Infrastructure, Connecting Barriers

Graduation Project - Thesis
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Colophon

Graduation Project 2014
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Introduction

We as urban designers are not always aware of the impact of our interventions. We tend to look at a problem on a certain scale level and try to solve it in that same scale level, not realising that the interventions might also have influence on different scale levels.

One thing I noticed when I was working on study projects or looking at real projects is that urban designers and planners often try to connect different areas with each other because they believe that it makes the connected areas stronger. So many times I saw people drawing big arrows on maps, showing they wanted to make a connection. What they are not realising is that these arrows are representations for physical connections made by infrastructure and that this will have an impact on the area it goes through.

This contrast is something I came across a lot during the first year of the Master studies. I saw it with the train tracks in Rotterdam but also on the other side of the world in Buenos Aires where highways separated the coastal area from the city.
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1. Problem statement & Analysis

1.1 Problem Statement

The main way to connect areas with each other is by making an infrastructural connection. Infrastructure is a great way to connect different areas and people. Strong connections (fast connection, good capacity) require large-scale infrastructure, you cannot use a dirt road to connect two cities like Den Haag and Rotterdam. But there is an interesting contrast with the large-scale infrastructural projects. While these large-scale infrastructural projects connect on a large scale they tend to do the opposite on the smaller scale. A highway can cause a separation between the two areas on both sides of it. Large infrastructure also tends to have empty undefined space around it, increasing the effect of separation. The problem is the multi-scalarity of urbanism; most interventions do not have an effect in only scale but in several scales. If an urban designer only designs in one scale level he or she cannot oversee the results in a different scale. The results are projects that cause a collision of scale levels. In order to divert traffic around the city centre many cities chose to build a ring road but the cities were still expanding and the new urban expansions were built outside the ring road. So the ring roads excluded the new urban areas from the inner city.

1.2 Relevance

Ring roads have been built in order to divert traffic around the inner city (Van Nes, 2001) but the consequence of the ring roads is that it also excludes urban area from the inner city. There is a pressure to extend the capacity of these ring roads, for example in Brussels where the Flemish government wants to broaden the ring road because the capacity is currently not enough which causes a lot of congestion. The idea is to split up the local and going through traffic and give them separate lanes. There is controversy about this decision in the Belgium society because it will increase the barrier effect and have a negative effect on the emissions (Belga/TE, 2013). The Dutch government decided that the speed limit on the Dutch highways where possible should be increased. The maximum speed limit on the A10-West is raised from 80 km/h to 100 km/h. On November the 28th there were several news organisations which published about a research that showed that tens of thousands inhabitants of Amsterdam will have a lower life expectancy because of the speed limit increase at the A10-West. The research was done by the Dutch non-governmental organisation Milieudefensie which saw a big increase in emissions (Novum/ANP, 2013). The fact that a speed limit increase has such a big effect shows that the ring road and the urban landscape are very close together and have a big influence on each other and widens the possibilities in an area. Transportation can be seen as a major driver of city competitiveness. There was a survey held under 522 officials and influential people of 25 Megacities to see what the most important factors for economic attractiveness are. Transportation came out as the number one factor having three times as much votes as the number two on the list, Safety/Security (27% vs 9%) (Miller & Hazel, 2007). Besides transportation, infrastructure is also important in urban organisation. It gives structure in spatial organisation, as well as a hierarchy. It forms the city plan where it creates the space for building blocks. Heelings, Meyer and Westrik (2002) realise that the essence of the city plan itself is that it distinguishes between land use for general/public good and private land use. They call the land use for public good, the "network" of public space, while the private land use is called the "islands". The city plan is the most important intermediary layer between what they see as the bottom and top layer of an urban area, the territory and usage. The structure of city plan also dictates the place where utility networks can be laid in the ground. Infrastructure networks can be binding and connecting territorially cohesive urban spaces.

1.3 Problem Analysis

In the last paragraph the problem was recognised, in this chapter the problem will be analysed. The problem is about infrastructure and the different scales that clash, so first is checked why infrastructure is important. Why do we need that infrastructure? The stated problem is probably not something completely new, that is why is analysed what is noticed about this problem before. The chapter will end with an analysis about strategies and designs that are already mentioned in literature.

1.3.1 Why is infrastructure important?

There is a reason that urban designers and planners like to connect by infrastructure. Infrastructure provides the ability to transport goods and people and the contrast of infrastructure is noticed before. In Toronto Canada there are two highways running parallel to each other in east-west direction with only a few kilometres between them. ‘Ironically, although both highways provide travel routes through the in-between city, they create significant barriers to any non-vehicular north-south travel within the study area.’ (Keil & Young, 2011, p13) So here is the spatial side effect noticed that highways tend to have. And it does not just stick with spatial problems, the spatial problems can also cause social problems. ‘These barriers to north-south travel (the 407 and the power transmission corridor) are..."
widely perceived as the physical divide between “inside” and “outside” within Toronto’s in-between city. The districts just inside this divide are home to substantial and increasing numbers of poor households and stagnant job growth (a kind of “badlands of the urban region”); ironically, those inside this divide are “outsiders” when it comes to employment opportunities while, just outside is the realm of middle-income families and a landscape of post-Fordist industry’ (Keil & Young, 2011, p13).

In the Netherlands contrasting infrastructure also appears. In De Mobiele stad (2011, p30-38) mention Van den Boomen and Venhoeven train station Rotterdam Alexander. The area around the station is a very successful commercial area with low office vacancy and the fourth biggest shopping centre of the southern Randstad. The area has a great accessibility by car, train and subway. But according to Van den Boomen and Venhoeven the same infrastructure that makes Prins Alexander well accessible from long distances barriers on a local level. They realize that in this time period with the economic crisis there is little chance for big top-down projects. But they suggest that it might be possible to improve some things with small short term projects. They look at Zaanland where architect Sjoerd Soeters created a lively transition zone from station to city centre whereas the two used to be separated by a provincial road, desolate square and aboveground garage.

1.3.3 Automobile

The automobile is a very dominating element in contemporary cities. Public transport limits people in their mobility whereas owning a car gives people a freedom of movement. It gives people the opportunity to visit places which are hard to reach with public transport but also transporting other people who have more difficulty travelling on their own like children or elderly and having the ability to take larger goods with them. (Dupuy, 2008, p128). According to Calabrese (2004) there was a change in the mid-1960 in the relation between highway and city. The highways were originally planned to connect already existing urban areas but from the 1960s on the European cities experienced a boom thus shortening the distance between the highway and the city. The highway was absorbed in the urban fabric of the city. The highway had an impact on the people in the city and according to Calabrese (2004) the highway has an image of a physical barrier. Calabrese (2004) also mentions another problem with highway planning. The highway itself is not designed by urban designers but by engineers, which results in an out-of-scale highway, including the exits, compared to the urban fabric it crosses. The car density in contemporary cities is so high that not all car traffic in a city can go through the centre. Therefore you can find many cities which have a ring road around there centre so that traffic that does not have the centre as its destination can be diverted around it. A ring road also helps the way that local traffic enters the centre of town according to Van Nes (2001) because the centre can be accessed from different areas. Van Nes (2001) researched the effects of a ring road on its town centre, how did it influences the functions, mainly shops, in the centre and how it affected the structure. The conclusion of her is that it all depends on how well the ring road is integrated in the streets around it; if the ring road is well connected it will not affect the pattern of shops in the town centre.

1.3.4 Public Transport

Public transport was a major driver of city expansions in the 19th century. There was rapid urbanisation, because the city was the place where people could find jobs. Not everyone could live next to their job, in the centre, so the newly invited train filled in a gap of demand. With the train, people had the ability to live outside city centre but still work in the centre. The automobile did not exist yet, so public transport was the way to still move away from your work. The faster the transportation mode is, the further away people can live. Although the car was the most dominant factor in the twentieth century after the Second World War, there were still times where public transport was used as the basis of city expansion, for example the Copenhagen Fingers Plan in 1947 (Cahasan & Clark, 2006). Even in twenty-first century public transport can be the base for urban plans, for example the planning concept of transit oriented development (TOD). Cunningham (2012, p1) says about TOD in the United States’ The main goal is to create livable environments where people can access transit arteries to employment centers, services and shelter with minimal use of cars; Calabrese (2004) signals that this type planning is easier to do than planning a city based on massive automobile use, which is what happened after the Second World War in European city expansions. The “transit city” was a lot simpler in its basic corridor structure and much more amenable to centralised planning and control. Trains and trams ran along fixed corridors and people basically had to live near them to gain access to transport. Transport demand could be relatively easily measured and changes responded to by increasing the service levels on lines or opening up new transit lines” (Calabrese, 2004, p52). However, train stations were not only placed in expansion areas, the most important stations were the stations placed in the existing urban structure as close to the city centre as possible. A railway is not a network people from the surrounding area can just link in, the only places where you can link the network is at the train stations. This means it is important that these places are well integrated in the urban fabric and local networks. The major train stations in the Netherlands are the centres
in the network where different transport modes come together. That is why many major train stations in the Netherlands are being reconstructed so that they really become multimodal transport nodes (Van den Boomen & Venhoven, 2012). Public transport is a transportation mode that poor people can use as well, as opposed to private car use. Owning and using a private car can be quite expensive so not everyone can afford it. On the opposite, using a car is more convenient for people, it also gives more independency and flexibility with a higher comfort and faster travel time while being more reliable than public transport. A car ride is perceived to be more pleasurable but travelling with public transport is perceived as a safer travel (Steg, 2003). The influence on its surroundings is different between a car road and public transport line because although both transportation modes create noise pollution, public transport does create air pollution on its direct surrounding as opposed to cars.

1.3.5 What strategies are used?

There are some important lessons to be learned from urban renewal in Lyon, France based on the findings of Stouten & Rosenboom (2013). The urban renewal in Lyon has an integral approach on different scale levels where transformations in public transport networks go together with a re-design of public spaces. It is important to realise that a problem area is not an area on its own but is part of a regional network, the regional aspects are important for planning and designing. Networks within the area are needed for a neighbourhood but besides that a neighbourhood also needs well provided connections with the other parts of the region. An area should not be a single unit or a ‘backyard’ but should be an integrated and important part of the region. There needs to be a balance between strategies on a city-region scale, with the goal to re-connect excluded areas and households, and neighbourhood and area based initiatives. Connectivity is being part of the networks and having the ability to link up to the modernized public transport and infrastructure and a modernization of the urban fabric. The physical interventions such as demolition and new construction should go together with social and economic interventions in an integral approach. Streets used to have a multi functioning purpose, besides a transit place it was a place where people could meet and children could play. But the intensive use of cars has changed the use of streets to a place that is only used for transportation and parking cars. (Graham & Marvin, 2001, p119)

The Netherlands is a densely populated country where space is scarce. This result in more interest in spaces that are not mono-functional but multifunctional used, which means that the space will be more intensively used. This requires an innovative way of using space by new concepts and ideas coming from various disciplines. Multifunctional use of space helps to integrate physical infrastructure. Besides the multifunctional use, there is another point that improves the integration of infrastructure and that is the fact that infrastructure should not only be planned but also be designed. The past decades the Dutch spatial planning policy makers have used the logic of the large-scale where it was more focussed on planning with its logistic and strategic aspects than on the cluttering effects of the infrastructure in its territory. This is changed and the current policy makers recognise the cluttering effects and that is why they have an increased interest in integrated infrastructure projects. (Calabrese, 2004, p213-215)

There have been densification projects in the Netherlands but densification is not the same thing as intensifying. As Calabrese pointed out, using space not mono-functional but multifunctional means a more intensive use of space.

1.3.6 What design interventions can be done?

Large scale transportation lines like highways or train lines are not usable itself for multiusage because one would have to close it down in order to use it for something else. If however the tracks are raised and placed on columns, the space under tracks could be used for something else. The reverse is also possible, to sink the infrastructure into the ground in a tunnel. This way the space above it on the ground is free for a different use. In his dissertation “RingRing”, van der Hoeven (2001) researches and discusses the possibilities for building underground in relation to the ring roads of Rotterdam and Amsterdam. Space is scarce in The Netherlands but there is still more and more need for extra infrastructure, newly build or expansion of already existing infrastructure. This increases the negative barrier effect, especially at ring roads which separate an existing city with its surroundings including its own expansions. Tunnelling could help in solving this problem and he investigates the options and looks at projects in the Netherlands where in the process was looked at the option of tunnelling infrastructure, for example at the Zuidas in Amsterdam or Liedsche Rijn in Utrecht. It is not necessary to always complete close of the tunnel; a big impact could already be reached with a half open tunnel so that the infrastructure has much less negative effects on the ground level. By putting the infrastructure underground the infrastructure is hidden from its surroundings but that does not mean it is gone. Shannon and Smets (2010) see that putting infrastructure underground creates a paradox and two different worlds with two different professional involvements. The paradox is that it looks like an acceptable landscape while in the mean time the landscape is actually destroyed by the infrastructure underneath. The two worlds are the domains of on one hand the engineers who make the tunnelling possible, and on the other the landscape architects whom fill in the regained space.
2. Theory

This chapter will be about the theory of networks and infrastructure in order to understand the systems behind it. Understanding the systems behind the problem will help to solve the problem in a strategy and design.

2.1 Theory of networks

2.1.1 Dupuy’s theory of networks

Dupuy (2008) recognises that there are three different levels of network operators that organise urban space (see illustration 1).

Level-one operators are operators that provide large-scale infrastructure and broad-based community services.

Level-two operators are the actors using the level-one networks that they are offered according to their needs. There are three sets to describe these level-two operators according to Fishman:

- Production networks: e.g. company logistic networks of suppliers, subcontractors, customers, and so on, together with an additional layer of relations with the labour market, and all of the linkages required for a company’s informal needs;
- Consumption networks: what Fishman calls the malopols of shopping centres, distribution channels, brands and franchises – together with leisure facilities – that increasingly enable consumers to see a product in one place, to check out the price in another and to make their purchase in a third, bearing in mind that we are talking about the same product and brand;
- Personal networks: made up of all the points crucial to one’s life, including close family and parents’ friends, for example, together, in the case of households with children, with crèches, schools and various children’s activities located in various places. (Dupuy, 2008, p48)

Level-three operators are urban households that use the infrastructure of level-one to make connections among the level-two networks to make the multidirectional journeys that creates a persons city.

According to Salingaros (2005), the smallest urban components relate to the size of a human and are the most vulnerable urban components. These smallest urban components should be protected from larger urban elements. Therefore, the smaller scales have to be defined before the larger ones. Rooij (2005, p237) hypothesises that ‘vital city depends on good connectivity within and between the lowest levels of scale’.

Salingaros (2005, p87) realises that the forces from the long-range create the large-scale structure defined on the smaller scales. There is no alignment but the large-scale structure can destroy the small-scale connections.

A long time ago before cars existed, the city design was mostly based on slow traffic modes. Mobility patterns like the linear and star pattern are best suited for this slow speed traffic, while a grid pattern is best for fast traffic. With the increased use of the car the city plan also changed because the car became more important in city planning. Cars travel at higher speed and therefore there

Illustration 1 Dupuy’s three network layers (2008)

Dupuy’s model is an interesting model which might be helpful to urban designers, which should be the goal of such a model in the end. The problem stated earlier in this report is a situation where the three different layers do not match.

2.1.2 Theory of networks related to spatial quality and local scale connections

Van Schalk (2005) states that knowledge about the relation between the three layers is meaningless if one has no knowledge in urban design or planning, while Rooij (2005) recognises the fact that spatial design interventions are only done in the first two levels and not in the third level. However, Rooij states that understanding the third level is needed in order to make functioning design interventions in layers one and two.

The three levels can be related with spatial scale levels. Level one is related with the global or regional scale, level two with the city scale and level three more or less with the human scale. You cannot design how urban households make use of the first two layers, but that does not mean there is no need to design on the human scale. The spatial environment on the human scale is what urban households experience every day. ‘Successful cities ... in terms of efficiency, vitality, and liveability meet both the physical and psychological needs of the human scale with their physical structures and surroundings. Successful cities provide spatial quality’ (Rooij, 2005)
were fewer intersections needed. Having less intersections result in a wider grid which is not beneficial for slow traffic (Bach et al, 2006, p134)

A highway is a bundling of the car traffic, the same goes for main roads in a city. If a city has a grid pattern than the car traffic is more dispersed. Every place than has less traffic nuisance like emissions, hazard distribution, fragmentation and barrier effect but the total amount of traffic nuisance can be bigger. Grid is also not the ideal pattern for slow traffic like pedestrian or cyclists because they always have to take a detour. For slow traffic a star-shaped grid would be better, (Bach et al, 2006, p138)

The concept of Dupuy is a model representing one aspect of reality: urban networks. The real world consists out of more than one aspect, thus a model is not reality but an abstraction of only one aspect of reality. Therefore the recommendation of Van Schalk (2005, p262) to supplement the Network City model with other, related, concepts, such as those of “lived space”, “place” and “collectivity” is interesting because it connects network (relations) with places (see illustration 2).

If aspects about spatial quality and the human scale are not taken into account than the large-scale connections in the network really become the “traffic machine” (verkeersmachine) Palmboom (1987) talks about. The traffic machine is characterised by a specialisation of networks where the lines are only there for transportation over large distances and not for access of the direct environment. The traffic lines are only accessible for certain transportation modes and the other modes are excluded. The traffic machine can make connections far away but works as a barrier in its direct environment (Palmboom, 1987, p35)

2.1.3 Splintering Urbanism - Highways

According to Graham & Marvin (2001) infrastructure networks are complex network architectures which bring heterogeneous places, people, buildings and urban elements into dynamic relationships and exchanges which would otherwise be impossible. They realise that infrastructure networks are the providers for the distribution grids and topological connections which are able to link the production networks with the consumption networks. So just as Dupuy (2008), Graham & Marvin link the physical networks of for example roads with the networks of production and consumption. However, Dupuy went a bit further and also linked these types of networks with the individual networks of a household.

On the other side, Graham & Marvin realise that the dynamic relationships and exchanges made by infrastructure networks bind spaces together, over administrative boundaries defining material and social dynamics. But this does not happen in an equally divided way. Infrastructure networks transform both the spaces and times of interaction and all of its aspects, social, economic, cultural, physical and ecological. With these processes, the infrastructure networks also create a difference in urban spaces; urban spaces are not equally linked to the networks. This can create the situation in which certain urban areas are better connected with urban areas geographical further away than with urban areas geographical close by. Fast and high capacity infrastructure bypasses areas (and with that people) which are less favoured. The bypassing is a choice, it is part of the network design because you cannot connect everything with everything and everyone with everyone in the fastest way with the highest capacity. So choices have to be made, which points will be
connected and which or what can use the network.

Graham & Marvin (2001, p118) see that in order to support metropolitan integration there was an extension of standardised highways and roads beyond but also across the metropolitan region. This extension meant to metropolitan integration works out differently in practice because it supported the partitioning and with that fragmentation of urban space. Graham & Marvin identified three (inter-related) processes about motorisation of metropolitan life which supported this fragmentation.

- ‘First, motorisation has supported a shift in the use of streets from multi-use meeting and transit spaces to single-use space which does nothing but vector car flow or house parked or grid-locked stationary vehicles’. The cars have taken over the street. They are a very dominant feature in contemporary cities and thus in urban design.

- ‘Second, the widespread shift to highways and automobiles as the dominant transport system of polynuclear cities has strongly supported the broader shift towards urban physical and social fragmentation and separation. Highways and motorisation have contributed to a coarsening, widening and stretching of the urban fabric. To Haug the private car, together with the running down of public transport, carves up the towns no less effectively than saturation bombing, and creates distances that can no longer be crossed without the car’.

So at first, the car as a transportation mode widened the possibilities for people to move around. Car owners got the freedom to move further away from their jobs or amenities they used. But now, the table has turned and instead of an object of freedom the car has become a sheer necessity.

- ‘Finally, urban spaces are being increasingly reconfigured towards dominant car-using users as inward-looking ‘islands’ or ‘enclaves’, surrounded by the physical highways, connections and services to support motor access, parking and use. In a growing number of cities, traditional streets, laid out under the influence of the early stages of the modern infrastructural ideal and before, have often been marginalised by the growth of highways as places of danger, fear and mistrust’ (Graham & Marvin, 2001, p118-121)

2.1.4 Two disciplines

The highway has changed the urban conditions in the city and in its suburbs. They were originally planned to make a connection between existing urban areas but that situation has changed because the cities have grown over and along the highways (Calabrese, 2004). The highways have little relation with its surrounding urban fabric and public space because they were designed by people from different disciplines which have no relation with each other. The highways (and other infrastructure like rail ways) were designed by civil engineers but the urban fabric and its public space was designed by urban designers. There was little contact between the two disciplines during the design process. (Bach, van Hal, de Jong, & de Jong, 2006 and Calabrese, 2004).

When the urban landscape was built around the highways it was realised that the highways can cause environmental and noise issues on the surrounding residential areas. So from that moment on there was a tendency to keep large-scale infrastructure at a distant from residential areas. For example in Rotterdam where based on laws the harbour, the highways and the residential areas were kept at safe distances. The places where those elements met have now become no-man’s-land which Vanstiphout (2002, p179) calls ‘leftover areas’ and ‘urban antimatter’. Vanstiphout (2002, p179-180) sees that these leftover areas exist on one hand out of the elements that created them, namely the large-scale infrastructure, but on the other hand out of functions which were not desired at any other place in the city. Vanstiphout mentions functions like allotments or scrap yards. The areas are neither informal nor unplanned, it is like the dumping ground for city functions.

Besides the leftover area Vanstiphout (2002, p180-181) notices two other types of areas arise next to the highways of Rotterdam. These types thrive on the excellent accessibility the highway gives. The first one is the office park where shiny offices are placed in a well thought and clean environment. But these places are very mono-functional and there is little human activity in the public space. The second type is the facilities for the mass. Examples are the furniture mall Alexandria, the football stadium and a hospital. In the zone around the highway is enough room for all the needed parking space. The only thing these facilities need is an exit of the highway.

To conclude, Graham and Marvin (2001, p11) see that ‘the construction of spaces of mobility and flow for some, however, always involves the construction of barriers for others. Experiences of infrastructure are therefore highly contingent’.

2.1.5 Integration of the train network

Designing station areas it is important to have a good local integration for slow traffic modes. The network of train lines only works optimal if the places where you can enter the network are well accessible. Bach et al (2006) realise that there are a few essential elements for designing the routes to the station, no matter what the design process is. The elements they describe are based on a few principles, the route to the station should be logical, time-saving and the spatial quality of the route should be optimal for pedestrian and bicyclists for whom it should be easy to cross. The station itself should be a nice place
to stay because one might have to wait here. That means it should give shelter against the weather but also that it is a safe place to stay. The last element Bach et al (2006) think is important is the FSI (Floor Space Index) rises the closer you get to the station.

Bosselmann (2008, p177) thinks that ‘the role of accessible transit in creating liveable neighbourhoods remains one of the central themes within urban design’. He describes researches done to measure the integration of train station in the San Francisco Bay Area. These researches were done out of the negative reactions on stations with a lot of parking lots around it. Although a lot of parking space around a station does not enhance local integration nor spatial quality, there is something to say for the connection between the car network and rail network. Van den Boomen and Venhoeven (2012) plea for a connection between different modes of transportation, including public transport and car transport. They realise that the strength of a network is determined by the amount of connections with nodes it can make and once the networks of public transport and car are connected both networks have increased nodes in their network. Van den Boomen and Venhoeven (2012, p22) even think combining these two networks is ‘indispensable’ for the accessibility of the Netherlands.

The ideas of Bach et al (2006) and Bosselmann (2008, p177) are good examples of how small-scale connections (slow traffic) can help large-scale connections (train network).
3. Research Questions & Methodology

3.1 Main research question

What kind of spatial strategies can be used to make local spatial interventions in order to let large-scale ring-infrastructure act less as a barrier for urban area outside the ring and how can the local interventions be used in other situations with similar problems?

