of the new canopy. The new station would have an island platform, which needs to be protected from rain. As a solution the roof of the tram station would be connected to the new canopy to make the area feel as one central intervention. Due to the width of the platform, this section would also feature a skylight.

The location of the station is just as the central meeting / community area based the main flows around the area. It is therefore possible to make a dedicated place for the tram stop. While the rest of the tram tracks is part of the shared space, the rails around the platforms are placed inside grass to prevent other people and vehicles blocking the space for the tram.

Figure 17.7: The connection of the Tram station with the new Canopy

Figure 17.8 (Right): the new Tram Station

Entrance

THE ROOF

17.3.1 Central Meeting Area

As stated before, the area above the canopy would be a new green waiting area. This area can be accessed via multiple routes, but the main entrance would be a staircase and elevator located at the northern side of the new canopy. This new staircase would also be one of the main access routes to the new extension of the Post Office Building.

The area above the canopy would also feature a connection to the adjacent platform. This combination of the platform and the extended waiting area would make this the ideal track for the summer and special trains to depart from. It is therefore that this area above the canopy also functions as a meeting point for these special trains. This allows the travellers to gather before departure while not disturbing the main platform.

Figure 17.10: The main entrance to the roof

Figure 17.9 (Right):The upper section of the roof

EXTENDED BUILDING

18

Extended Building

INTRODUCTION

18.1.1 Extension of the Building

Besides the main new waiting area, the area above the canopy will also become the main connection to the extension of the Post Office Building. As stated before, the current building will be extended to make room for the community functions that were located inside the building and will disappear with the planned renovation. This way the functions can stay in their place and get a dedicated place in the station.

Figure 18.1: The Extension of the Post Office Building

FUNCTIONS

18.2.1 Creating a new place

Since this extension is located above the canopy, the lowest floor of this building is located on the same height as the second floor of the Main building. This floor and the floor above will host a large bar and café, which will have several rentable rooms for meetings. This bars firstly serves as an enclosed space where people can work and meet people when they need to wait on their train. Further it is aimed to be a central gathering place for the neighbourhood and can be rented for community events.

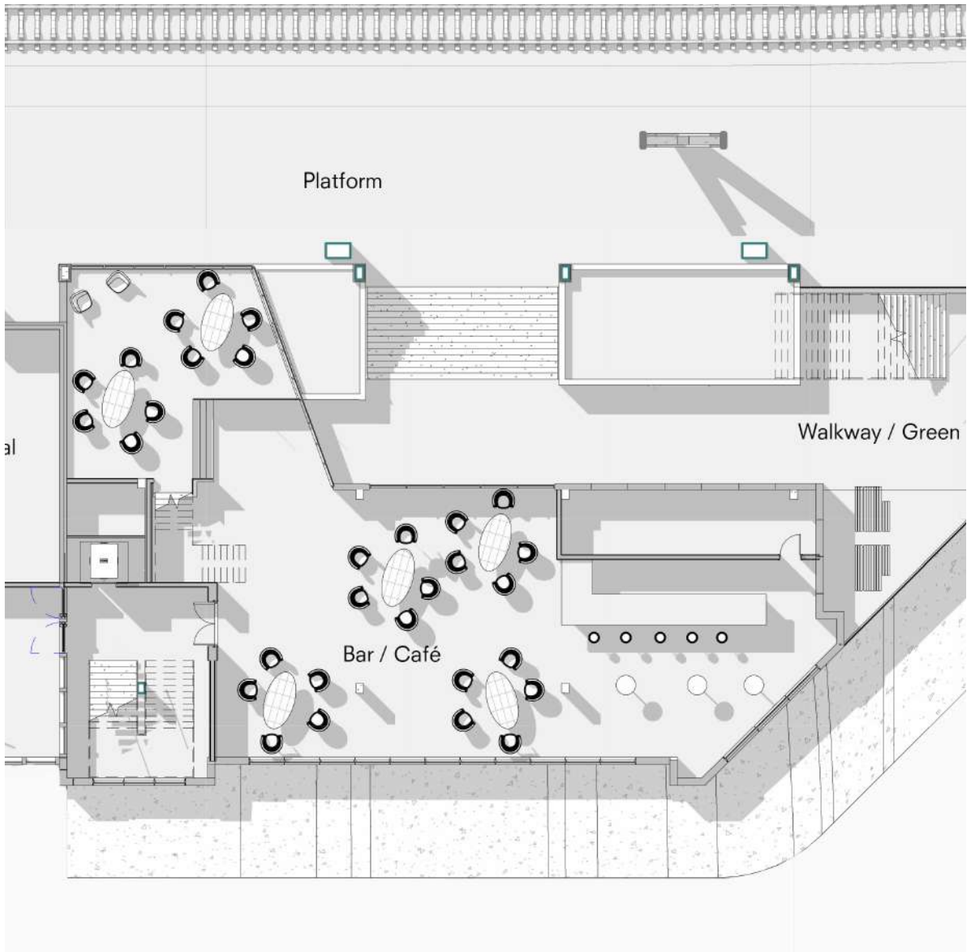


Figure 18.2: The first floor of the Extension

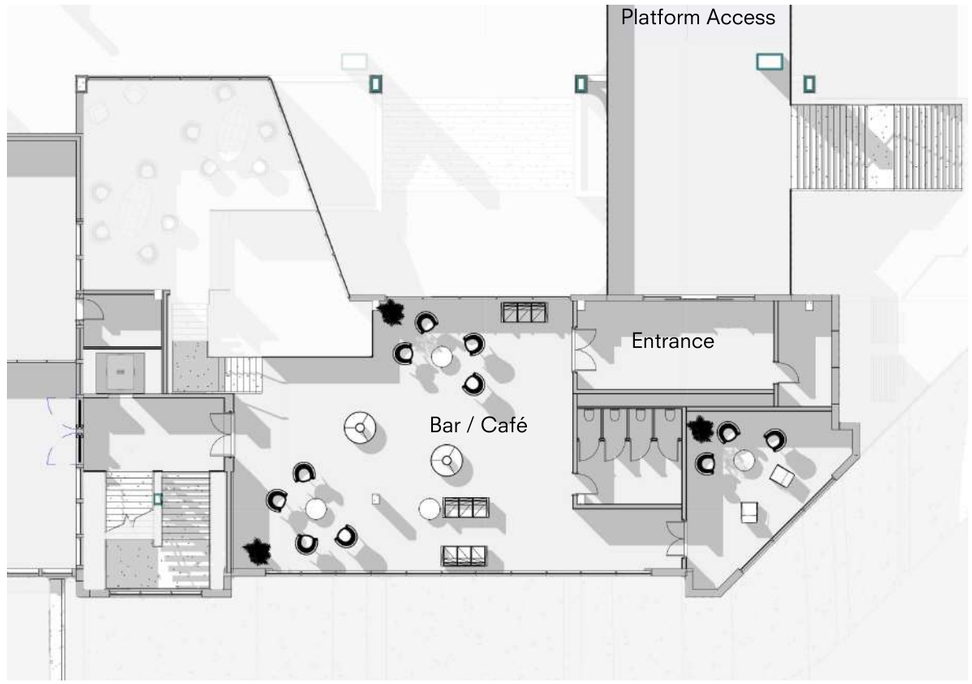


Figure 18.3: Second floor of the extension

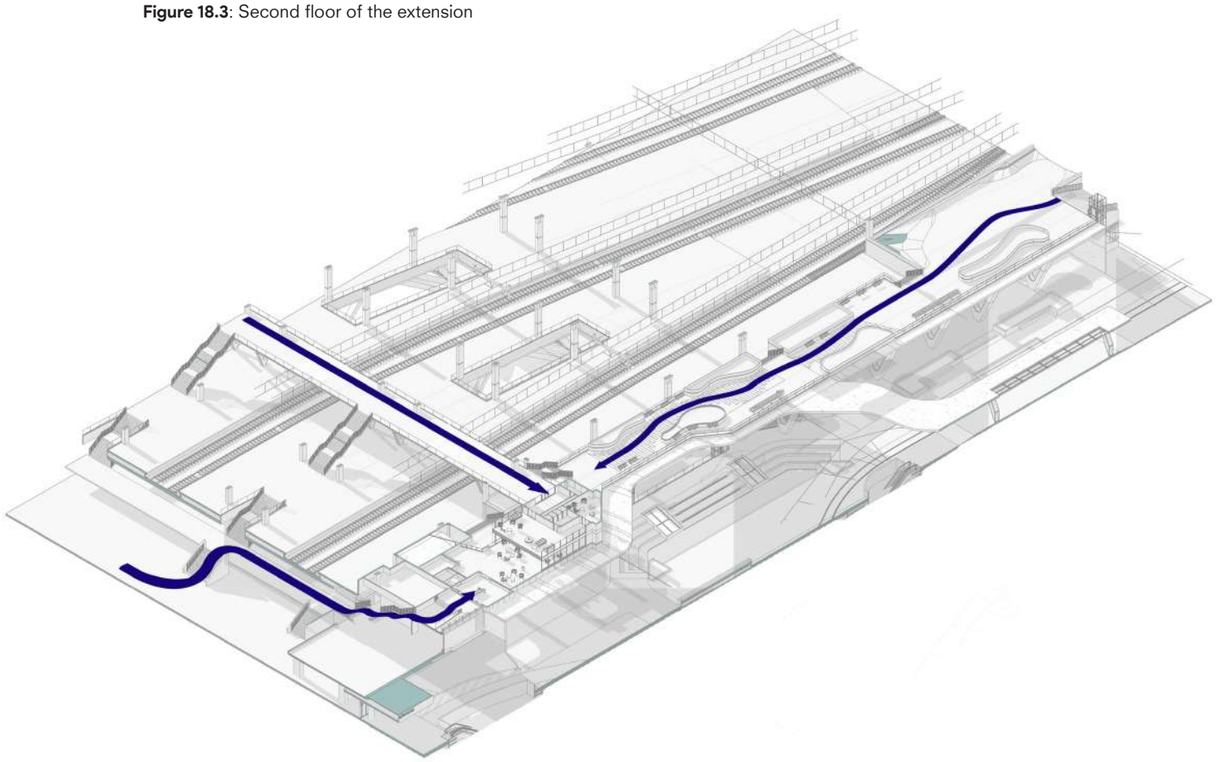


Figure 18.4: The main access routes to the extension

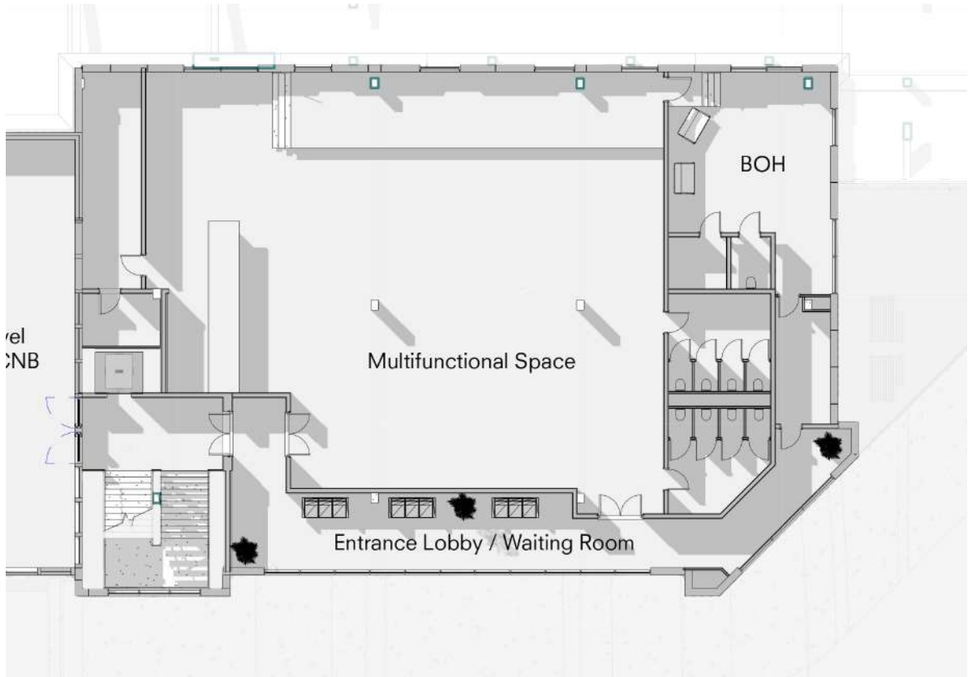


Figure 18.5: The Third floor of the Extension Building

Avenue Fonsny

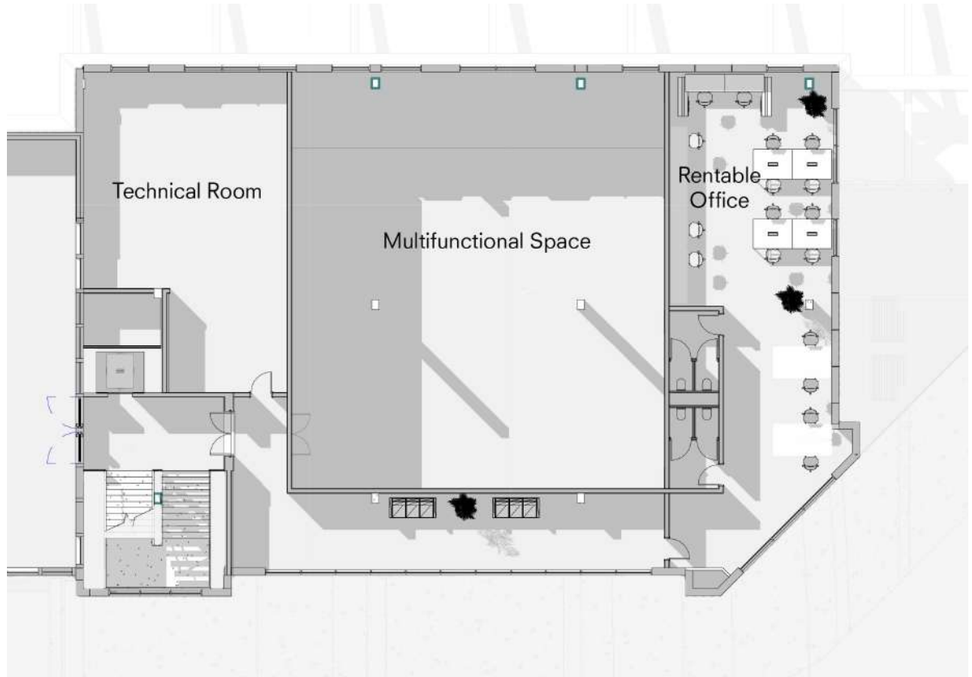


Figure 18.6: Fourth floor of the Extension building

18.2.2 Creating a new place

The level above the bar consists mostly of one central room. This room is the replacement for the pop podium that will be removed during the renovation of the Post Office. This new space consists of a large room with a temporary podium and will also be a place for community meetings, theatre, and other things for the community. This new community centre is directly connected to the main public level in the SNCB/NMBS Office, allowing for easy access to this floor from multiple locations. Furthermore, this space relates to the bar below, allowing the bar to function as an entrance lobby, catering service or as a waiting space during intermissions.

Besides the main multifunctional hall, this floor also has dedicated back of house area connected with the central room that can be used by artists, store equipment and other things needed for the multifunctional space. Since these functions require often more space for equipment on the ceiling, the room will continue the floor above. The layout of the floor above is therefore planned around this central room. The area above the BOH will be a rentable office space, which a company can rent for a limited time. The space on the other side of the central room is the technical room for this section of the building. This room, while not connected on the top floor, hosts the central air units and features therefore a connection to the outside via a shaft parallel to the elevator and an additional connection in the façade of the building. The position besides the central large community hall also limits the amount of large air ducts needed in the building.

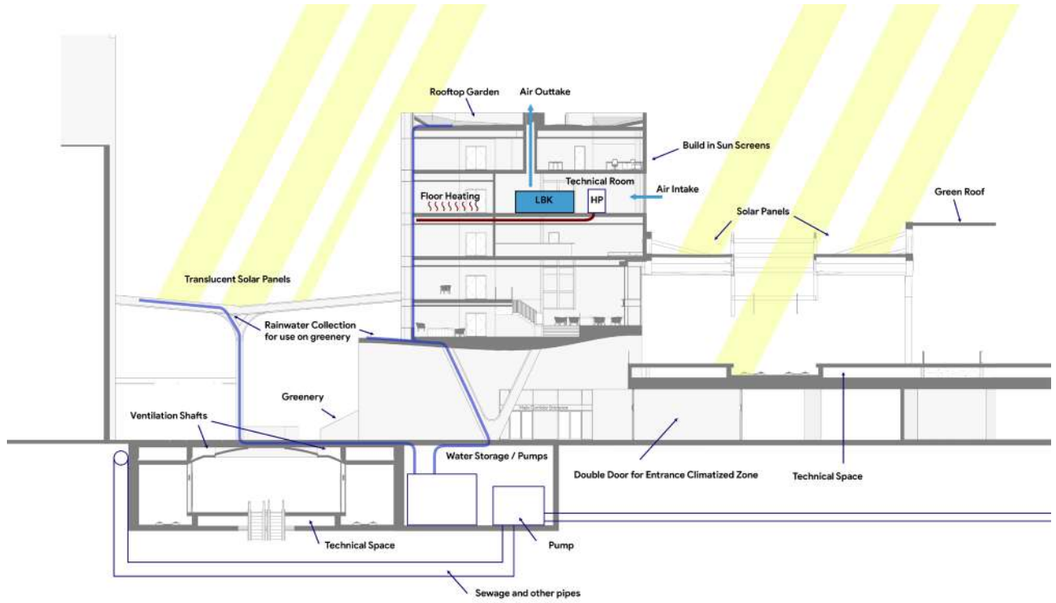


Figure 18.7: Climate System of the building and adjacent roofs

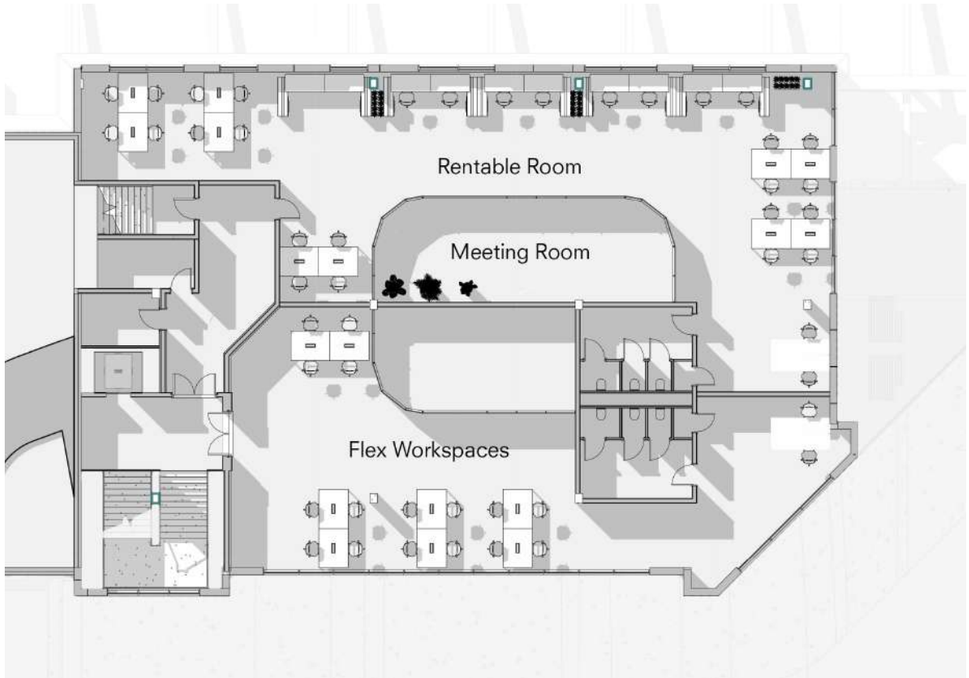


Figure 18.8: Fifth floor of the Extension Building

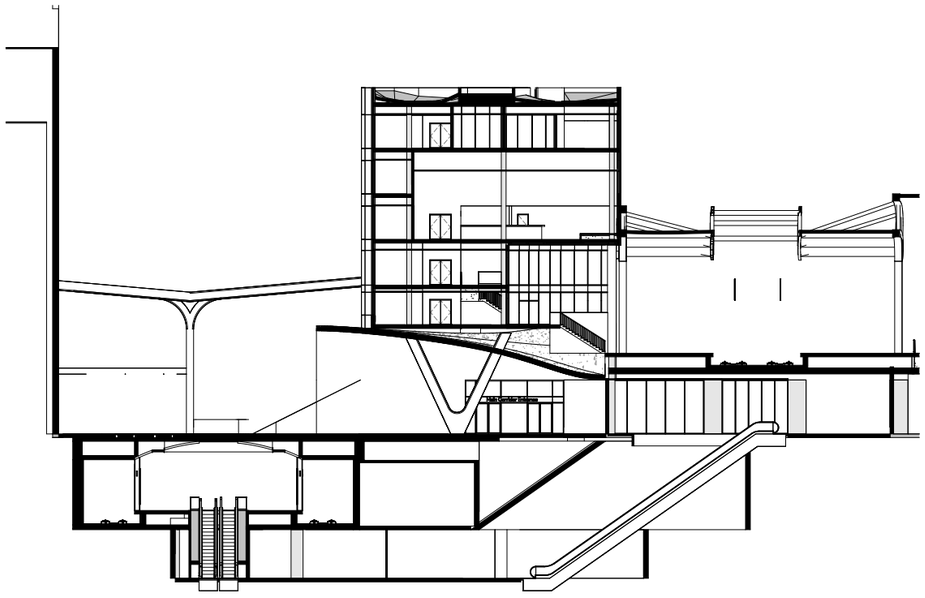


Figure 18.9:Section of the Extension

18.2.3 Creating a new place

The final floor of the building will be a quieter area. This space is mainly dedicated to office functions, with a medium sized rentable office and multiple flex workspaces. These spaces can be rented out on short noticed and can be used as emergency workplaces. This floor will be directly connected to the planned roof garden of the NMBS/SCNB Office. This roof garden will be extended to include the roof of the extension of the building.

