

# *Put the bike on top!*

Improving the cycling system in Lund  
using the Dutch city of Leiden as an example

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# General introduction

Dear reader,

Welcome to my thesis and thank you for reading!

I am currently studying in the city of Lund, which is a city that is known for having a lot of students and lots of biking. This project will focus on the second part, the biking. I was born in the Netherlands, and this is where I spent the first 21 years of my life. The Netherlands are well known for being a country that is incredibly bike friendly. Therefore, I biked (almost) every day from the age of 6. This means that I fancy myself somewhat of a biking expert.

As a self-proclaimed biking expert, as well as an urban design student, it was impossible for me not to think about how biking is organized in Lund. I found that when biking in Lund, the physical infrastructure of the city does not give a high priority to cyclists. With that in mind, I decided to write this thesis to explore my ideas on cycling in Lund, and to see if I can contribute to the discussions around cycling. I therefore ask the question:

***“How can Lund be improved to show that cycling is a high priority?”***

Since this is a very large question with many possible answers, this thesis is divided into three scale levels:

*City level*

*Social level*

*Street level*

Each of these levels has one or several focus points, which will anchor the research. For the city level, these points are topography and connectivity. The social level focuses on social equality and education. The street level will focus on materiality, traffic lights, accidents, parking and speed differences, and includes a detailed analysis and design of the city centre.

To gain a greater understanding of the challenges Lund faces as well as the possible solutions, this thesis includes a comparison study between Lund and the Dutch city of Leiden. The reason why I choose to compare Lund to a Dutch city is because I believe that the Netherlands gives an example of what cities can look like when cyclists are given a high priority. It is such an important mode of transport in our country, that this is visible in almost every traffic situation. The choice for the city of Leiden was made because of the similarities between the two cities, which will become clear in the city overview.

## Why does the bike network need to be improved?

You might be reading this and thinking,

*“Why does cycling need to be improved in the first place?”*

or

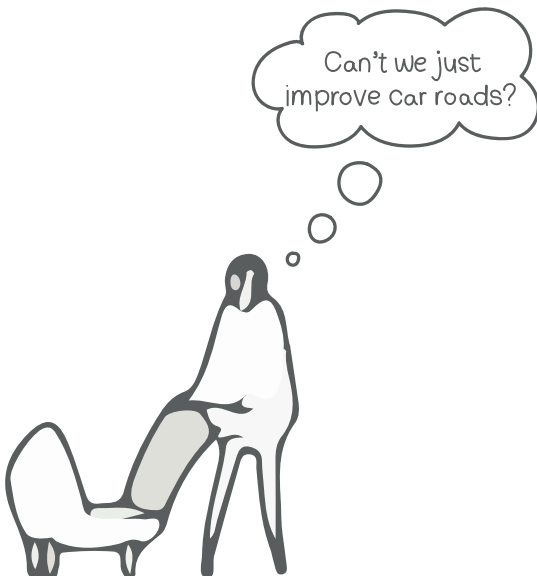
*“Can’t we just keep using the car or public transport?”*

I’d like to convince you why it is important to have a good bicycle network, and why it should be improved in the case of Lund.

The bike is an incredible mode of transportation for many reasons. For instance, it is a great boost to physical and mental health of the cyclist, while providing independence and flexibility.

Besides that, the bike takes little resources to make, is relatively cheap, and does not produce toxic emissions. This makes it an ideal mode of transportation for the environmentally conscious city. Since the climate crisis is such a pressing issue, becoming more environmentally friendly is a big goal for the city of Lund. Because the bike can play such an important role in this, and the use of the bike in Lund is declining, improvements can be made.

Improving the bike network will not only promote bike use and make Lund more environmentally friendly, it will also markedly increase traffic safety. Seeing as around 340 cyclists are hurt in traffic annually, improving traffic safety is a prominent issue.



# City Level

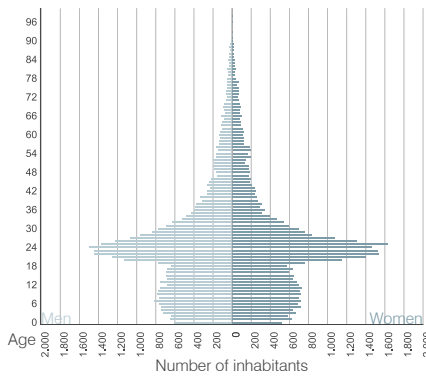




# City introduction

## Lund

Size	25,75 km <sup>2</sup>
Inhabitants	124.935 (2019)
Density	4.852 inh./km <sup>2</sup>
# Cars	36.980 (2019)
Trips by bike	42% (2019)



Lund is a medium sized city in the south of Sweden. It is located in the Skåne province, and is part of the Öresund region. Lund is known for being a university city with students forming around half of its population. It has a strong student life with many study-, and student-organizations. The main attraction of the city in the cathedral, which was built over 1000 years ago, and is the most visited cathedral of Sweden.

Lund university was founded in 1666 which makes it the second oldest university of Sweden. Since the university was founded so long ago, it has had a large influence on the city structure. The original university buildings are located in the middle of the city, as well as several other university buildings. There is a botanical garden right outside the centre, and a large campus stretching from the city centre to the edge of town to the north east. Lund also

has many student housing complexes throughout the city.

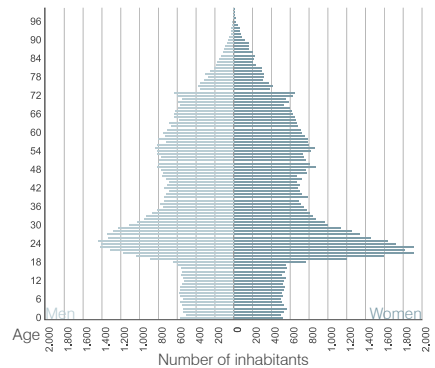
Lund municipality is hoping to create a better milieu for cycling in order to lower the CO<sup>2</sup> emissions created by cars in the city. At the moment the increase in the number of inhabitants is larger than the increase in bike users. This constitutes a percentual decrease of bike users. To stimulate Lundians to bike more, the municipality has written a bicycle strategy which will hopefully generate an increase in bike usage. This strategy will be discussed more in the city introduction on pages 16 to 19.

## City introduction

Leiden



Size	23,27 km <sup>2</sup>
Inhabitants	125.099 (2020)
Density	5.376 inh./km <sup>2</sup>
# Cars	39.585 (2019)
Cycles daily	68% (2019)



Leiden is a medium sized city in the Netherlands. It is located in the province Zuid Holland, and the Randstad region. The city is known for its university and strong student culture. Leiden is built on the banks of the Rijn which flows from east to west through the Netherlands and finds its origin in Switzerland. The presence of the river has led to the building of several canals and waterways used for defense of the city, transport within the city, and transport to surrounding cities.

Leiden is home to two universities and a college, with Leiden university being not only the oldest of the city, but of the country as a whole. The university has known many famous professors, for example Albert Einstein, and has many famous alumni, including our current prime minister, Mark Rutte, and king, Willem-Alexander van Oranje Nassau. Because the university was founded in 1575, it has had a big influence

on the city form. It's buildings take prime place in the city centre, and the botanical garden is still located within the original protective waterways.

Since cycling is such a large part of Dutch culture, most municipalities have a bicycle strategy to help create a safer and better cycling environment and Leiden is no exception to this. Leiden will try to increase bike parking, and create better cycling connections both within the city and to neighboring cities. By doing this, they hope to see an increase of 40% in the number of cyclists between 2020 and 2030. The bicycle strategy will be discussed further in the city introduction on pages 16 to 19, after a brief dive into the histories of Lund and Leiden through a timeline.

# Historic Timeline

## Lund



A sketch of what Lund would have looked like around 1150 including the cathedral and city wall

Lund is founded

990

A city wall and rampart is built around Lund

1134



The wall around Lundagård

A wall is built around Lundagård

1459

The Swedish king Gustav Vasa reforms Sweden to protestantism

1527



Lunds first apothecary

The first apothecary of Lund opens on the same location as the current Svanen Apotek

1624

The treaty of Roskilde is signed, Skåne now officially belongs to Sweden

1658

Lund university is founded

1666



 City Expansion

 Memorable Fires  
12 - City Level

 Disease

860

First mention of Leithon (by the waters)

# Historic Timeline Leiden

1200

The first defense waterway is dug. The waterways were used for defense and transport



Estimation of the situation at the beginning of the 13th century

1266

“The birth of Leiden”: Earl Floris the fifth acknowledges and expands the city rights of Leiden

1335

The first city wall is built

1450

Stone roofs become mandatory for fire safety



Leiden is liberated from the Spanish 1574 by W.H. Hoogkamer ca. 1750

1550's

Johannes Calvijn rises in popularity and protestantism (calvinism) is adopted in the northern Netherlands

1574

Leiden is under siege by the Spanish until 3 october, when the Watergeuzen flood the Rijnland and the Spanish are defeated. Leiden is liberated.

1575

Willem van Oranje gifts Leiden a university, the first in the northern Netherlands

1600's

The connection with surrounding cities -Haarlem, Delft, Den Haag, Utrecht- is improved through efficient trekschuitdiensten, boats pulled by horses



City level - 13  
Trekschuit between Den Haag and Delft. Unnamed, 19th century

# Historic Timeline

## Lund



The battle of Lund by Johann Philip Lemke (1631-1711)



Lilla torget with Lundagård in the background around 1800



The first steam engine at Berlings Stilgjuteri

The battle of Lund, the final battle in the war between Sweden and Denmark  
Lund university closes temporarily as a result of the unrest

Denmark and Sweden declare peace

Lund university opens again

Lundagård is given to the university

A new fire decree announces that all roofs must be made of stone within 20 years

Lunds first steam engine is installed in the steel factory

Train tracks are built between Lund and Malmö

Lunds Tekniska Högskola (LTH) is founded

Norra Fäladen is built

1676



1679

1682

1688



1734

1845



1865



1961

1966



City Expansion



Memorable Fires  
14 - City Level



Disease



1670

After several city expansions, the current city centre with its canals and narrow streets is fully formed

## Historic Timeline Leiden



Three days after the gunpowder explosion of 1807 by Johannes Jelgerhuis (1770-1836)

1807

A ship filled with gunpowder explodes in the heart of the city. 160 lives are lost and the city had no funds to rebuild the gaping hole left by the explosion

1816

The first steam engine in the north of the Netherlands is installed in Leiden

1842

Train tracks are built between Leiden, Haarlem, and Den Haag



Statue of Van der Werff in the van der werf park by Andries Jager end of the 19th century

1886

The van der Werf park is planted in the hole left by the gunpowder explosion of 1807



1966

De Merenwijk is built

City level - 15

Sketch design II Merenwijk september 1967



## Overview Lund



Now that we know a bit more about both cities, it's time to dive a little deeper into biking in Leiden and Lund. These maps show the overall city structure of both Lund and Leiden. The reason why biking is so popular in these cities is clearly visible as both have an extensive network of bike paths all across the city that make it easy to get around. It also shows that Lund is a rather green city, with many parks and green spaces. This creates an attractive atmosphere for biking as well as living.

Even though cycling is popular in Lund, graph 1 shows that even though the car use has gone down, in 2018 the car was still the most popular mode of transport, accounting for roughly a third of the trips. The bike was the second most popular mode of transport with 27% of the trips done by bike. If the municipality wants the percentage of bike trips to increase, certain efforts should be made to improve cycling in the city.

# Overview Leiden



Cycling in both Lund and Leiden is taken very seriously. To improve the bike networks, both cities work with a cycling strategy. Even though the strategies of Lund and Leiden are rather different, the topics they touch on are fairly similar.

One of the topics that both bicycle strategies address is cycling culture. Both cities struggle with bikes parked where they shouldn't be and anti-social behaviour of cyclists, among other problems. The way

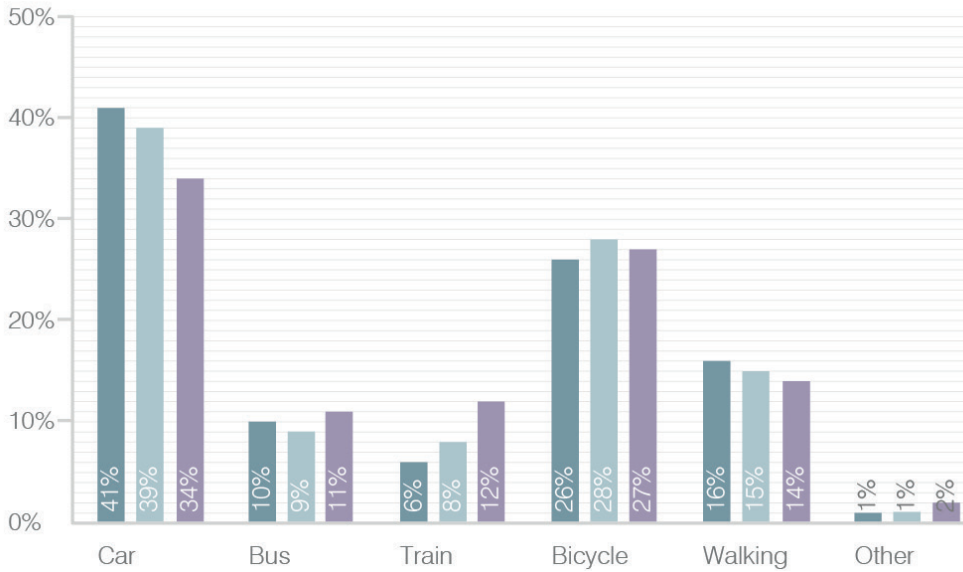
both cities are trying to combat this though, is very different. The bicycle strategy of Lund sees the solution to this problem in campaigns. These campaigns are focused on four topics: biking attentively, parking correctly, bicycle safety, and gearing up for winter<sup>1</sup>. This should decrease the amount of accidents, increase the following of rules and create more satisfied traffic participants. Apart from these campaigns, Lund municipality doesn't detail further plans to enhance the cycling culture in its



Image 1 - Steenstraat Leiden - a cycling street with one way motorized traffic

## Mode of transport

■ 2007 ■ 2013 ■ 2018



Graph 1<sup>3</sup>

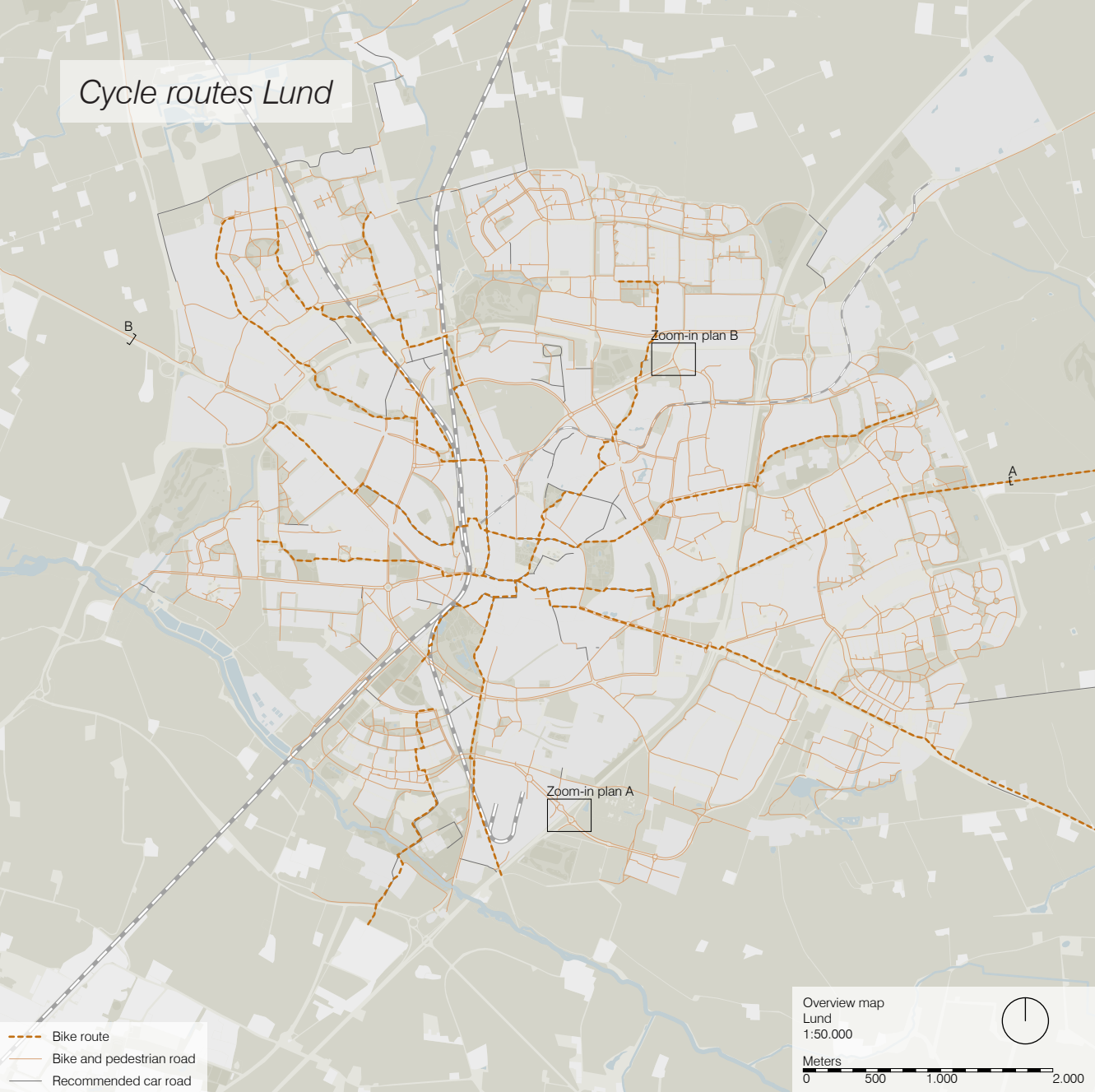
city.

Leiden has a very different approach to these issues. They state that misbehaving cyclists are often a result of insufficient infrastructure<sup>2</sup>. For instance, cyclists will feel the need to park their bikes where they shouldn't when bike parking is inadequate. This way of looking at the problems is much more active and in all likelihood more useful. Leiden municipality also sees education and skill as important factors to increasing self-confidence and security. By giving extra attention to education and skill building for risk groups, mainly youth and elderly, safety on bike paths will increase markedly. By trying to find the source of the problems and subsequently taking it away or improving it, the chance of actual improvement is much higher.

Another interesting topic both strategies mention is the cycle street. This is a street where cyclists are the most important traffic participant and all others need to adjust themselves to work around them. This is a phenomenon that is already rather common in the bigger cities of the Netherlands. An example of this is the Steenstraat in Leiden shown on the facing page and discussed in more detail on page 85. The Lund bicycle strategy specifies that they would like to start implementing this in the future: "Within a few years it will probably be possible to introduce the bicycle street, which prioritises bicycle traffic and where motorized traffic drives on the cyclists terms"<sup>1</sup>. The design possibilities of a bicycle street will be explored in the detail designs further on in this thesis.

By looking at the physical implementation of these cycle strategies, the priority of cycling becomes clear. As we know, actions speak louder than words, so let's look at how these cities organise their cycle networks.

## Cycle routes Lund



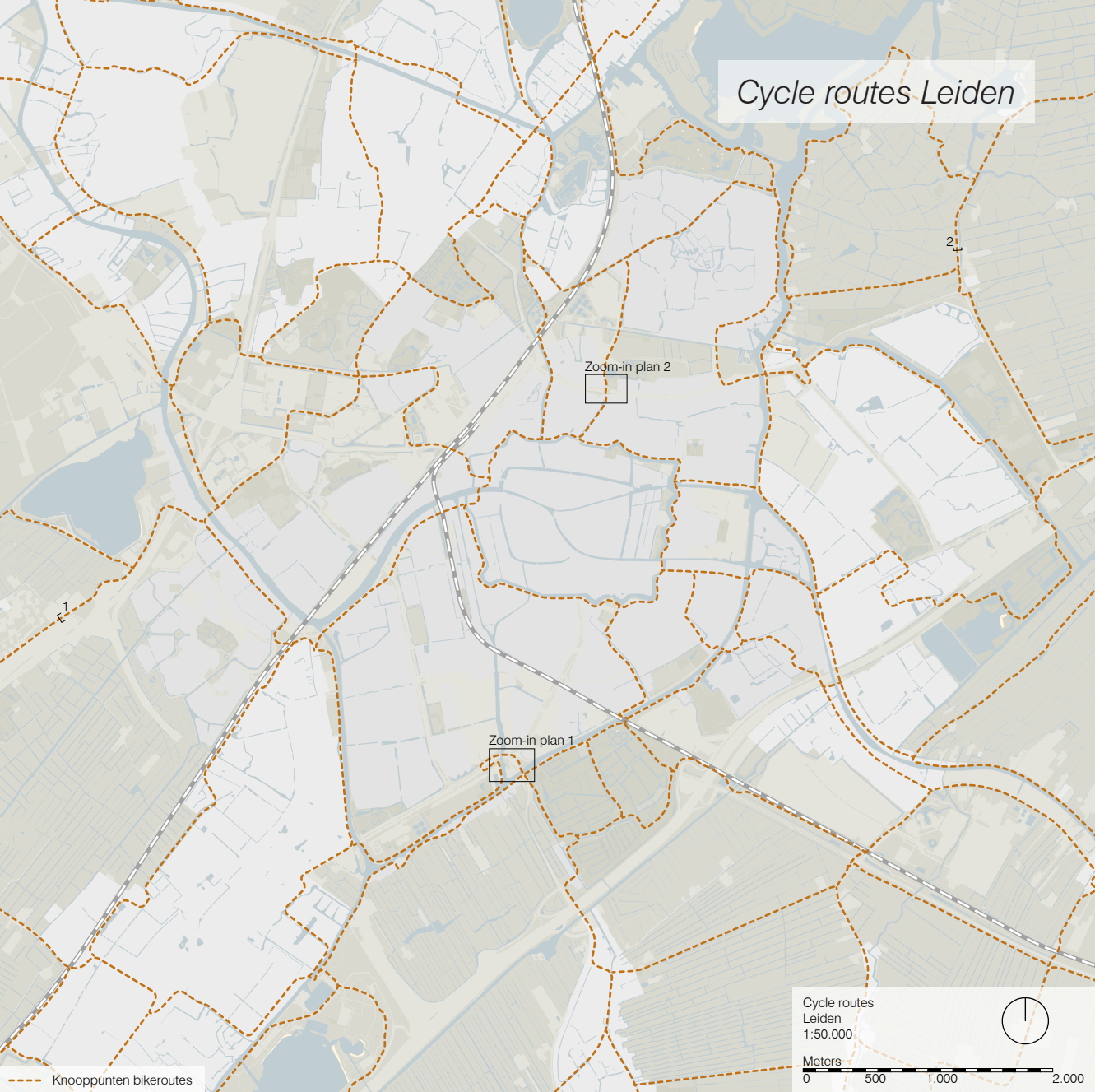
An important factor of being a bike friendly city is the available cycling routes. When these routes are interconnected and present throughout the city, it becomes much easier and more comfortable to navigate the city and to choose the bike as mode of transportation. The maps above show the cycling routes available in both Lund and Leiden.

In the Netherlands, there is a system in place of so called “node cycling routes”,

a network that spans across the whole country of nodes that are connected through routes. A digital planning tool helps you plan your route through connecting nodes, which are indicated with signs on the streets. These routes follow cycling friendly streets or separate bike paths.

The map of Lund shows the selected bike routes provided by the municipality as well as the bicycle-pedestrian paths and the car roads that cyclists can safely use. Lund

## Cycle routes Leiden



barely has any specific biking paths, as most paths are shared with pedestrians.

When comparing solely the cycling routes of the two cities, the shape of the network is substantially different. In Lund, the cycling routes converge in the city centre, while in Leiden the routes form a sort of patchwork that connects more widely. As a result, you'll find that biking to the city centre is an easy feat in both cities, but biking from one suburb to another can be challenging in

Lund.

Connecting the suburbs with one another is an important step in improving cycling in Lund. Another improvement can be made by strengthening the connections to other cities, especially Malmö, since there currently isn't a direct bikeroute from Lund to Malmö. Creating a direct cycling route from Lund to Malmö will make commuting by bike much easier and more attractive.

# Section A Lund

Hardebergaspåret - 1.200

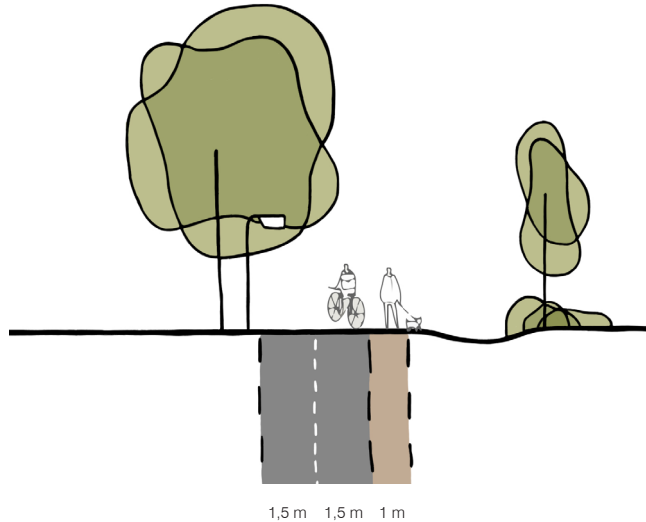


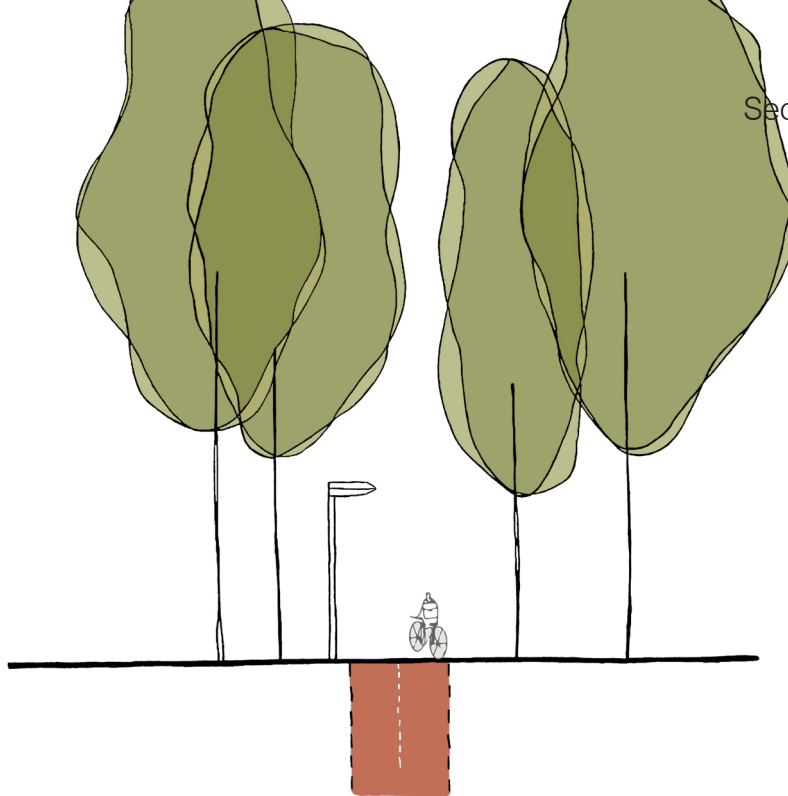
Image 2 - Unpaved sidewalk on Hardebergaspåret



Image 3 - A pedestrian on the bike path

These first sections are a great example of how the cities of Leiden and Lund are connected to their surroundings. They both show a bicycle highway, which means that cyclists have the highest priority at crossings, and can bike the whole route without having to stop. These bike paths are incredible because they are both in good condition which makes the biking easy, and their separation of other traffic makes them pleasant to use. Hardebergaspåret is my personal favourite route to cycle in the summer, even if it's destination, Södra Sandby, isn't the most interesting place.

As visible in the section and the photos, Hardebergaspåret has a pedestrian path running alongside it. However, this path isn't paved and thus rarely used by pedestrians. This doesn't mean that pedestrians don't use this route though. It is actually laid out as a running track with kilometer markers and exercises to do along the way. Since the pedestrian path is unpaved and at some points absent, the pedestrians most often find themselves on the bike path, which happens most often in summer when there is lots of traffic. The addition of a separate pedestrian path will increase usability for both pedestrians and cyclists and will



1,25 m 1,25 m



Image 4 - A great commute

ensure safety, especially on the more busy days. Adding a *paved* pedestrian path would increase usability and show that both bikes and pedestrians have a high priority in the city of Lund.

According to the bicycle strategy of Leiden, an important part of the enjoyment of cycling comes down to the attractiveness of the route<sup>1</sup>. It determines that the attractiveness of a route determines up to half of the enjoyment of cycling along it. This means that this is an important factor for people choosing a route, and deciding to take a route again. Both of these bike



Image 5 - The trees give an attractive character to the Trambaan

paths, Hardebergaspåret and Oude Trambaan, have an attractive look and feel. According to Leiden's bicycle strategy, attractiveness comes down to four points: variety, pleasantness, stimulation, and maintenance. Both these paths meet all four requirements, which makes them appealing to use again and again.

It would be incredible if all cities were connected through bike paths like these, but sadly bike paths are often located along connecting car roads. Section B/2 will show these types of roads.

# Section B Lund

Fjelievägen - 1.200

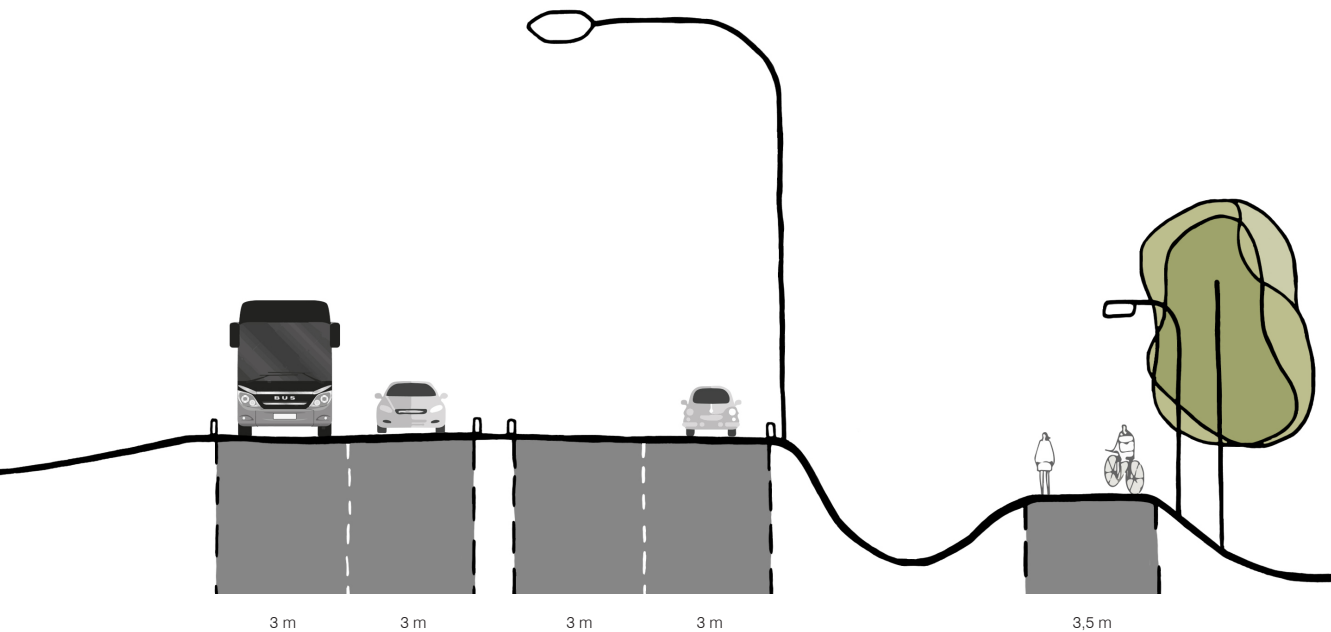


Image 6 - A cold day on Fjelievägen with lots of traces of use

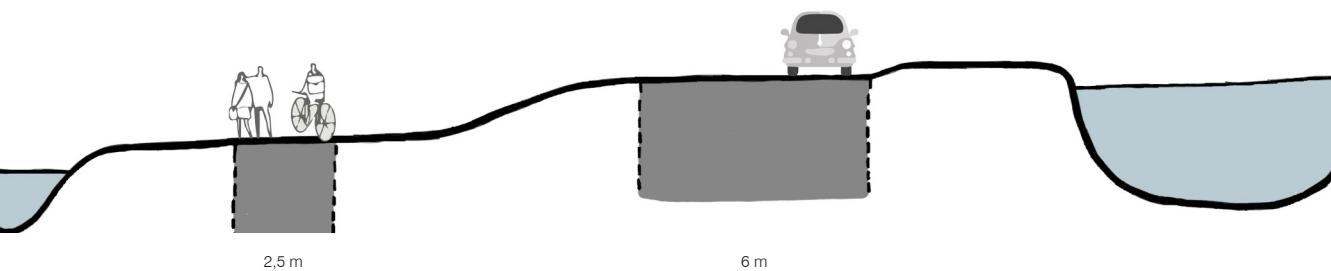


Image 7 - Commuting with different modes of transport

As mentioned, these sections show a bike path that runs along a car road. It is important to note the difference between the widths of the car roads in these sections. As shown in the overview maps on pages 16 and 17, Lund has a much more clear city border than Leiden does. This is because the Netherlands, and especially the Randstad, is very densely populated. It is therefore rare that cities and towns are completely separate from each other. This in contrast to Sweden, where everything is much less densely populated, and thus has more space between cities. The consequences of this on the traffic system

is clearly visible in these two sections. The roads between cities in Sweden are much larger and often faster than those in the Netherlands.

Another common factor between these roads is that they run through farmland, which is flat and wide open. This results in monotonous routes that are open to wind. These routes are therefore less attractive than Hardebergaspåret and Oude Trambaan, they lack variety, stimulation, and a degree of pleasantness. For Fjelievägen this is exacerbated by the heavy and noisy traffic on the car road, which decreases



2,5 m

6 m



Image 8 - Exposed but with a beautiful view

pleasantness even more. It is therefore not surprising that these routes are used less frequently and heavily. Something that could help with this is planting more trees to create more variety and protection of wind, sun, and noise.

Lastly, both these roads have a shared pedestrian-bike path. In this respect, Lund scores better than Leiden since the path is a meter wider. One meter may not seem like a lot, but it makes a big difference, especially when the path is shared by multiple types of traffic. The 3,5 meter wide path on Fjellievägen definitely has a more



Image 9 - A narrower road suitable for it's use case

suitable width for this type of use.

These routes are good for commuting since they give a direct road between two cities. This makes it very easy to find your way from one city to the next. If Lund would want to promote bike commuting to Malmö, a road like this, or like Hardabergspåret, would be a good way to do that.