3.2 Subquestions

- How does large-scale ring-infrastructure act as a barrier causing urban fragmentation?

- What kind of strategies can be used to let large-scale ring-infrastructure act less as a barrier in urban area?

- How do the strategies lead to spatial interventions?

- How can the spatial interventions be used in other locations?

3.3 Definition Terms

This section will explain some terms used in this report.

Spatial Strategy

A spatial strategy is a set of (possible) solutions or steps that can be taken in order to deal with a spatial problem.

Local Integration

Local integration is the fact that an urban element is also part of the urban structure or system on the small scale instead of being a barrier or causing spatial fragmentation on the small scale.

Highway ring road

The term highway refers to controlled-access highway (in Dutch ‘snelweg’) which is a public road designed for high-speed vehicular traffic and free of any intersections. The fact that it has controlled access means that not every type of vehicle can enter and that the points where you can enter the highways are set. The term ring road refers to a road (or a series of roads) that encircles a city, or a part of the city. A highway ring road is thus a situation where the road(s) that encircle a city are all controlled-access highways.

3.4 Methodology

The problem defined in this project is the fact that large-scale infrastructure can make a connection on the large scale but can act as a barrier on the small scale causing problems in the urban fabric. The goal of this project is to solve this problem at a specific location and then show how these spatial interventions can be used in other location with similar problems.

First a general analysis about the problem has been made. In order to create a theoretical framework, a literature review has been made to see how network theories work and what the relation of large-scale connections with small-scale connections is. Secondly, the criteria of the problems are determined, in what way act large-scale infrastructure like ring roads as a barrier? Defining the criteria is done by comparing and researching possible locations and learning from these problems.

In order to find the right location five cities in the Dutch and Belgium context have been analysed and compared. This is done by visualisation methods like mapping and by web search where information about the dynamics, former and new plans or visions, ongoing processes, excluded urban environment and spatial qualities of the compared area among other aspects. After this design case study a research area has been chosen, this is the area around the western ring road and western railway of Amsterdam.

This location has been researched and analysed which showed the particular problems in the research area. This research has led to a vision for the research area which has lead to a strategy to achieve this vision in the plan area. Including the analyses were also Space Syntax, Isovist and agent based modelling analyses which were used to test what the result would be of several interventions. Interventions with a positive result have been used in the strategy.

After the strategy was made, each strategic intervention was researched. How could the interventions be implemented, what are the ways an intervention could be performed and what are the consequences of these interventions. In order to test the consequences of the interventions, the several different scenarios of the interventions have been tested with Space Syntax, Isovist and agent based modelling analyses.

The proposed interventions are meant specifically for the research area. However, they tackle some of the general problems of large-scale infrastructure as defined in the section Criteria. Thus the intervention can be used in other locations with similar problems. A toolbox has been development to show how, when and why to use these interventions while explaining how to test the specific interventions.

Besides leading to a generic toolbox, the proposed strategic intervention also lead to spatial consequences in the plan area, which are shown in the section Spatial Consequences. These spatial inter-
ventions should lead to a situation in which the large-scale infrastructure works less as a barrier which should unlock the potential the area has. That should lead to new living environment in the area.

Methods that have been used are:
- Literature Review
- Web Search
- Design case studies
- Behaviour Research
  - Observation
  - Drawing

General Problem

- Mapping
  - Modelling
    - Design

Tools that have been used:
- Space Syntax
- Isovist
- Agent based modelling

How does large-scale ring-infrastructure act as a barrier causing urban fragmentation?

In order to solve a problem, it is important to know what the problem is and how it is caused. What are the (negative) effects of large-scale ring-infrastructure acting as a barrier? This sub question is about answering these fundamental issues.

The first part of this question is very theoretical. What are urban network theories and how does that relate to the reality where there can be a mismatch between large-scale infrastructure projects, in this case ring roads, and the local urban fabric. Why is the large-scale infrastructure important and could the local scale connections be used to strengthen the role of the large-scale infrastructure. The second part of this question is about criteria that cause a ring road to act as a barrier. From the comparison of five ring roads in five cities it is possible to make a list of criteria found in these cases. These criteria are put together and can be used to analyse situation which experience problems with large-scale infrastructure in urban areas.

What kind of strategies can be used to let large-scale ring-infrastructure act less as a barrier in urban area?

The first sub question gives an understanding of the problem and a set of criteria of this problem. This question is about researching what strategies can be used to solve the problems found in the first sub question. This question is answe-
red in two ways, first is researched what strategies already have been used in order to solve the problem. This is done by literature research, web search and looking into reference projects.

Secondly, an own research has been done to see what strategy and strategic actions could be done in the research. This is done based on the location analyses which showed problems in the research area. The methods used for this were visualisation and design while the consequences were tested with Space Syntax, Isovist and agent based modelling analyses.

- Literature
- Web Search
- Reference Projects
  - Antwerpen, Groene Singel
  - Utrecht, Leidsche Rijn
- Visualisation
- Design

Tools that have been used:
- Space Syntax
- Isovist
- Agent based modelling

**How do the strategies lead to spatial interventions?**

The answer to the previous question gave a strategy to work with, but this question leads to the spatial translation of the strategy. The methods that have been used to answer this question are design, visualisation and using reference projects to learn from, while the proposals have been tested with Isovist, agent based modelling and All line analyses.

- Design
- Visualisation
- Reference Projects

Tools that have been used:
- All line analysis
- Isovist
- Agent based modelling

**How can the spatial interventions be used in other locations?**

The proposed interventions in the plan area tackle some of the generic problems of large-scale infrastructure. Therefore, these interventions can be used in other situation with similar projects as well. A toolbox has been development to explain how to use the interventions in these situations.

- Design
- Visualisation

Tools that have been used:
- Space Syntax
- Isovist
- Agent based modelling
- All line analysis

**3.5 Goal**

Large-scale infrastructure projects are meant to connect (areas/people) on a big scale but can work as a barrier and can cause spatial fragmentation on a local scale. The goal of the project is to create a spatial strategy which will lead to spatial interventions which should integrate large-scale infrastructure in its urban surroundings on a local level. The positive aspects of the large-scale infrastructure, large-scale connection, can give potential to an area which not always shows because of the negative aspects of the large-scale infrastructure. The spatial strategy and interventions should unlock this potential and create a situation where the large-scale infrastructure has a positive influence on the local urban situation.
3.6 Structure of the project

The project starts with a general analysis of the problem based on a literature research. This is explained in two sections, Problem Analysis and Theory.

Based on this problem analysis a design case study has been done for five cities in the Dutch and Belgium contest. The cities have been compared with each other and lead to two main things. First the location for a research area has been chosen (area around the west ring of Amsterdam) and secondly a set of criteria that show how large-scale infrastructure works as a barrier has been determined. These criteria are a generic set, so they are not only applied on the research location. These criteria create a framework that later has been used to understand the problems in the research location and to which the proposed interventions are related to.

The research location has been analysed further to understand its characteristics, trends and problems it has with its surrounding infrastructure. Based on these analyses and the problems potential interventions have been researched where some of these interventions have been tested in computer models like Isovist and put together in a strategy. The proposed interventions are location specific, however the problems they tackle fall under the definitions set with the list of criteria. That is why a tool box has been developed to show how the local specific interventions can be used in other situations with similar problems and how these interventions can be tested.

The local specific interventions have an impact in the plan area so the spatial consequences of the proposed interventions are shown in a design. This design should lead in the future to a dynamic living environment in the research area.
3.7 Computer modelling

Space Syntax explanation

Space Syntax is a computer model that uses a technique to analyse the network of spaces. It analyses extrinsic properties of space and is an objective method meaning it does not use socio-economic and demographic data to come to results. It does not show architectural typologies or styles and it does not say anything about the quality of the spatial design.

Space Syntax analyses the integration of each street compared to the integration of all other streets. It does that by calculating per street how many turns it takes to reach any other street in the area and sum these all up. The street with the lowest sum of turns has the highest integration. In this project two types of space syntax analyses have been used, the axial analysis and the angular analysis.

Axial analysis

The most basic analysis of space syntax is the axial analysis. In this analysis every street is represented by a single line. This line is drawn so that it shows the longest straight line of sight in that street. Illustration 6 shows an example of an axial map and the result when it is analysed. The numbers next to the street are used to distinguish each street so that a tree as in illustration 7 can be made. The axial analysis calculates per street how many turns (direction switches) it takes to reach every other street, the topological distance.

It is clear that the main street is the street that needs the least turns to reach every other street. Therefore, the main street is the best connected and highest integrated street of this map when related to the other streets in the map. There is no absolute value of integration so the integration of this main street cannot be used to compare with a completely different map. Because the main street has the highest integration it is coloured red while the lowest integrated streets are coloured dark blue.

The analysis of illustration 6 shows a global analysis, so it calculates the topological distance per street to every other street. However, it can also be interesting to analyse how well every street is integrated if you are only allowed to take three steps (R3 analysis). The results this type of analysis gives show the integration on a smaller scale.

Angular analysis

The axial analysis gives a rough image of the integration of streets. There are two aspects that can be added in order to make the analyses more precise. The first aspect is to analyse the segments of a line instead of the whole line. A line is cut up in segments when it crosses another line.

The second aspect that can be added is the angle the streets make. People tend to choose the direction with the least angular change. Adding these two aspects gives a much more precise analysis.

Just like the axial analysis, a global topological analysis, how many steps does it take to reach every street in the area, shows the large scale integration. A three steps topological analysis, how many streets can you reach with three steps, shows a local integration.

There are two types of angular analysis been used, the topological distance within a small and a large radius. The size of the radius has been based on the size of the map and thus is relative. These analyses show the integration for fast transport modes like cars (large radius) and the integration for slow transport modes like pedestrian (small radius).
Visibility analyses

The space syntax analyses give information about the network and configuration of streets. On the smaller scale however these analyses tend to be less useful. This is where the visibility analyses come in. They show the visibility characteristics of the area.

Isovist analysis

In the Isovist analysis it is analysed what the Isovist for every point is, showing how well visible each point is. The Isovist for every point is the area that is visible from a single point (Illustration 8).

The way to make an Isovist analysis is by drawing a map of the area where all spaces where you cannot see and walk through are drawn. All the open space is just left over and that is the space that is analysed. The Isovist analysis shows the potential certain spaces can have. If it the space is well visible than it means there is a lot of potential.

Agent based modelling

For the agent based modelling analysis the same base map as for the Isovist analysis is used. This analysis does not calculate for every point it characteristics but rather analyses the relation of the visible spaces. The analysis uses a set number of computer generated agents which are released in the open area of the map. They move randomly through the map based on what the visibility aspects are. The way these agents move (how many turns they take, how long they walk in a straight line, etc) is based on results from research from real people behaviour (Van Nes).

The results of this analysis once again show the potential spaces can have.

Illustration 8 The light blue area is the area that is visible from the circle Source: http://www.wikipedia.org

Illustration 9 A sample of an Isovist analysis Source: Author

Illustration 10 A sample of an agent based modelling analysis Source: Author

Illustration 11 A sample of an all line analysis Source: Author
4. Design Case Study

The suggested problem is a problem that can be found in many cities. In order to find the right location to make a design for, several cities with ring roads will be compared with each other. Five cities in the Netherlands and Belgium will be researched and compared on a city scale. Aspects that will be handled are how the ring roads act as a barrier, are there other infrastructural lines enhancing the barrier effect, what are the conditions around the ring roads, are the ring road elevated, what urban landscape is excluded by the ring roads and what is the context of the city around which the ring roads lie.

The five cities that have been researched are:
- Amsterdam
- Rotterdam
- Brussels
- Antwerp
- Utrecht

Out of these five, there are three cities that might have an interesting research and project location. These three locations are researched more deeply.
- Amsterdam
- Rotterdam
- Brussels
4.1 City Scale

4.1.1 Amsterdam

The ring of Amsterdam is relatively late completed. The first part (the Coentunnel) was finished in 1966 while the last part (north ring) was only finished in 1990. Amsterdam has large urban areas outside the ring road, especially in the west and southeast. In the north there is little expansion while in the south there is a large urban area but it mostly belongs to another municipality. The ring road is mostly elevated (see illustration 12).

At the south part of the ring is the most important business district of the Netherlands: The Zuidas. This is a strategic spot because there is a train line as well, and the important airport Schiphol is very close. Local integration is not very good here, while if it was it would improve the Zuidas. The Zuidas is a national important area and therefore the national government also brought in money for the development. This is not the case for the western part of the ring road where also plans were made for.

The city expansion in the west (today called Amsterdam Nieuw West) is build very close to the highway. Of all analysed ring roads, this is the part which is closest to the urban surroundings. There are large parts where there is just some green camouflaging the highway, but not creating a distance. This result in the most diversified barrier of all rings, and makes it difficult to qualify the type. There is also place on the west ring where the highway is tunnelled with buildings above it (bos en lommer plein).

The current amount of houses in Amsterdam is not enough to fulfil the future demand because the demand of houses will increase (Gemeente Amsterdam, 2012). There are two reasons for this, one is the increase of external demand and the other is the increase of internal demand. The increasing external demand is the fact that more people from outside Amsterdam are moving to Amsterdam. The internal demand is mostly caused by the fact that the average size of a household is shrinking.

Illustration 13 Principle ring road Amsterdam Source: Author
Illustration 14 Analysis Rotterdam Source: Author
4.1.2 Rotterdam

The ring road in Rotterdam is quite long (+/- 40 kilometres) and it is also the one where large parts have separated lanes for local traffic and through traffic. There are large areas which fall outside the ring, especially in the North and East (above the Nieuwe Maas). The ring road does have the actual circular shape and therefore has the nickname ‘the Diamond’ (see illustrations 14 and 15).

It is not a specially designed ring like in Amsterdam, Antwerp en Brussels. The northern, eastern and southern parts are all parts of much longer highways which come together around Rotterdam. The north ring (A20) runs further along the ring in both east and west direction. Coming from the north, the A13 crosses the A20. The A15 is the southern line of the ring and runs further in western direction and is crossed by the A29.

There are train lines running parallel to the ring road at the northern and the southern part of the ring road. At the northern part is also a major crossing of train lines which at the same place where the A13 meets the northern ring road.

There are plans to make a new highway connection between the A13 and A16 around Hilligersberg-Schiebroek (see illustration 16). This new piece of highway should relieve the part of the A13 going through Overschie and a part of the A20. The question is what will happen with the urban area it goes through and cuts off. The villages outside this new ring like Berkel en Rodenrijs also have a strong relation with Rotterdam and now they will have to cross two highways to reach the inner city.

The A15 in the south has a lot of empty space around and the distance with the urban area is quite large. The A20 in the north is closer to urban area although there is a large part where there is a canal running parallel to the highway. The highway itself is mostly elevated.

Illustration 15 Principle ring road Rotterdam Source: Author

Illustration 16 New highway connection A13 and A20 Source: www.rijkswaterstaat.nl
Illustration 17 Analysis Brussels Source: Author
4.1.3 Brussels

Brussels has the biggest ring of all five cases. Not only covers it almost the entire city, it is also extended to the south (around 12 kilometre below the municipality border). There is relatively little urban landscape outside the ring and it is not compact but split in several patches. Because the ring road is so large the urban area outside the ring is far away from the city centre and the relation with the centre is less (see illustration 17).

What makes Brussels interesting is the fact that just recently the Flemish government have decided to broaden the ring at the key part in the North. The Flemish government thinks the northern ring is a missing link in the Flemish highway network. The idea is to add extra lanes and make a separation between local traffic and through traffic. At two parts they will increase the number of lanes from 6 to 10 and at one part from 6 to 8.

This is done because there is a lot of congestion here and the traffic safety is far below acceptable. There is however controversy about the decision because it probably will increase the amount of unhealthy exhausts from cars and will have a negative impact on thousands of inhabitants living around the highway (Belga/TE, 2013).

Unlike Rotterdam and Amsterdam where there are several parts where the train lines run parallel with the ring road, the train lines in Brussels do no increase the barrier effect of the ring road by running next to it.

The plan area is divided into 2 regions, Brussels Gewest (Brussels region) and Vlaams Gewest (Flemish region), which are then divided into three different municipalities, Haren, Vilvoorde and Machelen. The ring road mostly runs through Flemish territory although there is a small part running over Brussels territory. This political chaos will be a major part of solving the issues in the area.

**Missing links 2010**

*Illustration 18 Principle ring road Brussels Source: Author*

*Illustration 19 The north ring as a missing link Source: Adamloos.be*
4.1.4 Antwerp

The ring of Antwerp is not completely a ring, the northwest part is missing. There have already been a lot of debates on how and where to finish the ring and the decision has been postponed and changed a lot. For a long time it seems that there would come a bridge called “Lange Wapper” but recently the municipality changed their opinion again and they want a tunnel now (see illustration 21). There is also a continuous debate on where the last part of ring exactly should come. There is an urban regeneration area “Eilandje” which lies northern of the city centre and the idea is to transform it from a harbour area into a high quality urban area. The museum MAS is a catalyst for this transformation. This area will be influenced by the possible new part of the ring road if the ring road would come close to the urban regeneration area.

There is a large urban area outside the ring. The ring itself is embedded in a ‘green river’, it is lowered and the walls are green (see illustration 20). The municipality of Antwerp have made a vision for the city and in it are some key projects (Stad Antwerpen, 2012). One of the key projects is the ‘Groene Singel’, it is realised that a large part of the inhabitants life fairly close to the ring and that the ‘green river’ can be used as a place of quality for the inhabitants. It should be a place that is well accessible for pedestrian and bicyclists (AG Stadsplanning Antwerpen, 2013).

Unlike Brussels but similar to Rotterdam and Amsterdam, a large part of the ring road of Antwerp has train lines running parallel to it.

The ring of Antwerp is much smaller than the other researched ring roads, where the other researched Belgium city has the biggest ring road of all five resear-

Illustration 22 Principle ring road Antwerp

Illustration 21 Possible extension of ring road Antwerp Source: http://upload.wikimedia.org
4.1.5 Utrecht

Three-quarter of the ring road of Utrecht consist out of highways; the part in the West, the South and the East. The northern part of the ring road is a so called n-road. There is relatively little urban outside the eastern part of the ring road, except for the municipality De Bilt is only the university area Uithof separated by the eastern ring (see illustration 23). The southern ring is one of the busiest highways of the Netherlands. Directly south of it are business areas located, the first residential areas on this side of the ring are south of the Amsterdam-Rijn canal situated. These areas belong to the municipality of Nieuwegein.

Outside the western ring lies the new city expansion Leidsche Rijn. During the planning process of this expansion the planners already realised that the ring road could form a barrier between the expansion area and the existing city. That is why the ring road is partly tunnelled. However, there is still the Amsterdam-Rijnkanaal between Leidsche Rijn and the old city. In the inner city the train tracks also form a barrier between east and west. Unlike the other researched Dutch cities, the train lines in Utrecht do not run parallel to the ring road but they all go straight to the station in the centre. The strategy used for Leidsche Rijn could be reviewed in order to learn from it

Utrecht is an important city in the mobility networks in the Netherlands. It is a cross point in the north-south connection and the east-west connection in the Netherlands.
4.1.6 Space Syntax Global Comparison

Space Syntax

Space Syntax is a computer model about that calculates how well streets are integrated compared to the other streets in the map. The model counts per street how many steps (turns) it takes to reach every other street and then compares it with the other streets. For more info see Section 3.7 Computer modelling.

Global Integration

The first space syntax analysis is about the global integration, how well is each street integrated in relation to all other streets in the model. Three cities have been compared (see illustrations 25 and 26).

Amsterdam

The space syntax analysis shows that the ring of Amsterdam south of the IJ is well integrated. The west ring is also well integrated and in Nieuw West there is a street, Johan Huizingalaan, which also runs in the north-south direction and is relatively well integrated. Between the Johan Huizingalaan and the west ring the train tracks are situated. The urban fabric here is broken and the integration of this area is divers and could be better.

Rotterdam

The ring of Rotterdam is very well integrated in the east and the south and a bit less but still good in the north. In the east the urban area around the ring road is also well integrated. In the north in the research area the integration in the urban inside the ring is alright where the area in Overschie is not very well integrated. This could improve if the con-
nection to the centre would be better integrated.

**Utrecht**

The ring road of Utrecht is very well integrated, at least the part that is a highway. The area inside the ring is also well integrated. The expansion Leidsche Rijn is best integrated close to the ring road, the further away from the ring road the worse the integration get.

*Illustration 26: Space Syntax analysis Global integration Utrecht Source: Van Nes*
4.1.7 Space Syntax Local Comparison

Integration R3

The second space syntax analysis used is about the integration on the local scale. The result of this analysis shows how well each street is integrated in three steps. In other words, it shows how many streets you can reach from a certain street if you can take a turn three times and compares that with the other streets (see illustrations 27 and 28). In the angular analysis the angle of the roads and the crossings is also taken into consideration.

Amsterdam

The west ring performs just like in the global integration very well on the local integration. The same applies for Johan Huizingalaan, which performs even better on the local scale than on the global scale. So there are two well integrated streets, although different types, running in the north-south direction. However, in between these two well integrated streets there is a clear break in the urban structure, which is the area around the train line. The zone around the west ring is an area with two large-scale infrastructure lines, namely the highway and the train line. Looking at the space syntax analyses, the train line might be a bigger problem than the highway because the highway is well integrated while the train line only disrupts the urban structure.

There are four streets running in east-west direction which are also very well integrated and some of them run quite well integrated into Nieuw West or the inner city. The areas in between these streets are mostly poor integrated.
**Rotterdam**

The ring road of Rotterdam is not very well integrated. The only part that does well is the northern part. There are some very well integrated streets around this part of the ring road but they are all situated within the ring. All of the area outside the ring is not well integrated, even the A13 running through Overschie.

The same situation can be found in the rest of Rotterdam, the urban area outside the ring is always poorly integrated.

**Utrecht**

The train tracks in Utrecht cause just like in Amsterdam a break in the urban fabric. The interesting thing that because of this break happens is that the streets running parallel and very close to the break, Amsterdamerstraatweg and the Rijnkade, are very well integrated on the local scale.

The ring road of Utrecht is very poorly integrated and the urban area outside it as well. The expansion LeidscheRijnis poorly integrated compared to the innercity.
4.1.8 Conclusion

There are three interesting options for a research and design location. The three options all have clear problems with the ring roads and parallel running infrastructure, excluding urban area from the city within the ring (see illustrations 29-31).

The first one is the west ring of Amsterdam. The urban area comes very close to the highway, closer than in any of the other researched areas. There is a double barrier because of the train line running parallel in the same area. There is a large urban area, Amsterdam Nieuw West, excluded from the inner city.

The second interesting option could be in Rotterdam North where there is an interchange between the A13 and the ring road north A20. The A13 runs through the district Overschie while the A20 is a barrier between Overschie and the inner city. There are also train lines running through the research area causing more spatial fragmentation.

The third option could be the northern part of the ring road of Brussels. Just like in the research area in Rotterdam there is an interchange between a highway and the ring road. The ring road in Brussels excludes relatively little urban area from the inner city but in this possible design location there is an urban area outside the ring road. There is also a canal and multiple train lines going through the area, while there is also an airport situated inside the research area.

These options with obvious challenges have been researched more deeply and the results will be shown in the next section.
4.2 District Scale

4.2.1 Amsterdam Ring West – Nieuw West

The ring road was planned to go around the existing city but when the ring road was actually realised there was a major city expansion build outside the ring road. There is a clear distinction between the typology of old city buildings in the east and newly build expansion in the west. The western part of the ring road is not the only infrastructural barrier in the area, because parallel to the ring road runs a train line. So there is a double barrier between the old city and the expansion Nieuw West (see illustration 32). However, this also creates opportunities because there are some strategic places like train station Amsterdam Lelylaan which is even in the vision of the municipality of Amsterdam a strategic location to invest in (Gemeente Amsterdam, 2012).