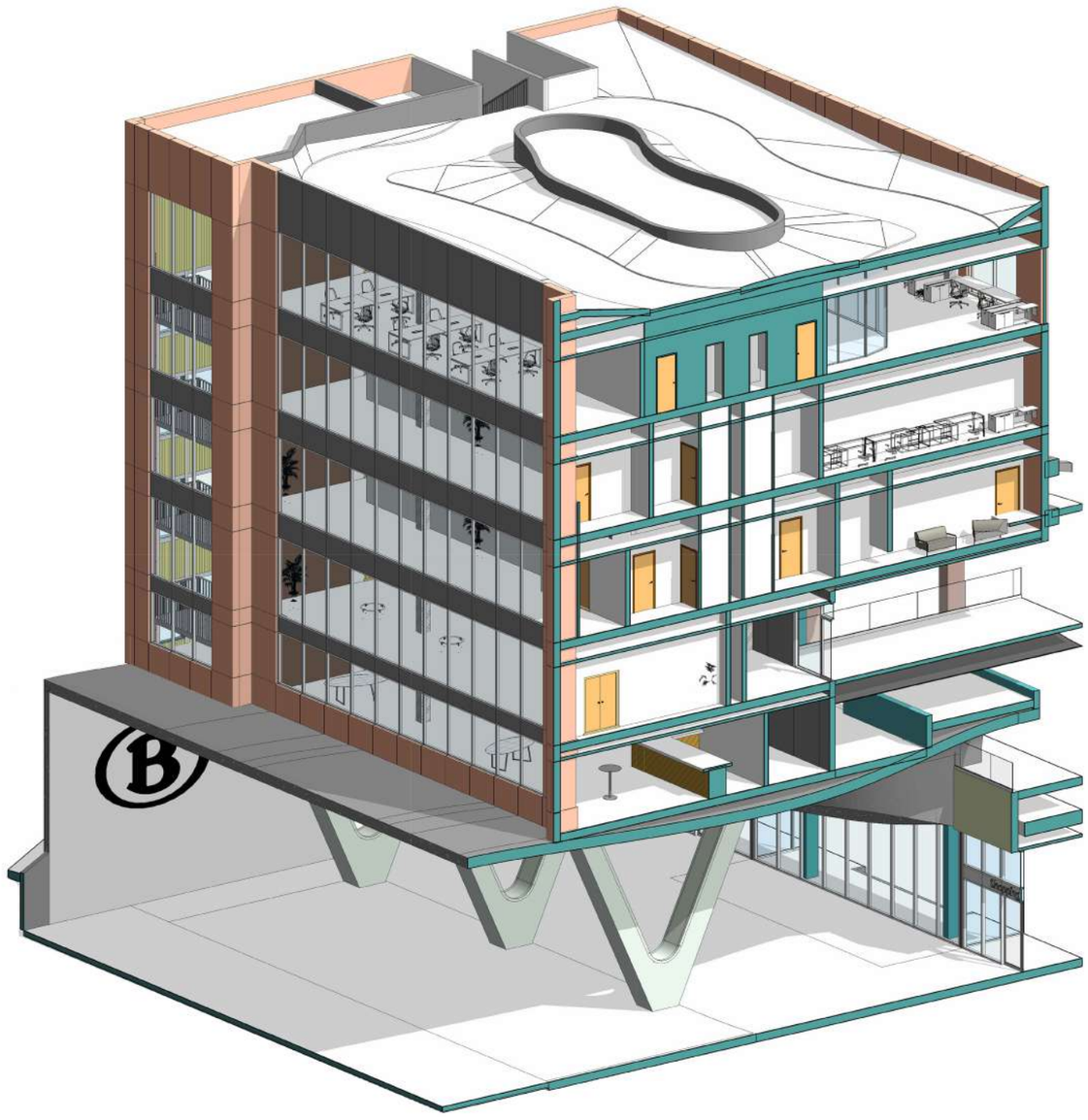


Figure 18.10: Fragment of the extension building

18.2.4 Creating a new place

As for the design of the extension, the building needs to fit in with the current streetscape while also stand out as a community area and entrance. The building will therefore bel mostly based on the existing design of the Post-Office Building. The design will continue the rhythm in height and depth, while giving the building a more proper finish by rotating the last extrusion. The building will be constructed mostly out of steel to allow for as minimal of supports around the entrance area. The façade of the building will be made from Corten Steel Panels and Curtain walls. Corten steel panels were chosen since this system allows for easy maintenance and the panels can be made from recycled materials.

Furthermore, the colour reflects the metal materials used for the transport mode in Brussels. Since most of these metals are in the red orange spectrum, the colour corten steel gives fits perfect with these materials.

Other sections of this extension will be made of curtain walls. These walls will mostly contain glass panels in a rhythm that is also used for the rest of the Post Office Building. This connection is furthered by using the same stone panels as accent detail for these sections. These stone panels will be used to hide the build in solar protection screens which can individually be controlled.

