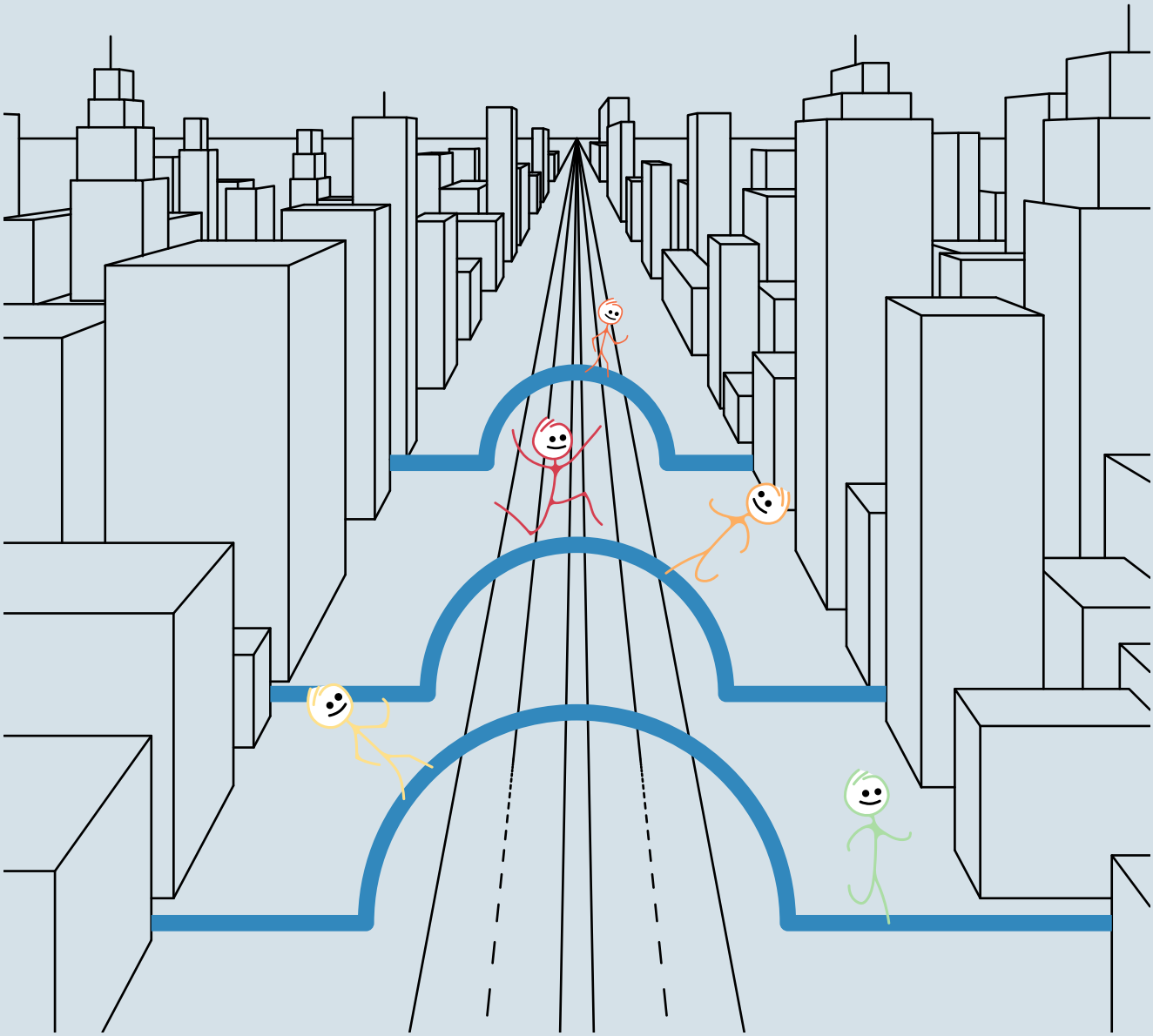
BRIDGING INFRASTRUCTURE

A Broad Study, Applied On Älvängen



Helge Berntsson - Master Thesis 2025

Examiner: Jorge Gil - Supervisor: Job Van Eldijk

Chalmers School of Architecture - Department of Architecture & Civil Engineering

CHALMERS
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Helge Berntsson

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Profile: Urban and Rural Design and Planning

Master Program: Architecture and Planning Beyond Sustainability (MPDSD)

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Cover: Illustration of an urban landscape, split in the middle by a infrastructure barrier.

ABSTRACT

As society has developed and expanded, the transport network has grown. The small, simple path has turned into a street, and today that street is a motorway that runs straight through the community. This is a common sight in towns that have grown with the car, and it's a structure that creates infrastructure barriers. An obstacle along someone's path, creating barrier effects.

This structure exists today in Älvängen. The motorway and railway separate large areas next to the town centre, but the barrier effects can be considered minor as there is currently no attraction to the separated areas. This may change if the municipality's visions for the future are realised. How can barrier effects then be prevented when the need to cross the motorway and railway is created?

The foundation of the thesis is based on two theoretial oriented parts, one of which has been to test whether the conceptual model of barrier effects developed by Job van Eldijk as part of his research on infrastructure barriers can be used to develop a needs specification for a specific location, in this case Älvängen. The second part is a study of reference projects, using research for design as a methodology. How have infrastructure barriers been dealt with in different places around the world, and what can we learn from this?

The lessons learned from the reference projects have then been used to create a number of design principles that should be taken into account and used when designing new pedestrian and cycle bridges with the aim of reducing barriers. These design principles have then been applied, together with the needs identified for Älvängen, to create a proposal for a new pedestrian and cycle bridge over the motorway and railway in Älvängen. A new pedestrian and cycle bridge that will help the residents of Älvängen to travel between the town centre and the green areas along the Göta Älv river, while minimising any future barrier effects that may arise.

Finally, the lessons learned from the project as a whole are summarised, with a strong focus on footbridges, which have become the core of the project.

Keywords: Transport infrastructure, Infrastructure barriers, Pedestrian and cycle bridges, Älvängen

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INTRODUCTION

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1.1 Background
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1.3 Research questions & aim
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1.0 Introduction

Roads and streets in urban areas, communities and rural areas that form a network of streets, are something we as society take for granted today. This has not always been the case. Over several centuries, we have built structures that enable us to get from A to B as quickly and efficiently as possible. Today, we depend on this network to get goods to grocery stores, patients to hospitals, service workers to facilities, and all other citizens to work, school, or the desired destination. Roads are simply a necessity.

However, depending on the hierarchy of different roads and how they are interconnected, barriers can be created – so-called infrastructure barriers.

1.1 Background

With the widespread adoption of the car by the general public in the early 1900s, the needs and expansion of the road network increased. Roads grew in proportion to communities, and the shift to the car as the primary means of daily transport has shaped the landscape. The focus became regional accessibility by car, and thus roads and transport infrastructure were given space, and in many places continue to be given space. This is also the case for new construction in urban environments. Regional accessibility in Sweden is under the responsibility of the Swedish Transport Administration (a government agency), and therefore the municipality must work with the Swedish Transport Administration to create an urban environment that everyone is satisfied with. This can be difficult as the various authorities have different interests. See the plan for the ongoing reconstruction of the Brunnsbomotet interchange (City of Gothenburg, 2019; Swedish Transport Administration, 2025b) as a modern example of a new construction and reconstruction project where the infrastructure facility is allowed to occupy central land in the city. What was originally a normal street or a rarely used railway track has now grown into a large four-lane motorway or a heavily used double-track railway. These large infrastructure facilities are often surrounded by fences, noise, odours and traces of severed connections from the older street network.

Motorways also bring heavy traffic in the form of lorries, and railways bring freight transport. These are two modes of transport where the impact of accidents is often greater, and therefore usually require large safety zones. This is especially true when dangerous goods are being transported. Safety zones are left undeveloped and prevent densification and community development.



Figure 2
Aerial photograph from around 1975 of Älvängen.
— Severed connections
— Extent of today's infrastructure



Figure 3.
Photo from 1946.
Demolished buildings that stood where the infrastructure is today.
Buildings that no longer exist for other reasons.

1.2 Problem description

Major roads connect destinations on a regional scale, but also cut off other roads on a local scale.

The barriers created by major transport infrastructure result in inaccessibility, areas with reduced sense of security, and social divisions within communities. Which side of the barrier people live on can affect their access to amenities, services, and attractions. They contribute to monotonous urban landscapes where grade-separated structures for car traffic stand out with their grey and anonymous character. The lack of architectural design and form in Swedish transport infrastructure becomes clear when nothing stands out.

In Älvängen, a small commuter town 20 minutes north of Gothenburg, a similar infrastructure barrier as described above, exists. A small road has grown into a four-lane motorway (E45) and the simple railway is now western Sweden's connection to Trollhättan, Vänersborg and on to Norway. A heavily used double-track railway with a lot of freight traffic and commuter trains running in quarter-hour intervals.



Image 1: An old industrial building advertising that empty premises are available for rent.

This has created a clear barrier between the two sides. On one side is Älvängen town centre, residential areas and commerce. On the other side are the old industrial sites and green spaces along the Göta Älv river. Two sides with a lot of history, where the side along the Göta Älv river with the old industrial sites is being forgotten, with some buildings standing empty (Image 1). These are areas that could be used by Älvängen to develop the community and reach the goal of doubling the number of residents in 30 years (Ale kommun, 2021, 2024).

As mentioned earlier, the motorway and railway are under state responsibility, which leaves Ale Municipality and Älvängen themselves to try to reduce the barrier. This means that simplicity and economy are high on the list of priorities for the project to be feasible. The municipality's own plans for the development of Älvängen rarely mention the river side as being useful. The assumption is that the municipality itself does not know what is required to make these areas accessible. This assumption indicates that the problems with infrastructure barriers are complex.

For the future and for Älvängen, it is therefore interesting to investigate how we can bridge transport infrastructure facilities, taking several aspects into account and allowing design to play a central role.

1.3 Aim & research questions

By answering the three research questions (RQ) below, this study intends to address the question of how Älvängen can reduce the physical separation caused by the motorway and railway.

RQ1. How can the conceptual model of barrier effects be applied on Älvängen to identify needs?

RQ2. How can infrastructure barriers be bridged, and what characteristics do these solutions have?

RQ3. What might a barrier-reducing solution look like in Älvängen?

The goal is to develop a design proposal that concretises how a future connection could be designed and what functions and characteristics are important for a functional connection that interacts with Älvängen's current and future needs.

1.4 Relevance for sustainable development

The transport sector accounts for a large proportion of global emissions and is undergoing a major transformation, with a strong focus on electrification. Another parallel track under development is changing the methods of transport we use to move around.

By bridging an infrastructure barrier, more locations are created where the barrier can be crossed. More locations to cross means a finer-meshed network and shorter transport distances. This benefits active modes of transport such as walking or cycling, as these involve physical movement. By making walking or cycling more attractive, we can reduce car use and contribute to ecological sustainability. A higher proportion of journeys made on foot or by bicycle also benefits public health (SDG 3).

By bridging infrastructure barriers and the way in which this is done, we can influence the social barriers created from physical segregation within an urban environment. Reduced physical segregation affects who has access to what, thereby strengthening social sustainability. By improving accessibility and connectivity in the city, we can make a positive contribution to SDG 11.

From a material usage perspective, it is also beneficial to investigate the various options available for overcoming infrastructure barriers. Different solutions create different opportunities, but also have varying degrees of impact on the environment. This includes both pure environmental aspects and consequences for the local surroundings of a long-term construction site. To reduce the barrier effect, is it really necessary to dig a new tunnel or cover a motorway with expensive concrete solutions?

Note: The UN Sustainable Development Goals (SDGs) (https://sdgs.un.org/goals) describe 17 different areas that the world needs to work on in order to achieve peace and prosperity for all of Earth's inhabitants, animals and nature.

1.5 Delimitations

The focus of this project is on understanding how to design a new connection between the two sides of a barrier, and what parameters can be incorporated to maximise its impact. The project will therefore not design the surrounding area on a larger scale, such as designing a new network or nearby buildings, but will be based on what exists today and the rough sketches and plans that the municipality has developed for the future.

As it has historically been engineers who have been in charge of designing transport infrastructure, this project will instead let architecture take the lead. What might the design look like if we put the creative and subjective perspective first? For this reason, no load-bearing calculations or other calculations related to construction and traffic engineering properties will be performed. In order to design a realistic project, the infrastructure requirements specifications from the Swedish Transport Administration (Trafikverket, 2023a, 2023b, 2024) and the Gothenburg Technical Handbook (Göteborgs Stad, 2025) will be used as guidance.

1.6 Methods, tools & structure

The structure of the work is based on what is illustrated in Figure 4 and rests on a combination of research for design, site visits, and case studies. Through a subsequent analysis of the collected material, together with the development of speculative scenarios and well-founded subjective assessments, the framework on which the project is based is established.

Site analysis & needs identification

Through site visits to Älvängen, both physical and digital (Google Earth), a basic understanding of the barrier that Älvängen must deal with is created. The physical site visit is particularly important because it adds an acoustic and sensory dimension.

Our understanding of Älvängen's current situation and future needs is expanded by studying the reports and reference documents that have been produced for Älvängen, such as the Ale comprehensive plan. A number of personas are created based on a demographic survey. These are examples of people who represent all the residents of Älvängen and their everyday lives and abilities.

In order to study the barrier-creating physical structure in Älvängen, the situation was analyzed using the conceptual model of barrier effects described in chapter 1.6.1. The model helps the user to identify different factors and their relationship to each other. The model is being used in the project to identify specific characteristics that should be taken into account when developing a barrier-reducing solution.

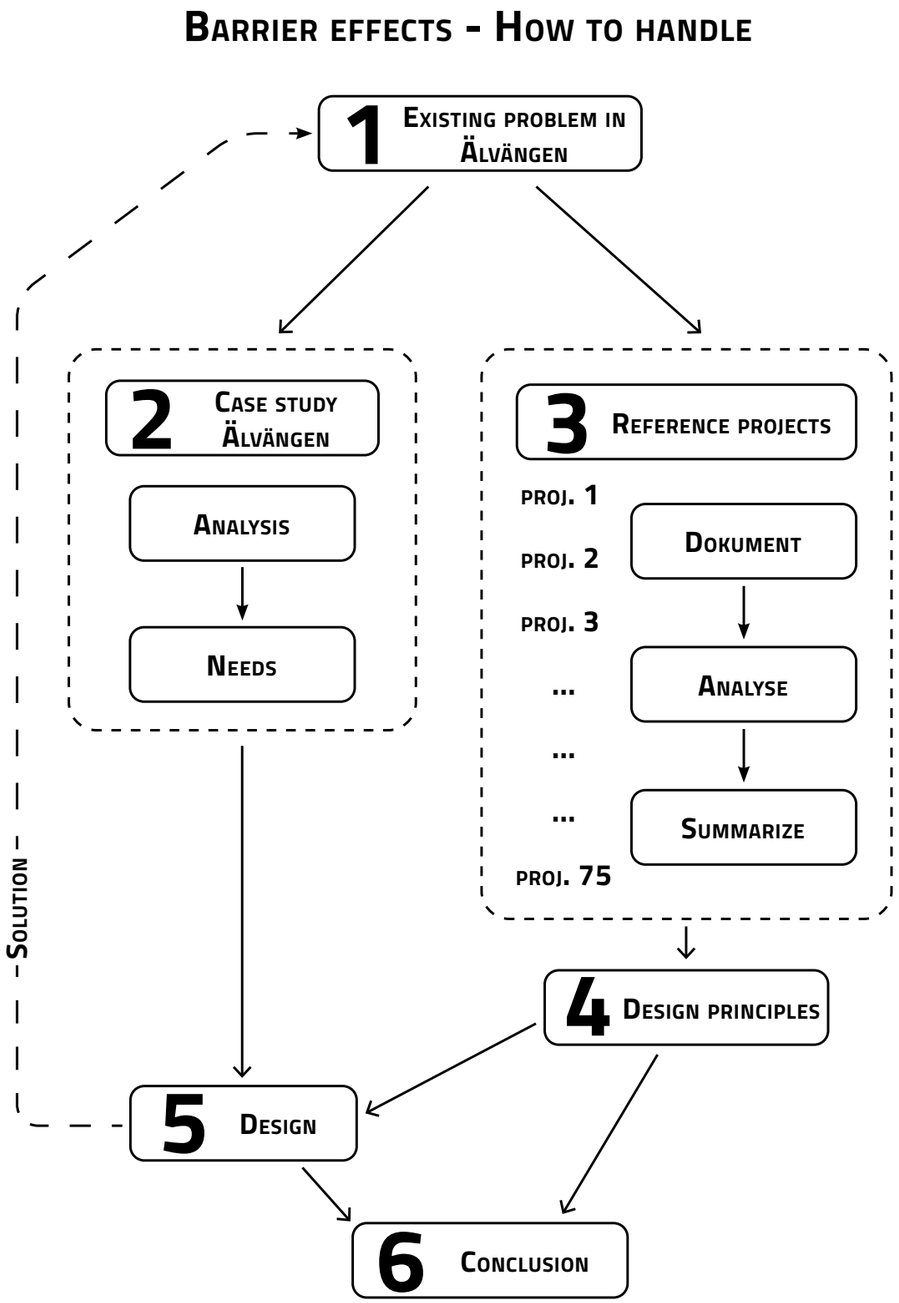


Figure 4: Project structure.