There have been already quite some modifications to the building stock in the ring zone. The densification in the researched area already went up, but this still can be improved. The area in the ring zone is considered an urban dump area which lacks structure and the public space does not have a very high quality (Gemeente Amsterdam, Dienst Ruimtelijke ordening, 2013). The buildings are built quite close to the highway and railway, especially on the west side of the ring road. Some of the densification projects were exactly at the western edge of the railway.

There are relatively a lot opportunities to pass the ring road compared to researched areas in Rotterdam and Brussel, although some of those are just for pedestrian bicyclists and not for car traffic. A few of the underpasses are important city roads connecting the old city with Nieuw West, but the municipality realises that the connection between Nieuw West and the city centre is still far from ideal. They hope that new and improved connections between the centre and Nieuw West can lead to new dynamic and new investments in the city (Gemeente Amsterdam, 2012).

The municipality of Amsterdam realises that the (whole) ring zone is a very promising area for investments. There are opportunities to create an attractive urban environment which is important for the inflow of highly educated people. The land prices are relatively low in the ring zone compared to the inner ring area. This means that there is the possibility to have more houses for starters or bigger houses in the middle segment (Gemeente Amsterdam, 2012).

The municipality sees the ring zone as the link between more successful and less successful areas in the city. Improving the link can help both areas, for example the expansion Nieuw West can profit from the successful centre while the people in the centre can profit from the green in Nieuw West. The inner ring area is quite successful, but the accessibility of this area is depending on the ring zone. In the ring zone itself sees the municipality a lot of chances for social and economic improvements and for decentralized energy and district heating. There is room for densification and diversification of functions. There are already some private investors investing in empty office spaces and the municipality hopes this will grow. The municipality wants to create the idea of a sport ax which runs from the old Olympic stadium in the inner city to the bosbaan south of the ring (Gemeente Amsterdam, 2012 & Gemeente Amsterdam, Dienst Ruimtelijke ordening, 2013).
The municipality made at the beginning of the twenty-first century a vision for the city district Nieuw West called Parkstad 2015 (see illustration 33). The vision Parkstad 2015 starts off with explaining the regional position of Amsterdam Nieuw West and relations it has in the Northern part of the Randstad. In the vision is Nieuw West a new centre in the region. The focus in the vision is less on the relation the extension has with the old city. Of course Nieuw West, especially the area around the ring road, is greatly regionally and even nationally and internationally connected, but the relation of the city expansion with the inner city should also be high priority.

The vision is very ambitious with large project areas and a lot of demolish and new building plans. Plans like this cost a lot of money and the municipality of Amsterdam already run out of money for these plans in 2005, thus before the economic crisis in 2008.

In the vision Parkstad 2015 a large part of Nieuw West will get a highly urban character with highly urban functions. Nieuw West is in its current situation mainly has a garden city environment and many inhabitants like the fact that it is a green area. But according to the municipality the popularity of Nieuw West as a residential area is decreasing because it.

The vision provides a task of densification in the area. A densification will also lead to more traffic pressure on the roads while some roads are already acting as a barrier because they are not at ground level but are raised.
The rest of Nieuw West should keep its quiet garden city environment while the ringzone should be a more dynamic living environment.

Relation with City

In the vision, the relation between Nieuw West and the city centre is strengthened. The Sloterplas should be easier accessible for the people living in the inner city. This way Nieuw West also has something to offer for the inner city and not only the other way around.

Public transport

In the current vision (Gemeente Amsterdam, stadsdeel Nieuw-West, 2013) there are options to extend the public transport network. There is the suggestion of a new metro line running from the city centre to the Osdorp in Nieuw West and possibly even further to Schiphol (see illustration 34). There is also a suggestion of a new train station on the already existing line between Amsterdam Le-lylaan and Amsterdam Sloterdijk. The proposed train station would come at the Jan van Evertslaan, as close to the Sloterplas as possible. The station should make the Sloterplas better accessible for people to visit, making it a attractive place to visit.

Dynamic Living Environment

In the vision about the city district Nieuw West there is a proposed difference in living environment in the ringzone and the rest of Nieuw West.
4.2.2 Rotterdam Overschie

The researched area is a very fragmented area with several types of infrastructure dividing it. There is a crossing of two highways, three train lines coming together and a canal running parallel to the ring road. There are fewer underpasses in the researched area in Rotterdam than in Amsterdam because there are fewer underpasses just for pedestrian and bicyclists. And even if you cross the highway via an underpass you have not passed the parallel running canal yet. Crossing the canal is the bottleneck in going from or to the area outside the ring (see illustration 35).

The age and type of buildings is clearly different outside and inside the ring road just like in Amsterdam. However, unlike the situation in Amsterdam the two different urban areas are not situated right next to each other. There is a zone where there are no houses nor offices or businesses, but amenities like the zoo Diergaarde Blijdorp, sport facilities, allotments, a park and a prison.

Although there are multiple train lines going through the researched area, there is no station for them in the area. Besides the lack of train station, there is also a lack of other high quality public transport like a metro or rapid bus line.

The airport of Rotterdam is situated north above the researched area, placing the researched area in between the airport and the city centre. The municipality of Rotterdam has an important role for the airport in mind because they want to create a science park called Science Port Holland around the airport. The municipality sees the location around the airport as a strategic location between the universities in Rotterdam and Delft.

The municipality of Rotterdam does not have a lot of plans or visions for the researched area. It is only part of the connection of the centre with the recreational areas outside the city (Gemeente Rotterdam, 2007). But since the area is also situated between the airport and the centre and the connection between the two areas is not good, the plan area could be a link between the centre and the airport.

Although the researched area does not come up much in the vision of the municipality of Rotterdam, the municipality realises that the living conditions around the highways is not very good, especially in Overschie which is crossed by the A13 (Gemeente Rotterdam, 2007).

There can be doubts about the possibilities that can be done in the researched area in order to solve the problem of the barrier. There is no possibility of tunnelling the ring road because there is an interchange with another highway. It might be possible to relieve the pressure of the A13 running through Overschie, but this highway is not a heavy barrier in Overschie. The focus on this area would be about how to handle values of certain functions and areas.
In the visions the municipality made for Rotterdam there is very little about the researched area. There are a lot of ideas for areas in close proximity like the city centre, the airport and other residential areas in Rotterdam north (see illustration 36).

The municipality wants to increase the attractiveness of Rotterdam as a residential city. There are some areas selected where there should be an increase in an attractive residential environment. Among these selected areas are Groot Hillegersberg in Rotterdam north, Groot Kralingen in the east, the centre, areas next to the river (on both sides) and around the Zuiderpark. The residential area in the researched area is almost not included so it is not an area in which the municipality sees a lot of potential.

The municipality does realise that the ring road causes problems with air pollution. The same goes for the A13 in Overschie for which the municipality thinks that the living quality should be increased.

The municipality has an important role for the airport in its vision. They want to create a new high quality science and business park called Science Port Holland next to the airport. This science and business park should be accomplished in co-operation with the universities in Rotterdam and Delft. There should also be space available for other high quality airport related businesses. The area has a great connection to networks in the Randstad but the connection with Rotterdam itself could and should be much better. The public transport connection is not sufficient and should be improvement from which also Science Port Holland and neighbouring residential areas could benefit. However, at the moment it is not clear how this is going to be realised (Gemeente Rotterdam, 2007).

The researched area lies between the airport and the city centre, two important areas for Rotterdam which are not very well connected. Maybe the area could play a role as a link between the two areas (see illustration 37).
4.2.3 Brussels North

The urbanised landscape is clearly fragmented by different infrastructure coming together. Besides the ring road there is also a perpendicular highway crossing the ring road, there are a lot of train lines, some n-roads and a canal causing fragmentation in the area (see illustration 38).

The functions in the researched area are mixed up. The area along the canal is occupied by old industry which is deprived and does not have good spatial quality. At the same time there is an international airport in the area, separated by infrastructure and a small residential area from the old industrial area. There is no coherent plan for the area and it is a patchwork of areas which most of the time have no relation with each other.

In the municipality of Machelen is a big shopping mall called Uplace planned. The shopping mall will also include public space like roof gardens and entertainment industries like an amusement park, fitness centre, cinema/theatre, bowling and bars as well as a hotel. There will also be a 92 metre high skyscraper with offices in it. This will all be housed at 190,000 m² floor area which is 30,000 m² more than the recently opened ‘de Rotterdam’ which is the biggest building in the Netherlands measured in floor area. Uplace is planned in the old deprived industrial area with low spatial quality and which needs an upgrade (Uplace Brussels, 2013).

The question that can be asked now is what an enormous project like this will add to its surroundings. The spatial quality of the area is poor at the moment, but will a project like this have a positive impact on the spatial quality or will it stay as it is? Will there be room for new functions in the area or will the need
already be completely fulfilled by Uplase? If so, what good is a big deprived area where most of the buildings are not in use anymore but where there is one spot where all the live is? Would it not be more important to make a plan for the whole industrial area instead of having one individual project that has no relation with its surroundings? This is also realised by Peter Swinnen (2013), Vlaams Bouwmeester, who compares Uplase with ‘a black hole that is sucking up all the energy’ and thinks that this type of projects that happen without good planning and consultation between all the parties is something of the past. Besides Uplase, there are two other similar projects around the northern ring of Brussels: project “Neo” and project “Just under the sky”.

The residential area of Vilvoorde lying next to the ring road has only one underpass to the other side of the highway besides the R22. There are more ways to cross the R22 to the old industrial area than there are to Brussels. The R22 has also more underpasses than the ring road when the two are running parallel to each other.
The plan area is divided into 2 regions, Brussels Ge-west and Vlaams Gewest, which are then divided into three different municipalities, Haren, Vilvoorde and Machelen (see illustration 40). The ring road mostly runs through Flemish territory although there is a small part running over Brussels territory. An example of the complicated situation in the area is the airport. The airport is also not situated completely in one municipality but the border runs across the airport.

This political chaos will be a major part of solving the issues in the area, because a coherent plan will run over the borders.
Vision maps

There are not only different municipalities in the researched area but also two different regions. There is the Brussels region, which includes nineteen municipalities, and the Flemish region in which both Vilvoorde and Machelen lie. This governance diffusion is also reflected in the plans made for the researched area.

When the Flemish government makes a vision, strategy or spatial structure plan for its land than the area of the Brussels region is left out because the Flemish government has nothing to say there (see illustration 41). But in reality there is of course a relation between the two areas. The area on Flemish soil close to the Brussels region is strongly influenced by Belgium's biggest city and capital. Besides being the capital of Belgium, Brussels is also the capital of the EU and has the head quarters of the NATO. Brussels has the most office space of all cities in Belgium, so the municipalities around the Brussels region strongly relate to it. Having a vision for the municipalities around the Brussels region without the Brussels itself in it seems not very handy.

Machelen has made a vision that includes the researched area. One of the things the municipality wants is to create a green structure around the R22 (Gemeente Machelen, 2008). The question is how this green area is going to be because it will be hard to make this a quality zone where people come to enjoy the green if its next to a very busy street.

Vilvoorde has not much to say about the researched area. It says that the area next to the ring road should (or could) be upgrade but it does not say how. Saying that something needs to changed is easy, the more important question is how to change it into something desirable (Stad Vilvoorde, 2008).
4.2.4 Scale Level Comparison

The three researched areas are also compared at the scale level the areas and infrastructure function on (see illustration 42).

**Amsterdam**

In Amsterdam west there is a mix between city/regional connection and city district connection. There are two parallel large-scale connections running north-south and one east-west connection (the A4 linking in the ring west). The city district connections are all running in the east-west direction. The question is if the city district connections are functioning good enough.

The amenities operating on the large scale are located in the south next to the A4/Ring road south. The area in between the two parallel large-scale connections is quite mixed up, but there amenities that operate on a bigger than local scale but not on the large scale.

**Rotterdam**

The connections in the plan area in Rotterdam are less organised compared to the plan area in Amsterdam. They create a chaotic area with in the middle a national important function: Diergaarde Blijdorp. Around it are amenities that operate on the city or district scale, a park and sport facilities.

There is a lack of City District Connections in the plan area.

**Brussels**

The connections in the plan area in Brussel are maybe even more chaotic than in Rotterdam creating a fragmentised landscape which is reflected on the scale levels the areas operate. Noticeable there is a lack of area which functions on city district scale. There is an old business area close to the canal which operates on the city/regional scale, although not very well at the moment because it is old and deprived. Then there is the airport which is operating on international scale and in between there are areas which only operate on the local scale.
Conclusion comparison

All the five cities have their own problems with their ring roads.

The case of Amsterdam will be about spatial qualities, structure and integration of local structure and a (new) train station. The space syntax model shows that there is a disruption in the local structure and the integration of important streets could be better. The spatial quality in the area is not very good and could be improved. The existing train station in the area is not well integrated and the question is if the proposed new train station is at the right place. Adding a new train station also gives a lot of opportunities to the area.

The case of Rotterdam will be about the value and experience of functions and the connection of Overschie with the centre. Blijdorp is a nationally important function and together with the park next to it, it is a green area that is important to the whole city of Rotterdam. The A13 running through Overschie is not a very bad example of how large-scale infrastructure can be integrated while it also improves the connection of Overschie with the city centre.

The case of Brussels will be about governance, structure, spatial quality, regenerating industrial areas. One of the main problems in the researched area of Brussels is that it does not belong to one municipality or even one federal government. This is reflected in the current situation and it is something that has to be taken into account if this researched area would be the design area.

The case of Antwerp can be used as a reference project of how the space around the ring road can be used as a quality. The project ‘Groene Sin-
5. Criteria Barrier

The problem stated in this paper is about the fact that large-scale infrastructure is meant to connect on a large scale but can acts as a barrier on the small scale. A barrier is a physical structure that can obstruct or impedes something or someone. That can cause problems for people living on one side of the infrastructure while it might be valuable to be connected with the other side.

Besides being a barrier, large-scale infrastructure can have also influence on its surrounding urban landscape by causing spatial fragmentation. The infrastructure might also cause problems with the perception of people even though there is no actual physical problem.

5.1 Barrier

Elevation of the infrastructure

If the infrastructure is at ground level it is easier to cross, a difference in height works more as a barrier, it also makes a difference whether the infrastructure is elevated or lowered because an elevated infrastructure also is a visual barrier besides being a physical barrier. If the infrastructure is lowered and placed in a tunnel there is no air pollution in the surrounding area, only at the start and ending of the tunnel where the air pollution is actually a bit worse (van der Hoeven, 2001, p355). Lowered infrastructure is also less of a visual barrier.

In the analyses of the five different cities in Belgium and the Netherlands as described in section Design Case Study, it was also researched whether the ring road was either raised or lowered. In the case of Utrecht the highways are actually partly placed in a tunnel at the place where it divides the latest expansion Leidsche Rijn and inner city. Amsterdam and Rotterdam have mostly elevated ring roads (illustration 43).

The ability to pass the infrastructure

A barrier is something you cannot pass. The ability to pass the infrastructure makes the infrastructure less of a physical barrier. If there are very little opportunities to pass a long line of infrastructure than the barrier effect is bigger.

For example, the ring road of Amsterdam has a lot of underpasses while the ring road of Rotterdam has a lot less connections because there is also the canal acting as barrier (see illustration 44). The ring road of Amsterdam has especially a lot more underpasses which are only meant for slow traffic, meaning it is less of a barrier on the smaller scale.

What is the quality of the connection?

The amount of connections under or over the infrastructure is important, but the quality of these connections is just as important. In order to create a well functioning connection the experience of the connection should all right. For the right experience it is important that the spatial quality is good, that there is liveliness on the street level and that it is clear where to go. The connection does not work if people have to search if and where there is a connection. The connection itself should show the way. The spatial quality and liveliness have a relation, for example in the relation between the buildings and surrounding space. A modernistic building with storage space on the ground does not gives spatial quality and liveliness.
**Border Conditions**

There is a transition between the infrastructure and its surrounding space. The way this border is designed can either enhance or reduce the barrier effect. There are many situations where the spatial quality right next to the infrastructure is poor, which turns people away from the infrastructure and therefore enhancing the barrier effect.

Where most researched cases have ring roads with borders that have low spatial quality (see illustration 45), there is one case where this is not true. The ring road in Antwerp is embedded in a green landscape and the municipality wants to actually use this landscape in a way that it gives an extra quality to the surrounding areas (see illustration 46). This means it could actually attract people to the area and therefore reducing the barrier effect.

In Amsterdam the situation is differently because the ring road of Amsterdam is very closely surrounded by the urban landscape, especially at the west ring. This means there is less space occupied by the infrastructure. The southern part of the ring of Rotterdam is the opposite of the situation in Amsterdam because it has a big empty space around it. This makes the barrier a lot widener (and therefore bigger) but maybe there are also less people directly affected by it.

**Noise**

Large scale infrastructure projects like highways or railways are meant to be a fast connection. But travelling at high speed also causes a lot of noise nuisance. This is caused by two things, one is the fact wheels rolling on a surface always create noise and the second thing is the sound the engines make. This last problem will be less in electrical engines than a combustion engine. Trains have electrical engines but since they are much bigger and heavier than cars or trucks they create more noise with rolling resistance.

There are innovations in the automobile industry creating the possibility that in a few year cars with electrical engines will be commonly used instead of cars with combustion engines. This will lead to a decrease in noise pollution of highways although it will not be completely quiet because the rolling resistance will still cause noise.

Although noise can be very irritating, it is also something people can get used to. People living next to a railway stop hearing the passing trains after a few days. It is also possible to technically adjust buildings to reduce the nuisance inside the buildings.

**Air Pollution**

Vehicles running on combustion engines produce toxic exhausts. The exhaust increases with an increase in speed of the vehicle and since highways are the roads with the highest speed limit they also have the most toxic exhaust. The Dutch government recently raised the speed limits on several highways, including some ring roads. Several highways have now a speed limit of 130 km/h. The A10-West has its speed limit increased from 80 km/h to 100 km/h. This decision increases the amount of toxic exhaustion produced at highways and therefore has a negative effect on its surroundings. That is why there is now also critique at the decision to increase the speed limit. (News article nu.nl)

In the researched case of Amsterdam the building environment is build very close to the highway (see illustration 47). This means that the impact of the emission is much higher than in a situation where the urban landscape is far away from the infra-
structure. Placing the highway in a tunnel can help to locally reduce the exhaustion but this has as a side effect that the concentration of exhaust fumes is increased at the entrance and exit of the tunnel.

**Ecological Barrier**

Infrastructure can also work as a barrier for ecological processes, not just for people. Just like people the infrastructure can obstruct animals from going to the other side of the infrastructure.

It can be an interruption of an ecological area or corridor and just like humans animals have difficulty crossing it.

### 5.2 Spatial Fragmentation

**Disrupting Local Connections**

Large scale infrastructure is meant to connect on a large scale but this can cause a disruption on the local scale. It can be that local scale connections are made impossible because the large scale infrastructure is physically in the way. Illustration 48 shows a very interesting example of this phenomenon where the railway in the centre of Utrecht breaks up a lot of local connections.

**Focus on the large-scale connection**

It is also possible that everything in the surround is also possible that everything in the surrounding area of a large-scale connection is focused on that same large-scale connection and that there is little attention paid for the small scale qualities. This can for example result in amenities that function on the large scale like shopping malls (see illustration 49). These amenities have to be easily accessed by large scale transportation modes, like cars, but do not require a very good connection in the urban fabric for slow traffic like pedestrian and bicyclist. The spatial quality is also not that important for these large scale amenities while this very important for the small scale. Having a large-scale connection does not mean that an area is well connected (only the large-scale) and that everything is fine now. People live in and experience the small scale everyday and therefore this scale is important as well.

A large scale connection means a connection to other areas which are also part of the large-scale network. This results in a patchwork of areas that belong to this large-scale network, extending over regional, national but also international distances. But when everything in an area is focussed on the large-scale connections, there can be a strong sense of local disconnections even though the places can be physically close. (Graham & Marvin, 2001)

**Functions around the infrastructure**

There are many situations where in a city the less quality functions are placed away from the urban area next to the large-scale infrastructure. This is done because the functions are not desired in the urban area and the space around the infrastructure can also be an undesirable place. However, by doing so the space around the infrastructure becomes even less desirable and therefore enhances the barrier effect.

For example, in the case of Brussels there is old industry around the ring road (see illustration 50). This area is an area where people go away from and is not a desirable place at all. Another example is Rotterdam where there are parks and sport fields placed near the infrastructure. These are not functions that drive people away, as a matter of fact it attracts people. In the strategy for Leidsche Rijn in Utrecht
the parks and sport fields are placed in the centre of the urban area. However, these type of functions are not always in use and there are times when there not a lot of people there, reducing the social control. If someone has to pass this area at such a time it can feel unpleasant and because of that it can enhance the barrier effect of the infrastructure.

**Spatial Quality surrounding space**

The way the urban landscape around the infrastructure is filled in can either increase the barrier or it can soften the barrier. If it is space where people want to be away from than the infrastructure is a stronger barrier while if it is a place where people want to come to, the barrier is no so strong anymore. This aspect has a strong link with the previous aspect because functions influence the spatial quality.

The surrounding landscape can not only create a situation where the barrier side effect of large-scale infrastructure is enhanced but it can also go the other way where the barrier has a negative effect on its surroundings. The other aspect mentioned in this paragraph can create a situation in which the surrounding urban landscape is not an attractive or desirable landscape. This can lead to a degeneration of the spatial and maybe functional quality of the surrounding area, therefore enhancing the effect of a barrier.

5.3 Psychological barrier

*Can you enter the barrier?*

There can be a difference in the degree of accessibility of infrastructure. A highway is a controlled-access road which can only be entered at few access points where there are slip roads connecting the highway with the urban traffic network. The highway is only accessible by limited types of road user, fast motorised traffic like cars, buses, trucks or motor cycles. That is a different type of barrier than a busy urban street which has a lot of car traffic as well but also has a bicycle lane and a side walk for pedestrian. This makes it accessible to almost all traffic users and makes the road part of the network for everyone.

A railway is only accessible at a certain place and a certain time, it is only accessible at the train station where you can step into a train according to the time schedule. You cannot use the railway by your own with your own transportation mode.

If the infrastructure is not useful for the people living close by than those people will feel worse about the infrastructure than if it is useful for them.

*How do people perceive the area on the other side?*

If people are on one side of the infrastructure and there is something useful for them on the other side of the infrastructure like work or recreation than the infrastructure can feel as a barrier for the people. If there is not something useful on the other side of the infrastructure than the same infrastructure will not be perceived as much as a barrier.

*Safety*

Feeling safe or unsafe in a urban environment is a psychological aspect. Even though there might not be anything actually dangerous in a certain place, the place can feel unsafe. As discussed earlier in this section, large-scale infrastructure can have a big influence on its surroundings. The spatial quality can be degenerated, there can be low quality functions around the infrastructure and in order to pass it one might have to go through a tunnel. These are all aspects that might make an environment feel unsafe. For example, if there is low quality industrial area next to the infrastructure just like in the researched area in Brussels, than there will be almost no activity in the area after work hours. If you have to pass this area while you are driving a car then it is not that bad. But if you have to pass it as a pedestrian or a bicyclist then it is not very comfortable.

Another example is the southern part of the ring road of Rotterdam. There is a large space between the ring road and the urban area, basically a no-man’s-land (see illustration S1) and this makes it much less attractive to pass. So if one has to take a route through an unsafe feeling area in order to cross the infrastructure than people will less likely do this and the infrastructure has a stronger barrier effect.
These are the fourteen criteria that determine if and how large-scale infrastructure can work as a barrier. These fourteen criteria are not always and in the same intensity present in, depending on the situation some criteria are more or less present. This is important because not each aspect is solved by the same type of interventions. These criteria can be used as a framework in analysing the problems caused by large-scale infrastructure in urban landscape. In the section Toolbox will be described what the tools are that can be used to solve these criteria.
6. Strategy and concepts

Three strategies to overcome the barrier effect of large-scale infrastructure have been looked into.