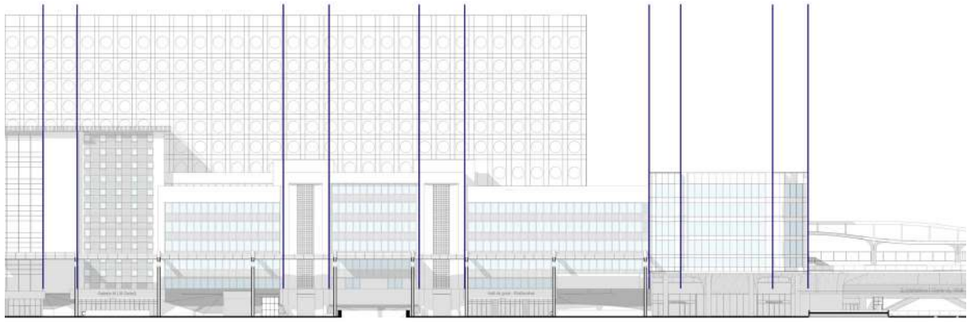


Figure 18.11: Rythem in the Post Office building and extension

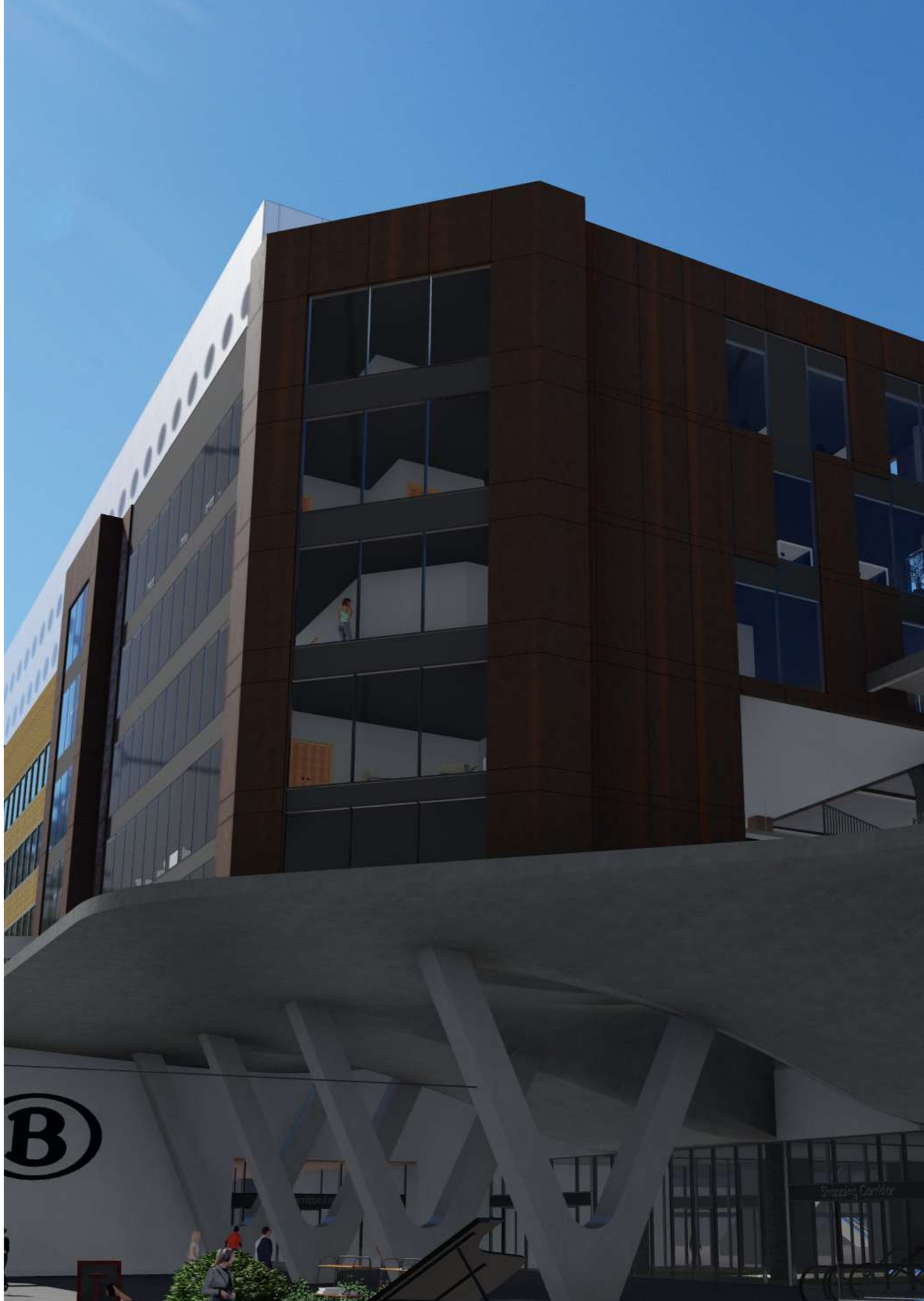


Figure 18.12 (Right): The main extension

18.2.5 Fragment of the Building

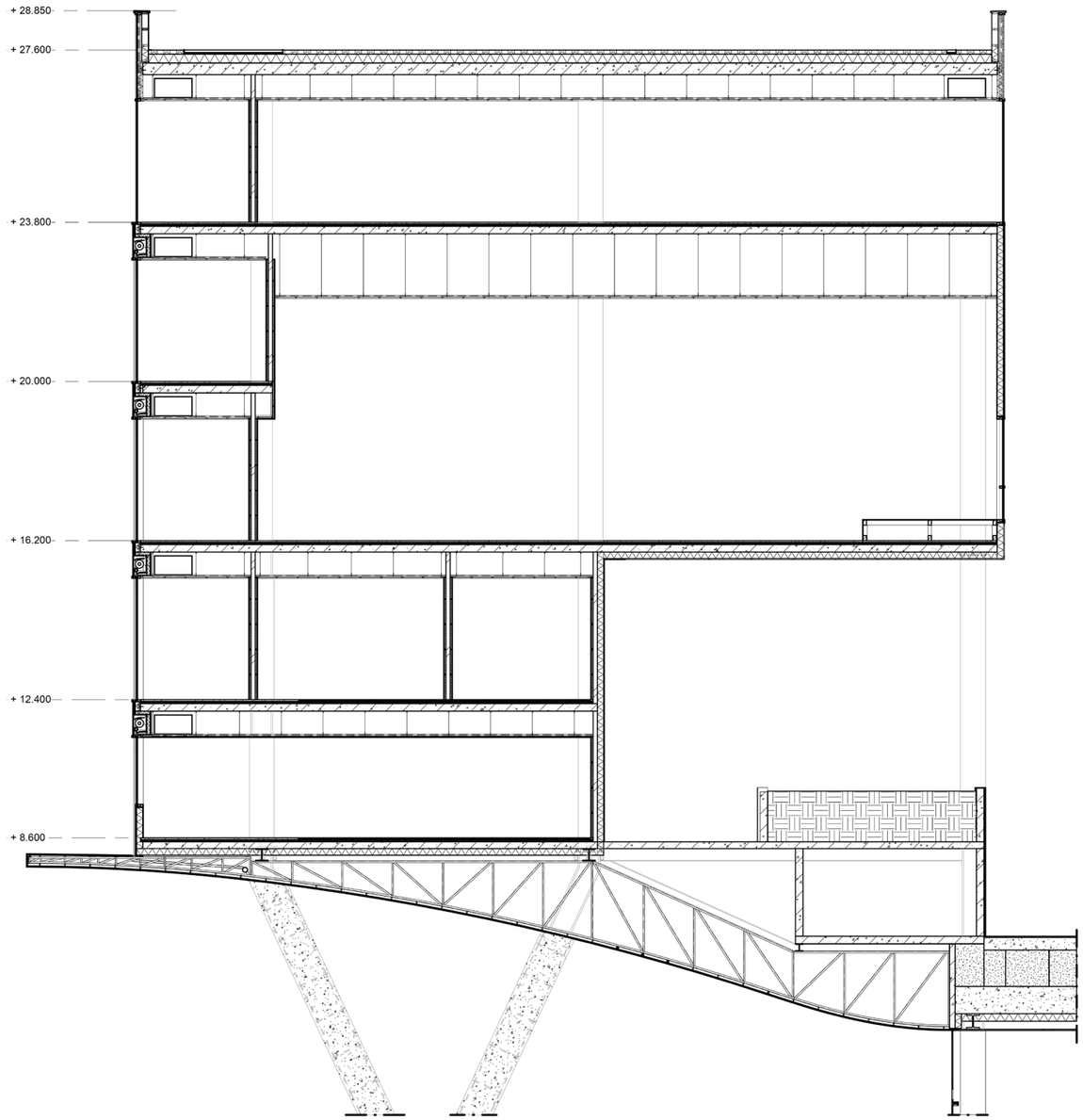


Figure 18.14: Fragment of the building

Figure 18.13 (Right):Render of the extension Building

DETAILS

18.3.1 Roof Detail

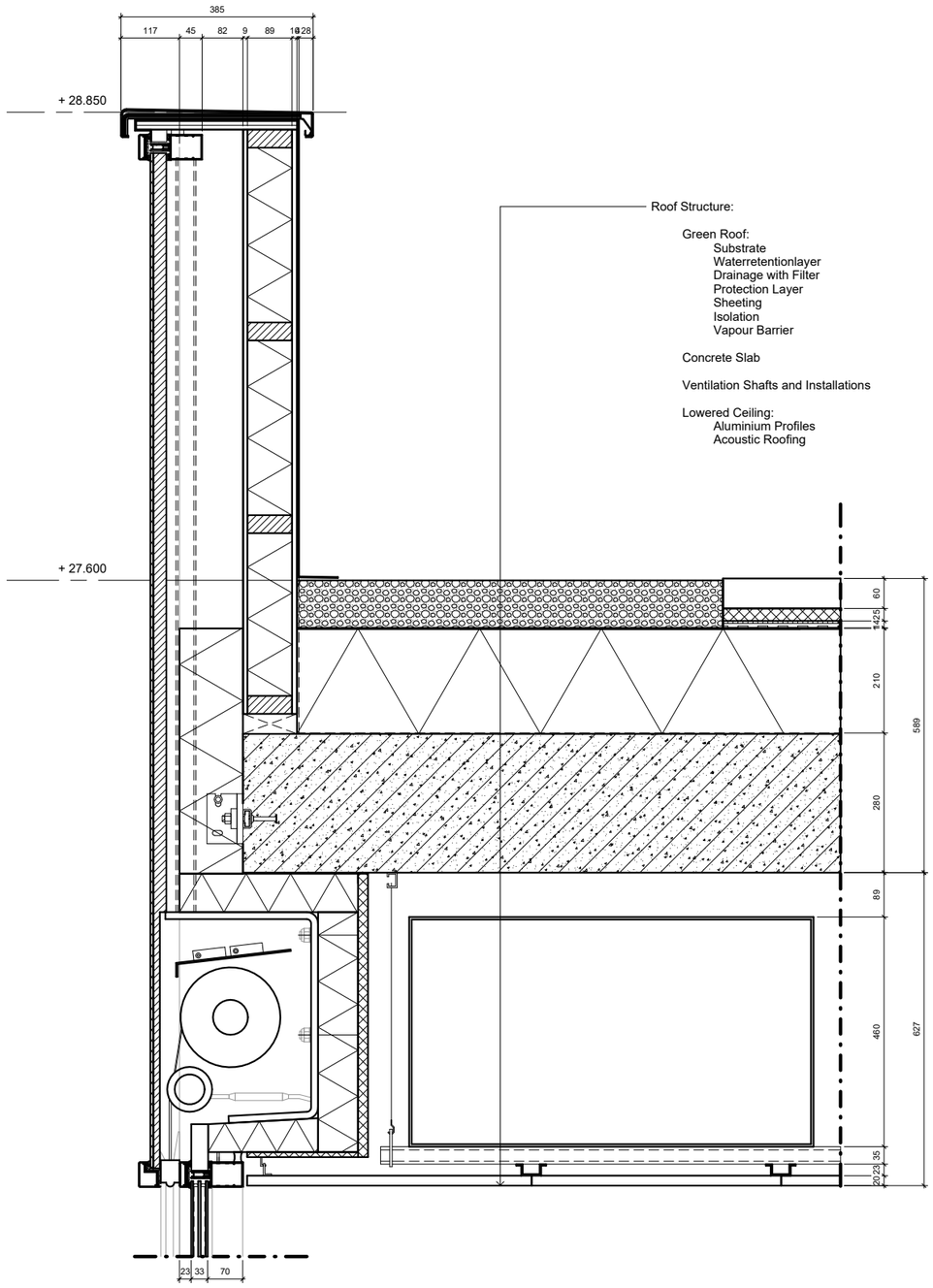


Figure 18.15: Roof Detail

18.3.2 Floor Connection Detail

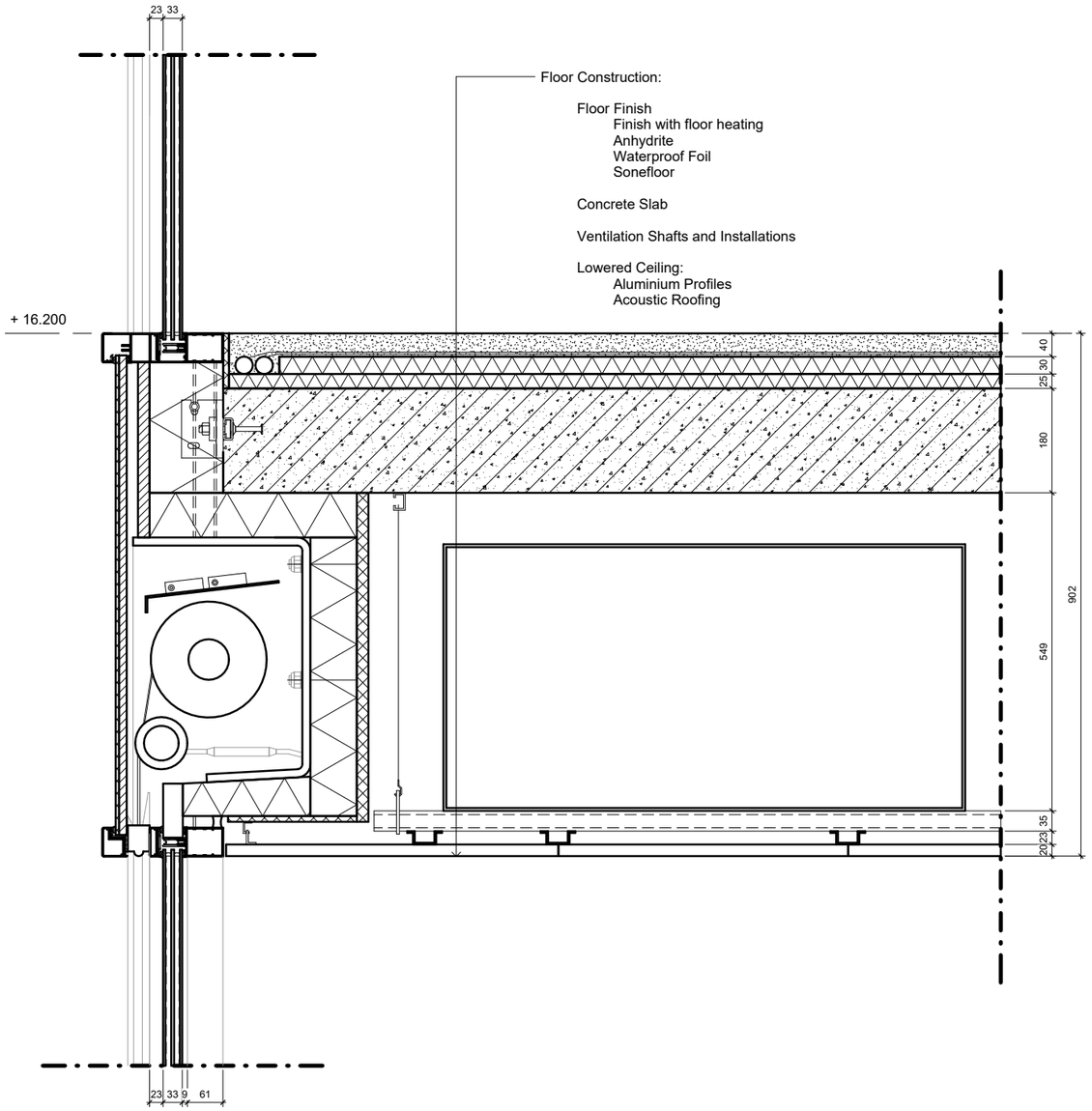


Figure 18.16: Floor connection Detail

18.3.3 Underside Floor connection

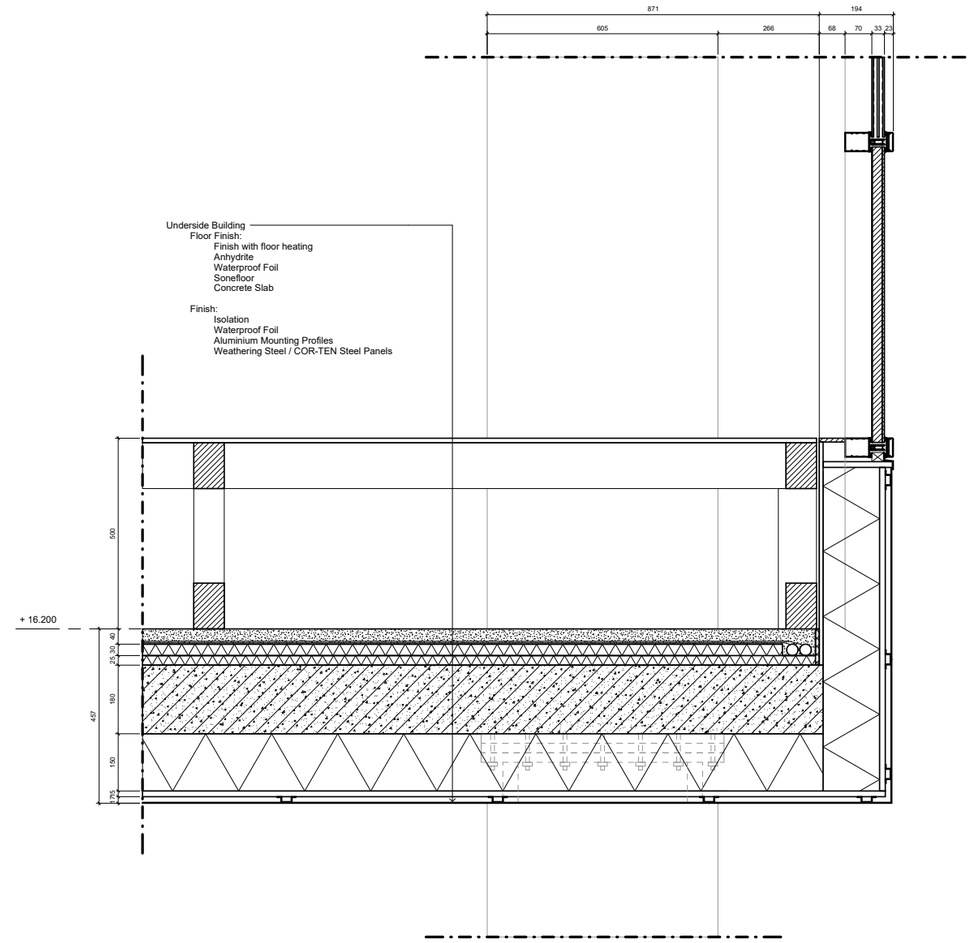


Figure 18.18: Underside floor detail

Figure 18.17 (Right):The backside of the Extension

THE RAIL PLATFORMS

19.1 | Redesign

19.2 | A new Roof

19

REDESIGN

19.1.1 Introduction

While technically outside the scope of this design, the design of the rail platforms has a large influence on the surrounding areas which are within the scope of the project. Therefore, several elements have still been designed and will be discussed in this chapter.

19.1.2 Larger Platforms

Important to the central functionality of this design is the reduction of the platforms and rail tracks. This section is necessary to create the required voids for the covered street and to make the experience on the platforms nicer. As discussed in the previous chapter about accessibility, this also allows for a clearer access route to the platforms. These new access voids will be placed on the location of the removed platforms. Other sections of the removed platforms will be repurposed for greenery or quality waiting areas. This should clear up the platforms further and allow them to function correctly. Furthermore, this design comes paired with a renovation of the platforms which should massively help the quality of the platform.

As part of the design, the rail platforms will also get a new access route. While not necessary for capacity, it aims to create a direct access between the new green waiting spaces around the entrance and the platforms itself. Furthermore, it aims to provide a connection between the slower travel speed areas on one side of the station with the other. This new access route is therefore not styled as one of the central accesses routes but is instead shaped as a bridge crossing all the other tracks with greenery on top. The new path will furthermore connect directly to the extension of the Post Office building. This improves the connectivity of this building while also allowing access directly from this building to the platforms.

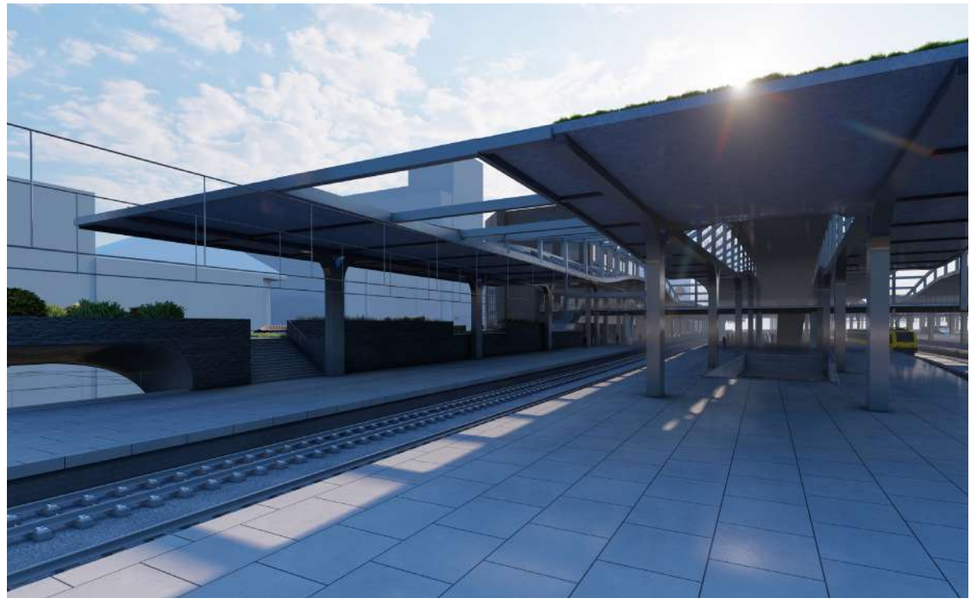


Figure 19.1: New platforms

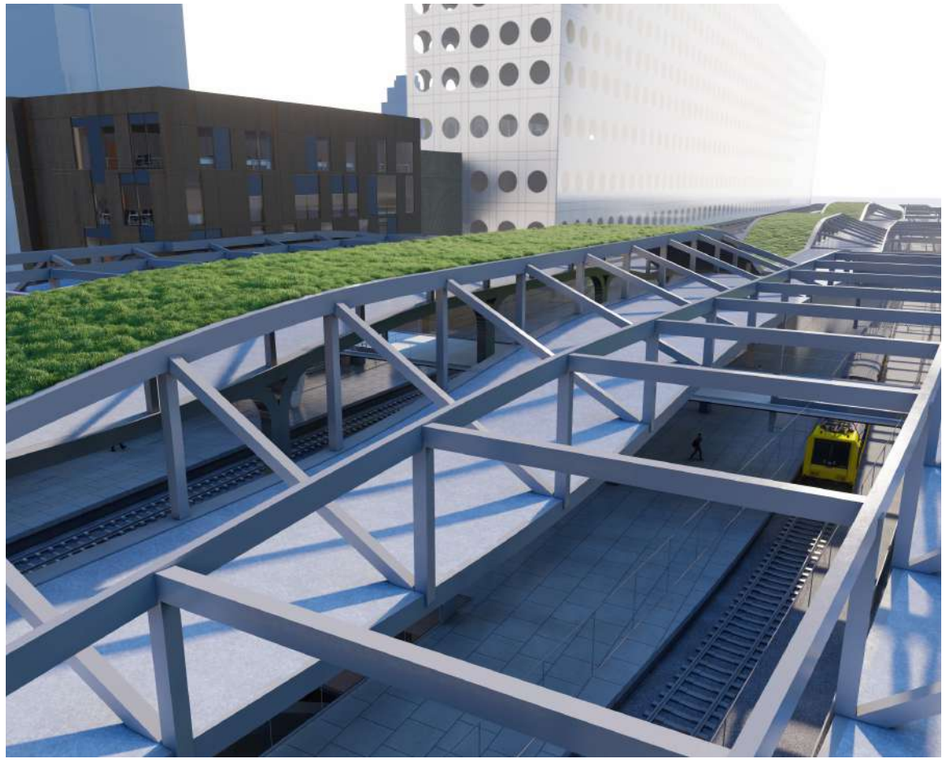


Figure 19.2: Upperside of the new Roof

A NEW ROOF

19.2.1 A Guiding Structure

To further upgrade the platforms, a new roof is designed to modernise the whole station. This new roof would be for the mainline rail lines and the international platforms to make the station feel as one. This new roof exists of higher and lower sections, creating higher and lower spaces on the platforms. The higher sections of the roof are placed around the central access points to the platform to steer travel to the right places. The result is a roof that waves parallel to the station. Not all elements of the roof will follow this pattern. This creates gaps between the roof allowing for light to go through these gaps.

The new roof will function as one of the central elements in the climate concept of the building. It is the ideal place for solar panels since it spans across a large area without hindrance from buildings. IT is therefore that the roof will have a large number of solar panels and sections with a green roof. This green roof helps the biodiversity in the area while also provide a more pleasant aesthetic for the surrounding buildings.

Other climate measures are created within the roof structure itself. The main goal of this roof structure is to create a lightweight structure across the whole platform. The holes created by the waving pattern will allow for light to pass through but also rain. It is therefore that these holes will be filled in with glass windows which protects the inside from rain but can be opened to help ventilate the station on hotter days.

However, panels are installed around these holes that can close of these areas in case of rain. This allows the station to prevent overheating while still offering protection from climate effects.

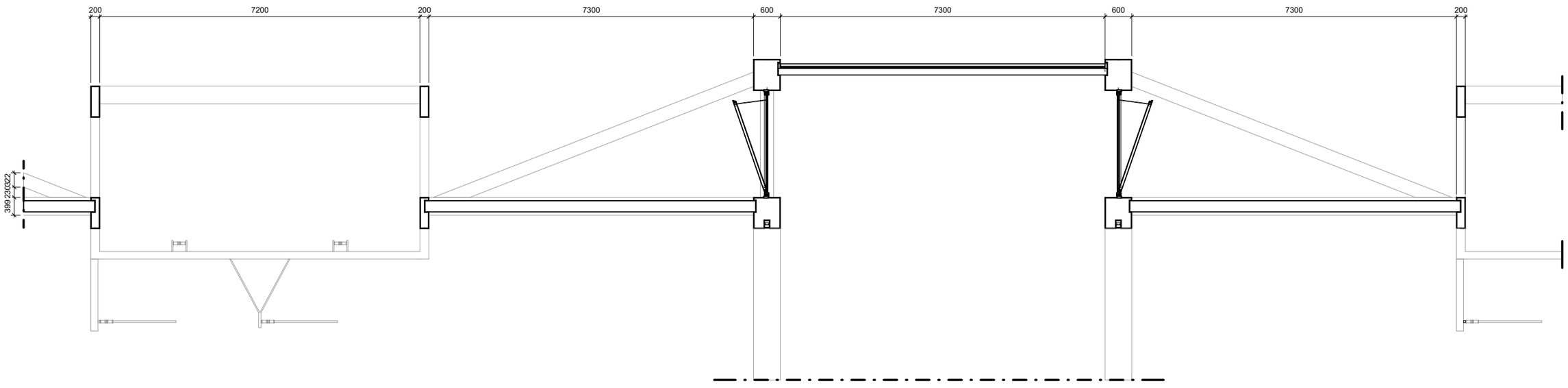


Figure 19.3: Detail of the Roof Structure

CONCLUSION

20

CONCLUSION

20.1.1 Research Questions

The aim of this research was to investigate the public space surrounding intermodal transport hubs hoping to find a way which in architecture can help improve this space and experience. Therefore, the central question asked was as follows:

"How can architecture contribute to the spatial layout and experience of public space in European intermodal transportation hubs of the future?

This question was expanded with four sub research questions:

"What is the current role for public space in transportation hubs?

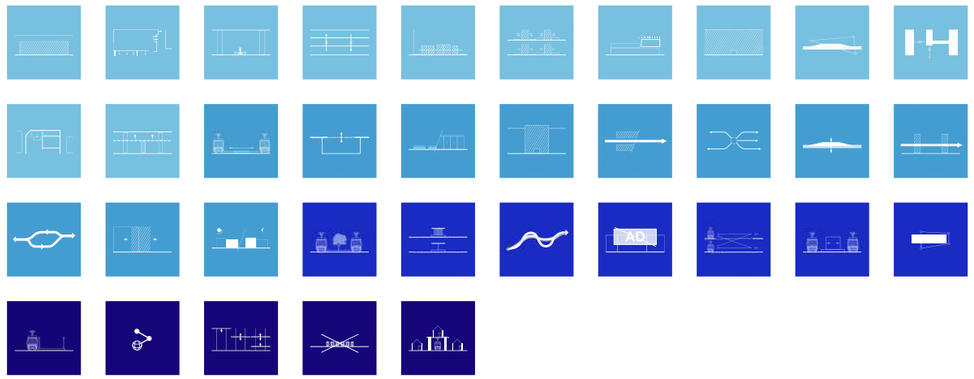
"What is the relation between different transportation modes in transportation hubs?

"How can the experience of transportation hub be improved without limiting the efficiency?"

20.1.2 Literature Research

From this research it can be concluded that there are many ways architecture can influence the experience and quality of the public space surrounding transportation hubs. This can be largely contributed to the many elements that have influence on these aspects. The literature Study established two major problems that contribute the most to these issues: lack of integration and diversity.

The lack of integration results in a disconnect from the surroundings, broken up spaces and barriers surrounding the spaces, while the lack of diversity creates a monoculture and an unattractive space to visit. Solving these problems would not only make the station a nicer place to visit but will also benefit the surrounding area and buildings. However, these problems are deeply connected with he designs and architecture of the hub itself and the spatial layout and are therefore difficult to change. Changing these elements would require large redevelopments of the area and station, which is often not in the budget of the stations. But with the increasing importance of train stations these issues will become larger while the benefits of the solution will also become greater. In the future these large changes will therefore be more attractive, which hopefully gives stations a push to transform their buildings.



Conclusion

20.1.3 Creating a new place

The research continued with investigating the spaces more deeply by using a case study analysis. For this research, the cases Hamburg Haupthbahnhoff, Gare de Paris Austerlitz, Berlin Ostkreuz and Brussels-South were chosen to investigate deeper. From this, four main lessons were identified related to the experience and design of the public space:

The Public area is often nothing more than an area

The connections between different modes are often the places that lack the most quality, but they should be prioritised.

Public Space is more than the main public area.

Transport hubs should be more than a transport hub and shopping centre.

While these lessons are quite generic and logical, it is still that most of the transportation hubs do not follow these lessons. New designs for transport hubs should address these issues and architecture is a great tool to for this. To help this, a series of design aspects were identified using these lessons, the literature, and the rest of the analysis. These aspects were created to help with the redesign of Brussels-South.

20.1.4 Creating a new place

The new redesign of Brussels-South focusses on improving the most problematic areas of the current building, creating a new open station that connects with the surrounding buildings, while creating new connections between the different areas. Wide open spaces were created to help with the wayfinding and make the connections between the different transport modes more interesting for the traveller. Surrounding the station, architectural interventions are used to create different types of spaces, aimed at different type of users of the station building. Combined a new recognisable image of the station the new design should improve the experience and start a connection with the surrounding area.

The new design of this part of the station should give a clear example how to manage the other parts of this large intermodal hub. However, it was not possible to create generic architectural lessons for other stations. Stations are complicated structures specific to their location and creating new generic architectural lessons would not be a specific solution of the area. This could lead to further lack of integration, while the aim should be to improve it. It is therefore that this research will not give generic architectural lessons. Still, the redesign and the design aspects can be used as a reference and example for the stations to give ideas for their redesign.

Figure 20.1 (Right): The new main entrance

RECOMMENDATIONS

20.2.1 Introduction

This research focussed on the investigation of public space inside and surrounding European intermodal transportation hubs resulting in a Redesign of the Covered Street and Avenue Fonsny near Brussels-South Railway Station. This research is therefore quite specific and multiple other research opportunities have been identified. This research therefore recommends the following research topics:

20.2.2 Related to this Research

To start, this design focusses on a small part of Brussels-Souths Railway Station. Several aspects outside the scope have been identified that should be studied further:

Research into the other areas of Brussels-South. This could be a follow up using the literature and analysis of this research but then applied on the other areas of the station.

Research into the relation of Border Patrol Areas and the public space.

Research to the current functions of the surrounding buildings and the impact of better integration to the real estate value

Research to the current functions of the surrounding buildings and the impact of better integration to the real estate value

Deeper research into the relationship of the surrounding functions with the station

Furthermore, more research into several design interventions of this station needs to be done by an expert in the respective field.

Deeper research into the operations of Brussels-South

Deeper research into expending the current North-South Connection in Brussels

Deeper research into the connection of the S-Train Station to the existing network

Deeper research into the current structure and the feasibility of the proposed intervention.

20.2.3 Related to the topic

Last, several other topics related to the central theme of this research were identified. While more generic, this research could help expand the current knowledge and bring more attention to the current problems.