The use of the conceptual model of barrier effects will answer RQ1.

Research for design & Reference projects

In order to develop a solution that suits Älvängen, a number of reference projects have been studied. By studying reference projects that have been applied in similar situations, an understanding is gained of the consequences these have had and which solutions would be most suitable for Älvängen. The results of the analysis of various reference projects have guided the project by creating a need to analyze more reference projects with other characteristics.

First, a number of reference projects were selected at the international level (Chapter 3.1). The goal was to gain an understanding of how the issue of infrastructure barriers has been addressed in other parts of the world. The projects were identified through basic literature reviews and database searches.

Gothenburg was then selected as the region to study (Chapter 3.2). Has Gothenburg, and if so, how has Gothenburg built pedestrian and bicycle bridges to bridge barriers? Gothenburg was chosen because it has a close connection to Älvängen, both geographically and contextually. The bridges in Gothenburg were identified using the method described in Appendix A.2.

To broaden the picture of what a pedestrian and bicycle bridge can be, a simpler literature review (Chapter 3.3) was also conducted on pedestrian and bicycle bridges that have received international acclaim for their characteristics.

Various methods have been used to analyze the reference projects. For reference projects that could not be visited, literature studies have been used as a method in combination with digital site visits. For reference projects that could be visited, a selection has been made that represents a wide variety of types and contexts as possible. Physical site visits were then carried out on these objects, and digital site visits were carried out on the remaining objects. The data collected through images and notes was further compiled as statistics, and conclusions were drawn based on the author's subjective assessments.

Through the work with reference projects, RQ2 will be answered.

Design principles

The summary of the reference projects is structured as a number of design principles. These principles can be used as guidance to create proposals that reduce barriers, both for Älvängen and for other projects of a similar nature. The principles are based on the lessons drawn from the reference projects. Lessons about materials, construction, design, adaptation to the surroundings, and perception.

In this case, the principles describe simple functions or characteristics that architects and designers can apply to create pedestrian and bicycle bridges in central environments.

Design solution

To illustrate how a pedestrian and bicycle bridge can be designed based on the design principles, a proposal for Älvängen is created. The characteristics, suitability, and function of the proposal in the community will be articulated by applying the Personas developed in the analysis of Älvängen.

By creating a design proposal for Älvängen, RQ3 will be answered.

Digital tools & sources

Open map data from OpenStreetMap was used to locate footbridges in Gothenburg. QGIS was used to analyze the map data. Google Earth and Overpass Turbo were used to study locations and find various elements in the physically built environment.

1.7 Literature

1.7.1 The Conceptual model of barrier effects of transport infrastructure

In the paper *Disentangling barrier effects of transport infrastructure: synthesising research for the practice of impact assessment* (Eldijk et al., 2022), part of Job van Eldijk's doctoral thesis on infrastructure barriers, the author has developed a conceptual model to show how a number of different factors can be related to each other. The model illustrates the characteristics that go into each factor and how these can be described.

Figure 5 illustrates the conceptual model, where five different determinants are linked together like a mathematical formula. The product (result) of the equation describes the barrier effect that exists in the scenario under investigation. The model functions as a mathematical formula, but there are no values for the input features, something that the author describes as interesting to look at for the future (Eldijk et al., 2022).

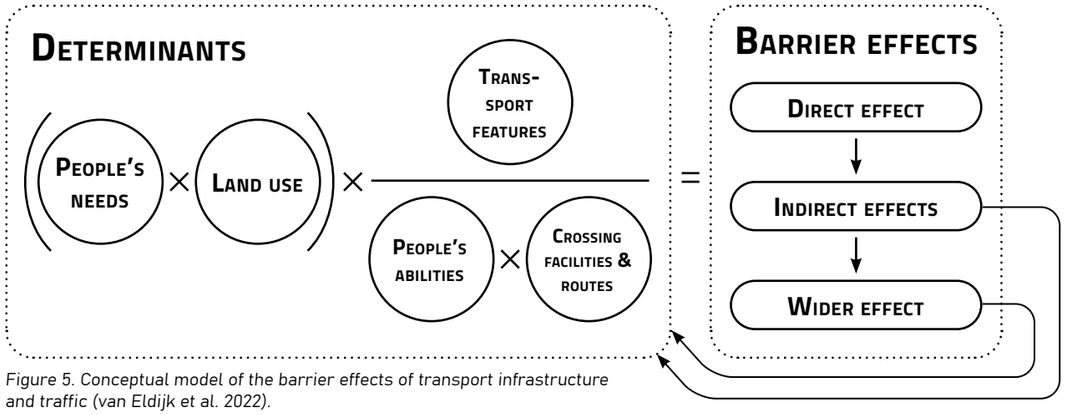


Figure 5. Conceptual model of the barrier effects of transport infrastructure and traffic (van Eldijk et al. 2022).

The five different determinants are:

Transport features describe the built environment that creates or could potentially create a barrier. In other words, the transport infrastructure that prevents someone from reaching a destination. The author divides the characteristics into physical barriers, such as fences (static) or traffic flows (dynamic), psychological barriers created by, for example, fear or discomfort, or formal characteristics such as rules that say you cannot cross at a specific location.

Crossing facilities & routes describe the possibilities for crossing the barrier. The author divides the characteristics into descriptions of the crossing point(s) itself, or the possible routes available for crossing the barrier. For example, whether there is one or more pedestrian tunnels, what characteristics the tunnel has, and how many ways there are to reach the tunnel.

People's abilities describe the opportunities or limiting factors that a person or group has to cross the barrier. Examples of this are age, mobility impairments or means of transport.

Land use describes how the surrounding area is built. What does it look like in terms of, for example, destinations for users or where things are located in relation to each other? One example could be if people live on one side of the barrier, while workplaces, schools and stores are located on the other side of the barrier.

Peoples' needs describe the needs of people moving to or from the area where the barrier is located. Important factors to consider here are age, socio-economic values and social connectedness within the neighbourhood.

The barrier effects that arise based on the five different determinants can be divided into three different levels that describe varying degrees of impact.

Direct effects describe the immediate effects that people experience when they cross the barrier. These may include longer travel times, increased discomfort or fear of accidents. They can also be effects that arise when one is forced to move along the barrier. Direct effects only arise when one chooses to cross the barrier because there is no other alternative, or because the threshold of what a person can accept has not been reached.

Indirect effects are the result of the threshold being reached, i.e. changing one's behaviour in order to avoid crossing a barrier. This may involve choosing a different route or destination.

Wider effects describe the effect that the barrier-creating structure has on the surrounding area and how it affects groups of people and the local environment. For example, it may not be possible to establish certain businesses on one side of a barrier because the conditions are not in place for potential customers to get there.

As the author writes, "*While the four determinants described so far all contribute to the potential barrier effects of a transport feature, it is through the needs of people that barrier effects are actualised*" (Eldijk et al., 2022), it is people's needs that play the most important role in the model. Without the need to cross the barrier, there is no barrier. In the model, the value of people's needs therefore becomes zero, and an equation multiplied by zero always equals zero. No barrier effect occurs.

1.7.2 Ale Municipality documents

In order to understand the context and situation in Älvängen, the project is based on these documents, which were created for or by Ale Municipality.



Structural sketch for Älvängen Centre: From gap to living room [Strukturskiss för Älvängen Centrum: Från mellanrum till vardagsrum] (Ale kommun et al., 2023)

The structural sketch for Älvängen Centre is a guiding document that What! Arkitektur has developed together with Ramboll and Ale Municipality on behalf of the municipality. The purpose of the document is to contribute to the work of developing Älvängen centrum for future needs and to achieve the environmental goal of a good built environment.

In the document, Älvängen is divided into four areas: Centrum, North-east, South-west and the Riverside. The analysis covers the area as a whole, while the structural sketch itself mainly focuses on the Centrum area, which is considered to be the area which will be developed first.

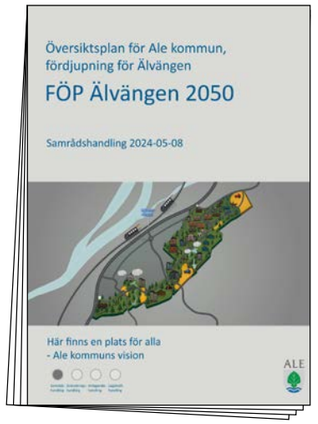
Three strategies are mentioned that will contribute to the development of the core. Work should be done to link and create nodes. Work should be done on space-creating infill and conversion, and finally, all gaps should be activated. It is also mentioned that Älvängen as a whole should develop its walking and cycling paths to make it safer and more convenient to choose active means of transport, and that denser construction should take place around the station.



Ale Comprehensive Plan 2021 (Ale kommun, 2021)

The Ale comprehensive plan has been developed to guide the development of Ale Municipality, of which Älvängen is the second largest urban area. Among other things, the document summarises how the municipality functions today and the guidelines and strategies that will guide development to achieve certain goals by 2050. It emphasises the desire for strong growth, for example, reaching 50,000+ inhabitants in the municipality by 2050, but that this must be done based on all three sustainability perspectives: ecological, social and economic.

The master plan highlights the Göta Älv river as an underutilised asset for the entire municipality, and there is a desire to invest in development around the station areas.



Älvängen detailed comprehensive plan (consultation document) (Ale kommun, 2024)

Ale Municipality is currently developing a detailed comprehensive plan for Älvängen, which is currently in the consultation stage. The detailed comprehensive plan covers an area of 400 hectares described as the “peripheral area.” Initially, the detailed comprehensive plan also included the center of Älvängen, but the scope of the work was revised in 2022.

The consultation document points to the fragmented pedestrian and cycle network in Älvängen as a problem for future efforts to reduce car use. It also highlights accident statistics in Älvängen, which indicate that most accidents occur at level crossings involving unprotected road users. It also emphasizes that the hierarchy of development should be ecological values, social values, and lastly economic values.



The railway-oriented community at Älvängen [Det stationsnära området i Älvängen] (Urban Futures, 2024)

Through a collaboration between Urban Futures, Chalmers University of Technology, the Gothenburg Region, Dalarna University and KTH Royal Institute of Technology, a report has been compiled based on a number of different workshops held on the development of Älvängen. Various analytical methods have been applied to develop different future scenarios, with the group participants deciding which scenario they believe best meets Ale Municipality's goals for Älvängen, but also what the group considers most realistic.

The report concludes with a vision for the future that is a combination of what best meets the municipality's goals and what is realistic to implement. The proposal identifies the riverside as having great potential for developing activities and a green corridor along the Göta Älv river that strengthens the community's connection to the water. They point out that a number of new connections across the infrastructure barrier are needed to link up the community's fragmented walking and cycling networks.

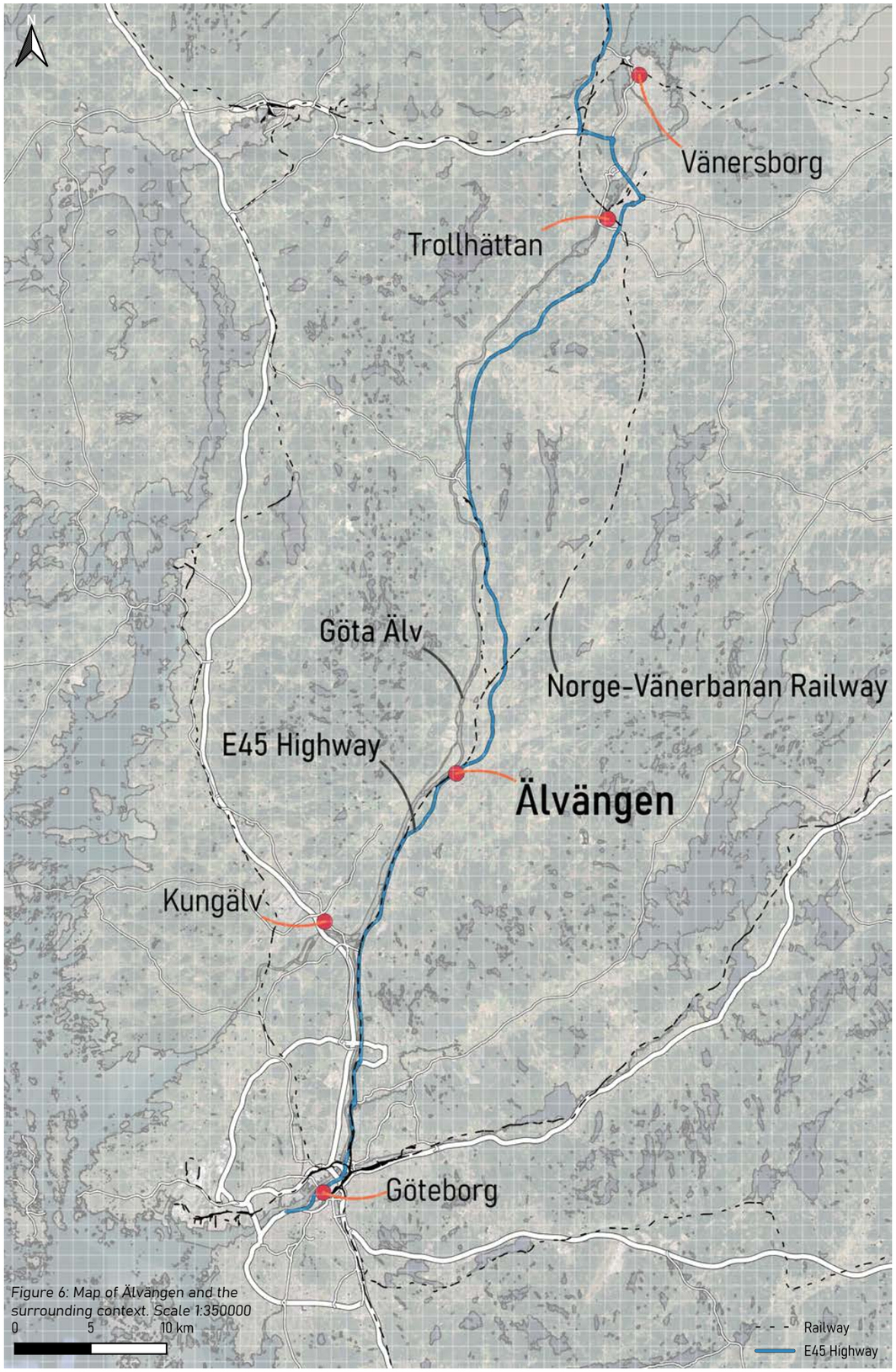


Figure 6: Map of Älvängen and the surrounding context. Scale 1:350000

PROJECT & SITE

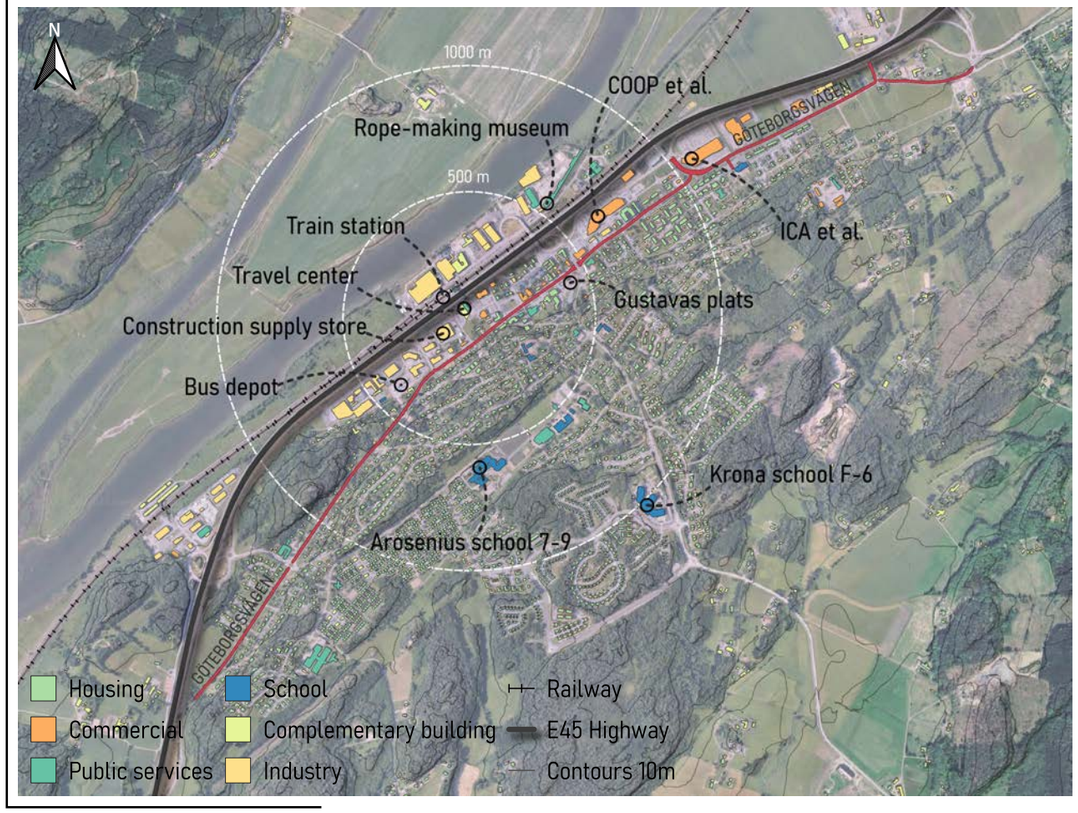
2

2.1 The context
2.2 The needs
2.3 Personas – Demographic
2.4 Barrier evaluation

2.1 The context

Älvängen is a small town in Ale Municipality, just north of Gothenburg, with approximately 6,500 inhabitants, and is part of Greater Gothenburg metropolitan area. With its geographical location almost halfway between Gothenburg and Trollhättan/Vänersborg, the community has emerged as a good alternative for people who work in the big cities but want to live in a smaller, quieter and more rural setting. Connections to the major cities were improved when the Swedish Rail Administration and the Swedish Road Administration (now merged into the Swedish Transport Administration) jointly implemented the 'BanaVäg i Väst' project, which was inaugurated in 2012 (Skanska, n.d.). The project involved expanding the E45 to a four-lane motorway between Gothenburg and Vänersborg, and the railway was improved with, among other things, five new and renovated commuter stations in the municipality of Ale. Älvängen is the terminus for the Alependeln commuter train to Gothenburg, and regional trains between Gothenburg and Vänersborg also stop here. It takes about 25 minutes to commute to Gothenburg by car and about 27 minutes by commuter train. Between 2025 and 2027, the Swedish Transport Administration will be working on a new railway plan to develop the track system in Älvängen. Additional

Figure 7: Map of Älvängen and the surronding buildings.



and longer tracks are needed to meet tomorrow's demands (TYPSA AB, 2025).