6.1 Utrecht Leidsche Rijn

There are a lot of situations where the areas around the ring roads are filled in with left over or low quality functions. One can find sport fields or green zones around the infrastructure but are they really second grade functions? In the case of the expansion Leidsche Rijn in Utrecht the area around the ring road is meant to become the new urban centre of the expansion.

The first step in achieving this goal is to put the highway A2 which lies between the city expansion and the old city underground in a tunnel. There is a train line going from the existing city to the expansion and the place where the highway and the railway cross is the location for the ‘second city of Utrecht’. The centre should not only attract visitors from the Leidsche Rijn but from whole Utrecht and the Randstad. This should be possible because it is placed at a very strategic location with both the highway and railway network very close by creating excellent accessibility. The train station is the place where all the different transportation modes connect, including the slow traffic modes. In the public space the slow traffic modes are put first and the design of the public space should be of high quality.

The centre should get a highly urban and multifunctional character with shops and with nightspots. The density should be high, just like the buildings. This is different from the rest of the Leidsche Rijn which has a highly residential character where there is much more green. The green and sport facilities are situated in the middle of the expansion making it accessible for all inhabitants.

So instead of placing the green and sport facilities on the edge of the area close to the ring infrastructure the green and sport facilities have been given a central spot in the area. On the edge of the area, between the expansion and old city, a new city centre will be created which should attract people from both sides. (Gemeente Utrecht, 2013)

6.2 Antwerp

The municipality of Antwerp has made a vision ‘Masterplan 2020’ and including this vision is a strategy for the ring road called ‘the Green Single’ (de Groene Single). This is an area where there was until 1906 a wall for military reasons. There have many plans for this area ever since (for example by Neutelings in 1988, see illustration 54) but the only thing that really happened was the ring road. The ring road is relatively broad, but embedded in a green zone. There is a large space around the highway which is still unbuild.

The municipality sees this space as underused and fragmented but recognises its potential to connect the inner city and the outer city. Because the ring road of Antwerp is relatively small there is a lot of urban area on both sides around meaning there are a lot of inhabitants living in close proximity of the ring zone. There are 155 000 people living within an 800 metre distance of the ring zone, so a large part of the inhabitants could actually use the space once it has a better quality.

The space around the infrastructure could be used as a quality for the people, a place which is open and transparent. For the inhabitants in the ring zone the project will not be planned as one big project but rather as several public and private project taken in steps. This should result in a ‘Green River’ which integrates all the infrastructure systems in the landscape (see illustration 55). It is a good example of how a space can become a place where people want to go to instead of turning away from. (AG Stadsplanning Antwerpen, 2013)
6.3 Delft

Delft has train lines going right through the city where the part right in the middle of the city is placed on a viaduct. In the current situation the space under the viaduct is mainly used for parking. This railway is an important line in the Dutch railway system because it is the connection between two major cities, Rotterdam and The Hague.

There are two major problems with this railway, the first problem is that the railway is a barrier in the city of Delft. It causes spatial problems and divides the city in fragments. The second problem is the capacity of the railway with only two rail tracks at some points is barely enough in the current situation to connect Rotterdam and The Hague. In order to have enough capacity in the future the amount of rail tracks should be extended to four rail tracks which is impossible to do in the current situation. The solution is to build a tunnel for the rail tracks and demolish the viaduct once tunnel is put into use. Once finished the tunnel will be 2300 metres long right next to the inner city.

The entire project consists beside a railway tunnel out of a new railway station, new municipal office, 1200 new dwellings, new office buildings, a park, facilities for parking and bicycles and roads on an area of around 40 hectares. This is all situated very close to the inner city. Although there will be a new train station with the new municipal offices in it, the old station will not be demolished and will be given a new purpose.

The tunnel will go under the streets Phoenixstraat and Spooringsel (see illustration 56) which will get a new canal in order to create a better spatial quality. The Phoenixstraat was a busy street with a lot of car traffic but will be downgraded although it still will be accessible for trams, busses and local traffic. To downgrade the Phoenixstraat there will be new accessed roads made which will a single lane in each direction. An underground parking will be build under the Spooringsel where it will lay next to the railway tunnel. The ground above the southern part of the railway will also get an upgrade in spatial quality. A city park will be built here which will include open water elements that will help with storing water.

In the current situation the rail zone is a barrier separating city districts from each other. In the new situation the area will have a high spatial quality and be a connection between the city districts that used to be separated. Just like in Antwerp, the idea is to create a zone where people want to come instead of turning away from (SpoorzoneDelft, 2013).
7. Location Analyses

The location is the ring zone around the West ring of Amsterdam. The Space Syntax model showed that the western ring road is actually well integrated. The same goes for the Johan Huizinga street, running west parallel to the train lines. There is a break in the urban fabric where the train line is running (see illustration 57). The proposed new train station is situated at the Jan Evertsenlaan.

The research area will be in the area around the train line in the western ring zone of Amsterdam. The focus will be on the area between the Johan Huizingalaan and the A10, but the areas on the other sides of these roads will also be taken into account (see illustration 58).
The building blocks in the research area are mostly open building blocks, as opposed to the closed building blocks in the old inner city (see illustration 59). The area in between the highway and the railway is mixed up, both in structure as in functions. There is a wide variety of functions in the area, from very local scale shops like greengrocers to large scale functions like the World Fashion Centre.

The train station Amsterdam Lelylaan is the place where the large-scale should meet the local scale. It is questionable if that really is the situation now. The fact that the street Lelylaan is partly elevated is also not helping in local connections. There is very little activity around the station because there are very few amenities around it (see illustration 59).

The proposed new train station lies at the Jan Evertsenstraat which is a less busy street than the close by Jan van Galenstraat (Gemeente Amsterdam, stadsdeel Nieuw-West, 2013). The situation at the proposed location is in the current situation not a place with a lot of activity around it. There is a workplace for the public transport company next to the location but that is hardly a high quality function. The proposed location is the closest place on the train line to the Sloterplas. Adding a train station close to the Sloterplas could attract more people to visit the Sloterplas which would be a good thing for the people outside the ring zone and Nieuw West (Gemeente Amsterdam, 2012). So what does the station have as added value for the inhabitants in the area? Could this station be a step of improvement or would another location (for example at the Jan van Galenstraat) be better for the inhabitants?
The municipality of Amsterdam provides data that they have placed on top of a map.

Dwelling Value

The map of the municipality (Dienst ruimtelijke ordening gemeente Amsterdam, 2013) shows that there is a clear distinction in dwelling value between the outer ring area and the inner ring area (top map of illustration 60). The map shows the amount square metre dwelling you can buy for €250,000, the darker the blue is the less space you can buy (thus the price is higher). With only very few exceptions the area west of the ring road is coloured red while the eastern area is mostly blue. Although northeast of the Rembrandtpark the prices are a bit lower than the rest of the inner city there is a very clear difference between the inner and outer ring city.

Residential density

Looking at the residential density (Dienst ruimtelijke ordening gemeente Amsterdam, 2013) there is also a clear difference between outer and inner city. This has of course a lot to do with the fact that the inner city has mostly closed building blocks while the outer ring area has mostly open building blocks (see illustration 60).

Non residential functions

In and around the ring zone are quite some non-residential functions although it is definitely not as widespread as in the inner city (Dienst ruimtelijke ordening gemeente Amsterdam, 2013).
Businesses with 1 employee

There are not much independent businesses in the ring zone compared to inner city (see top map of illustration 61) [Dienst ruimtelijke ordening gemeente Amsterdam, 2013]. The area between the highway and the railway has a bit more than the area west of the railway.

Empty office space

In the western ring zone there is a lot of empty office space around the train station Sloterdijk and on the south edge [Dienst ruimtelijke ordening gemeente Amsterdam, 2013]. This is a general trend in the Netherlands because there is simply too much office space available.

Green structure

There is a lot more green structure in the outer ring area, especially in Nieuw West [Dienst ruimtelijke ordening gemeente Amsterdam, 2013]. This is a quality which the inhabitants of Nieuw West appreciate in their living area. This map also explains why the municipality of Amsterdam is interested in connecting the Sloterpark better with the inner city because it has a quality which is not really found in the innercity.

Noticeable is also that the green around the railway also is drawn as part of the green structure, while it is not really usable for recreation.

One person households

The map showing the percentage of one person households is quite monotonous because most of the area on the map has over forty percent of the people living in a one person household. There are a few small exceptions with the most noticeable one in the research are right next to the railway.

Average household size

The average household size is bigger in the research area than in both the inner city and in Nieuw West. There is a small peak in the middle of the research area and the cause of this peak is shown in the next map.

Households with children

The average household size is of course caused by the amount of children. So the map showing the percentage of households with children has a lot of similarities with the map showing the average household size.

One parent household

The map showing the percentage of households with children with only one parent in the household shows another difference with the research area and its surroundings. Compared to the surrounding neighbourhoods in the inner city and Nieuw West, the research area has a relatively high percentage of one parent households.

Children under 14 years

The research area has relatively a lot of children younger than 14 years. This map is a bit comparable with maps showing the average household size and the households with children for obvious reasons,
Elderly above 65 years

The percentage of elderly above 65 years (from that age most Dutch people are retired) is very low. In most of the research area there is less than five percent of the inhabitants over 65 years old. There is one small peak just south of the Potjesweg where there is between twenty and twenty-five percent of the inhabitants above 65 years.

Non-Western immigrants

There is a very clear distinction between the several areas. In the ring zone and Slotermeer there is more than fifty percent of the people of non-Western origin. This opposed to other areas where the people of non-Western origin are less than twenty percent of the people. Especially in the inner city around and east of the Vondelpark there live very few people of non-Western origin, less than ten or sometimes even less than five percent. In the research area there is only one small area which has a bit lower percentage of people from non-Western origin (ten to twenty percent). This area has a lot of new buildings which might be the cause of this difference.

Average income per person

The map showing the average income per person shows an almost mirrored map of the previous map showing the people of non-Western origin. The highest income is around and east of the Vondelpark while the ring zone and the Nieuw West have low income people. In the ring zone there is one small exception, the area where the percentage of people from non-Western origin is lowest, the income per person is highest.
Nuisance

Noise train traffic

The train line in the research area causes relatively little noise compared to the train line in the south (illustration 65). There are two small peaks, one around train station Lelylaan and the other one in the area where the proposed new train station could come.

Noise nuisance traffic 24 h

The map showing the noise nuisance caused by road traffic (illustration 65) shows the most important roads in the research area like the Lelylaan, Jan van Galenstraat en Jan Evertsen staat. There is an interesting difference between the old inner city and the newer outer city because in the inner city the density of roads with high levels of noise nuisance is quite high. However, the noise nuisance does not spread out and remains close to the street it is caused by. This is the opposite of the outer city where the density of streets with high levels of noise nuisance is relatively low but the noise is much more spread out (yellow area). This happens because the closed building blocks close to the street in the inner city contain the noise while this does not happen in the newer areas.

Emission road traffic

The particulates measured in Amsterdam (illustration 66) and the nitrogen dioxide background concentration (illustration 66) are both denser in the inner city than the outer ring city. Looking at the nitrogen dioxide concentrations in illustration 66 however, it is very obvious that the highways in Amsterdam including the west ring stand out negatively.
Vision Municipality and City District

The vision of the municipality and the city district for the ring zone has been described in the section of the design case studies. Here is a small recap. Amsterdam will need to build more houses within the current borders in order to meet the demand. The best areas for developments and densification can be found in the ring zone. The city district of Nieuw West also sees opportunities for development in the western ring zone where they want to create a dynamic living environment (which the current situation is far away from) and they research the possibilities for a train station in the area.
**Public transport lines**

The map in illustration 73 shows the tram and metro lines in the research area. The metro line runs in north south direction, parallel to the railway. The tram lines run in east west direction, connecting the inner city with Nieuw West.
1. Jan Evertsenstraat Source: maps.google.com
2. GVB Workplace Source: Author
3. Derkinderenstraat Source: Author
4. August Allebéplein Source: Author
5. Rembrandtpark Source: maps.google.com
6. Johan Jongkindstraat Source: Author
7. Lelylaan Source: Author
8. View on train station Lelylaan Source: Author
9. View from metrostation Heemstedestraat Source: Author

Illustration 74 Photo’s research area
The spatial quality in the research area is not always good. There is a lot of space between the buildings which sometimes lead to feeling that the human scale is forgotten. This is not only around the large-scale function the World Fashion Centre (photo number 10 in illustration 35) but also around the very local functions like the small grocery and food shops around the August Allebéplein (photo number 4 in illustration 74).

Next to the train station Lelylaan is a large open lawn. One would expect that around a train station the density would rise but in this situation there is large space next to the station where nothing is happening.

There is a mix of functions in the research area, there are very large scale functions like the World Fashion Centre as well as very local scale functions (although not a lot) and city scale functions like hospitals (see illustration 59) and the public transport workplace. The latter is situated next to a hospital and in close proximity to the proposed location of the new train station.
In the research area there are several places where infrastructure can feel as a barrier. This is of course the case with the ring road and the train line but there are also some other situations in the area where it happens. The street Lelylaan is a very wide four lane street with in between the lanes two tram tracks (see photo 6 in illustration 76). The street is partly elevated, of course when it goes to the ring road but also west of the train line is the street elevated. This is a remaining of the city planning ideas after the Second World War in Amsterdam. It is very questionable if the elevation is still a good
idea. There is a green structure at the border of the Lelylaan which shields the street from the urban landscape, but this also widens the area between the urban landscape on both sides of the street. The Jan Evertsenstraat also has a green structure as a border (see photo 3 in illustration 76). In this situation there is also water next to the green structure.

The question is if the Lelyaan need to be this wide with this many lanes in order to still function properly as a city ax and connection between Nieuw West and the inner city.
Leefbaar Maps & Analysis

The leefbaar map is a map showing what the perceived liveability of the inhabitants is, based on a set of selected criteria. The results are put in a chart and mapped out. In the map is dark green very positive, light green is positive, yellow is negative and red shows very negative.

The result of the leefbaar map of the research is compared with other analyses to see if there is a spatial relation with the results in which a strategy and/or design can help.

Leefbaarometer chart

The leefbaarometer chart (Illustration 78) compares the results on an area to the national average, going from minus 50 to plus 50. A score of 0 means it is on the national average, a score above 0 means it performs above average while a score under 0 means it performs below average.

The leefbaarometer chart shows that the research area performs very badly in most aspects compared to the national average. The housing stock, the composition of the population and the safety all have scores close to the minimum. The social coherence performs under par as well. The only aspects that do (slightly) better in the research area than the national average are public space and the level of amenities. The score of the public space shows a positive trend in the last years while the level of amenities is decreasing.

On the selection of aspects can be some discussion because it is doubtful if these aspects cover the whole wide range of liveability. For example, aspects that have something to do with health are not part of the leefbaar research while they probably will have a big effect on the outcome. Living next to a polluting highway has a negative impact on the health of the surrounding inhabitants (Novum/ANP, 2013) so it would be strange if this does not affect the liveability. Infrastructure can also cause noise nuisance which is also not included in the leefbaarometer.
Leefbaar Map research area

The leefbaarometer map (illustration 79) shows a big difference between the area in the inner ring city and the area in the outer ring city. The inner ring city performs much better than the outer ring city while the areas are so close to each other. A very large part of the outer ring area is coloured yellow, meaning it is performing under par. Within the yellow areas there are also some smaller red areas, which is probably caused by demolition of buildings. When buildings are demolished this has a negative effect on the liveability that can last to five years. But even without this negative effect the areas are under performing without taking the nuisance into account.

There are a few exceptions in the research area which perform alright. These areas exist out of new buildings (see illustration 87) and as a result there live people with a higher income level (see illustration 64).

There might be a relation between the spatial arrangement and the results of the leefbaar map, as well as a relationship between the relation of buildings and their surroundings. Therefore, these aspects have been researched and mapped and
**Plinth analysis on map**

This map (illustration 80) shows what happens on the plinths of the buildings in the research area and how that is perceived from the outside. The modernism movement brought a building type that did not have houses on the ground floor but instead other functions like storage spaces with no windows. This has an effect on the outdoor space which is now looking at a dead wall.

The map shows for each street what happens on the ground floor on both sides of the street. The closed lines show that both sides of the street have the same type of plinth, either with houses, functions (like offices or shops) or nothing (dead walls). The dotted lines show that one side of the street has either functions (red) or houses on the ground floor while the other side of the street has a dead plinth.

It is clear that most of the research has at least on one side of the street a dead wall. With a dead wall there is no social control and it can feel unsafe.

**Entrance situation on map**

The amount of entrances in a street says something about the liveliness and social control in a street. When there are many entrances in a street there is much more social control which means that it will be more difficult to break in and people might feel safer entering a building in the late night.

The map (illustration 81) shows what the density of entrances is in each street. It is clear that there are only a few places where there is a high density of entrances, mostly in the new build residential areas. These areas also perform well on the Lee Barometer map.
**Cul-de-Sac**

Cul-de-sacs are used many times in residential areas because it creates a quiet living environment which belongs more to the people who live there than to outsiders. This happens because there is no going through traffic so the place is secluded. However, there are also situations where the cul-de-sacs do not work because the lack of going through traffic (both slow and fast) also means there is less social control from this going through traffic which means all the social control has to come from the people who live there. If the situation around the cul-de-sac is not optimal than this is difficult to do and there might be problems.

Both in the well perceived and bad perceived areas outside the ring road there are cul-de-sacs. That means that it is not necessarily related to a cul-de-sac. However, if the previous analyses about the plinth situation and the entrance density are included there is a trend visible. If the plinth situation and entrance density is positive than the cul-de-sac is positive, while if the plinth situation and entrance density is negative than the cul-de-sac is negative as well.

**Conclusion**

Plinth situation and entrance density have a negative influence on the liveability. This effect is strengthened when this situation is found around places with cul-de-sac. This happens because there is no going through traffic and no social control from the buildings.
The sections of the Jan Evertsenstraat between the highway and the railway show some interesting issues. The first noticeable thing is the width of the street which is quite big. This has to do with all the different types of transport lanes going through the street with two bicycle paths, two sidewalks (with one being quite large), the street for cars, tramlines, a ditch and then some small strips in between. This makes it also a bit messy.

The second thing is that on the north side of the street there is nothing really there to create space. At the south side of the street are buildings closing the space but in the north the space sort of continues into the area next to the street which does not have a great spatial quality.
Building age

The area outside the ring road is built after the Second World War which explains the different typology between the inner city and the outer ring city. In the research area has already a lot of renewal and rebuilding taken place which can be seen in the map showing the build years of each building (illustration 87).

Accessibility map

In this map (illustration 88) every non-accessible area is coloured black. With non-accessible area is meant the area that is inaccessible for pedestrian. This includes all private area but also areas which are officially public but you simply cannot walk there, for example the slope of a rail dike which is cut off by water.

This map shows very clearly the highway and the railway, the two shortly interrupted black lines are out of scale with the urban fabric around it. The width of these lines is much bigger than the buildings in the surroundings while there is also much less opportunity to pass the area. These two effects are more noticeable with the railway than with the highway. The black area of the railway is much broader; therefore the barrier is bigger and has used up more space. Each connection under the railway or highway is visible as a break in the black area and there are fewer breaks with the railway than the highway. Therefore there are fewer opportunities to pass the railway than the highway.
Rail is the bigger barrier

The accessibility map (illustration 88) shows very clearly that the highway and the railway are out of scale compared to the surrounding urban landscape. It also shows that the area occupied by the railway is much bigger than the area occupied by the highway. The map shows also that there are much more opportunities to pass the highway than there are opportunities to pass the railway. This suggests that the railway is a bigger barrier in the area than the highway.

This data is confirmed by the Isovist analysis (illustration 91). The black planes representing the railway and highway in the illustration show that both of them are bigger than the urban fabric around it but that the railway is even bigger and more out of scale than the highway. The railway has longer black planes (less connections) and is wider (occupying more space, wider barrier) than the highway.

The space syntax analysis (illustration 90, axial R3 analysis) shows that the ring road (highway A10) is very well integrated. This also applies for the global analysis and angular analysis (illustrations 25 & 27). The area where the railway is situated shows a strong break in the urban fabric. So while the highway is actually a well integrated structure (in space syntax) the railway breaks up local connections and is a big separator between neighbourhoods.

The analytical maps show that the railway occupies a large area. Therefore some sections of the railway are made (illustration 92) to research this effect further. The sections show that the railway is elevated and is placed on a dike. The result of this decision is that there is a slope on both sides of the dike which take up a lot of space. Right next to the slopes are running two ditches making the slope inaccessible. On the east side there is some small green space right next to the ditch. This is not of a very high quality though because all the buildings are turned away from this area making this area the backside of the neighbourhood. On the west side there runs a road next to the ditch but here the neighbourhood is more focussed on the other direction as well. So it is not the railway itself that takes up so much space, but it is the inaccessible area and low spatial quality around it that take up the majority of the claimed space.

This happened because when the railway was planned and built after the Second World War there was already a lot of experience with railways running through urban environment and the nuisance it gave. Therefore there was a large space around the railway reserved where nothing was build. The urban landscape should be placed away from the railway. This opposed to the highway where the urban landscape is build much closer by. There was less experience with highways when the A10 was build after the war and therefore there was less space reserved around the highway to lower the nuisance in the urban landscape.
8. Vision and Strategy

8.1 Vision

There are two large-scale infrastructure lines in the research area: the highway in the east and the railway in the west. The area in between the two large-scale infrastructure lines and the area around them is the problem area (purple area in illustration 93). This area feels the direct problems of the infrastructure lines. Then there is the issue of the city extension Nieuw West (green area in illustration 93) which is separated from the inner city by the two large-scale infrastructure lines.

As the location analyses show (see section Location Analyses) the railway forms a bigger barrier than the highway. It occupies more space and there are fewer connections while it is really the backside of the surrounding neighbourhoods. To improve the surrounding neighbourhoods the barrier should be overcome. This needs to be done on two scales, first on the neighbourhood scale.

By overcoming the barrier on the neighbour- hood scale the surrounding urban areas should directly profit from the diminished barrier effect. Secondly, the barrier on the city scale, where it excludes the city district Nieuw West from the inner city should be overcome. This should benefit the extension of Nieuw West and the ring zone (purple area) with it. With an improved connection of Nieuw West and the inner city the ring zone gets a stronger position within the city.

To overcome the barrier there need to be more connections under (or over) the barrier on the neighbour- hood scale. There are very little connections under the railway, especially when compared with

Illustration 93 Proposed vision research area Source: Author
the amount of connections under the highway. On the city scale there are already some large connections but not all of them are already using all their potential. By improving a city scale connection the barrier on the city scale can be reduced. The improvement of the city scale will be done by improving the accessibility, integration, spatial quality and the program around the connection.

Besides making new and improving existing connections the infrastructure needs to be better integrated in the urban landscape to reduce the barrier effect. This can be done in two ways. The first way is to change the way the infrastructure is physically situated in the urban landscape. By adjusting the barrier the space around the barrier can redesigned in a more urban way. The second way is by adding and integrating new nodes to the network of the infrastructure, in this case the train line with a new station. A new train station means that more people can use the railway while it gives a lot of potential to its surroundings. This train station needs to be integrated in the urban fabric to get the maximal result (see section Theoretical framework).

These interventions should lead to a diminished barrier effect of the large-scale infrastructure. By reducing the negative effects of the large-scale infrastructure the positive effects of large-scale infrastructure should become more obvious. Large-scale infrastructure brings a lot of potential to an area (see also section theoretical framework), but that is not always used because of the negative effects it also has. The potential of the area around the large-scale infrastructure can be unlocked by reducing these negative effects.