Research into the experience of Brussels-North Station

Research into the experience of public space inside and surrounding airport train stations

Research into the relation and experience of public space with international intermodal transportation Hubs

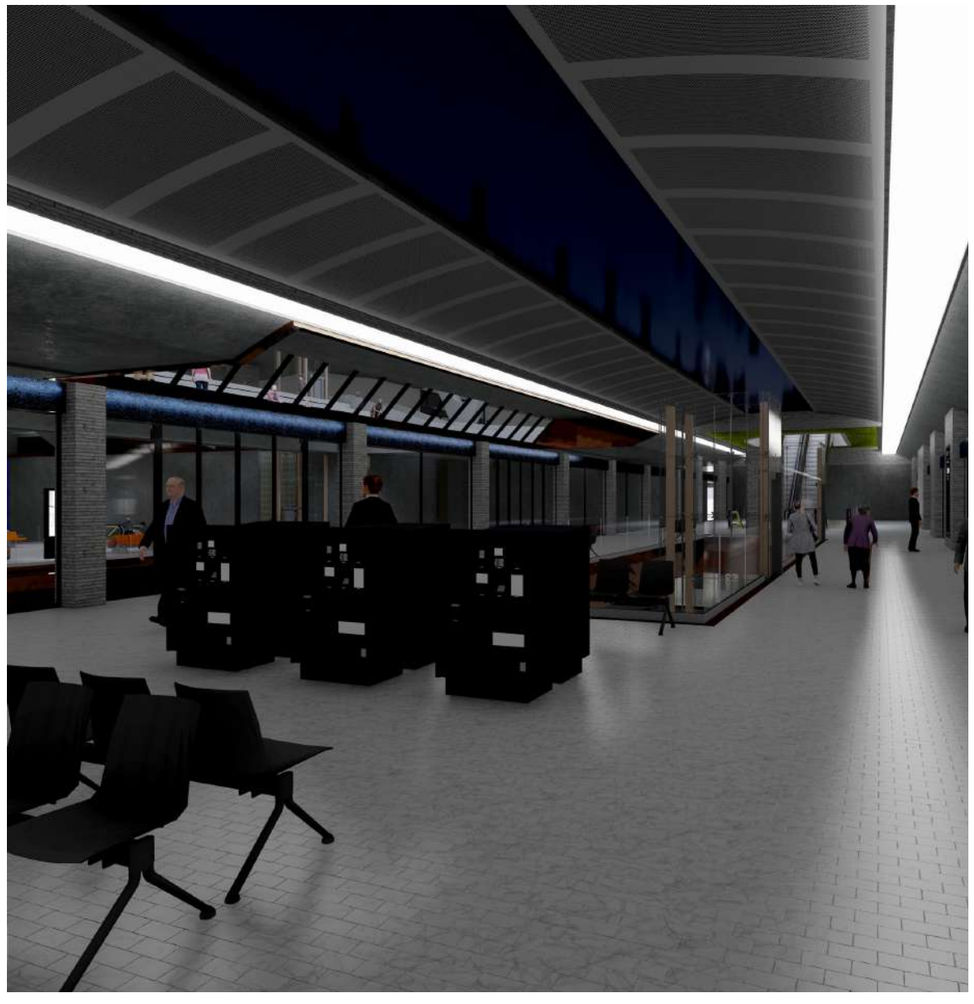


Figure 20.2: The new S-train Station

Conclusion
REFLECTION

20.3.1 Introduction

Train stations and other large public buildings have always fascinated me, due to the significant role they play in the public realm and the complexity of the functions inside of the buildings. Since the studio allowed people to work with their own fascinations, it allowed the opportunity to design and research one of these buildings which made me very happy. However, I have to say that I underestimated the scale and complexity of these structures before I started this project. All the different transport modes and functions combined make it difficult to narrow the scope of the project down. It is therefore simple to say that I think I have tried to take on as much in this project and design. The problem with the size of the project is also visible in the central theme in the study. The lack of quality in public space is an important problem with the design of transportation hubs, but also a difficult problem to tackle. It is therefore that my approach to the research and design has been flawed.

20.3.2 The Method

The main methods of research were a combination of a literature study and case study analysis. The literature would be used to understand the problems and identify the main aspects involved, so that they can be analysed in a selection of case studies. While I still think this method is the best way to understand this problem, it might not have been the best for this research. This is largely because of the limited time available to study the different case studies. In the time available I have only managed to study four case studies. This is sadly not enough to generalise the problems and most of the problematic aspects found would be site or context specific.

I knew at the start of the case study analysis that I would not have enough time to study more than four different case studies. To optimise the research, I reduced the wide selection of case studies by narrowing down the scope of the research. My goal was here to select four cases that would have various aspects between them, with the aim to keep the research as relevant as possible to all different types of transportation hubs. In hindsight this might have been the wrong call since it made comparison between the different case studies only more difficult.

Another issue with the small comparison is the relation that the public space has with the building. This and the potential of the different spaces are largely based on the context of the building. With only four cases it was therefore difficult to understand if the problems are context specific or type specific. It is therefore that the comparative case study analysis was not the best method that I could have used. The contribution of this research is dwarfed compared to the large amount of literature study done beforehand. The analysis of the design location combined with the literature study could have already been enough to understand the relation of the public space for the design assignment. Still, the comparative case study helped me understand the broader spectrum of transportation hubs, so while not the most relevant for the design itself it helped me understand the broader scale. It is therefore that I still believe that a comparative case study could be beneficial to a similar study, if the sample size is larger than what I used in this research.

Further improvements to this research can also be done in the selection of the final design location. During the selection process I was aware that the final choice would probably be largely influenced by the results of the case study selection. It is therefore not surprising to me that I ended up with one of the cases as final design location. However, I think I would have chosen a different site if I would do this research again. While I think the selected station shows a lot of the problems that I try to address in this research, it might have been too much to start off. It is one of the larger transport hubs in Europe and has a complicated structure above and below

ground. It might have been better to start with a smaller station for the first experience with designing transportation hubs. I think I might have been blinded by this because of my interest in the complexity of these stations. Furthermore, I could also save time by choosing this station since I already had a lot of analysis done. For the next time I will need to be more critical of these types of aspects when choosing a final design location.

20.3.3 Expectations

Another aspect that I struggled with during the research and design is the expectations. Since the research started with a large amount of literature research, I feel like I understand the current problem regarding public space in transportation hubs. However, solving these issues has been a complicated process. The experience and quality of the public space is subjective, resulting in some struggles with coming up with solutions regarding the problems in the design phase of the project. This was amplified by the confined space that the station was constructed in, making it harder to make large alterations to the building. I struggled therefore with creating solutions that would not harm other aspects of the station. And the times that I did find possible solutions, I was not happy with the design. This is mostly the result of my high expectation I had for the design of the station but designing a solution to the problems was harder than I expected. It is therefore perhaps that the problems still exist in the station today.

The struggles with the design can also be the result of the approach to the existing building. During the P2 presentation, I was unsure if I should use the existing building as a base of the design or design a new building using the existing transport functions. In the end, together with my mentors, we decided that I should use the existing building since the design of a new building would be impossible in the time. I think this was the right decision looking back at it. Most projects today involving transportation hubs are transformation projects and therefore this design is the most relevant for the future. However, this decision did make some aspects a lot more difficult and caused a lot of struggles. For a start, there weren't any plans available for station and planned renovation. This means that details and sections involving the old building had to be guessed. Since I did not want to create things based on pure guesswork I tried to work around this issue. But since a large amount of the project is focussed on the barrier between inside and outside and old and new this was quite problematic. I still think that this aspect is on some areas of the station underdeveloped. It still feels wrong to make assumptions to finish drawings.

In the end, the final design is therefore during writing of this reflection still in progress, much later than I would have liked. Still, the design currently already improves the station a lot and is getting to a point where I am happy with it. But there are still doubts regarding the passing of the final two presentations. This is mainly due to the complicated relationship of my research and the general architecture master tracks. In general, the graduation tracks want to know if I can design a building, details, structure, and other aspects regarding designing a building. My research however is largely focussed on the public space inside and surrounding the station. I used therefore a lot of my time during the studio to design the public space surrounding the station and the relationship with the underground. During this phase, I was worried that I was not designing enough "Building." To me, the focus was on the balance between the existing building, new additions, and the surrounding public space. But I knew in the end that I would be judged on designing a building itself. I ended up adding an extra volume to the existing building. While I am now happy with the design of this extra volume and can justify it being there, I still wonder if it is the best solution to add more volume to this already large building.

I think this struggle of focussing on a building or not is because of the complicated cross domain situation in this project. Since this is a cross domain studio, you are of course stimulated to look beyond architecture, and I like that. It is therefore conflicting that the results of this studio are a little one sided, with the focus being only on the Architecture

itself. I think I share the opinion that one of the teachers told us in the beginning: The barrier between urbanism and architecture can be very close or undisguisable. It is therefore that I wonder if all the work that I have done during the project is assessed in the best way possible. As an example, during the design of the station I also focussed a large amount on the transport network in this station. I wanted to know that if I make large adjustments to the structure of the station that they would be feasible. I know that the mentor that helped me with this function of the transport hub will appreciate it and make sure that it is considered in the grading of the project. However, I cannot say the same for the larger sections of street design that I have done. I do not think this is a fault of the mentors in the project. They have been supportive of this direction that I have chosen in this research and have been significant help. However, I feel like the limitations of still being an architecture track do limit the focus on only creating a building. In the end there are still requirements that even this cross-domain studio must fulfil.

This disconnect is I think the main reason why I sometimes felt lost in the design phase. The need to create a building was always on the back of my mind and maybe it should not have. Nevertheless, I still stand behind my choices that I have made during the design phase. I think I now have a good balance between the focus on architecture and other disciplines for the presentation to fit with both the requirements and my expectations.
Other areas where I struggled with is in the design with the creation of a separation between the inside and the outside. Following my research, it is important to not create barriers and integrate the building within its context. However, during the design of my building I realised that stations have a closing time, which would mean that the building needs to be able to close off. This would conflict with the current design that I had. Nevertheless, the mentors helped me with guiding me to workable solutions without creating large barriers. I still believe that I should have paid more attention to this aspect in the beginning. I am happy with the current solution, but I also wonder if a better solution would be possible. Perhaps changing the concept of a station building further and create more areas that are permanently open. This would require more research and could be interesting as a follow up study.

20.3.4 Relevance

One thing where I do have my doubts over is the relevance of the results of this study. While the topic discussed and written about is scientifically relevant, I do wonder about the possible design and conclusion. This is mainly because I feel that there should be more research done into this topic and I personally feel that this research is not extensive enough. There are several aspects to this research that can be improved to make it more relevant, but most of them are based on more time available. As stated earlier increasing the number of cases in the case study analysis can already help make it more relevant for more Transport Hubs.

To improve the research even further the scope of the project could also be widened. Currently, the focus of the research was on the public space inside and surrounding the station. However, for aspects like integration the surrounding building and functions are also incredibly important. In this research this aspect is reduced due to the limited time. This is therefore one of the areas that can be continued on with additional research.

Lastly, I also feel like that it is more difficult to generate a good result as an example for other studies. While conclusions are more easily made from the literature and case study analysis, it is harder to make the lessons learned from the re-design applicable for other possible designs. I thought in the beginning it would be possible to take general lessons from the design but looking at it now, it does not feel like the right thing to do. The most problematic areas are often site-specific, and context bound. They would require a specific solution to improve aspects like integration. Applying a generic design lesson would not be integrated enough in my

opinion. I do think that the approach is good. So instead of developing and investigating central lessons, it would be more beneficial to develop the design approach further with public space more central. Sadly, I have realised this to late to dive further into this idea.

In the end, I still look back positively to the entire process and learning experience. I have enjoyed working on a building where the aesthetics was not only the centre of the design but also functional part. And while in the bachelor and master I have designed several buildings that are open to the public, it was new for me to design a building where the public would be central. Working with the considerable number of flows caused me to be more aware of flows than I normally already am. Furthermore, it was new for me to work on a project where the building would not be central in the design, the surrounding area was just as or maybe more important. These things, new to me in the beginning of the research have only made me appreciate these types of buildings even more. I hope that I can continue working on these buildings after I have graduated.

20.3.5 Conclusion

To conclude, I have struggled with the massive scope of this project. Even though the project now is already a lot smaller than my first ambitions, I underestimated the complexity of the subject. Nevertheless, I have enjoyed my time spend on this research and design. I feel like this is the perfect conclusion to my Bachelor and Master tracks at Delft. It reflects my interest in architecture, urbanism, and transportation, while also highlighting the many cross domain studios that I have followed through the course. Therefore, this studio and project combines these aspects to form the perfect end project for my master.

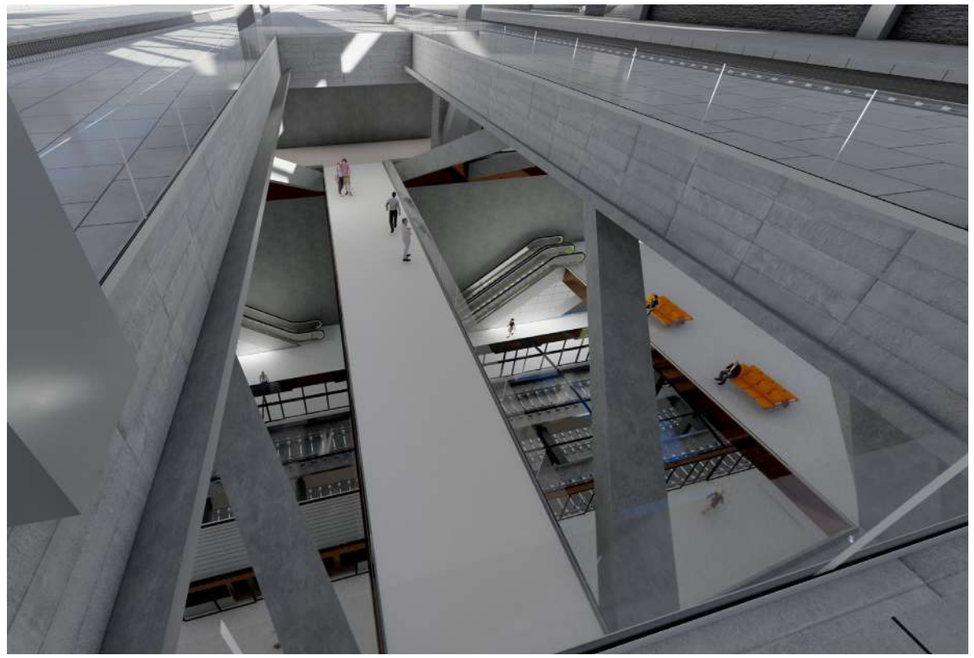
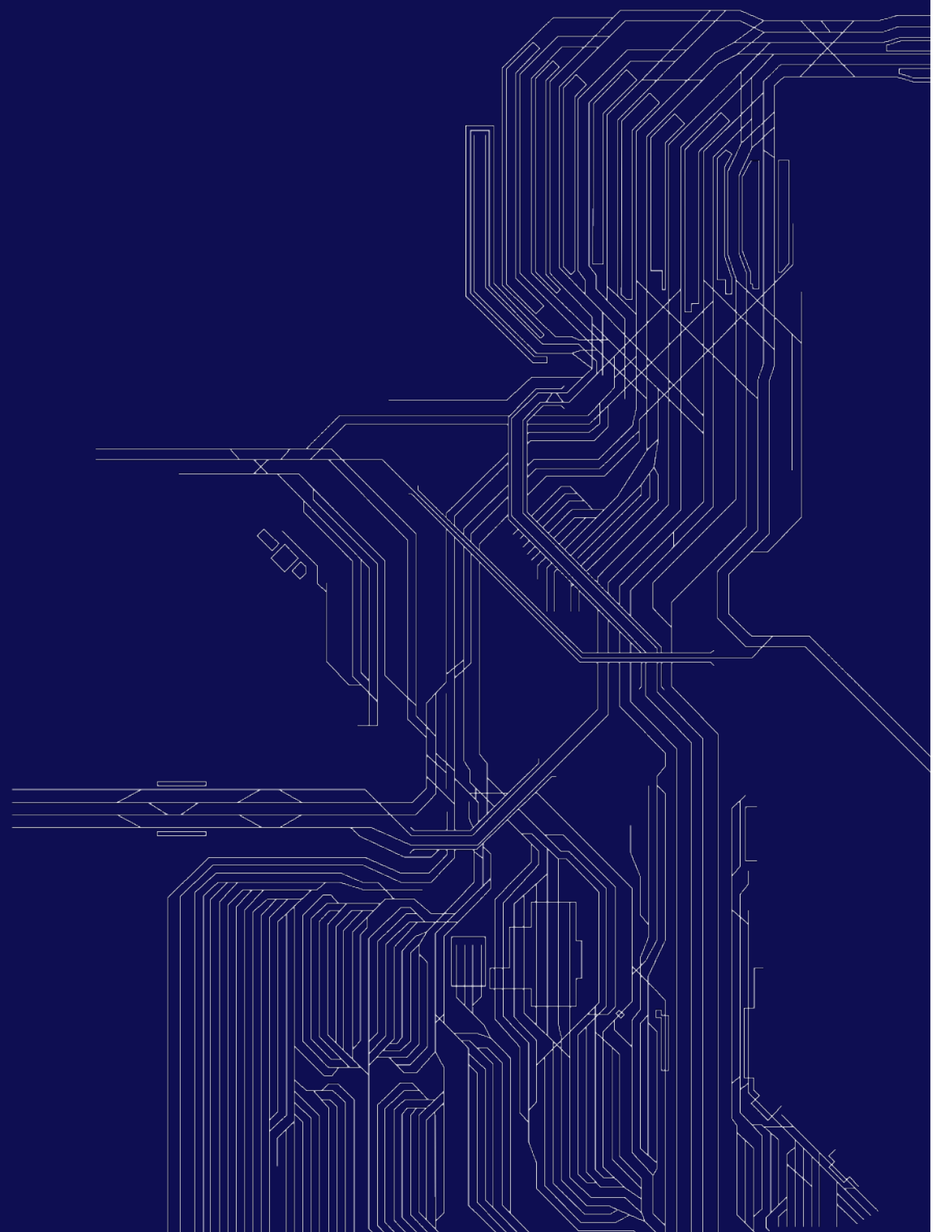