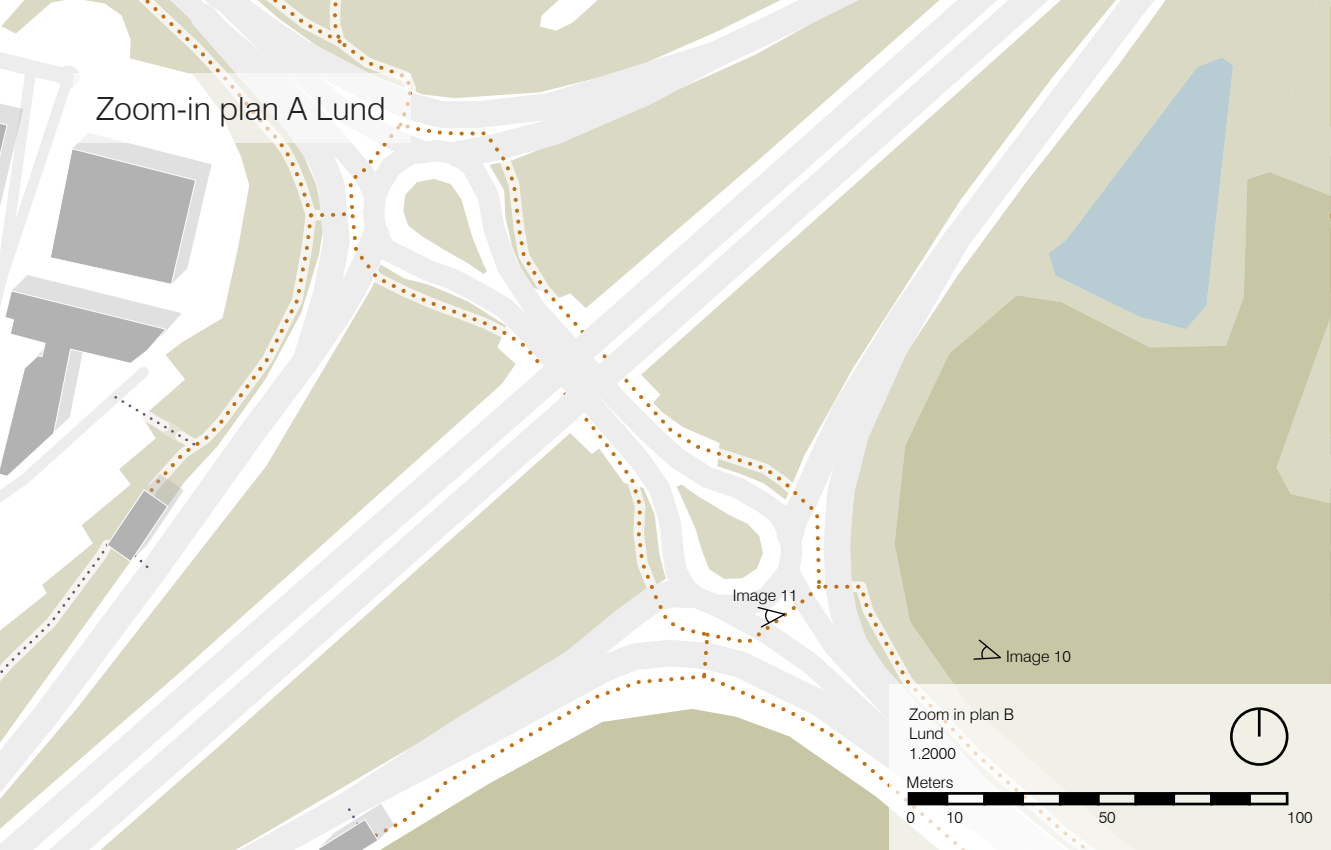


Image 10 - An overview of a complicated situation

Zoom-ins A and 1 show traffic nodes on the outskirts of the cities. They both feature a crossing of car roads as well as a separate bike network. The area in zoom-in 1 is used more heavily than that of zoom-in A.



Image 11 - Narrow paths and tight corners for cyclists

efficient car crossing, since there is no need to wait for cyclists. This minimized meeting between cyclists and cars creates a safer and more efficient crossing for both cyclists and cars.

The main difference between these two nodes is that in Lund, the bike path follows the car roads, while in Leiden, the bike crossings are separate. This separation is done through a height difference, with the bike paths located below the cars. This gives cyclists the chance to move through this complicated crossing without having to stop for car traffic. This also creates a more

This in contrast to the crossing in Lund which is efficient for cars, since they have right of way everywhere, but rather cumbersome for cyclists. The cycle route features sharp turns, narrow paths and several crossings. Since this crossing is not too heavily used by cyclists, the problem is not too pressing. The choice of design here is thus understandable, especially since it

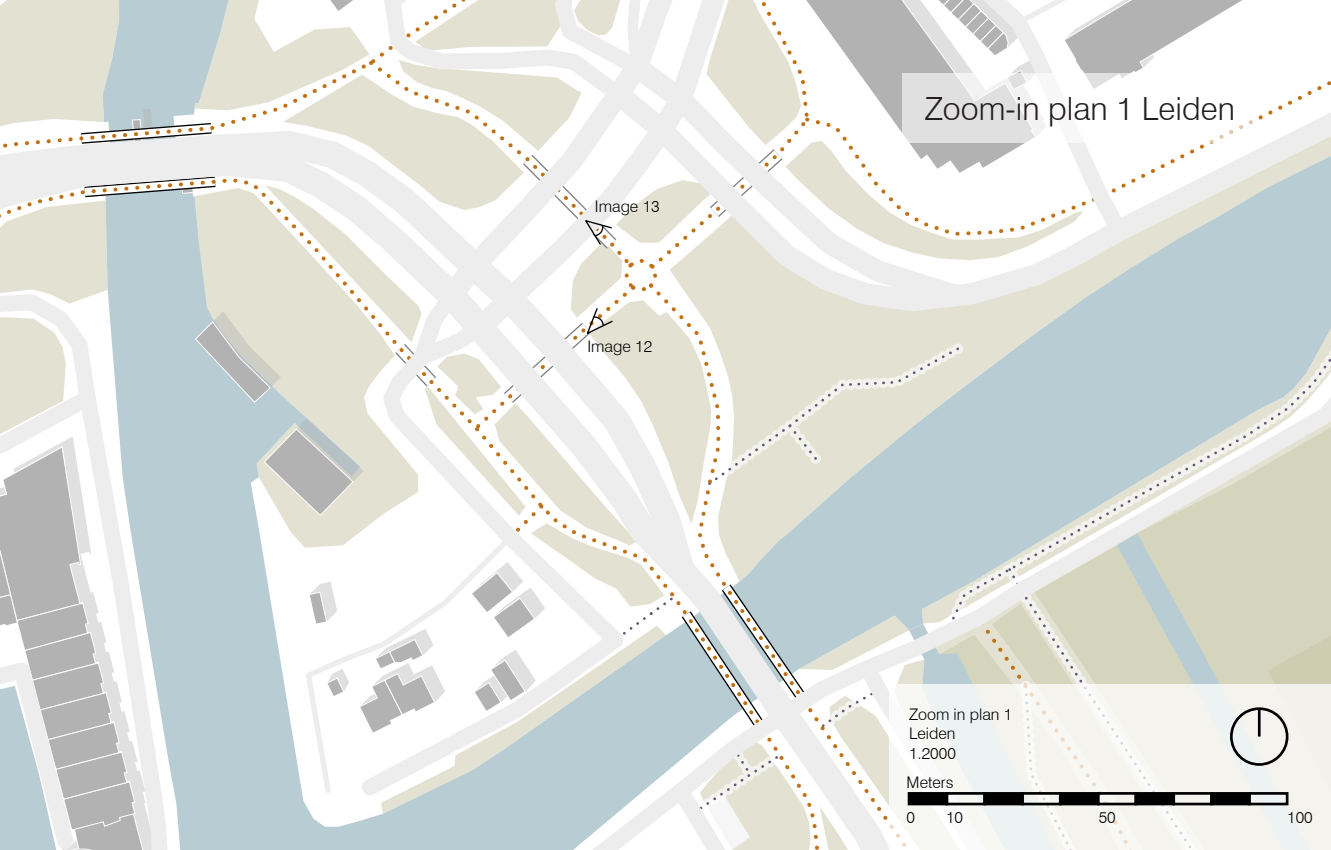


Image 12 - A roundabout for only cyclists!

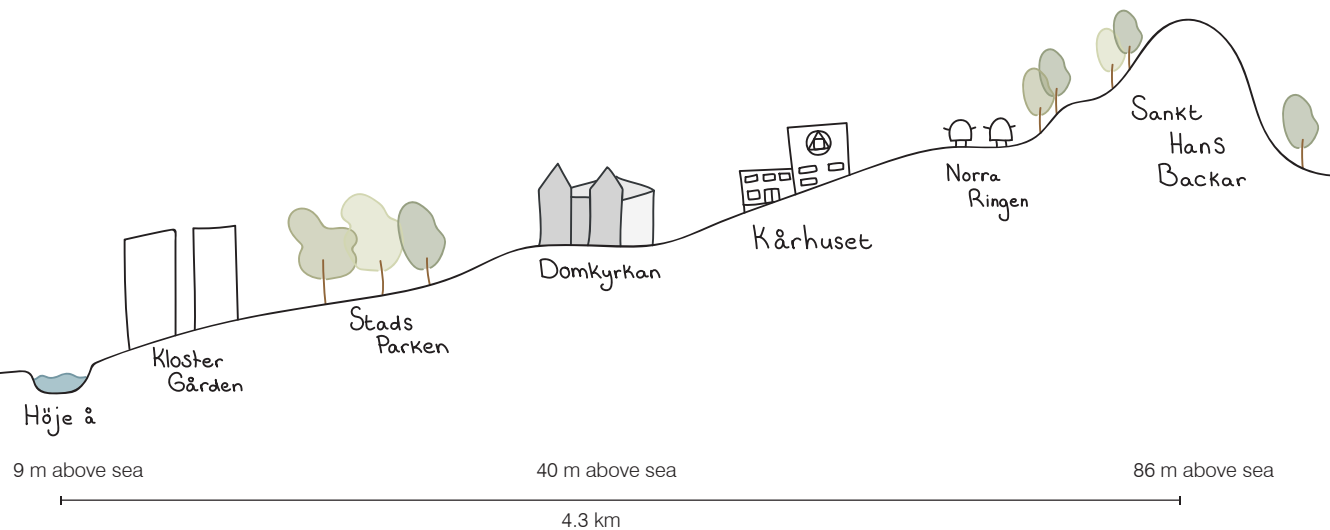
is a relatively simple and therefore cheap design.

If this crossing in Lund would become more popular for cyclists and thus in need of improvement, it would be interesting to look at the area in Leiden. By giving the cyclists more priority and designing a crossing that would be efficient for all traffic participants, a big improvement can be made here.



Image 13 - Suitable for commuting and leisure

# Topography



When it comes to choosing a mode of transportation, ease of use plays an important role. For cycling, topography can have a big influence on the ease of use. It therefore comes as no surprise that according to “Why don’t more women cycle? An analysis of female and male commuter cycling mode-share in England and Wales”<sup>4</sup>, hilliness is mentioned as the most important factor in choosing to cycle, for both men and women. This is rather problematic for Lund, since it is the municipality with the biggest height difference within its borders in all of Sweden. The concept section gives an idea of how big that difference is, with the lowest point lying at 9 meters above sea level, and the highest point at almost 90 meters above sea level. This section is taken from south to north and shows that Lund is not necessarily hilly, it is built on a slope. This generally means that cycling from north to south goes rather fast, while going from south to north is much more

challenging. Sadly, the topography itself is not something that can be taken away. However, there are ways to decrease or increase the impact of the topography on cyclists. One of those ways is through installing smooth surface cycling paths such as asphalt. This will be discussed in further detail later on when discussing materiality. Other aspects of the cycling network that can influence the impact of the topography are tunnels and overpasses, as well as the routes available.

## Tunnels and overpasses

One of the ways in which cycling is made easier is through providing tunnels and overpasses for crossing busier roads. This is great since it improves efficiency, and means cyclists don’t have to stop and wait. However, in a place where the original topography already poses a challenge, a tunnel or overpass can make a big difference. This difference is much more

noticeable to a cyclist than to a motorized vehicle. One example of a bike tunnel where topography gets in the way of comfortable cycling is a tunnel on the route mentioned on page 32. This tunnel is visualised in a section below. It is an underpass under train tracks in a suburb, with an incredibly steep incoming and outgoing path. The incoming path has a decline of about 5%, but since this area deals with topography as well, the outgoing path has an incline of 11%. This is a big issue, since in this case an incline of about 2% would be deemed comfortable<sup>5</sup>. It is therefore important to take topography into account when designing tunnels and overpasses, so as to decrease the effort that needs to be made by cyclists.

Another aspect of tunnels and overpasses that is worth mentioning, is the consideration of who gets to stay on ground level, and who must use a tunnel. Of course this is most often a financial decision, which is understandable. However, if a city really wants to prioritize cyclists, it is vital to try and keep them on ground level, while making the other traffic move around them. In situations where this is possible, car tunnels would be preferable over bike tunnels since for a car it is hardly noticeable when going down into a tunnel, while for a bike the incline can be a big challenge.

## Direct routes

The routes available to cyclists also play an important role in how topography is experienced. When the only route available is inefficient and has you going up and down multiple times while it is unnecessary, choosing a bike for that route is much less

attractive. Providing a direct route would minimize the impact of the topography, especially when cycling from east to west. Since the slant of Lund is in the north-south direction, a direct east-west route should have minimal topographical problems. However, when that route is meandering to avoid car roads, or because there simply isn't a direct route, the consequences of the topography are much more noticeable. This is shown very clearly in the analysis on pages 32 and 33.

## Conclusion

The topography itself is not something that is avoidable. However, the impact of the topography on cyclists can be minimized through strategic route placement and avoiding unnecessary tunnels and overpasses. Since Lund has such a large height difference, direct cycling routes are more important than in other cities. The topography has such a large impact, that efficient routes can make a big difference in promoting cycle use.



## Zoom-in plan B Lund

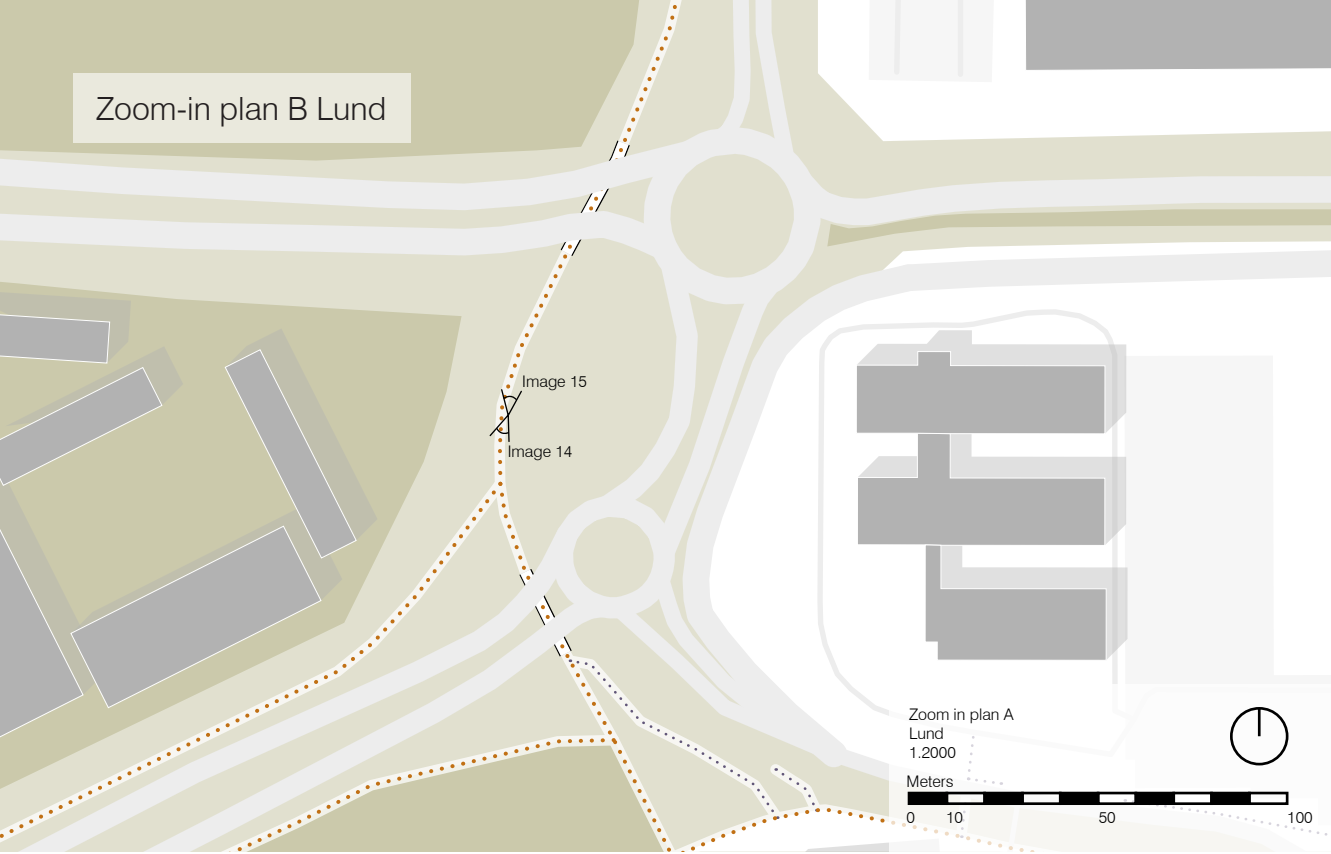


Image 14 - Separation for efficiency and comfort

These two zoom-ins show an example of what was mentioned in the topography section on tunnels and overpasses. As said before, these kinds of crossings increase efficiency and safety, however, in a place with lots of topography, they can pose an added challenge.

The crossings shown here are both located on the southern border of the two suburbs that will be examined more closely further on in this thesis. They are therefore popular crossings for people coming from de Merenwijk in Leiden and Norra Fäladen in Lund, when going to the city centre.



Image 15 - A climb awaits you on the other side

The main difference between these two locations is the choice of underpass versus overpass. When it comes to extra effort put in by cyclists in overcoming the height difference, there is no preferable option between the two. The benefit of an overpass is the added safety in the dark. Tunnels can give a feeling of being trapped, especially at night, that can be hard to avoid. An overpass has a more open feeling which humans register as more safe since there is more opportunity to flee from danger.

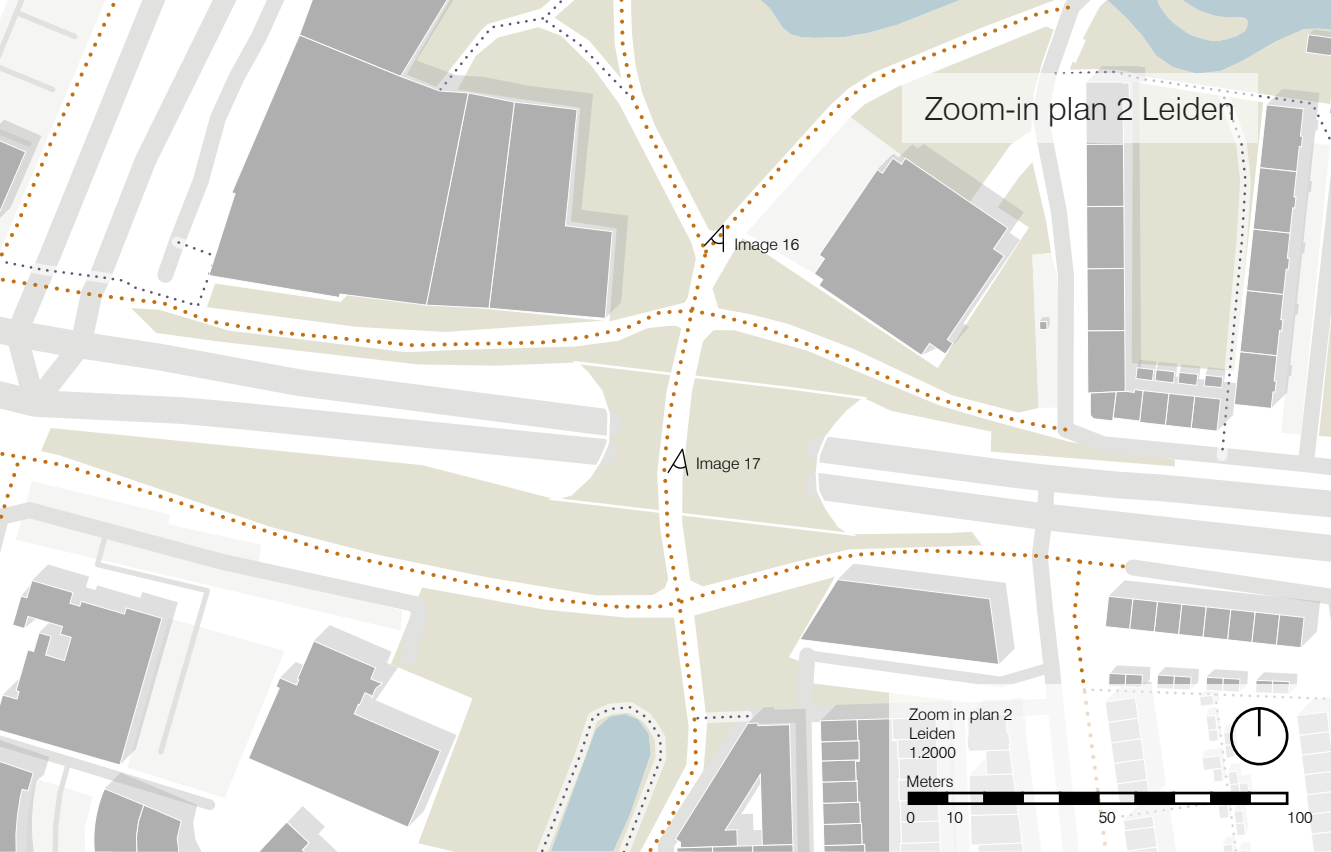


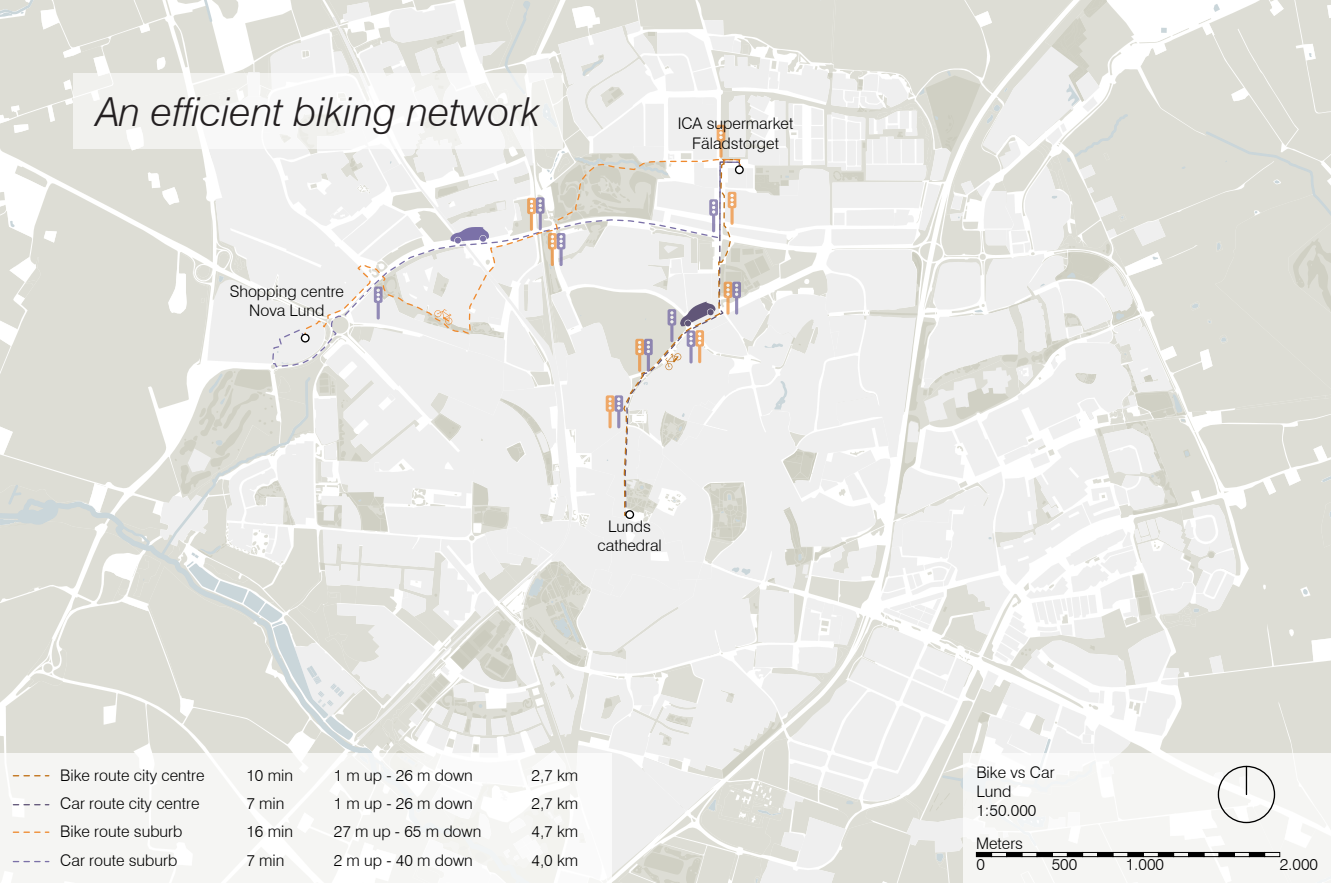
Image 16 - An open and green surrounding



Image 17 - Gives a good overview

If these crossings were located in a city that had bicycles as their number one traffic mode and viewed cars as “less than”, these crossings would look differently. As mentioned on the previous page, a perfect world would feature a tunnel for cars instead of a tunnel or overpass for cyclists. This would mean that cyclists can continue their route without having to go up or down. Of course this is much more expensive since a car tunnel would need to be much larger. This makes it an unlikely scenario for any smaller and/or car focused city.

## An efficient biking network



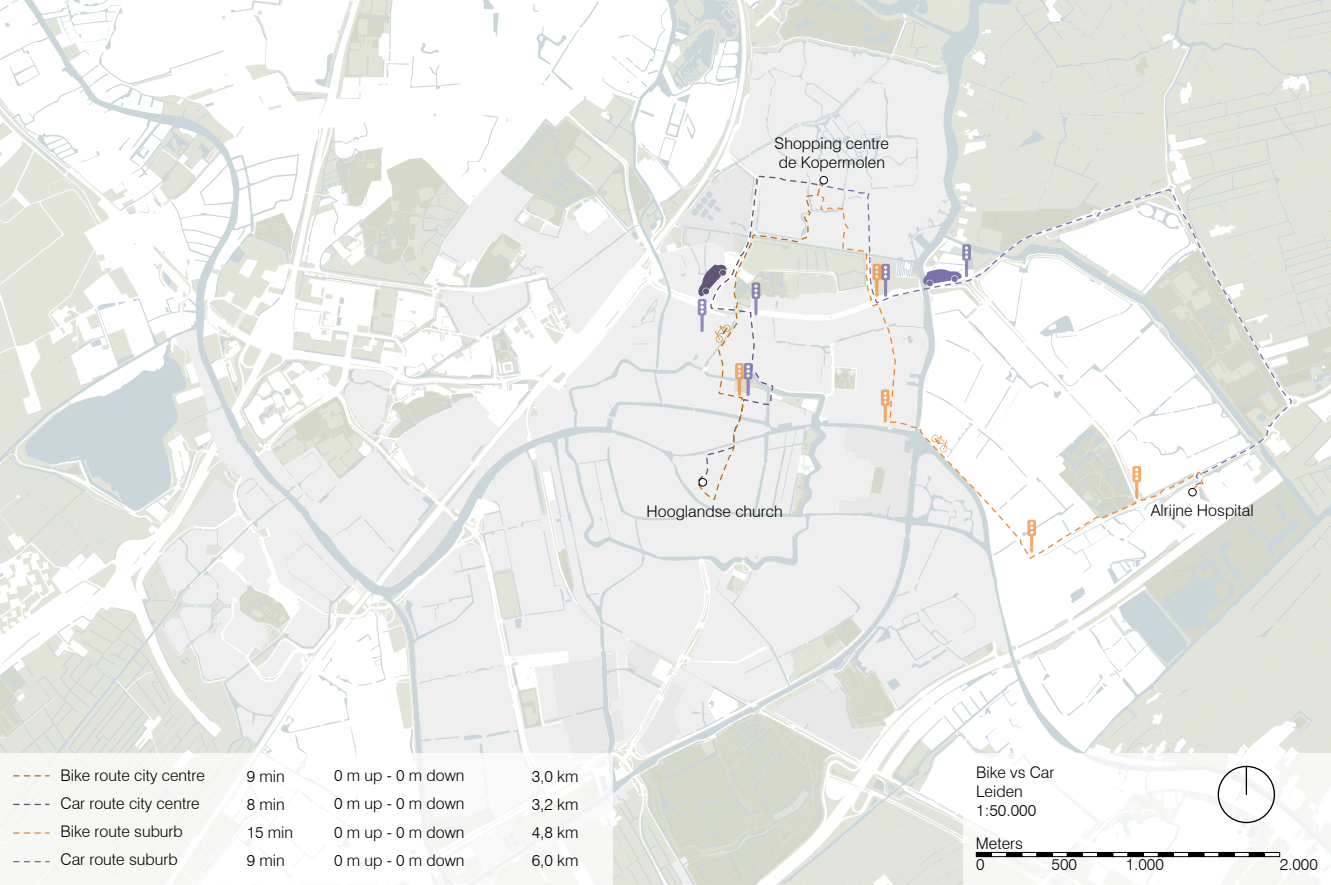
One way to see if a city places priority on biking is to compare car routes to bike routes. This will tell you something about how bike efficiency plays a role in the city design and how that translates to ease of use. For this instance, I have chosen to compare two routes per city. It is important to note that this can not give a definitive answer, since there is too little data. This means that the comparisons between Leiden and Lund will not be completely fair or accurate, because it is highly dependent on the route chosen.

For both cities I have chosen the shopping centres of the suburbs featured in the next section of this thesis as starting points. There are two routes per city, one to the city centre and one to an important destination in the outskirts of town. For Lund this is a large, car oriented shopping centre called Nova Lund, for Leiden this is a hospital. The distances of the routes are comparable, and the routes shown are based on

recommendations by Google maps.

Let's first look at the route to the city centre in Lund. The route for the bike is the same as the car route which means that the distance and height difference is the same. The difference in time is therefore extra interesting, since the car is only three minutes faster. This small difference is likely due to the relatively low car speed and the traffic lights encountered on the way. From this we can conclude that the only downside to taking the bike for healthy, able-bodied people is the topography. This is in line with the earlier drawn conclusion that biking routes to the city centre in Lund are excellent.

When we look at the suburb to city centre route in Leiden, the difference between car and bike routes are similarly small. However, since the car route is taking different roads than the bike route, the user experience is very different. This



particular bike route encounters only one traffic light because the route is mostly separated from car roads, while it's Lund counterpart has five traffic lights. By giving cyclists direct routes with little crossings, the user experience becomes not only more pleasant, more efficient, and faster, it is also safer.

Biking from one suburb to another is a different story. The bike routes in Lund and Leiden for the suburb are similar in distance and time. The car routes however show a much bigger difference. In Lund the car route is not only faster, it is also shorter and clearly much more simple. Though the car route in Leiden is more simple and even faster than taking the bike, it is a much longer distance.

What is important to note here is the difference between bike and car routes for the distance between Norra Fälåden and Nova Lund. This is where it becomes very

clear that a direct route gives much less trouble with topography than a roundabout route. The bike route is so indirect that the difference in height is significant. Creating a more direct route would minimize this height difference, and thus the influence of the topography.

It is difficult to compare these routes since it is nearly impossible to be faster by bike in the suburbs than it is by car in any city. The route from Fålådstorget to Nova Lund is an extreme case, but an important one nonetheless. It shows clearly the many hoops a cyclist must jump through to get from north to west Lund. Improving routes like this will have an enormous impact on making cycling more enjoyable and attractive in Lund.

An average suburb  
Lund - Norra Fäläden



When looking at how a city is connected with itself and its surroundings, looking at a suburb on the edge of town can give some insight. The two suburbs chosen for this thesis are Norra Fäläden in Lund, and de Merenwijk in Leiden. Norra Fäläden was chosen for its diversity in types of housing and traffic situations while de Merenwijk was chosen for its similarity to Norra Fäläden. Please note the difference in scale between the two maps.

As pointed out in the historic timeline, the construction of both Norra Fäläden and de Merenwijk started in 1966. The similarities don't stop there. Both suburbs have a small shopping center, a large park that serves the whole city, and several pre-, and primary schools. Even in size and number of inhabitants, the two areas are relatively similar.

Traveling by bike from the heart of Norra Fäläden to the city centre takes around 12



## Leiden - de Merenwijk

Zoom in plan 3

de Merenwijk  
Leiden  
1:10,000

Meters

0 100 500

minutes and 27 meters down hill. Traveling from de Merenwijk to Leiden city centre by bike takes around 10 minutes without going up or down hill.

When comparing the two maps, it seems like Norra Fälåden has a lot more bike lanes than de Merenwijk does. This makes it seem like Norra Fålåden is much more bike friendly, but this skews reality for two reasons. Firstly, when biking in de Merenwijk, it is very common to find yourself

sharing the road with cars whenever possible. This means that there are much less specific and separate bike lanes. In Norra Fålåden however all the bike lanes that are shown on the map are shared with pedestrians. The consequences of this difference are clearly visible in the upcoming sections and zoom-in plans.

# Section C Lund

Bike lane by Parternas Gränd - 1.200

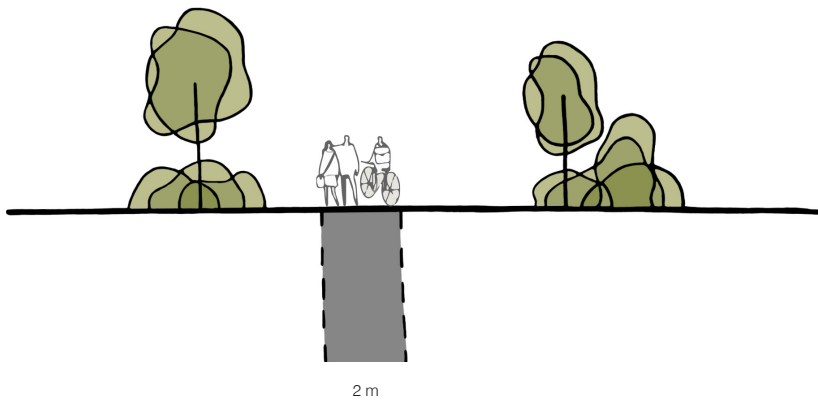


Image 18 - A typical bike-pedestrian path in Lund



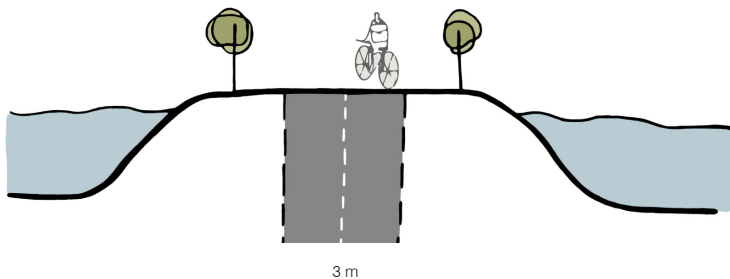
Image 19 - A warning of a cracked surface

These first sections show a bike path set in a green park-like surrounding. These paths are separate from car traffic which makes them calm and relatively safe to use for people of all ages.

The paths both feature black asphalt and are used by cyclists and pedestrians. This is where the first issue arises. The Broekweg was designed for only cyclists and therefore has no specific space for pedestrians. This can cause some confusion and needs extra communication between cyclists and pedestrians. The communication is aided by the dotted line featured in the

middle of the road. This helps create clear boundaries of where you're supposed to bike. By having this path clearly designed as a bike only path, it gives a signal to the pedestrians to pay close attention and get out of the way if needed.

The bike path in Lund however has no such guidelines. Furthermore, it is designed as a path for both cyclists and pedestrians, which results in even more confusion. Since this path is for both cyclists and pedestrians, it is never clear who is supposed to be where. This causes unsafe scenarios where pedestrians walk wherever



3 m



Image 20 - A dedicated bike path

they want and cyclists have to make a considerable effort to move around them. This becomes doubly unsafe when children are involved who often either don't pay attention, or are unsure what to do.