The city district Nieuw West sees the ring zone as an area with a dynamic living environment in the future (see illustration 94). The current situation is very far away from such a living environment but when the potential of the area is unlocked this vision could happen. The area is one of the best large scale connected areas of the city and even the region because of the large-scale infrastructure lines in the area. So when the negative effects are removed (or at least reduced) the possibility of creating a dynamic living environment in the ring zone will be increased.
Scenario extension Jan Evertsenstraat

One of the east-west running streets that performed well in the angularR3 analysis is the Jan Evertsenstraat (top map of illustration 95). The street does not run into Nieuw West so there might be potential with this street if it was extended to Nieuw West. The street is also the proposed location for the new train station.

Therefore there are two scenarios tested in which the Jan Evertsenstraat is extended into Nieuw West. In the first scenario (top left map in illustration 95) the street is just extended and there only connections with streets that cross the new extension. In the second scenario (bottom left map in illustration 95) is tested what happens if streets which end closely to the new extension are connected with the new Jan Evertsenstraat.

The Jan Evertsenstraat stay very well integrated in the first scenario even the new extended part. The other streets in the area are not really changed in this scenario. That changes in the second scenario because beside the Jan Evertsenstraat also other streets seem to improve. The most noticeable is the President Allendelaan which also turns up red. But also the Derkinderenstraat which runs parallel to the ring road is improved. So an intervention in Nieuw West also has a positive effect in the ring zone.
Integration Angular R3 Scenario 2

Existing situation

Extension Jan Evertsenstraat with a few extra connections from Slotermeer
Illustration 95 Space Syntax analysis scenario extension
Jan Evertsenstraat Source: Van Nes, edited by Author
8.2 Strategy

Extending the Jan Everstenstraat shows a lot of potential as described in the previous paragraph. It improves the connection between Nieuw West and the inner city while also improving the situation in the ring zone. Therefore this extension is a proposed intervention in the strategy (illustration 96). By extending the Jan Everstenstraat the street becomes more important and becomes an important axis in the area. For a good working connection it is important to create the right experience of the connection. This means that the spatial quality of the connection itself and the space around it should be good enough. Therefore the space around the new connection will be improved so that this right experience can be achieved.

As described in the vision, a new train station can give a lot of potential to its surrounding areas. There are already two train stations at this rail line close by, Sloterdijk north of the area and Lelylaan south of the area. In between these two stations there is still room for a new station. This station will be placed strategically between the new axis of the Jan Everstenstraat and the already important Jan van Galenstraat. There is also a tram line running through this area and there is already a metro station, making it a strong node.

The area around the new station in between the two important axes has a very strategic place in the research area with these new interventions. Therefore, this area will be changed in order to let it match its new strategic position. There will be set some guidelines and conditions for the design of this area and the spatial consequences will be shown.

The way the railway is currently situated in the urban area is far from optimal as shown in the location analyses. In order to overcome the barrier effect it is important to adjust the barrier itself in a way that it is better integrated in the urban landscape. This will also have an effect on the area right next to the infrastructure which will come open and free to use after the adjustment of the barrier. There will be some guidelines set for this area leading to some spatial consequences.

There will be new connections under the railway added in the area. These connections are not the large scale connection like the extended Jan Everstenstraat but will work on the neighbourhood scale. The location of these connections will be based on the situation of the surrounding neighbourhoods and will be tested with Isovist and agent based modelling analyses.

Since the new connections are based on the situation in the urban fabric the experience of the connections is also depending on the spatial quality in the urban fabric. As shown in the section location analyses the plinth situation of the current building stock is not of a very quality at the moment. That means that there will be interventions on the plinth situations in the existing neighbourhood in order to create the optimal experience of the connection so that the barrier effect of the infrastructure is reduced. This intervention can be copied into the rest of the area since the problem of the plinths is common in the research area.

The extension of the Jan Everstenstraat has some consequences in its surroundings. It is planned in to go through the Sloterpla, cutting a small piece of the Sloterpla off. That means that the small marina in that area will have to be displaced. This area now comes free for new developments, which could strengthen the new axis and has the potential for a nice new residential area. There will be given some guidelines for the development of this area but the spatial consequences will not be designed because the development of this area does little for the main issue of the project, which is solving the barrier effect of large scale infrastructure.

In conclusion, there are several interventions needed to reduce the barrier effect of the railway in the research area. The interventions work on different scale levels, where the extension of the Jan Everstenstraat works on the city scale. The adjustment of the barrier itself is an intervention on the district scale while the new connections are interventions on the neighbourhood level. Then there is the interventions on the current building stock which work on the scale of the buildings. Each intervention by itself will have a positive effect, but put together they can actually have a great impact.
Possible New Development

Existing axis

Extension axis = Intervention on larger scale

New Station

Open space next to rail

Extra connections on smaller scale

Repeat improvement

Adjustment railway

Experience of the connection

Illustration 96 Proposed strategy Plan area Source: Author
9. Strategic interventions

9.1 Extension Axis

The Space Syntax scenario showed very promising results (page 80-81) when the Jan Everstenstraat is extended into Nieuw West. With this extension the Jan Everstenstraat will become a more important city scale connection from which the area in the ring zone can also profit with an increased accessibility and connectivity.

The extension runs right next to Slottermeer where it can be connected to the urban fabric there. The impact there is not too big there in the way that there is not much that need to be changed. There is only a small ditch that needs to be displaced (illustration 100).

The extension crosses the Slotterplas where it cuts off a small piece of water (illustration 99). There is also a small marina in this area which will have to be displaced. If the small piece of water is left the extension will have to go over a bridge. This is an expensive investment to keep a little bit of water. Instead of leaving a small piece of the Slotterplas the water could be filled up. That means that the area is free to use for new developments. By making new developments in this area a part of the investment that is needed to realise the extension can be earned back. The development will make the extension as a city scale connection stronger. By having more urban fabric next to it, the connection becomes better integrated while the experience of the connection also improves.

The sections of the current part of the Jan Everstenstraat between the highway and railway (Illustration 84, page 74) showed that at one side of the road there are no buildings. That means that there is nothing at that side of the street to create space. The spatial quality there is not too good because there are just large parking lots (Illustration 98). This does not create a good experience of the connection. The functions for which the parking lots are meant are a hospital (Sint Lucas Andreas ziekenhuis) and the workplace and depot of the public transport municipality.
Illustration 100 Proposed extension Jan Evertsenstraat Source: Author
9.2 Adding new station

The city district Nieuw West has in its vision a new train station close to the Sloterplas. They want to attract more people from outside Nieuw West to the Sloterplas which has a high recreational value. The municipality also has a vision where the Sloterplas is better connected with the rest of the city. A train station is a very interesting intervention which can have much more positive effects than just getting people from other parts of the city or region to the Sloterplas. The station enhances the potential of the area around where new or extra program can come. The people living close by will have a much better accessibility. As described in the section Criteria, people who make use of the infrastructure might not have as much problems with it as people who never use the infrastructure. With a new station more people have the option to use the train which can reduce the barrier effect.

As explained in the section Theoretical framework, it is important to have a node that is locally well integrated. In order to let the large network (in this the train) work, the smaller scale networks have to work as well and the relation between the different networks is important.

Since a train station gives so much potential, adding a new train station is part of the strategy. The location of the new train station is chosen in between the existing train station Lelylaan and Sloterdijk (illustration 102). It is placed in between two important city scale axes, the Jan van Galenstraat and the extended Jan Evertsenstraat. There is also a tramline running right next to this location making this location an ideal cross point between the different transport networks, creating a good potential in this area.

The train station can become a place where the barrier is overcome and it is integrated in the local fabric. The spatial quality and arrangement around the station should stimulate this. The station needs to be well visible. The area around the station and in between the axes has a lot of potential and that should be used. The program in this area should be a reflection of this potential. In the current situation there are a tennis park (west of the rail), a depot and work place for busses, a hospital (Sint Lucas Andreas ziekenhuis), offices and a student hotel. The sport park and the bus depot are not functions that need to be close to a train station and can be displaced. The other functions are more attractive to keep in the area. A hospital is function which attracts a lot of people while it also has many employees. The hospital is a merger between two hospitals in 1996, when it got a big renovation and extension. The student hotel attracts of course a lot of students which can add liveliness in the area and the potential of bars and cafes.
9.3 Adjustment barrier

The analyses of pages 75-77 show that the railway is the biggest barrier in the research area, even bigger than the highway. There are fewer connections under the railway than under the highway and the way the railway is situated in the urban landscape is different than the highway. When the highway was build after the Second World War there was little experience with highways and their effect on the urban landscape. The result was that the urban landscape came very close to the highway. When the railway was built after the war there was already a lot of experience with railways in urban environment and their negative effects. As a result there was a lot more space reserved for the railway and the urban environment was much further away.

The railway was placed on a dike with big slopes on each side. The slopes were used for greenery and on each side of the slope is a ditch. Right next to the ditch is more green and not in a high quality way that attracts people. It is really the backside of the urban area.

The way the railway is currently situated in the urban landscape is probably one of the worst ways to place a railway in urban landscape. It is a physical and visual barrier with low spatial quality, no room for functions and it takes up a lot of space. Therefore a research has been done on how the railway itself could be better situated in the urban landscape so that the infrastructure works less as a barrier. The research is done by making scenarios of possible ways to place a railway in an urban environment. In the current situation there are two lines for the train and two lines for the metro. The scenarios that are made also include these four lines.

9.3.1 Scenarios
Explanation scenarios
Fourteen scenarios of how a railway can be situated in urban landscape have been made. Out of these fourteen scenarios the worst one is the scenario in the top left corner of illustration 105. This is the current situation of the railway were there very little physical and visual connections and a very large space is reserved for the railway while not being used. So even if more connections were made in the current dike (the scenarios on the left hand side) there still will be a question about the quality of these connections. People will have to move through a big no-man’s-land and the tunnel they have to go through is the largest in all situations. In all the other scenarios the slope of the current dike is gone which means that there is more space next to the railway that can be used.

Scenario number four is a scenario were sheet piles are placed into the dike which can take up the outward forces of the dike so that the slope of the dike can be removed. This means that there is a large space next to the railway that becomes free to use for something else. Even if a park would be placed here it would be better than the current situation because now the green zone on the slope of the dike is inaccessible with the ditch in front of it.

Technically bit more difficult to realise are the scenarios were the dike is replaced by one or two viaducts (scenarios 5-8). The advantage of having a viaduct instead of a dike is that the space under the railway is open so there is no visual barrier anymore. The space could be used for something else, for example parking, although that probably would not be a high (spatial) quality function. The space under the railway could become a place for loitering which would enhance the barrier effect. Therefore, an option could be to place water under the viaduct. This
Lifting the railway creates an open space under it

The space under the railway can be used for functions or for visual connections.

Getting rid of the slope

2 viaducts gives more light

Half lowered tunnel

Illustration 105 Possible scenarios to adjust the way the railway is situated in its urban landscape Source: Author
would prevent loitering and it could have a positive
effect on the spatial quality. In order to improve the
experience of the connection the four lines could be
placed on two smaller viaducts instead of one big vi-
aduct. This would allow light to be let through and
this could improve the quality of the connection.

There are examples were old train viaducts were re-
novated and have functions placed under the old ar-
ches of a rail viaduct, for example in Rotterdam with the
Hofbogen and in Paris with the Viaduc des Arts. But
in Berlin there is even a train line with functions un-
der it like a famous bookshop. The interesting aspect
of this typology (scenarios 9&10) is that the func-
tions attract people so that the infrastructure line be-
comes an attraction for people instead of something
people go away from. However, it is quite expensive
to realise this and it will probably impossible to use
this typology for the whole railway. So this typolo-
gy should only be used at some strategic locations.

Instead of having an elevated railway the railway
can also be lowered into a tunnel. This can either
be a closed or a (half) open tunnel. The advantage
of a tunnel is that there is no visual barrier and in
the case of a closed tunnel even no physical barri-
er. There is also less noise nuisance and the space
around the railway is open for new developments.
However, this type of interventions is very big and
radical which will make it very expensive. This could
only work if it was done at some strategic places
instead of placing the whole railway into a tunnel.

Criteria for choosing scenarios
Not all scenarios can be used together in the research
area, so a choice has to be made. Therefore a set of
criteria is made in order to evaluate the scenarios.

First of all, the realisation of the proposed adjust-
ment should be feasible. There are three aspects to
the feasibility. First, the technical complexity, how
complicated is it to realise the transformation? Se-
condly, if it is technically realistic to realise, how long
will there be a disruption of trains running on this
track? Is it only possible to keep trains running by
building temporary tracks next to the current tracks?
Thirdly, how expensive is the transformation?

Besides being feasible, the chosen scenario(s)
should tackle the main issues caused by the rail
line: the lack of connections under it and the
width it has (taking up large space and increasing
the size of the barrier). By improving these as-
pects another advantage can be achieved and that
is reducing the visual barrier. This is a bit less im-
portant to improve than the two main problems.

The newly transformed railway should not be-
me a place where loitering is likely to happen and
in the ideal situation a place where people are at-
tracted to. This can happen if the space where the
rail way is running is also used for other functions.

The spatial quality of the structure can help in re-
ducing the barrier effect. A viaduct with a visu-
ally nice structure will improve the spatial quality
of the surroundings. It can also help in the spatial
quality of the connection and with that the experi-
ence of the connection. Lastly, the transforma-
tion of the railway can reduce the nuisance of it.

- Feasibility (technically, economically, influ-
ence on current train schedule)
- Solving the width problem (and making
room for new developments)
- Providing new connections
- Visual barrier
- Likeliness for loitering
- Possibility for multifunctional use
- Spatial Quality of the structure (does it
look nice)
- Spatial Quality of the connection
- Reducing nuisance.

Used scenarios
In the research area every scenario instead of the
current one would be an improvement. The sce-
naories with functions under the arches of the railway
are very interesting because it would attract people
to the infrastructure and with that it can help to inte-
grant that infrastructure. Because this type of inter-
vention is so big and expensive it will not be used along the whole line but only at a few places. The most interesting one is at the proposed new train station. This will be already a very high profile place and this can be strengthened by this typology. Even the train station itself can be placed into these arches.

For the rest of the line the scenario with the sheet piling will be used (scenario 4). This is technologically feasible and can have a big positive impact because the space the barrier uses will be greatly reduced. This space can be used for new developments.
Testing the intervention

Scenario 4 has a result that the space occupied by the dike is reduced. The slope is removed and the space can be used for something else. However, the question is if this space has any potential for new developments or that it is just left over space. In order to test this question, the Isovist analysis and agent base modelling analyses are used. First is shown what the current situation is and then what the new situation with the dike removed is.

The Isovist analysis of the current situation (Illustration 106) shows the dike as a big black plane that is out of scale if compared to its urban surroundings. If the slope is removed and free to use than the width of this black plane is reduced and brought more to scale compared with the urban landscape. The Isovist analysis of this new situation (Illustration 107) shows that this new area is highly visible. As a matter of fact, it is the best visible area within the research area. This is especially the case where this new area crosses a connection under the railway. It means the area has a lot of potential to become a high quality area. An Isovist analysis does not show the spatial quality of a place but the potential that a place can have. This means that it is worth it to make a design for this new area but that the actual spatial quality should be achieved via the design.
The agent based modelling analysis in the current situation (illustration 108) shows very little positive areas next to the railway. This means that in the current situation there is not so much potential in the area next to the railway and that is reflected in actual spatial situation. In the new situation where the adjusted dike is shown (illustration 109) there is a completely different situation. Suddenly the area right next to the railway has a very positive outcome. Once again, this analysis shows the potential the new area has.
9.4 Extra Connections

One of the problems with railway in the research area is the fact that there are not so much passing's under the railway connecting the urban one side with the urban area on the other side. Although the adjustment of the railway itself reduced the occupied space of the railway (see illustration 107) there are still large parts where there is no possibility to cross the infrastructure which can be seen in the accessibility analysis (illustration 111) and the Isovist analysis (illustration 112). The length of the black planes representing the railway is quite long and there is clear difference between the railway and the highway.

The ability to pass the infrastructure is an important aspect of the barrier effect of infrastructure as explained in section Criteria. By making extra connections the surrounding neighbourhoods should profit from it, not every new connection needs to be a city scale connection. Therefore the situation in the neighbourhoods is taken into account by making the new connections. The adding of new connections can help with the disruption of the local fabric. As explained in the section Criteria, the amount of connections is important but the quality of the connections is important as well. That means that when the locations of the connections are found there has to be attention paid to the quality of the connection, spatially and programmatically. This should be done in the new part as well in the existing urban area because the new connections are based on what happens there. So the existing urban area is part of the experience of the connection.
Where should the connections come?

In order to find out what the right locations for new connections under the railway are, two analytical maps have been used. The first map is the map showing the accessible and inaccessible areas in the research map and the second map is the Isovist analysis of the current situation. These maps show lines and potentials in the urban areas and based on these maps a whole lot of possible new connections can be found (a few of them shown as red arrows in illustrations 111 and 112).

There are a lot of possible new connections but not every connection is needed. Only the best connections with the biggest impact should be used. That means that the possible connections have to be tested to see what their potential is. The next pages will be about the testing of the new connections.
Testing the connections

The possible new connections have been tested with Isovist and agent based modelling. Each possible connection was individually drawn into the map of the current situation. Then an Isovist and agent based modelling was made for each possible connection separately.

The effects of the individual connections were compared with each other and the ones that had the most positive effects were put together and tested again. With the comparison there was looked at two effects. The first one was how the area of the new connection itself was analysed (the area in the red ellipses in illustration 113). How many “agents” in the agent based modelling went through the connection? A higher density of agents is a better result for the connection, just like a higher visibility in the connection is better.

The second effect that was looked at was how the urban area in the research area responded with the new connections (the orange ellipses in illustrations 113 & 114 show the area). Was there an improvement in the urban area based on the Isovist and agent based modelling analyses?

When the most promising possible connections were selected based on the two effects they were put together and tested again. Each connection has individually an effect, but there is a very positive improvement when the connections are put together. The connections itself do fairly well, although not spectacular (red ellipses). The urban area in between the railway and highway show some very positive effects. The potential of the area has been improved, the possibility to create a more lively and dynamic area has been increased.
Combining the extra connections with adjustment of the barrier

The Isovist and agent based modelling tests of the adjustment of the barrier showed that the space right next to the railway had great potential. The peak was where this space was crossed by a connection under the railway. This implies that there is a possibility that making extra connections could strengthen the intervention of the adjustment of the barrier and vice versa. To see if this idea is right both interventions are put together in a map and once again tested with an Isovist and agent based modelling analyses.

Both the Isovist analysis and agent based modelling analysis showed great improvement (illustrations 115 & 116). The agent based modelling map showed a strong improvement in the area parallel to the highway, so in the space that comes free when the slope of the rail dike is removed. The Isovist analysis showed great potential in the areas where the space next to the railway crosses the extra connections.

The analyses have had the highway as border so far. Now the proposed changes show positive results, it is interesting to research what happens if the extra connections are continued under the highway. They run through the Rembrandtpark until they connect with the urban fabric in the inner city. This is once again tested with an Isovist and agent based modelling analysis (illustrations 117 & 118). The connections itself in the east had some good results although there is only little improvement in the ring zone. A well functioning connection through the Rembrandtpark can have a positive effect on the park as well. A well functioning connection means that a lot of people pass by which adds liveliness in the park, which should also reduce loitering. Because the extensions of the connections to the
Illustration 117 Agent based modelling analysis of the possible new connections continued east and open space next to the railway Source: Author
east have little effect in the ring zone but function in itself they will be proposed but not elaborated. The focus will be on the connections under rail where one of the connections will be elaborated (the connection in the red circle in illustration 118).

Illustration 118 is west analysis of the possible new connections continued east and open space next to the railway Source: Author
9.5 Creating line

In order to let a connection function at its best, it is important that the user gets the right experience. It will help if the connection itself and its surroundings are creating the feeling of a line. Improving the experience of the connection means that the connection should have the right spatial quality. This will lead to a more pleasant and safer connection which should lead to more people actually using the connection.

People need to feel and understand by the spatial that there is a connection, the naturally need to follow the line of the connection instead of having to look where they can actually cross.

Current situation

As seen in the section analysis of the Jan Evertsenstraat (page 74), one side of the road does not help in creating the idea of a line. There are no elements or buildings in creating space while there is also no landscape elements that can help create the feeling of a line.

Adding buildings

One solution to the problem in the current situation could be by adding buildings on both sides of the streets so that a space is created. Adding buildings can add liveliness, social control and program to the line. To realise this it is important that the plinth of the buildings are well designed and that there is something happening on the ground floor of the building, either with houses or functions. The plinth situation is a major problem in the current building stock (see page 72) so this mistake has to be avoided in new buildings.

Adding elements

Instead of adding buildings other elements could also be placed on the side of the streets.
Elements like trees can also help in creating a space and can offer spatial quality, to the side and offers no spatial quality, if placed more prominently than it could offer spatial quality and works as a guiding element along the line.

**Using water as a guide**
The road arrangement can be changed so that the water takes up an important role. In the current situation the water runs through a ditch put away far of a line. Trees can have a positive effect on the spatial quality and can work as a guide just like the water.

**Water surface**
An open surface of water (like the Sloterplas) next to a street can offer a spatial quality and can help on focusing of the line of the street. However, creating a pond or a lake is not something that should be done just to create the feeling of a line.

**Criteria for choosing scenarios**
Each scenario has its own benefits and in order to choose which scenarios will be used in the research area a set of criteria has been made. The goal of this intervention is to create the right experience of the connection. This includes having the right spatial quality, enough liveliness and social control, but the experience is also improved when there is a clear space which guides you through the connection.

- Creates Space
- Creates Spatial Quality
- Adds liveliness on street
- Adds program
- Social Control / Safety
- Guiding effect (connection should be easy to find & follow)

**Used scenarios**
The focuses of the solutions for the research area in general and the Jan Evertsenstraat in particular will be on the scenarios were buildings or other elements are placed on both sides of the streets so that a space is created. This will help in improving the spatial and programmatic quality of the connections.
9.6 Plinth Improvement

As identified in the location analysis, the ground floor situation of the buildings is in many cases not optimal. The ground floor of many buildings do not have a high quality function, most of the time there is just some storage space or something similar creating a dead wall on the outside. Since the extra connections under the rail are based on the situation of the neighbourhood, the quality of the connection is also depending on what is the spatial experience in the existing neighbourhood. The poor plinth situation in a majority of the current building stock does not help the experience of the connection.

Instead of storage space the ground floor could be used for houses. Before the modernism movement it was normal to have either houses or functions on the ground floor. So if the buildings with the dead walls on the ground floor would be renovated and the ground floor would be used for houses again the plinth of the building would get a whole new look. This would also lead to more entrances in the building. The effect would be that there is more social control and liveliness on the street. The spatial quality would improve and the experience of travelling along the building would improve as well.

When houses are placed on the ground floor of the existing buildings instead of storage units the plinth of the buildings will no longer have dead walls. These new houses can also get gardens in front of them. This can be gardens just for the new houses on the ground floor or for the whole building. In any case, the gardens make a transition between the public space and the private space inside the building. The gardens can also bring spatial quality and create a nice living atmosphere.

Plinth situation

Illustration 122 Intervention Plinth Situation Source: Author

Houses on the ground floor

Illustration 123 Possible scenarios Source: Author

Gardens
Functions on the ground floor

Houses bring life in streets at certain times a day while other functions can bring life at other parts of the day. For example shops create liveliness during shopping hours, offices when the workers start, leave and lunch while restaurants and bars create liveliness in the evening. Having functions in the area creates in any case more liveliness in the area than if there are only houses and is a condition for a dynamic living environment. It can also create a situation where people are brought in from outside the street or area.

Extension Plinth

It could be that the ground floor of the existing building is not large enough for houses or other functions. In that case an option could be to extend the ground floor by placing a newly build part in front of the existing building. This way the space on the ground floor can be used for houses or other functions and the plinth situation can be improved. This only works if the existing side walk is broad enough.