Figure 20.3: The view from train tracks

EXTRA'S



21

P4

LITERATURE LIST

21.1.1 Related to Transport Hubs

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MODEL

Figure 21.1: Model created for the Final Presentation

Figure 22.2: Avenue Fonsny

Figure 21.3: The new community area and canopy

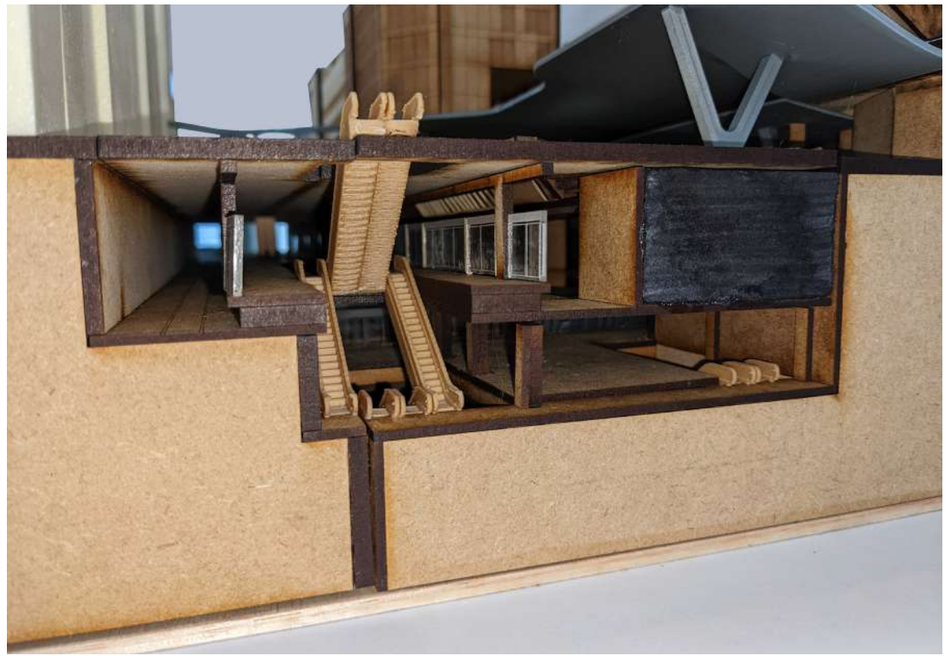


Figure 21.4: The main access tower on the northen side of the station

Figure 21.5: Overview of the S-train Station

Figure 21.6: The interchange between the S-train Station and the Metro station

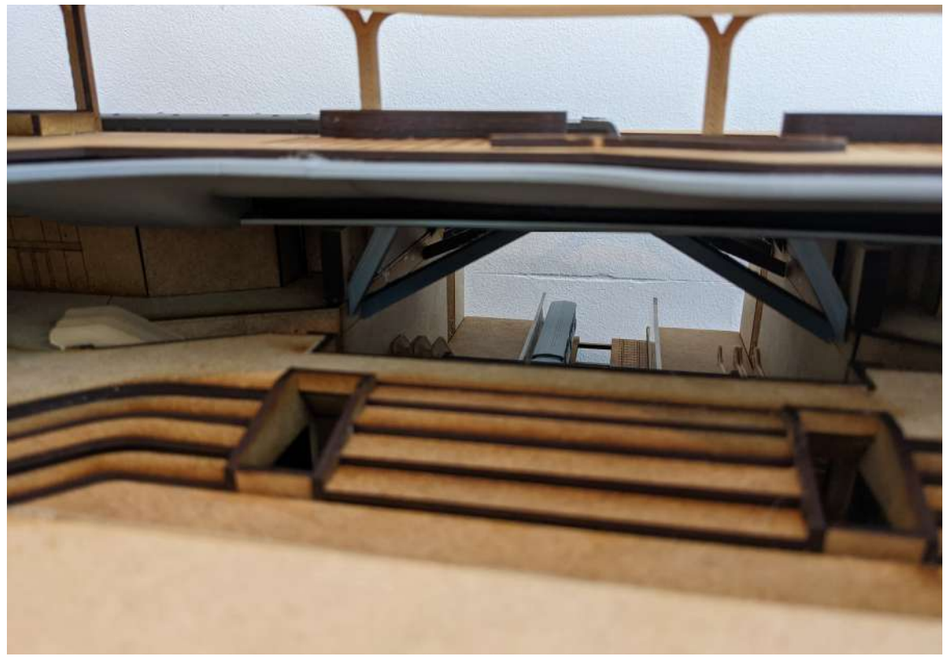


Figure 21.7: View to the metro station

Figure 21.8: The metro station with the new structure

Figure 21.9: The interchange between the S-train station and the Metro

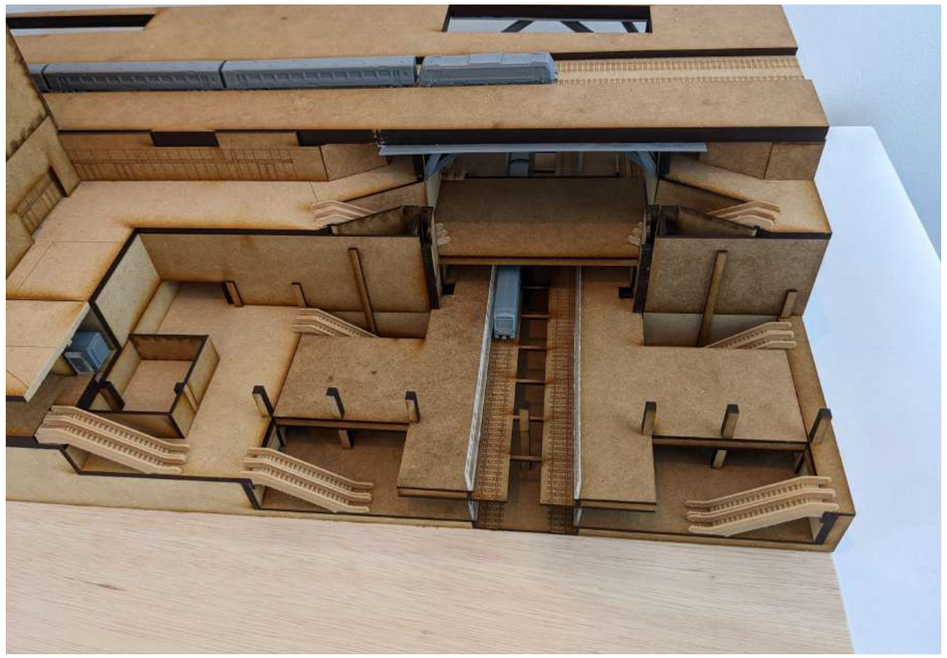


Figure 21.10: The metro station

Figure 21.11: The bottem level of the station

Figure 20.2: The cascading patern going downwards into the station

FIGURE LIST

Extra's

APPENDIX

A1 | Research Plan

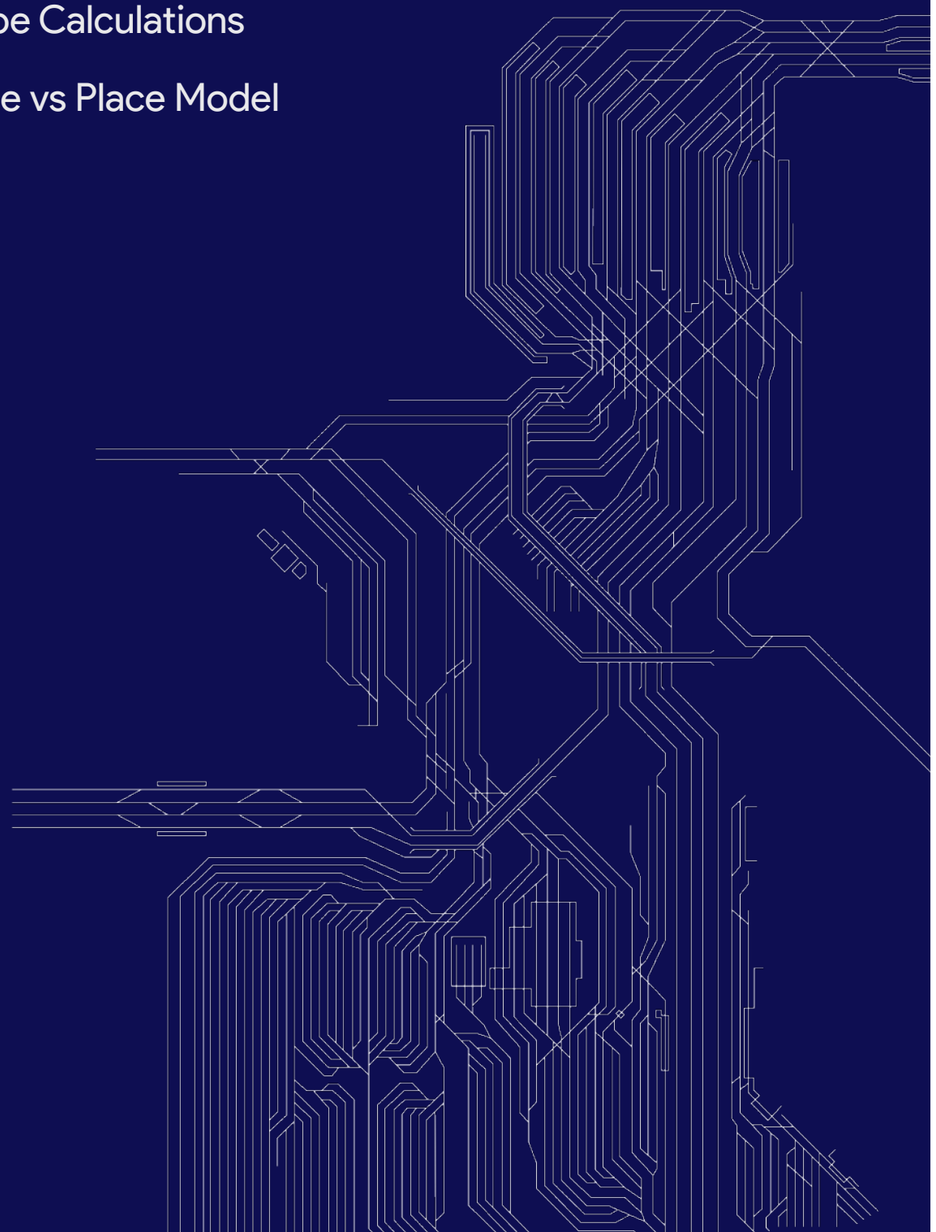
A2 | Transportation Hub List

A3 | Case Study Matrix's

A4 | Train Network Analysis

A5 | Slope Calculations

A6 | Node vs Place Model



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Appendix

INTRODUCTION

The next couple of pages are dedicated for calculations, matrixes and tables that had been created during this research. Aiming to give more background information

Appendix 01

RESEARCH PLAN

Transport Hubs as Public Space

Using architecture to improve the public space in future intermodal transportation hubs

Research Plan
Cities of the Future Cross Domain Studio
Faculty of Architecture

Mike van Weerdenburg
4679040

Keywords: Intermodal Transportation hub, Station Design, Public Space, Wayfinding, Experience, Future Stations

1. Introduction

The implementation of high-speed rail in transportation hubs and stations have caused a series of (re)developments in European cities. These developments however have not addressed the problems of integration and experience of the public space in and around the stations. Therefore, this research continues the studies to improve the spatial experience and integration of public space in transportation hubs, focussing specifically on the relation of public space inside intermodal transportation hubs with the current and future transport modes.

The aim of this research is to understand the relation that public space has with the different transport modes inside an intermodal transport hub and how this space can be improved and integrated within the complex and the city using architectural methods and tools.

1.1 Research Background

Stations have been part of the urban fabric for a long time and are considered essential to a good functioning city. With the increasing population of urban areas and the need for environmentally friendly transport, their role and importance will only increase. Combined with the need to implement high speed rail most cities are transforming their stations to adapt the high-speed rail and the increasing number of travellers. Most often the redevelopment is considered an success, while researchers see it as a missed opportunity to rethink stations.[1]

The redevelopments kept the same layout and principles, pleasing the financial stakeholders with focussing on efficiency. Other aspects like the experience of users often not prioritised.[2]

The lack of focus on the experience of the users is becoming an bigger problem with the functional shift that stations are going through. The last couple of years the major stations are partly changing from an place to travel to an place to be. However, this change is not reflected in the way the stations are designed. Transport hubs are often still just stations, not an place of its own[3]. The role of public space inside the station is therefore not utilised to its potential, leading to the public space mostly being unattractive. The problems continue when looking at the surroundings, with an clear disconnect of the public space inside and the public space surrounding the area.[4] This last problem is not only related to the public space, but the stations in general being disconnected from the urban context. [5]

With the introduction of autonomous vehicles, shared vehicles, and other new modes of transport most of the stations will have to transform again to adjust for these options. This transformation is another opportunity to rethink how public space inside stations should be, which is the main reason behind this research.

2. Problem Statement

As stated before, transportation hubs have gone under several redevelopments and transformations, but are always neglecting the experience and spatial performance of the hubs itself. This lack of focus on these aspects leads to unattractive public space inside the area and an disconnect to the surrounding urban fabric. The methods from designers and experts like Bureau Spoorbouwmeester are implementing therefore space where people can stay,[6] but this space is often still undefined, unattractive, and not prioritised. Most often this leads to the same formula of shops and cafes, not designed places itself.[7] Since the public space inside the hubs as place to be is becoming more important, the design of the transportation hub should reflect this change. Otherwise, the potential and functioning of these transportation hubs will decline and will in the future be avoided by the travellers due to the negative experience. Therefore, a change is needed to the design of public space inside and around the hubs. This change could be implemented during the next redevelopment, integrating new transportation modes that will be implemented the near future.

The interaction of the different transport modes and the public space in between is therefore important to understand to be able to investigate the required changes needed. This leads to the focus of this research being on intermodal transportation hubs with at least three different types of transportation modes. One of these transport modes will be rail transport since these stations have the most opportunity to be its own place inside the city and could benefit the most from this research. This research will exclude transportation hubs with boat & air travel since these are not as common or require a specific solution. Another limitation in this research is region. Since culture and regions cause major differences in transportation systems and their usage, this research will only focus on the transportation hubs inside Europe. Further mentions in this research will therefore refer to these specific intermodal transportation hubs, unless mentioned otherwise.

[2] Yo Kaminagai, “Intermodal hubs as urban spaces,” in *Station as Nodes* (see note 1), 33-35.
[3] Yo Kaminagai, “Intermodal hubs as urban spaces,” 33-35.
[4] Ana Conceição, *From City Station to Station City* (Delft University of Technology, 2015), 17.
[5] Cavello, Roberto. "The Railway and the Dutch City." OverHolland 5 (2007): 43-59.
[6] Bureau Spoorbouwmeester, *Het Stationsconcept.* (2011).
[7] Conceição, "From City Station to Station City," 14, 23.

3. Research Questions

The central goal of this research aims to investigate the spatial relationship between the different transportation mode in the transportation hub of the future, with the goal of understanding how the public space currently exists and how the function of this space can change to an place of its own. To understand how this goal can be reached, the following main research question (RQ) is formulated:

“What can architecture contribute to the spatial layout and experience of public space in European intermodal transportation hubs of the future?

To answer this main research question, four sub research questions (RsQ) are formulated. These questions are based on the several aspects that will be investigated in the research.

“What is the current role for public space in transportation hubs?

“What is the relation between different transportation modes in transportation hubs?

“How can the experience of transportation hub be improved without limiting the efficiency?”

“How will the new transportation modes influence the transportation hubs?

The first two questions are set with the purpose of understanding the current situation of transport hubs, with the first question focussing on the public space itself and the second question more on the relation between the different modes of transport. These questions should give an overview how the current spatial situation is inside and surrounding the hubs. The third question was created to investigate deeper the experience the current situation gives and how this should be improved. The final question looks to the future and investigates what new modes of transportation could change. The answers from these question function as an base of knowledge that can be used to answer the main research question.

4. Theoretical Framework

To study and analyse the space inside an structure, this research must go beyond the scope of architecture and the traditional scope of the building. The connection with the surrounds and functioning of the stations itself will have to be considered when researching to prevent the solution only being focussed on the domain of architecture. Instead of limiting to only using the domain of architecture, this research will therefore expend the scope with theory from the domain of Urbanism and the domain of Transport, Infrastructure and Logistics (TIL). Nevertheless, the research will use mostly tools from the domain of architecture.

The public area will be investigated through multiple methods, consulting different fields of theory. To study the spatial layout, part of the research will be an architectural typology study, studying the important aspects of this type of building. This theory should give insight in the spatial configurations of transportation hubs, which is essential to understanding the role of the public space. This research will be combined with insights to the functioning and performance of these public areas by investigating the experience of the users. This insight is supported with theory from the field of phenomenology and praxeology.

Besides these fields, the research will be supported by a wider framework of other sciences to wider the discussion and relevance. As example, the research will consult the field of axiology to understand the complicated stakeholders situation this research is operating in and to provide an deeper understanding of how the problems surrounding the unattractive public space have originated.

5. Methodology

This research investigates the physical layout and function of public space inside and surrounding intermodal transportation hubs of the present and the probable future mostly using the method “design research”. The research itself is divided in three sections, split into three parts. The first part forms an base of knowledge and an deeper understanding of the problem, which will be used for the second part. The second part consists mostly as an comparative analysis of an selection of case studies. The final part will take shape of an design assignment and will use the method “research by design”. The result of this final part will be an design and several design interventions to improve the public space inside hubs. An overview of the different sections is visible in the research diagram in figure 1.

5.1 Part One: Literature Research

The research is split in three different sections each investigating one of the aspects of public space related to transportation hubs. This division will already happen in the beginning of the research. The first section will focus on the spatial layout of the public space in and surrounding the transportation hub, with the aim of answering the first two research questions. The second section of this research will focus on the performance of the public space, by studying the experience and function. The third section will investigate the different modes of transport itself and the potential future additions. In the first part of the research, all these sections will take shape as an literature study, with the goal of gathering information to proceed in the analysis of the case studies.

Following the introductory literature research, an separate study will investigate a wide selection of transportation hubs in Europe, with the goal of making an selection of case studies that will be analysed further in a comparative analysis. The case studies will differ in size, modes, and complexity to analyse all different kind of scenarios and different roles for the public space. The variating aspects of the transportation hubs will be displayed in analytical graphs and heatmaps, displaying an overview of the different transportation hubs. These graphs will help make an informative choice for the selection of case studies, with the goal of an range as wide as possible and make sure that the results of this research can be applied to as much different transportation hubs as possible.

5.2 Part Two: Comparative Analysis

The second part of the research will focus on the comparative analysis of the case studies. Each of the sections will analyse the case studies with its designated method to extract the required information to answer the research questions. The first section will use the method plan analysis to construct an graphical analysis of the physical public space in and around the transportation hubs. This method requires the availability of floor plans, which could also be acquired from navigation maps that are often present inside the hubs. With the previous acquired knowledge from the literature study this section will answer the first two research questions. As this section answers more than one question, it is expected that this section will use more time than the other sections.

The second section will continue the investigation to the usage and experience using methods relating to phenomenology and praxeology. The methods tracking and sensory mapping combined with the earlier literature research are chosen to provide information to answer the third research question. These methods however can take an large amount of time, which should be considered when executing this part of the research. If it happens that the methods would require more time than available, literature studies into the same topics could provide enough information to still answer the third question.

The third section uses the found information and knowledge from the first two sections to help answer the fourth research question. Combined with the literature information it should give insight to what effect each transportation mode has on the public space, and therefore should be able to understand what influence the future transportation modes will have. The results of this are depending on which case studies are selected, making the right selection even more important.

5.3 Part Three: Research by Design

The answers to the different research questions and the found knowledge will be translated into several design interventions that should help improve the public space in and around transportation hubs. These interventions are created using “research by design”. This progress will take shape as an design process, aimed to create an more ideal transportation hub using the knowledge learned from this research. This design will be a new concept of transportation hub or as an transformation of an existing transportation hub and will be created on the location of one of the case studies since information about this location is already known. The design interventions created during the design process should be made in consideration with the problems relating to formulaic designs, meaning that these interventions should not result in an formula that can be applied anywhere but interventions that can change the core of the functionality of the transport hubs.

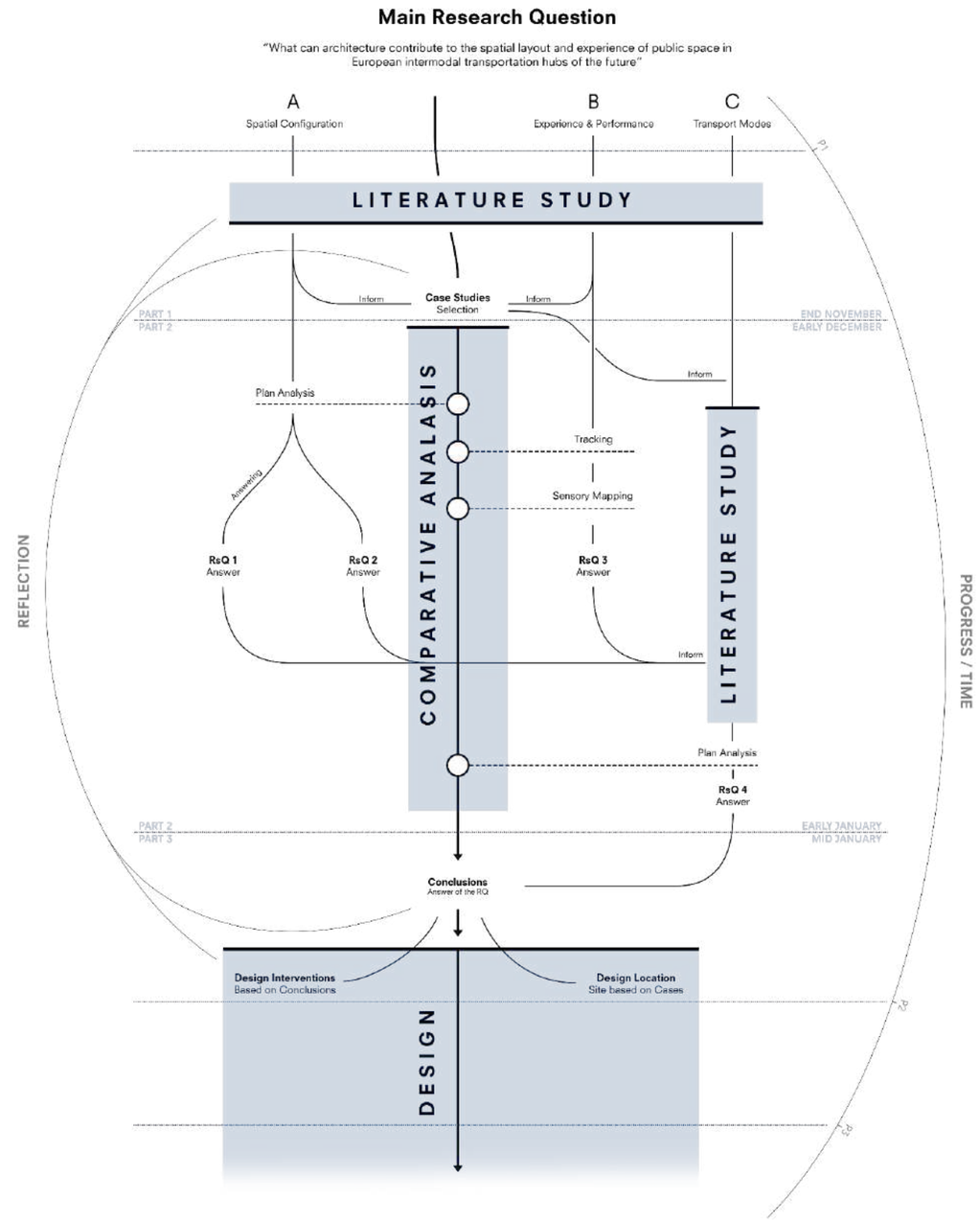

Figure 1: Research Diagram

6. Results & Relevance

The aim of this research is to rethink and revalue the public space inside and around intermodal transportation hubs to improve the experience and usage of the space. The place inside the station should become an place on its own. This research is expected to contribute to this goal with an series of design interventions, which should be applicable to as much transportation hubs as possible. With the role of transportation hubs only becoming more important and the hubs itself bigger, the issues that currently plague the hubs should be resolved.