History

The name Älvängen, originally Elfängen, means 'the meadows by the river' (ängarna vid älven) and thus describes the location of the town very well, i.e. directly adjacent to the Göta Älv. The connection to the river and the establishment of the railway are what have driven Älvängen to become a densely populated area. The land by the river was originally excellent pastureland where farmers did not need to worry about their animals' access to water, and later the river became an excellent way to transport goods and people to Gothenburg and the west coast, or inland towards Lake Vättern and Vänersborg. Later, the agricultural land developed into an industrial area along the waterfront, which today, unfortunately, has fallen into a state of slow decay. The industries that are still active have no activities on the water. The last boat traffic disappeared around 1940 (Älvängen, 2024). Of the original activities that existed in Älvängen, only the 300-metre-long rope-making track lives on as a museum after P A Carlmark's rope-making business was sold. The rope-making business moved to Älvängen in 1917 and has been a museum since 1996. The remaining industrial buildings are now used for other activities or stand empty.

Railway

Älvängen has been classified as a railway station since 1886. The last station building was demolished in 1976 after passenger traffic ceased, but passenger traffic resumed in 2004 and a new commuter centre opened in 2012, located directly adjacent to the railway station and the old town centre.

Urban development

The old town centre is structured along Göteborgsvägen, which used to be the main road to Gothenburg. Today, you will find the typical small-town selection of small-scale businesses such as hairdressers, small shops and a number of different churches, mixed with residential properties. Both single-family houses and rental flats. The grocery store that used to be in the centre of the town has moved about 500 metres north to a new retail park with several large retailers. Southwest of the town centre is a business area with a construction supply store, a bus depot and a trucking company (Ale Municipality et al., 2023).

Some changes have taken place in recent years in central Älvängen, with new, larger and modern premises for daily goods retail. 117 new rental apartments are being built in two stages, with completion in

Q3 2025 and Q2 2026, on the corner plot of Gustavas plats in the centre. Furthermore, densification and additional construction are expected in the most central parts in accordance with the detailed plan for Utby 2:76. The planning work is based on the structural outline (Ale Municipality et al., 2023) that has been developed as a guide for the development of the town centre. Approximately 700 metres southwest of the station area, detailed planning work is underway, outside the area covered by the structural sketch, to enable more housing in the centre (Ale Municipality, 2025).

Älvängen has been identified as a station-proximate community in a report by Urban Futures (Urban Futures, 2024). According to the report, areas close to stations often have great potential but also complex challenges. Potential for strong growth in the local community thanks to the strong regional connection that the station provides. In Älvängen, many of the limitations and complexity lie in the geographical layout of the community and the barriers created by the Göta Älv and the motorway/railway.

Movement patterns

As described above, Älvängen is a commuter town. In 2016, approximately 2,000 bus journeys were made from Älvängen's travel centre and approximately 8,000 train journeys were made from Älvängen per average week (Sweco & Ale kommun, 2016). Commuting mainly takes the form of work commuting from Älvängen to Gothenburg, Kungälv and Trollhättan.

As society has developed with the car as the primary means of transport, the cycle network is generally poorly developed. The detailed master plan for Älvängen describes the cycle network as fragmented (Ale Municipality, 2024), with some routes ending abruptly, and the branch from the larger cycle route along Göteborgsvägen is limited. Poor conditions, old habits and shorter travel times have meant that many short journeys in Älvängen are made by car. For example, many residents in and around Älvängen take the car to the station to commute to work. This picture is reinforced by all the commuter car parks around the station. The same applies to everyday shopping.

Note: Strava Global Heatmap are maps from the company Strava that are created based on their users logging their training and exercise in their app. https://www.strava.com/maps/global-heatmap

Based on maps from Strava Global Heatmaps, it's clear that there's a need today to cross the E45 motorway and the railway to get to Fabriksgatan, which connects to the exercise trails along the Göta Älv river. For cycling, Hålstensvägen also stands out as a popular route. Today, the barrier is crossed via the car bridge with its associated footpath and cycle path that crosses the motorway and railway, as there is no other alternative for this purpose.

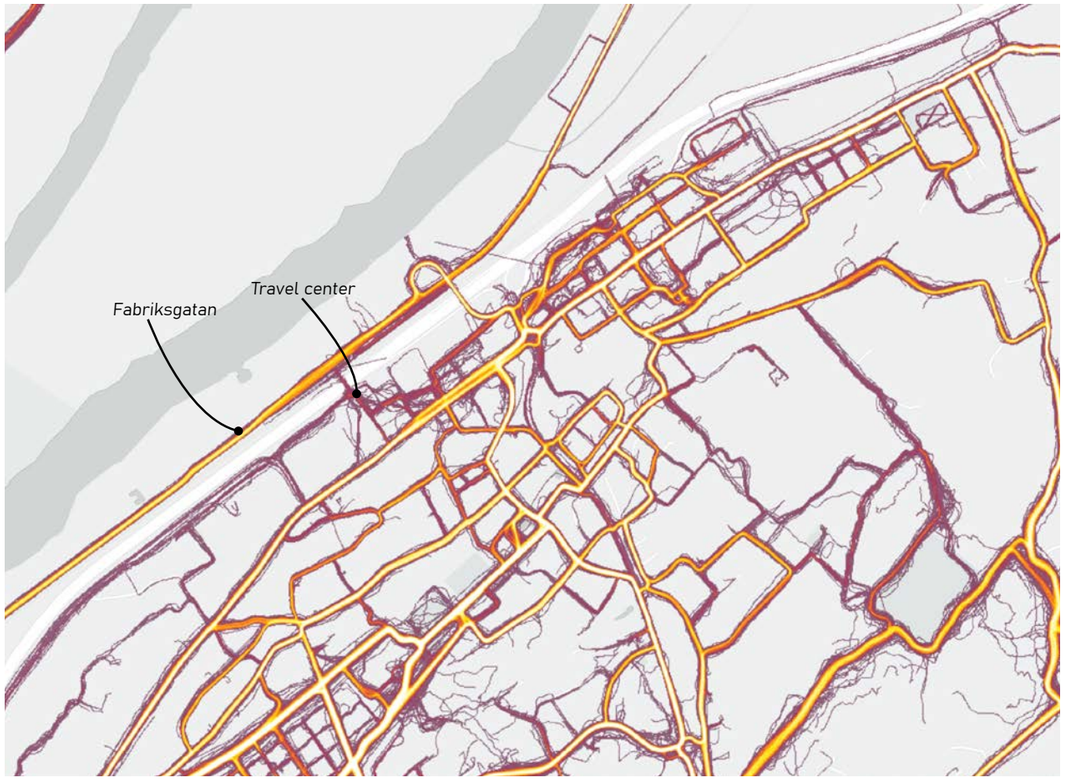


Figure 8: Strava Global Heatmap - All Foot Sports

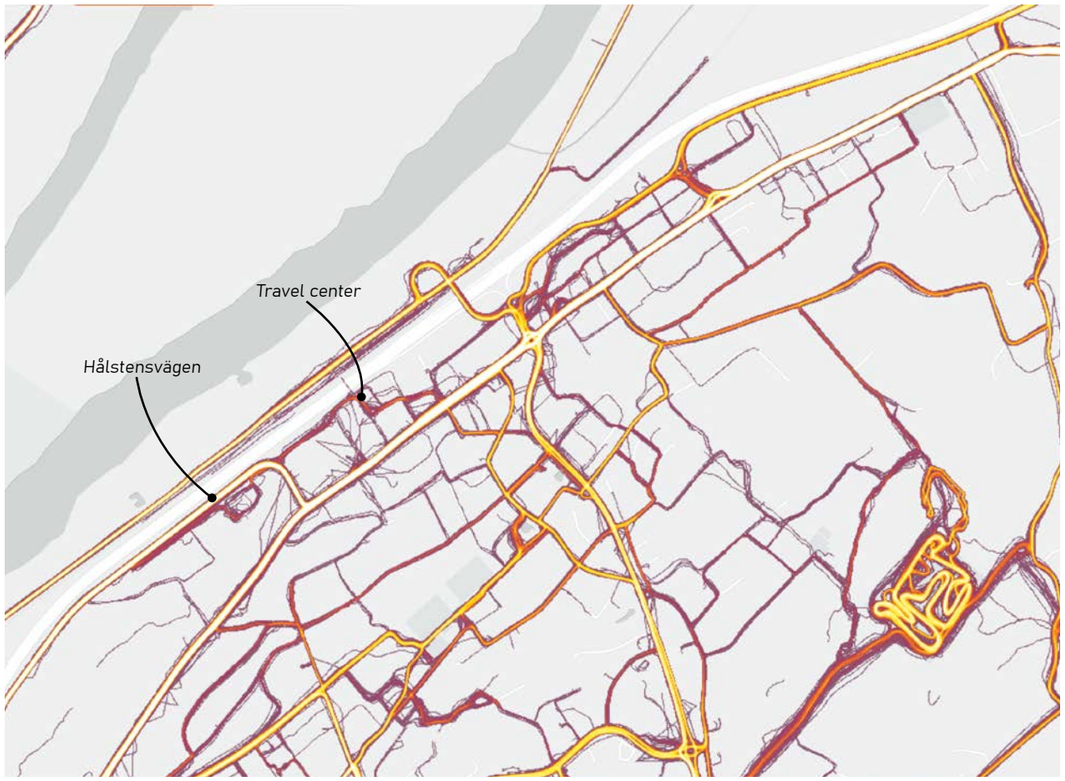


Figure 9: Strava Global Heatmap - All cycle sports

2.2 The needs

For many decades, the physical design of Älvängen has been based on car-dependent residents. As a result, there is a very fragmented network of footpaths and cycle paths in Älvängen. The major physical barrier created by the motorway and railway lines has caused the urban environment to develop in a half-moon shape. All buildings in Älvängen are located on the same side, away from the Göta Älv river, except for a few old industrial buildings squeezed between the Göta Älv river and the barrier.

The old industrial sites on the river side provide excellent space for the expansion that Älvängen is seeking. Ale Municipality is planning for significant population growth, with the ambition of reaching 50,000 inhabitants by 2050 (Ale kommun, 2021). For Älvängen, this means doubling its population to 13,000 (Ale kommun, 2024), from 6,500 today, and in order to implement this development, an in-depth comprehensive plan is being drawn up, which is currently out for consultation.

However, such a large population growth will not only require new housing, but also additional community services and commercial facilities. The industrial sites on the riverside are not suitable for housing, due to requirements for transport routes for dangerous goods. In the structural outline by Ale Municipality together with What! Arkitektur and Ramboll in 2023 (Ale kommun et al., 2023), the riverside is identified as ideal for public functions and offices. The detailed comprehensive plan highlights Älvängen and the riverside's location, between Gothenburg and Vänersborg, as areas with good potential for developing public functions that can attract people to Älvängen during the day and in the evening.

In order for the planned vision of the riverfront to be feasible, better connections between the riverfront and Älvängen town centre are required. The structural outline (Ale kommun et al., 2023) proposes that two new connections across the barrier should be investigated. The report 'The station-close community of Älvängen' (Urban Futures, 2024) also proposes that several new connections across the barrier should be implemented to make the development realistic.

There is an existing need to improve connections across the barrier. The natural values and areas for exercise and outdoor activities on the riverbank are often mentioned as incredible qualities that should be enhanced (Ale kommun, 2021; Ale kommun et al., 2023; Naturcentrum AB, 2017; Urban Futures, 2024). Today, Strava Global Heatmaps (Figure 8 & Figure 9) show that it is primarily the car bridge with its combined pedestrian and cycle path that is used to reach the riverside. The footbridges at the commuter train station are also used to some extent when traveling by foot. These are two connections that are not designed for this purpose.

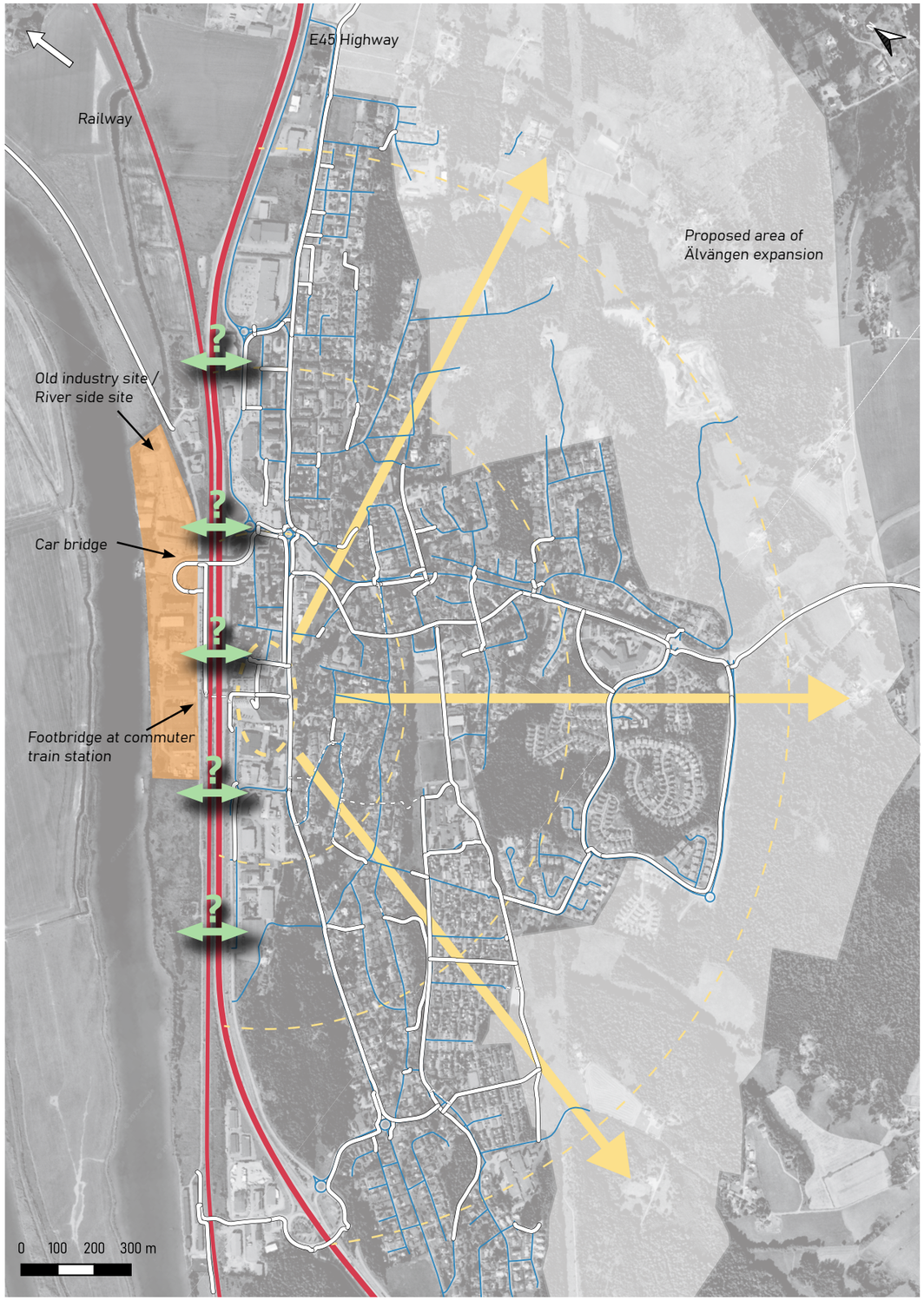


Figure 10: Illustration of the barrier's impact on the built environment. Scale 1:15000
Registered paths for biking and/or walking at NVDB (https://www.nvdb.se/)
Registered paths for walking at NVDM
Registered roads in OSM data with speed limit of 50 kph or lower
Radial expansion rings of Älvängen
Barrier creating structures

2.3 Personas – Demographic

In order to evaluate how the barrier in Älvängen affects residents, a demographic survey has been conducted. The survey is represented by six personas – examples of people who could live in Älvängen. The different personas represent the residents of Älvängen by taking into account age, gender, role in the household, daily activities and physical ability. The personas have also been given fictitious home addresses and other characteristics in order to include as many different aspects as possible.