Improvement sidewalk

The spatial experience is not only bad because of the function and design of the ground floors of the buildings but also because the sidewalk itself lacks spatial quality. Improving the spatial quality of the sidewalk will improve the experience of the connection. However, it does not do anything about the relation between building and space and the dead walls on the plinth are still there.
9.7 Proposed interventions

Illustration 125 shows a map with all the proposed interventions in the research area together. As described there will be a new train station which means the space around it will be changed. The extension of the Jan Evertsenstraat means it becomes a more important city scale connection and that should be reflected in the space and buildings around it.

The proposed adjustment of the barrier means that the space currently occupied by the slope of the dike becomes free to use for something else. This space will cross the extra connection that is proposed. This connection works on the smaller scale and is in that way different than the city scale connection. The last proposed intervention is the adjustment of the plinth situation at the current buildings in order to improve the spatial quality and experience when travelling along these buildings.
9.8 Focus Area

The focus area is around the proposed interventions and includes two types of connections (illustration 126). One connection is on the city scale and lies next to the new train station. The second connection is on the smaller neighbourhood scale under the railway. The spatial consequences around these two types of connection will be shown in two separate proposals where each one will show how the space around that type of connection can be used.

The proposal around the city scale connection will also show how the space next to the train station and in between the axes will be filled in, spatially and programmatically. The proposal of small scale connection will include the way the open area next to the rail will be used and what could happen to current building in order to create the optimal experience.
10. Toolbox

The interventions proposed in the strategy can work in the specific research area where they can tackle the specific problems. There are several ways that infrastructure can work as a barrier as explained in the set of criteria and in the research area these criteria come back in their own specific way. In order to solve the specific way the criteria are manifested several ways of intervening have been researched. The research of the interventions have lead to a specific choice of solution in the specific location but the research can be used in other situations as well.

Each intervention is a tool that can be used to improve one or more criteria.

The tools that can be distinguished are:
- The adjustment of the barrier; how is the infrastructure situated in urban surroundings
- Creating extra connections under or over the barrier; How can new connections help the surrounding neighbourhoods
- Creating a line; How can space create the right experience of a connection
- Plinth Improvement; How can the relation between buildings and the surrounding space help in improving the experience of the connection
- City scale connection; Improving or adding a strong connection on city
- Adding a new train station;
- Placing the right program; How can program next to the barrier or connection help in overcoming the barrier

10.1 Tool - Adjustment Barrier

The way the infrastructure is situated in the urban fabric influences how big of a barrier the infrastructure is. Physical aspects that influence the barrier effect (as described in section Criteria) are the height of the infrastructure and the border condition while it also influences the nuisance and the spatial quality of the surroundings. By adjusting the physical implementation of the infrastructure these aspects could be improved.

There are a lot of different ways infrastructure can placed in an urban environment as described in the section Strategic interventions. These scenarios can also be used in other situations where large-scale infrastructure runs through urban area. An adjustment of the barrier itself can be a very strong tool in reducing the barrier effect and. This section explains the advantages and disadvantage of each scenario in order to help choosing the right scenario in the right situation.
Dike

Advantage:
- At least there is a rail

Disadvantage:
- No visual and physical connection
- Large unused space around infrastructure
  (=waste + creating extra barrier)

Extra Connections in dike

Advantage:
- At least there is a connection

Disadvantage:
- Still a visual barrier
  - Tunnel is a dark unattractive place so not a good route
- Large unused space around infrastructure
  (=waste + creating extra barrier)

Regular Connections in dike

Advantage:
- A lot of physical connections

Disadvantage:
- Still a visual barrier
  - Tunnel is a dark unattractive place so not a good route
- Large unused space around infrastructure
  (=waste + creating extra barrier)
Getting rid of the slope

Advantage:
- More space around the infrastructure means less of a barrier
- Room for developments next to the infrastructure
- Easy to realise in practice.

Disadvantage:
- Still largely a visual barrier

Lifting the railway on columns

Advantage:
- Overall visual connection
- Possibilities for physical connections
- Space under the rail could be used for something else (parking for example)
- More space around the infrastructure means less of a barrier
- Room for developments next to the infrastructure
- Possibility of a nice design of the structure

Disadvantage:
- Possibilities for loitering
- Not really place for quality programming under the rail
- Not easy to realise in practice, although technically doable.

Making 2 viaducts

Advantage:
- Overall visual connection
- Better spatial quality of the connection because of the extra light
- Possibilities for physical connections
- More space around the infrastructure means less of a barrier
- Room for developments next to the infrastructure
- Possibility of a nice design of the structure

Disadvantage:
- Possibilities for loitering
- Not really place for quality programming under the rail
- Not easy to realise in practice, although technically doable.
**Putting water under the railway**

**Advantage:**
- Overall visual connection
- Possibilities for physical connections
- Water could have a spatial quality
- More space around the infrastructure
- Means less of a barrier
- Room for developments next to the infrastructure
- Possibility of a nice design of the structure
- No place for junkies or loitering

**Disadvantage:**
- Space under rail could not be used for programming
- Not easy to realise in practice, although technically doable.

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**Putting water under the 2 viaducts**

**Advantage:**
- Overall visual connection
- Better spatial quality for route because of the extra light
- Water could have a spatial quality
- Possibilities for physical connections
- More space around the infrastructure
- Room for developments next to the infrastructure
- Possibility of a nice design of the structure

**Disadvantage:**
- Space under rail could not be used for programming
- Not easy to realise in practice, although technically doable.

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**Arches 1**

**Advantage:**
- Possibility for visual and physical connections
- Possibility for functions under the rail
- Adaptable to situation of the surrounding (either functions or visual/physical connection)
- Can have spatial quality
- Room for developments next to the infrastructure

**Disadvantage:**
- Difficult and expensive to realise
- The space under the rail might be too small for quality functions
- Functions might have nuisance from the rail
**Arches 2**

**Advantage:**
- Possibility for visual and physical connections
- Possibility for functions under the rail
- Adaptable to situation of the surrounding (either functions or visual/physical connection)
- Can have spatial quality
- More space per functions than previous scenario
- Room for developments next to the infrastructure

**Disadvantage:**
- Difficult and expensive to realise
- Functions might have nuisance from the rail

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**Half Open Tunnel 1**

**Advantage:**
- No visual barrier
- Less noise nuisance
- Room for developments next to the infrastructure

**Disadvantage:**
- Difficult to realise
- Expensive to realise

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**Half Open Tunnel 2**

**Advantage:**
- No visual barrier
- Less noise nuisance
- Room for developments next to the infrastructure

**Disadvantage:**
- Difficult to realise
- Expensive to realise
Closed Tunnel

Advantage:
- No visual barrier
- No noise nuisance
- As many connections as needed can be realised
- Room for developments next to the infrastructure
- Top of the tunnel can be used for spatial quality (e.g. park)

Disadvantage:
- Difficult to realise
- Expensive to realise

Half Lowered Tunnel

Advantage:
- Less noticeable in surroundings
- No noise nuisance
- Room for developments next to the infrastructure
- Easier to realise than normal tunnel

Disadvantage:
- Difficult to realise
- Expensive to realise
- Connections can only go over the tunnel = more difficult to travel

Open Tunnel

Advantage:
- No visual barrier
- Less noise nuisance
- Room for developments next to the infrastructure

Disadvantage:
- Difficult to realise
- Expensive to realise
10.2 Tool - Extra Connections

One of the major problems with large-scale infrastructure is the amount of connections under or over it. If there is a lack of connections the large-scale infrastructure literally works as a physical barrier between the two sides. So when it is needed to solve a problem with large-scale infrastructure in urban landscape the tool to add extra connections can be a very powerful tool.

How to test?

For this tool there is no selection of scenarios like with the previous tool adjustment barrier. In order to find the right locations for the extra connections, it is necessary to test every (possible) location. The testing is done by finding out the possible locations, analyse them with Isovist and agent based modelling and compare with the same type of analyses of the current situation.

So the first step is to make an Isovist analysis and agent based modelling analysis of the current situation. These maps are the base to find out the possible connections. Based on the situation in the urban areas around the infrastructure one can draw a lot of potential interesting connections. Interesting aspects to look for when drawing the potential connection are open spaces, possibilities to continue existing lines and areas that have a positive outcome in the current analyses. Examples are shown in illustration 133 where the red arrows represent possible connections.

The next step is to make a separate map for each possible connection and run for each map the Isovist and agent based modelling analyses. The connections that give the best result in these analyses can be drawn together in one map which is then once again analysed with the Isovist and agent base modelling analyses.

On the next page will be explained were to look for when the analyses are made.
**Where to look for in the test results?**

The test result of the connections can be evaluated on two types of effects. The first effect that can be evaluated is the result of the area of the new connection itself (red circles in illustration 134). How well does the connection itself perform, has it a high visibility in Isovist and is there a high density of “agents” going through the connection? If the analyses show that the connection does not perform so well than it means that this connection could be a place for things like loitering. That would result in a connection that will not be used so much even though it would make sense from a designer or planner point of view.

The second effect to look for is what changes in the urban area are there (orange circles in illustration 134). Do the visibility and/or density of “agents” improve? Because the connections are made to have a positive effect in urban around the infrastructure it is important that there is an improvement in these areas.

When the most promising connections are tested together it is interesting to see if they influence each other. Are they still performing well if there are other options available? Or are they all becoming stronger because they strengthen each other (pink circles in illustration 135). The latter is of course the desired scenario and that should be visible in the urban area where the general visibility and density of “agents” has been increased (red circle in illustration 135).
10.3 Tool - Creating a line

One of the criteria that create the barrier effect of infrastructure is the quality of the connection (see section Criteria). The quality of the connection makes sure that the users get the right experience of the connection. The spatial quality on and around the connection should guide people, they need to find their way naturally and do not have to search for a way to cross. This tool provides some scenarios on how to create the right conditions for such situation.

This tool is meant as a support tool that does not tackle the big issues of the barrier effect by itself, but it can help other interventions such as creating Extra connections and City scale connection. If the scenario which adds buildings is chosen it is a good idea to make use of the tools Plinth improvement and program in order to avoid recreating mistakes from the past.

Buildings on both sides of the road

Advantage:
- Creates space
- Potential for more liveliness
- Social control
- Possibility for program or houses

Disadvantage:
- If the plinth is not well designed than the advantages are offset

Having elements on the side of the road

Advantage:
- Creates space
- Creates spatial quality
- The space behind the elements is still visible from the road

Disadvantage:
- No social control
- No possibilities for houses or program
Water as a guide

Advantage:
- Spatial quality
- Guiding element

Disadvantage:
- Does not create space
- Does not add program
- Still need a solution for the sides of the roads

Trees as a guide

Advantage:
- Spatial quality
- Guiding element
- Can help in creating space

Disadvantage:
- Does not add program
- Still need a solution for the sides of the roads

Water surface

Advantage:
- Spatial quality
- If already present, the water can be used

Disadvantage:
- No possibilities for houses or program
- Too big of a intervention too add just for this tool
10.4 Tool - City scale Connection

The barrier effect of large-scale infrastructure does not only work on the neighbourhood scale but also on the city scale. A whole city district can be excluded from other parts of the city excluding it from possible benefits. There are even expressions about this phenomenon, for example living on the wrong side of the rail. When a whole city district is feeling the barrier than there is more needed than extra connections on the neighbourhood scale. The general connection between the excluded city district and the rest of the city should be improved. A better connection can also unlock the qualities the excluded part has which have been “hidden” for the rest of the city. This way the rest of the city also profits from the improved connection.

The improved connection can be achieved by creating a new axis either by adding a new street or improving an existing street. This new axis should be well integrated in the urban fabric in order to have the most effect. So it should have a connection with as many streets as possible, having the maximum integration and creating the best accessibility. To let the well integrated connection function at its best the spatial quality of the connection and the program next to it should be alright (see sections Tool – Creating Lines, Tool – Plinth Situation and Tool – program).

How to test?
The new city scale connection needs to be well integrated into the urban fabric. The way to test this is to do Space Syntax analyses. The most interesting one for this situation is the angular R3 analysis. Run this analysis of the current situation in order to understand the current situation. Based on this analysis some potential new strong connections can be spotted. For example, this could be well integrated streets that do not make the full connection (top left map in illustration 142) or streets that are in a promising place but are coloured yellow or orange.

The next step is to think what could improve the integration of the chosen street. If a street is chosen which is in a promising place but not well integrated (only yellow/orange) than there should be research where extra streets could be connected to this street. If a street is chosen which is well integrated but does not make a full city scale connection than it should be research where and how the street could be extended. These changes should be drawn and tested with same Space syntax analyses again (bottom left map in illustration 142).

If the results are negative the street might not be as promising. But in both a positive and negative result it might be very interesting to see if there are additional measures that can be taken to strengthen the chosen street even further (or at all). These additional measures can be tested once again with the Space syntax analysis (right map in illustration 142). This might lead an even stronger result, but in any case it will help to understand the dynamics that are taken place in the area.
10.5 Tool - Plint Improvement

What happens on the ground floor of a building has influence on the spatial quality and experience of space around the building. In order to let a connection function at its best, it is important that the plinth situation of the buildings around the connection is all right. This tool gives a selection of scenarios of how the plinths of buildings can be shaped and what the advantages and disadvantages are per scenario.

Plinth situation

Advantage:
- The houses have storage space

Disadvantage:
- No social control on ground floor
- No liveliness on street level
- Dead wall on plinth, no spatial quality
- Does not create a good experience
- Very little entrances
- Not a dynamic living environment possible

Houses on the ground floor

Advantage:
- Social control
- More liveliness on street level
- Better spatial quality
- More entrances

Disadvantage:
- Is the quality of the space on the ground floor good enough for houses?
- Is the space big enough for houses?
- Is the investment worth it?

Illustration 143 Possible scenarios Source: Author

Gardens

Advantage:
- People having their own space
- Transition between private and public
- Can improve spatial quality
- Creates a nice living atmosphere

Disadvantage:
- Does not work if the sidewalk is too small
Functions on the ground floor

Advantage:
- Brings in live in the streets at different times
- Can help in creating a dynamic living environment
- Can bring in new people in the area
- More entrances

Disadvantage:
- Is the quality of the space on the ground floor good enough for functions?
- Is the space big enough for functions?
- Is the investment worth it?

Extension Plinth

Advantage:
- Social control
- More liveliness on street level
- Better spatial quality
- More entrances

Disadvantage:
- Does not work if the sidewalk is too small
- Big investment

Improving sidewalk

Advantage:
- Improves spatial quality
- Improves the experience of the connection

Disadvantage:
- Does nothing about the relation of the building with the surrounding space
10.6 Tool – Adding new station

The addition of a new train station can have a lot of benefits. The area around a new station has a lot of potential because of the excellent accessibility. In the Netherlands there is a tendency to increase the density around the stations. The train stations in the Netherlands are becoming more and more multimodal nodes in the Dutch transport system (Van den Boomen and Vehhoeven, 2011). Adding such an important node in an area greatly enhances the potential of the area. If there are functions around the station which attract people instead of turning them away the barrier effect is reduced. For the people living fairly close to the new train station it becomes much more interesting to use the train. People who make use of a large-scale infrastructure line might have fewer problems with this line than people who never make use of it and only feel the negative consequences. Besides having a positive effect on the people living around the station, the station can also have a positive effect for people outside the area. The qualities around the station are now well accessible for people further away from the area.

The station will bring more people to its surrounding, either by new functions profiting from the enhanced potential or by making existing qualities better accessible. By bringing in more people in the area the liveliness of the area can be increased, which is something beneficial for the inhabitants as well.

A train station can be the place where the barrier that the large-scale infrastructure is, is overcome. It can be the centre in the multimodal transport networks and the place where people come to instead of going away from it. The station itself can be an extra connection under or over the barrier.

**How to test?**

The conditions for a new station have to be good in order to let the train station function optimal. The new station should not be placed too close to another station so that it lays it that stations’ catchment.

As explained, train stations are becoming more and more multimodal transport nodes. In order to let the train network function at its best the train station should be well integrated in the other transport networks. This means that the location should have access to a better quality of city public transport than a bus line, like a tram or metro line. Such a line means a fast and regular connection to the station. The location should also be at place in the urban fabric which is well integrated into the street network. This can be tested with space syntax analyses, in which the angular R3 can be an interesting one. A location close to at least one high integrated street is necessary, more well integrated streets close by is better (illustration 146). It will help the success of the station if there are already qualities near the location that will attract people. This can give the station a kick start. If the spatial quality is good around the location than that would be a positive aspect, but it is not completely necessary because it can be changed when building the station. After the station is build the spatial quality should be good.
10.7 Tool - Program

Well chosen program gives people a reason to come to an area. One of the reasons that large-scale infrastructure can work as a barrier is that around there are functions placed which rather push people away than attract them. By adding program this can be turned around while it can also bring more liveliness to an area.

There are two places where adding program can help in overcoming the barrier effect. The program can be placed next to the barrier itself or next to the connection that passes the barrier. So a distinguishing has been made in the tool. First the program next to a connection is explained followed by an explanation of the possible program next to the barrier.

10.7.1 Program next to connection

The quality of a connection depends on the spatial quality and the experience of the connection. Program can have a positive effect with both aspects. In the toolbox there are two types of connections described, on the city scale and on the small neighbourhood scale.

City Scale Connection

The program next to the city scale connection should reflect the city scale. That means that there can be functions that attract a larger group of people even from outside the area. The city scale connection works best when it crosses a large-scale connection, like a railway, and at this crossing a function that attracts a lot of people, like a big public function, would work excellent. This could be for example a local government office, a hospital or an education institution.

The space next to the connection could also be used for mixed functions, including shops and restaurants. This can create a lot of liveliness on the street which would improve the experience of the connection.

Small scale connection

The program around the small scale connection would be much more focussed on the qualities of the residential areas. So obviously housing is a good option to place along the small scale connection, as long as the ground floor is also used for housing. Apartment buildings with storage space on the ground floor would have a negative impact. To create a friendly living environment it can help to give the houses some garden. There could also be space for some neighbourhood functions like some small shops or a community centre.

10.7.2 Program next to barrier

The area next to a large-scale infrastructure can be either very high profile or very low profile. If the area is close to a node in the large-scale infrastructure than it is very high profile because very large groups of people will come here. That means functions like shops, a large public function (school, government institution) are perfect here.

If the area next to the barrier however is further away from a node than it becomes very low profile. These areas are not very desirable because of the nuisance the large-scale infrastructure can cause. At these areas functions like smaller business or offices for starters could work, just like workplaces which already produce a lot of noise themselves. For these areas it is important that there are connections under the infrastructure crossing these areas because the crossings are the places with the most potential. If there are no crossings the area next to the infrastructure become quiet, poorly visible areas.

![Illustration 147 Program under the railway in Vienna Source: https://voony.wordpress.com](https://voony.wordpress.com)
## 10.8 Toolbox

<table>
<thead>
<tr>
<th>Tools</th>
<th>Adjustments Barrier</th>
<th>Extra Connections</th>
<th>Creating Line</th>
<th>Plinth Improvement</th>
<th>City Scale Connection</th>
<th>Adding Station</th>
<th>Program</th>
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*Illustration 148 Matrix showing which criteria are tackled by which tool Source: Author*
<table>
<thead>
<tr>
<th>Tools</th>
<th>Adjustment barrier</th>
<th>Extra connections</th>
<th>Creating line</th>
<th>Plinth improvement</th>
<th>City scale connection</th>
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Illustration 149: Matrix showing which criteria are tackled by which tool. Source: Author
What criteria do the tools tackle?

The research for how infrastructure works as a barrier resulted a selection of criteria in which infrastructure works as a barrier. There is not a single intervention that can tackle all the criteria at once. Instead, each intervention only has a positive effect on a few of the criteria. This means that each intervention on its own can have a positive outcome on the barrier effect of infrastructure but when faced in a situation where more aspects are involved more tools are needed to solve the issue.

The matrix in illustrations 148 & 149 shows which criteria each tool tackles. The matrix can be used in two ways. The first way is to look what the impact of a certain tool can be. Each tool has a positive influence on at least one criterion.

The second way is to look which tool is needed to solve found criteria in an area. So if there is a situation where infrastructure is causing problems in an urban environment it is important to analyse what the exact problems are. Then the next step is to check which tools have a positive influence on that specific criterion. For example, in some situations the problem might be that there is a problem with the quality of the connections while the way the infrastructure is situated in the urban environment is good enough to prevent an adjustment of the barrier.

How to use the tools

Every tool has its own characteristics which have to be taken into account. For example, not every tool works on the same scale level. Illustration 150 shows the characteristics of each of the tools, what type of tool it is, how to test it, what have to be taken into account when designing the intervention, what tools can be combined and what the benefits are when using the tool.

It is important to realise that not every tool is a design itself, but only creates the conditions for a design. For example, the tool Adjust Barrier can create a situation where the space occupied by the barrier is reduced. The space that comes free from this intervention than has to be designed in order to make feel use of its potential.

Each tool can be used individually to have a positive effect, but combined this positive effect can be increased. Some tools especially benefit when combined, for example a new connection (Tool extra connections) works so much better if the quality of that connection is good which can be realised with the tools Creating line and Plinth Improvement.
<table>
<thead>
<tr>
<th>Tools</th>
<th>Type</th>
<th>Scale</th>
<th>Test</th>
<th>Design</th>
<th>Combination tools</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment barrier</td>
<td>Main</td>
<td>City district</td>
<td>Isovist +</td>
<td>Important to combine with a good design. This tool creates better conditions in the urban area which need to be unlocked by an adequate design.</td>
<td>* Extra Connection * Next to Barrier</td>
<td>Spatial Quality</td>
</tr>
<tr>
<td>Extra connections</td>
<td>Main</td>
<td>Neighbourhood</td>
<td>Isovist</td>
<td>The tools 'Creating Line', 'Plinth improvement' and 'Program' can be used to design this intervention.</td>
<td>* Creating line * Plinth improvement * Next to Barrier * Next to connection</td>
<td>Mobility</td>
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<tr>
<td>Creating line</td>
<td>Support</td>
<td>Neighbourhood</td>
<td>Scenarios</td>
<td>When adding buildings is used in this tool it is important to look at the plinth improvement tool to avoid previous mistakes.</td>
<td>* Plinth improvement * Program: * Next to connection</td>
<td>Spatial Quality</td>
</tr>
<tr>
<td>Plinth improvement</td>
<td>Support</td>
<td>Street scale</td>
<td>Scenarios</td>
<td>What is the spatial impact of this intervention?</td>
<td>* Extra Connection * Program: * Next to Barrier * Next to connection</td>
<td>Spatial Quality</td>
</tr>
<tr>
<td>City scale connection</td>
<td>Main</td>
<td>City scale</td>
<td>Space Syntax</td>
<td>What is the experience of the line?</td>
<td>* Creating line * Plinth improvement</td>
<td>City scale coherence</td>
</tr>
<tr>
<td>Adding station</td>
<td>Main</td>
<td>City scale</td>
<td>Node</td>
<td>What happens in the area around it, spatially and programatically?</td>
<td>* Program: * Next to Barrier * Next to connection</td>
<td>Integrating the infrastructure</td>
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<td>Program</td>
<td>Support</td>
<td>City scale</td>
<td>Conditions</td>
<td>Program itself should be combined with good spatial quality</td>
<td>* Adjustment barrier * Plinth improvement * Adding station * Extra connection</td>
<td>Spatial Quality</td>
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<td>Next to Barrier</td>
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<tr>
<td>Next to Connection</td>
<td>Support</td>
<td>City scale</td>
<td>Conditions</td>
<td>Program itself should be combined with good spatial quality</td>
<td>* Extra Connection * Creating line * Plinth improvement * Adding station</td>
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<td>Experience</td>
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</table>
11. Spatial Consequences
The plan area contains two different types of connections, one on the city scale and one on the neighbourhood scale (see illustration 151). Two designs have been made around these connections in order to show how they spatially and programatically work.

11.1 Current situation city scale connection
The first design is focused around the area where the city scale connection passes the new train station (illustration 152). The map in illustration 156 shows the current situation of the design area, which lies between two axes (Jan Evertsenstraat in the south and the Jan van Galenstraat in the north) and in between the highway and railway and is therefore a location with a lot of potential. In this area there is currently a hospital which is founded in 1996 when two hospitals merged. The building was then renovated and extended. A hospital is a function which attracts a lot of people so it makes sense to keep the function here.