However, Transportation hubs are complicated structures in complex and unique situations. It is therefore difficult to research all different hubs or make the design interventions relevant for every single type of hub. The boundaries mentioned earlier aim to limit the research, to make sure that the design interventions can work on these hubs. Nevertheless, the relevance will not be impacted much since these hubs represent the majority of the transport hubs.

The relevance of the research is also dependent on the selection of case studies. The wide range of case studies will make the research more relevant to an wider range but requires extra thought into the differences between these cases. This research therefore also studies the role of the public space itself, to see how the different scales of transportation hubs influences the role and requirements of the public area.

7. Bibliography

The research focusses mostly on the architecture domain. The literature however uses information from multiple domains, to support the research most angles related to transportation hubs. Below, a preliminary list of literature is located which will be consulted during the research. The list is divided into subjects, to help understand where the research will be used for.

7.1 Stations & Transportation hubs

The main subject of investigation are the transportation hubs. Therefore, this section of literature is the most important of the research. The main source in this section is the book: Station as Nodes. This book is an collection of different opinions and research from current experts in stations. Therefore, this source functions to give insights to various topics which could be useful to study. However further research must be done to be able to apply these topics to this research.

Cavallo, Roberto. "Design Studies on the Coexistence of City and Rail." EURAU, 2012.

Cavallo, Roberto. “Het Spoorwegstation: Van Monument Naar Multifunctionele Terminal. Het Geval Van Het Amsterdamse Centraal Station.” *OverHolland*. 2007.

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Fleming, Douglas K., and Yehuda Hayuth. "Spatial Characteristics of Transportation Hub: Centrality and Intermediacy." *Transport Geography* 2, no. 1 (1994): 3-18.

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Triggianese, Manuela, Roberto Cavallo. "The Station of the Future: Amsterdams Stations in Transition." *OverHolland* 20 (2019): 33-60. https://doi.org/10.7480/overholland.2019.20.4143.

7.2 Public Space

The focus of this research is placed on the public space, inside and surrounding the transportation. The sources below help understand the relation of the public area with the transportation hubs and the surrounding area. More literature relating this aspect with stations itself is found in the aforementioned book Station as Nodes.

Abutaleb, Ayman, Kevin McDougall, Marita Basson, Rumman Hassan, and Muhammad Nateque Mahmood. “The Impact Of Transit-Oriented Shopping Mall Developments (TOSMDs) on Metro Station RIDERSHIP: Dubai Metro Redline.” *Urban Rail Transit* 6, no. 3 (2020): 157–70. https://doi.org/10.1007/s40864-020-00129-0.

Cavallo, Roberto. “Railways in the Urban Context.” Thesis, s.n., 2008. ISBN 978 90 5269 361 3.

Fleming, Douglas K., and Yehuda Hayuth. "Spatial Characteristics of Transportation Hub: Centrality and Intermediacy." *Transport Geography* 2, no. 1 (1994): 3-18.

Harteveld, M. G. A. D. “Interior Public Space: On the Mazes in the Network of an Urbanist,” 2014.

7.3 Underground Space

Due to the nature of transportation hubs often there are some parts located underground. The relation between the space above and space underground is therefore important to the functioning of the transportation hub. This section or research focusses therefore in understanding this relation.

Admiraal, Han, and Antonia Cornaro. "Why Underground Space Should Be Included in Urban Planning Policy – and How This Will Enhance an Urban Underground Future." *Tunnelling and Underground Space Technology* 55 (2016): 214-20. https://doi.org/10.1016/j.tust.2015.11.013.

Cui, Jianqiang, Andrew Allan, Michael A.P. Taylor, and Dong Lin. “Underground Pedestrian Systems Development in Cities: Influencing Factors and Implications.” *Tunnelling and Underground Space Technology* 35 (2013): 152–60. https://doi.org/10.1016/j.tust.2012.12.009.

Cui, Jianqiang. "Building Three-Dimensional Pedestrian Networks in Cities." *Underground Space* 6, no. 2 (2021): 217-24. https://doi.org/10.1016/j.undsp.2020.02.008.

Durmisevic, Sanja. "The Future of Underground Space." *Cities* 16, no. 4 (1999 1999): 233-45. https://doi.org/https://doi.org/pii: s0264-2751(99)00022-0.

van der Hoeven, Frank, and Akkelies van Nes. “Improving the Design of Urban Underground Space in Metro Stations Using the Space Syntax Methodology.” *Tunnelling and Underground Space Technology* 40 (2014): 64–74. https://doi.org/10.1016/j.tust.2013.09.007.

7.4 Experience

To understand how people experience transportation systems, several aspects relating to it must be studied. The main aspect that will be researched is the aspect wayfinding, an element crucial to the functioning of a transportation hub. Literature related to this subject and other research relating to experience is in this section

Carvalho, Joao, Manuel Marques, and Joao Paulo Costeira. "Understanding People Flow in Transportation Hubs." *IEEE Transactions on Intelligent Transportation Systems* 19, no. 10 (2018): 3282-91. https://doi.org/10.1109/tits.2017.2775285.

Clever, Jan, Jimmy Abualdenien, and Andre Bormann. "Deep Learning Approach for Predicting Pedestrian Dynamics for Transportation Hubs in Early Design Phases." 2021.

Loukatou-Sideris, Anastasia, Brian D. Taylor, and Carole Turley Voulgaris. *Passenger Flows in Underground Railway Stations and Platform.* Mineta Transportation Institute (Mineta Transportation Institute, 2015).

Mbatta, Geophrey, Thobias Sando, and Ren Moses. "Developing Transit Station Design Criteria with a Focus on Intermodal Connectivity." *Transportation Research Forum* 47, no. 3 (2008): 77-91.

Molyneaux, Nicholas, Riccardo Scarinci, and Michel Bierlaire. "Pedestrian Management Strategies for Imporving Flow Dynamics in Transportation Hubs." Swiss Transport Research Conference, Monte Verità, 2017.

Shi, Yuqi, Yi Zhang, Tao Wang, Chaoyang Li, and Shengqiang Yuan. "The Effects of Ambient Illumination, Color Combination, Sign Height, and Observation Angle on the Legibility of Wayfinding Signs in Metro Stations." *Sustainability* 12, no. 10 (2020). https://doi.org/10.3390/su12104133.

Zhang, Yuanyuan, Xiaohong Chen, and Jingwen Jiang. "Wayfinding-Oriented Design for Passenger Guidance Signs in Large-Scale Transit Center in China." Transportation Research Record: Journal of the Transportation Research Board 2144, no. 1 (2010): 150-60. https://doi.org/10.3141/2144-17.

Appendix 02

TRANSPORT HUB LIST

	Basic Information							Situation												Numbers
Station Name	Amount of Modes	Types: Train	Metro	S-Bahn/RER	Tram	Pre-Metro/ Stadsbahn	Bus	Urban Position	Surrounding	Density	Position	Role	International	Build Style	Original Build Year	Build Year Current Station	Last Rebuild/ Design	Change	Planned Redevelopme or Rebuild	Total Amount of Rail Tracks
Amsterdam Centraal Station	4	Yes	Yes		Yes	No	Yes	Historical Center	Closed Off	High Density	Front focussed	Main Station	Yes	Historical	1889	1889	2017	Same Building	-	19
Amsterdam Sloterdijk	4	Yes	Yes		Yes	No	Yes	Center Outskirts	Semi Open	Medium Density	Front focussed	Supporting Station	No	Semi Modern	1983	1983	2008	Same Building	-	12
Amsterdam Zuid	4	Yes	Yes		Yes	No	Yes	Center Outskirts	Closed Off	High Density	Through Station	Supporting Station	No	Semi Modern	1978	1978	2012	Same Building	2019 - 2030	8
Rotterdam Centraal	4	Yes	Yes		Yes	No	Yes	Modern Center	Closed Off	Medium Density	Front focussed	Main Station	Yes	Modern	1957	2014	2014	New Building	-	20
Utrecht Centraal	3	Yes	No		Yes	No	Yes	Modern Center	Closed Off	High Density	Through Station	Main Station	Yes	Modern	1843	2016	2016	New Building	-	16
Den Haag Centraal	4	Yes	Yes		Yes	No	Yes	Modern Center	Partly Open	High Density	Front focussed	Main Station	Yes	Redeveloped	1870	1973	2016	Combined Building	-	14
Berlin Hbf	5	Yes	Yes	S-Bahn	Yes	No	Yes	Modern Center	Semi Open	Medium Density	Through Station	Main Station	Yes	Modern	1868	2006	2006	Same Building	-	16
Berlin Freidreichstrasse	5	Yes	Yes	S-Bahn	Yes	No	Yes	Center	Partly Open	High Density	Through Station	Supporting Station	No	Semi Modern	1882	1882	1999	Same Building	-	10
Gare de Nord	4	Yes	Yes	RER	No	No	Yes	Outer Center	Closed Off	High Density	Front focussed	Main International St	Yes	Historical	1846	1865	2018	Same Building	2019-2024 (Possible (	33
Gare de l'est	4	Yes	Yes	RER	No	No	Yes	Outer Center	Closed Off	High Density	Front focussed	Supporting Station	Yes	Historical	1849	1849	2007	Same Building	2018-2024	35
Gare Lyon	4	Yes	Yes	RER	No	No	Yes	Outer Center	Closed Off	High Density	Front focussed	Supporting Station	No	Historical	1854	1900	2010	Same Building	-	28
Châtelet-Les Halles	3	No	Yes	RER	No	No	Yes	Historical Center	Partly Open	High Density	Semi Front focussed	Supporting Station	No	Modern	1977	2017	2017	Same Building	-	17
Paris Saint-Lazare	4	Yes	Yes	RER	No	No	Yes	Outer Center	Closed Off	High Density	Front focussed	Supporting Station	No	Historical	1837	1889	2014	Same Building	-	39
Wien Hbf + Südtiroler Platz	4	Yes	Yes	S-Bahn	Yes	No	Yes	Center Outskirts	Closed Off	High Density	Front focussed	Main Station	Yes	Modern	1846	2015	2015	New Building	-	16
Praterstern	4	Yes	Yes	S-Bahn	Yes	No	Yes	Outer Center	Mostly Open	Medium Density	Front focussed	Supporting Station	No	Modern	1865	2007	2007	New Building	-	7
Wien Mitte	5	Yes	Yes	S-Bahn	Yes	No	Yes	Center	Closed Off	High Density	Surround	Supporting Station	No	Modern	1859	2013	2013	New Building	-	9
Antwerp Centraal	3	Yes	No		Yes	Pre-Metro	Yes	Center	Partly Open	High Density	Front focussed	Main Station	Yes	Historical	1836	1905	2007	Same Building	-	14
Brussel Midi / Zuid	4	Yes	Yes		Yes	Pre-Metro	Yes	Outer Center	Closed Off	High Density	Front focussed	Main International St	Yes	Semi Modern	1840	1952	1994	Same Building	-	24
Kings Cross	3	Yes	Yes		No	No	Yes	Outer Center	Closed Off	Medium Density	Front focussed	Main Station	No	Historical	1852	1852	2012	Same Building	2018-2021	20
Sint Pancrass International	2	Yes	No*		No	No	Yes	Outer Center	Closed Off	Medium Density	Front focussed	Main International St	Yes	Historical	1868	1868	2007	Same Building	-	13
Liverpool Street	3	Yes	Yes		No	No	Yes	Center	Closed Off	High Density	Surround	Supporting Station	No	Historical	1874	1874	1991	Same Building	-	22
London Bridge	3	Yes	Yes		No	No	Yes	Center	Closed Off	High Density	Front focussed	Supporting Station	No	Mixed	1836	1864	2017	Major Redevelopme	-	19
Victoria	3	Yes	Yes		No	No	Yes	Outer Center	Closed Off	High Density	Front focussed	Supporting Station	No	Historical	1860	1925	1980	Same Building	-	23
Charring Cross	3	Yes	Yes**		No	No	Yes	Center	Closed Off	High Density	Front focussed	Supporting Station	No	Historical	1864	1864	1990	Same Building	-	10
Euston	3	Yes	Yes		No	No	Yes	Outer Center	Closed Off	Medium Density	Front focussed	Supporting Station	No	Semi Modern	1837	1968	1979	Rebuild	-	24
Waterloo	3	Yes	Yes		No	No	Yes	Center	Closed Off	High Density	Front focussed	Supporting Station	No	Historical	1848	1922	2017	Same Building	-	32
Paddington	3	Yes	Yes		No	No	Yes	Outer Center	Closed Off	Medium Density	Front focussed	Supporting Station	No	Historical	1838	1970	2016	Redeveloped over ti	-	18
Bremen Hbf	3	Yes	No	Regional	Yes	No	Yes	Outer Center	Closed Off	Medium Density	Front focussed	Main Station	No	Historical	1889	1889	2000	Original Building	-	12
München Hbf	5	Yes	Yes	S-Bahn	Yes	No	Yes	Outer Center	Closed Off	High Density	Front focussed	Main Station	Yes	Semi Modern	1848	1960	1987	Rebuild	2019-2028	38
Dresden Hbf	4	Yes	No	S-Bahn	Yes	No	Yes	Outer Center	Partly Open	Medium Density	Front focussed	Main Station	No	Historical	1848	1898	2021	Renovated		17
Frankfurt Hbf	5	Yes	Yes	S-Bahn	Yes	No	Yes	Outer Center	Closed Off	High Density	Front focussed	Main Station	Yes	Historical	1888	1888	2013	Renovated	2020-2024,2030-2040	37
Hamburg Hbf	4	Yes	Yes	S-Bahn	No	No	Yes	Center	Closed off	High Density	Through Station	Main Station	Yes?	Historical	1906	1906	1991	Rebuild several time	2025-?	18
Berlin Ostkreuz	3	Yes	No	S-Bahn	No	No	Yes	Center Outskirts	Mostly Open	Low Density	None	Interchange Station	No	Modern	1882	2018	2018	Completly redesigne	-	13
Berlin Ostbahnhoff	3	Yes	No	S-Bahn	No	No	Yes	Center Outskirts	Mostly Open	Low Density	Front focussed	Supporting Station	Yes	Semi Modern	1842	2000	2011	Multiple times Rede	2018-2025	9
Berlin Südkreuz	3	Yes	No	S-Bahn	No	No	Yes	Center Outskirts	Partly Open	Low Density	Front focussed	Interchange Station	Yes	Modern	1901	2006	2007	Redesigned	-	12
Gesundbrunnen station	4	Yes	Yes	S-Bahn	No	No	Yes	Center Outskirts	Semi Open	Low Density	Front focussed	Supporting Station	No	Semi Modern	1872	2016	2016	Reception Hall Adde	-	8
Hannover Hbf	4	Yes	No	S-Bahn	No	Stadsbahn	Yes	Center	Closed off	High Density	Front focussed	Main Station	No	Historical	1843	1879	2010	Rebuild	2019-2032	12
Stuttgard Hbf	4	Yes	No	S-Bahn	No	Stadsbahn	Yes	Center Outskirts	Partly Open	High Density	Front focussed	Main Station	No	Historical	1922	1922	1950	Under Redesign	stutgart 21	19
Köln Hbf	4	Yes	No	S-Bahn	No	Stadsbahn	Yes	Historical Center	Closed off	High Density	Front focussed	Main Station	Yes	Semi Modern	1859	1957	2000	Rebuild	2019-2030	15
Nürnberg Hbf	5	Yes	Yes	S-Bahn	Yes	No	Yes	Center Outskirts	Closed off	High Density	Front focussed	Main Station	Yes?	Historical	1846	1906	2002	Rebuild	-	30
Chamartín	3	Yes	Yes		No	No	Yes	City Outskirts	Semi Open	Medium Density	Through Station	Supporting Station	No	Semi Modern	1967	1967	2015	Same Building	2020-2044	25
Madrid Atocha*****	3	Yes	Yes		No	No	Yes	Center Outskirts	Closed off	High Density	Front Sided	Main Station	Yes	Historical	1851	1992	1992	Replacement	-	27
Barcelona - Sants	3	Yes	Yes		No	No	Yes	Center Outskirts	Mostly Open	High Density	Surround	Main Station	Yes	Semi Modern	1979	1979	1979	Same Building	-	18
Stockholm City / T-centralen	3	Yes	Yes		No	No	Yes	Center	Closed off	High Density	Front focussed	Main Station	Yes	Historical	1871	1927	2013	Remodel	-	33
Zürich HBF	3	Yes	No		Yes	No	Yes	Center	Closed off	High Density	Front focussed	Main Station	Yes	Historical	1847	1871	2015	Remodels	2020-2023	26
Bern	3	Yes	No		Yes	No	Yes	Center Outskirts	Closed off	High Density	Front focussed	Main Station	Yes	Semi Modern	1860	1930	2003	Rebuild	2017-2029	18
Roma Termini	4	Yes	Yes		Yes	No	Yes	Center Outskirts	Closed off	High Density	Front focussed	Main Station	Yes	Semi Modern	1863	1950	2016	Modernisation	-	31
Milano Centrale	4	Yes	Yes		Yes	No	Yes	Center Outskirts	Closed off	High Density	Front focussed	Main Station	Yes	Historical	1931	1931	2010	Same Building	-	28
Torino Porta Nuova	4	Yes	Yes		Yes	No	Yes	Center Outskirts	Closed off	High Density	Front focussed	Main Station	Possible?	Historical	1864	1864	2017	Rennovated	-	22
Stazione di Venezia Santa Lu	1	Yes	No		No	No	No	Center	Closed off	High Density	Front focussed	Main Station	Yes	Semi Modern	1861	1952	2009	Same Building	-	24
Helsingin Päärautatieasema	4	Yes	Yes		Yes	No	Yes	Center	Partly Open	High Density	Front focussed	Main Station	No	Historical	1862	1919	2003	Renovations	2023	21
Moscow Yaroslavsky	4	Yes	Yes		Yes	No	Yes'	Center Outskirts	Mostly Open	Medium Density	Front focussed	Supporting Station	No	Historical	1862	1904	1995	Rebuild	-	20
Moscow Kursky	4	Yes	Yes		Yes	No	Yes	Center Outskirts	Closed off	High Density	Front focussed	Supporting Station	No	Semi Modern	1896	1896	1972	Renovations	-	23
Oslo sentralstasjon	3	Yes	No		Yes	No	Yes	Center Outskirts	Partly Open	High Density	Front focussed	Main Station	Yes	Semi Modern	1882	1980	1980	Renovation	-	21
Norreport station	3	Yes	Yes		No	No	Yes													12
Gare D'austerliz	4	Yes	Yes	RER	No	No	Yes	Centre Outskirts	Partly Open	High Density	Side Focussed	Supporting Station	No	Historical	1843	1869	2015	Renovations	2020?	29
Warsaw West?																				0
	3.607142857																			19.93
																				1136