In order for the personas to serve as test subjects for evaluating the current situation and the future, they have been given fictitious life situations. These life situations create a pattern of movement in society. For the future, a speculative scenario has been created based on the functions proposed to be located around Älvängen town centre and the riverside.



Noah, 8 year old

Home & Family: Noah and his family live in one of the multi-family houses on Länsmansvägen. Noah likes cycling, but his mum thinks it's dangerous because there aren't always footpaths and cycle paths.

Daily activities: Noah is in Year 2 at Arosenius School.

Free time: In his free time, Noah plays football for Älvängen IK. He also likes swimming, but his parents have to drive him to Skepplanda for that.

Speculative scenario: The family and Noah appreciate the new swimming pool that has been built on the Älvsidan side, which means that Noah can get to swimming lessons by himself.



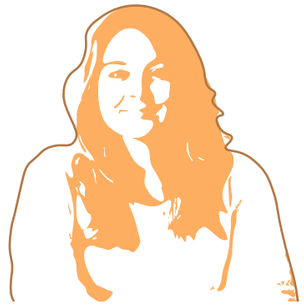
Alice, 17 year old

Home & Family: Lives just south of the town centre on a farm in Utby with her family. Takes her moped to the station every day to catch the commuter train to Gothenburg. Alice's best friend was involved in a traffic accident while riding her moped, which is why Alice finds all the big intersections on the way to the train station particularly unpleasant.

Daily activities: Attending the first year of high school in Gothenburg.

Free time: In her free time, Alice dances a lot at the cultural school in Ale, which means she has to take the train to Nödinge, where the lessons and premises are located.

Speculative scenario: Alice appreciates that Älvängen has built new dance facilities adjacent to the rope-making museum.



Malin, 35 year old

Home & Family: Malin lives in a small terraced house on Nytorpsvägen. She lives alone in her home.

Daily activities: Works at the library in the city centre.

Free time: She cycles a lot, preferably on gravel and country roads. She often cycles along the Göta Älv river, which is part of the 52 km cycle route around Ale.

Much of her social life is still in Gothenburg, where she studied. She often takes the commuter train, but sometimes she takes the car.

Speculative scenario: Malin loves that it has become easier and safer to get over to the Älvsidan side, and now enjoys training even more on this side.



Peter, 45 year old

Home & Family: Lives alone in a townhouse on Blåsippsvägen in southern Älvängen.

Daily activities: Commutes to Gothenburg daily. Four out of five times he takes the train, and sometimes he takes his bicycle with him on the train. Sometimes he works from home.

Free time: Peter's greatest interest is cooking and eating with his friends.

Speculative scenario: Peter is spending more and more time working from the office hotel that has been built on the riverside. He also appreciates the new river restaurant that has been built on the riverside.



Lars, 52 year old

Home & Family: Lars has lived his entire life in Älvängen and has been married with two children for many years. One of his children has moved away from home to study. The house is located on Rannebergsvägen.

Daily activities: Works at Mauser-Noreko, located on the Älvsidan side of the river. Drives a lorry. Always takes the car to work because it is easier and more comfortable than walking or cycling.

Free time: He has a small boat moored in Älvängen marina, which he likes to take out for fishing trips. He is a member of Ale Fishing Centre. He also helps young people repair their A-tractors at Älvis Garage, located in an old industrial building on the banks of the river.

Speculative scenario: Lars' workplace has been relocated to Krokstorp, and he now has a longer commute to work, but does not need to travel to Älvsidan.



Agneta, 69 year old

Home & Family: Worked for many years in the municipality of Ale, but retired at the age of 67. Recently moved into a rented flat in central Älvängen with her husband. Has had hip problems for a long time, so walking long distances and climbing stairs is not easy. Recently had hip replacement surgery, so Agneta is currently wheelchair-bound.

Daily activities: Long-time engagement with the rope-making museum.

Free time: She often visits the library and borrows books, which she reads when she is not knitting new hats for her grandchildren.

Speculative scenario: The rope-making museum remains on the riverside.

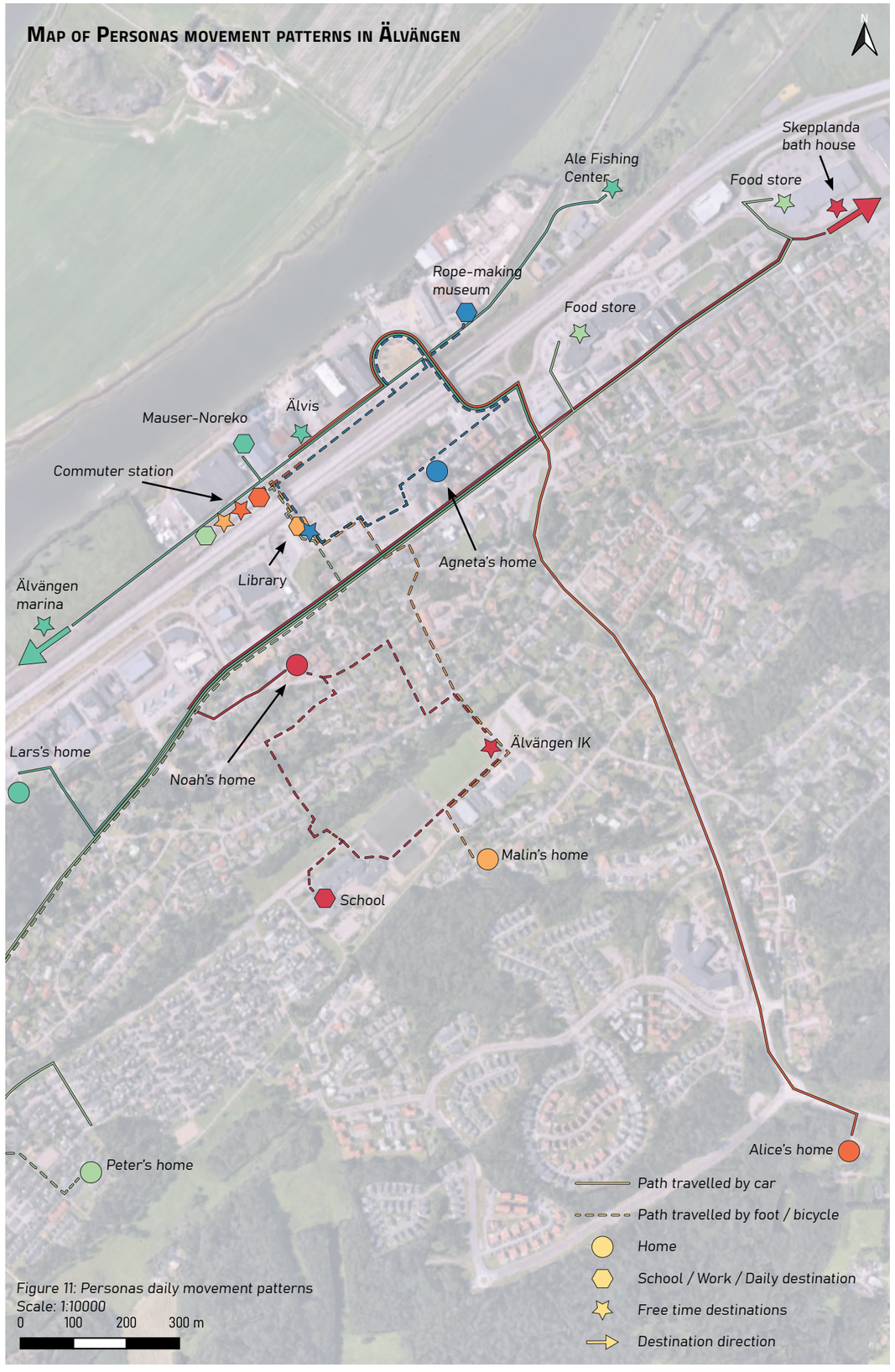


Figure 11: Personas daily movement patterns

2.4 Barrier evaluation

In order to gain a holistic understanding of how the location of the motorway and railway in Älvängen affects residents and the community, the barrier is evaluated based on the conceptual model developed by van Eldijk as part of his doctoral thesis. With the help of the model, we can break down the barrier into various factors that influence and determine how large or small an infrastructure barrier may be perceived to be, or whether it exists at all.

2.4.1 The determinants

Transport features

The physical barrier in Älvängen consists of a four-lane motorway and its exit and entrance lanes, together with the Norge-Vänerbanan railway line. The railway runs parallel to the motorway and contributes to the barrier's width varying between 60 and 70 metres along a 2 km stretch.

The stretch is characterised by a flat and straight surface with traffic barriers on both sides of the motorway. Along the southern side of the motorway, there are noise barriers that screen off the town centre and have a certain degree of transparency. In addition to their sound-absorbing properties, they also act as a barrier to prevent people and animals from entering the motorway. Between the old industrial buildings and the railway, along the northern side of the barrier, there is a simple steel fence that prevents unauthorised persons from entering the track area.

Traffic on the motorway is very dynamic and follows normal commuting times, with peaks at 6-7 a.m. in the direction of Gothenburg and 3-5 p.m. in the direction of Älvängen and further north (Trafikverket, 2025c).

Crossing facilities and routes

There are two bridges in Älvängen that enable passage over the motorway and railway. One bridge is primarily a car bridge that serves two purposes. It connects the town centre with the old historic industrial area via both a vehicle road and a pedestrian and cycle path, and it is also part of the motorway infrastructure. Together with the exit and entrance ramps for southbound traffic, the bridge forms the Norra Älvängen interchange.

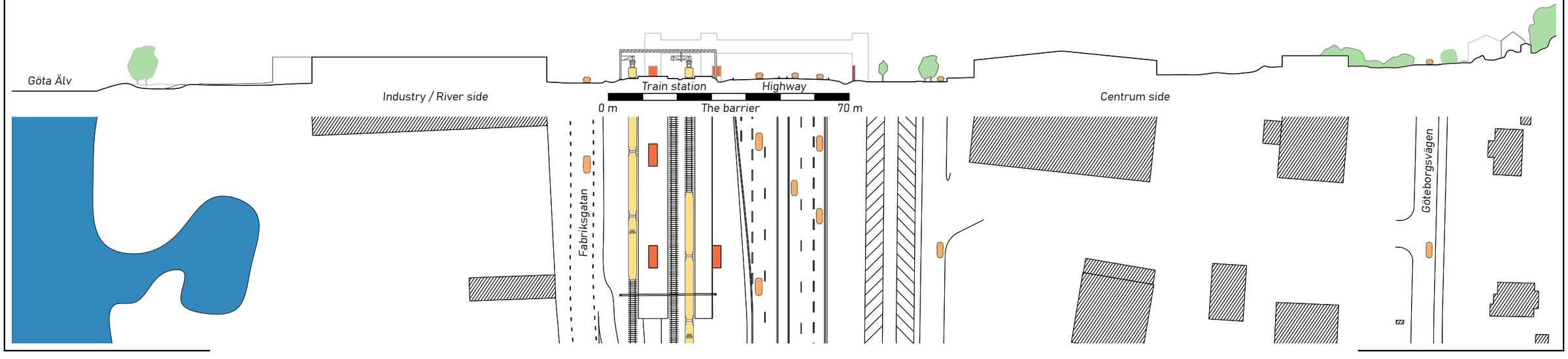


Figure 12: Car bridge with on- and off-ramps to the motorway, and the dangerous intersection between motorists and pedestrians. (Aerial photo: Google Earth)

Pedestrians and cyclists find the footpath and cycle path on the car bridge very unsafe and unattractive (Ale kommun et al., 2023). It is poorly marked and the frequency of car traffic is relatively high at the intersection in the middle of the bridge between motorists and pedestrians/cyclists. This is especially true in the morning when many people commute by car to Gothenburg. During a site visit, the pedestrian and cycle path was perceived as repulsive. It gave the impression that one should not be there.

The car bridge is a standard, simple concrete structure, the design of which has clearly been guided by traffic engineering considerations. All dimensions appear to be exactly as large or small as they need to be to meet the requirements for turning radius and gradients for motorists. The design for pedestrians and cyclists has been given secondary consideration.

The second bridge is a footbridge connecting Älvängen's travel centre with the train station. The design is a repeat of the four other stations built at the same time in Ale municipality, consisting of three stairwells and passageways between them. The stairwells and footbridges are glazed, and there is a lift. There is one stairwell at the travel centre and one on each platform. At the stairwell



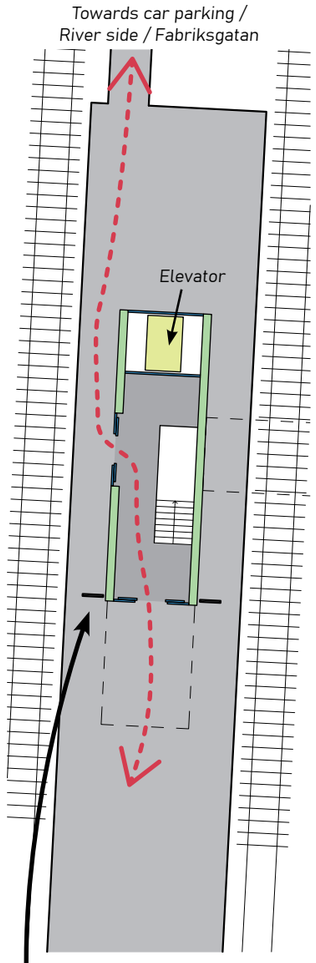


Figure 13: Illustration of proposed route to the riverside and Fabriksgatan

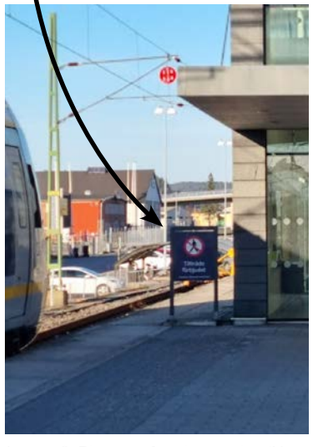


Image 2: Picture of a sign saying 'No entry'

on the far platform (where the commuter train stops), there is a compromise solution that allows connection to Fabriksgatan and the old industrial buildings through a side door at the rear of the stairwell.

During a site visit, it was noted that the underside of the footbridge is relatively open towards the motorway, which meant that noise and traffic noise created a relatively loud atmosphere by bouncing off the glazing. This was perceived as unpleasant. It was also noted that most people who were physically able chose to carry their bicycles up the three flights of stairs instead of taking the lift.

People's abilities

Based on the personas that were developed, it can be concluded that people with different circumstances live in Älvängen, but nothing stands out. Approximately 30% of the population is under 19 years of age, approximately 50% is between 20 and 64 years of age, and the remaining approximately 15% is over the retirement age of 65+ (Ale kommun, 2025a). The average age is 40.1 years, and just under 40% live alone (with or without children), while 55% live with another adult (with or without children) (SCB, 2025).

Given that Älvängen is a commuter town, where the car has been central, we can assume that many families have access to a car. According to a report from MRF, 85% of all households in Sweden have access to a car (Motorbranschens Riksförbund (MRF) et al., 2017). This percentage can therefore be assumed to be at least 85% in Älvängen.

It is worth mentioning that, according to a 2022 survey by Statistics Sweden (SCB), Ale Municipality ranks last among Sweden's 290 municipalities in terms of the proportion of employees who can cycle to work in 15 minutes. In Ale Municipality, only 10% have this opportunity (SCB, 2022).

No statistics have been found that indicate how many people live with some degree of mobility impairment in their everyday lives. We therefore assume that all types of mobility impairment must be taken into account.

Land use

Land use on both sides of the barrier is currently varied, with a clear functional separation. The north side of the barrier, between the motorway and the water, is home to the old industrial buildings structured along Fabriksgatan. The buildings date from the 1920s to the 1950s. Most of the buildings are still active workplaces today, while some stand empty awaiting new tenants or are in some stage of decay. Adult education and cultural activities in the form of the rope-making museum are also located here.

All activities along the Göta Älv river are, by their nature, activities that take place from morning to afternoon. In the evening and at night, the area is deserted and can feel unsafe.

On the south side of the barrier lies what is known as Älvängen. This is the old town centre, with shops and residential buildings. Southwest of the town centre, along the motorway, there are also some industrial buildings from the 1960s and 1970s.

In the middle of the barrier is Älvängen railway station, with three tracks and two platforms.