Right next to the proposed new train station is currently a bus depot for the public transport company and a student hotel on one side. On the other side there are tennis courts with a clubhouse. A student hotel brings a lot of people and liveliness to the area so therefore it is well situated in this new area. However, the tennis courts and bus depot are not functions that live up to the potential of the area.

The station can be an important node in the integration of the railway. Therefore an extra connection between the two axes which runs through the new station is investigated. This can be done in several ways, from southwest to northeast and vice versa. So the several options have been tested with agent based modelling and all line analyses (page 126).
11.2 Investigation diagonal connection

The main function in the plan area is the new train station. The train station will be located between two important city scale axes. The train station will be an important place to integrate the railway in its surroundings and to support that, an extra connection between the two axes through the station has been researched (Illustrations 157-162). Several options have been compared and tested with agent based modelling and all line analyses. The option to let the diagonal street run from southeast to northwest performs well in both the all line analysis and agent based modelling analysis. Besides these results, there is also a tram line running around the current station area from south east to northwest which could run over the new diagonal. This way the integration of the station is even strengthened.

This diagonal connection is tested in a design (Illustration 164). Although the idea is interesting and it indeed strengthens the station as the main node, it also gives some complications. The diagonal cuts the area east of the train station into two triangles with acute angles. This makes the layout and design of this area a bit messy. One of the reasons for the diagonal was that the tram line could run over it but the angle the tram line has to make in the north to connect to the Jan van Galenstraat is very sharp. The angle is too sharp for trams to take and it gives also problems with the access of the buildings next to it. In order to change the angle the buildings next to the line would have to be demolished.

So, the diagonal connection is tested with a design and does not give a satisfying result. Therefore it will not be used in the final design.
11.3 Typology research

In order to make a good design a typology research has been done (illustration 165-172). In this research it has been investigated which possible typologies could be used in the area next to the train station. In the Netherlands the areas around train stations are the places that can be densified. But there are many ways in which the current situation can be transformed into a much denser area.

The types that have been researched are (in multiple scenarios):
- Big blocks with towers
- Free standing towers
- Long closed blocks
- Long open blocks
- Row blocks
Scenarios

Based on these typologies some scenarios have been made (illustrations 173-176). The basic typology that has been used in these scenarios is the long open blocks, especially in the area east of the train station.

11.4 Landuse

The scenarios (illustrations 173-176) form the base for the land use plan (illustration 177). The main function in the plan area is the new train station. The train station will be located between two important city scale axes. Under the station is room for shops so the space in front of the station on the east should be open. On the other side of the station there is room an extension of the station where more shops and a education institution can be located.

The area around the train station can be filled in with housing where the ground floor of the blocks can be used for other functions as well (yellow area in illustration 177). Since the area is close to the train station it should have a high density.

The area from the entrance of the hospital to the station should become an important lane where some places where people can stay are situated.

The area in between the hospital and the Jan Evertsenstraat needs to be developed in order to improve the city scale connection (see Section Creating Line, pages 100-101). The development should include residential buildings next to the Jan Evertsenstraat in order to create space. The area between these new buildings and the hospital should also be redeveloped where the parking should be done in buildings (but not on the ground floor). These buildings should create quite green spaces which can be used by people from the hospital as well (employees, visitors and patients).
11.5 Design city scale connection

The conditions set in the landuse map are the base of the design (illustration 180). The dike on the railway is transformed along the whole line with the removal of the slope by placing sheet piles into the dike (see section adjustment barrier, page 86). The railway itself still lies on a dike, so the space under it cannot be used for something else. At the place of the new train station however, a different scenario has been chosen. Here the railway is placed on a viaduct with functions under it. Because a train station is such a high profile place it is possible to do such a drastic transformation. The functions under the railway will be filled with shops which should benefit from the large flow of people to and from the station. There are other situations where shops and other functions have been placed under the arches of (old) rail viaducts, for example in Berlin (illustration 185), Vienna (illustration 186), Paris (illustration 187) or Rotterdam.

The purple blocks next to the train station are an extension of the first two floors of the train station. In these blocks there are entrances for the train station but there is also space for an after high school education function and extra space for shops. The ring zone already contains several spread out schools and with the new node in the transport network this location is ideally situated. Students are very likely to use public transport to get to school and they can bring liveliness into the area. On top of the biggest purple block there is a tower planned. The tower is placed next to the Jan Evertsenstraat just like two already existing towers on the south side of the street (illustration 181).

The area next to the train station is divided by four parallel running axes. There is a hierarchy in these axes; the most important one is the axis from the entrance of the hospital to the train station and the water in the west. It has trees on both sides of the streets and the middle of the street is made out of semi-porous material. Close to the entrance of the hospital there is a tram stop meaning that there can be a large stream of people walking on this axis, bringing a lot of liveliness in the street. The axis runs to the water in the west and continuous with a bridge. On the ground floor of the buildings adjacent to the axis is space for other functions. Next to the axis and the water there is nice a public space where people can stay. On the east side of the station there are two small buildings placed next to the axis. They create a space which can be used for terraces for cafes or restaurants. The second axis in hierarchy is the third axis from the top and has trees on the north side of the street. It is a bit bigger than the two remaining axes and runs from the parking entrance next to the hospital to the water in the west. The two axes ‘lowest’ in the hierarchy are smaller and have a more living and quiet atmosphere. Therefore there are front gardens on both sides of the streets.

The blocks in the area east of the train station have small openings while the blocks in the west area are completely closed off. Together with the hierarchy of the axes and the front garden this leads to hierarchy in publicness.

The analyses of the current situation showed that there are currently no buildings on the northern side of the Jan Evertsenstraat. That means that there was nothing to create space and the feeling of linear connection. This is solved by placing new buildings parallel to the Jan Evertsenstraat. Not just at the station area, but also in the area south of the hospital there are buildings placed parallel to the Jan Evertsenstraat (illustration 180). In between these new buildings and the hospital there are some small green pockets placed so that a bit of a campus atmosphere is created.
Impressions

Bird's eye views
The bird’s eye view impressions (illustrations 181-183) show clearly the organisation of the area next to the train station. They show that there is a hierarchy in the new streets perpendicular to the station. The buildings parallel to the Jan Evertsenstraat form a border of the street while the buildings next to the hospital create small green pockets. The new tower next to the station and the Jan Evertsenstraat forms a spatial relation with two already existing towers next to the Jan Evertsenstraat.
Open space next to the train station

The space under the train station is used for shopping so the space in front of the station is open. The buildings on the other side of this space will also have shopping and other function on the ground floor. With a train station there will attract so many people that shops are viable here. The Space Syntax analysis (Illustration 188) shows that the street in front of the station is quite well integrated which makes shops even more viable here.
**Axis hospital – station**

The axis running from the entrance of the hospital under the railway to the water is the most important one of the east-west axes that is created in the stations area. This importance is represented by two lines of trees and the different surface in the middle. There is a tram stop next to the hospital which means that a lot of people will walk from there to the station which will bring a lot of live in this street. The new buildings adjacent to the street can be used for amenities and there is a place where people can stay with cafes and or restaurants.
Street in front of hospital

The street in front of the hospital (Jan Toorpstraat) is the link between the two city scale axes Jan Evertsenstraat and Jan van Galenstraat. The tram line that comes from the inner city runs over the Jan Evertsenstraat via the Jan Toorpstraat to the Jan van Galenstraat. The Space Syntax analyses show that the street is quite well integrated although not as much as the Jan Evertsen and Jan van Galenstraat. The importance of the street is accentuated by a double line of trees on both sides of the street.

There is an axis running from the entrance of the hospital to the train station and further. The place where this axis crosses the Jan Toorpstraat is accentuated by the pavement and the opening in the double tree lines. The lines of trees that run along the axis are also stopped, so the crossing is an open space. The tram line has its stop right next to this area. That means that both people who want to go to the hospital or the station can use this stop. When the people want to go to the station they can walk on the new axis, bringing this area to life.
Sections

The train station is placed in between two main axes on the city scale, the Jan van Galenstraat and the Jan Evertsenstraat. These streets perform well in the Space Syntax analyses (illustrations 197 and 198). Both streets have a part where a tram line is running on the streets and a part without a tram line. Two sections for both streets have been made, one with the tram line and one without it.

Sections Jan Evertsenstraat

In both sections of the Jan Evertsenstraat (illustrations 194 and 195) there is a single line of trees in between the street and the bicycle path. These trees are placed at a constant distance from each other and are placed in a rectangular green spot. This repetition should lead to recognition so that it is clear for people that this is an important connection in the city.

On the north side of the street there buildings placed which now border the street and create space. There is room for program in these buildings because they are located at a high potential location.

In the current situation there is a ditch running parallel to the street. In the new situation the
ditch is displaced. In the part where there is a tramline the ditch is displaced behind the buildings because of the lack of space. In the part where there is no tram line the ditch is placed between the buildings and the street. This is done to keep the area behind the buildings organised.

The tramline is displaced so that it runs in the middle of the street with opposite direction lanes on both sides. The surface under the tramline is paved and slightly elevated compared to the car lanes.

Section Jan van Galenstraat
The Jan Galenstraat has an extra line of trees compared to the Jan Evertsenstraat and the section is also wider. Besides the line of trees between the street and bicycle path, there is also a line of trees on the sidewalk (illustrations 199 and 200).

Just like the Jan Evertsenstraat the tramline runs in the middle of the street with opposite direction lanes on both sides. However, in this situation the surface is not paved but has grass on it. At the part where there is no tramline this middle isle remains and has an extra line of trees. Since this part is close to a major crossing over the highway the amount of lanes is higher because of sorting.
Principles

The design has some important principles in it. This section will break down some parts of the design into a set of design principles.

Open space next to train station
The space under the station will be used for shops. The space in front of the station will be a pedestrian zone and the space will be open in order to keep the good Isovist qualities. On the other side of the pedestrian zone buildings have to be placed in order to create space. To get the best spatial quality and experience the buildings opposite the station also have to have liveliness on the plinth.

Density & height
The density will be increased closer to the train station. In the area close to the train station is also room for high rise. The higher density leads to a higher mix-use potential.

Mixed functions outside, residential inside
The area east of the station is developed with housing. The buildings on the outside of this development lie adjacent to the more important streets in the area where possibly a lot of people will come. There is the open space next to the station, the axis from hospital to station, the new city scale axis Jan Evertsenstraat and the link between the Jan Evertsenstraat and the Jan van Galenstraat. That is why these buildings have room on the ground floor for mix-use. The inside buildings are focused on housing.
**Hierarchy in axes**
The structure of the area that has been developed next to the station is made by four parallel axes. There is a difference in hierarchy between the axes. The one running from the hospital to the station is the most important one where a lot of people will come. Therefore the buildings can have functions on the ground floor. The other ones have houses on the ground floor where the two axes lowest in hierarchy also have gardens in front of the buildings.

**Axis from hospital to station**
There will be an axis running from the entrance of the hospital to and under the station. In front of the hospital there is a tram stop, meaning that a lot of people will move over the axis between the tram stop and the train station.

**Place to stay**
In the station area there is not only place for people that are on the move but there is also place where people can stay and sit. This place is located close to the station and next to the new axis from the hospital. Two small buildings are added next to an existing building on the north side of the axis which create a nice space.
Using plinth improvement tool for existing buildings
The existing buildings on the south side of the Jan Evertsenstraat have a problem with blind facades on the ground floor. Therefore the plinth improvement tool is used in order to create a better spatial quality, a better experience of the connection and more social security.

Buildings parallel to Jan Evertsenstraat
As found out in the analyses, there are no buildings or other elements on the northern side of the Jan Evertsenstraat to border the street and create space. There is no social control or liveliness on that side of the street. Therefore new buildings are proposed parallel to the Jan Evertsenstraat, which have functions or housing on the ground floor.

Green pockets next to hospital
Between the hospital and the new buildings parallel to the Jan Evertsenstraat there are small green pockets created that give a campus atmosphere. These green pockets give some quiet spaces in a busy area and can be used by the people who live around them and the people from the hospital.
11.6 Current situation small scale connection

The second design is focused on the new neighbourhood scale connection (illustration 211). There are a few important aspects for this type of connection (illustration 212). The experience of this connection should be good and therefore the current building stock around the new intervention is part of the design area. The adjustment of the barrier creates a situation where the space next to the railway currently occupied by the slope of the dike will be free to use. The relation between this space and the connection will be important.

The map in illustration 216 shows the current situation of the design area. It is very clear that there is a lot of green space in the plan area. But the green space is not always of a high spatial quality and much used by the people. The green area on both sides of the railway lies on the slope of the dike and has ditches in front of it. This makes it an inaccessible area. But the green area right next to the ditch on the east side of the rail is not a high quality and well used area even though it is accessible. This area is really the backside of the neighbourhood where all the buildings are turned away from. There are some playing grounds for children in this area, but there is very little social control here because there are storage boxes and bushes placed between the neighbourhood and these playgrounds.
11.7 Landuse small scale connection

The main thing that is determined in the design area of the neighbourhood scale connection is the location of the new connection. The location is chosen based on Isovist and agent based modelling analyses (see section Extra connections).

The way the railway is situated on a dike has been changed (see section Adjustment barrier) which means that the slope of the dike is no longer necessary. The ditch running next to the slope on the east side will be placed closer to the railway so that the space becomes free to use. This space should be used for housing in a way that there is a better spatial ending to the neighbourhood (yellow area in illustration 217). The relation between this area and the neighbourhood should be improved so there has to be made changes to the storage boxes which are currently in between the design area and the courtyards in the neighbourhood.

The relation between the current buildings and the space in front of it should be improvement in a way that it also improves the spatial quality. This is space next to the small scale connection so it should create a nice living environment (light green area in illustration 217).

On the other side of the railway the space will be filled in differently. The Isovist analysis showed a lot of potential when the space next to the railway would be open. However, when this area is completely build up again then the Isovist analysis will show a completely different result. Therefore at least half the space should be kept open. With that condition it would be difficult to create a nice residential area that would not be strongly influenced by the railway and have a strong relation with the surrounding neighbourhood. However, this area is perfectly located for small businesses (purple area in illustration 217). These can be small businesses and small offices for example for start ups or workplaces.

Placing these types of functions on the whole west side of the railway would be too much. Therefore the area south of the connection will be used for a well designed park (dark green area in illustration 217). There should be enough open space so that the visibility of the area is clear. With the removal of the slope and the addition of a new connection this area this green area is well accessible and can actually be used. If the addition of the small businesses in the purple area is a success and there is need to extend than this can always happen later on in this area.
11.8 Design small scale connection

Based on the conditions set with the landuse map a design proposal has been made (illustration 219). The small businesses are placed in a new building which is placed directly against the railway on the west side. They will not be placed under the railway but in a technically freestanding construction. When the dike of the railway and the building for the businesses are two different buildings it will help in reducing the nuisance of the railway. Because the businesses are placed directly against the railway there is still half of the area visually open so that the Isovist characteristics are not completely reduced. A small business incubator could be placed close to the train station to help the area getting started. The park south of the new connection has yet to be designed in a way that the visual characteristics still show potential in the Isovist analysis. Since this park is placed next to the railway, outside the neighbourhood, it is important that this does not become a dark and unclear space where no one wants to come. The new connection will help with that, but the design will have to be good as well.

The current apartment buildings next to the new connection do not have a good plinth situation and in order to improve the experience of the connection and the surrounding spatial quality, the relation between the building and the surrounding space should be improved. Therefore, the tool of the Plinth improvement will be used. The ground floor of the current building will be renovated so that apartments can be placed on the ground floor. These apartments will have their own gardens in front of the building.

The space east of the railway that has come free with the removal of the slope and displacement of the ditch will be filled in with housing. The storage boxes will be removed and new buildings with housing will be place here. These buildings will not be placed in a continuous line but there will be open space between them. This is done so that there will be relation with the existing courtyards and the newly developed space (illustration 218).

Next to these new buildings a new small street will run in north-south direction, parallel to the railway. On the other side of this street, next to the displaced water, new housing blocks will be built. The blocks will be closed for three-quarters, only the side next to the railway will be open because houses here would not be of a great quality. The eastern side of the block helps to create the space around the new north south street. In between the new building blocks are new public spaces created.
Sections

The sections of the new situation (illustration 221) around the railway show very clearly that the area occupied by the railway is strongly reduced. With the new development, the area around the railway has been densified.

All line analysis

The design around the small scale connection has been tested with an all line analysis. In this analysis the design of the station area is also included. It is compared with the situation where the space next to the railway is completely open, again with the design of the station area included.

It is interesting to see that the areas on both sides of the railway perform well. The length of the sight lines has not been changed, because the lines in the east area are still yellow while the lines in the west area are still green/yellow. The only thing that is changed is the width of the area in which the sight lines run, but that is impossible to prevent.
Impressions

Two impressions have been made showing the relation with the new building blocks, the railway and the open space between the new blocks (illustrations 224 and 226).
Principles

The design has some important principles in it. This section will break down some parts of the design into a set of design principles.

**Western area should remain well visible**
Against the west side of the railway new buildings have been placed which give room for small businesses and workplaces. The Isovist analyses showed great potential when the space was completely open. That is why the building is placed against the railway, so that the space in front of it remains open and well visible. If the building would be standing free the space in between the building and the railway would be poorly visible which would destroy the Isovist potential.

**Start developing close to the station**
The western area of railway will be used for small businesses. These are well located because they are close to the new train station. The area north of the new small scale connection will be developed first since this area is closest to the station. The area south of the small scale connection will be used for a park. If the development of the northern part is successful than the southern area can later be developed as well.

**Garden in front of current buildings**
A large part of the current building stock has a blind façade on the ground floor. For this problem a strategic intervention has been made (see Section Improving Plinth). The experience of the small scale connection is also depending on the experience and quality of the current building stock, therefore a scenario from the Improving plinth tool has been used. The small scale connection is a connection on the neighbourhood scale so the scenario that has been chosen is the one where gardens are placed in front of the building. This will create spatial quality and a nice living atmosphere.
North south route should be open
The Isovist and all line analyses showed great potential in the eastern area next to the railway if it was open. In order to create a better ending to the neighbourhood and a better relation with the railway it is interesting to develop the area. In order to keep the positive aspects of the all line and Isovist analysis there should be a north south axis that remains open. That axis will remain well visible from the connections under the railway and vice versa.

Relation with courtyards/neighbourhood should be made
The space next to the railway is currently really the backside of the neighbourhood. The transformation of the rail like however gives the potential to change this and improve the relation of the area next to the railway with the surrounding neighbourhood. Therefore the design opening up the courtyards to the new developed area.

Height of the buildings
The building blocks that are placed close to the railway are not of a constant height. The buildings closer to the railway are lower, meaning that more sun can come into the courtyards of the building blocks and the public space in between the blocks. The higher blocks accentuate the north south axis (see previous principle).
11.9 Sloterplas Development

The extension of the Jan Evertsenstraat has consequences for the Sloterplas. A small part of the Sloterplas will be cut off. Leaving the Sloterplas intact as it is means that the extension will have to be a bridge which is a high investment for a small piece of water. If the small piece of water is filled in, the area can be developed which means it can give some profits (Illustration 233). The location of the area is very good between two well integrated streets, close to a train and metro station and very close to the Sloterplas. This means that a nice residential area can be developed here. That will also have a positive influence on the quality of the new city scale connection.

This area will not be designed in this project because it is not a direct solution to the problem that is researched in the project. However, two scenarios for the development of this area have been researched and tested. The first scenario shows what would happen if the streets of the surroundings would be continued in the area, which would have consequen-
ces for the existing building right next to the current Sloterplas (illustration 234). The second scenario shows what would happen if the current buildings and structures would remain (illustration 236). Both these scenarios have been tested in Space Syntax.

The space syntax analyses show that the first scenario works better than the second scenario. When the link is made with the more important streets in the surrounding the new streets in the development area slightly perform better. But the existing streets in the developed area also perform better. Scenario 1 has a much bigger impact than scenario 2 because some buildings will have to be demolished. This is an energy waste because the energy put into the current buildings is much more than could be gained back with putting new energy efficient buildings.

Scenario 1 looks more promising because it has a positive effect on its surroundings and it creates the opportunity to develop a nice new residential area on a top location.
12. Desired living environment

Dynamic living environment

In the vision of the city district Nieuw West the ring zone area is desired to be an area with a dynamic living environment as opposed to the other areas in Nieuw West which are designated to become either a quiet or free to develop area. The current situation of the area is far away from having a dynamic living environment. There are very little places with mixed functions in the ring zone. There are some larger scale functions but they stand alone and do not a more vibrant street life.

However, even though the current situation is far from having a dynamic living environment, the ring zone actually has the potential in having this type of living environment. It is a perfect place to create this type of living environment because it is strategically located with good large-scale connections. That makes it an interesting future living environment for the research area. In order to achieve this living environment, the negative aspects of the infrastructure have to be dealt with.

Definition dynamic living environment

A dynamic living environment is a living environment where more is happening and to be done than just living. It is an area which is characterised by its multifunctional atmosphere. Functions like shops, restaurants and bars can be found in the area and since it is a dynamic area these functions sometimes might include the trendy ones.

The area will be a high urban area as opposed to the garden city characteristics of Nieuw West. However, the quieter green areas for recreation are never far away. With a high urban area there will also be higher density in the area. The city of Amsterdam needs to increase the density in order to accommodate the extra demand for houses and the ring zone is the perfect area to realise the densification. A higher density also means that the shops, restaurants and other functions are also more feasible. The area will have excellent public transport connections in order to compete with the car use. There will be both working and living in the area while it will attract more young people.

How do the proposed interventions lead to this desired living environment?

The proposed strategic interventions will help in realising this desired living environment. All the interventions together will result in a strong reduction of the negative aspects of the surrounding large-scale infrastructure. However, the positive aspects of these large-scale infrastructure lines are still there and even improved. The area in the ring zone is very well integrated on the regional and even national scale. It is also very well connected with the international airport Schiphol.

The new added train station will attract more people to the area because functions around it will be more feasible with the increased accessibility. Both the ex-
tra people and functions will add more liveliness in the area. Since the area will have an increased accessibility, it will be more attractive for people to live in the research area. And lastly, the increased public transport accessibility means the pressure of the car use can be reduced (although maybe just slightly).

The improved city scale connections means that the ring zone is better connected with the inner city and becomes the centre of the improved connection between Nieuw West and the city centre. The improved connectivity on the city scale means a better potential for the area.

The adjustment of the railway means that the railway occupies less space. This space will be used for new developments which mean it densifies the ring zone area. It will also create a space with better spatial quality and a better ending of the urban fabric. This should increase the potential in the area.

Extra connections under the railway have been added which should increase the small scale mobility and accessibility. The area is in the current situation already well connected on the large scale but that will also be improved with the new train station. Then the connection on the city scale is improved with the extension of the Jan Evertsenstraat and the connection on the small scale is improved with the new passings under the railway. So the connectivity has been improved on three scale levels which greatly enhance the potential of the area.

The interventions creating line and plinth improvement will improve the spatial quality of the area, which means there will be better living environment. These interventions also give the possibility to add more and different functions on the street level which is an important characteristic of a dynamic living environment.
13. Conclusions
The research has tackled generic problems caused by large-scale infrastructure and specific problems found in the research area. This section explains the conclusions that can be drawn based on this project.

General

Urbanism is a multiscalar discipline, which means that interventions proposed on one scale level can have an effect on a different scale level, both intentional and unintentional. Large-scale infrastructure is meant to make a connection on the large scale (regional, national or international scale) but can cause problems on the smaller scale when placed in an urban landscape.

This problem has different elements in it and can be tackled by a set of interventions on multiple scale levels. The scale levels on which the interventions in this project work on are:
- City scale
- District scale
- Neighbourhood scale
- Building scale

City Scale
Large-scale infrastructure can work as a barrier on the city scale where it can separate whole city districts from each other. This means that some city districts are excluded from other areas in the city which could have great value for them.