Appendix 02

TRANSPORT HUB LIST

				Transportation																						
	Travelers, Annualy 2019			Train										S-Bahn/ RER Tracks					Metro/ Stadsbahn							Tram
Station Name	Based on Train (millions)	Total Amount of Platforms	Floors	Tracks	Platforms	Extra Tracks	Floors	Level	Exits	Directions	Terminating	Terminating Tracks	Continuing Tracks	Tracks	Platforms	Level	Lines	Seperated	Tracks	Floors	Level	Exits	Directions	Terminating	Lines	Seperated	Tracks
Amsterdam Centraal Station	72.821150	15	3	15	11	4	1	1	2	1	Partly (1 Track)	1	14						4	2	-1	3	2	No, Yes	4	No	8
Amsterdam Sloterdijk	22.072280	12	3	10	10	0	2	0; 1	5	3	No	0	10						2	1	1	2	1	No	2	No	2
Amsterdam Zuid	25.075135	8	2	4	4	0	1	1	2	1	No	0	4						4	1	1	2	1	No, (Line does)	3	No	2
Rotterdam Centraal	37.132180	16	3	17	13	4	1	1	3	1	No	0	17						3	1	-1	2	1	No, (Line does)	2	No	4
Utrecht Centraal	75.686400	16	2	16	16	0	1	0	4	2	Partly (4 Tracks)	4	12														6
Den Haag Centraal	36.068570	14	3	12	12	0	1	0	3	1	Yes	12	0						2	1	2	1	1	Yes	1	No	8
Berlin Hbf	120.100000	16	5	12	12	0	2	2; -2	4	2	No	0	12	2	2	1	4	No	2	1	-2	1	1	Yes	1	No	2
Berlin Freidreichstrasse	95.600000	10	3	4	4	0	1	1	2	1	No	0	4	4	4	-1; 1	8	Partly	2	1	-1	2	1	No	1	No	2
Gare de Nord	292.200000	32	5	23	22	1	1	0	1	1	Yes	23	0	4	4	-2	4	Partly	6	1	-3; ?	4	2	No	3	No	
Gare de l'est	41.200000	35	3	29	29	0	1	0	1	1	Yes	29	0						6	1	-2	4	1	No	3	No	
Gare Lyon	150.200000	28	3	22	22	0	1	0	1	1	Yes	22	0						6	2	-2; -1	4	2	No	2	No	
Châtelet-Les Halles	66.600000	17												7	7	-2	3	No	10	3	-3; -2; -1	9	5	Partly (1 Line)	5	No	
Paris Saint-Lazare	107.300000	39		27	27	0	1	0	1	1	Yes	27	0	4	4	-2	1	Yes	8	3	-3;-2;-1	8	4	No	4	No	
Wien Hbf + Südtiroler Platz	97.800000	14	3	12	10	2	1	1	2	1	No	0	12	2	2	-1	1	Yes	2	1	-2	2	1	No	1	Yes	4
Praterstern	12.775000	7	3	5	0	5	1	1	2	1	No	0	5	0	5	1	5	No	2	2	-2; -1	4	2	No	2	No	3
Wien Mitte	97.800000	9	3	1	1	0	1	-1	2	1	No	0	1	4	4	-1	5	No	4	2	-2; -1	4	2	No	2	No	2
Antwerp Centraal	14.464220	14	4	14	14	0	3	-2; -1; 1	4	1	Partly (2 Floors)	2	12														3
Brussel Midi / Zuid	23.279335	24	2	22	22	0	1	1	4	1	Partly (3 Track)	3	19						2	1	-1	3	1	No	2	No	2
Kings Cross	32.532000	20	6	12	12	0	1	0	1	1	Yes	12	0						8	4	-5; -4; -3; -2.	8	4	No	5	No	
Sint Pancrass International	36.040000	15	1	13	15	-2	1	0	1	1	Yes	13	0														
Liverpool Street	65.985000	22		18	18	0	1	0	1	1	Yes	18	0						4	2	-3;-2	4	2	No	4	No	
London Bridge	63.095000	19	4	15	15	0	1	1	2	1	Partly (6 Tracks)	6	9						4	2	-2, -1	4	2	No	2	No	
Victoria	73.559000	23	4	19	19	0	1	0	1	1	Yes	19	0						4	2	-2;-3	4	2	No	2	No	
Charring Cross	28.344000	10	2	6	6	0	1	1	1	1	Yes	6	0						4	2	-2;-3	4	2	No	2	Yes	
Euston	44.777000	22	5	18	16	2	1	0	1	1	Yes	18	0						6	3	-2; -3; -4	6	3	No	3	No	
Waterloo	86.904000	32	4	24	24	0	1	0	1	1	Yes	24	0						8	2	-2,-3	8	4	No	4	No	
Paddington	44.870000	18	3	14	14	0	1	0	1	1	Yes	14	0						4	2	-2; -1	4	2	No	2	Yes	
Bremen Hbf	53.700000	9	2	12	9	3	1	1	3	1	No	0	12														6
München Hbf	150.700000	38	2	32	32	0	2	0	1	1	Partly (32 Tracks)	32	0	2	2	-1		Yes	4	2	-1;-2	4	2	No	5	No	6
Dresden Hbf	24.500000	16	2	17	16	1	1	1	3	1	Partly (8 Tracks)	8	9														4
Frankfurt Hbf	179.900000	33	3	29	25	4	1	0	3	1	Yes	29	0	4	4	-2	8	Yes	4	1	-1	2	1	No	2	No	2
Hamburg Hbf	196.000000	16	3	10	8	2	1	0	3	1	No	0	10	4	4	0	6	No	4	1	-1	4	2	No	4	Yes	
Berlin Ostkreuz	91.300000	12	2	7	6	1	2	0; 1	5	2	No	0	7	6	6	0; 1	8	No									
Berlin Ostbahnhoff	36.500000	11	2	5	7	-2	1	1	2	1	No	0	5	4	4	1	4	No									
Berlin Südkreuz	65.300000	10	3	8	6	2	2	0; 1	2	1	No	0	8	4	4	-1; 1	7	No									
Gesundbrunnen station	74.100000	12	3	6	6	0	1	-1	2	1	No	0	6	4	4	-1	6	No	2	1	-2	2	1	No	1	No	
Hannover Hbf	95.300000	14	3	10	8	2	1	1	2	1	No	0	10	4	4	1	8	No	2	1	-1	2	1	No	9	No	
Stuttgard Hbf	93.100000	19	1	17	15	2	1	0	1	1	Yes	17	0	2	2	-1	8	Yes	2	1	-1	2	1	No	8	Yes	
Köln Hbf	116.100000	15	3	9	9	0	1	1	2	1	No	0	9	2	2	1	4	No	4	1	-1	4	2	No	3	No	
Nürnberg Hbf	76.700000	26	4	24	20	4	1	1	2	1	No	0	24	2	2	1	2	No	4	2	-2; -1	4	2	No	3	No	3
Chamartín	32.900000	25	3	21	21	0	1	0	2	1	No	0	21						4	1	-1	3	1	No	2	No	
Madrid Atocha*****	116.600000	27		25	25	0	1	0	1	1	Partly (14 Tracks)	14	11						2	1	-1	2	1	No	1	No	
Barcelona - Sants	43.600000	18	2	14	14	0	1	-1	2	1	No	0	14						4	1	-1	4	2	No	2	Yes	
Stockholm City / T-centralen	39.200000	33	5	27	27	0	2	-3; 0	2	1	Partly (14 Tracks)	14	13						6	2	-2; -1	6	2	No	7	No***	
Zürich HBF	154.600000	26	2	26	26	0	2	-2; 0	3	1	Partly (16 Tracks)	16	10														4
Bern	67.200000	16	3	18	16	2	2	-2; -1	3	2	Partly (4 Tracks)	4	14														4
Roma Termini	150.000000	31	1	27	27	0	1	0	1	1	Yes	27	0						4	2	-2;-1	4	2	No	2	Yes	4
Milano Centrale	120.000000	28	3	24	24	0	1	1	4	1	Yes	24	0						4	2	-2;-1	2	1	No	2	Yes	7
Torino Porta Nuova	70.000000	22	1	20	20	0	1	0	1	1	Yes	20	0						2	1	-1	2	1	No	1	No	4
Stazione di Venezia Santa Lu				24	22	2	1	0	1	1	Yes	24	0														
Helsingin Päärautatieasema	73.200000	21	2	19	19	0	1	0	1	1	Yes	19	0						2	1	-1	2	1	No	2	No	2****
Moscow Yaroslavsky	79.900000	15	1	16	11	5	1	0	1	1	Yes	16	0						4	1	-2; -1	4	2	No	2	Yes	2
Moscow Kursky	71.600000	22	1	17	16	1	1	0	2	1	Partly (6 Tracks)	6	11						6	3	-3;-2;-1	6	3	No	3	Yes	2
Oslo sentralstasjon	54.800000	21	2	19	19	0	1	0	2	1	Partly (8 Tracks)	8	11						2	1	-1	2	1	No	5	Yes	4
Norreport station	53.700000	12		12	12	0	1	-1	2	1	No	12	0														
Gare D'austerliz	21.682800	29	3	21	21	0	1	0	1	1	Yes	21	0	4	4	-1	1	Yes	4	2	1;-1	3	3	Partly	2	Partly	
Warsaw West?		0				0							0														
	77.572056	19.36	2.82	16.36	15.55	0.80	1.18	0.26	2.05	1.11		16.36		3.45	3.70	-0.47	4.89		4.02	1.61	-0.86	3.66	1.84		2.91		3.85
	4266.463070	1084		900	855	45						900		69	74		93		177	71					128		100

Appendix 02

TRANSPORT HUB LIST

								Bus				
Station Name	Floors	Level	Exits	Directions Locations?	Terminating	Lines	Included in the Building	Floors	Locations	Level	Lines	Included in the Building
Amsterdam Centraal Station	1	0	2	2	No	7	No	1	1	1		Yes
Amsterdam Sloterdijk	1	0	2	1	No	1	No	1	1	0		No
Amsterdam Zuid	1	0	2	1	No	2	No	1	1	0		No
Rotterdam Centraal	1	0	3	2	No	9	No	1	1	0		No
Utrecht Centraal	1	0	3	2	Partly	3	Yes	1	2	0		Yes
Den Haag Centraal	2	0; 1	5	2	No	4	Partly	1	1	1		No
Berlin Hbf	1	0	2	1	No	4	No	1	2	0	10	No
Berlin Freidreichstrasse	1	0	2	1	No	2	No	1	1	0	2	No
Gare de Nord								1	3	0	4	No
Gare de l'est								1	2	0	6	No
Gare Lyon								1	2	0	8	No
Châtelet-Les Halles								1	1	0		No
Paris Saint-Lazare								1	2	0		No
Wien Hbf + Südtiroler Platz	1	0	4	2	No	4	No	1	3	0		No
Praterstern	1	0	2	1	No	2	Yes	1	2	0		Partly
Wien Mitte	1	0	2	1	No	2	No	1	1	0		No
Antwerp Centraal	2	-2;0	6	3	No	2	No	1	2	0		No
Brussel Midi / Zuid	1	0	2	1	Yes	5	No	1	3	0		No
Kings Cross								1	2	0		No
Sint Pancrass International								1	1	0		No
Liverpool Street								1	2	0		No
London Bridge								1	2	0		No
Victoria								1	1	0		No
Charring Cross								1	1	0		No
Euston								1	1	0		No
Waterloo								1	2	0		No
Paddington								1	2	0		No
Bremen Hbf	1	0	4	1	No	11	No	1	1	0	24	No
München Hbf	1	0	5	3	No	6	No	1	3	0		No
Dresden Hbf	1	0	4	2	No	5	No	1	2	0		No
Frankfurt Hbf	1	0	3	1	No	6	No	1	1	0		No
Hamburg Hbf								1	3	0; 1		No
Berlin Ostkreuz								1	1	0		No
Berlin Ostbahnhoff								1	1	0		No
Berlin Südkreuz								1	1	0		No
Gesundbrunnen station								1	1	0		No
Hannover Hbf								1	2	0		No
Stuttgard Hbf								1	1	0		No
Köln Hbf								1	2	0		No
Nürnberg Hbf	1	0	3	1	No	3	No	1	2	0		No
Chamartín								1	1	1		No
Madrid Atocha*****								1	1	1		No
Barcelona - Sants								1	3	0		No
Stockholm City / T-centralen								1	1	1		No
Zürich HBF	1	0	5	2	No	7	No	1	2	0		No
Bern	1	0	3	1	No	5	Partly	1	3	0		No
Roma Termini	1	0	3	2	Partly	3	No	1	1	0		No
Milano Centrale	1	0	4	2	No	3	No	1	3	0		No
Torino Porta Nuova	1	0	4	2	No	2	No	1	2	0	10	No
Stazione di Venezia Santa Lu												
Helsingin Päärautatieasema	1	0	2	1	No	6	No	1	2	0		No
Moscow Yaroslavsky	1	0	2	1	No	4	No	1	1	0	3,2	No
Moscow Kursky	1	0	1	1	No	3	No	1	1	0	3	No
Oslo sentralstasjon	1	0	5	2	No	6	No	1	2	0		No
Norreport station												
Gare D'austerliz												
Warsaw West?												
	1.07	0	3.15	1.56		4.33		1	1.68	0.10	8.38	
	29	0				117		53	89		67	

Includes 2 Trollyb

Appendix 03

TRANSPORT HUB MATRIX

Location in city vs Surrounding	Open Surrounding	Closed Surrounding
Center	**8. Berlin Freidreichstrasse** 12. Châtelet-Les Halles 17. Antwerp Centraal 51. Helsingin Päärautatieasema	1, Amsterdam CS 16. Wien Mitte 21. Liverpool Street 22. London Bridge 24. Charing Cross 26. Waterloo 32. Hamburg Hbf 37. Hannover Hbf 39. Koln Hbf 44. Stockholm City **45. Zurich Hbf** 50. Venice
Close to Center	7. Berlin Hbf 15. Praterstern 30. Dresden Hbf 38. Stuttgart Hbf 43. Barcelona - Sants 52. Moscow Yaroslavsky 54. Oslo sentralstasjon	4. Rotterdam CS 9. Gare du Nord 10. Gare de l'est 11. Gare Lyon 13. Paris Saint-Lazare **18. Brussel Midi / Zuid** 19. Kings Cross 20. Sint Pancrass 23. Victoria 25. Euston 27. Paddington 28. Bremen Hbf 29. München Hbf 31. Frankfurt Hbf 40. Nürnberg Hbf 42. Madrid Atocha 46. Bern 47. Roma Termini 48. Milano Centrale 49. Torino Porta Nuova 53. Moscow Kursky
Outskirts	2. Amsterdam Sloterdijk **33. Berlin Ostkreuz** 34. Berlin Ostbahnhof 35. Berlin Südkreuz 36. Gesundbrunnen station 41. Chamartín	3. Amsterdam Zuid 14. Wien Hbf

Location in city vs Surrounding	Open Surrounding	Closed Surrounding
Main Station (from International Perspective) Knooppunt ruimtelijk schaalniveau	**7. Berlin Hbf** 17. Antwerp Centraal 30. Dresden Hbf 38. Stuttgart Hbf 43. Barcelona - Sants 51. Helsingin Päärautatieasema 52. Moscow Yaroslavsky 54. Oslo sentralstasjon	1, Amsterdam CS 4. Rotterdam CS 9. Gare du Nord 14. Wien Hbf 18. Brussel Midi / Zuid 19. Kings Cross 20. Sint Pancrass 28. Bremen Hbf 29. München Hbf 31. Frankfurt Hbf **32. Hamburg Hbf** 37. Hannover Hbf 39. Koln Hbf 40. Nürnberg Hbf 42. Madrid Atocha 44. Stockholm City 45. Zurich Hbf 46. Bern 47. Roma Termini 48. Milano Centrale 49. Torino Porta Nuova 50. Stazione di Venezia Santa Lucia
Secondair Station	2. Amsterdam Sloterdijk **8. Berlin Freidreichstrasse** 12. Châtelet-Les Halles 15. Praterstern *33. Berlin Ostkreuz* 34. Berlin Ostbahnhof 35. Berlin Südkreuz 36. Gesundbrunnen station 41. Chamartín	3. Amsterdam Zuid 10. Gare de l'est 11. Gare Lyon 13. Paris Saint-Lazare **16. Wien Mitte** 21. Liverpool Street 22. London Bridge 23. Victoria 24. Charing Cross 25. Euston 26. Waterloo 27. Paddington 53. Moscow Kursky

Appendix 03

TRANSPORT HUB MATRIX

Location in city vs Surrounding	Center	Outer Center
Main Station (from International Perspective)	1. Amsterdam CS 5. Utrecht Centraal 17. Antwerp Centraal **32. Hamburg Hbf** 37. Hannover Hbf 44. Stockholm City 45. Zurich Hbf 50. Stazione di Venezia Santa Lucia 51. Helsingin Päärautatieasema	7. Berlin Hbf 4. Rotterdam CS 9. Gare du Nord 14. Wien Hbf **18. Brussel Midi / Zuid** 19. Kings Cross 20. Sint Pancrass 28. Bremen Hbf 29. München Hbf 30. Dresden Hbf 31. Frankfurt Hbf 38. Stuttgart Hbf 39. Koln Hbf 40. Nürnberg Hbf 42. Madrid Atocha 43. Barcelona - Sants 46. Bern 47. Roma Termini 48. Milano Centrale 49. Torino Porta Nuova 52. Moscow Yaroslavsky 54. Oslo sentralstasjon
Supporting Station	**8. Berlin Freidreichstrasse** 16. Wien Mitte 21. Liverpool Street 22. London Bridge 24. Charing Cross 26. Waterloo	2. Amsterdam Sloterdijk 3. Amsterdam Zuid 10. Gare de l'est 11. Gare Lyon 12. Châtelet-Les Halles 13. Paris Saint-Lazare 15. Praterstern 23. Victoria 25. Euston 27. Paddington **33. Berlin Ostkreuz** 34. Berlin Ostbahnhof 35. Berlin Südkreuz 36. Gesundbrunnen station 41. Chamartín 53. Moscow Kursky

Role vs Style	Modern	Semi Modern	Historical
Main Station (from International Perspective)	4. Rotterdam CS 5. Utrecht Centraal **7. Berlin Hbf** 14. Wien Hbf	6. Den Haag Centraal **18. Brussel Midi / Zuid** 29. München Hbf 39. Koln Hbf 43. Barcelona - Sants 46. Bern 47. Roma Termini 50. Stazione di Venezia Santa Lucia 54. Oslo sentralstasjon	1. Amsterdam CS 9. Gare du Nord 17. Antwerp Centraal 19. Kings Cross 20. Sint Pancrass 28. Bremen Hbf 30. Dresden Hbf 31. Frankfurt Hbf **32. Hamburg Hbf** 37. Hannover Hbf 38. Stuttgart Hbf 40. Nürnberg Hbf 42. Madrid Atocha 44. Stockholm City 45. Zurich Hbf 48. Milano Centrale 49. Torino Porta Nuova 51. Helsingin Päärautatieasema 52. Moscow Yaroslavsky
Supporting Station	12. Châtelet-Les Halles 15. Praterstern 16. Wien Mitte 22. London Bridge **33. Berlin Ostkreuz** 35. Berlin Südkreuz	2. Amsterdam Sloterdijk 3. Amsterdam Zuid **8. Berlin Freidreichstrasse** 25. Euston 34. Berlin Ostbahnhof 36. Gesundbrunnen station 41. Chamartín 53. Moscow Kursky	10. Gare de l'est **11. Gare Lyon** 13. Paris Saint-Lazare 21. Liverpool Street 23. Victoria 24. Charing Cross 26. Waterloo 27. Paddington

Appendix 03

TRANSPORT HUB MATRIX

Style vs Role	Modern	Semi Modern	Historical
Closed Surrounding	4. Rotterdam CS 5. Utrecht Centraal **14. Wien Hbf** 16. Wien Mitte 22. London Bridge	3. Amsterdam Zuid 6. Den Haag Centraal **18. Brussel Midi / Zuid** 25. Euston 29. München Hbf 39. Koln Hbf 46. Bern 47. Roma Termini 50. Stazione di Venezia Santa Lucia 53. Moscow Kursky	1. Amsterdam CS 9. Gare du Nord 10. Gare de l'est 11. Gare Lyon 13. Paris Saint-Lazare 19. Kings Cross 20. Sint Pancrass 21. Liverpool Street 23. Victoria 24. Charing Cross 26. Waterloo 27. Paddington 28. Bremen Hbf 31. Frankfurt Hbf **32. Hamburg Hbf** 37. Hannover Hbf 40. Nürnberg Hbf 42. Madrid Atocha 44. Stockholm City 45. Zurich Hbf 48. Milano Centrale 49. Torino Porta Nuova
Open Surrounding	7. Berlin Hbf 12. Châtelet-Les Halles 15. Praterstern **33. Berlin Ostkreuz** 35. Berlin Südkreuz	2. Amsterdam Sloterdijk **8. Berlin Freidreichstrasse** 34. Berlin Ostbahnhof 36. Gesundbrunnen station 41. Chamartín 43. Barcelona - Sants 54. Oslo sentralstasjon	17. Antwerp Centraal 30. Dresden Hbf 38. Stuttgart Hbf **51. Helsingin Päärautatieasema** 52. Moscow Yaroslavsky

Role vs Heigth (Tracks vs Surroundings)	Underground	Ground Floor	Above Ground
Main Station	7. Berlin Hbf 17. Antwerp Centraal 32. Hamburg Hbf 43. Barcelona - Sants 44. Stockholm City 45. Zurich Hbf 46. Bern	5. Utrecht Centraal 6. Den Haag Centraal 9. Gare du Nord 19. Kings Cross 20. Sint Pancrass 29. München Hbf 31. Frankfurt Hbf 38. Stuttgart Hbf 42. Madrid Atocha 44. Stockholm City 45. Zurich Hbf 47. Roma Termini 49. Torino Porta Nuova 50. Stazione di Venezia Santa Lucia 51. Helsingin Päärautatieasema 53. Moscow Kursky 54. Oslo sentralstasjon	1. Amsterdam CS 4. Rotterdam CS 7. Berlin Hbf 14. Wien Hbf 17. Antwerp Centraal 18. Brussel Midi / Zuid 28. Bremen Hbf 30. Dresden Hbf 37. Hannover Hbf 39. Koln Hbf 40. Nürnberg Hbf 48. Milano Centrale
Supporting Station	2. Amsterdam Sloterdijk 16. Wien Mitte 21. Liverpool Street	2. Amsterdam Sloterdijk 10. Gare de l'est 11. Gare Lyon 12. Châtelet-Les Halles 13. Paris Saint-Lazare 23. Victoria 25. Euston 26. Waterloo 27. Paddington 33. Berlin Ostkreuz 35. Berlin Südkreuz 36. Gesundbrunnen station 41. Chamartín	3. Amsterdam Zuid 8. Berlin Freidreichstrasse 15. Praterstern 22. London Bridge 24. Charing Cross 33. Berlin Ostkreuz 34. Berlin Ostbahnhof 35. Berlin Südkreuz