People's needs

The main reason why the general public wants to cross the infrastructure barrier is to reach the commuter station on the other side of the motorway, along Fabriksgatan. For this purpose, there is a footbridge with stairs and a lift. Many people in Älvängen, based on the commuter parking areas, also travel to the station by car. This makes it necessary to cross the barrier by car, as some of the commuter parking spaces are located on the river side.

There is also a need for employees, customers and gods to be able to get to and from the workplaces and businesses located here. This requires a reliable road connection.

The industries and businesses located here are not places that the general public needs to visit on a daily basis. Some businesses, such as NMH Packaging AB and Mauser-Noreko AB, both of which are subcontractors to the manufacturing industry, are never visited by the general public. Other businesses, such as Ale Stenlager AB (stone retailer) and Emanuelsson Bil AB (vehicle service and car sales), are businesses that the general public may need to access from time to time. Generally very rarely. All needs, such as schools, grocery stores and social contexts, are located on the same side as Älvängen centre and where the residents live.

There is a need and desire to be able to access the exercise and green areas located on the outskirts of the industrial area along the waterfront. During a site visit, a couple of young people were seen socialising at the old pier by the water. An elderly person in a wheelchair was seen sitting on the town centre side, under the car bridge, enjoying the sun and the small stream that ran by the site. The need to make the natural values of the Göta River accessible was clear.



Image 3: Photo of a person sitting and enjoying the spring sunshine and the stream flowing under the car bridge.

2.4.2 Barrier effects

By analysing the five different determinants together, an overall picture of the barrier that exists in Älvängen is created. The analysis is speculative.

Direct effects

One of the direct effects of the current barrier is the risk of accidents when crossing the barrier on the car bridge. The design exposes pedestrians and cyclists to the risk of being hit by cars when crossing the motorway access ramp. The speed limit on the road is 70 km/h and there are no warning signs for crossing pedestrains.

There is also a feeling of insecurity when using the compromise solution (Figure 13) to get from the commuter train to Fabriksgatan/ Pendelparkeringen on the river side. When there are large flows of people, the passage can become crowded and there is a risk of being pushed off the platform due to the small width along the building.

Cyclists who need to get to the commuter train and take their bikes with them, such as Peter, experience logistical difficulties as they have to take two lifts or carry their bikes up the stairs. The alternative is to 'cycle around' over the car bridge, but this is a considerable detour.

The majority of residents in Älvängen (40%) live in Södra Älvängen, the area furthest from both the car bridge and the footbridge at the station. For these residents, such as Lars and Peter, getting to the river side requires a certain trip effort. This situation does not make active modes of transport attractive.

Indirect effects

As people in Älvängen are already very accustomed to using cars, and it is currently more practical to travel to the riverside by car, most people whose destination is on the riverside travel there by car. The exception is people whose destination and activity consists of walking or cycling for exercise, such as Malin.

There is a certain risk that the cultural heritage site, the rope-making museum, has a reduced number of visitors given the alternative routes that lead here. The feeling of a significant risk of accidents may mean that parents do not allow their children to cross the motorway and railway on their own without adult supervision. Even teenagers' movements in the community, such as Alice, may be restricted by parental rules.

Wider effects

The feeling of fear and risk of accidents may make the riverside inaccessible to the younger population (children and teenagers) and the older generation. Today, there is a youth activity (Älvis garage) on the riverside whose purpose is to help young people with motor vehicles to tinker with their vehicles. This activity works in this location because the car bridge is there for the purpose of transporting vehicles. Youth activities that are not related to vehicles therefore risk having poorer conditions in this location.

The fact that the river side is perceived as not being integrated with Älvängen itself may mean that many residents, who normally have no reason to visit the river side, do not feel welcome here. This, together with the land use on the river side, the fact that there are no destinations here for spontaneous visits, apart from nature and possibly the museum, contributes to the river side's urban life being very limited.

Conclusion

Even though the industrial sites and the Göta Älv river are accessible by all modes of transport, including walking, cycling and driving, psychological feelings of fear and risk contribute to the riverside being perceived as inaccessible. The fact that there are only two ways to cross the barrier, together with their design and purpose, contributes significantly to the barrier-creating qualities.

As described above, there is no barrier effect if there is no need to cross a barrier. As the number of destinations on the riverside and its users are relatively few, the value of people's needs and land use is small, and thus the value of barrier effects is small. This means that the barrier effects are currently considered to be relatively small, but not non-existent. Primarily, it constitutes an obstacle to the continued development and transformation of the industrial sites.

The risk of accidents experienced when crossing the barrier creates a feeling of insecurity for all users, but has a greater impact on the younger and older populations. Noah's parents would never let Noah cycle here alone because of his age, and pensioner Agneta also feels uncomfortable given that she has poor eyesight and hearing and moves slowly, while cars drive fast. This indicates that a new solution for crossing the barrier, with a focus on safety and security, should be prioritised.

The location of the current bridges, in the centre and just north of it, combined with the fact that a large proportion of the population lives to the south, suggests that any new connection should be located to the south.



Figure 14: Collage of references.

REFERENCE PROJECTS

3

3.1 A STUDY OF WORLDWIDE REFERENCE PROJECTS

3.2 A STUDY OF PEDESTRIAN BRIDGES IN THE GOTHENBURG AREA

3.3 A STUDY OF RENOWNED BRIDGES

3.1 A STUDY OF WORLDWIDE REFERENCE PROJECTS

In order to understand the types of physical interventions in the urban environment that are being used today to address barrier effects and at the same time create a toolbox of different solutions, a number of different reference projects have been studied, to different extents. The projects are from different countries and cultural backgrounds and also of varying scale and scope.

In order to easily get an overview of the scale and focus of each project, each reference project has been assigned a type classification describing the type of solution applied. The solution refers to the original problem and not necessarily what the result has been on the ground. For example, a motorway may have been tunnelled and given the type classification "Tunnel", while a new park has been created on the land that was freed up.

The type classification has also been given a prefix describing the mode of transport for which the new solution is mainly adapted.

TYPE (OF CONSTRUCTION)

Tunnel - Structure that runs under another structure.

Bridge - Structure that goes over another structure.

Highway-Lid - Structure that encloses existing major transport infrastructure (often motorway or railway) with a roof and walls. A "lid" is placed on top.

Boulevard - Road type often characterised by long straight rows of trees. Generally, many different types of traffic share the same road, but with their own defined spaces.

Greenway - A green space that extends lengthwise, usually intended to transport people on foot and by bicycle in an urban environment. Usually favours biodiversity in urban environments.

Park - A large green area for recreation and health. Is often an end point for the visitor, as opposed to a greenway which is usually just a thoroughfare encouraging further movement.

Socioduct - Bridge-like structure whose purpose is to hold together the social values of a local context. Compare with ecoducts (wildlife passages) whose purpose is to keep the ecological contexts together or viaducts that are for cars and railways.

Mega project - Projects where it is difficult to specify a main type of construction, but instead a combination of different solutions has been applied.

PRE-FIX (MODE OF TRANSPORT)

Bicycle - Solution where the design is mainly adapted to improve the environment for cyclists.

Pedestrian - Solution where the design is mainly adapted to improve the environment for pedestrians.

Bike and pedestrian - Solution where the design is mainly adapted to improve the environment for both cyclists and pedestrians.

Car traffic - Solution where the design is mainly adapted to improve the environment for motorists. This may involve new routes, faster or slower speeds on roads, or redesign of roads and junctions.

Multi-traffic - In many cases, solutions are designed to change the environment for many different types of road users. In these cases, the prefix multitraffic is given to indicate this.

Projects have also been categorised according to approaches based on the conditions that existed on site. For example, whether a completely new structure has been built, or rebuilt. Sometimes a combination of the two.

(PROJECT) APPROACH

New construction - Projects where one or more completely new solutions are built. Can be above or below ground. For example, a completely new bridge or tunnel is built. There must not have been a similar solution before in the same place.

Reconstruction - Project where the purpose is not changed, only the solution. For example, if a motorway is converted into a boulevard. The new solution must be in the same location as the old solution.

Transformation - When you change the purpose of the built infrastructure to something new. For example, changing a land area from street to park.

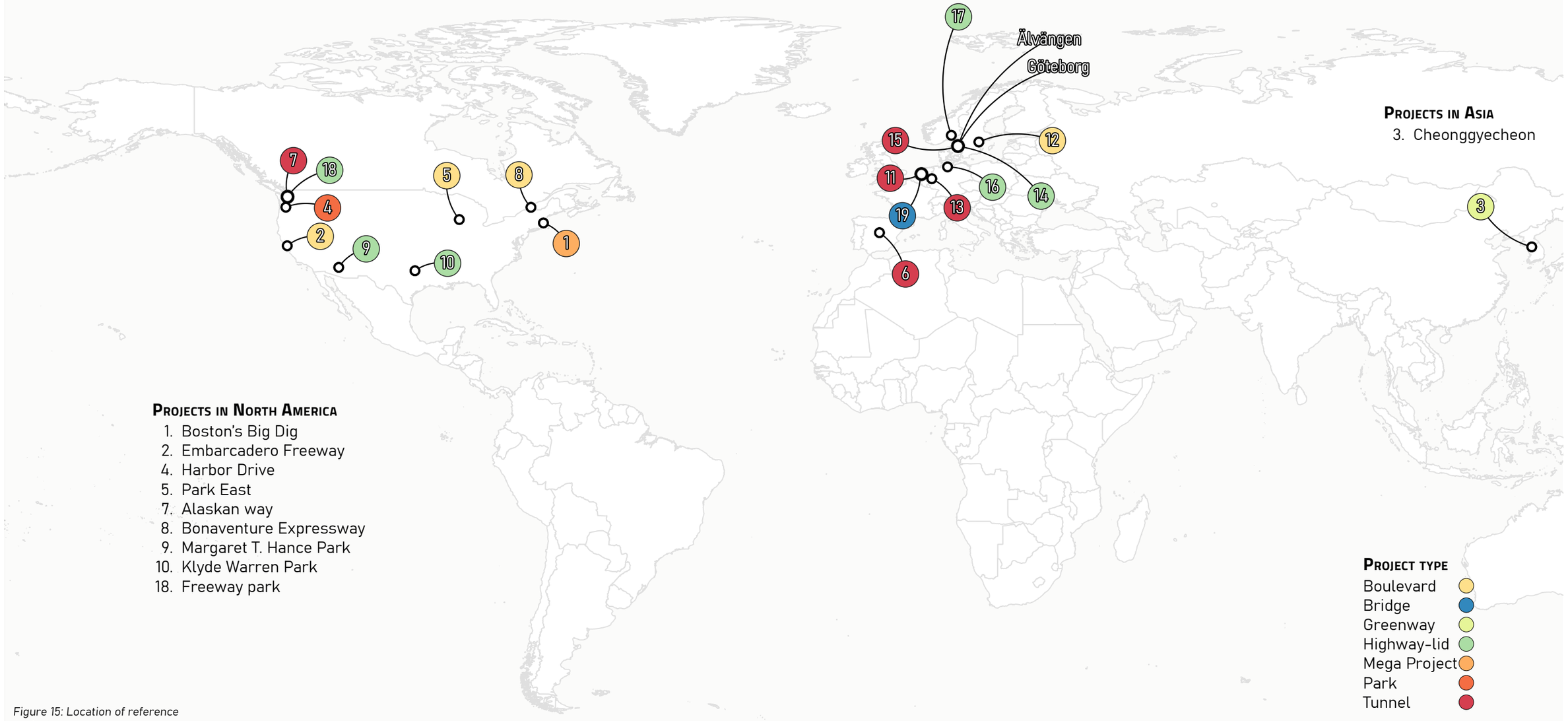
Removal - Projects where the solution has required removing existing built infrastructure to make way for something new.

Both the type classification and the approach should be seen as a rough generalisation. Many of the reference projects are based on several different solutions and approaches. Often these overlap, making it difficult to give an explicit classification.

For each project, a number of pluses and minuses have also been noted. These are partly anchored in facts and analyses, but can also be the author's own conclusions from having studied the projects.

3.1.1 The worldwide reference projects

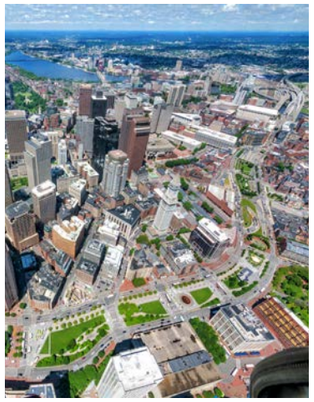
The projects are presented in no particular order. 10 projects are from North America, 1 from Asia and the remaining 11 from Europe. Mainly northern Europe.



Projects in Europe

6. Rio Madrid
11. Cuyperspassage
12. Östra promenaden
13. Rheinufer Promenade
14. E45 Gullbergstunneln
15. E45 Götatunneln
16. A7 highway
17. Skøyen
19. Luchtsingel bridge

Figure 15: Location of reference projects



By Greenway Conservancy - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=79674491

1. Bostons's Big Dig, 1991-2007

Type: *Car traffic mega project*
Approach: *Removal / New Construction*
Geolocation: *42°21'58"N 71°03'37"W*

The Cental Artery motorway in Boston had reached its maximum capacity and the accident rate was 4 times the national rate in the United States, with traffic jams 10 hours a day. It was therefore decided to rebuild large parts of the motorway system by constructing new tunnels, interchanges and bridges, thus creating better traffic flows through the city. Removing the motorway from street level created the opportunity to create better connections between nearby neighbourhoods and a greenway where the motorway used to run. A total of 45 new park and square areas were built.

+ Improved car traffic flows
+ Reduced carbon monoxide levels
+ Created new greenways and parks
+ Strengthening the connections

– Long construction time
– Resource intensive
– Expensive

Source: ("Big Dig," 2025), (CNU, n.d)



By Miia Ranta from Finland - San FranciscoUploaded by Fæ, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=24971724

2. Embarcadero Freeway, San Francisco, 1991

Type: *Multi traffic boulevard*
Approach: *Removal / Reconstruction*
Geolocation: *37°47'39.0"N 122°23'34.7"W*

Along the waterfront in San Francisco ran an elevated double-decker motorway, which over 100,000 vehicles passed through daily. There had been discussions since the 1980s about removing the motorway, but it was only after a major earthquake in 1989 destroyed parts of the motorway that the decision was taken. Public opinion changed when it was realised that the existing network could swallow the diverted volumes after the earthquake and that public transport was an effective alternative. The replacement was a new boulevard that increased access to the waterfront and further enhanced public transport.

+ 15% increase in public transport use
+ Cheaper than any alternative solution
+ Increased land value

– Requires other infrastructure to exist that can swallow the volumes of traffic

Source: (Walker, 2016), (CNU, n.d-b)

3. Cheonggyecheon, Seoul, 2003-2005

Type: *Multi traffic greenway*
Approach: *Removal*
Geolocation: *37°34'07"N 126°58'58"E*

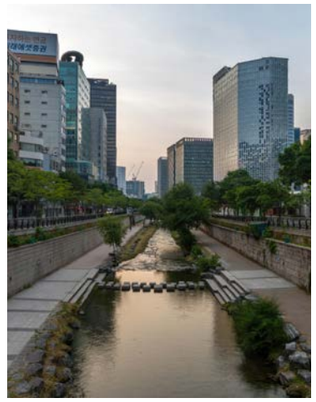
In 2003, a major transformation project began with the removal of the Cheonggye Expressway, an elevated motorway that ran through the middle of South Korea's capital. The area was transformed into a greenway. A natural stream used to run under the expressway, but it disappeared in the fifties, and no traces could be seen when the expressway was built in 1976. The greenery and biodiversity of the site were not considered when the motorway was built, which would ensure that the slum area the motorway would pass through would have the opportunity to develop economically for the future.

When the motorway was demolished, the natural stream that used to flow through the site was recreated. The new popular greenway has helped to reduce city temperatures, become a place for people to socialise and has contributed to an increase in biodiversity. More residents are also taking the bus or other alternative modes of transport.

+ Temperature reduction
+ Fish and wildlife return to the city
+ Reduction of car use to get into the city

– Construction cost, ~281 million dollars
– Maintenance cost, ~5 million dollars per year (2016)
– Speeds up traffic around the city

Source: (Walker, 2016), ("Cheonggyecheon," 2025)



By Basile Morin - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=150950392

4. Harbor Drive, Portland, 1974

Type: *Bike and pedestrian park*
Approach: *Transformation*
Geolocation: *45°31'15.8"N 122°40'12.7"W*

Along the waterfront in Portland, the Route 99 motorway limited the city's connection to the water. New alternative highways built created better alternatives for motorists, and Route 99 became unused. In 1968, the Governor of Oregon proposed transforming the highway into open park to create a local connection to the waterfront, which began in 1974. In 1978, 148,000 square metres of parkland opened, which was renamed Tom McCall Waterfront Park in 1984 as a tribute to Governor Tom McCall's contribution to the beautification of the waterfront.

+ Huge park area
+ Connection to the water
+ Catalyst for similar projects

– Required other infrastructure to be built or existing to be feasible.