Another difference worth mentioning, is the width of both paths. Broekweg, a cycle path designed for two way cycling, is three meters wide in total. The path in Lund however, is only two meters wide. This is small considering that it is designed for both pedestrians and cyclists going two ways. This makes this path difficult to use because it is often not wide enough to pass



Image 21 - A nice direct route through the neighbourhood

each other if it is used by more than two people at the same time.

The last thing that is important to mention is the quality and user friendliness of the paths. The path in Lund has many cracks and holes in the asphalt which makes it difficult to navigate, especially in winter or darkness. This needs to be addressed much quicker than it has been so far. At the time of writing, there is a blockade placed on the bike path visible in image 19, that has been there for weeks already without improvement.

# Section D Lund

Norra Gränsvägen - 1.200

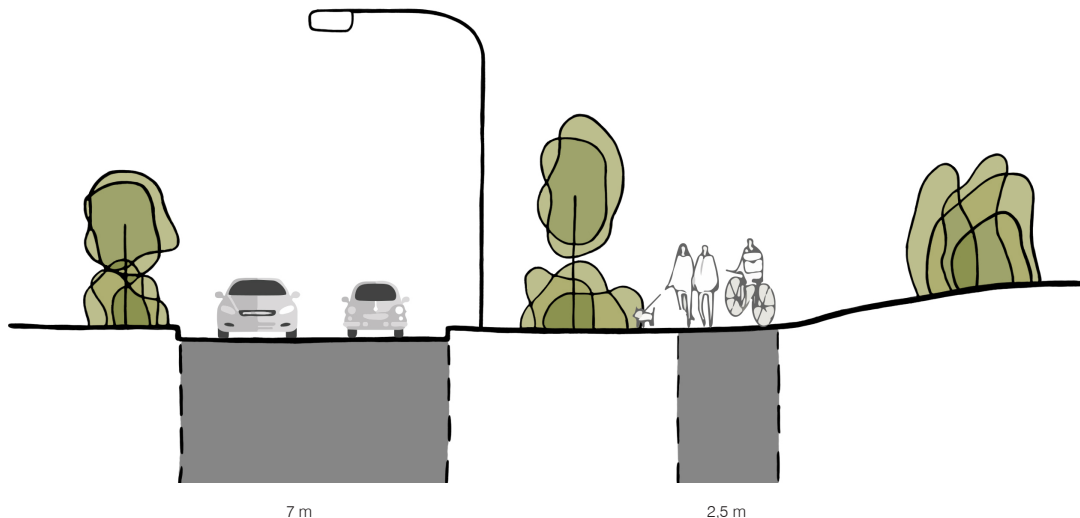


Image 22 - Norra Gränsvägen in the snow



Image 23 - Lots of space for grass, little space for users

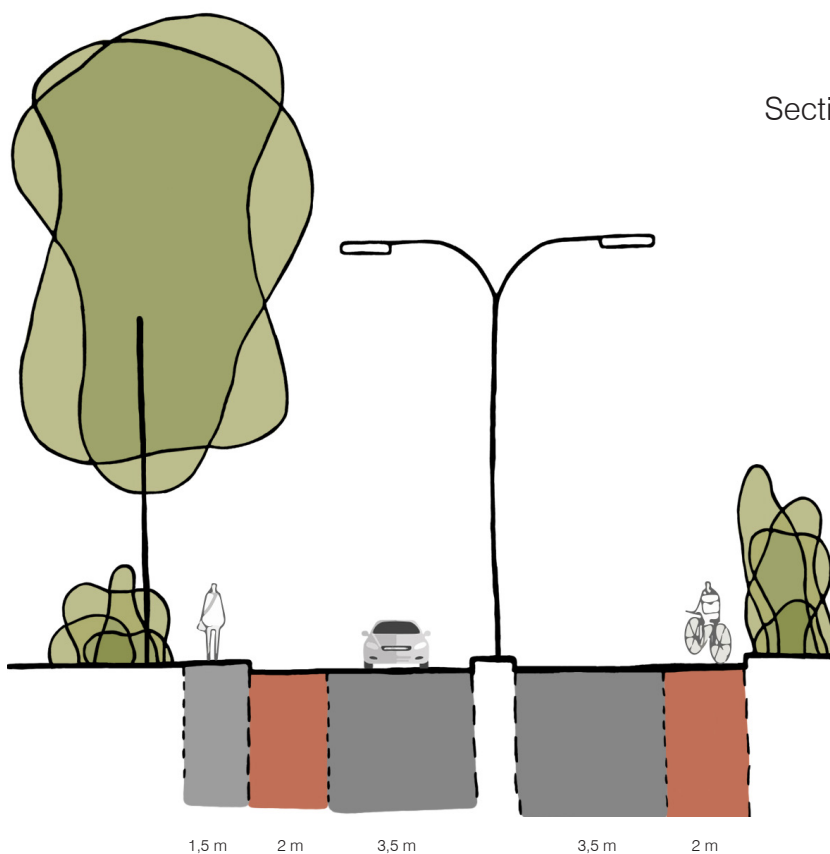
This second set of sections illustrates two larger roads that connect the different housing areas within the neighborhood. Both have a maximum speed of 50 km/h for cars, and have space for cars, cyclists, and pedestrians.

The first noticeable difference is the separation of car traffic on the Norra Gränsvägen, while on the Zwartemeerlaan car, cycle and pedestrian traffic is combined. This can be explained by the fact that de Merenwijk is much more densely populated and thus simply doesn't have the space to separate the flows of

traffic.

When comparing the two roads, you'll notice that the total width of the street profile is roughly the same. The amount of space for cyclists and pedestrians however, is almost twice as much on the Zwartemeerlaan. Even though the width of the car road is exactly the same. A mere 2,5 meter wide strip of black asphalt is calculated to be enough on the Norra Gränsvägen for two way cycle traffic, and two way pedestrian traffic.

This strip is again not outfitted with any sort of indication of how to use it, which



1,5 m    2 m    3,5 m    3,5 m    2 m



Image 24 - A clear contrast in road colors

allows for uncertain and unsafe situations for pedestrians and cyclists. This is in stark contrast to the clear and relatively spacious layout of the Zwartemeerlaan. Here there is no doubt who is supposed to be where, which creates certainty and safety for all users. This clarity is caused by the contrasting use of material, the step up for the sidewalk and the white dotted lines that indicate the bike lanes.

The last thing that is important to point out is that many cyclists in Sweden would not feel safe sharing a road like this with cars. This is not an unfounded fear, especially



Image 25 - Is it safe enough?

when the road is laid out like Norra Gränsvägen. Therefore I want to make clear that I am not against the separation of cars from slower traffic like bikes and pedestrians. However, safety for cyclists and pedestrians does not only come from being shielded from cars. It also comes from easy traffic situations which are caused by clear demarcation for cycle and pedestrian space.

# Section E Lund

Trossvägen - 1.200

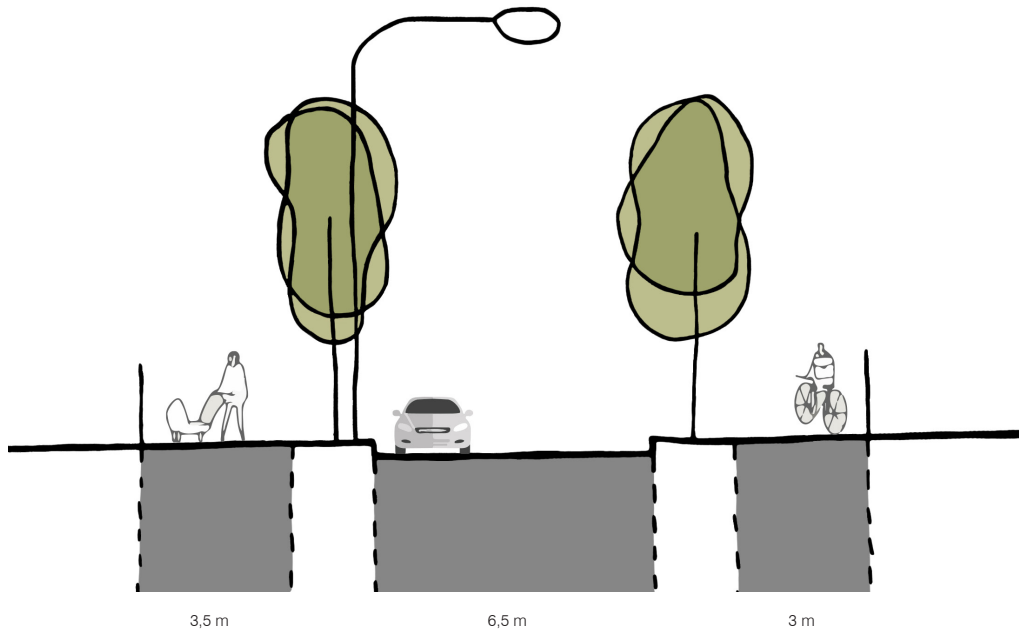


Image 26 - A wide road, great for driving fast

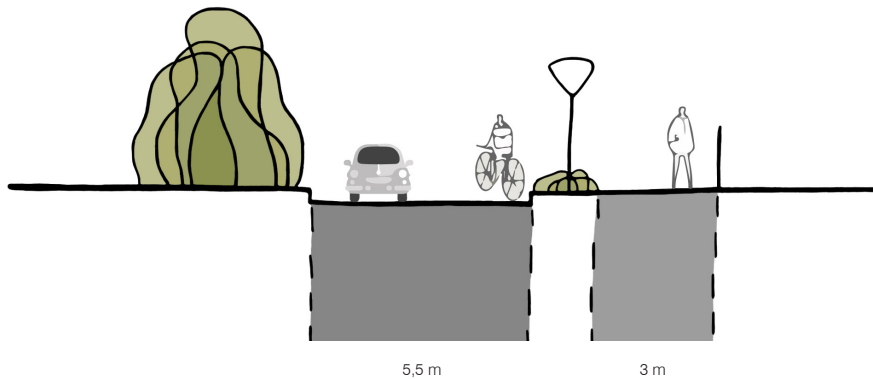
The third and final section shows a connecting street between housing blocks. The smaller streets that lead from both Trossvägen and Drontermeerlaan are all shared streets with a 10/15 km/h maximum speed. Trossvägen reads as a 50km/h road, while Drontermeerlaan reads as a 30km/h street.

The main reason why these streets read differently can be found in the width of the profile and the car road in particular. Not only is the car lane on Trossvägen a meter wider, it is also officially only built for cars. The word officially is international here,



Image 27 - Where would you cycle?

since on this road, I've observed cyclists both on the sidewalks and the main road. This ambiguity is caused by the use of material (only black asphalt) combined with little continuity throughout the city. If all streets that feature black asphalt on both the car road and the sidewalks have cyclists located on the car road, it is clear. However, in Lund there is no such clarity. In situations like these, it is equally likely for cyclists to be located on the car road, as it is for them to be on the sidewalks. This is solvable through clear design featuring contrasting demarcations and/or different materiality, and continuity throughout the city.



5,5 m

3 m



Image 28 - Biking on the road slows down the cars

The width of this street easily allows for bike paths added onto the car road by adding white dotted lines. This gives clarity to the cyclists, and makes cars slow down to 30km/h because they have less space, and they share the space with slower moving traffic participants.

Besides the difference in width, Trossvågen and Drontermeerlaan are relatively comparable. An unknowing eye would comment that Drontermeerlaan has the same issue with unclarity as Trossvågen does, since it doesn't have a clear demarcation for cyclists. The difference



Image 29 - The sidewalk is only for pedestrians

however, is continuity. In the whole of the Netherlands, if you encounter a street like this, you cycle on the car road. There is no ambiguity which increases safety since cyclists don't have to be uncertain, and cars know to look out for cyclists.

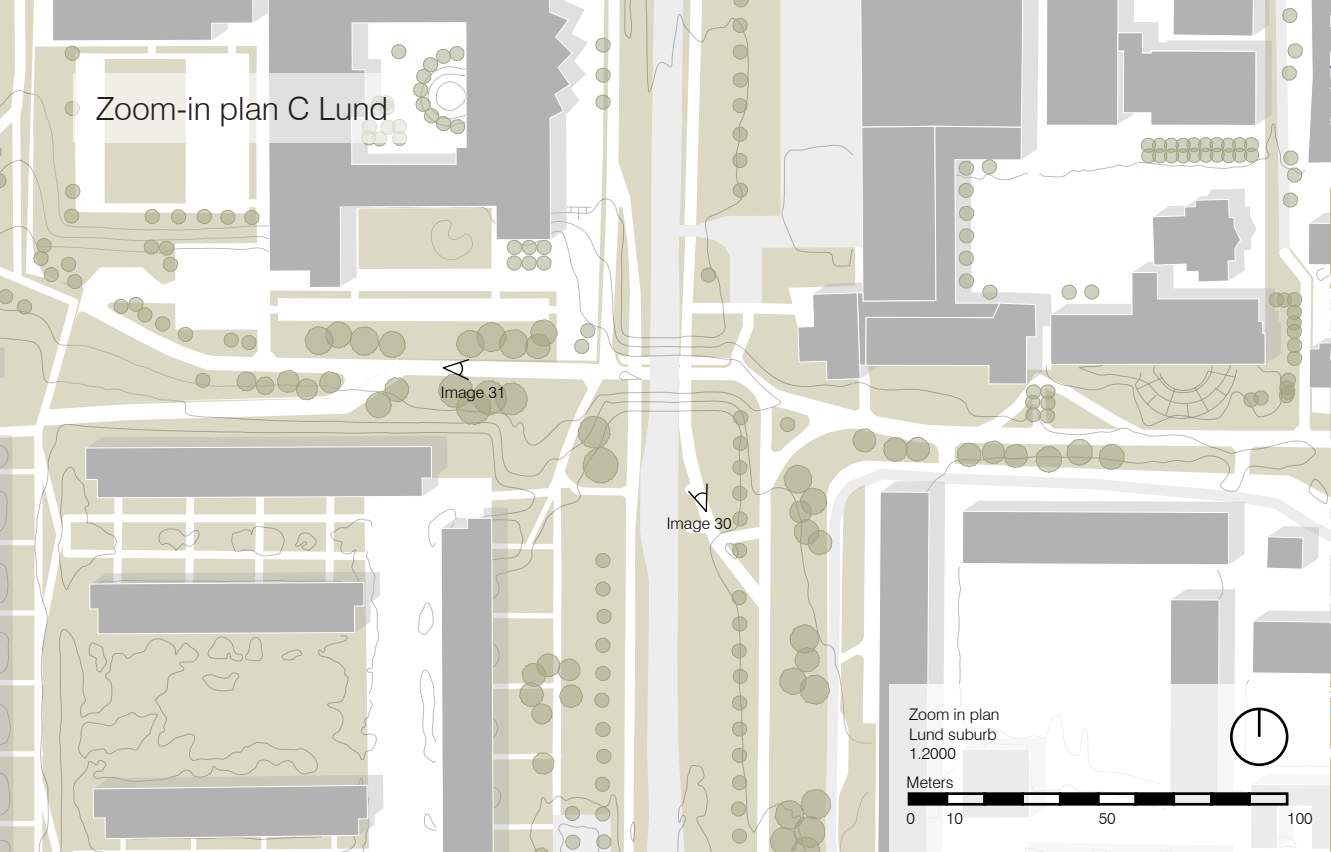


Image 30 - Svenshögsvägen from above

The two zoom-in plans show the crossing of a cycle path with a car road. The one in Lund features a bike tunnel, while the one in Leiden shows a single level crossing.

The zoom-in of Norra Fälåden shows a crossing with Svenshögsvägen, the busiest road of the neighbourhood. This road leads from the city centre out of the city boundaries to the north while crossing the ring road. This has resulted in a high traffic road, and it is therefore not surprising that the crossing features a bike tunnel. The zoom-in of de Merenwijk shows a crossing with the Veluwemeerlaan, which



Image 31 - Svenshögsvägen from below

has substantially less high traffic. This is a ring road that only serves de Merenwijk and therefore doesn't feature traffic from other parts of the city.

On top of the business of the road, the surrounding buildings also play a role in the choice of tunnel. In de Merenwijk, this area features only housing. This means that even though the bike path is a thoroughfare, it will not be extremely busy. In the Norra Fålåden zoom-in however, the buildings have a more diverse use. The large building on the left upper corner is a school, while the buildings in the right upper corner are part

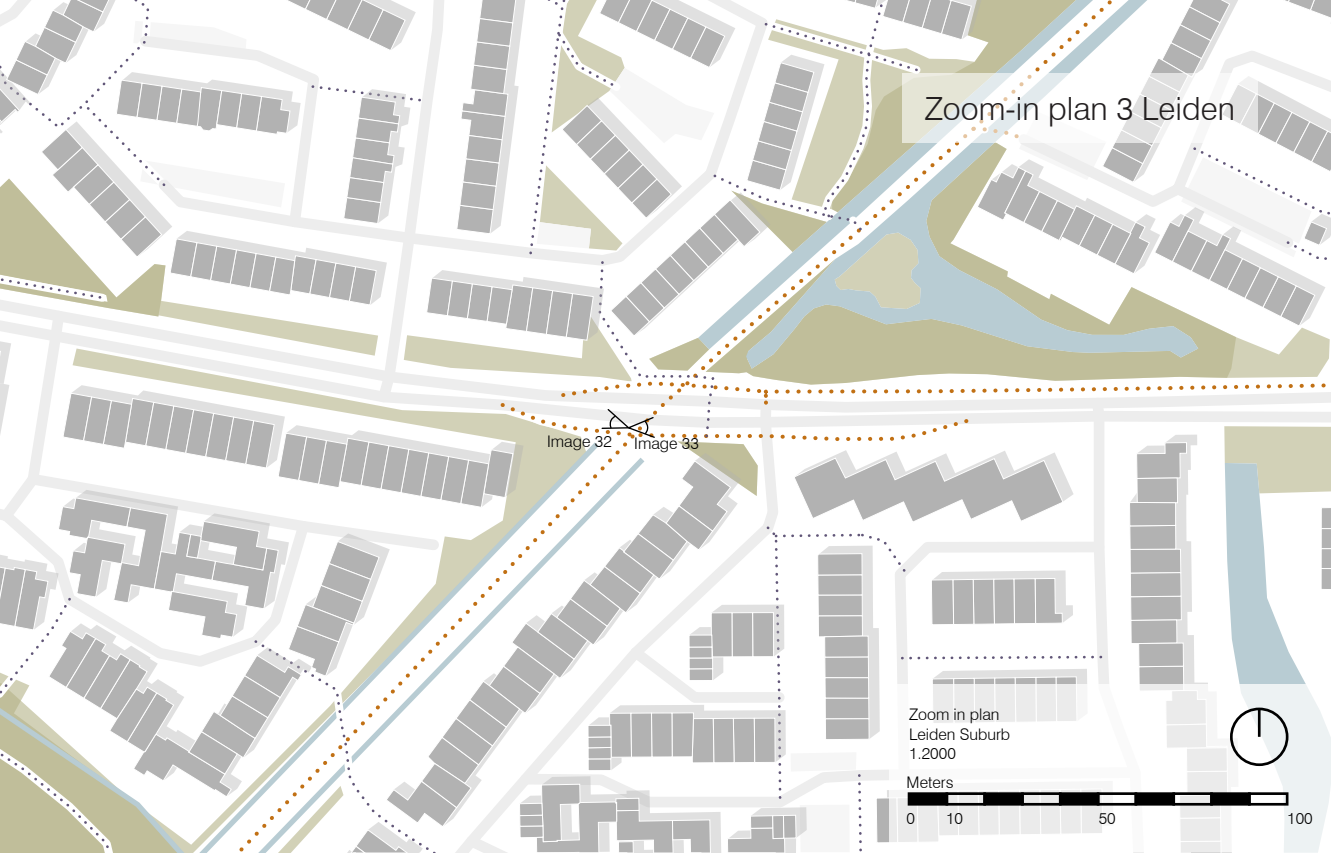


Image 32 - The road colors have high contrast

of a small centre with healthcare facilities and a supermarket. This indicates that this crossing is used by teenagers going to the supermarket during their breaks, which is another reason to build a tunnel.

What I'd like to point out once more is that these photos make it very clear what a difference it makes when red asphalt is used. The contrast between the red and the black road surface is immediately noticeable, even in the dark. This increases safety and clarity of the traffic situation.



Image 33 - The materiality communicates clearly

Lastly, this zoom-in also illustrates perfectly the point made earlier about bike paths not featuring on the Merenwijk map. As is visible on the photos, the bike path clearly runs along the whole Veluwemeerlaan in a contrasting read. The map however, only shows the bike paths that are separated from the cars.

## Conclusions and recommendations

What can Lund learn from Leiden?

- A more detailed cycling strategy that is active, not reactive
- Better connections between the suburbs
- Crossings that function for bikes and car equally well
- A separation of cyclists and pedestrians
- Contrasting and clear materiality



Firstly, this chapter has clearly shown that Lund is an excellent city for cyclists. It has many bike paths, and is safe and pleasant to bike in. However, since the municipality has clearly stated that they would like to see an increase in bicycle use of its inhabitants, a few improvements could be made. These improvements will lead to an even more pleasant and usable bicycle network which should result in an increase of bicycle use.

Making improvements should start with a renewed bicycle strategy. Since the current strategy was made for the timespan of 2018 to 2021, it will soon be time for a new one. I would recommend the municipality to make this new strategy more detailed. The current document shows intentions, it would be great to see some concrete plans.

### ***Updating the bicycle strategy should include citizen participation.***

Since it is impossible for city officials to use every single stretch of road, participation could really help map what points need improvement, as well as what is missing. A strategy for this could be to ask people at “destinations” like bus stops or shopping malls, where they come from and what route they took. This could help determine the most used routes which will create a better understanding of use patterns. Besides that, not everyone has the same opinion, so asking citizens what they are missing would give a greater understanding of what is needed. Participation should not only include people that use the bike as their main mode of transport, but it is just as important to ask those that don't bike. Asking people why they choose not to bike is a great way to increase understanding of what is missing, and how the city can actively improve to get more people biking.

Looking at the network as a whole, Lund is pretty well connected. A big difference with

Leiden however, is the connections between the suburbs.

### ***Improvements could be made by adding missing links in the network, especially those connecting the suburbs.***

An increase of direct routes outside the city centre would increase efficiency for cyclists with a destination other than the city centre.

### ***Another increase in efficiency could come from improving crossings.***

It is important to treat cyclists as equally important as cars. Too often bike lanes are superimposed on a design which creates friction. This could be avoided if bike lanes were part of the design from the beginning.

### ***To increase the number of cycling commuters, connections to the surrounding towns are vital.***

Especially the connection to Malmö is important, since this is the biggest city in the immediate area around Lund. Sadly this is the only city around Lund that does not have a direct bike connection. Adding this would make commuting by bike from Lund to Malmö much easier and more pleasant.

Generally speaking, Lund is a great cycling city. By implementing these recommendations, the city will be even more bike friendly. However, the cycling network on a city level does not merely consist of its physical manifestation. The social side of city cycling plays an equally important role in improving the cycling experience. This will be discussed in the following chapter.

# *The social level*

If my friends have a bike,  
we can play together  
more often!





# Social equality

Social equality plays an important role in city life, as it gives everyone the freedom to contribute to society to the best of their abilities. Cycling can play a big role in this, since it gives independence and flexibility. Biking takes away the need to wait for someone to drive you, or to spend time and money on public transport. This independence can help broaden the range of activities a person can do on their own.

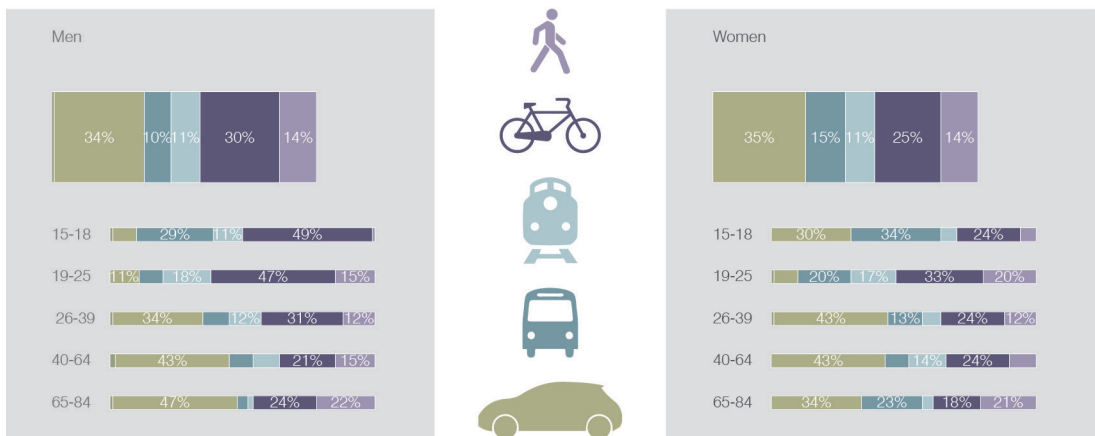
When striving for social equality through cycling, we must first know who bikes, and who doesn't. This might give an insight into why people don't bike which will help with

adjusting the cycling network to become more accessible.

Graph 3 shows the number of trips by bike taken daily, while graph 4 shows the percentage of cycling trips in relation to all trips taken. Please note that graph 3 shows the averages of only the people who chose the bike as their primary mode of transport, while graph 4 is an overview of all people living in Lund.

This section will focus specifically on the topics of gender, age and income.

Primary mode of transport - 2018



Graph 2<sup>o</sup>

## Gender

Gender plays an important role in social equality. Looking at cycling through the lens of gender can indicate something about the culture and the user friendliness of the cycling network. Since women make up around 50% of the population, their behaviour is easily measured, and it can

give clues about how certain networks are lacking in inclusion.

When looking at the amount of cycling trips per day, the difference between men and women is next to nothing. This implies that when the bike is used, gender doesn't influence the frequency of use. When looking at the percentage of people



Image 34 - The crossing to Stortorget in Lund

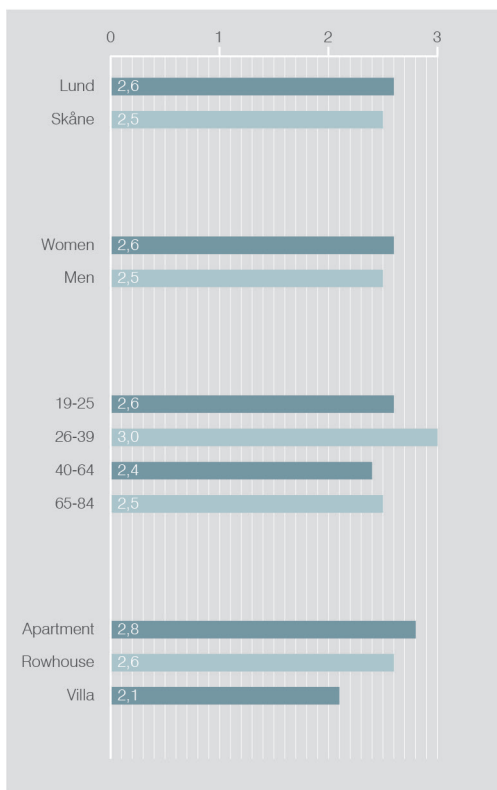
who use the bike as their primary mode of transport, there is a slight difference. The average shown in graph 2 reveals that the percentage of men using the bike is 5% higher than that of women, while women tend to take the bus more often. This difference is relatively small and can be caused by many different factors.

According to the article “Why don't more women cycle? An analysis of female and male commuter cycling mode-share in England and Wales”<sup>4</sup>, the general attractiveness of the route is the most important reason for women to choose the bike. This study was done through comparing 17 different factors of route attractiveness grouped by gender. The article concludes that the factors separately have a small impact, but their combined impact is what makes cycling for women less attractive. The article explains that hilliness has the largest individual impact for both women and men. The influence of topography and how this can be minimized has been discussed before. Traffic density

is named as the second most influential for women. The traffic density can be improved upon through discouraging car use and better road design, which will be discussed in more detail later on in this thesis.

The differences in relation to gender become more striking when they are split up into age categories. Especially the 15-18 category shown in graph 2 gives a concerning disparity. It shows that while about 50% of male teenagers use their bike to get around, only 25% of female teenagers do so. The concern grows when looking at car use for the same age. Graph 2 shows that around 1 in 10 male teenagers use the car, while for female teenagers it is almost 1 in 3. As most people in this category fall under the age of 18 and are thus not allowed a drivers license, this indicates that around 1 in 3 young women are driven around. This is concerning since having to rely on other people for transportation severely limits personal flexibility and independence. This begs the question: why are young women so much

Number of cycling trips per day - 2018



Graph 3<sup>3</sup>

less inclined to use a bike than their male counterparts? The fact that the car use of young women is so high, makes me think that the reason lies more in the cultural differences than the physical bike network. Since young women seem to be driven around much more, this could indicate that young women are still seen as weaker or more vulnerable. Independence is vital for young women’s personal growth, which makes this a highly problematic topic.

### Age

Age can greatly influence the choice of transportation, especially in the 65+ category. This is the category that least often chooses the bike, with only 20% giving the bike as their primary mode of transportation<sup>6</sup>. Graph 3 shows that for the seniors that do choose the bike, the amount of trips taken daily doesn’t decrease

notably. The overall average number of trips senior citizens in Lund makes in a day is 1,7<sup>3</sup>, which is significantly lower than the 2,5 and 2,4 trips daily taken by senior cyclists and car mobilists respectively. This implies that having a personal mode of transport increases the amount of trips taken.

When looking at the choice of transportation for people over 65, the car clearly dominates the field for both men and women. This can be caused by many reasons including habit, fear of safety, or convenience. Motivating the elderly to choose the bike will have a positive impact on their physical and mental health. This can be done through minimizing barriers and increasing safety, as well as offering classes on bicycle safety for seniors and specialized equipment.

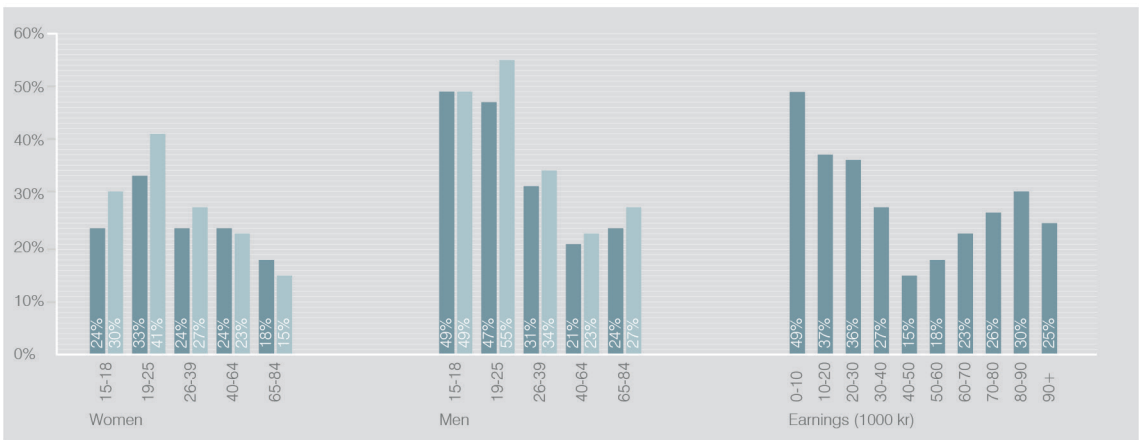
### Income

Your financial situation can also have a large impact on what types of transportation are available to you. It is therefore not surprising that the lower income groups more often rely on the relatively cheap bike as transportation. Graph 4 shows that almost half of people earning less than 10.000 swedish kroner per month rely on the bike to get around. This makes a strong contrast to the next group earning between 10 and 20 thousand kronor, where only around a third of people use a bike. This drop can be caused by people either having the money to travel by car, or their work is further away which makes biking more difficult. Since higher income jobs are often more specific, and thus located in larger towns, this can result in longer commutes.

When looking at the amount of trips taken per day shown in graph 3, the housing situation can give an indication of the number of daily bike trips taken. Income can play a role in this since apartments

## Cycling trips (% of total trips) - 2018

■ Average ■ Workday



Graph 4<sup>e</sup>

are on average cheaper than houses. This could, for instance, indicate that the people who live in villas that cast aside the bicycle as the primary mode of transport, might rely on other modes of transport for additional trips such as grocery shopping.

On the other hand, it could indicate that people living in apartments might simply make more trips per day. This could be because apartments are often located in the city centre, which makes the need for efficiency less pressing as most amenities are close by.

In the category of income, the target group for promoting bicycle use would lie in the 30 to 70 thousand kronor range. The reason why they choose not to bike might be the distance to work, or the distance to their daily needs such as schools and supermarkets. For promoting cycling to work, the e-bike plays an important role, especially for longer commutes. Having employers promote the use of e-bikes for longer commutes could have a large impact. When it comes to daily needs, connectivity is key. It should simply be easier to reach schools and supermarkets by bike, than by car. This should be combined with improved bike parking, and reduced car parking.

Even though low income often leads to higher bike use, the very poorest in the community should not be forgotten. There are groups who can't afford a bike, especially children in low income households are vulnerable to this type of transportation poverty. Leiden's cycle strategy mentions a program that gives these children vouchers so they can purchase a second hand bike<sup>2</sup>. They have given out over 400 such vouchers in 2019, and they expect this number to increase over the years. Giving these children a bike gives them more freedom and independence, as well as an easier commute to school. Having a bike will improve these childrens' lives substantially, through a relatively small investment from the government.

## Conclusions and recommendations

Social equality is important, and cycling can help with creating a more equal society. However, cycling must be accessible to all to do that.

*By creating equal biking opportunities, a more equal society is achieved.*

This chapter has established three categories that should be the focus of bike promotion: young women, the elderly, and working people with a midrange income.

Promoting cycling for young women is easiest done in school. Empowering this group through education gives them the confidence to use the bike as their mode of transportation. How this cycling education can take shape will be discussed in the next section. Another important part of this is educating parents on the importance of cycling and bike safety.

*By giving parents the tools they need to promote cycling to their daughters, their daughters in turn will be more inclined to rely on their bikes for transportation.*

When it comes to the elderly, minimizing barriers is vital for the promotion of cycling. This can take the form of creating bicycle parking that is more accessible, making sure cycle paths are well lit and maintained, as well as creating safe and direct routes with low traffic pressure. Another important factor in a nordic city such as Lund is snow removal. By making sure bike paths are free of snow and ice, cycling in winter becomes much more enjoyable and safe, especially for those who are a little less stable.

*Minimizing physical barriers is vital, but it won't be enough. The feeling of safety is almost more important than*

*the actual safety, and a great way to improve that is through educational events.*

How these events could take shape will be discussed in the next section.

The last group are the medium income commuters. Promoting cycling for them will mostly be organised through their employer. Municipalities can help set up a cycling promotion plan that companies can put in place. This will make it easier for employers to implement this, as the plan is already made, and can give municipalities some influence on the companies in their town. A vital part of this is proving good parking spaces for commuting cyclists. This could be supplemented with other incentives such as extra vacation days.

*Monetary incentives should be approached with caution, since this will only make a difference for the lower income groups and gives the rich the easy option of continuing to use their car.*

This puts the burden on the lower income groups which would decrease social equality instead of increasing it.