Appendix 03

TRANSPORT HUB MATRIX

Heigth / Style	Underground	Ground Floor	Above Ground
Modern	*7. Berlin Hbf* 12. Châtelet-Les Halles 16. Wien Mitte	5. Utrecht Centraal 23. Victoria *33. Berlin Ostkreuz* *35. Berlin Südkreuz*	4. Rotterdam CS *7. Berlin Hbf* 14. Wien Hbf 15. Praterstern 24. Charing Cross *33. Berlin Ostkreuz* *35. Berlin Südkreuz*
Semi - Modern	*2. Amsterdam Sloterdijk* 43. Barcelona - Sants 46. Bern	*2. Amsterdam Sloterdijk* 6. Den Haag Centraal 29. München Hbf 36. Gesundbrunnen station 41. Chamartín 47. Roma Termini 50. Stazione di Venezia Santa Lucia 53. Moscow Kursky 54. Oslo sentralstasjon	3. Amsterdam Zuid 8. Berlin Freidreichstrasse 18. Brussel Midi / Zuid 22. London Bridge 34. Berlin Ostbahnhof 39. Koln Hbf
Historic	*17. Antwerp Centraal* 21. Liverpool Street 32. Hamburg Hbf *44. Stockholm City* *45. Zurich Hbf*	9. Gare du Nord 10. Gare de l'est 11. Gare Lyon 13. Paris Saint-Lazare 19. Kings Cross 20. Sint Pancrass 25. Euston 26. Waterloo 27. Paddington 31. Frankfurt Hbf 38. Stuttgart Hbf 42. Madrid Atocha *44. Stockholm City* *45. Zurich Hbf* 49. Torino Porta Nuova 51. Helsingin Päärautatieasema	1. Amsterdam CS *17. Antwerp Centraal* 28. Bremen Hbf 30. Dresden Hbf 37. Hannover Hbf 40. Nürnberg Hbf 48. Milano Centrale

History vs Renovation	Modern	Semi Modern	Historical
Renovation Planned		3. Amsterdam Zuid 29. München Hbf 34. Berlin Ostbahnhof 39. Koln Hbf 41. Chamartín 46. Bern	9. Gare du Nord 10. Gare de l'est 19. Kings Cross 31. Frankfurt Hbf 32. Hamburg Hbf 37. Hannover Hbf 38. Stuttgart Hbf 45. Zurich Hbf
Renovation done since 2010	4. Rotterdam CS 5. Utrecht Centraal 12. Châtelet-Les Halles 14. Wien Hbf 16. Wien Mitte 33. Berlin Ostkreuz	6. Den Haag Centraal 22. London Bridge 36. Gesundbrunnen station	1. Amsterdam CS 13. Paris Saint-Lazare 26. Waterloo 27. Paddington 44. Stockholm City 48. Milano Centrale 49. Torino Porta Nuova
Renovation before 2010	7. Berlin Hbf 15. Praterstern 35. Berlin Südkreuz	2. Amsterdam Sloterdijk 8. Berlin Freidreichstrasse 18. Brussel Midi / Zuid 25. Euston 43. Barcelona - Sants 50. Stazione di Venezia Santa Lucia 53. Moscow Kursky 54. Oslo sentralstasjon	11. Gare Lyon 17. Antwerp Centraal 20. Sint Pancrass 21. Liverpool Street 23. Victoria 24. Charing Cross 28. Bremen Hbf 30. Dresden Hbf 40. Nürnberg Hbf 42. Madrid Atocha 51. Helsingin Päärautatieasema 52. Moscow Yaroslavsky

Appendix 03

TRANSPORT HUB MATRIX

History vs Renovation	Pre-1900	1900-1999	2000-2021
Renovation Planned	9. Gare du Nord 10. Gare de l'est 19. Kings Cross 31. Frankfurt Hbf 37. Hannover Hbf 45. Zurich Hbf	3. Amsterdam Zuid 29. München Hbf 32. Hamburg Hbf 38. Stuttgart Hbf 41. Chamartín 39. Köln Hbf 46. Bern	34. Berlin Ostbahnhof
Renovation done since 2010	1. Amsterdam CS 13. Paris Saint-Lazare 16. Wien Mitte 22. London Bridge 49. Torino Porta Nuova	6. Den Haag Centraal 26. Waterloo 27. Paddington 44. Stockholm City 48. Milano Centrale	4. Rotterdam CS 5. Utrecht Centraal 12. Châtelet-Les Halles 14. Wien Hbf 33. Berlin Ostkreuz 36. Gesundbrunnen station
Renovation before 2010	8. Berlin Freidreichstrasse 20. Sint Pancrass 21. Liverpool Street 24. Charing Cross 28. Bremen Hbf 30. Dresden Hbf 53. Moscow Kursky	2. Amsterdam Sloterdijk 11. Gare Lyon 17. Antwerp Centraal 18. Brussel Midi / Zuid 23. Victoria 25. Euston 40. Nürnberg Hbf 42. Madrid Atocha 43. Barcelona - Sants 50. Stazione di Venezia Santa Lucia 51. Helsingin Päärautatieasema 52. Moscow Yaroslavsky 54. Oslo sentralstasjon	7. Berlin Hbf 15. Praterstern 35. Berlin Südkreuz

Surrounding vs type	Open Surrounding	Closed Surrounding
Underground	7. Berlin Hbf 12. Châtelet-Les Halles 17. Antwerp Centraal **32. Hamburg Hbf** 36. Gesundbrunnen station 43. Barcelona – Sants	16. Wien Mitte 21. Liverpool Street 44. Stockholm City 45. Zurich Hbf 46. Bern 53. Moscow Kursky
Ground Floor	2. Amsterdam Sloterdijk 33. Berlin Ostkreuz 35. Berlin Südkreuz 41. Chamartín 52. Moscow Yaroslavsky 54. Oslo sentralstasjon	5. Utrecht Centraal 42. Madrid Atocha 44. Stockholm City 45. Zurich Hbf
Elevated	2. Amsterdam Sloterdijk 7. Berlin Hbf 8. Berlin Freidreichstrasse 15. Praterstern 17. Antwerp Centraal 30. Dresden Hbf 33. Berlin Ostkreuz 34. Berlin Ostbahnhof 35. Berlin Südkreuz	1. Amsterdam CS 3. Amsterdam Zuid 4. Rotterdam CS 14. Wien Hbs **18. Brussel Midi / Zuid** 22. London Bridge 28. Bremen Hbf 37. Hannover Hbf 39. Koln Hbf 40. Nürnberg Hbf
Terminus	38. Stuttgart Hbf 51. Helsingin Päärautatieasema	6. Den Haag Centraal 9. Gare du Nord 10. Gare de l'est 11. Gare Lyon 13. Paris Saint-Lazare 19. Kings Cross 20. Sint Pancrass 23. Victoria 24. Charing Cross 25. Euston 26. Waterloo 27. Paddington 29. München Hbf 31. Frankfurt Hbf 47. Roma Termini 48. Milano Centrale 49. Torino Porta Nuova 50. Venice

Appendix 03

TRANSPORT HUB MATRIX

Surrounding vs type	Open Surrounding	Closed Surrounding
Underground	7. Berlin Hbf 12. Châtelet-Les Halles 17. Antwerp Centraal 36. Gesundbrunnen station 43. Barcelona – Sants	16. Wien Mitte 21. Liverpool Street 32. Hamburg Hbf 44. Stockholm City 45. Zurich Hbf 46. Bern 53. Moscow Kursky
Ground Floor	02. Amsterdam Sloterdijk 33. Berlin Ostkreuz 35. Berlin Südkreuz *38T. Stuttgart Hbf* 41. Chamartín 52. Moscow Yaroslavsky 54. Oslo sentralstasjon *51T. Helsingin Päärautatieasema*	05. Utrecht Centraal *06T. Den Haag Centraal* *09T. Gare du Nord* *10T. Gare de l'est* *11T. Gare Lyon* *13T. Paris Saint-Lazare* *19T. Kings Cross* *20T. Sint Pancrass* *23T. Victoria* *25T. Euston* *26T. Waterloo* *27T. Paddington* *29T. München Hbf* *31T. Frankfurt Hbf* 42. Madrid Atocha 44. Stockholm City 45. Zurich Hbf *47T. Roma Termini* *48T. Milano Centrale* *49T. Torino Porta Nuova* *50T. Venice*
Elevated	02. Amsterdam Sloterdijk 07. Berlin Hbf 08. Berlin Freidreichstrasse 15. Praterstern 17. Antwerp Centraal 30. Dresden Hbf 33. Berlin Ostkreuz 34. Berlin Ostbahnhof 35. Berlin Südkreuz	01. Amsterdam CS 03. Amsterdam Zuid 04. Rotterdam CS 14. Wien Hbf 18. Brussel Midi / Zuid 22. London Bridge *24T. Charing Cross* 28. Bremen Hbf 37. Hannover Hbf 39. Koln Hbf 40. Nürnberg Hbf

Appendix 04
SLOPE CALCULATION

Extra Treinen

↳ 14 x Piek uur Trein

20 + 14 = 34 ??

34 + 12 = 46 Treinen

↳ + 2x lnr ⇒ 48

Therefore:

6 Plo Tracks +

6 ⇒ 12 Perron Tracks

120

2 side Platform vs island Platform

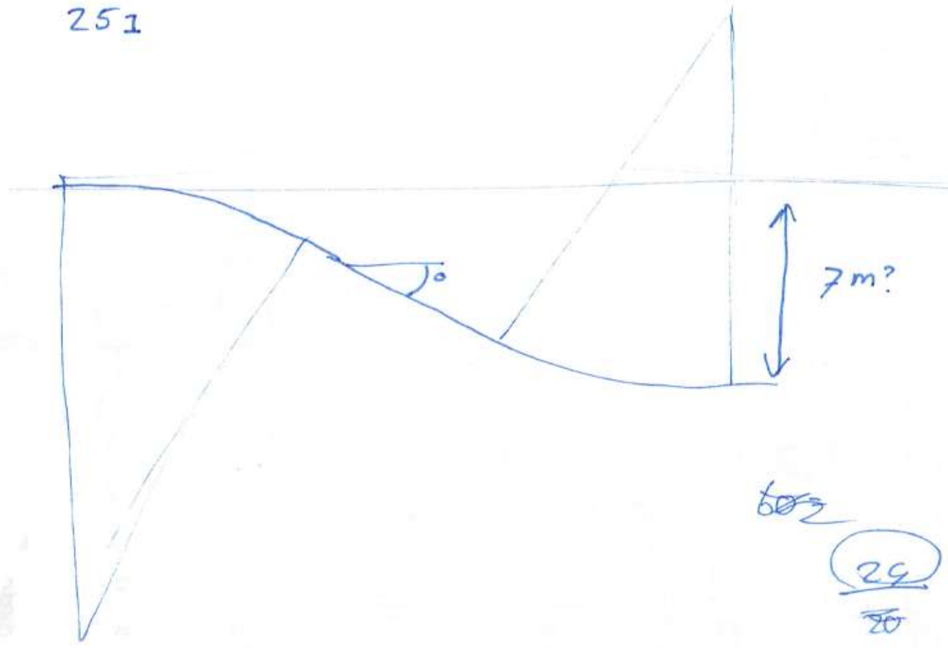
↳ Can connect with Tram
↳ Supports in the middle
↳ Can connect Direct with Ticket Hall

↳ Single Main Entry
↳ Probably no support needed
Can still connect with Metro

- Requires 2 entrances / Gaps

Calculation Boogstraal

251



120 : 25

60 — 12,5
30 —

603

25
20

$R_v = \frac{v^2}{a_z}$ $\frac{80^2}{0,3}$ ⇒ 21333

2560 m gewenst

a_z = 0,6 bij voet
0,46 bij top.
0,3 tegenwoordig

$R_v = 0,25\ v^2$ voor top en voetboog

$0,25 \cdot 80^2$ = 1600 meter.

0,3 ·

Toelaatbaar = R_v

4900/2 . 25/1000

Vuistregel:
4% + 2x 20 veel overgangsboog

4°

$\frac{\Delta h}{d} \cdot 100 = \frac{4}{100}$

$\Delta h = \frac{4 \cdot d}{100}$

8 =
800 = 4·d
200 meter?

200 + 100 bogen

Appendix 04

SLOPE CALCULATION

Calculation Slope Tram

5% bij Tram

Gewenst 4.5% 1:22

$R_v = 0,25 \cdot 40^2 = 400m$

$T_a = 400/2 \cdot 33/1000 \Rightarrow$

Hoogte: 7500? /33 = ~~227 meter~~ works

Appendix 05

AMOUNT OF TRAINS

Train Network

IC 01 03 05 06 06a 07
11 12 13 14 16 17 18
20 22 23 23a 26 29
31

20 IC's -

	Per uur	NZT.	
IC: 31	1x per uur	yes	
29	1x " "	yes	
26	1x per uur	yes	Alleen doorde weeks!
23a	1x per uur	yes	
23	1x per uur	yes	
22	1x per uur	yes	
20	1x per uur	yes	
18	1x per uur	yes	
17	1x per uur in het weekend!	yes	In het weekend!
16	1x per uur	yes	
14	1x per uur	yes	Alleen door de weeks!
13	1x per uur	yes	Alleen doorde weeks!
12	1x per uur	yes	Alleen doordeweeks
11	1x per uur	yes	Alleen doordeweeks

	X	NZT	
IC 07	1x per uur	yes	Alleen werkdagen
IC 06	~~1x~~ per uur 1x	yes	Alleen werkdagen
06a	1x per uur	yes	
IC 05	1x per uur	yes	Alleen werkdagen
IC 03	1x per uur	yes	
IC 01	1x per uur	yes	
Totaal	20x per uur	Allemaal	
	-		
Int.			
IC 35	1x per uur	yes	1x → Am 1x Dort.
ICE 79	0.6 per uur	yes	samen met THA 9400 uurdienst
THA 9300	11x per dag	yes	uurdienst, dus 1x per uur rekenen
THA 9400	3+5x per dag	yes	samen met ICE uurdienst
EUR	~~1x~~ per dag 2x	yes	3. 4x ⇒?.
Totaal Int.	1x ICD		
	2 a 3 x per uur	yes	Afhankelijk van Schema Eurostar

Concl.
Met 16 treinen per uur zijn 4 sporen ruim voldoende, ook nog ruimte voor Int. treinen.

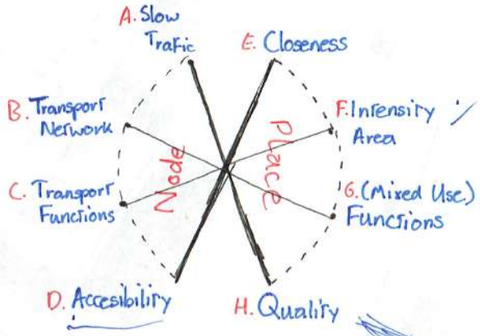
NODE VS PLACE MODEL

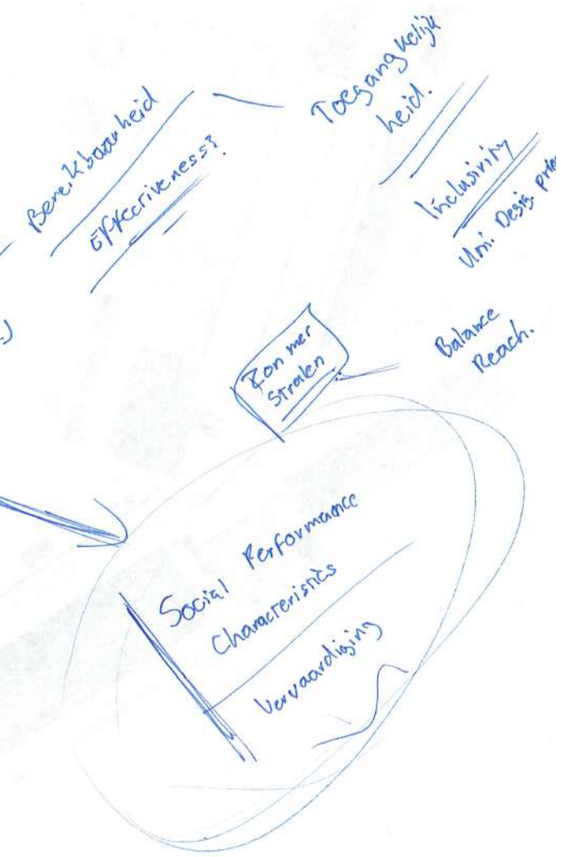
A. aspects Important:

- Centrality (of Functions) ⇒ Remaind. ~~Slow Traffic~~
  Ratio 300m + 1200m
- Mixed Use
  - Differences in the ~~model~~ functions surrounding the stations
- Spatial Quality
  - Perhaps based on factors Ns doc.
- Integration Transport Network.
- Slow Traffic ⇒ Remained, partly Stripped.
- Car Presence ⇒ Stripped for Central Stations
- Closeness ⇒ Remaind the same
- Blending ⇒ New category
- Wayfinding &
- Safety → (Social safety, sightlines, Activity.)
- Experience / Quality
- Acces?

→ Performance???

Alt. 01





Notes:

- B+C & F+G
  Might need Renaiming or balancing
- D.
  Don't make it to "place"y?

Transport Options ⟺ Intensity

Transport Network ⟺ Functions ⟺ Balance, Diversity
Integration.

Wayfinding ⟺ Quality ⟺ Comfort, Safety

Slow Traffic ⟺ Closeness / * Centrality

(or Accessibility?)

Transport Facilities
↳ Parking Places, Ov types
(+ Waiting Rooms etc. ?
Accessibility.) ⇒ Too much Place?

Alt. 01 Functions/Meaning

D. Accessibility
- ↳ Barrier effect
- ↳ Entrances
- ↳ Spatial Layout
- ↳ Closeness other Modes
- ↳ Wayfinding
- (↳ Integration?)

H. Quality
- ↳ Experience (Belevingswaarde)
- ↳ Comfort
- ↳ Safety ~~(see above)~~
- ↳ Greenery
- ↳ ~~Klimaate~~ Climate Messures

G. Functions/Usage
- ↳ Diversity
- ↳ Quality
- ↳ Balance
- ↳ "Blending"

C. Transport Facilities
- Parking Places
- Mobility Types
- Bicycle Storage
- Ticker Halls
- Service points

B. Transport Network
- Frequency
- Directions
- Destinations

F. Intensity
- ↳ Amount of Travelers, workers and residences.

Alt. 02

Node vs. Place

What defines what?

F. Intensity Area
→ Performance of the Hub?
>> Originally: Density of users, residents and visitors.
↳ Belongs to Place?

~~Node~~ Accesibility: Node
- How many destinations can be reached from this area?

Place:
- How many and how diverse are the activity

Bur also:
By whom?

> The more people can get there, more interaction
vs
> The more activities that are there, more interaction

Accessibility:

→ Network of Transport
↳ Reach of the Network ⇒ Node, obvious.

→ Station Reach
↳ How many people are reached ⇒ Node, Quality or performance or Node.
↳ Diversity? (Ratio workers, users, visitors) ⇒ Node, or Quality of mix: Place

→ Integrations & Barriers
↳ Including Entrances? ⇒ Place, better performance / usage
↳ Toegankelijkheid.

The Station:

→ The functions in the station ⇒ Place, including diversity and "Blending"

→ The facilities of the station
→ Parking Places, Bike storage ⇒ Node, essential to functioning
→ Service desks, waiting areas ⇒ Place, perhaps combined with comfort.

Performance:

→ Spatial Performance } Perhaps combined ⇒ Place
→ Quality of Space? ⇒ Place
→ Network Performance ⇒ Node

Transport Network <=>
Network Facilities <=> Station Facilities
Station Reach <=> Functions Area
+ Diversity + Usage
Network Performance? <=> Spatial Performance.
↳ Really important?

A. Slow Traffic
↳ Amount of Network available

vs

E. Closeness
↳ Ratio functions within 300 m
+ Integration?

B. Transport Network (Reach) vs. (F1. Integration of Modes + Wayfinding)

B2. Station Reach
+ Diversity of Reach

vs F. Functions in Station
+ Diversity in Functions.

C. ~~§~~ Network ~~Performance~~ Facilities

vs G. Station Facilities

D.

vs H. Spatial ~~/~~ Social Performance
(Old Quality)
→ Way Finding, Inclusivity

H2. Experience, greenery & Comfort.

Alt H1: Accesableness
↳ Integration Nodes
↳ Integration Area
↳ Spatial Layout
↳ Way Finding

I. Experience, greenery & Comfort
+ Safety