Source: (Walker, 2016), ("Harbor Drive," 2025)



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By Paul Hohmann - Milwaukee Freeway Demolition 2002, CC BY-NC 2.0, https://www.flickr.com/photos/vanishingstl/4737732696

5. Park East, Milwaukee, 2002

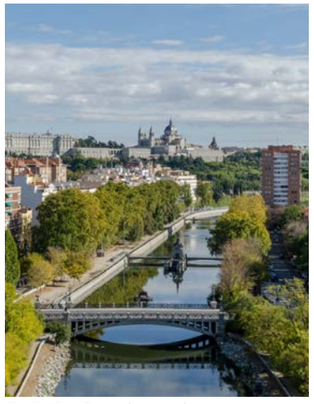
Type: *Car traffic boulevard*
Approach: *Removal / Reconstruction*
Geolocation: *43°02'49.2"N 87°54'57.0"W*

In the 1960s, plans were made to encircle downtown Milwaukee with a motorway. Large areas were cleared, and construction of an elevated motorway began. By the 1970s, the project had stalled, only one mile of the motorway had been built and the ring road was not complete. The motorway was poorly used and the surrounding area was negatively affected. The area underneath the elevated motorway could only be used for surface parking and was therefore a barrier to future development projects.

In 1999, it was decided to remove the motorway to make more space for the city, and in 2002 it was demolished. A new 6-lane boulevard replaced it, linking existing roads together.

+ Free up 24 acres of land
+ Fully connect the street network
– 6 lanes for car traffic
– No bike lanes

Source: (Walker, 2016), (City of Milwaukee, n.d)



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6. Rio Madrid transformation, Madrid, 2003-2011

Type: *Car traffic tunnel*
Approach: *Removal / New construction*
Geolocation: *37°47'39.0"N 122°23'34.7"W*

Along the Manzanares River in the centre of Madrid, the M-30 ring road, Spain's busiest road, stretched on both sides. These roads made the river largely inaccessible, created a barrier to movement in the area and contributed to a lot of pollution in the river. The motorway was in need of renovation, so it was decided to tunnel parts of the road, in a project called 'Calle 30'. When the tunnelling was completed in 2007, new parks and green spaces were created in the areas where the motorway ran. The new park area, Rio Madrid, was inaugurated in 2011 and studies show that people living in the neighbourhood have become healthier and live healthier lives.

+ Healthier residents
+ Green corridor boosting the city's biodiversity
+ Recreational areas
– Expensive
– Time-consuming construction

Source: (Walker, 2016), (Ayuntamiento de Madrid, n.d), (ITA-AITES, n.d)

7. Alaskan Way, Seattle, 2009-TBD

Type: *Car traffic tunnel*
Approach: *Removal / New Construction*
Geolocation: *47°36'06"N 122°20'10"W*

Alaskan Way was an elevated double-decker motorway that ran along the waterfront in downtown Seattle. Built in the 1950s to the construction standards of the time, the motorway was damaged in an earthquake in 2001, but remained functional. However, it was considered that a new solution was needed to meet today's standards, as a total collapse was seen as a likely outcome of another earthquake. The motorway was also considered a barrier to the waterfront, so the new design called for a new tunnel. This has given way to the Waterfront Seattle Project, a new boulevard street with a focus on increased accessibility for pedestrians.

+ Improved pedestrian movement.
+ Added cycle lanes.
+ Waterfront access.
– Expensive
– Long construction process

Source: (Walker, 2016), ("Alaskan Way Viaduct," 2025), (Waterfront Seattle, n.d)



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8. Bonaventure Expressway removal, Montreal, 2016-2017

Type: *Multi traffic boulevard*
Approach: *Transformation / Reconstruction*
Geolocation: *45°29'50"N 73°33'34"W*

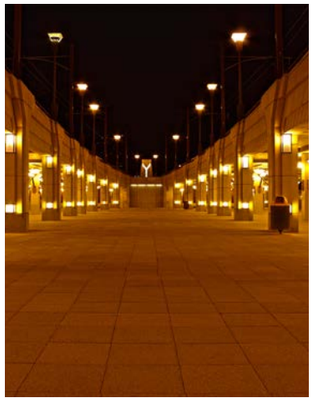
Motorway in downtown Montreal, built to facilitate access to the 1967 World Fair. Parts of the elevated 11-lane motorway that stretched like a barrier along the northern part of Griffintown and was also severely underused after the World Fair. It was proposed in 2002 to be converted into a 6 to 9-lane boulevard-like structure at grade. The transformation removed what was described as a no man's land underneath the elevated motorway, as well as enabling the linking of the street network. The success and results of removing the first 800 metres of the Bonaventure Expressway have contributed to the continuation of the transformation of the motorway along the waterfront into a boulevard and waterfront promenade starting in 2025.

+ Reduced Urban Heat
+ Storm water control
+ Green space created
+ Reduced space allocated for traffic
+ Sustainable reconstruction model
+ CatalysatorPlatskrävande
– Space consuming
– Expensive
– Reconstruction of nearby roads needed

Source: (CNU, n.d-c), (Lapierre, 2023)



By Mtlfiredude - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=62290482



By Alan Stark from Goodyear, AZ, United States - Central Avenue Bridge at Night, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=112995494

9. Margaret T. Hance Park, Phoenix, 1990

Type: *Multi traffic highway-lid*
Approach: *New construction*
Geolocation: *33°27'41"N 112°04'34"W*

As a result of decades of focusing on traffic planning, the I-10 motorway cut right through downtown Phoenix. It was decided to cover the motorway to create more space for the city at street level, specifically park space. The park and its surrounding area are home to many cultural and social activities, such as the Japanese Friendship Garden and the Burton Barr Phoenix Central Library. Whether the park area has been a success from the start is unknown, but in 2014 the city proposed a new plan to revitalise the park for $118 million over a ten-year period.

+ Creating usable land
+ Cultural meeting place
– Unclear success from the start

Source: (Walker, 2013), (City of Phoenix, n.d)



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10. Klyde Warren Park, Dallas, 2012

Type: *Multi traffic highway-lid*
Approach: *New construction*
Geolocation: *32°47'21"N 96°48'05"W*

Klyde Warren Park is a public park, but run by a foundation. The highway was covered over and the park was built as a way to link Dallas' uptown neighbourhood with the city's arts and downtown buisniss centre. Funding was provided by a partnership of private and public sector organisations. Nearly USD 50 million was raised, and the park is named after the son of billionaire Kelcy Warren, who donated 10 million USD.

The park is visited annually by 1.3 million people.

+ Open green spaces in the city centre
+ Improved environment for pedestrians
+ Community
+ Catalysing increased interest in similar features in the state environment.
– 11 years from idea to finish
– Expensive operating budget, 3 million USD
– Expensive construction

Source: (Klyde Warren Park, n.d), ("Klyde Warren Park," 2025)

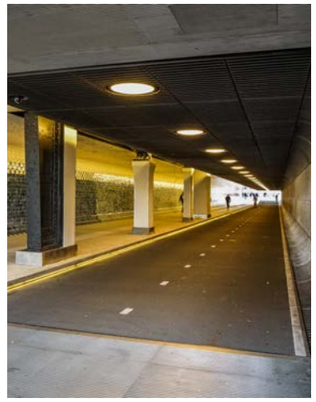
11. Cuyperspassage, Amsterdam, 2010-2016

Type: *Bike and pedestrian tunnel*
Approach: *New construction*
Geolocation: *52°22'46"N 4°53'54"E*

Along the central river IJ in Amsterdam lies the old central station from 1889. Since 1997, the station and its surroundings have been undergoing extensive renovation to develop it into a central public transport mega-node. In 2008, the decision was taken to also investigate the possibility of creating a direct link for pedestrians and cyclists through this major physical barrier. The result is a 110x10x3 metre pedestrian and cycle tunnel straight through, under Amsterdam Central Station. The tunnel has a clear design, with cyclists confined to one half and pedestrians to the other. The tunnel's straight, ground-level location has created a clear and direct link between the old centre and the ferries across to Amsterdam North, requiring no detours or inconvenience.

+ Passage for 15000 cyclists daily
+ Streamlined and shortened the journey
– Expensive
– Requires constant movement of people to not feel unsafe

Source: (Castro, 2016), (PublicSpace, 2019), (Benthem Crouwel Architects, n.d)



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12. Östra promenaden, Norrköping, 2021-2023

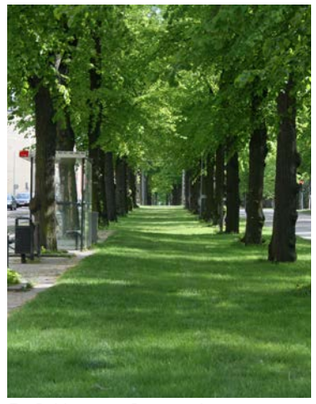
Type: *Multi traffic boulevard*
Approach: *Reconstruction*
Geolocation: *58°35'09"N 16°12'01"E*

Around Norrköping, 3 promenades were created more than 100 years ago to provide fresh air and exercise for city residents. By 2021, car traffic had taken over more and more of the promenades, which had a negative impact on the lime trees and the historic park environment. The physical links had also been weakened by the increased volume of traffic. The city therefore decided to rebuild the Eastern Promenade, re-route underground utilities that prevented the lime trees from developing roots and reclaim the historic environment. At the same time, the roads have been future-proofed to meet the transport demands of the future.

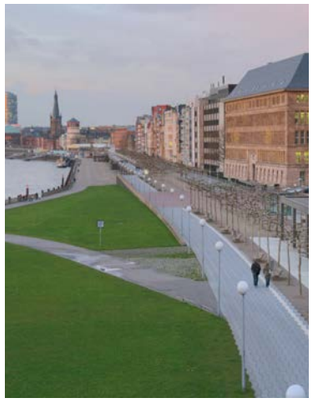
By prioritising walking, cycling and public transport, it has been possible to recreate the recreational areas and park environment for which the walks were intended. An old pedestrian tunnel that felt unsafe has also been removed.

+ Prioritising walking and cycling
+ Removing old pedestrian tunnels
– Cutting down old trees

Source: (Norrköpings kommun, n.d-a), (Norrköpings kommun, n.d-b)



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13. Rheinufer Promenade, Düsseldorf, 1995

Type: *Multi traffic tunnel*
Approach: *New construction / Reconstruction*
Geolocation: *51°13'13"N 6°45'59"E*

What used to be Düsseldorf's frontage on the Rhine had turned into a dirty backside, dominated by an industrial estate and a state motorway carrying 50 000 vehicles a day. The industrial estate had also begun to lose both tenants and profitability, prompting the city to consider how to transform this historic environment. The solution was to rebuild the riverbank in the 1990s, burying the road in a tunnel and restoring the area as a walkway with flexible waterfront spaces. The area has become a popular tourist destination, and is often featured on social media as a prime example of how cities can transform their infrastructure from prioritising car traffic to walking and cycling.

+ Areas for public events
+ Green areas
+ Flood protection
+ Tourism
– Potentially high maintenance costs
– Tourism pushes out locals
– Made it easier to use the car within the city
– Deserted areas when there are no events

Source: (PublicSpace, 2018)



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14. E45 Gullbergstunneln, Göteborg, 2021

Type: *Car traffic Highway-lid*
Approach: *New construction*
Geolocation: *57°42'46"N 11°58'22"E*

Being one of the most central areas of Gothenburg, between Göta Älv and the central station, the Gullbergsvass district is planned to be developed in the coming years. To make these areas accessible, it was decided that 800 metres of the Götaleden/E45 in front of the central station would be lowered by about 6 metres, at the same time as 400 metres were covered in what became the Gullbergstunneln. The highway-lid is designed for neighbourhoods to be built on top of it, but 4 years after completion, the overpass remains unbuilt. As the tunnel openings lead to concentrations of exhaust gases, the area does not meet the EU limit value for nitrogen dioxide. This means that a new solution is needed to enable the development of housing and schools, for which the area was planned.

+ New space for 3,500 workplaces and 400 homes
+ Plans for green avenues
+ Connecting neighbourhoods
– Planned construction not authorised
– Expensive, SEK 1.6 billion (2024 money value)
– The tunnel limits the design of the buildings

Source: (Göteborgs Stad, n.d-a), (Göteborgs Stad, n.d-b), (Kruse, 2022), (Kruse, 2024)

15. E45 Götatunneln, Göteborg, 2000-2006

Type: *Car traffic tunnel*
Approach: *New construction*
Geolocation: *57°42'23"N 11°57'45"E*

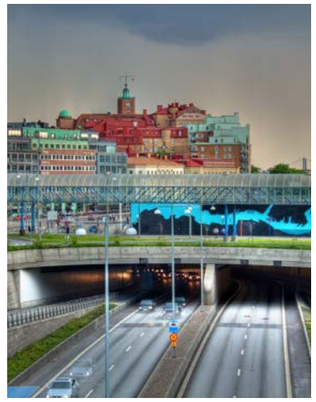
The E45 motorway ran at ground level alongside the Göta Älv river in the center of Gothenburg and formed a major barrier to the water with around 65,000 cars per day. Already in the 1980s there were political discussions about building a tunnel and after agreements in 1991 the city together with the state started building the Götatunnel in 2000.

Development of the area that was freed up was to be managed by Södra Älvstranden Utveckling, which later became Älvstranden Utveckling AB. A municipal company that is currently being discontinued. Today, almost 20 years after the tunnel was completed, hardly anything has happened to the land that was freed up.

In the autumn of 2024, the tunnel's western exits and entrances were closed off for construction in the form of highway-lids. This will enable the construction of Järnvågsparken, a new neighbourhood park.

+ Reducing traffic in the urban environment
+ Potential for new development
– Nothing has happened
– Reconstruction due to Västlänken
– Reconstruction due to Järnvågsparken
– Exhaust problems

Source: ("Götatunneln," 2025), (Trafikverket, 2025)



By Tatiana Afendik - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=24025140

16. A7 highway, Hamburg, 2014-TBD

Type: *Multi traffic highway-lid*
Approach: *New construction*
Geolocation: *53°35'59.9"N 9°55'21.8"E*

Hamburg's busiest motorway, the A7, which carries around 150 000 motorists every day, needed to be widened to cope with planned future increases in traffic flows. At the same time, the city needed to solve the problem of noise and air pollution. Starting in 2014, Hamburg began covering 3 separate sections of the A7. In 2021, section 1 in the Schnelsen district was completed, covering 560 metres, and in 2022, section 2 in Stellingen was completed, covering 893 metres. 2029, the final section in the Altona district is planned to be completed, covering an impressive 2300 metres. At the same time as the motorway is being covered, the road surface is being widened to 8 lanes, and substantial noise barriers are being built to protect the surrounding neighbourhoods.

The highway-lids have and will create new park areas and residential space. They are also connecting neighbourhoods that have been very separated for years. In the current phase in the south, the roof will be filled with allotments with urban cultivation. A settlement structure that does not weigh much and therefore fits well.

+ Noise protection
+ Fewer accidents
+ Good traffic flow
– Optimised for traffic flow
– Expensive!

Source: (City of Hamburg, n.d), (Petrov, 2014)



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By Peter Fiskerstrand – Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=16108769

17. Skøyen, Oslo, 2003

Type: *Bike & pedestrain highway-lid*
Approach: *New construction*
Geolocation: *59°55'12"N 10°40'46"E*

Skøyen is an old industrial area in Oslo, but has been redeveloped since the 1980s as a mainly residential and office area. The Norwegian Fair's exhibition centre used to be located here, but was moved to Lillestrøm in 2002. The area has both a train and metro station, and around 21,000 (2016) people work in the station area.

After the exhibition centre was relocated, the land was identified as attractive to build new housing with a premium standard given the location, central and close to the water. However, the waterfront is on the other side of the E18 motorway, which is currently used by about 75,000 vehicles every day. It was therefore considered necessary to hide the motorway in order to build premium housing. The housing project therefore paid for the overpass, at a cost of NOK 75 million. The total construction cost of the housing project was NOK 920 million. The highway-lid is called Sjølystlokket and is 170 metres long and 30 metres wide. Under the overpass and the motorway, the Hoffselva river flows in pipes.

+ The design only allows for green space
+ Green space
– Complicated renovation of Hoffselva in 2023
– Solution optimised for a small local area.
– Solution for the wealthy

Source: ("Skøyen," 2024), (Statens Vegvesen, n.d), (Aas-Jakobsen, n.d), (Wärnhjelm, 2010)



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18. Freeway park, Seattle, 1976

Type: *Multi traffic highway-lid*
Approach: *New construction*
Geolocation: *53°35'59.9"N 9°55'21.8"E*

Running parallel to Alaskan Way, Interstate 5 passes right through downtown Seattle. As one of the earliest examples of how to overcome barriers caused by large-scale infrastructure, the motorway was covered in 1976. The highway-lid made it possible to connect the street network, it enabled the construction of the Seattle Convention Centre and the Freeway Park urban park. Freeway Park is a brutalist-style, architecturally designed park where running water drowns out the noise of the freeway, creating a green oasis in the middle of skyscrapers.

The park's construction was largely funded by "Forward Thrust" bonds, a Seattle municipal bond programme in which city residents lent money at interest. The region, the state and the federal government also contributed to the financing.