Image 35 - A cycling pedestrian path in Norra Fåladen, Lund

# Education

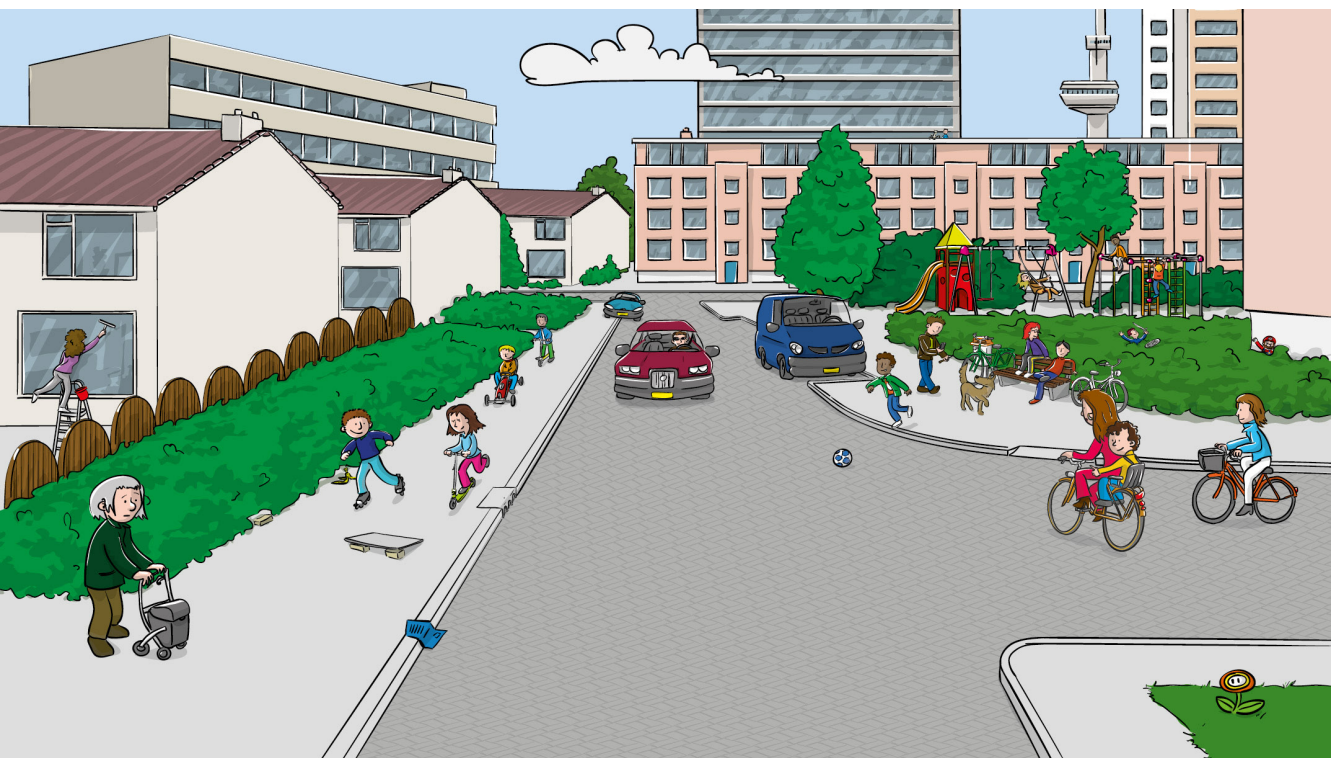


Image 36 - Example image from School op Seef

When it comes to biking safely, education plays an important role. If people are taught how to behave around bikes in traffic, all traffic participants will be able to act in a safe manner. This will increase confidence and reduce accidents, while also creating a more pleasant experience. As we've learned before, education can also have a positive influence on promoting social equality through cycling.

Education can have many focus groups but the most important ones are children, immigrants, and senior citizens. Children need to learn how to estimate the danger of a situation, how to behave, what is expected of them, and what the rules are, as well as how to feel comfortable on a bike. This will help them be independent from an earlier age, as well as increase traffic safety. For immigrants the situation is a little different since they have experience with traffic, but oftentimes no experience

with cyclists. It is important that they know how to behave around them, but also how to behave as a cyclist themselves. The senior citizens mostly need some repetition of traffic rules and help with adjusting to possible new equipment, and their ageing bodies.

I have been in contact with several schools and immigration organisations in both Lund and Leiden who have given me insight into how traffic is taught in these cities. This has been summarised in the following chapter.

### Children

Primary school is the most common place for children to learn about traffic. It is mandatory to give traffic education at this age in both the Netherlands and in Sweden, though no specific requirements are set for the education. Primary school in the Netherlands is for children age 5 to 11, and

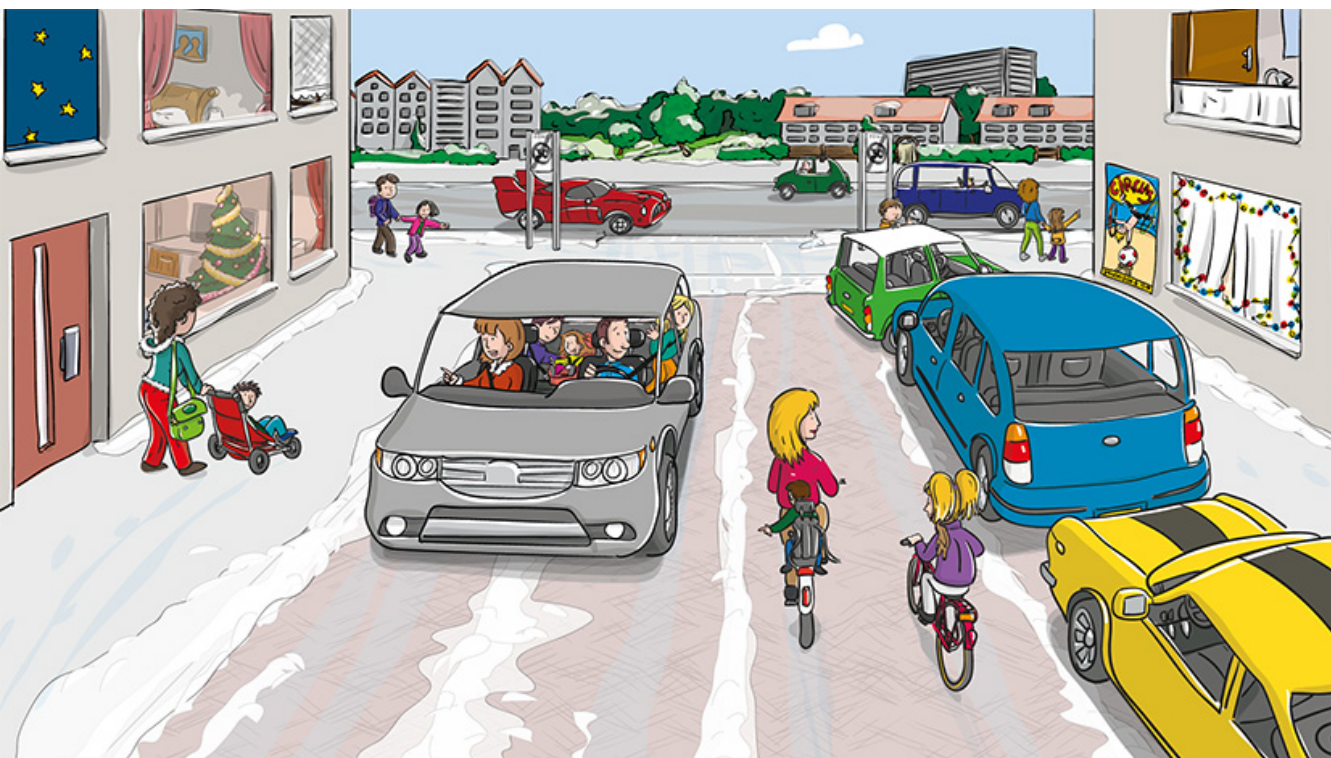


Image 37 - Example image from School op Seef

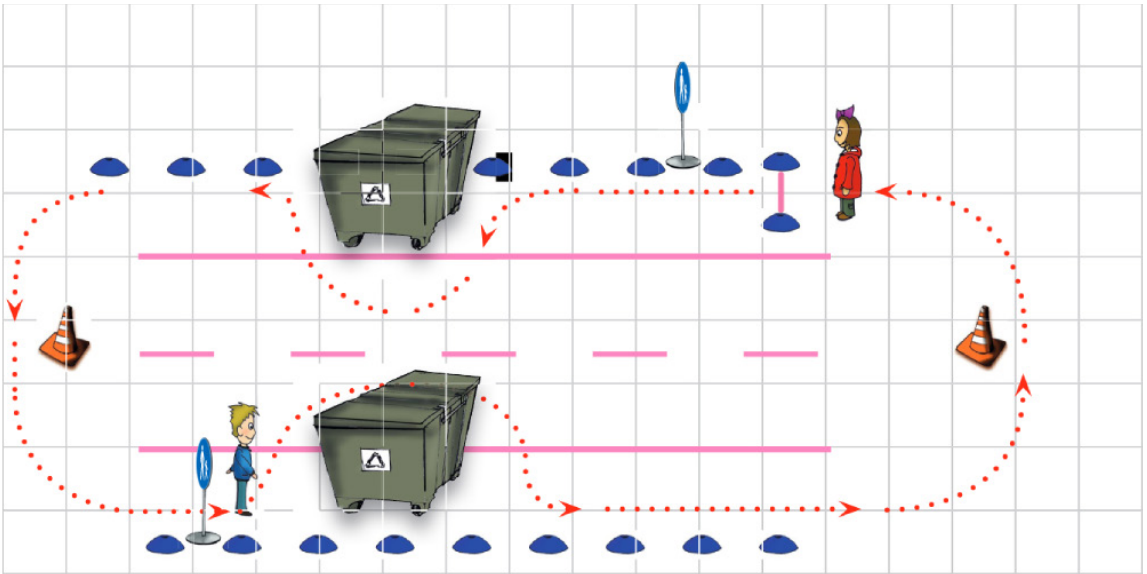


Image 38 - An activity for 5-6 year olds<sup>11</sup>

in Sweden for children age 8 to 16. Sweden works with a so-called “Läroplan”, a teaching plan. This is a document that details everything teachers must educate, without giving direction on how this should be done. Most of the responsibility to determine how certain topics should be taught lies with the principal in conversation with the teachers. The teaching plan states that children should know how to “orient themselves in their local environment and behave in traffic in a safe manner”<sup>8</sup>.

Fälädsskolan in Lund tells me that they speak about traffic briefly to their year four students, age 10-11. This is mostly focused on how one should behave in traffic when cycling from school to the gym. There is a short introduction in the classroom, and of course some practical education on the way to physical education. This is the only traffic education children get and is focused on how to behave as pedestrians and cyclists and not much on what to expect from cars.

In the Netherlands, there are laws about what children should be taught in school. These laws are very broad, and do not

specify any methods or requirements. On the topic of traffic, the law states that “The pupils learn to behave independently in a social manner, as traffic participants, and as consumers”<sup>9</sup>.

This leaves a lot of room for school to interpret what children should learn about traffic, just as in Sweden. Most kids bike to school from around the age of 6, especially in places where the bike is simply the easiest way to get around. This means that there is a need for children to learn more specific rules about traffic from an early age. It is therefore common for primary schools to give traffic lessons, followed by an exam. There are multiple organisations that create lesson plans around traffic or even send out trained teachers. One of the organisations that is commonly used is School op Seef. This organisation prepares a variety of lessons for all ages using several teaching methods. The topics and teaching methods are dependent on the age group the lesson is aimed towards.

School op Seef emphasizes the importance of traffic lessons being a yearly recurrence. All children learn and develop at different

pace so returning to the lessons gives all children the ability to get everything out of the lessons. They mention that the practical lessons are the most important, since children learn best by doing. These practical lessons help the children learn both cycling skills and traffic safety which increases independence and confidence, as well as safety.

Image 38 shows an example of an activity proposed by School op Seef for year 1 and 2 (age 5-6). This activity is focused on how to walk on the sidewalk and what to do when there is an obstacle. Image 39 gives an example of a more complicated situation suitable for year 7 and 8 (age 11-12). This

activity focuses on crossing safely as a pedestrian and cyclists when dealing with traffic participants from multiple directions.

At the end of primary school, most schools organise a traffic exam. The practical part of this test involves children biking a set route in small groups while parents and teachers are stationed along the way to grade them on traffic safety. There is also a theoretical part which contains 25 questions where children step into the role of pedestrian, cyclists, or passenger<sup>10</sup>. The traffic exam is organised by Veilig Verkeer Nederland (Safe Traffic Netherlands).

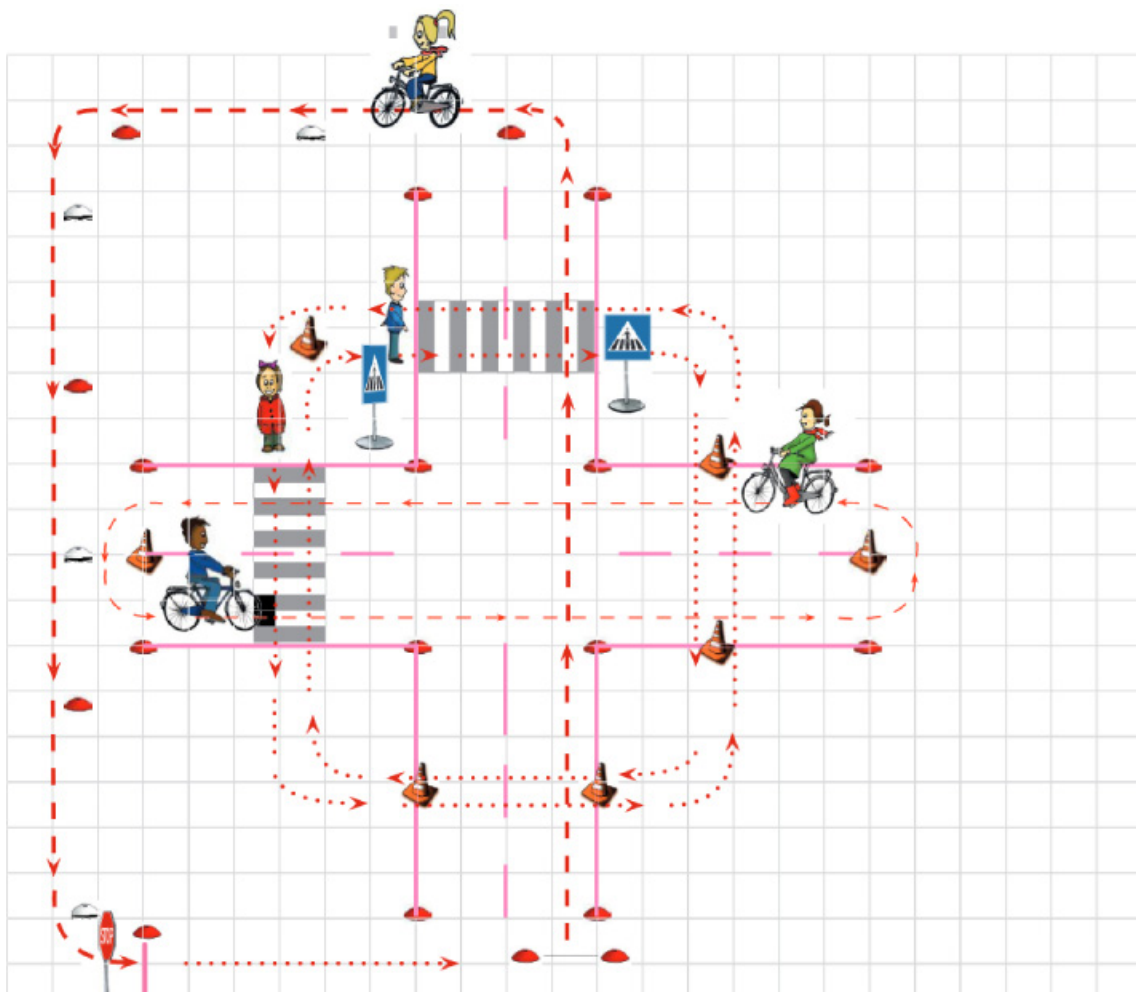


Image 39 - An activity for 11-12 year olds<sup>12</sup>

# Case study; Traffic Playground Copenhagen



Photos by Ursula Back<sup>13</sup>  
58 - Social Level

A great way to get children to learn is through play, as has been established before. A nice example of learning about traffic through play is the traffic playground in Copenhagen. Biking in Copenhagen is just as popular as it is in the Netherlands, so there is no surprise that they take their traffic safety seriously. This playground is a great feature to have in a city such as Copenhagen and actively participates in a safer environment for all traffic participants.

If a traffic playground like this one would be built in Lund, it could be located in one of the parks such as Sankt Hans Backar, or Stadsparken. Alternatively it could be located on an existing schoolground, or in a city expansion area such as Brunshög.

The playground features child-sized traffic situations and includes:

*Roads*

*Bike and pedestrian paths*

*A roundabout*

*Traffic lights*

*Traffic signs*

*Zebra crossings*

*Bus stops*

*Bike rentals for smaller kids*

*A gas station*

*Parking lots*

For the very youngest children, age 2 to 5, there is a small fenced-in playground with a simplified layout located in the north west of the playground. The main playground is made for children age 2 to 14, and is therefore suitable for traffic safety lessons in pre- and primary school. The playground is open to children with their parents, or can be booked by schools and other child-oriented organisations. The park was built in 1974 and has been completely renovated in 2014.

Creating a similar playground in Lund would make it even easier for schools to teach about traffic, since they won't even have to do it themselves. Bringing children here for a fun day of learning about traffic safety is something that could take place once or twice a year. It would be a simple way to incorporate traffic education into the curriculum for all schools in Lund.

## Immigrants

Immigrants are the second target group for traffic education. They are a difficult group since they aren't as easily reachable as school children. They don't all go through the same process, or come to a country with the same goals and needs. It therefore seems harder to find cycling lessons for this group. As there are roughly three reasons why someone would move to a different country: work, education, or refuge, I contacted universities and refugee organizations in both Lund and Leiden, as well as language schools that teach Dutch/Swedish. These seemed most likely to offer or know about cycling lessons.

This sadly yielded very little result. In Leiden I haven't been able to find any organisation giving cycling lessons to immigrants. From the university I got the reply that the students are to ask their dutch friends, and the refugee organisations could not point me in the right direction either.

In Lund I've found the red cross bike school through the language school. This organisation is a combined effort of the red cross and Bike Kitchen Lund, a company that gives bicycle repair workshops. Their aim is to teach adults and children over 13 how to bike to increase their independence. It is now closed because of COVID, but before that it was a popular course.

One group of immigrants that should be specifically named are the international students. There are a lot of them in Lund and many use the bike to get around. This is a group that should be given a bicycle safety lecture in the beginning of their study period. Giving this group a short lecture on the importance of lights, a bell, and how to use the infrastructure, should improve cycling safety for the whole town.

## The elderly

When looking for ways to increase bike use in the elderly, education can make an impact. Many seniors avoid the bike in fear of their safety. Education will give them the confidence they need to get back onto the bike paths and start cycling again. Sometimes education is not enough and special equipment is necessary. This can take the form of a mirror when bending backwards becomes difficult, finding a bike with a lower instep, or having some electrical support to conquer the hills of Lund. Education can in turn help seniors to get used to their new equipment and get the most out of it, which will help them stay on their bike much longer.

Organisations such as Stenkrossen and the red cross cycling school could play a role in organising these types of courses.



Image 40 - At the "fietsschool voor senioren"<sup>14</sup>

An example of this is the “fietsschool voor senioren” organised by the fietsersbond fietsschool in the Netherlands<sup>14</sup>. This organisation creates events for people over 60 that they call cycling parties. These parties include a bike check, a parkour, education on e-bikes, traffic quizzes and more which ensure that everyone in attendance has both a fun and an educational experience.

## *Conclusions and recommendations*

What can Lund learn from Leiden?

- Organized primary school education
- Cycling activities for the elderly

Education is important, especially if it keeps people safe. It is therefore vital that traffic safety is taught repeatedly from a young age. After learning about the small amount of time spent on traffic in primary school, I was no longer surprised by the regular annoyances caused by children while biking. It seems that Lund municipality relies on pedestrian-bike paths and parents to keep children safe in traffic, without feeling the need for additional education. I would therefore recommend a more extensive traffic education program for children age 5 to 12. The lesson plans should be created by an external organisation, so as to not put even more pressure on the teachers and to create equal traffic education across schools. This could be picked up by the municipality themselves, or a separate organisation. A lesson plan would be a good starting point for teachers to help them give more specific traffic education. One step further could be to have the organisation come in and teach in schools, instead of relying on the teachers of the primary schools. It is important to create

a lesson plan that could be used all over Lund, and maybe even all over Sweden. This could be followed by an exam, though I would recommend to focus on the education more so than the exam.

When it comes to immigrants, Lund is doing rather well. I would recommend this red cross school to spread their focus group a little wider. This could entail for instance a lecture for new international students about traffic rules and behaviour. Especially educating students, who will make extensive use of their bike and are often boisterous, would improve traffic conditions. Apart from that the red cross cycle school is a great organisation that actively improves lives.

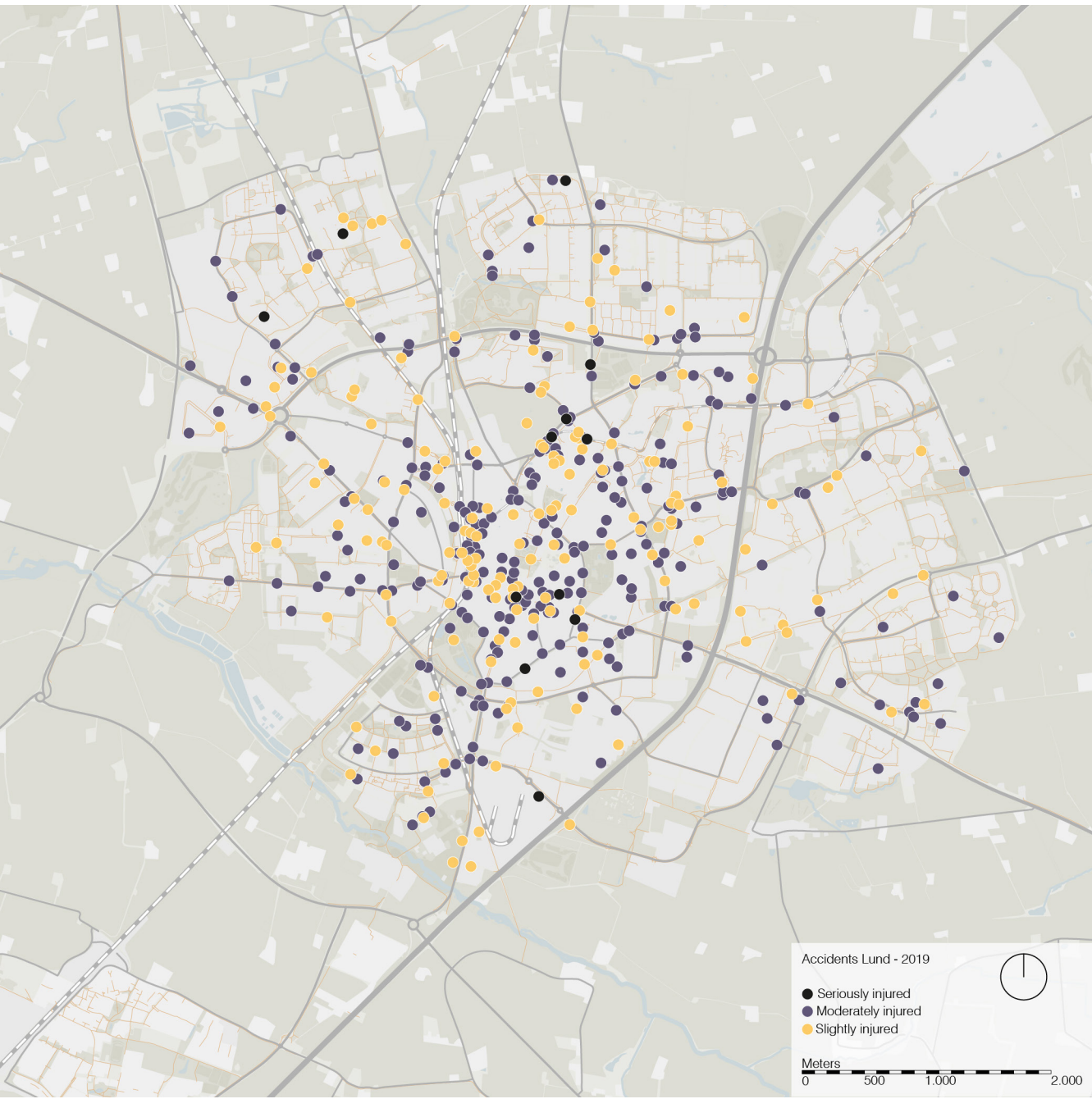
Lastly, organizing fun and educational activities for the elderly could help them feel confident to get back onto the bike, so I would recommend the municipality or the red cross biking school to look into this.

# Street Level





# Accidents and Incidents



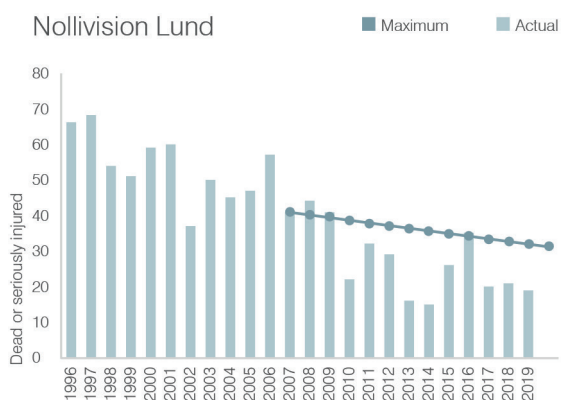
One of the most important factors for increasing bicycle use is traffic safety. With that in mind, this thesis would not be complete without an analysis of the accidents and incidents in Lund involving bikes. According to Lund's bicycle policy, around 340 cyclists are hurt in traffic in Lunds municipality each year<sup>1</sup>. Luckily, most of these accidents do not involve other traffic participants as they are mostly single accidents where cyclists fall on slippery surfaces or bumps in the road.

The Swedish government published the Nollvision in 1996. This vision specifies that nobody should die in traffic or be so seriously hurt that they cannot reclaim their previous bodily functions<sup>15</sup>. This vision included step-wise goals, one of which being that the number of serious and deadly accidents should be halved by 2007.

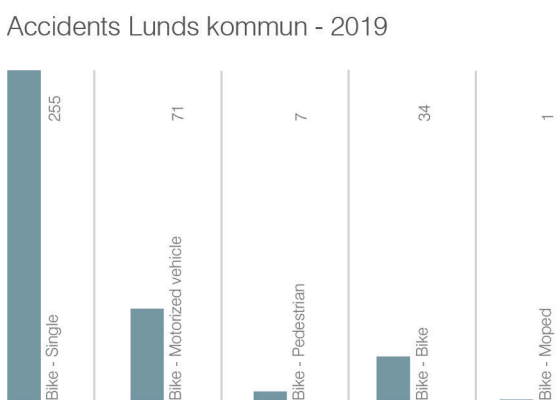
This meant that in 2007 in all of Sweden, only 270 such accidents were allowed to happen<sup>15</sup>.

Since the introduction of the Nollvision, Lund has been working on improving dangerous crossings and decreasing traffic accidents. Graph 5 shows the amount of accidents in Lund and the comparison with the Nollvision. With the exception of 2015, Lund has managed to stay under the Nollvision from 2010 onwards. This is a great trend to see and to keep an eye on.

As this thesis focuses on cycling, this section will be limited to accidents involving bikes. All the data is from hospital and police records from 2019. They were provided by the Transport and Roads faculty of LTH.

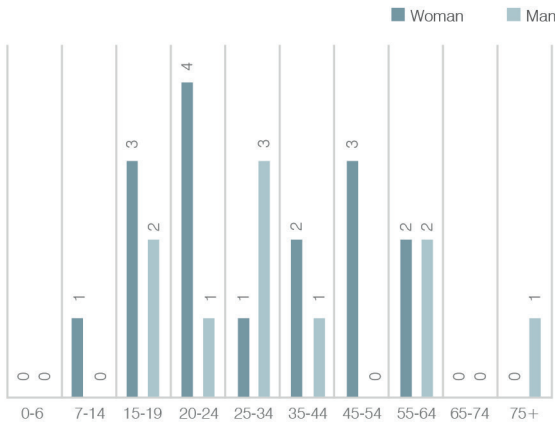


Graph 5<sup>15</sup>



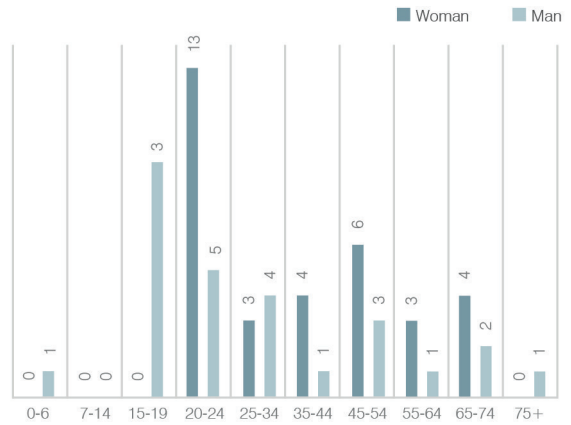
Graph 6<sup>16</sup>

Age and gender - Norra Fäladen - 2019



Graph 7<sup>16</sup>

Age and gender - City Centre - 2019



Graph 8<sup>16</sup>

## Accidents and incidents in Lund

Before zooming in, it is good to have an overview of how the city is doing in general. Page 64 contains a map showing the locations of all the accidents that took place in the city in 2019 involving cyclists and pedestrians. There is a clear concentration around the city centre, which is to be expected considering the high pressure on the traffic system. Graph 6 shows the number of accidents in Lund kommun in 2019 where bikes were involved, separated by the type of traffic participants involved. It clearly shows that most bike accidents are single accidents. They are the hardest to avoid, but often also the least damaging. They are mostly caused by leaves, the weather conditions, or inebriation.

## Norra Fäladen versus the City Centre

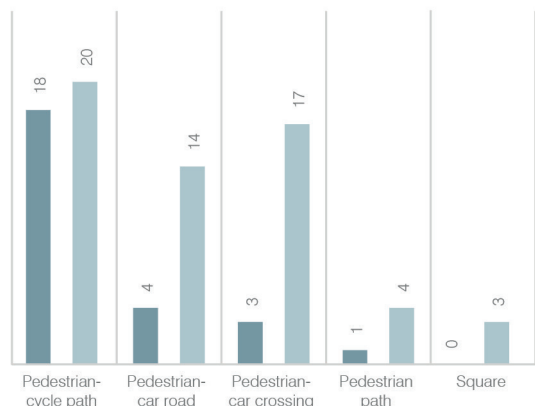
From here on, all the graphs are comparisons between the city centre and Norra Fäladen and all accidents involve

bicycles. This focus will create a more specific image of these neighbourhoods. Norra Fäladen is chosen for the part of the research because as a suburb it will have different accident patterns than the city centre. This can teach us something about what different traffic structures can have for effect on accidents. This is the same suburb as was analysed earlier on in this thesis.

To get a greater understanding of the accidents that take place, it is key to know who gets into these accidents. Graphs 7 and 8 show the gender and age of the people involved in the accidents. As we've seen on the map, most accidents take place in the city centre. This explains the difference in numbers between the city centre and Norra Fäladen. It is therefore more compelling to compare the neighbourhoods with themselves than it is between each other. The most noticeable outlier is the same in both graphs, namely women between 20 and 24 years old. This group has the most accidents of all age and

Road type - 2019

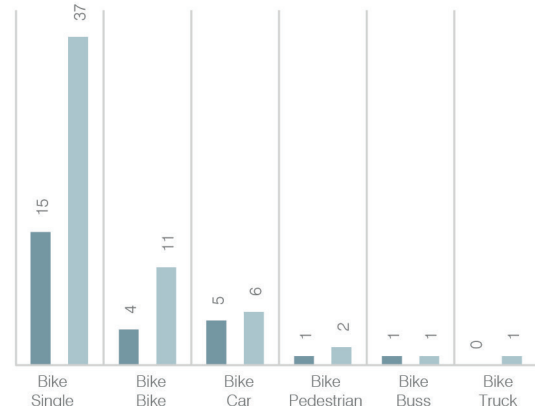
■ Norra Fälåden ■ Centre



Graph 9<sup>16</sup>

Type of accident - 2019

■ Norra Fålåden ■ Centre



Graph 10<sup>16</sup>

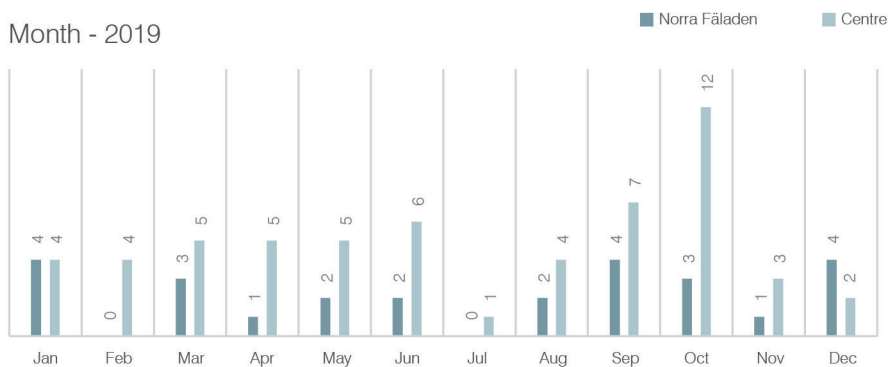
gender groups. This could be caused by the large influx of students of that age, and the relative insecurity in relation to traffic that women experience. This insecurity creates vulnerability which translates into more accidents. Another interesting observation is the small amount of accidents involving senior citizens. An explanation could be that senior citizens avoid busy places like the city centre, thus are less prone to accidents.

Now that we know who gets in these accidents, we should also know what type of accidents they are, and where they take place. Graph 9 shows us the types of locations where bicycle accidents took place, which reveals that the most accidents take place on the pedestrian-cycle paths. Especially in Norra Fålåden, as much as 70% of the accidents take place on this type of road. This could be caused by the fact that this is simply the most used type of road for bicycles, especially in the suburbs. Though this can account for the high percentage, it doesn't explain what

causes the accidents. As graph 10 clearly illustrates, most accidents are single bike accidents. When comparing this to graph 9, the assumption could be made that most of the accidents taking place on pedestrian-bike paths are single accidents. From here we can start to speculate what the cause of these accidents could be. There is a high chance that most of these accidents are caused by the road surface. This could be because the roads are either slippery or badly maintained. Better maintenance of the pedestrian-bike paths around Lund will probably decrease the amount of single bike accidents drastically. A quick response to and removal of snow and leaves on these paths would also help decrease accidents.

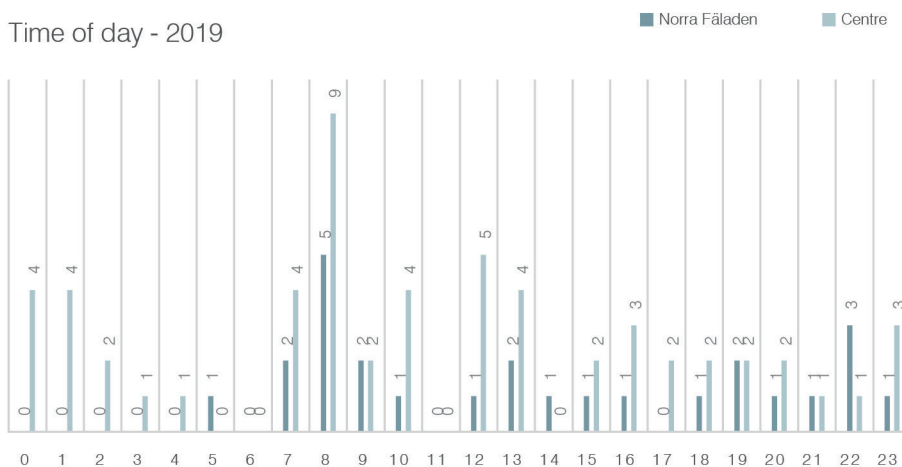
When looking at road types for the accidents in the city centre, there is more diversity. This can be attributed to the fact that people bike on a more diverse set of roads in the city centre. Even though the types of road are more diverse, even in the city centre 64% of accidents are single bike

### Month - 2019



Graph 11<sup>16</sup>

### Time of day - 2019



Graph 12<sup>16</sup>

accidents. From this we can conclude that having people bike on a more diverse and mixed set of roads, does not necessarily mean more accidents involving other traffic participants. In fact, the chances of getting into a bike-car accident in the suburb is higher (19%) than it is in the city centre (10%). Since the amount of data is relatively small, we can't take any definitive conclusions from this. However, this does indicate that it is safer to create roads where cars are forced to acknowledge and be mindful of bikes, than it is to completely separate them.