A solution to this problem is to improve the city scale connections. This can be done by either improving existing connections or adding new connections. These connections should be well integrated in the fabric (which can be tested with Space Syntax analysis) and the experience of the connection should be good.

District scale

The way that the large-scale infrastructure is situated in the urban landscape has an influence on how big of a barrier effect it has. The space occupied by the infrastructure can be very large and the spatial quality of the border between the infrastructure and the urban landscape can be poor.

A transformation of the infrastructure can help in both aspects, it can help in reducing the amount of space occupied by the infrastructure which than can be used to upgrade the spatial quality and possibly add new developments. This can lead to a better relation between infrastructure and the urban surroundings.

Neighbourhood scale

A problem of the large-scale infrastructure can be that there is a lack of connections under or over it which causes a strong break in the urban fabric. Adding new connections that work on the neighbourhood scale this break in the urban fabric can be reduced. The location of these new connections should be based on the situation in the surrounding neighbourhoods for which Isovist and agent based modelling analyses can be used.

Building Scale

Connections under or over large-scale infrastructure can help in reducing the barrier effect of the infrastructure. It is not just the amount of connections there are but also the quality of the connections is important. With the right quality the experience of the connection will be optimal so that people actually will be using the connection.

The experience of the connection is determined in the spatial quality around the connection which is strongly influenced by the surrounding buildings. What happens on the ground floor of the buildings around the connection has an effect on the experience of the connection. It is very important that the plinths of the buildings are not just some blind facades but actually contain some functions.
Specific

In this project the area around the western ring road and railway in Amsterdam has been chosen as a research area. For this area a vision has been made as well as a spatial strategy to achieve this vision. Based on research and analyses the railway turns out to be biggest barrier in the research area and the goal is to create a situation where it works less as a barrier for its urban surroundings. The strategy consists out of a set of proposed interventions that tackle the different problems caused by the railway.

Train station

The first major intervention that is proposed is the first major intervention that is proposed is the addition of a new train station. It is located in-between the existing train stations Amsterdam Lelylaan and Amsterdam Sloterdijk. Adding a new train station means that more people in the area can make use of the network of which the railway is part of. The station enhances the potential of the area around it and creates a situation where it is more likely to have a dynamic living environment. The station area is a place where functions can flourish, which attracts people instead of turning them away. It is the central place in overcoming the barrier that the railway currently is.

Extension axis

The infrastructural barrier excludes the city district Nieuw West from the inner ring city. By improving the connection on the city scale this barrier effect can be reduced. In the spatial strategy for the research area this is done by extending the Jan Evertsenstraat. The Space Syntax analysis of the current situation showed that the Jan Evertsenstraat performs well but does not run into Nieuw West. An extension of the Jan Evertsenstraat into Nieuw West showed very promising result in a Space Syntax analysis. In order to let it function properly as a new city scale connection the open space next to the street is redeveloped.

Adjustment barrier

In the current situation the railway is situated on a dike with wide slopes and occupies therefore a large space. In the spatial strategy an adjustment on this situation is proposed. There are two different transformations proposed. At the location of the new train station a transformation is proposed where functions will be placed under the railway. This is feasible around the new station because the station will bring many people to this location. For the other part of the railway a transformation is proposed where sheet piles are placed in the dike so that the slope of the dike can be removed, that will reduce the width of the barrier and creates the opportunity to redevelop the area next to the rail in a way that the spatial quality is improved and a better ending of the neighbourhood is created.

Extra connections

There are very little connections under the railway in the research area compared to the highway in the research area. Therefore new connections under the railway are proposed. These new connections are based on the spatial layout in the surrounding neighbourhoods. The analyses of the current situation are used to find potential locations for the connections which are then drawn and tested with Isovist and agent based modelling analyses. These results showed that the surrounding neighbourhoods could profit from the new connections and that there is a lot more potential for a more lively and dynamic neighbourhood.

Improving Plinth

Since the extra connections are placed based on the spatial situation in the current surrounding neighbourhoods, the experience of the connections is also based on the experience of the current neighbourhoods. The neighbourhoods are built after the war and that is reflected in the buildings. A large part of the current building stock has no housing or functions on the ground floor, just storage space. That leads to bland facades on the outside of the buildings which does not create a proper experience. Therefore a transformation of these type of buildings is proposed where the ground floor is reused for either housing or amenities.
14. Recommendations

When to use the framework provided by this project?

This research project has created a strategic framework that creates a better relation between large-scale infrastructure and its surrounding urban landscape. This framework can be applied in two situations, the first situation is when an already existing large-scale infrastructure line works as a barrier, like in the research area of this project. In this situation an analysis of the situation should be made where the problems that are caused by the large-scale infrastructure are identified. Then the toolbox created in this project can be used, leading to the necessary interventions.

The second situation is when a new large-scale infrastructure will be made which runs or later may run through urban areas. In that case the strategic interventions can be used for guidance in planning and designing the large-scale infrastructure.

What products could be added in this project?

A project is always restricted by time. If there was more time to work on this project then there are some things that could be added or improved.

First of all, it could be further investigated how the interventions and the design could be realised. For that, it would be good if an analysis of all the actors involved would be done in order to understand who has to do what and who benefits. Understanding who would have to pay and why. The investigation in how the elements could be realised it is also needed to make a phasing. With the current economic climate it is not realistic that big projects are developed all at once, so it is important to think how it could be developed step by step. The first steps could be the catalyst for the other interventions.

Secondly, the details in the two designs proposed in this project could be worked out more. The designing is done mostly in one scale so there is room to go deeper into the design.

Lastly, the extension of the Jan Evertsenstraat cuts off a piece of the Sloterplas. This area has a lot of potential to be redeveloped because it is close to the new station, two city scale axes and a nice city lake. In this thesis two scenarios are explained but these are still very superficial. The reason for that is the fact that this development is not a major part of the solution of the main research question.

What could a follow up study be doing?

The research project provides a specific and generic framework in overcoming large-scale infrastructure as a barrier in an urban environment. A follow up study could be interesting when focussed on the generic framework. It could be researched if and how the toolbox could be improved. Are there more scenarios for the interventions or are there more interventions possible? Could there be more interventions on the building scale or even smaller scale?

It would also be interesting to research how the toolbox works with other types of large-scale infrastructure, besides railways. One of the main interventions in the toolbox is the addition of a new station, but the question is if a comparable intervention is possible for highways for example.
Bibliography


Appendix I
Reflection

Problem statement

Urban design and planning is a profession that requires looking at different scale levels and how these interact with each other. Urban designers or planners often try to connect different areas with each other because they believe that this makes the connected areas stronger. The main way to connect areas with each other is by making an infrastructural connection. Infrastructure is a great way to connect different areas and people. Strong connections (fast connection, good capacity) require large-scale infrastructure but there is a contrast between these large-scale infrastructure because while they make a connection on the large scale they can act as a barrier on the local scale and cause spatial fragmentation in urban landscape.

A good example of this contrast is noticeable with ring infrastructure like ring roads and ring railways. They are built to divert traffic around the city centre but the cities did not stop expanding after the infrastructure was built. These new urban expansions were now excluded from the inner city.

Structure of the project

The graduation project starts with an analysis of the general problem, based on a literature and web research. This gave a framework and basic understanding of the project.

Based on this problem analysis a design case study has been done for five cities in the Dutch and Belgium contest. The cities have been compared with each other and lead to two main things. First the location for a research area has been chosen (the area between the west ring of Amsterdam and the parallel running railway) and secondly a set of criteria that show how large-scale infrastructure works as a barrier has been determined. These criteria are a generic set, so they are not only applied on the research location. These criteria form a framework in which the proposals for the research are related to.

The research location has been analysed further to understand its characteristics, trends and problems it has with its surrounding infrastructure. Based on these analyses and the problems potential interventions have been researched and some of these interventions have been tested in computer models like Isovist and put together in a strategy. The proposed interventions are location specific, however the problems they tackle fall under the definitions set with the list of criteria. That is why a tool box has been developed to show how the local specific interventions can be used in other situations with similar problems and how these interventions can be tested.

The local specific interventions have an impact in the plan area so the spatial consequences of the proposed interventions are shown in a design. This design should lead in the future to a dynamic living environment in the research area.
Reflection on methodology

Working towards the P2 presentation a methodology scheme was made. This scheme showed the steps taken and what steps would come next. The scheme showed how the general problem and the context lead to a comparison of five cities in the Dutch and Belgium context. This comparison leads to the location of a research area, to some example of used strategies to tackle the problem and a set of criteria defining the problems that large-scale infrastructure gives. The idea was then that this should lead to a specific strategy which should lead to a specific design and then it should be researched how these specific elements could be used in other situations as well.

Now finishing the P4 booklet a new methodology scheme has been made to see how the actual steps were after P2. The basic idea in the P2 scheme where the defined criteria, the characteristics of the research area and the inventory of possible strategies should lead to a specific strategy and that should be a specific design. Both the specific strategy and specific design were considered equally important. However, during the process there was a change. There was much more focus on the strategy and its strategic actions and how these actions could tackle the generic defined problems (criteria) represented in the research area. These leads to a new step in the scheme because a toolbox was developed to show how the specific interventions of the strategy could be used in other situations. So the emphasis was much more on the toolbox and especially the strategy with its associated actions than on the specific design.

A very crucial step in the process was the comparison of the five cities. After the P1 there was still some doubt about the location for a research area and therefore a comparison of five cities was made in or-

Illustration 2 Methodology Scheme before P2 Source: Author

Illustration 3 Methodology Scheme before P4 Source: Author
der to make a well thought and argued choice for the research location. But this comparison study gave a lot more and was more useful. It tremendously helped in understanding the problems of the large-scale infrastructure and made it possible to create a set of criteria. These criteria have been used as a framework in the project helped to evaluate the strategic interventions and helped in creating the toolbox.

Relation between research & design in the project

The strategic interventions have been a key aspect in the project. There was not a single intervention that came out of the blue. Each of the interventions has been tested and researched in order to find the optimal solution. There have been two basic ways of testing an intervention. The first way was to make scenarios. For example, when analyses showed that the way the railway was situated was maybe not optimal a research has been done to see in what other way the railway could be situated. A list of scenarios was made and then the scenarios were compared with each other to see what benefits and problems each option would give and how realistic and feasible they were.

The second way of testing was with computer models. Analyses like space syntax, isovist, agent based modelling and all line give information about certain characteristics of an area or street. This can be the integration of street or visual characteristics. The testing was done by drawing the possible changes into a map of the right format and then the map was analysed with one or more of the analytical tools. The results were compared with the results of the analyses of the current situation. Based on the test results, more or different interventions were researched when finally the interventions with the best result (based on the problem that needed to be solved) were chosen.

Relation with project and studio

The chosen graduation studio was the studio Urban Regeneration. It is about regeneration existing urban areas in the western European context and is closely related to the research studio design of the urban fabric. According to Machiel van Dorst, one of the coordinators of the studio, the mission of this research studio is to ‘understand, through research, how we can contribute to the making of sustainable, attractive and vital urban design’. The problem of large-scale infrastructure is that it can act as a barrier and can cause spatial fragmentation, therefore disrupting the urban fabric. Because it acts as a barrier, the large-scale infrastructure can exclude urban area from other vital, attractive and high value urban areas. This can give problems for people in the excluded areas. This is not a sustainable and definitely not an attractive situation and the people living in the excluded area suffer from it. And we make cities for the people living in them, so it is important that we think of them when designing (or redesigning) the cities.

Relevance

Infrastructure is an important tool in the discipline urbanism because it can create connections. In world that is more and more connected it is very important for a city or region to connect itself with other cities/regions, even if they are geographically far away, via large-scale infrastructure. But the large-scale infrastructure can act as a barrier and exclude urban landscape from other urban landscape. This separation can have a societal impact where for example areas outside a ring road are considered less good than the inner city. Or one side of the railway is ‘good’ while the other side can be considered ‘bad’.

The problem is recognised in the scientific world and much research has been done on this topic. On this faculty there have also been many researches on this topic, which has been used in this graduation project.
Illustration 4: The goal is to let the different scales work together, as well as large-scale infrastructure and the local urban environment. Source: Author
Appendix II

Computer model tests
Scenario building in open space next to railway and train station, all line analysis.

Scenario building in open space next to railway and train station, all line analysis.

Scenario building in open space next to railway and train station, all line analysis.
Scenario building in open space next to railway and train station, all line analysis.

Scenario building in open space next to railway and train station, all line analysis.

Scenario building in open space next to railway and train station, all line analysis.
Appendix III
Design studies & scenarios
Appendix IV
Policy documents
Amsterdam

These are four pages out of the policy document “Toekomstvisie 2020” made by the municipality of Amsterdam and the city district Nieuw West (2013) in which a vision for the future of Nieuw West is presented. There will be extra public transport routes and there three types of preferable living environments.
The city district Nieuw West made a strategy for the Sloterplas called Ontwikkelstrategie Sloterplas (2013) in which they seek the opportunities that the Sloterplas can give.
The municipality of Amsterdam made a strategic plan for the city of Amsterdam in which the ring zone West plays an important role (2012).
Plannen voor woningbouw en strategische locaties

Infrastructuur, Connecting Barriers - Graduation Project - 06/05/2014 - Luuk van der Bugt - 1210629

De meeste locaties voor woningbouw-projecten liggen in de ringzone.

Gemeente Amsterdam. (2012)

Gebiedsindeling

Locaties met grote verdienpotentie

Projecten waar per ge-investeerde Euro het hoogste rendement gehaald kan worden liggen voornamelijk binnen de ring en in de ringzone.

Gemeente Amsterdam. (2012)
Zone Buiten de ring

Gemeente Amsterdam (2012)

Infra- en Openbare Projectlocaties OGA

- Projectlocatie plaats
- Projectlocatie zonder grenen
- Pijlweergave ingrediënt voor de planzaak 2012
- Hername Beneden Verouweg 2012 (HDV)

Infra- en Openbare

- Stratenrout te ontwikkel/uitbreiden
- Boutenbrug tijdelijk
- Bouwmond rect
- Ondergrondse bundel
- Beter beneut pakwegraags
- Touwspanen fietstenningen

Gemeente Amsterdam (2012)
'Levensverwachting daalt door 100 op A10'

Door de snelheidsverhoging op de A10-West van tachtig naar honderd kilometer per uur lopen tienduizenden Amsterdammers een groter risico op luchtwegaandoeningen en chronische ziekten.

Hun levensverwachting daalt met 79 dagen, zei Milieudefensie. De organisatie baseert zich op metingen van de GGD. De organisatie kaart haar bezwaren tegen de verhoging vrijdag aan bij de rechtbank in Amsterdam.

De uitstoot van roet en stikstofdioxide is volgens Milieudefensie, sinds de snelheid vorig jaar juli werd verhoogd van tachtig naar honderd, met 7 procent toegenomen. Dat is ongeveer evenveel als langs de A13 bij Overschie, waar de snelheidslimiet vorig jaar ook is verhoogd.

In Amsterdam is de vervuiling echter groter en er wonen meer mensen, aldus Milieudefensie.

Milieudefensie stelt dat de extra vervuiling bijna vijf keer hoger is dan door minister Melanie Schultz (Verkeer) was voorspeld. Ook de gemeente Amsterdam is over de snelheidsverhoging De concentratie stikstofdioxide komt volgens het rapport uit op 55 microgram per kubieke meter. Dat overschrijdt de Europese norm van 40 microgram per kubieke meter fors - een norm waar heel Nederland over een jaar aan moet voldoen, stelt de milieuorganisatie.

Minister Schultz", aldus Ivo Stumpe van Milieudefensie. De club eist dat de maximumsnelheid op de A10 weer teruggaat naar tachtig kilometer per uur. Dat levert de automobilist 44 seconden vertraging op, zo is becijferd.

Bij die eis sluit GroenLinks zich aan. Tweede Kamerlid Liesbeth van Tongeren wil dat de snelheid direct omlaag gaat op de ringwegen. "Voor 44 seconden tijdswinst op de weg, sterven omwonenden gemiddeld 79 dagen eerder. Dat zal echt niemand acceptabel vinden", aldus het Kamerlid. D66 grijpt het onderzoek van Milieudefensie aan om nogmaals te hameren op een extra gezondheidscheck langs de trajecten waar de snelheid is verhoogd. "Natuurlijk is het belangrijk om door te kunnen rijden, maar de minister kan niet zomaar voorbij gaan aan de gezondheid van de bewoners", vindt Kamerlid Stientje van Veldhoven.

Milieudefensie stapte eerder ook voor de snelheidsverhoging op de A13 naar de rechter. Die bepaalde vorige week dat minister van Infrastructuur en Milieu Melanie Schultz van Haegen (VVD) fout zat.

Ze heeft de belangen van omwonenden te weinig meegewogen en moet opnieuw een beslissing nemen over de bezwaren tegen de verhoging.

Nitrogen dioxide emission road traffic

The speed limit increase on the Dutch highways has an impact on the people living in close proximity of a highway. This is especially the case with the A10 West because the urban landscape lies very close to the highway (Novum/ANP, 2013).
This is a map of all the current tram and metrolines in Amsterdam.

www.amsterdam.nl
The municipality of Amsterdam provides a lot of maps with data in it.
The municipality of Rotterdam made a vision (2007) for the city in which they have visions and strategies for several aspects.
Vlaamse regering kiest voor verbreding Brusselse Ring

25/10/2013 om 13:56 - Bijgewerkt om 14:05

De Vlaamse regering heeft de knoop over de Brusselse Ring doorgehakt. De regering kiest ervoor het lokaal en het doorgaand verkeer te scheiden, met op de meeste plaatsen 3 rijstroken voor doorgaand verkeer en 2 rijstroken voor lokaal verkeer.

Bedoeling is dat eerst (vanaf 2016) de werken in de zone Zaventem starten. Die zone is op sommige plaatsen al meer dan 10 rijstroken breed, dus daar zullen de werken het minst ingrijpend zijn.

De kosten van de werken in de zone Zaventem worden geraamd op 98 miljoen euro. Aansluitend wordt de rest van de Ring aangepakt. Die werken zouden zo’n 280 miljoen euro kosten.

De Vlaamse werkgeversorganisatie Voka juicht deze "historische beslissing" toe. "De beslissing is uitstekend nieuws voor alle mensen en bedrijven die gebruik maken van de ring", zegt Voka-gedelegeerd bestuurder Jo Libeer.

Toch is deze oplossing niet voldoende. De werkgeversorganisatie dringt aan op een duurzame combinatie van de verschillende vervoersmiddelen.

'Meer fijn stof en gezondheidsproblemen' (Groen)

Oppositiepartij Groen is tegen de aanpak van de Brusselse ring door de Vlaamse regering. Ook de groenen zijn voor een scheiding van het lokale en het doorgaande verkeer, maar willen daarvoor geen extra rijstroken. Dat de regering de ring op sommige plaatsen wel wil verbreden, zal zorgen voor meer fijn stof en gezondheidsproblemen en het fileeleed verplaatsen naar de open afritten, luidt het.

"Een verbreding van de ring schaadt de gezondheid en de levenskwaliteit van duizenden omwonenden in Brussel en Brabant", reageren parlementsleden Hermes Sanctorum en Anemie Maes. Zij vrezen dat nieuwe rijstroken extra auto’s zullen aanzuigen, met meer fijn stof en meer lawaai tot gevolg. De groenen waarschuwen ook met een berekening van Transport and Mobility Leuven waaruit zou blijken dat de kosten van een verbreding niet opwegen tegen de baten.

'Beslissing blijven aanvechten' (Greenpeace)

Ook Greenpeace is niet tevreden maar geeft de strijd niet op. "Wij zullen deze beslissing blijven aanvechten tijdens de vergunningsprocedure", zegt Joeri Thijs van Greenpeace. "Want er zijn voldoende andere alternatieven. Het verbeteren van het openbaar vervoer zou al veel kunnen oplossen", besluit hij. (Belga/TE)
In the researched area of Brussels are several governments in charge which all have their own plans and visions.
Infrastructuur: Connecting Barriers - Graduation Project - 06/05/2014 - Luuk van der Bugt - 1210629

Gemeente Machelen (2008)

Stad Vlivoorde (2008)

Stad Vlivoorde (2008)
Antwerp

The city of Antwerp has made an extensive vision for the city in which the ring road is designed as a 'green river' through the city.

GROENE RIVIER

De Groene Rivier is het basisconcept voor de herinrichting van de Groene Singel. Het concept vertrekt van de stedenbouwkundige logica van de ruimte, die in grote mate wordt bepaald door de contouren van de voormalige Brialmontomwalling en de daarin ingebedde infrastructuur. Die historische contouren zijn overigens nog goed afleesbaar op kaart en luchtfoto.

Het concept van de Groene Rivier maakt van deze eigen logica een troef. Infrastructuur, landschap en bebouwing van de Groene Singel moeten dan ook anders zijn dan in de binnen- en buitenstad. De Groene Singel moet in de stad even herkenbaar aanwezig zijn als de Schelde.

De logica van de Groene Rivier wordt verder vertaald in de overige tien concepten.
CONCEPTEN VOOR HET LANDSCHAP

In de langszijde wordt met het concept van het Bermenlandschap ruimtelijke eenheid gecreëerd. De bermvegetatie en het reliëf worden zo gemodelleerd dat er samenhang in een informeel landschap wordt gebracht. Het landschap wordt ook ingezet om het groentekort in de stad te vangen en de lucht- en geluidskwaliteit te verhogen. Het is een ecologische corridor voor fauna en flora met een verkoelend effect op de stad.


De grote parken van Antwerpen bevinden zich in de buitenstad en worden van de binnenstad gescheiden door de infrastructuurbundel van Ring en Singel. Die barrière maakt de parken vanuit de binnenstad moeilijk bereikbaar, terwijl net in het stadscentrum het groentekort het grootste is. Het concept Parkverbindingen laat deze grote parken daarom aansluiten bij de binnenstad via een uitbreiding over en door de infrastructuur heen.


CONCEPTEN VOOR INFRASTRUCTUUR

Binnen het concept Multiway Boulevard heeft elke verkeersstraat zijn eigen functie. Het bovenlokaal verkeer blijft in de bedding van de Ring rijden en het lokaal verkeer komt op de Singel terecht. Stedelijke en grootschalige functies die bovengelokaal (auto) verkeer gerenereerden, worden geconcentreerd nabij openbaar vervoerknooppunten en op- en afritten van de Ring. Lokale functies die weinig autoverkeer generereren, kunnen een plaats krijgen in de ruimte tussen die grootstedienden functies. Een nieuwe Singeltramlijn vormt een belangrijke aanvulling op het bestaande netwerk van centrumgerichte openbaar vervoerlijnen.


CONCEPTEN VOOR BEBOUWING

Het versterken van de contouren van de Groene Singel door middel van Randbebouwing is noodzakelijk voor het beleefbaar en leesbaar maken van de figuur van de Groene Rivier. In een aantal geselecteerde randzones van de strategische ruimte is bebouwing mogelijk onder strikte voorwaarden. Op die manier wil het stadsbestuur aangenaam wonen met zicht op de Groene Rivier mogelijk maken.

In de loop der jaren ontwikkelde de zone langs de Singel zich tot een belangrijke kantoorlocatie met hoge parkeerdruk en veel bovenlokaal verkeer. Om die trend te keren, worden nieuwe toplocaties en kantoorlocaties opgevat als Keien in de Groene Rivier. Het betreft compacte ontwikkelingen op openbaar vervoerlocaties, die worden geënt op een bij voorkeur rechtstreeks via de Ring ontsloten parkeersystemen. Op die manier wordt de open ruimte gedaald en worden de Singel en de omringende wijken gevrijwaard voor groen. Daarom zijn er – behalve op top- en kantoorlocaties – uitsluitend lokale publieke voorzieningen toegestaan.