+ Connected streetnetwork
+ Green spaces
+ Meeting spaces
+ Developable land
– Expensive
– Maintenance costs

Source: (Walker, 2013), (Seattle, n.d)

19. Luchtsingel bridge, Rotterdam, 2015

Type: *Pedestrian bridge*
Approach: *New construction*
Geolocation: *51°55'32"N 4°28'45"E*

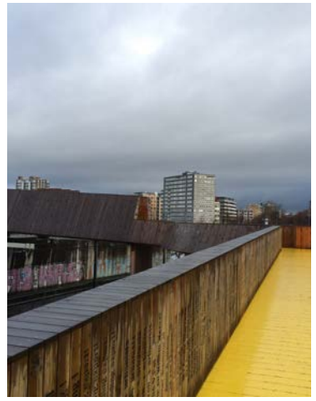
Luchtsingel bridge is a crowd funded pedestrian bridge in the centre of Rotterdam that connects 3 different neighbourhoods in a three-dimensional way. According to its creators, it is the world's first crowd funded infrastructure with a length of 400 metres. The structure is based on the idea of being permanently temporary and adaptable to the evolutionary development of the city over time.

The structure is also very simple, with what appears to be a timber frame of larger size, which has then been covered with wooden planks. Each plank also has a name or text engraved on it as part of the crowd funding. The £25 donation gave the possibility of optional engraving. However, the fact that the structure is all wood seems to have contributed to the fact that large sections had to be closed and dismantled in early 2025 after the municipality discovered major rot damage that affected safety. Part of the bridge also burned down recently. However, this has been replaced.

The bridge, which connects Delftsehof, a popular nightlife area, Pompenburg Park for children and young people, and the green area of the former Hofplein Station, is likely to be rebuilt in some way. The popularity and appreciation from both the community and the municipality has left its mark. Given the evolution of the original structure, 4 years from idea to completion, it will probably not be long before a new solution is in place. Hopefully this time with solutions adapted for the mobility impaired.

+ Crowd funding
+ Simple construction
+ Clear architectural qualities
+ Connects separated neighbourhoods
– Not wheelchair accessible
– Graffiti friendly
– Poor durability
– Vulnerable to fire

Source: (ArchDaily, n.d), (Frearson, 2015), ("Toch weer verbonden Luchtsingel over het spoor in Rotterdam," 2025), (Yasamin, 2025)



By Kars Alfrink from Utrecht, Netherlands - Original version, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=63655312

3.1.2 Takes from reference projects

In many major cities around the world, infrastructure barriers have arisen as cities have grown and streets have kept pace. What began as a small network with a central street has grown into a medium-sized network with a clear thoroughfare. Ultimately, it has resulted in a large network with a motorway running straight through residential areas. This situation is most evident in countries and cities around the world that developed rapidly for the car in the middle of the last century, such as North America and Europe. This is why most reference projects have been found in these regions.

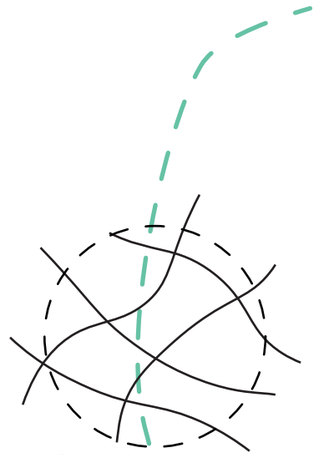
It is only many years after the expansion into a large network that it is understood that many urban values and the residents around these major infrastructure roads are negatively affected. Segregated areas with social structures, areas with health risks such as noise and air quality, have been formed. Street networks that prevent easy active travel routes and thus counteract a shift to more sustainable travel. Barriers that hinder urban development based on today's goals and guidelines. The results of the reference projects show that, in most cases, very large interventions and measures have been necessary. Solutions that have been possible when the economy, resources and desire have been available, as they do in big cities, or when no other alternative is possible.

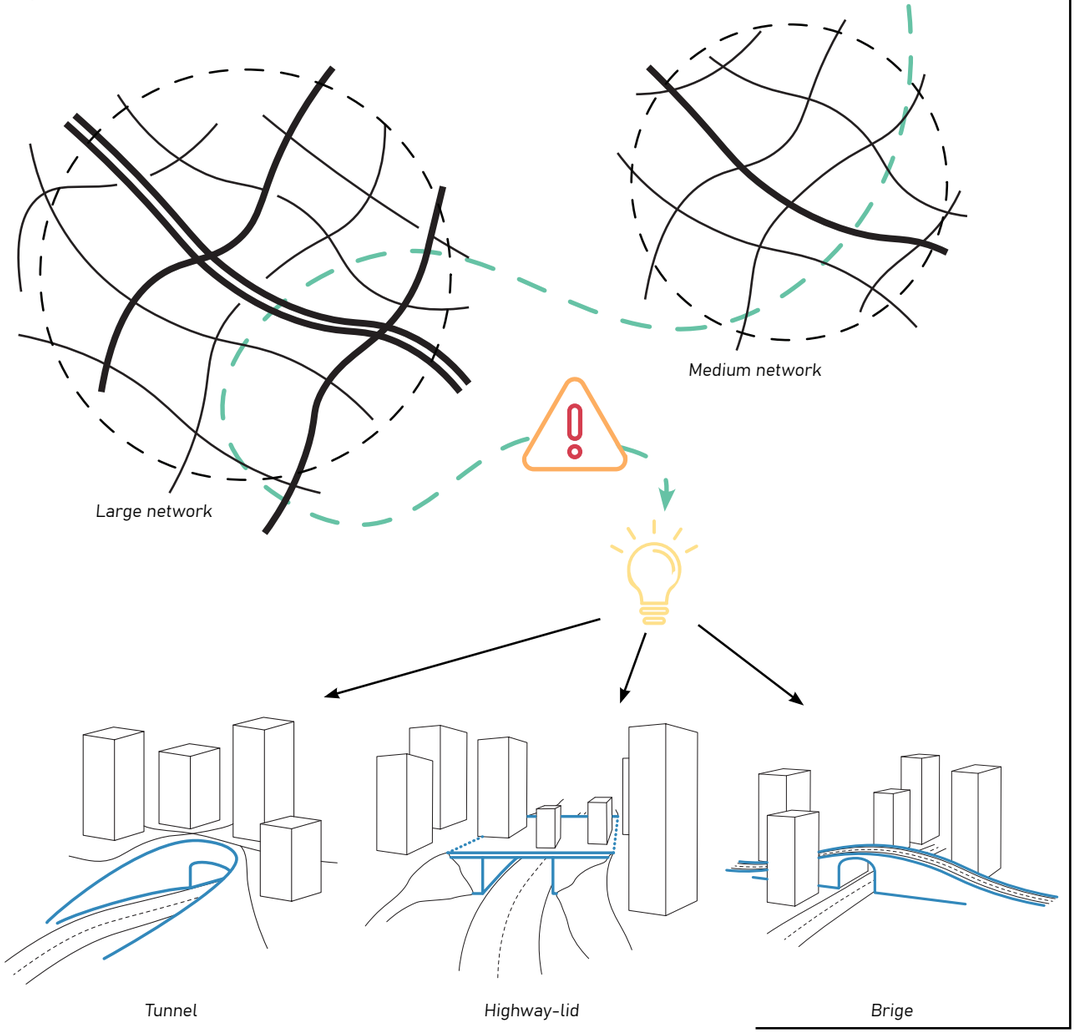
The approach chosen to deal with the barrier effects in many cities around the world is often to apply one of three different solutions. Digging larger roads (motorways) into tunnels, building large bridges over roads or highway lids. These are three solutions that have two things in common. They are incredibly expensive and take a long time to implement, from planning to opening. If you look at smaller solutions, they are often small pedestrian and cycle tunnels, or bridges for pedestrians and cyclists. Pedestrian and cycle tunnels, such as the Cuyperspassage in Amsterdam, only work well if there is a large flow of people around the clock. This reduces feelings of insecurity and the risk of crime. In Älvängen, with a total population of 6,500, this flow will not be achieved. Pedestrian tunnels are also something that is avoided in new construction in Sweden today due to associations with insecurity (Gång- och cykeltunnlar, 2025) and crime (Ceccato & Ioannidis, 2024). Where possible, they are being removed, as has been done along Gunnestorpsvägen in Tuve, or at the Rambergsvallen bus stop in Gothenburg.

For this reason, pedestrian tunnels are not an option for Älvängen, leaving pedestrian and cycle bridges as the option that would currently be most suitable for Älvängen.

Features and functions worth mentioning from the reference projects include the possibility of masking traffic noise with running water, as has been done at Freeway Park. This is a simple solution that is relatively non-technical. The new spaces created with the help of tunnels or freeway lids have been used in many cities for new green park areas. This seems to be an aspect that is given the highest priority and is needed in the city in order to reconnect it and turn the tide towards a green transition.

When constructing highway lids, the freed-up space is almost exclusively covered by parkland, areas where people do not stay permanently or for long periods of time. If the land is to be used for housing or other areas where people stay more permanently, greater demands are placed on the structures in terms of accident risks, particularly in connection with the transport of dangerous goods, which is often permitted on major roads such as motorways. These requirements complicate the project and make it more expensive.





3.2 A study of pedestrian bridges in the Gothenburg area

To gain an understanding of how pedestrian and bicycle bridges have been built in Sweden in the past, Gothenburg was chosen as a case study, as it also has close connections to Älvängen. Gothenburg has a few larger, more well-known bridges, such as Älvsborgsbron, Götaälvbron – now replaced by Hisingsbron – and Angeredsbron. The city also has a mix of new and older pedestrian and bicycle bridges of various sizes over the old canals and in residential areas along the Göta Älv river, such as Osthyveln (Stora Bommens Bridge, no. 57) and Bazarbron (no. 60). What smaller bridges does Gothenburg have that bridge transport infrastructure and create small-scale connections? Do they exist, but maintain anonymous, or do they not exist at all?

To map the smaller pedestrian and bicycle bridges in Gothenburg, a combination of information from Open Street Map (OSM) and a visual inspection of satellite maps from Google was used, together with the author's local knowledge. See Appendix +A.2 for queries used in Overpass Turbo to identify pedestrian and bicycle bridges in the Gothenburg region.

The focus has been on pedestrian and bicycle bridges that cross transport infrastructure in the form of motorways, railways, and major roads. Waterways can also be classified as transport infrastructure, but bridges that cross these are not included in the analysis or statistics. The reason for this is that the project aims to compare similar conditions in Älvängen and Gothenburg.

Note: The type of bridge construction is estimated based on visible characteristics observed during site visits and photographs.

In Gothenburg, a total of 51 pedestrian and bicycle bridges were identified, and an additional 19 that crossed water. Of the 51 bridges, these are exclusively concrete or steel structures, designed as slab bridges, beam and slab bridges, truss bridges, or Vierendeel bridges. There are also a few pure concrete beam bridges, a steel structure on I-beams, and a steel box girder bridge.

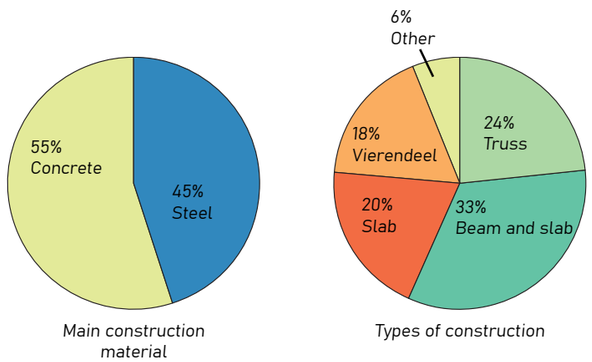
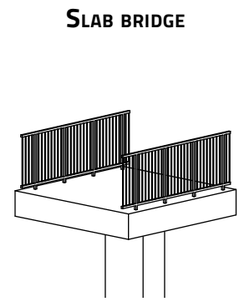
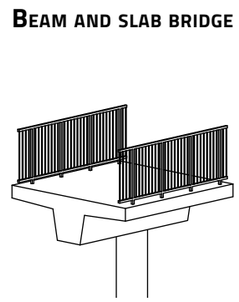


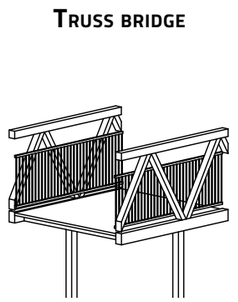
Figure 16: Statistics from bridges in Gothenburg



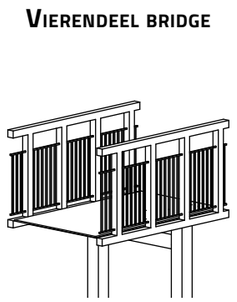
Slab bridge



Beam and slab bridge



Truss bridge



Vierendeel bridge



2. GC-bro Inlandsgatan



4. G-bro Gårda



24. GC-bro Hjällbo



7. GC-bro Högsbohöjd



3. G-bro Gamlestaden



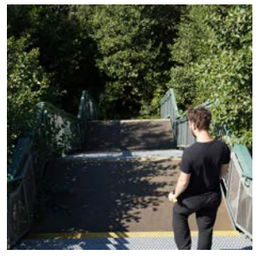
5. G-bro Brämaregården



9. GC-bro Frölunda



29. GC-bro Länsmansgården 2



21. G-bro Göta Älv



19. GC-bro Askim 2



34. G-bro Amerikaskjulet



44. GC-bro Angered 2

3.2.1 The footbridges in Gothenburg

Bridges 12, 13, 17, 56, 65 and 66 are located within the city of Mölndal and the municipality of Partille, respectively. However, they are included in the project as the area is included in the Gothenburg region.

Based on their location, characteristics and likely users, the bridges have been divided into four categories in order to understand their significance for the city. The categories are as follows:

Bridges that primarily connect residential areas on a local scale across barriers such as roads.

Bridges that form part of the city's major pedestrian and bicyle transport routes, such as commuter routes, whose purpose is to connect the city.

Bridges that primarily serve specific businesses or industries and are therefore used by a more limited group of residents.

Bridges whose main purpose could not be determined and have therefore been placed in an unclear category.

Note: Bridges with dedicated real names are listed under the made-up names used in the project.

Bridges names

1. *GC-bro Änggården* **'Änggårdens Gångbro'**
2. *GC-bro Inlandsgatan*
3. *G-bro Gamlestaden* **'Fåfängan'**
4. *G-bro Gårda*
5. *G-bro Brämaregården* **'Ludvig Tingströms gångbro'**
6. *GC-bro Slotsskogen*
7. *GC-bro Högsbohöjd*
8. *GC-bro Högsbo*
9. *GC-bro Frölunda* **'Topasbron'**
10. *GC-bro Frölunda 3*
11. *GC-bro Grimmered*
12. *G-bro Åby*
13. *GC-bro Mölndal* **'Ekekullsbron'**
14. *G-bro Olskroken*
15. *G-bro Lisseberg* **'Lisebergsbron'**
16. *GC-bro Färjenäs Gamla*
17. *GC-bro Partille*
18. *GC-bro Askim*
19. *GC-bro Askim 2*
20. *G-bro Sävenäs*
21. *G-bro Göta Älv*
22. *GC-bro Hjällbo Centrum*
23. *GC-bro Hjällbo Centrum 2*
24. *GC-bro Hjällbo*
25. *GC-bro Hammarkullen 3*
26. *GC-bro Hammarkullen 2*
27. *GC-bro Brunnsbo*
28. *GC-bro Länsmansgården*
29. *GC-bro Länsmansgården 2*
30. *GC-bro Länsmansgården 3*
31. *GC-bro Länsmansgården 4*
32. *G-bro Kvillebäcken*
33. *G-bro Kvillebäcken 2*
34. *G-bro Amerikaskjulet* **'Erik Johannessons Gångbro'**
35. *GC-bro Gråberget*
36. *GC-bro Frölunda 2*
37. *GC-bro Frölundatorg*
38. *GC-bro Tynnered*
39. *G-bro Annedal*
40. *G-bro Landala*
41. *G-bro Landala 2*
42. *GC-bro Hammarkullen*
43. *GC-bro Angered*
44. *GC-bro Angered 2*
45. *GC-bro Rannebergen*
46. *GC-bro Gårdsten*
47. *GC-bro Gårdsten 2*
48. *GC-bro Lövgärdet*
49. *G-bro Göta Älv 2*
50. *G-bro Danmarksterminalen* **'Stenabron'**
51. *G-bro Tysklandsterminalen*

Excluded bridges

52. *GC-bro Eriksberg* **'Dockbron'**
53. *GC-bro Eriksberg 2* **'Sannegårdsbron'**
54. *GC-bro Slottsberget* **'Tranchells Gångbro'**
55. *GC-bro Lindholmen* **'Lindholmsbron'**
56. *GC-bro Mölndal 3* **'Vänortsspången'**
57. *GC-bro Stenpiren* **'Stora Bommens bro, "Osthyveln"'**
58. *GC-bro Tyska bron* **'Tyska bron'**
59. *GC-bro Brunnsparken* **'Brunnsparksbron'**
60. *GC-bro Kungstorget* **'Bazarbron'**
61. *GC-bro Drottningtorget* **'Drottningstorgsbron'**
62. *GC-bro Ullevi* **'Ågrändsbron'**
63. *GC-bro Ullevi 2* **'Dämmebron'**
64. *GC-bro Bältbron* **'Bältbron'**
65. *GC-bro Krokslätt*
66. *GC-bro Mölndal 2* **'Lasarettspången'**
67. *GC-bro Svenska Mässan* **'Underåsbron'**
68. *GC-bro Marieholmsbron* **'Norra Marieholmsbron'**
69. *GC-bro Marieholmsbron 2* **'Södra Marieholmsbron'**
70. *GC-bro Gamlestaden*