The last thing to look at when it comes to accidents, is when they take place. For this reason, graph 11 and 12 show the accidents per month and time of day. This can tell us something about seasonal changes, rush hours, and week versus weekend traffic pressure.

When looking at graph 11, the most obvious outlier is October with roughly 20% of all city centre accidents taking place in that month. The most probable factor for this is the

change in season. October is a relatively slippery month with leaves on the road and lots of rain. If this is combined with the days growing darker and the group of relatively new students that arrived in september, it is not surprising that october is an accident prone month. Sadly, these influences are largely outside of our scope of interference. It is therefore difficult to have an impact on these numbers.

Lastly the times of day in graph 12 show clearly what the rush hours in Lund are. The biggest one is around 8 in the morning, when people of all ages leave their homes to go to work or school. This higher pressure on the traffic system has an obvious impact on the number of accidents taking place. A similar though smaller peak can be found around lunchtime. This graph could also tell us something about the lighting situation in Lund. If the lighting is too little, more accidents would happen in the evening. This does not seem the case, so we could conclude that the lighting in Lund is sufficient.

## Conclusions

To conclude, Lund is a rather safe place to bike, as most bike accidents are single accidents. There is a rather small percentage of accidents that involve more than one person which means that the traffic is organized well enough to avoid collisions. To decrease the number of single accidents on pedestrian-cycle paths, an improvement of the road surface would be welcome.

The numbers also indicate that it is safer to mix traffic types, especially in the city centre. This increases alertness and reduces speed which decreases the number of collisions between cars and bikes even further. These small changes would make Lund an even safer and more user friendly place to bike. How this can manifest in physical changes will be discussed in the rest of this thesis.

# Traffic Lights



Image 41 - Traffic light with button attached to the light - Lund



Image 42 - Enough distance between the light and the button - Amstelveen, the Netherlands

In the design of a city, traffic lights may seem like a small detail, but they are an important part of many traffic situations. Leiden's cycle strategy even has a whole section specifically about traffic lights for cyclists. This is because traffic lights are one of the biggest annoyances cyclists face, according to the Leiden cycle strategy<sup>2</sup>. The strategy also mentions that cyclists are much more likely to ignore traffic lights than cars, especially when it is unclear why they are waiting. This can have disruptive effects on the whole traffic situation, and should be avoided.

Another reason why cyclists might ignore traffic lights are weather conditions. Since it rains relatively often in both the Netherlands and south Sweden, it is an important point of attention. In certain weather conditions cyclists should be given a green light more

often than their shielded counterparts such as cars. This will stimulate cycling in poor weather conditions. However, not only poor weather conditions could be a reason to increase the frequency of green lights for cyclists. By giving cyclists more frequent green lights in general, it gives a motivation boost in favour of the bicycle, since cycling will become faster than driving. The Leiden cycle strategy mentions that in certain high pressure crossings cyclists get a green light twice to three times more often than cars<sup>2</sup>.

Not only the frequency of green lights has an impact on traffic safety, the physical form of the traffic lights plays an important role as well. This section will therefore focus mainly on the physical form of traffic lights for cyclists.

## The physical form of traffic lights

The physical form of traffic lights plays a large role in their user friendliness. Most traffic lights for cyclists feature a button and three colored lights, which creates a simple and recognizable urban feature. In Dutch cycling traffic lights, the buttons are most often only present for show as most cycling crossings feature sensors embedded in the road surface that activate the lights. The button is there so cyclists get a visual and physical confirmation of the traffic light being activated. In Lund this is rarely the case, most traffic lights only activate after pressing the button. This can be especially frustrating when it causes cyclists to stop even though they should have a green light, which could be avoided through sensors in the road.

When looking at the physical form, the difference between the average traffic lights in Lund and Leiden is the location of the button. Image 41 shows how the button in Lund is most often located on the same post as the light itself, while image 42 shows a separate post for the button in the Netherlands. The distance created by the separation of the button is enough for the front half of a bicycle, as shown in image 44. This distance ensures that cyclists can comfortably press the button while remaining fully on the bike path, and have a view of the traffic lights. Without this distance, cyclists must either reach across the front half of their bike as shown in image 43, or have the front half of their bike protruding onto the road and risk getting hit by a car as shown in image 45. Having



Image 43 - Having to reach across your bike - Lund



Image 44 - A comfortable button to push - Amstelveen, the Netherlands



Image 45 - Bike protruding onto the road and impossible to see the light - Lund



Image 46 - Sensors are visible by the white arrows, a good distance from the traffic light - Getingevägen, Lund

the button on the same post as the light creates dangerous situations where cyclists risk falling over, or getting hit by a car on their front wheel. These situations are extra difficult to navigate for children, the elderly, and people carrying children, groceries, or other large or heavy items on their bike.

Another reason to increase the amount of sensors embedded into the road surface would not even have crossed our minds two years ago. As the world is going through a global pandemic, the awareness of how diseases are transmitted has increased. This pandemic has taught us that hard materials such as metals and plastics are a good environment for viruses such as Covid-19. This means that objects in the public sphere that require touching from many different hands on a daily basis are under scrutiny. Traffic light buttons are among the types of objects we would now rather avoid touching, begging the question whether these buttons should be present at all. An obvious and previously discussed solution for this is sensors embedded into

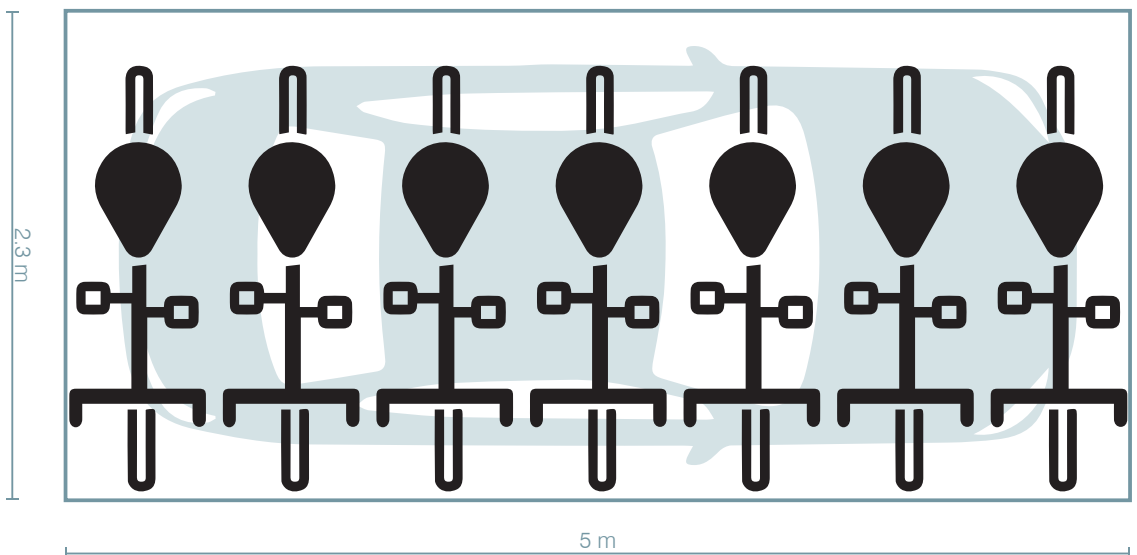
the road surface. However, as we've learned from Leidens cycle strategy, this often doesn't reassure cyclists that the traffic lights are working, which increases chances of them being ignored. The traffic lights should therefore be outfitted with signals that show cyclists that the lights have been alerted to their presence. The newly renovated stretch of the Getingevägen that runs along the university hospital in Lund has traffic lights with sensors though they also still feature buttons (image 46), similar to what is done in the Netherlands. When approaching these cycle traffic lights, the button lights up to inform the cyclist that the traffic light is activated. This is highly effective, especially when it's dark. In addition to this, a sound could be added to alert cyclists even further. In a time where it is common for people to not pay attention to the road, but instead look at their phone, an audio cue could form a welcome addition. At the same time this will increase clarity when the sun is out and the lights are less visible, as well as make it easier for people with visual impairments.

## Conclusions

Traffic lights form an important part of cycling safety, but can become annoying barriers. That is why giving cyclists higher priority on crossings with traffic lights will stimulate bike use while simultaneously discouraging car use. The physical form of traffic lights are key to creating safer, more user friendly cycle crossings. A large portion of creating a safer bicycle crossing is the location of the traffic light button. By creating a

distance between the button and the light, it becomes more comfortable and safe to use. An even safer solution is to embed sensors into the road surface which allows cyclists to avoid the need for pressing buttons. This helps minimize the spread of disease through the population.

# Parking of cars and bikes



Car parking is an important pull factor to a city centre but it could be used as discouragement as well. The same cannot be said for bicycles, since especially students and other young people will continue using their bike even without proper parking. This means it is extra important to create ample parking space for bicycles to prevent messiness like in the photo below.



Image 47 - Chaotic bike parking at the central station

The map on the left shows the parking space available for both cars and bicycles in Lund city centre. It clearly shows how much car parking space is available and how little bike parking. This is concerning because Lund has expressed their intention to push people to leave their car and use their bike. This is a clear representation of the mismatch between promoted priority and shown priority of Lund municipality

Of course it is not possible or even desirable to take away all parking in the city centre. It is important to maintain accessibility for those who need it, for instance the disabled community. One way to improve the image of Lund to seem more bike friendly is to minimize or even completely eliminate street parking. This would allow for much more pedestrian space and space for bicycle parking, in addition to keeping cars out of sight. The parking garages should have enough capacity to service the whole city centre. A clear option for this would be Klostergatan as discussed on page 84.

Transforming street parking for cars into street parking for bicycles takes away a relatively small amount of car parking spots, while adding an incredible amount of bicycle parking. As visible on the graphic to the left, one car parking space can contain between 6 and 10 bicycles.

When it comes to maintenance of bike parking, it is important to keep an eye



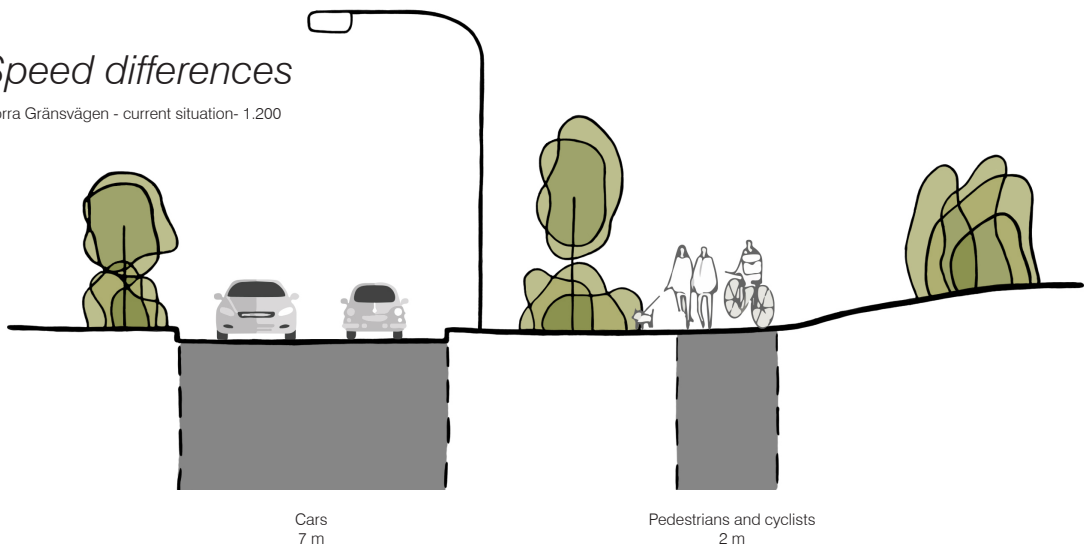
Image 48 - Car parking on Klostergatan

on disused bikes. This is especially problematic around the train station. Many cities face the problem of bikes being left in public parking spaces, which clogs up the space and decreases the usefulness. The bike policy of Leiden has a specific chapter dedicated to “wrecks and orphanbikes” that states a maximum of 28 days of use for such bicycle<sup>2</sup>. After 28 days they are removed by the city and taken to a second location where they can be picked up for a predetermined amount of time before being sold or destroyed. This is something that I would encourage Lund municipality to be more active in.

To conclude, having ample parking for bikes and difficult to reach parking for cars will increase bike usage in town. Transforming street parking into bicycle parking will not only drastically improve bike parking possibilities but also give Lund a more bike friendly appearance.

# Speed differences

Norra Gränsvägen - current situation- 1.200

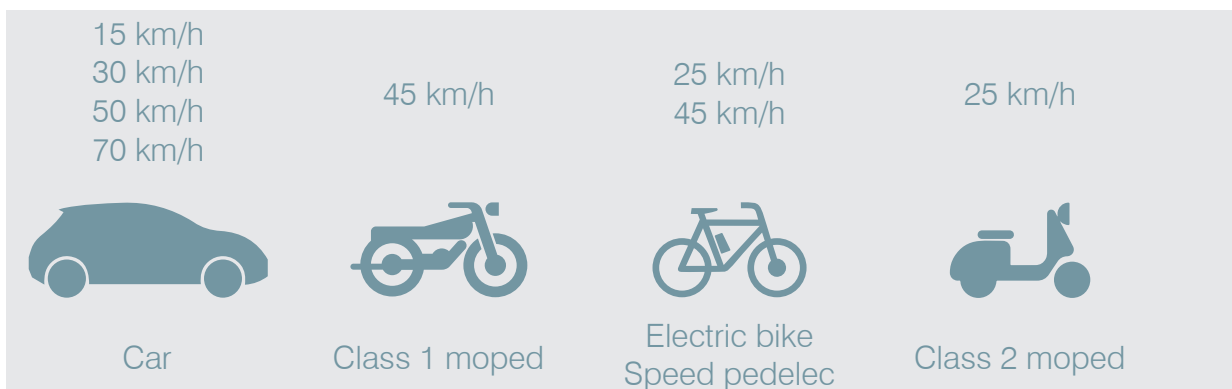


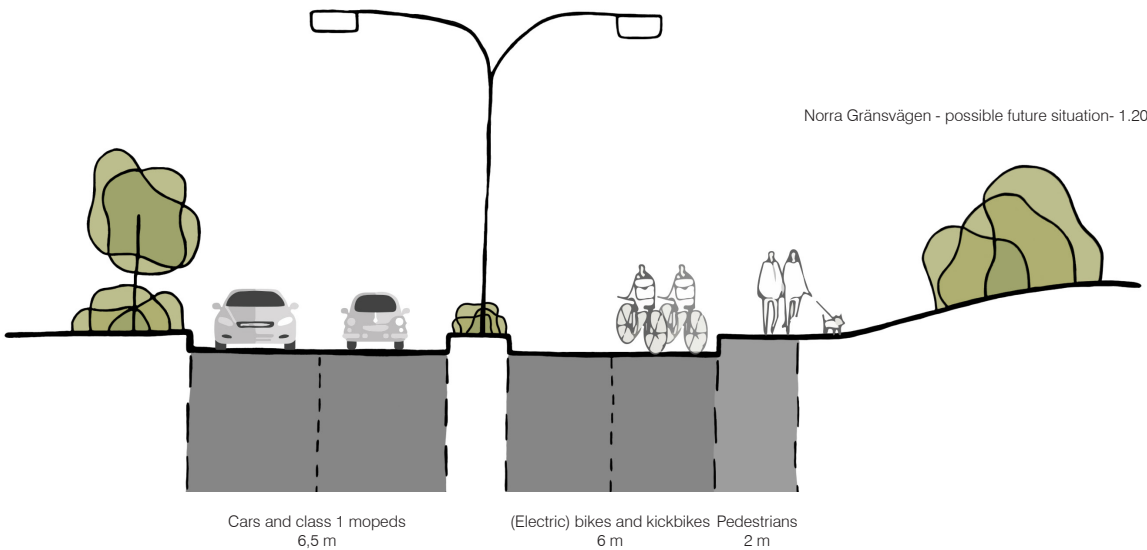
The increasing diversity of traffic participants and their speeds creates an ever more complicated traffic situation. Especially within a suburb, the speed differences become exaggerated where speed limits for cars can be anywhere between 30km/h and 70km/h. This is very different from a city centre where the car often isn't allowed to go over 30 km/h. The decreased density also allows for commuters using other types of vehicles to increase their speed. For instance, a speed pedelec user might lower their speed to 15 km/h when they are in the city centre, but they might reach higher speeds of around 40 km/h in the suburbs. This raises the question, what types of traffic participants should share a road surface?

In an average suburb in Lund, the cars are separated, while the rest of the traffic is made to share one space. As the variation

in speeds continues to increase, it is time to start thinking about how to restructure traffic to accommodate this.

If we take Norra Gränsvägen, a ringroad in Norra Fäladen, as an example, there are a lot of possibilities to improve this relatively busy road. This road has a maximum speed of 50 km/h for cars, this means that the car space can be shared with class 1 mopeds. Because of the busses that also use this road and the relative frequency of use, it seems sensible to keep the bikes separated. For the reimagination of Norra Gränsvägen visible above, the exact same width as before is used. Utilizing this space more efficiently, it is possible to introduce a two lane bike road, as well as a separate sidewalk. This bike path would give enough space for cyclists, electric cyclists, and electric kickbike users. By creating a height difference between the bike path





and the sidewalk, it decreases the chance of cyclists using the sidewalk to overtake others, while also alerting the pedestrians to be careful if they have to step onto the bike lane for whatever reason.

Separating the traffic in this way increases safety for all users. On top of this, it creates better usability, especially for cyclists. There now is enough space to bike calmly without having to be on constant high alert for pedestrians. Keeping the cars separate gives an increased sense of safety and less options for accidents.

Lastly, the reimagination of Norra Gränsvägen features a double streetlight, as opposed to the current single light. Adding more light at the cycle path allows for safer situations at night time, especially when the variation in bike speeds increase. There is less of a chance for someone to

“come out of nowhere” when there is more light.

This analysis is specific for a location where traffic is focused on getting from A to B as fast as possible. Another way of increasing safety for all is by forcing everyone to slow down. This could be done in so-called bicycle streets. These are streets where a regular bike dominates the street and opposes it’s speed to all users, including cars and mopeds. This is especially useful in locations with a lot of bicycle traffic. The speed limit would be around 15 km/h and the road surface would be shared between bikes, cars, mopeds, and kickbike users. Pedestrians often still have separate sidewalks since their speed is only around 5 km/h. These types of streets are more suited to the city centre.

Average speeds of common modes of transportation

25 km/h



Racing bike

25 km/h



Electric kickbike

12 km/h



Bicycle

5 km/h



Pedestrian

# Materiality

Low contrast



Image 49 - Bredgatan, Lund



Image 50 - Prinsessenkade, Leiden

The material makes the crossing unclear



Image 51 - Kyrkogatan, Lund



Image 52 - Veluwemeerlaan, Leiden

High contrast



Image 53 - Kyrkogatan, Lund



Image 54 - Clemenstorget, Lund

Cobblestone gives character

Materiality plays an important role in the safety and comfort of traffic. Good use of materiality increases clarity and comfort, especially if used consistently. A good example of creating clarity through use of material is the use of contrasting colors to indicate different types of use. The large contrast in colors ensures that the difference is visible during all lighting situations. Image 52 is a good example of what clear contrast looks like. The black and red of the asphalt is contrasting enough to notice under varying lighting situations, and the white lines strengthen the visibility even further.

Using contrasting colors is one thing, but using them consistently makes them even more useful. If all bike paths have a similar color or material, it becomes very easy to spot them for all traffic participants. In the Netherlands, this is done through the overwhelming use of the color red for bike paths. This is not present everywhere, but many municipalities are trying to eliminate the use of black for bike paths. The result of this is that every inhabitant of the Netherlands knows that red means bicycle.

Making the materials communicate for you creates an environment where traffic participants don't have to rely on signage to have a quick overview over the traffic situation. This creates safer traffic situations where everyone knows what is expected of them.

When looking at materiality in Lund, there are roughly two materials used. Outside of the city centre, almost all surfaces are black asphalt. Inside the city centre, the use of cobblestones is prevalent. Cobblestones can be seen in all images of Lund on the facing page, they come in a variety of colours, though the difference is often subtle and thus hard to see. Lund municipality relies on subtle color and pattern changes to indicate bike lanes and

crossings. The use of the cobblestones gives a lot of character to the city and complements the older architecture of the city centre very well.

Sadly, cobblestones are not the best choice for traffic safety for a number of reasons. The first reason, as mentioned before, is contrast. By relying on the subtle color differences in the cobblestones, the clarity of the traffic situation is reduced, as shown in image 49. This is especially true for faster moving vehicles like busses and cars. Images 49 and 50 show similar situations in Lund and Leiden, a street where bikes have the upper hand and should be respected as such. The use of materiality in Leiden gives this signal much more clearly than it does in Lund. The subtlety of the color differences are exacerbated when cobblestones are also used to indicate crossings such as in images 51, 53, and 54. Because the material of the bicycle crossing and the car road is the same, the crossing is unclear and often ignored even though cyclists have right of way.

Secondly, the texture of the street creates resistance and makes for a bumpier ride. This decreases comfort for cyclists tremendously, especially in a city with a steep incline. The topography creates a strong preference for smooth asphalt. Fortunately, the reddish cobblestones that are used for bike paths are considerably smoother than the greyish ones used for cars. This increases the comfort, though only in places where there is a specific bike path.

Now that we know the importance of good use of materials, the challenge for the design part of this thesis will be to choose a material which gives character, comfort, and clarity.

# *City centre Introduction*





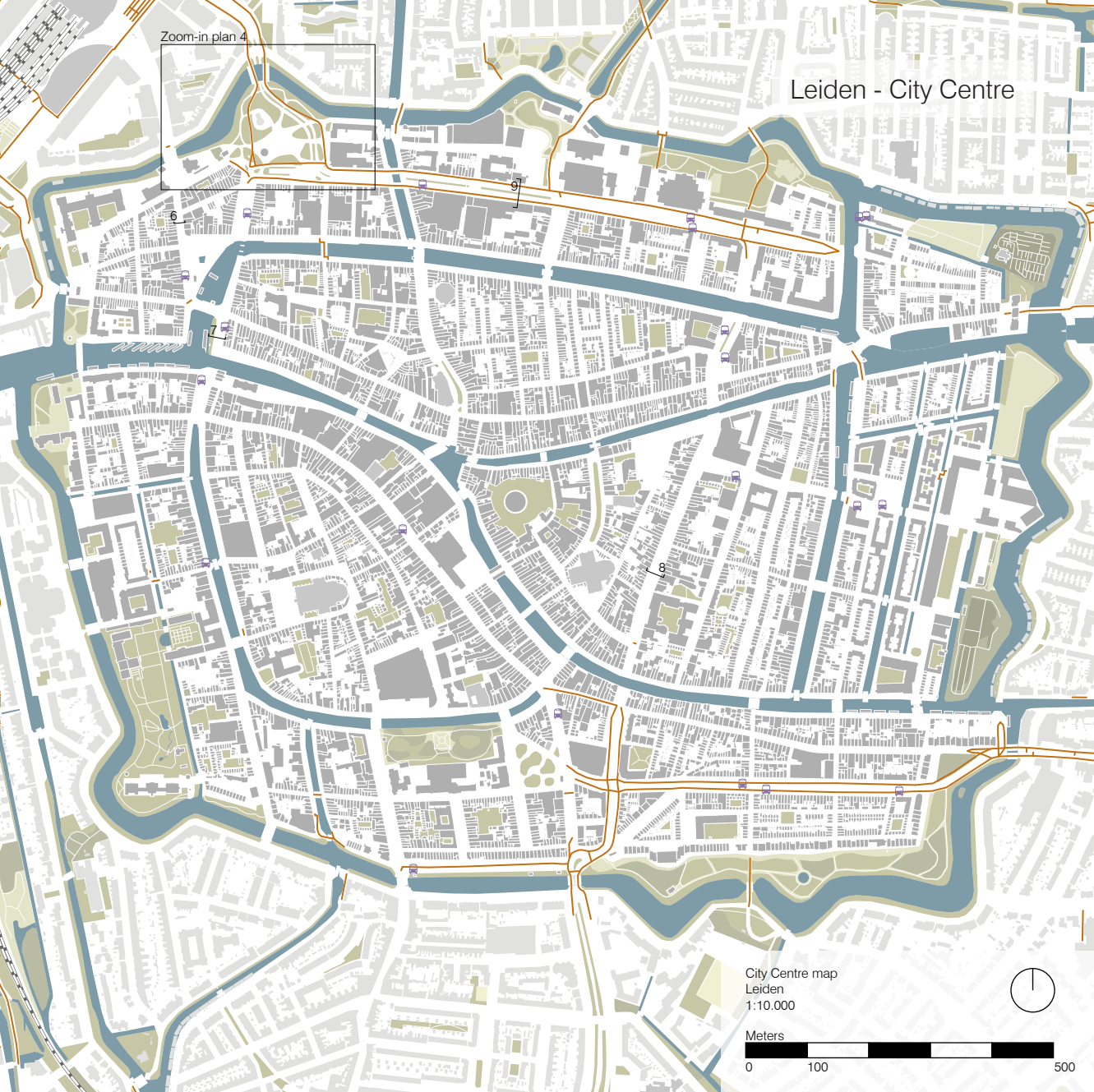
## A historic city centre Lund - City Centre



Both Lund and Leiden are cities with over a thousand years of history. This is still visible today in both city centres, mostly through the architecture that has remained over the years. The city structures however are much older than the architecture. The oldest structures that still shape the cities today are the defensive waterways in Leiden and the city rampart in Lund. The first waterway of Leiden was dug in 1200 and it still makes up an important part of the city structure. The rampart around Lund was built in 1134

and measured approximately 3.700 meters in length<sup>17</sup>. Sadly only around 460 meters of this has been preserved in the city park south of the city centre. Though the rampart itself may be gone, it has shaped the city centre in ways that are still traceable today.

Even today both city centres feature a clear border, though they are no longer used for defensive purposes. The city centre of Leiden has maintained its waterways as a clear border. The city centre of Lund has a



border made up of parts, namely the train tracks to the west, the ring road to the north and east, and the city park to the south.

This analysis will look at what bike paths look like in the city centre. Streets that communicate clearly what behaviour is expected from traffic participants are important in city centres since the traffic pressure is high. A city centre will always pull people in, which leads to many streams of traffic that come together in the

densest part of a city. This requires careful consideration from traffic planners to create a space that is safe and easy to navigate.

Through looking at several sections and zoom-in plans, this chapter aims to pinpoint where the priority lies. By finding the physical results of either cars or cyclist priority, changes can be made to the physical structure to shift the priority towards cyclists.

# Section F Lund

Klostergatan - 1.200

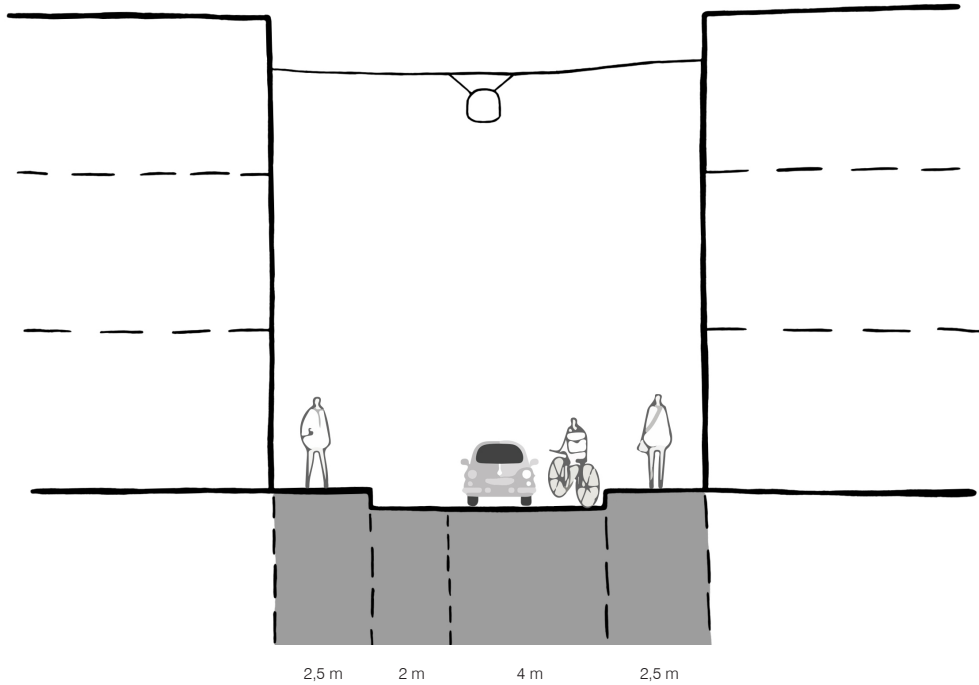


Image 55 - Many pedestrians on a small sidewalk



Image 56 - Lots of unnecessary car parking

This first section shows Klostergatan and Steenstraat, two smaller streets that have shops and eateries on either side. Both are one way streets and have a bus line running through them. Klostergatan is 11 meters wide while Steenstraat is 9,5 meters wide.

The first thing that stood out to me was the parking space on Klostergatan that takes about a fifth of the street width. I found this a surprising choice because of the relative narrowness of the street in combination with high traffic pressure. This street is used by large numbers of pedestrians, as well as cyclists and busses. Of course parking is

important to create accessibility for disabled people and give space to suppliers of the shops and eateries, but there is space for around 14 cars. Some of this two meter strip is also given to cycle parking, 8 spaces in total. This gives me a very clear signal that the car has a higher priority.

When comparing the two streets, the difference in material can't be ignored. As discussed previously, red asphalt in the Netherlands signals a bike path. This results in the Steenstraat reading as one large bike path that busses and cars have permission to use. This gives a very different signal of

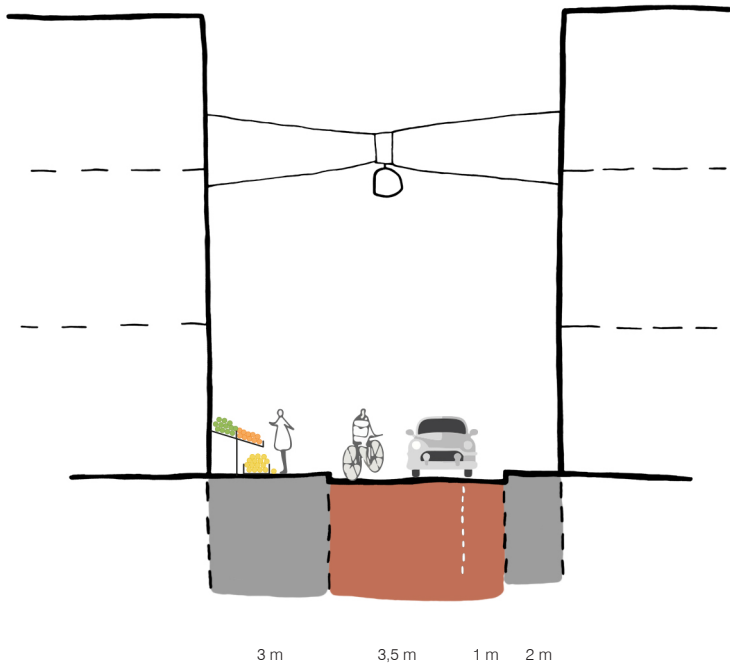


Image 57 - A bus using the cycling street

priority, one in which bikes are the most important.

I believe Kloostergatan has the potential to be much more user friendly by giving more space to pedestrians and cyclists, as opposed to car parking. This would attract more pedestrians and cyclists, instead of cars. Seeing the similarity of the two roads, Kloostergatan would be a great candidate for a cycling street. One where cars and busses would be welcome, but the space is dominated by cyclists, both in use and speed.



Image 58 - The street width gives space to many types of use

The space taken by car parking could be redistributed to include bike parking and more space for pedestrians. This could be done while maintaining parking space for disabled people and space for delivery trucks. This possibility is explored in the detail design further on in this thesis.

## Section G Lund

Stora Södergatan - 1:200

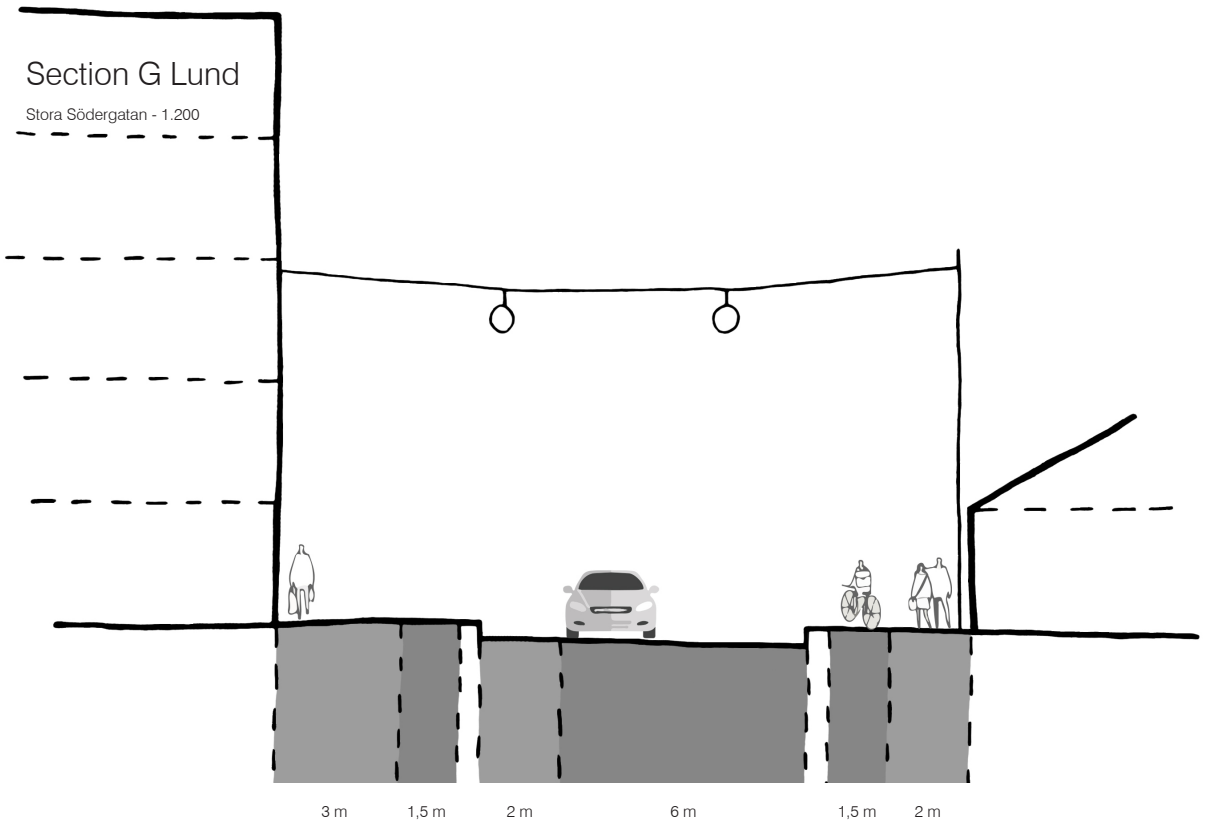


Image 59 - A barrier free transition between bike and pedestrian space

This second set of sections show Stora Södergatan in Lund and Princessenkade in Leiden. Both streets feature two way car-, bike-, and pedestrian traffic. The widths of the different traffic lanes are all comparable.

The main difference visible in the sections are the height differences present in both streets. Stora Södergatan features a bike lane that is on the same level as the sidewalk, while the bike lanes on Princessenkade are on the same level as the car lanes. This difference shows the distinct attitudes to biking that exist in Sweden and the Netherlands. The



Image 60 - The moment where cyclists are separated from the cars

difference is subtle and hard to pinpoint, but I believe that the authorities in the Netherlands see cycling as a mode of transport that needs to move from A to B in the most efficient way. In Sweden however, the authorities often focus mainly on protection. The result of this is that cyclists in Lund are separated from cars at whatever cost to create a sense of safety while often decreasing cycling efficiency.

In this case, the decrease in efficiency comes from the frictionless transition between the pedestrian and the cyclist path. This leads to cyclists on the sidewalk and

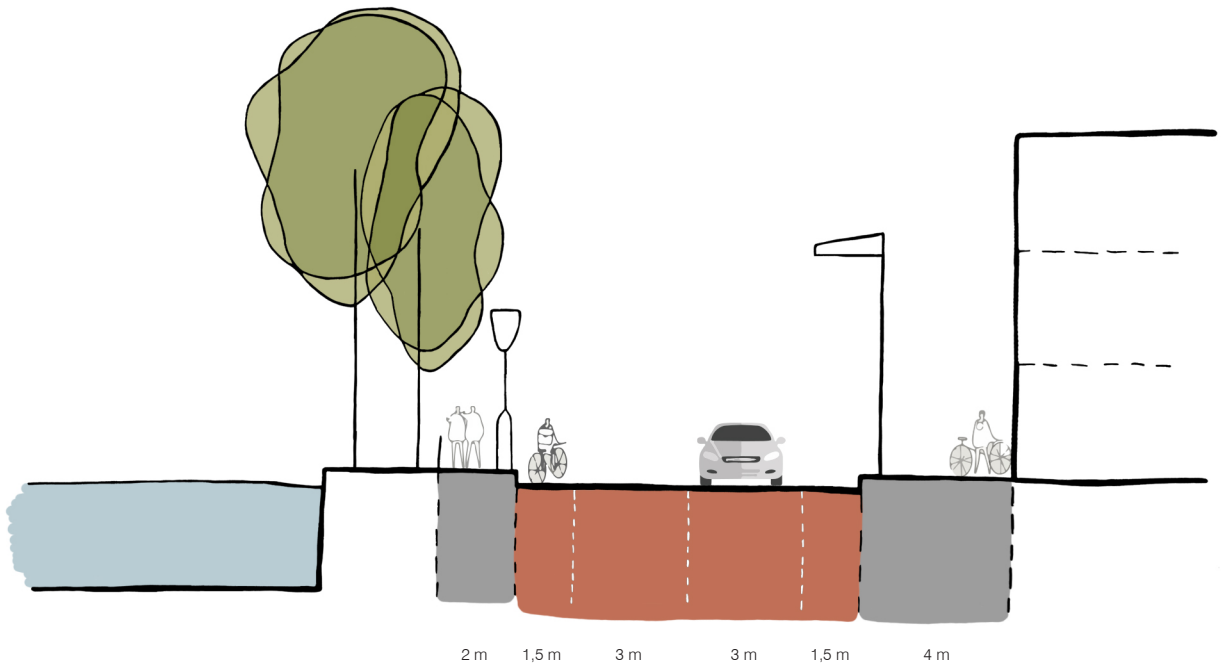


Image 61 - The red asphalt communicates a clear priority

pedestrians on the bike lane. This crossing is made even easier knowing that it is not as big of a safety risk for a pedestrian to step onto the bike lane as it would be to step onto the car road. This liberal mixing of pedestrians and cyclists leads to frustration and a decrease in efficiency, as well as an increase in smaller accidents.

To add to this, 1,5 meter wide bike paths are barely wide enough to bike with two people side by side. It is therefore implied that an overflow will take place, either on the sidewalk or the car road. This again makes it easier, if not unavoidable, for bikes



Image 62 - Cyclists on the "car space"

to make use of the sidewalk. As visible in the photos of Princessenkade, cyclists make use of the car space here, just like cyclists on Stora Södergatan make use of the sidewalk. This once again boils down to the attitude towards biking, one of efficiency versus one of protection.

Lastly, the material of the Princessenkade again signals to cars to watch out for cyclists. The bright red is impossible to miss and clearly gives priority to cyclists.

# Section H Lund

Biskopsgatan - 1.200

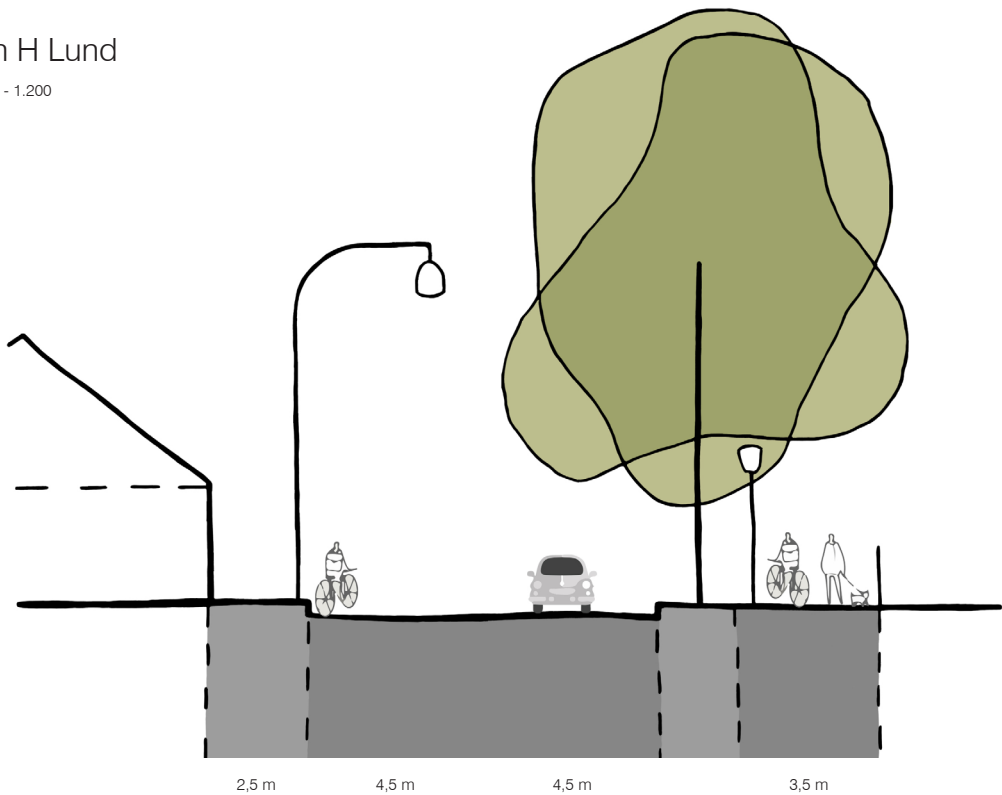


Image 63 - An incredibly wide car road



Image 64 - Obstacles on a narrow bike path

The third section of the city centre shows Biskopsgatan and Hooigracht. Hooigracht is a newly renovated street and was still under construction when I went to visit Leiden in December 2020. Both streets have similar use patterns and fulfill a similar function in the city structure.

Biskopsgatan is an interesting street when it comes to cycling because of its lack of clearly demarcated cycling space. On the right side of the street, the bikes are separated from the car space and combined with pedestrians. This is no surprise after the conclusions from the

previous sections about separating bikes from cars at all cost. On the left side however, there isn't a single sign of where one should cycle. It is therefore common to see cyclists on the car road, but also trying to bike in two directions on the 3,5 meter strip shared with pedestrians on the right side. This crates confusing and frustrating situations for everyone involved.

In combination with this, I'd like to briefly mention the width of the car space in both streets. Hooigracht shows a very common 3 meter per lane car road, while Biskopsgatan features a vast 9 meter wide car space. This

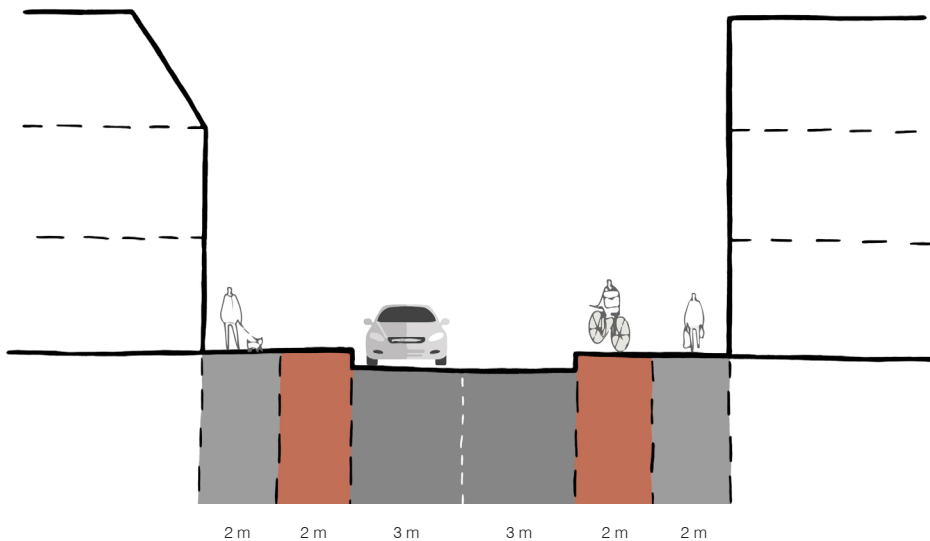


Image 65 - A separation between cyclists, cars, and pedestrians

is surprising for the width of the section and the incredibly small amount of space given to pedestrians and cyclists.

Lastly, I'd like to come back to the efficiency focus of the Netherlands. The bike strategy of Leiden aims to have a minimum number of objects on or directly next to bike lanes<sup>2</sup>. This is important to keep cyclists safe and keep the chances of accidents and collisions to a minimum. When it comes to objects on bike paths, Biskopsgatan is a good example of what Leiden would like to avoid. Not only is the bike path too narrow, it is also obstructed by tree stumps and



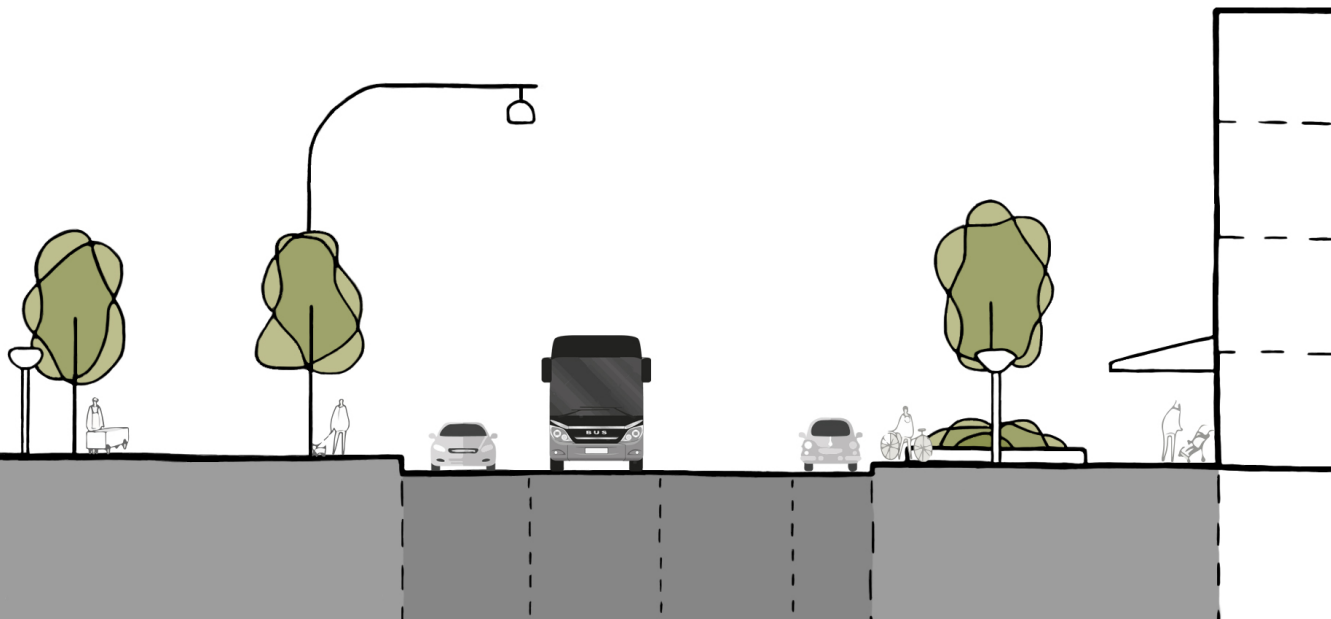
Image 66 - 3 meters per car lane is enough space to drive comfortably

lampposts placed on the bike path. This increases the chances of collisions with pedestrians, other cyclists, and the objects themselves since cyclists will have to swerve around them.

I'd like to encourage Lund municipality to rethink this section to create more priority for cyclists and less for cars. There is enough space to accommodate all traffic flows, if the time is taken to restructure this street and make it truly bicycle friendly.

# Section I Lund

Bangatan - 1:200



11 m

3,5 m

3,5 m

3,5 m

2 m

9 m



Image 67 - A road that is difficult to cross

This final section of the city centre shows a notoriously dangerous road in Lund, Bangatan. It is compared to a busy and wide road in Leiden, Langegracht. Bangatan is a two way street with a bus lane in the middle and parking on one side. There are bus stops on both sides of the street and no bike lanes. Langegracht features a two way car street with parking on both sides. The northern side has a one way bike lane, while the southern side has a two way bike lane.

Bangatan runs parallel to Lund's train station. It is a busy road that sees a lot of



Image 68 - Poorly accessible bike parking

traffic from busses and cars, while also having many pedestrians crossing the street to reach the station. As said before, there are no bike lanes present and the incredible amounts of motorized traffic make this a difficult and dangerous road to cycle along.

A large portion of space on the eastern sidewalk is reserved for bicycle parking which is not surprising considering the proximity to the train station. However, the layout of the street makes this parking space barely reachable for cyclists. For this parking space to be truly functional, the

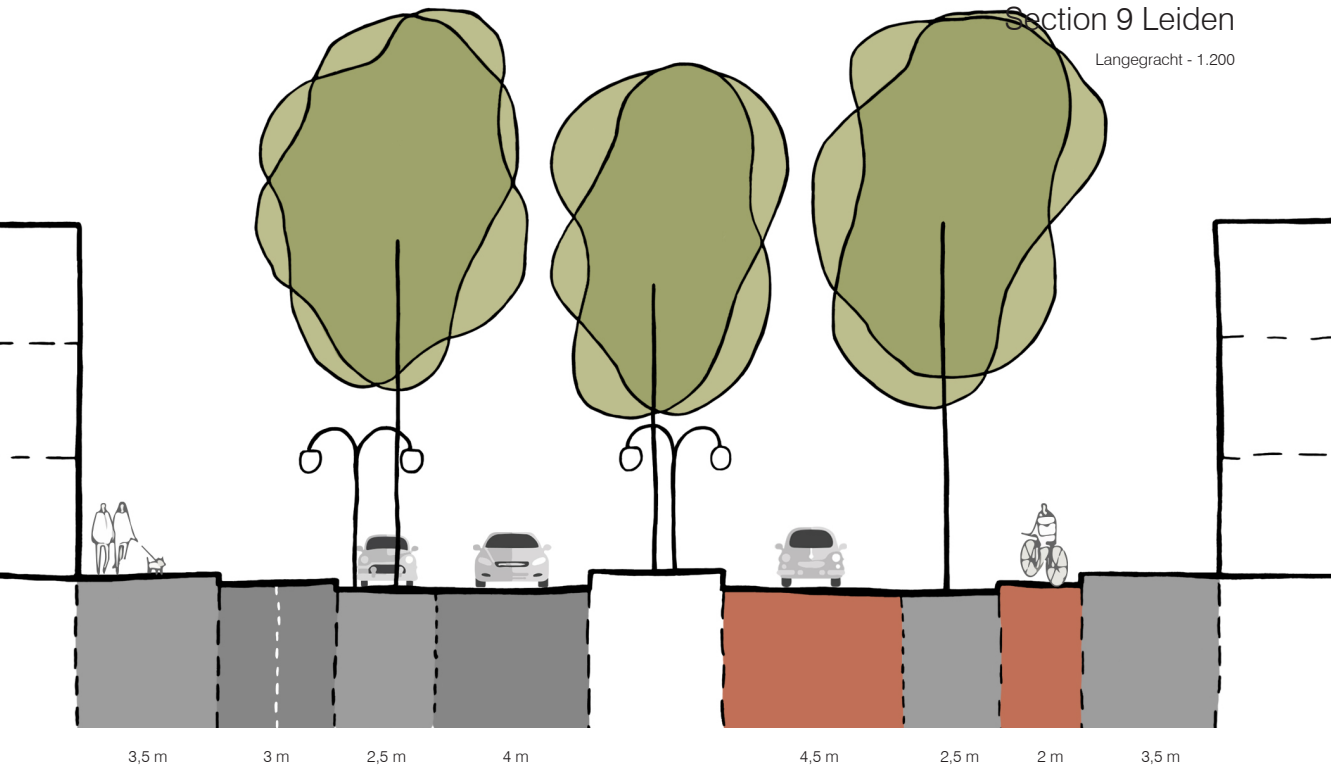


Image 69 - This profile has enough room for grass and big trees



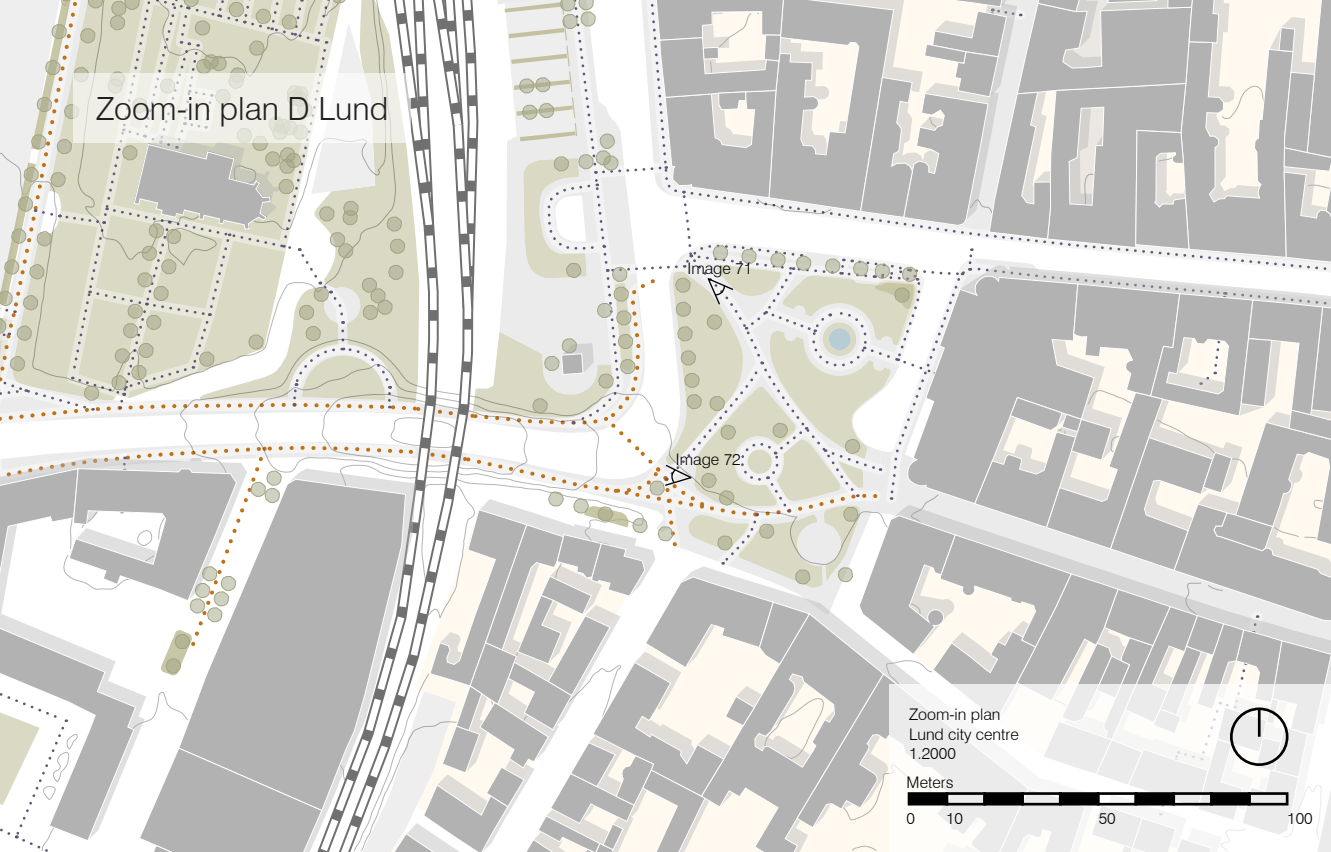
Image 70 - Lots of space for cyclists

accessibility needs to be much better.

Bangatan is an incredibly difficult traffic situation. It connects to two railway crossings, one to the north, and one to the south. It is therefore difficult to take out the whole street, as it forms an important connection from the city center to the west side of Lund. The detail design will explore an alternative layout to Bangatan which entails taking a large portion of the car road away.

As seen on the Langegracht section, it is possible to have two way car lanes and

separate bicycle lanes using the same or less street width. Of course Langegracht is not the perfect comparison as it doesn't feature many busses coming and going or the connection to the train station, but it does show how much is possible in the same street width.



Zoom-in plan D Lund

Zoom-in plan  
Lund city centre  
1:2000

Meters

0 10 50 100



Image 71 - Are you allowed to bike on Bantorget?

The two zoom-in plans of the city centre show two ways of entering a city. Both feature the crossing of a barrier and landing in a park-like setting. After passing under the railway lines in Lund, Bantorget is reached. If this name sounds familiar, it is because Bantorget lies at the bottom of Bangatan, the street that was discussed on the previous page.

There are two important differences to note between these areas. The first is that the bike lanes that lead into the city of Leiden are connected to the bike lanes of the city centre. There is a clear route to follow that



Image 72 - Turns out, the cobblestone is also for bikes?

will take you further along your commute. In Lund, the bike paths end either in a park, or onto a busy and dangerous road, as discussed previously. This gives a sense of directionlessness and confusion as to where you're allowed and supposed to bike.

This brings me to the second point, which is once again materiality. The map of Bantorget shows a clear wish of the municipality for the bike lane to continue into the park. When looking at the photos however, this is not clear at all. The asphalt of the bike lane continues along the

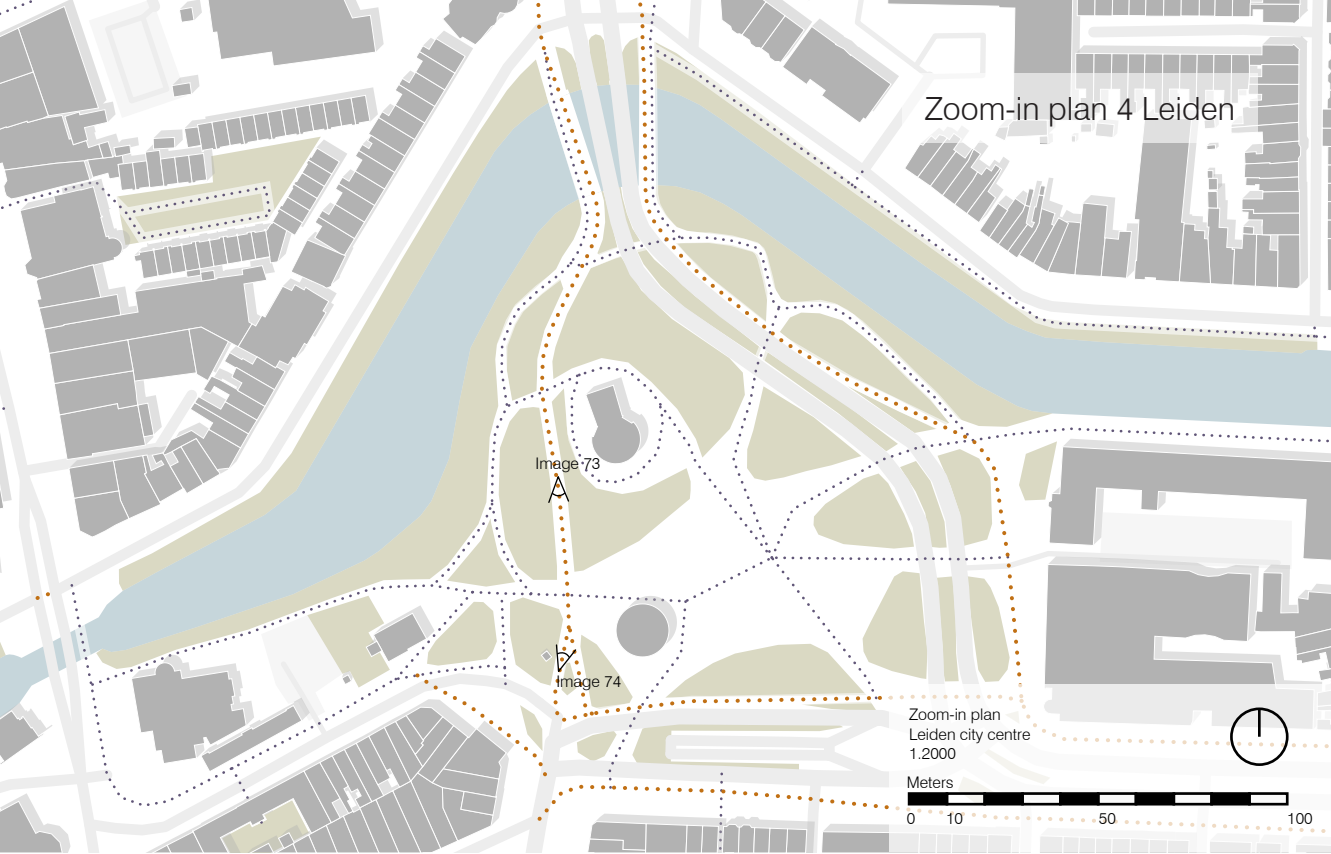


Image 73 - A clearly defined bike path

road, while the material of the park is a contrasting brick. I would not have known that this was meant for bikes had I not seen other people use it as such. This confusion is increased through the knowledge that the separation between bike path and sidewalk is often not more than a change in material. It therefore reads like the bricks are sidewalk, and the asphalt is bike lane. On the Molenwerf, the difference between sidewalk and bike path is a difference in material, which is an expected indication of separation.

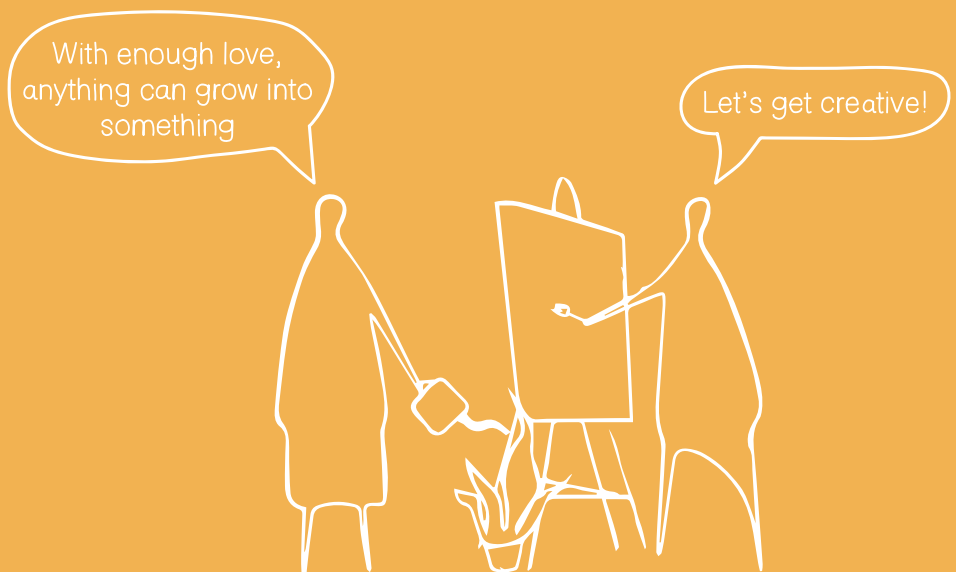


Image 74 - The edge to the grass gives a nice seating opportunity

down to a request to Lund municipality to clarify and unify their traffic situations. This will create a safer and more user friendly city for everyone.

The main point of this comparison comes

# *City centre detail design*





Introduction



Bangatan



Klostergatan



Lilla Fiska





For the design section of this thesis I have chosen to focus on the city centre for two reasons. Firstly, the city centre has a high traffic density, which exacerbates the need for high quality urban design and clear traffic situations. Secondly, the city centre is where traffic meets city life. This means that this design does not only give the opportunity to improve traffic situations, but also to create more opportunities for people to interact and take pleasure from being in the city.

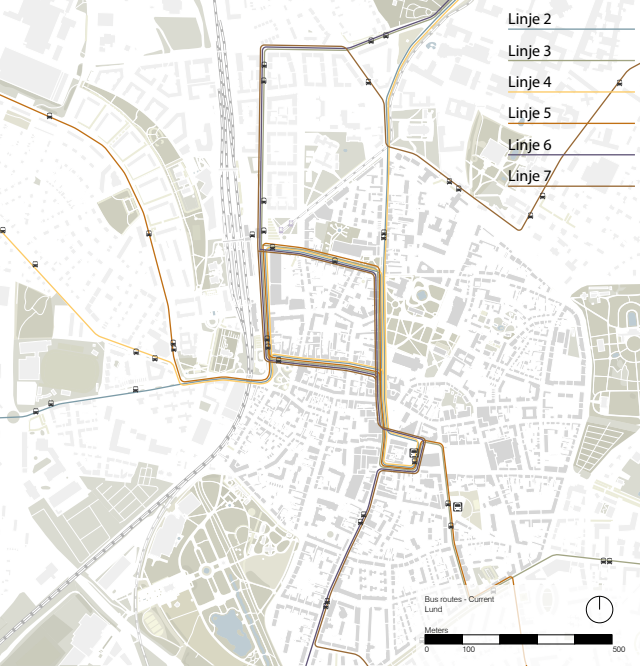
When looking at the city centre, the area between the train station and the cathedral has a high traffic pressure, while also showing room for improvement. That is why this design focuses on that area. The design zooms in on four streets and two intersections, with Bangatan divided into three sections, as shown on the map. The areas are roughly ordered from most to least pressing.

1. Bangatan  
Current situation (2021)

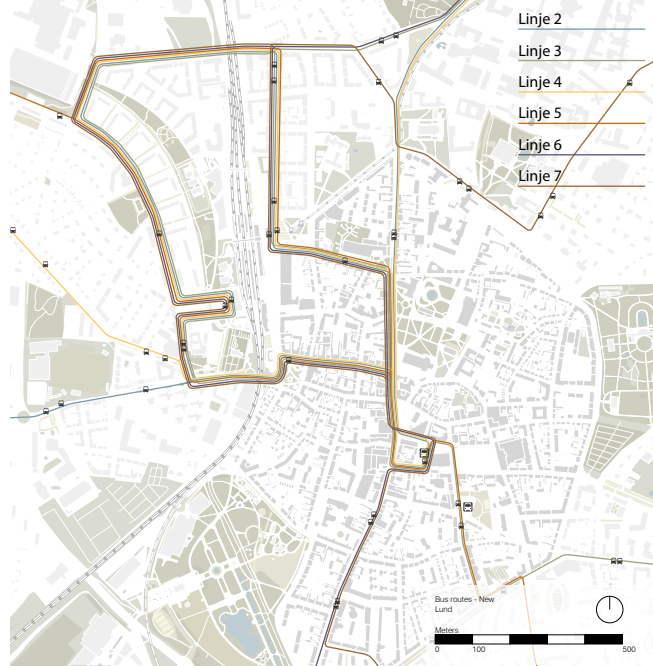


Design proposal





Current bus routes (2021)



Alternative bus routes

The first area to redesign in Bangatan. As established before, this street is notorious for its high traffic pressure and danger to cyclists and pedestrians. Having a street like that run in front of the train station, a place that needs to be reached by thousands of pedestrians and cyclists daily, is not desirable. On top of that, it does not give a good first impression to those arriving to Lund by train. Lastly, Bangatan does not only feel unsafe, it actually is unsafe, as illustrated on the map on page 64. This makes Bangatan a high priority street to improve, and this design will give a possible solution for the problems.

This design proposes to take away the car and bus traffic completely between Bantorget and Clemenstorget. This will create an open area in front of the train station where pedestrians and cyclists can easily and safely access the station. This square will also add a high quality public space to the city centre. To ensure car access to the city centre from the west, the tunnel to the south of the station remains open to one way car and bus traffic going into the city centre. To realise this, all the bus routes need to be changed, and since there are several one-way streets involved,

this was a complicated task. The design proposes to keep the one-way loop already in place, but to make it slightly larger and have the busses stop on the west side of the station. The west side of the station already features a kiss and ride and a good amount of car parking space. This can easily be supplemented with some bus stops and a taxi area. How this will take shape precisely will not be discussed in this thesis, and is a task that a traffic engineer would be better suited for.

This design also features extra bike parking made possible by the decrease of car space. This parking can be found by the ICA supermarket on Clemenstorget, and around the north entrance to the train tracks. This bike parking is in addition to the large amount of bike parking already present in the station area. The bike parking gives the possibility for a quick visit, but also for commuters to park their bikes longer term.

To give a better impression of the design of Bangatan, a closer look at three parts of the street will follow through zoom-in plans, a section, and visualisations.

Bangatan North

Entrance to train platforms

Extra bike parking

Clemenstorget

Existing trees

Extra bike parking

ICA supermarket

Cafe

Bike parking

Bike repair-shop and rental

Fountain

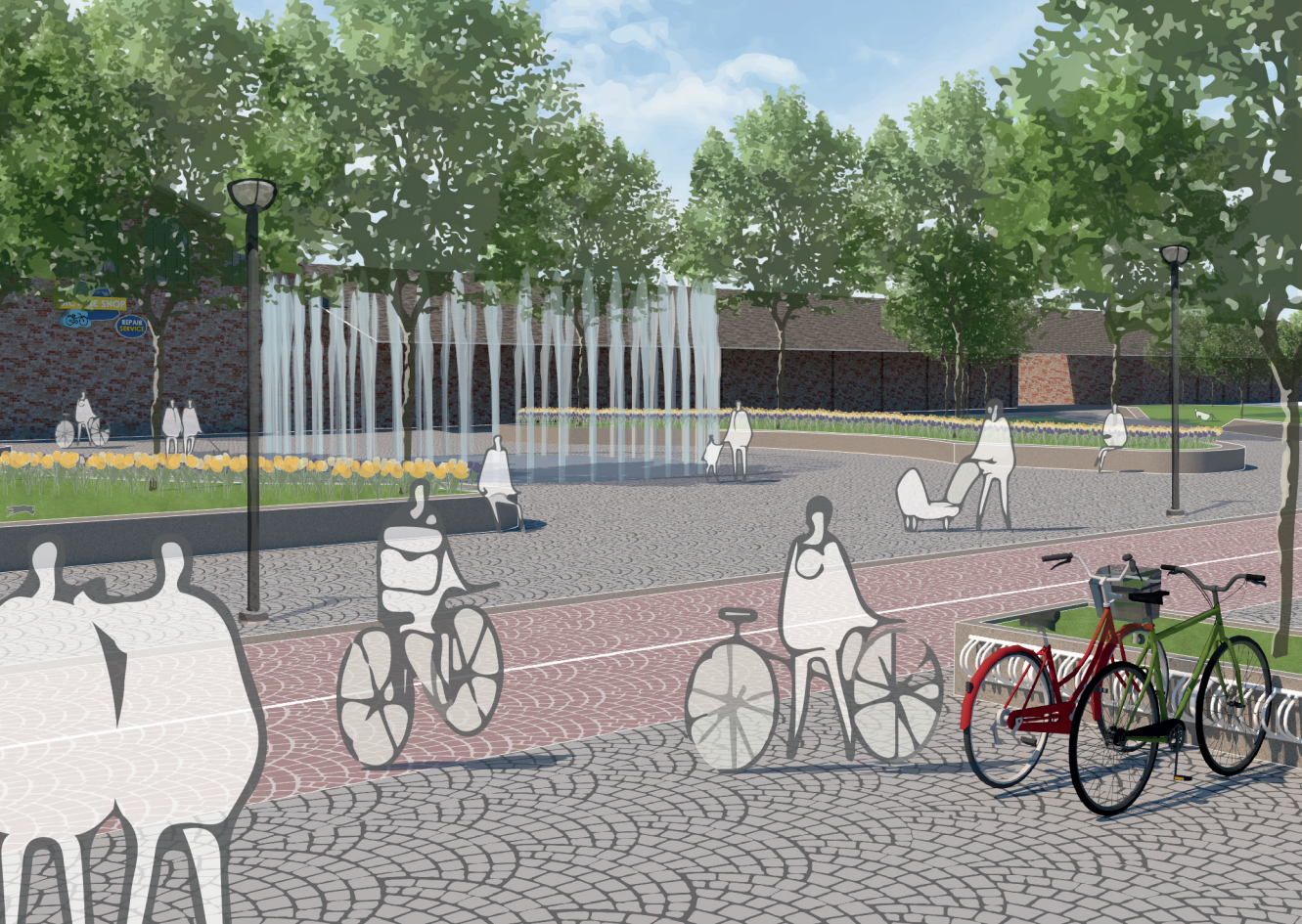
Shop

Pizzeria

Bioswale

Toy store

Cafe



The north part of Bangatan is where it connects to Clemenstorget. There is a lot of foot traffic happening here because of the access to the platforms of the train station, the bike parking, bus stops and the recent addition of the tram. That is why the corner of Clemenstorget features a shared space crossing to indicate priority for pedestrians that move to and from the train station. This area is accessible for cars, busses and bikes, but they need to move around the pedestrians.

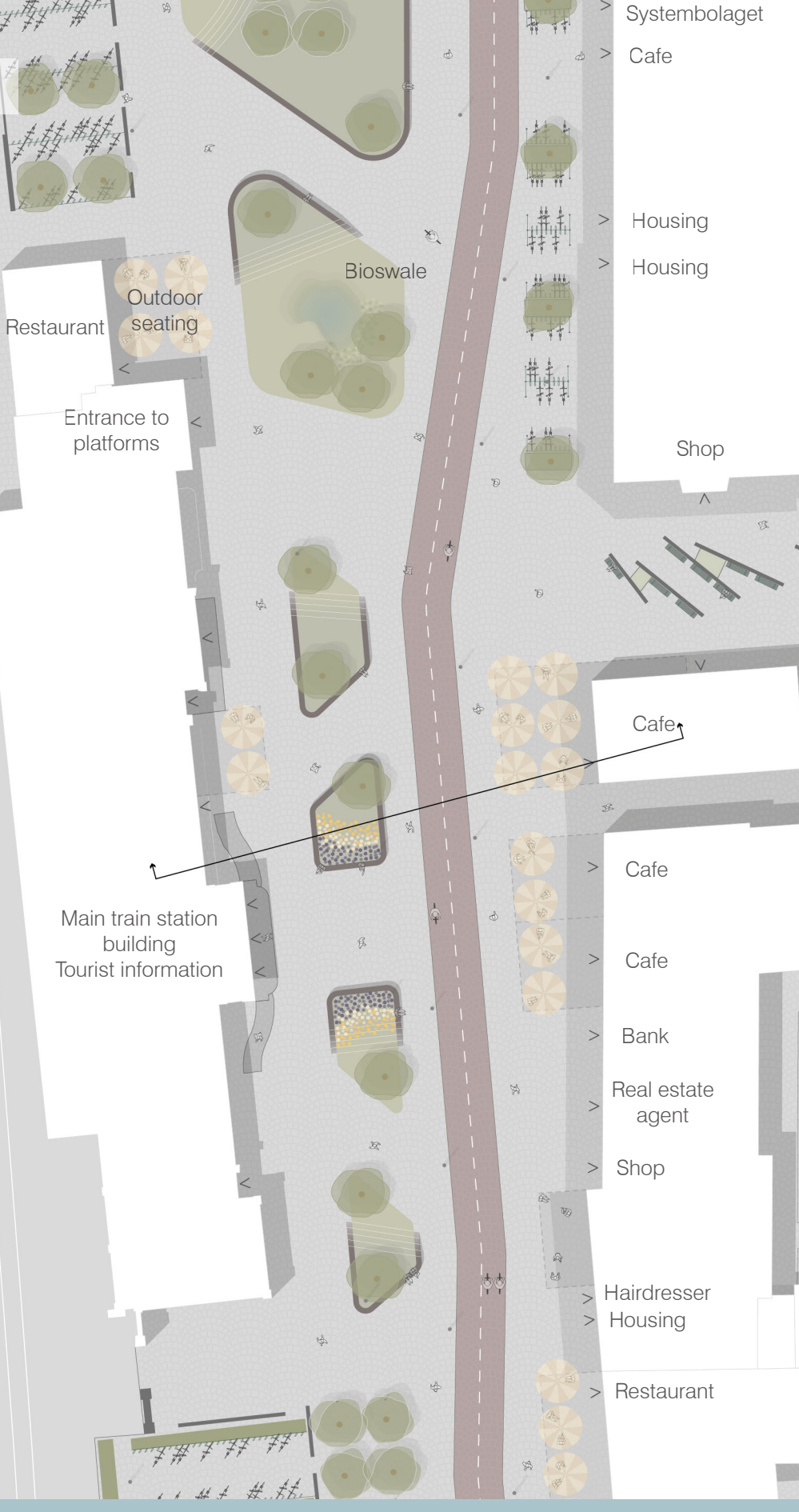
The new public space design of Bangatan has taken inspiration from the other public spaces in Lund, like Lundagård and Bantorget. By doing this, those who enter Lund via the train station get a good impression of what Lund looks like. One of the aspects often found in public spaces in Lund is a central fountain. This design mimics the traditional set up with a circular

fountain, but uses a modern alternative for a more interactive and playful experience.

The position of the green spaces is carefully chosen through an analysis of the most used walking routes. By carving out the walking spaces of the square, these in-between spaces are left over and filled to make green spaces similar to those found around Lund.

Another added feature to this part of Bangatan is the bicycle repair shop and retail in the old station building. Adding a bike repair service this close to the station will make it much easier to get your bike repaired or maintained for many commuters. You can simply drop off the bike on your way to work, and pick it up when you come home. All in the same location where you need to be anyways, the train station.

Bangatan Middle



Restaurant

Outdoor seating

Entrance to platforms

Bioswale

Main train station building  
Tourist information

Systembolaget

Cafe

Housing

Housing

Shop

Cafe

Cafe

Cafe

Bank

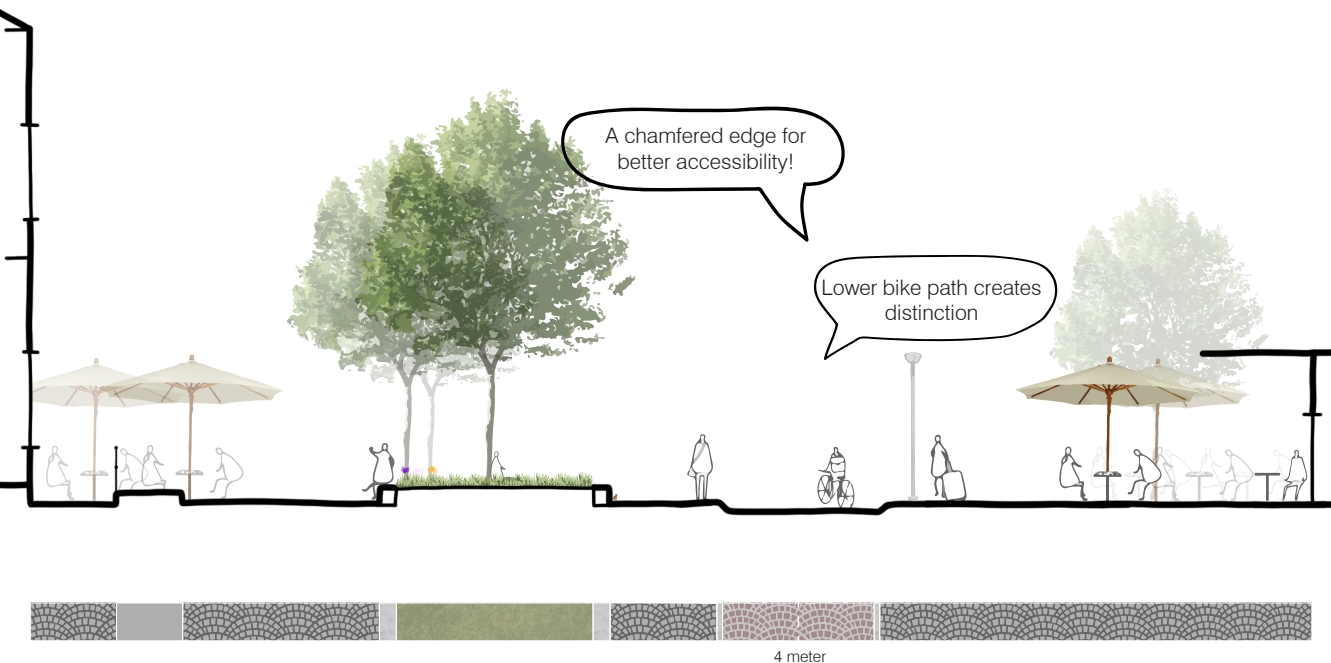
Real estate agent

Shop

Hairdresser

Housing

Restaurant



The section above shows how the bike path is slightly lowered in relation to the rest of the square. This gives a clear distinction between bike space and pedestrian space. The chamfered edge makes sure that the bike path is easy to cross with a wheelchair, pram, or bike when accessing the bike parking.

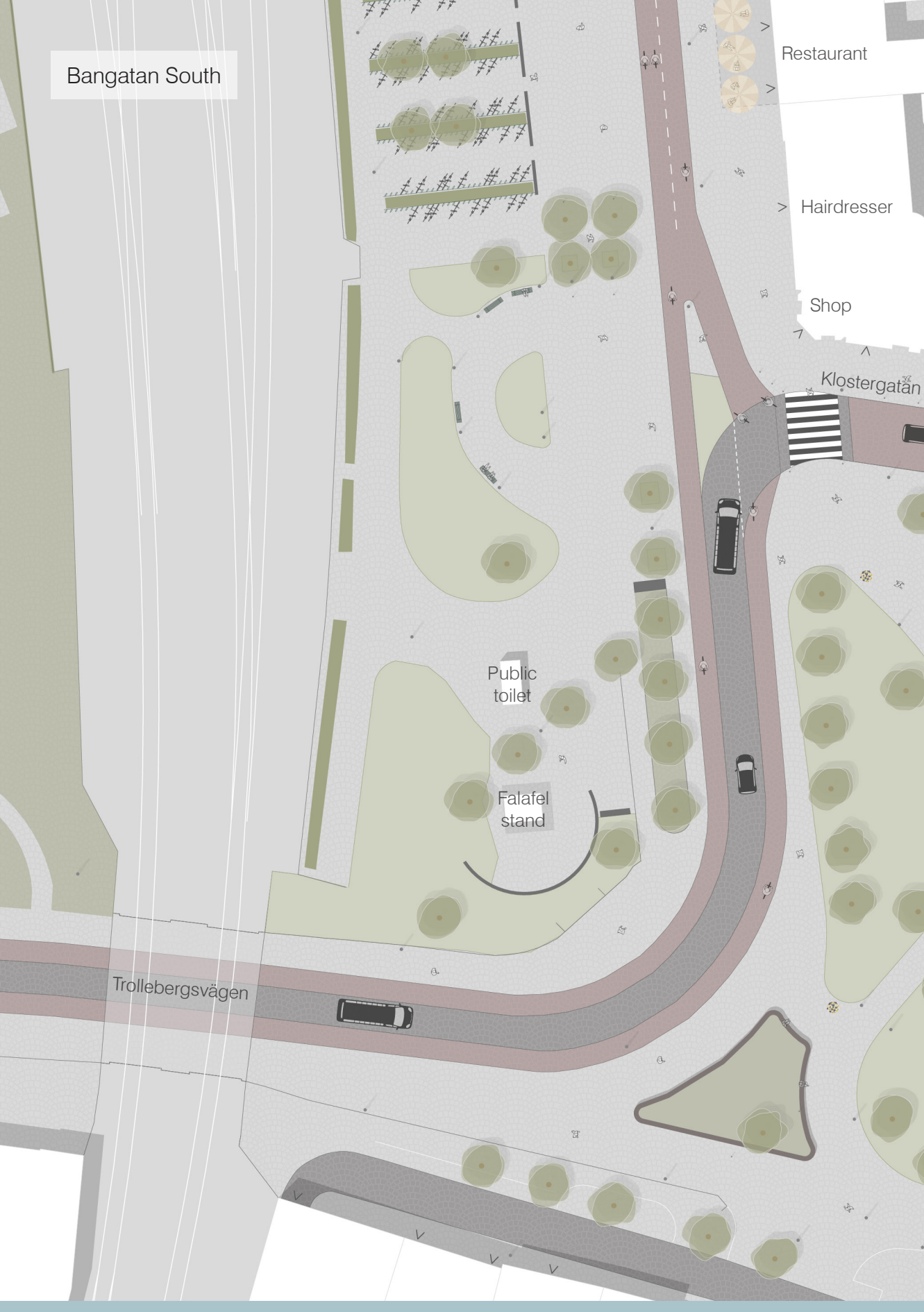
According to the cycle strategy of Leiden, a separate two way bike lane should have a width of four meters<sup>2</sup>. The design of Bangatan follows this advice.

The plan gives an indication of the different types of activities that are possible in this space. By taking away a large amount of car space, more space is available for

outdoor seating for the restaurants, green areas, and of course cycling and walking. The bike path has some slight curves, which are easy to navigate but prevent high speed cycling along Bangatan.

Parts of the green areas are flush with the sidewalk and give a great opportunity for stormwater reservoirs. This will help with water management at the station area. Some of these green spaces are therefore layed out as vegetated bioswales, as shown in the map. This is a place where the grass dips a little to create space for rainwater to collect. These areas are dry most of the time, but are available as catchment areas when needed.

Bangatan South



Restaurant

> Hairdresser

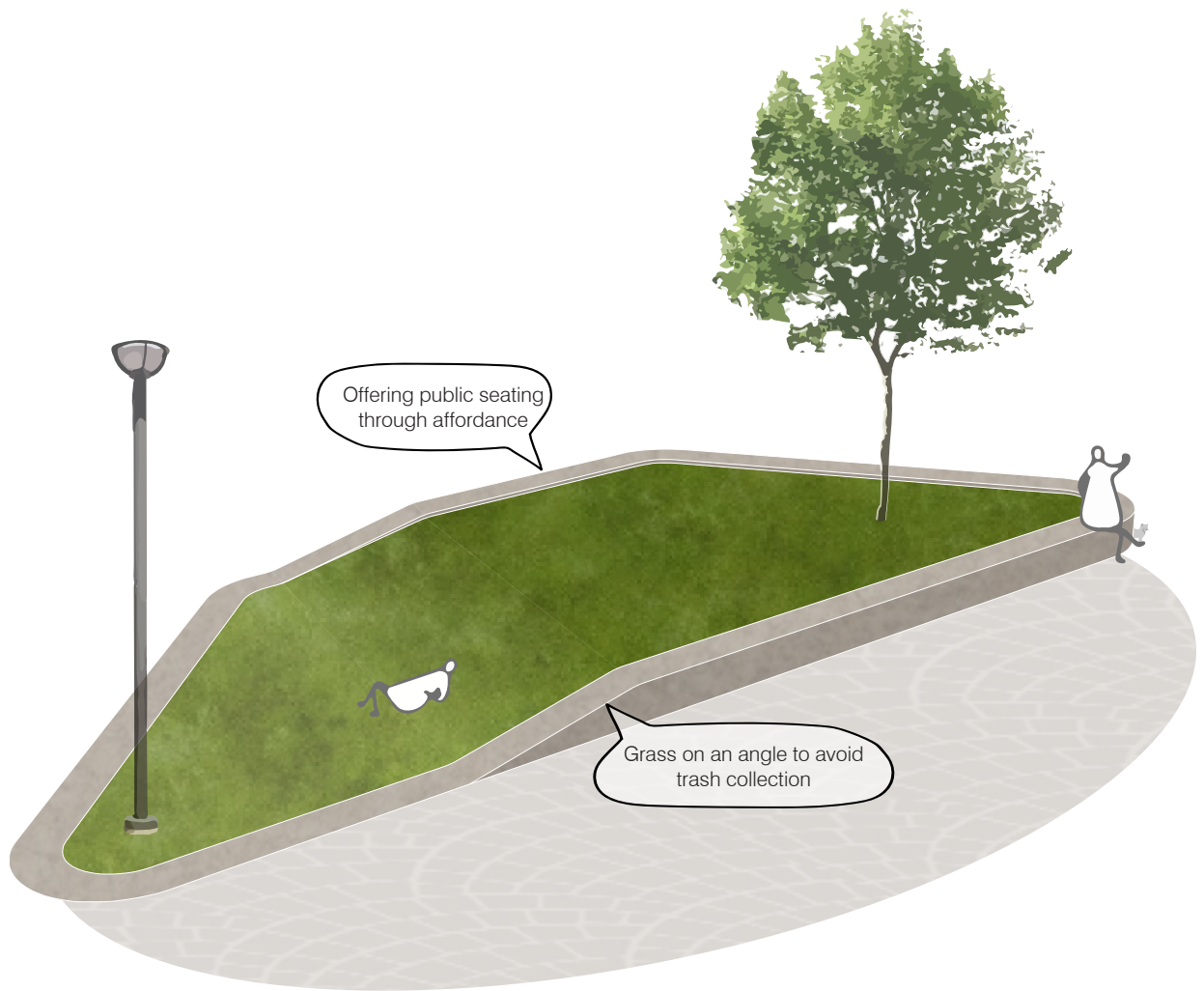
Shop

Klostergatan

Public toilet

Falafel stand

Trollebergsvägen



Bangatan south is where the bike path on Bangatan connects to Trollebergsvägen and Klostergatan. By taking out the car access on Bangatan, this road is one way, which means a much narrower car surface. This gives more space on Bantorget for an extra green patch. It also allows for two meter wide bike paths on both sides of Trollebergsvägen. This is wide enough to allow for normal cycling, as well as larger cargo bikes.

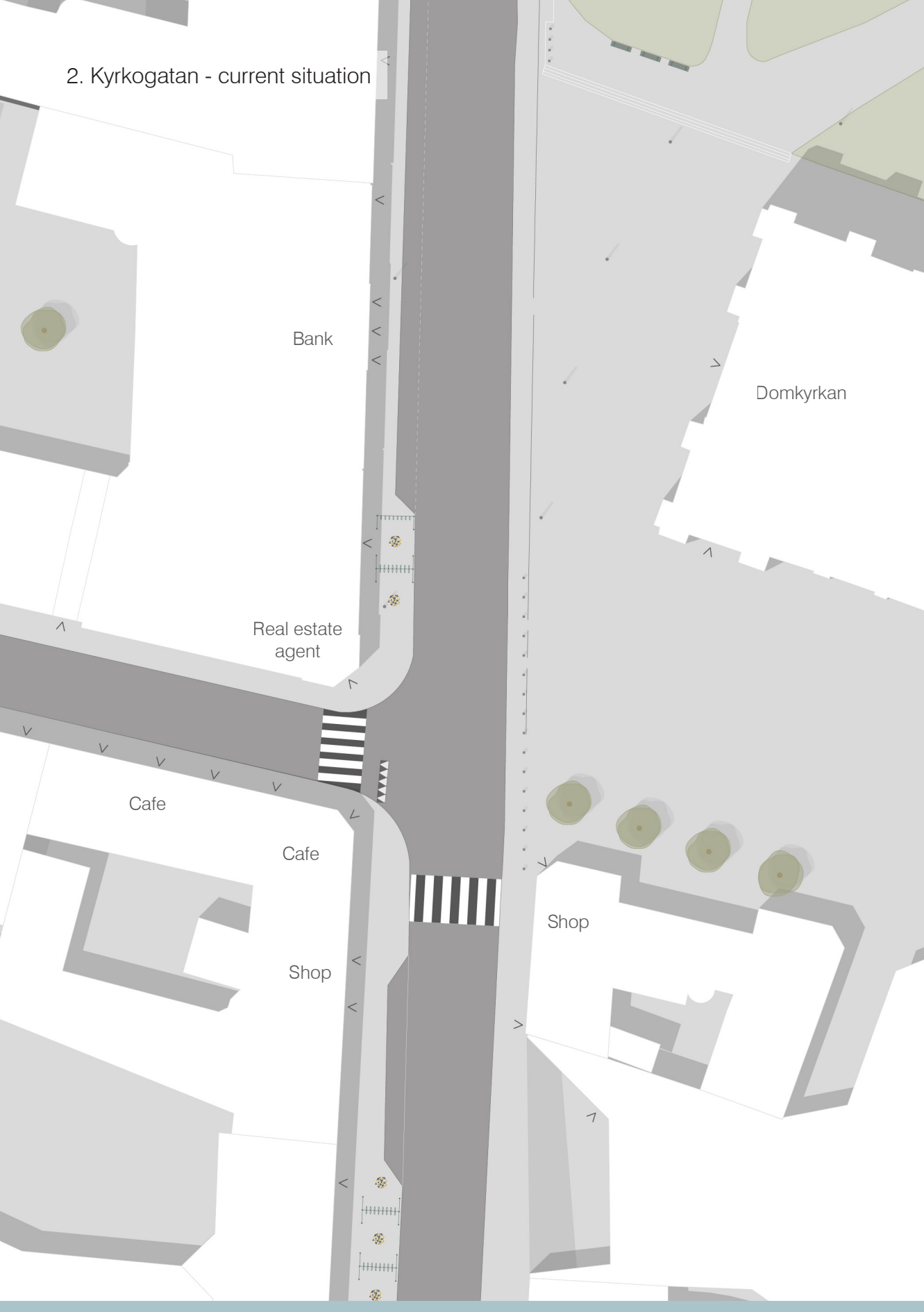
The bike path is kept at a distance of the buildings on the south side of Bangatan to create more space for outdoor seating for the restaurants currently located here.

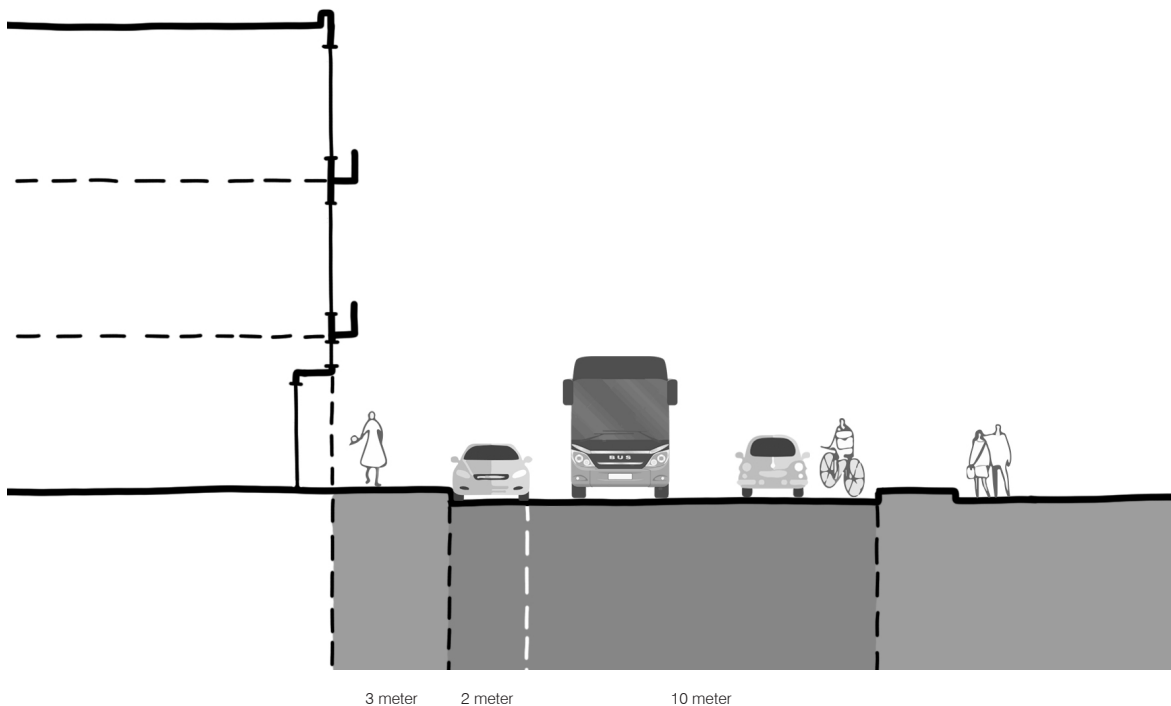
The green areas on Bangatan are sometimes flush with the sidewalk like in

Lundagård, and sometimes come up with a wide stone edge to create additional public seating, like in Bantorget. The design of Bangatan has a clear visual dialog with other public spaces in Lund and creates a consistent look and feel throughout the city centre.

The image above gives an idea of how these green spaces give character and provide extra public seating. Creating public seating opportunities in places like this is very important since it gives the public the chance to wait comfortably without having to purchase anything. The grass will come up with the stone edge to avoid creating catching spaces for trash. The movement in the green areas creates a wave pattern that adds a playful character to Bangatan.

## 2. Kyrkogatan - current situation





3 meter

2 meter

10 meter



Image 75 - Kyrkogatan with Lundagård in the background



Image 76 - A cyclists riding up Kyrkogatan

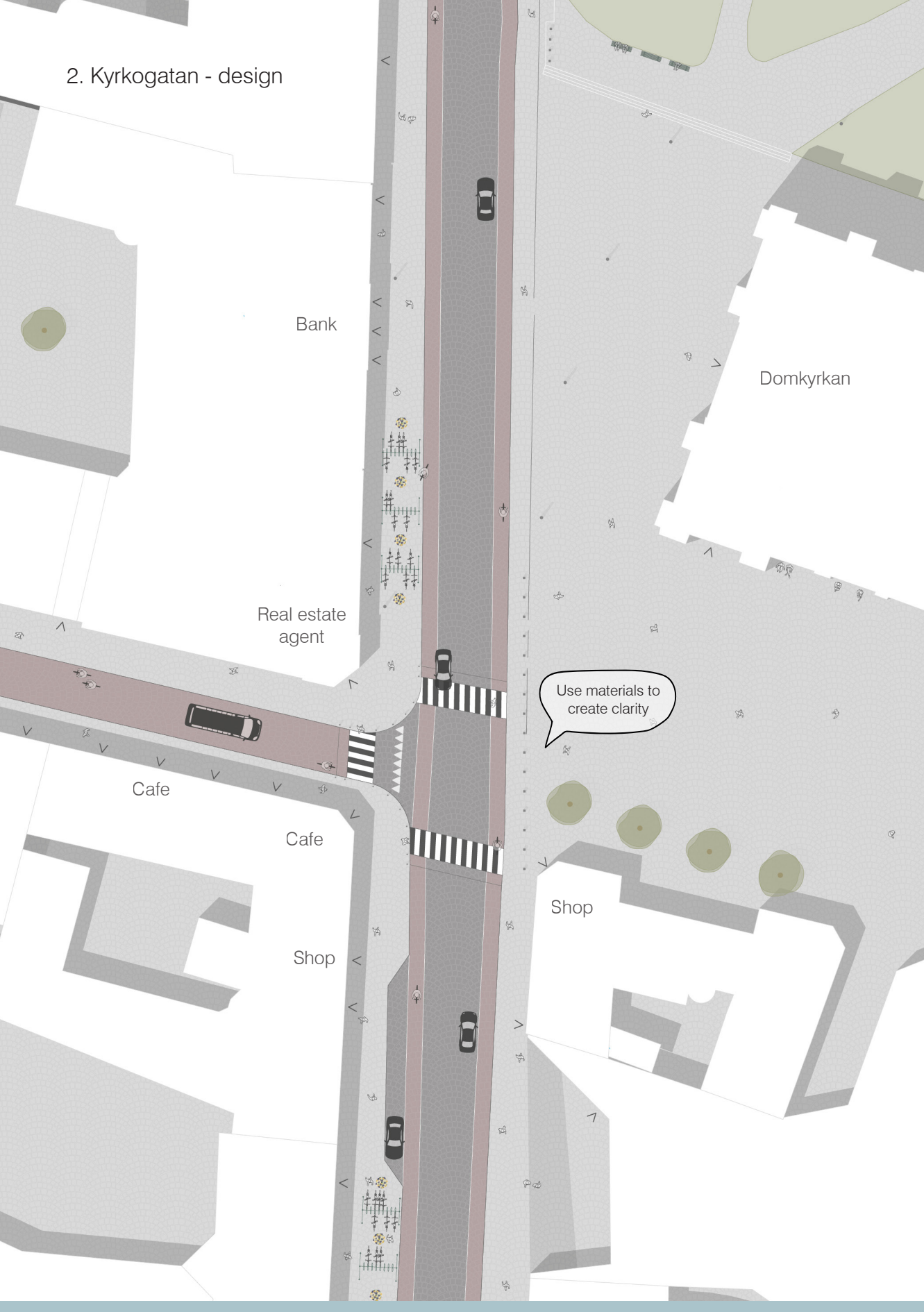
The second area for improvement is Kyrkogatan. This is the street that runs in front of the cathedral, and consists of two way car traffic with street parking. Transforming this street consists mostly of taking away most of the street parking in favour of bike lanes and a wider sidewalk. This wider sidewalk will also be able to accommodate more bike parking. The new design is shown on the next pages.

The cycling lanes on the design proposal of Kyrkogatan are 1.7 meters wide. This is the minimum of a bike lane on a shared surface, according to the cycling strategy of Leiden<sup>2</sup>. A preferred profile on a street like this would be a three tiered system where

the bike lanes are a little higher than the car road, and the sidewalks a little higher than the bike lanes. However, this would make the profile much bigger as the car road would need to be six meters wide, and the bike lanes two meters each. Since this is a historic city centre, walkability is the most important part of the public space, which is why I decided to place the bike lanes on the car road, and have wider sidewalks. On top of that, sharing a street with cyclists will slow down cars to a tempo more suited for a historic city centre.

As is clearly visible, this redesign also features some new materials. These are the same materials used throughout the

## 2. Kyrkogatan - design



Bank

Domkyrkan

Real estate agent

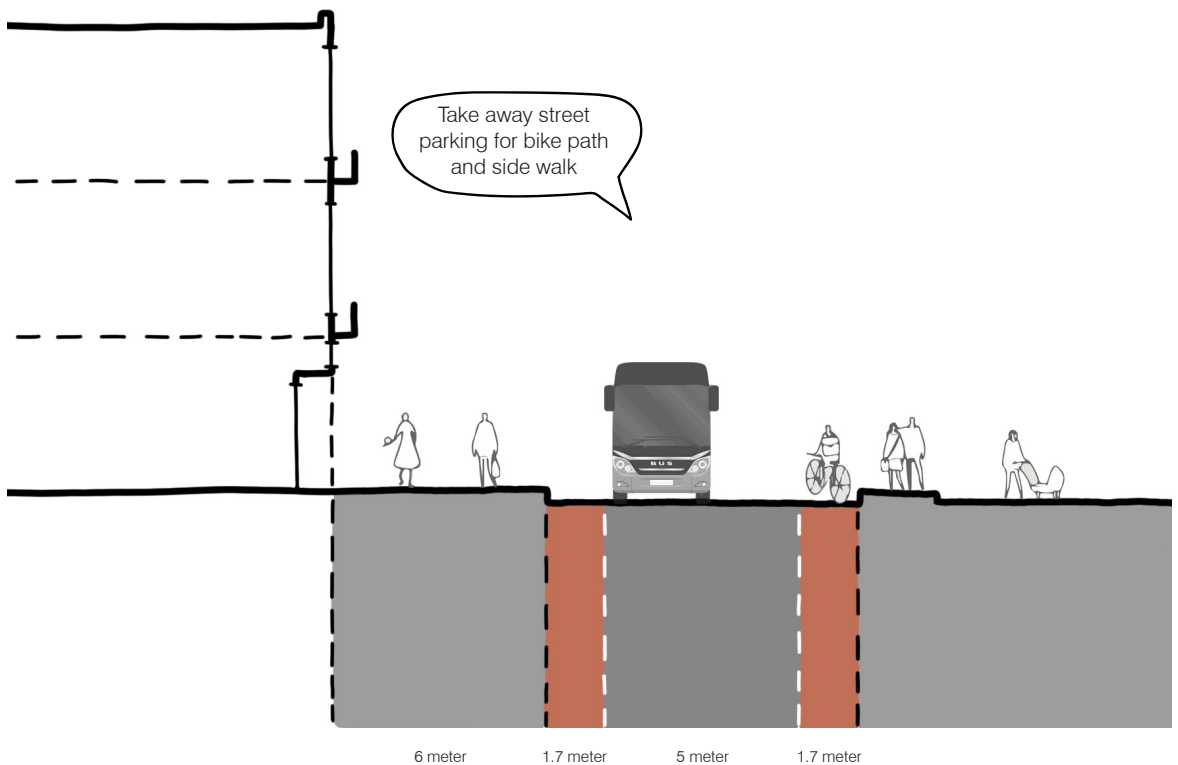
Use materials to create clarity

Cafe

Cafe

Shop

Shop



6 meter

1.7 meter

5 meter

1.7 meter



Image 77 - White and grey cobbleston in Lund



Image 78 - Grey cobblestone and flagstone in Lund

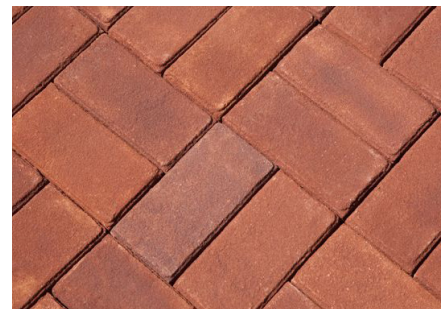


Image 79 - Red clay bricks<sup>18</sup>

whole design, since being consistent with materiality creates clarity.

The materials currently used in Lund city centre are cobblestones and flagstone paving, as shown in image 77 and 78. To be able to clearly communicate the bike lanes, a contrast in colour is needed. What makes this difficult is that the cobblestones used in Lund have a very warm grey tone. On top of that, using natural stone will never have a bright colour, so the red cobblestone is very muted. Replacing all of the grey cobblestone in Lund for something with a cooler tint is not a viable solution. It is therefore important to choose a different material for the bike lanes that is able to contrast with the warm grey tones. I suggest

red clay pavers as they are very flexible in size and shape, give a lot of character, have a brighter colour, and have a smooth which creates a more comfortable experience for cyclists.

These clay bricks can also be used for car roads, which means that they can withstand vehicular traffic. This includes delivery trucks for the shops and restaurants, as well as emergency vehicles. This type of vehicular access is needed for places like Bangatan, where there is no other car access. The times at which delivery trucks may use the bike path on Bangatan should be limited and outside of rush hours to minimize the interference with bike traffic.



### 3. Klostergatan - current situation

Klostergatan forms an integral part of the city centre through its location and the functions it houses. Along this street you'll find shops, cafés, restaurants, and small offices. Many people bike and walk through this street daily, though the layout is mainly car orientated. Klostergatan not only houses a car road, but also street parking along practically the whole street, as discussed before on page 84. A street that is this widely used by pedestrians and cyclists, needs to be more accommodating to them.

One way of doing this is through taking out the street parking for cars and transforming

it into a wider sidewalk, bike parking, and the minimal though necessary car parking for disabled people and delivery trucks. This gives space back to the people, and makes the street much more pleasant to use. When adding this extra pedestrian space, it is important to make sure it works in a nordic climate. For that reason, the sidewalk on the north side of the street will become wider, while the sidewalk on the south side will remain the same width. This results in more sun exposed pedestrian space on Klostergatan, which cafés can use for outdoor seating, or pedestrians can simply enjoy.

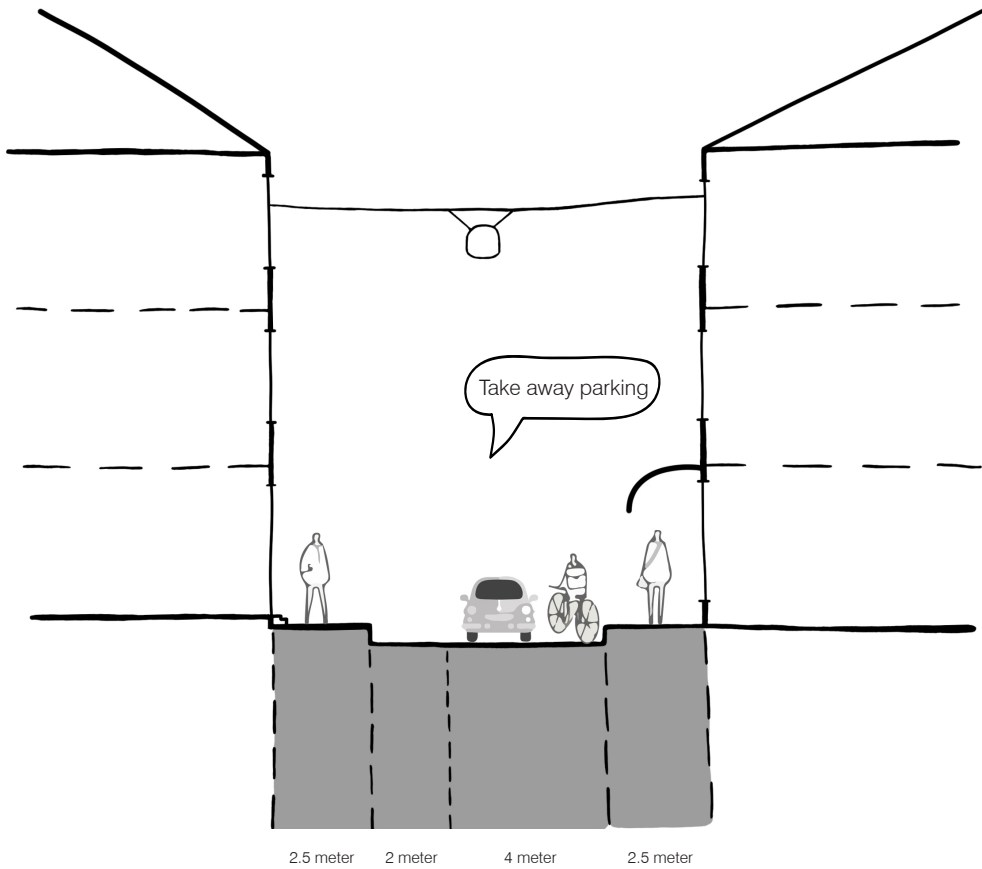


Image 80 - Klostergatan, lots of car space



Image 81 - Klostergatan, big bus narrow street

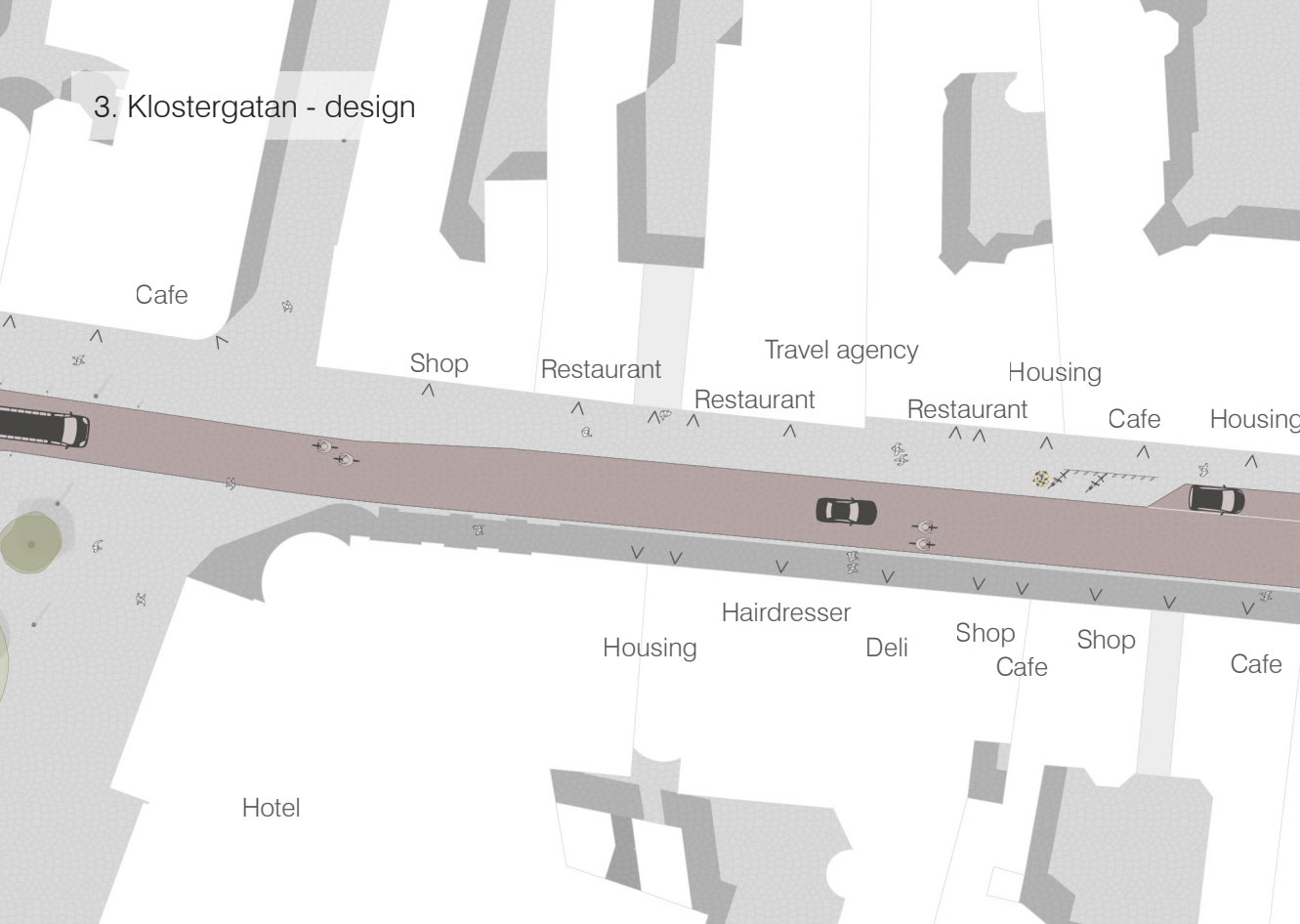


Image 82 - Klostergatan, a little bike parking



Image 83 - Klostergatan, little space for life

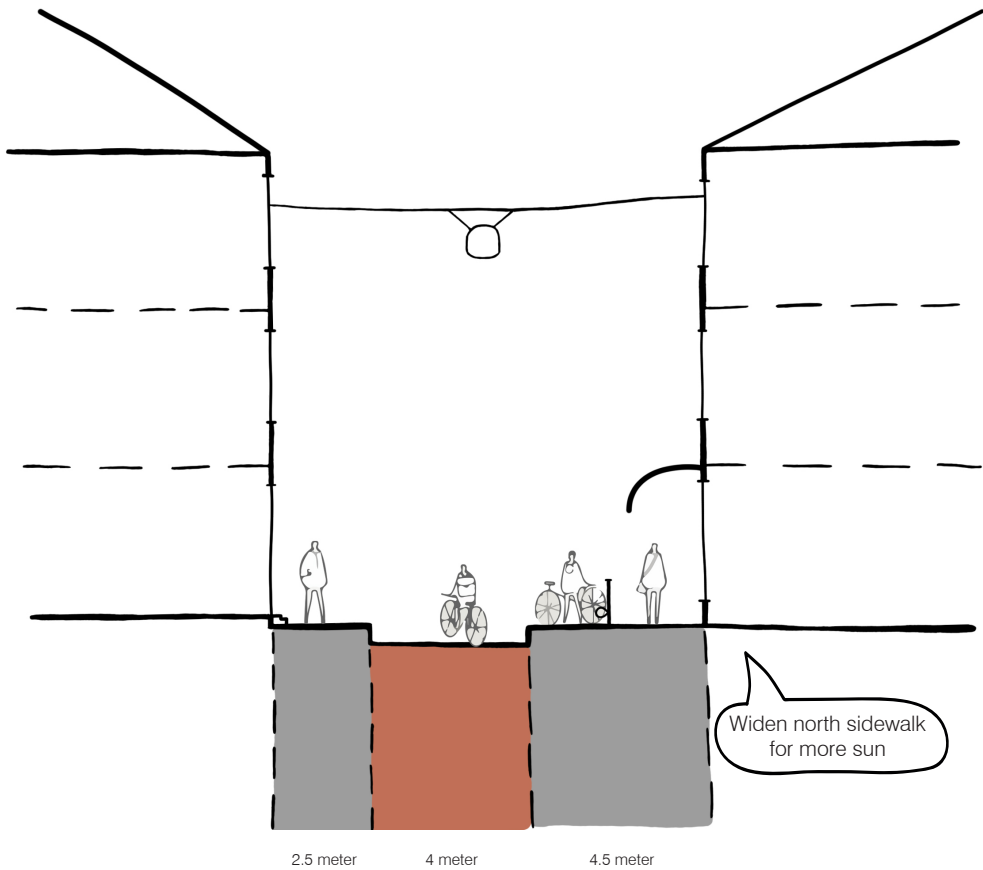
### 3. Kloostergatan - design



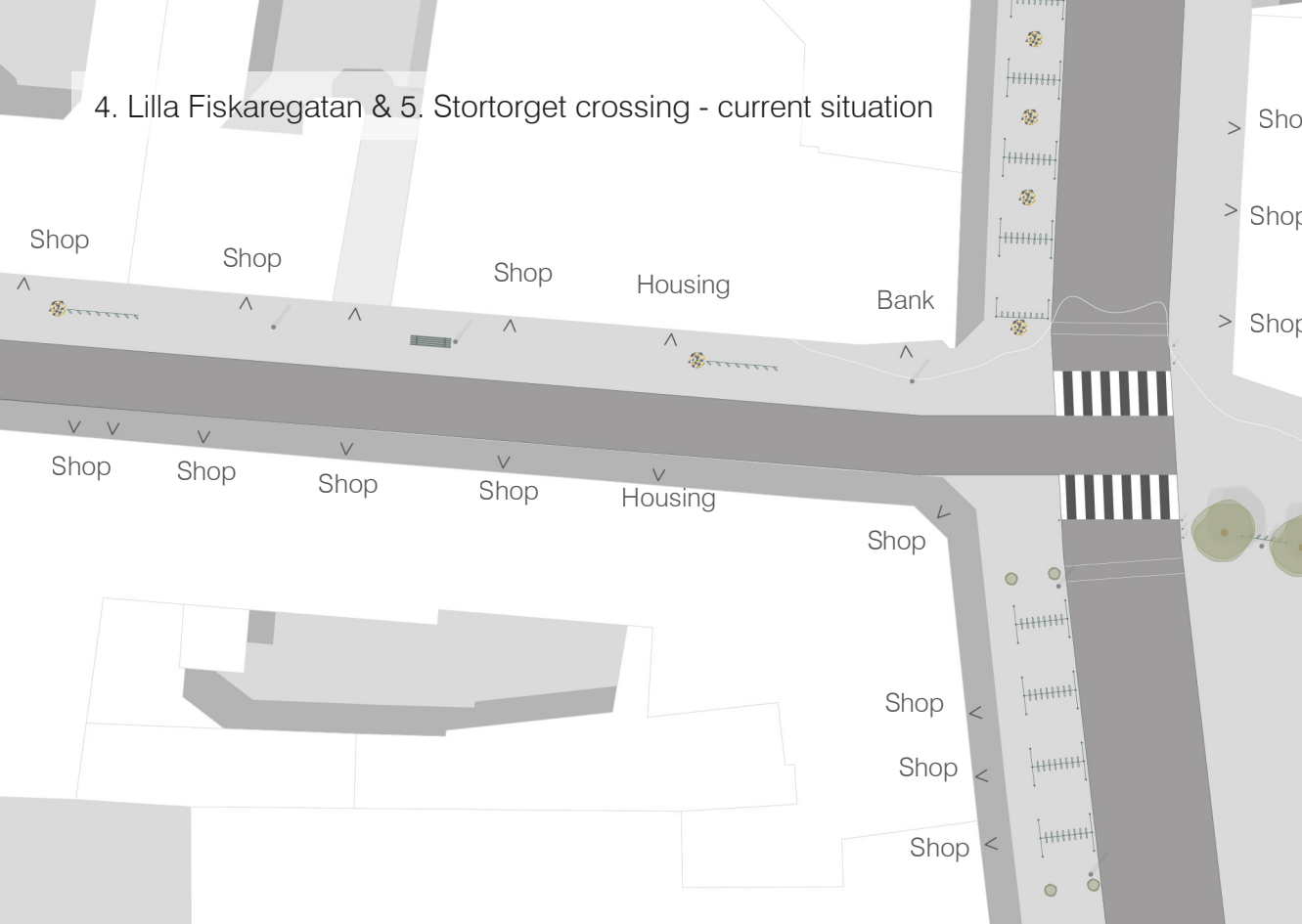
Another important change to Kloostergatan is a concept that is briefly mentioned on page 19, 84 and 85, the cycling street. A cycling street is made up of several different components, according to Leiden's cycling strategy. It is a street where the materiality clearly communicates a priority to cyclists, in this case the red clay bricks. Since a red road surface is used all throughout town for bike lanes, cars and busses are acutely aware that they are allowed on this street only as guests. Besides that, a cycling street has a width that is too narrow for cars to easily overtake cyclists. This will minimize doubting behaviour of cars, since

it is clear that they won't be able to pass, which will increase safety<sup>2</sup>. Putting these ideas together creates a road that is more pleasant to use for pedestrians and cyclists, while still being accessible to cars and busses.

According to Leiden's cycling strategy, a cycling street with one way car traffic should have a width of 3.8 meters<sup>2</sup>. However, since this street is used frequently by busses and delivery trucks, this design gives a little more space. The four meters of the road gives enough space for busses and two way cycling.



#### 4. Lilla Fiskaregatan & 5. Stortorget crossing - current situation



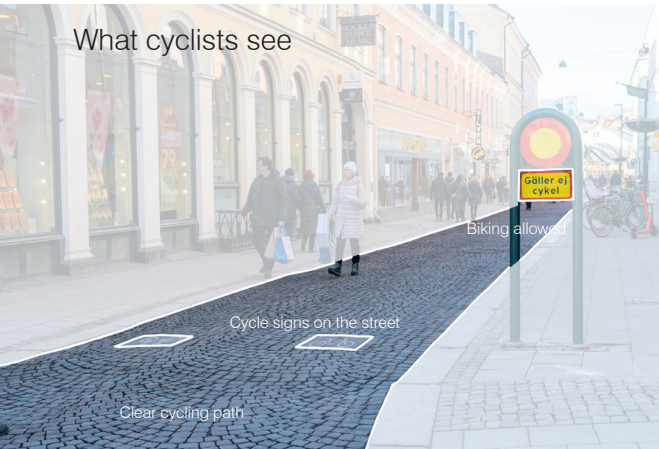
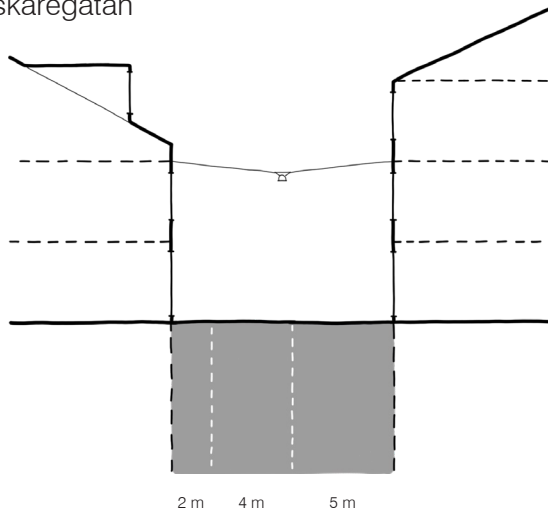
Through analysing Lilla Fiskaregatan, it quickly becomes clear that there is a disconnect in how pedestrians and cyclists experience the street. Cyclists see a street with a clear bike path, and road signs that state that cycling is allowed. Pedestrians however see a shopping street with a sign that says no traffic allowed, and a single surface. This gives rise to confusion and annoyance as both cyclists and pedestrians expect the other to behave differently. Pedestrians walk on the bike path since they don't notice it and expect cyclists to bike around them, while cyclists expect pedestrians to get off the bike path since to them, it's a clear bike path.

This confusion can be addressed in two different ways. Either the cyclists get priority and the bike path becomes more noticeable

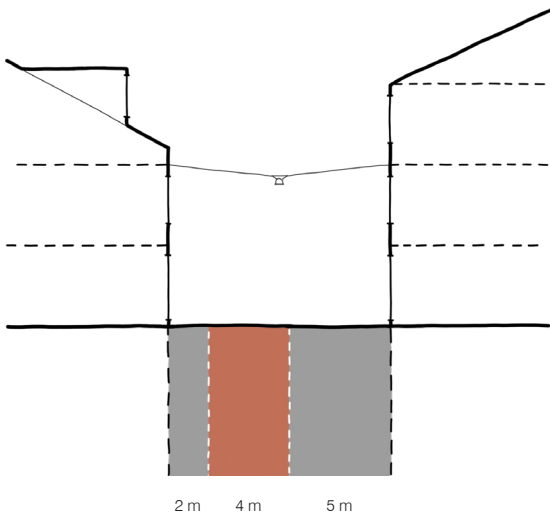
through a different color, material, or even a slight lowering of the bike path surface. On the other hand, this could also become a complete shared space where everyone needs to be in constant communication and look out for each other.

When it comes to the crossing between Lilla Fiskaregatan and Stortorget, materiality again causes confusion. The crossing consists of two separate zebra paths, divided by a bike crossing. This bike crossing is a continuation of the already hard to notice bike path on Lilla Fiskaregatan. What makes this crossing extra confusing is that the bike crossing is paved in the same cobblestone as the car road. It is therefore nearly impossible for cars to notice that this is actually meant as a bike crossing.

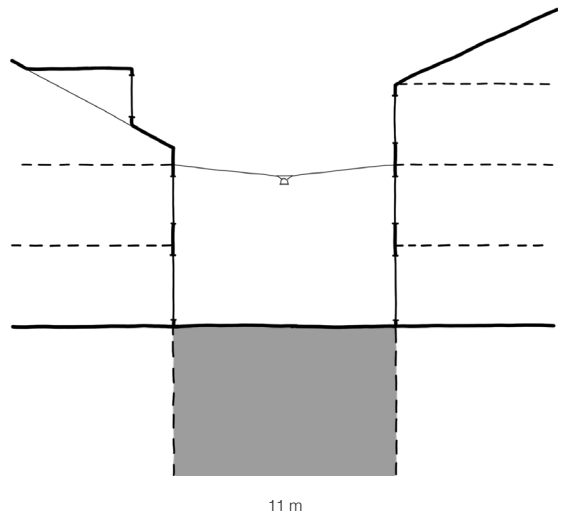
Current situation Lilla Fiskaregatan



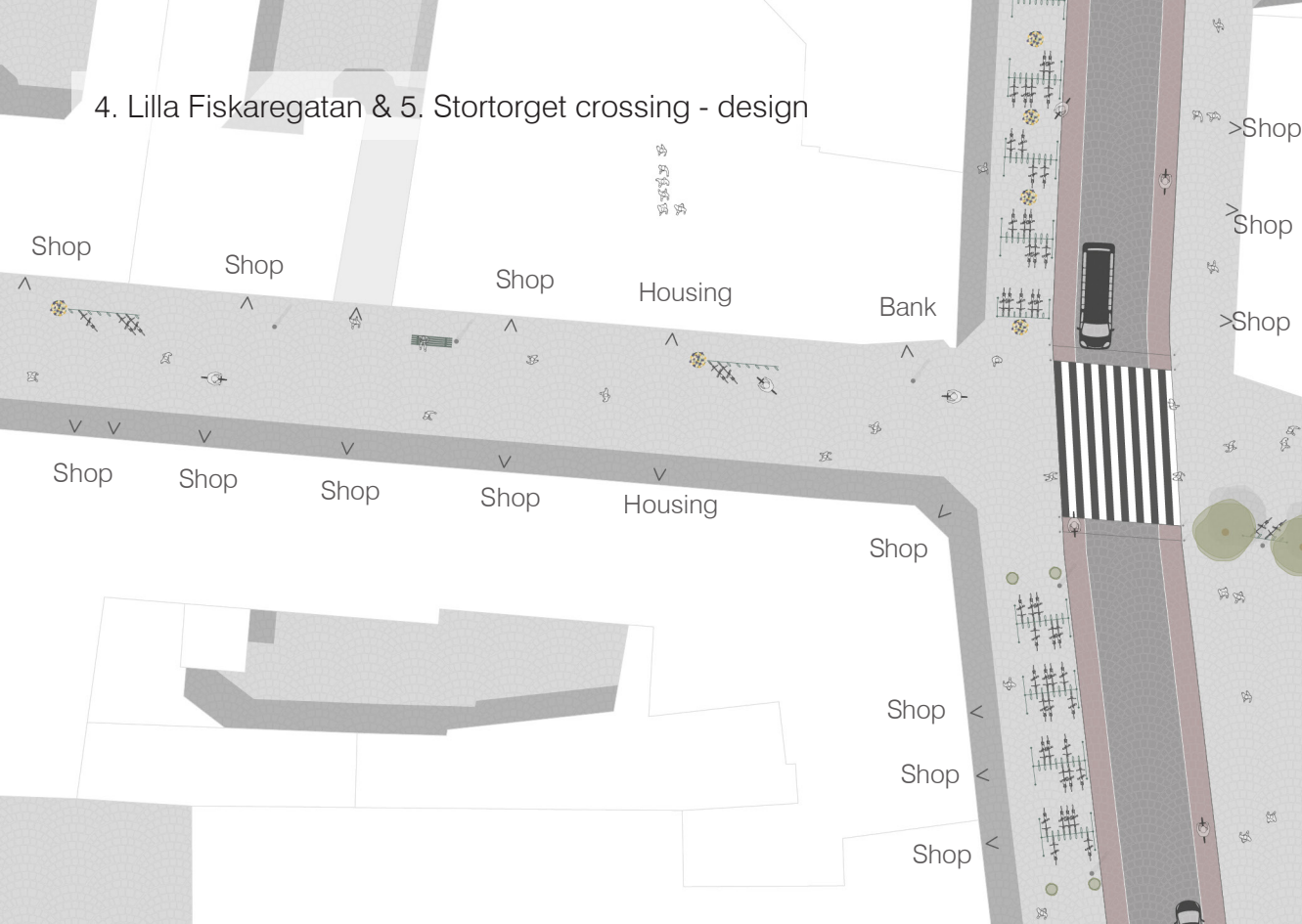
Alternative 1



Alternative 2



#### 4. Lilla Fiskaregatan & 5. Stortorget crossing - design



As discussed on the previous page, for Lilla Fiskaregatan one could either create a more clear bike path, or have the whole street function as a shared space. This is dependent on the type and use of the street. In this case, it is a shopping street which is well used by pedestrians. For that reason, this design prioritizes the pedestrian, over the cyclists. The design features a shared space where cyclists are allowed to bike, but must be mindful of all times of the pedestrians shopping here.



Image 84 - The shared street in Brighton & Hove<sup>19</sup>



Image 85 - Bike parking on the shared space in Brighton & Hove<sup>19</sup>



A good reference for this type of design is located in the city of Brighton and Hove, and is designed by Gehl Architects. This is a shopping street that used to have a car road down the middle, but now features a shared pedestrian and bike street with outdoor seating for restaurants and lots of space for city life, as shown in images 84 and 85.

By taking out the bike path on Lilla Fiskaregatan, the need for a bike crossing

to stortorget is taken away. This is replaced by a zebra crossing that spans the full width of Lilla Fiskaregatan, so the flow of the street can continue onto the square. The simplification of the situation will increase clarity for vehicles and cyclists on Kyrkogatan. The single zebra crossing gives a clear signal that this is one crossing and pedestrians have right of way over the whole width of the street.



Image 86 - Where are we supposed to cross?



Image 87 - Difficult to get an overview of the crossing



Image 88 - Cyclists on the sidewalk, pedestrians crossing diagonally



Image 89 - The crossing when approached from Paradisgatan



## 6. Paradisgatan crossing - design

The last place this design proposal zooms in on is the crossing between Paradisgatan, Kyrkogatan, Bredgatan, and Sankt Petri kyrkogata. This is a complicated crossing since the buildings create a sort of zig-zag crossing for pedestrians and cyclists that move between Paradisgatan and Sankt Petri kyrkogata. The images give a good impression of the crossing and its difficulties.

There are several aspects of this crossing that make it hard to navigate for all traffic participants. The pedestrians coming from Sankt Petri kyrkogata have no direct crossing, so they usually cross diagonally and the cyclists coming from Paradisgatan tend to sneak through traffic however they can, creating dangerous situations. For cars the crossing is hard to oversee since the bumps indicating the crossing are located at quite a distance from the crossing itself,

making the crossing seem much larger than it is. Lastly the cars turning from Bredgatan onto Sankt Petri kyrkogata have a very large turn, which makes it very easy for them to turn. This decreases the attention given to cyclists and pedestrians moving southward from Bredgatan, often resulting in almost-accidents.

This is all addressed in the design proposal where materiality creates clarity and more space is given for pedestrians to cross comfortably. The bumps for the cars are moved much closer to the crossing, making it feel much smaller and easier to overview. The cyclists coming from Paradisgatan no longer have a cycling path leading directly onto the road, but face a bump when crossing the sidewalk. This will increase awareness of the cyclists and will slow them down to improve safety.

Masterplan

Clemenstorget

Station building

Bantorget

Klostergatan

Lilla Fiskaregata





All these separate parts join together in a masterplan of part of the city centre of Lund, as shown here. The plan features more bike lanes on the access roads of the city centre and better traffic safety for all traffic participants. There is an increase in clarity and a simplification which will allow a smoother and more enjoyable cycling experience. Apart from this, the masterplan also adds high quality public spaces for pedestrians which will increase walkability and make the city a more enjoyable place.

From designing this masterplan I have learned that creating better accessibility for cyclists improves the city for all. There is more space for enjoyment and less space taken up by cars and busses. This results in a city that is not only more pleasant to cycle in, but also safer for cars, better for pedestrians and gives a big boost to city life in general.

It has also become clear to me that creating better situations for cyclists does not always mean making it easier for them. Especially in Lilla Fiskaregatan and the Paradisgatan crossing, the design for cyclists has increased in friction. This creates better awareness which results in a situation with less friction, which is better and safer for all.

## Instant improvements

The design proposal in this thesis is a big project which involves a lot of time, money and effort. I therefore wanted to include some ideas on how to improve cycling in Lund tomorrow. These ideas are not new, and have been present in Lund in years before, so this will serve as a reminder of what can be done to create instant improvements.

One way of improving Lund instantly is through temporary bike paths. These can be painted onto the road and give an instant boost to bike accessibility. These painted paths can also serve as an experiment for Lund municipality to test which paths are used most, and where adding bike paths is not necessary. A good place to start with this would be Kyrkogatan/ Stortorget, and Sankt Petri kyrkogata. These streets have some form of bike path in place already, but by using paint these can be extended and clarified.

Another way to create instant improvements is through adding temporary bike parking on car parking spaces. This gives an easy solution to minimizing street parking in Lund, while adding bike parking at the same time. These types of bike racks can already be found in Malmö during the summer months, and have been used in Lund before. Klostergatan would be a great place to add these, since this street features a lot of street parking, and very little bike parking. Other streets to add this instant bike parking could include Kyrkogatan and Bangatan. Through tracking use patterns, these parking structures can give a good indication of where bike parking is lacking. This can help the municipality figure out where more permanent bike parking is needed.



Image 90 - Temporary street signage<sup>20</sup>



Image 91 - Painted bike lane<sup>21</sup>



Image 92 - Temporary bike parking<sup>22</sup>

## Reflection on current plans

As a final part of the design phase, I thought it would be interesting to reflect on what Lund municipality is currently planning for the station area. Their plans include a complete redesign of Bangatan, as well as the west side of the station and a new station building. All information about these plans is taken from "Ramprogram för Lund" published by the Stadsbyggnadskantoret on the 10th of march 2015. To keep the reflection relevant to my thesis, I will focus on the plans for Bangatan.

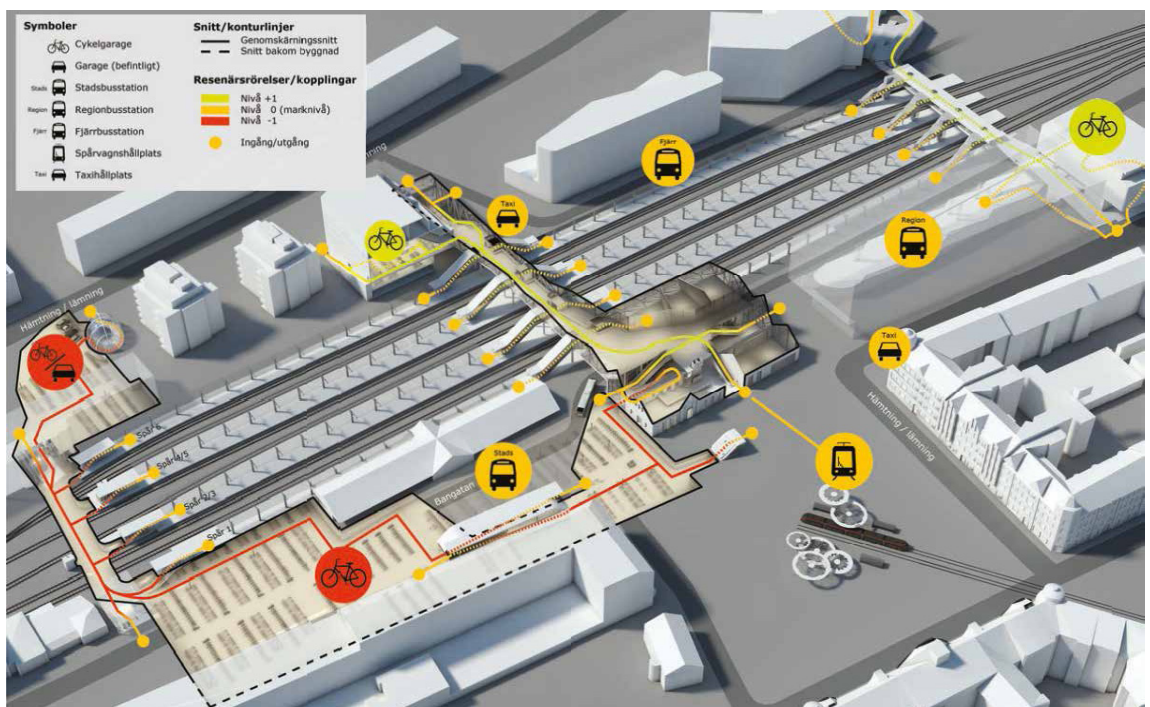
The plan made by the municipality takes away the car road on Bangatan like my design, but keeps the busses there. This is something that I considered as well, though ultimately decided against. In my opinion, the busses form a big part of the barrier effect of Bangatan, so keeping them would need to be organised incredibly well for it to not be too disruptive.

Secondly, the plan also takes into account different and new buildings. The new buildings frame the square better, and a new station building by Clemenstorget

shifts the main focus point of the station to the north. In my opinion, these changes are good, changing the station building will have a huge impact on the ease of use for both travellers and commuters. Personally I didn't include any buildings in my design since I focussed on trying to implement a design into the current situation as seamlessly as possible.

Another addition by the municipality that I fully support is the underground bike parking under the whole station area, as seen in the image below. If the station becomes even more popular, more bike parking will be needed. In doing my own design I discovered that adding bike parking to the current situation is difficult, since the layout of the buildings makes it difficult to add more bike parking without disrupting the whole square. Adding underground parking may be expensive, but I believe it to be worth it.

Lastly, the atmosphere on the square in my design and that of the municipality is very different. The municipal plans have a clear



vision of creating a “stone city on the east and a park-mileu on the west”. This is in contrast to my design where Bangatan has a more green and park-like appearance. I understand that with the bus on Bangatan, a more stone-heavy design functions better, but I believe that when connecting Clemenstorget to Bantorget, a greener environment would be better.

Since this municipal document does not contain a detailed design, I cannot comment on their bike-paths or any more detailed design choices. What I am hoping to see is a square that clearly communicates what traffic is supposed to go where, to create a safe and pleasant environment for all.



# *Closing statement*



This thesis project has taught me a lot, not only about cycling but also about time management and motivation during a pandemic. It was a great way to grow as an urban designer, and explore a type of research closely related to urban design. Having a topic that was close to my heart helped keep me motivated to continue learning and researching. However, a topic this personal also came with its own challenges. As a Dutch person, I have rather strong opinions on how things should be when it comes to cycling. Sometimes it can be hard to be open to different solutions to a problem, when you already know one solution. This means that the research and the subsequent design has very strong roots in Dutch cycling culture. As a result, some things that were obvious, or even subconscious, choices to me, were questioned by my jury and supervisors. This has helped me grow and become more aware of my background and baseline for what I think is normal.

For the thesis itself, I had to make choices on what to discuss. Seeing as there are so many topics closely related to cycling, it was impossible to address all of them. One of these things is the problem of the busses in Lund. Bus drivers often don't give space to cyclists, or give them right of way where they should. This creates dangerous and unpredictable situations, where cyclists should never have to find themselves if bus drivers follow the rules and are a little more flexible. This is an issue that is difficult to tackle in a thesis like this, but still an important one that needs to be addressed by the municipality.

The large number of related topics addressed in this thesis also make space for possible follow up questions and research. One of the things that I think would be interesting to look at is a speed limit for electric vehicles in the city centre. This is something that came up during

discussions on how the city can manage the ever growing wealth of electric vehicles such as electric bikes, kickbikes, speed pedelecs, etc. When more and more people start to commute longer distances with electric bikes or similar, the bike paths will need to be suitable for a large range of speeds. In the city centre, this can be challenging due to the lack of space. One possible way to deal with this would be imposing a speed limit on the electric bikes so they aren't allowed to go much faster than regular cyclists in the city centre. This would create a safer environment for both cyclists and pedestrians.

I hope that this thesis has provided some inspiration and food for thought for you, my reader. It would be an honor if my work would help inspire people to create a more cycling friendly environment, and help start conversations at schools and municipalities. Most of all, I hope you enjoyed reading it, thank you.

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