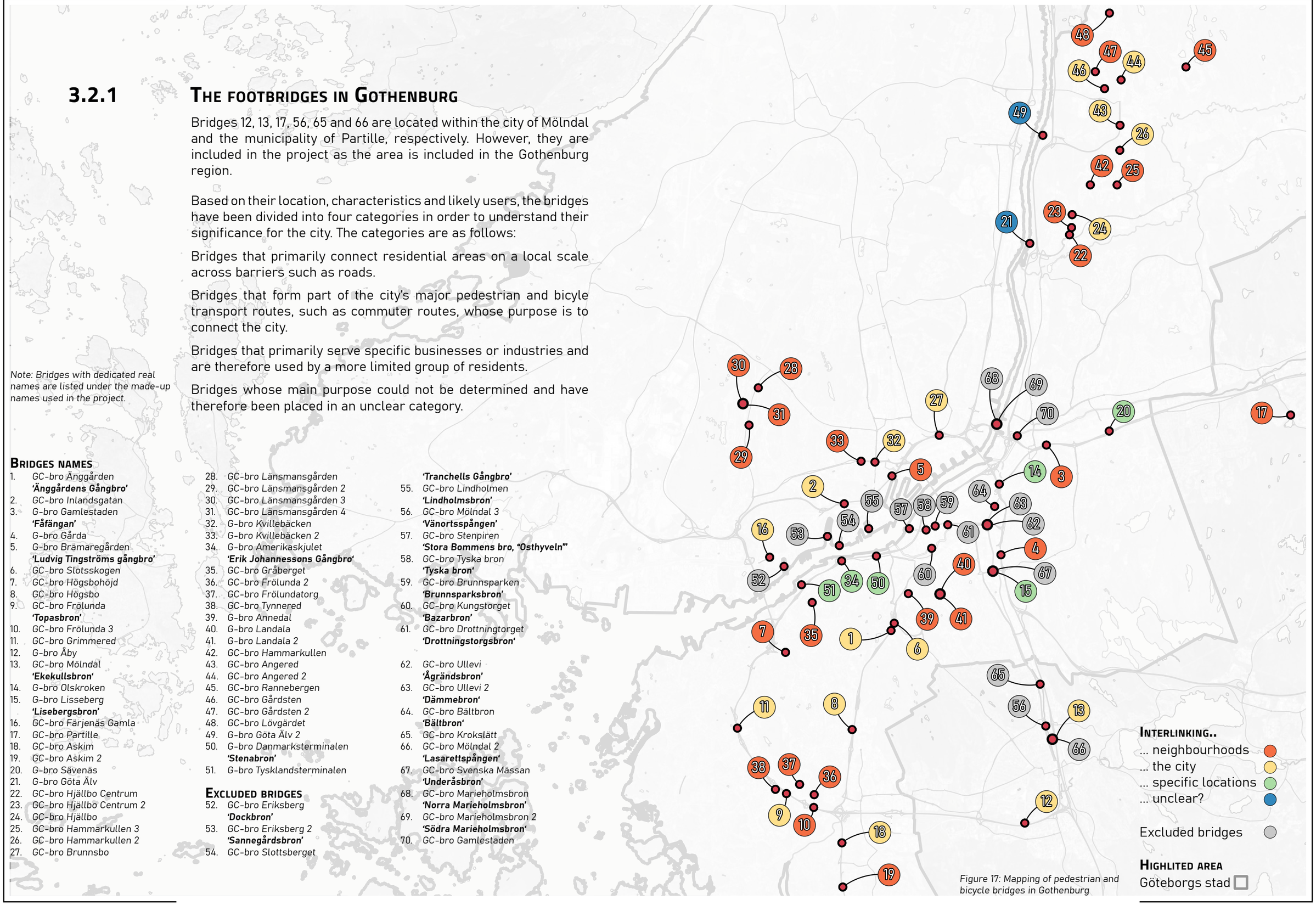


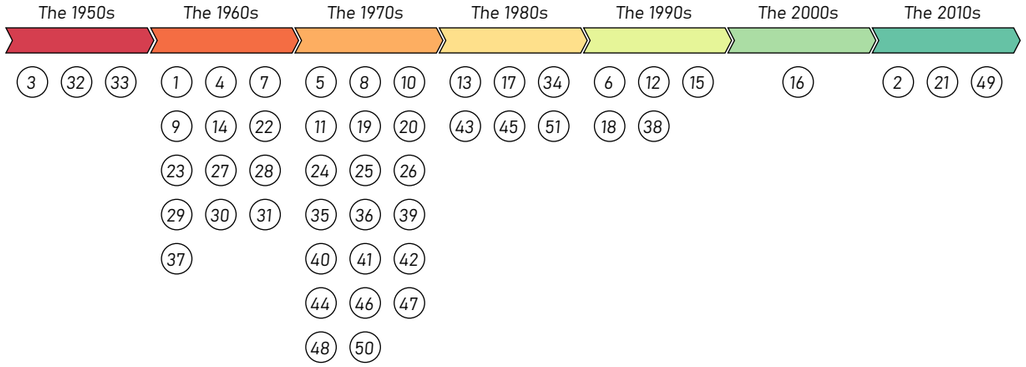
Figure 17: Mapping of pedestrian and bicycle bridges in Gothenburg

3.2.2 Footbridge analyses

Several interesting aspects were identified in the 51 bridges, in addition to material selection and construction types. The following aspects were examined:

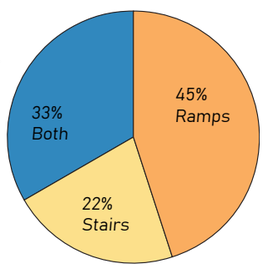
Year of construction (decade). Based on when the bridge was built, it is possible to gain an understanding of the norms and principles that applied in society at that time. The city has also developed, which can make a bridge more or less relevant. What was once a popular bridge may now have been overshadowed. Historical aerial photographs from the decade in question reveals a lot.

Note: As it has been difficult to find the exact year of construction for certain bridges, a time interval is given between the year when the bridge did not exist and when it was built. This has been determined by studying aerial photographs from the Land Survey of Sweden's database (https://geolex.lantmateriet.se).

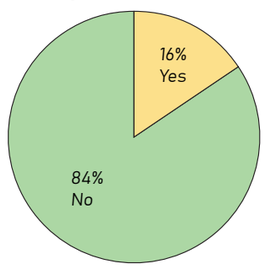


Accessibility options. How do you enter the bridge? Are there ramps, stairs, or both? Do you have to walk, or can you ride your bicycle up the bridge without dismounting? Can a wheelchair or parent with a stroller cross without difficulty?

Note: Accessibility was only measured in the question 'are there ramps or only stairs'. Aspects such as slopes or landings, which are important measures of accessibility, were not studied. In the study, lifts have been equated with ramps. Some bridges that only have stairs also have either one gutter to guide bicycles up, or two gutters adapted for strollers. These are not included in the aspect of 'Does the bridge have a ramp?'.



Accessibility options



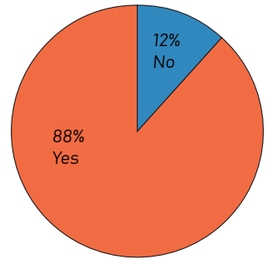
Separate footpaths and bicycle lanes

Figure 18 (L) & 19 (R): Statistics from bridges in Gothenburg

Separate footpaths and bicycle lanes. What are the possibilities for cycling safely across the bridge with dedicated lanes for cyclists and pedestrians? This is an interesting aspect to consider when examining how practical and useful the bridge is in connecting the city in a sustainable way and facilitating easy commuting by bicycle.

Clearly connected pedestrian and/or bicycle network on both sides of the bridge. Is it safe and easy to get to the bridge, and what happens on the other side when you step off the bridge? If the bridge is not clearly connected to an existing network, its attractiveness and function are reduced.

Note: Some bridges have a connecting network on one side; these are not classified as connected to the network. Similarly, ordinary roads are not counted; only connected footpaths and/or cycle paths have been included.



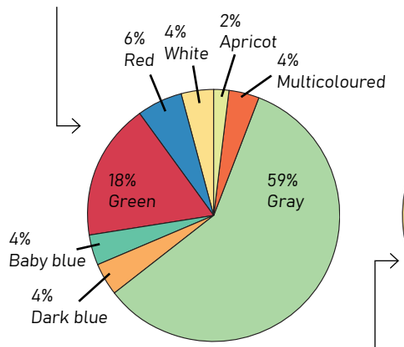
Clearly connected pedestrian and/or bicycle network

Figure 20: Statistics from bridges in Gothenburg

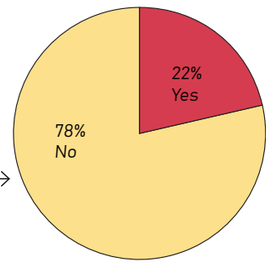
Two additional aesthetic characteristics were examined in order to understand the impact that bridges have on their surroundings.

Colour scheme. Colour has been defined as the overall colour conveyed by the bridge. Some bridges are painted in only one colour, which is then obvious, while others are painted in multiple colours, for example, the bridge and railing have different colours. In such cases, the colour that makes the strongest impression has been noted. Two bridges are covered with paintings on the outside and are classified as multicoloured.

Note: Colour scheme refers to the outside of the bridge. The inside, which is what you see when you are standing on the bridge, may be a different colour.



Colour scheme



Designed elements

Figure 21 (L) & 22 (R): Statistics from bridges in Gothenburg

Designed elements. Designed elements have been defined as features of the bridge's appearance that are clearly distinguishable from a distance and are not necessary from a structural or traffic engineering perspective. In other words, they should be elements that exist solely to enhance the bridge's appearance and aesthetics, thereby making it more eye-catching, appealing and safe. Examples of this include colour, shape, pattern and material. Quite simply, elements that are designed to contribute to the aesthetics, rather than because they are necessary.

Viewshed analysis

To investigate how well the bridges in Gothenburg relate to their surroundings from a visual perspective – that is, how visible they are – a number of viewshed analyses were carried out in QGIS using the Visibility Analysis plugin (Čučković, 2024). It is interesting to study how and from where a bridge is visible in order to understand its potential to influence its surroundings. The more visible a bridge is, and especially from where it is visible, the greater its significance for orientation and mobility. Visibility therefore affects how easy the bridge is to find and which groups actually find their way to it. A bridge that is not visible to its intended users risks becoming ineffective.

A viewshed analysis looks at how far you can see theoretically based on elevation data in a digital model, in this case a DSM model created from lidar data from Lantmäteriet. The measurements were taken in 2010 and 2011, which means that in some cases they are slightly outdated in areas that have undergone urban development since 2010 and therefore lack information about new buildings. In these cases, the data has been supplemented with updated data on existing buildings, which for the purposes of the analysis have been given an infinite building height. In a viewshed analysis with a large area, this becomes misleading, but for the analyses carried out in this work with a radius of 800 metres, it is negligible.

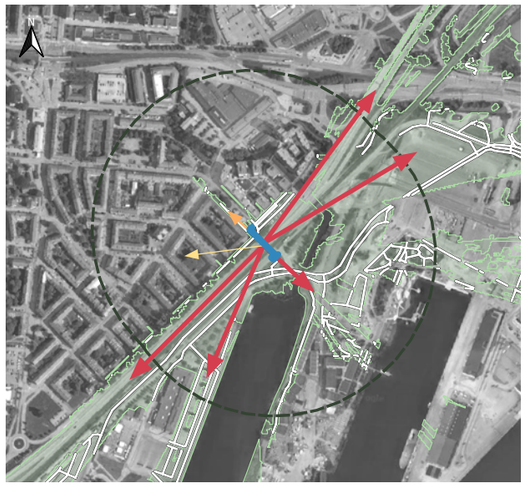
Note: Lantmäteriet is the Swedish mapping, cadastral and land registration authority.

The analyses measure from which points 0.5 m above the bridge deck you can see points within a radius of 800 metres that are 1.7 metres above the ground. The bridge is divided into points evenly spaced 4 metres apart across the entire centre axis of the bridge deck. Visible surfaces from each point are merged into a common surface. In other words, from which viewing points can a spectator with an eye height of 1.7 metres see any part of the bridge? The analyses should be seen as an estimate and are not exact.

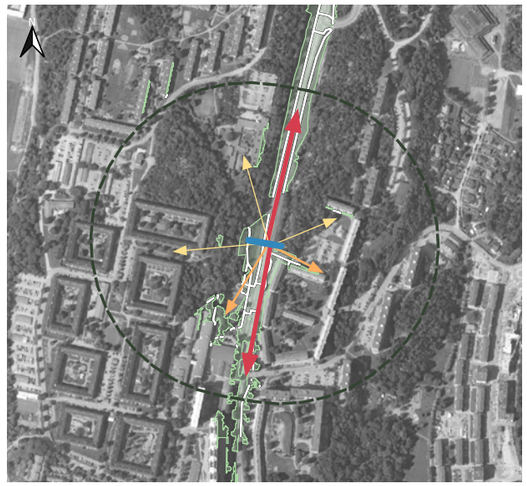
From the six examples of bridges in Gothenburg illustrated on the right, it is clear that, for obvious reasons, the bridges are most visible from the road they span. This is problematic because it is not people travelling on the road who need to use the bridge, but users in the areas on either side of the road. The fact that they are difficult to see from inside the areas they are supposed to be linking makes them sometimes difficult to find. It is more advantageous when a visual axis is created that leads people to the bridge. Compare bridge 24 in Hjällbo with bridge 8 in Högsbo.

In some cases, the bridge also appears very suddenly, such as bridge 1 at Slottsskogen. If you are in the forest area west of the bridge, which has lots of footpaths and cycle paths, you are unaware that a bridge will suddenly appear, enabling you to cross the road. This makes it easy to miss. It is not clear what destination you are heading for.

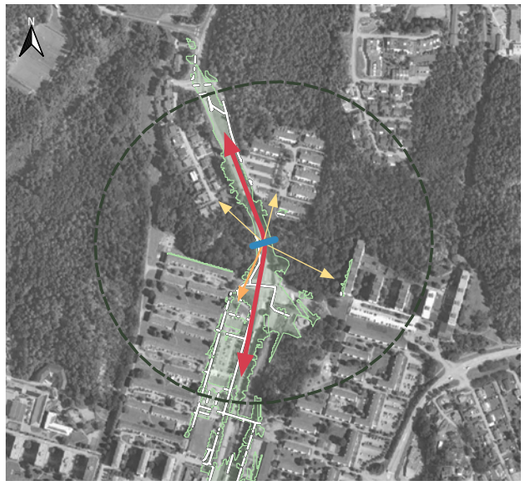
5. G-bro Brämaregården



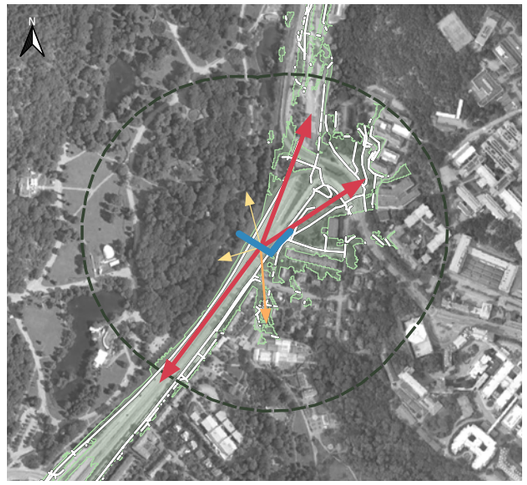
29. GC-bro Länsmansgården 2



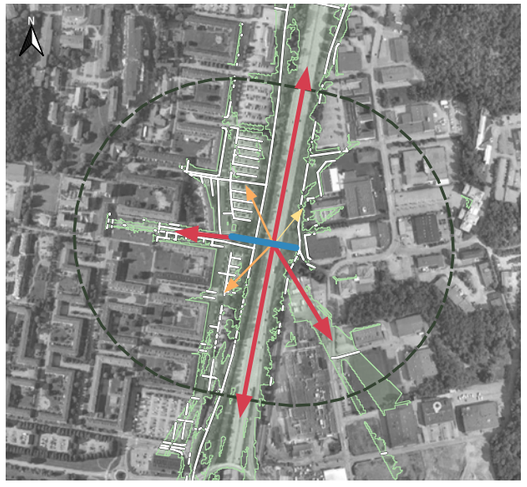
24. GC-bro Hjällbo



1. GC-bro Änggården



8. GC-bro Högsbo



9. GC-bro Frölunda

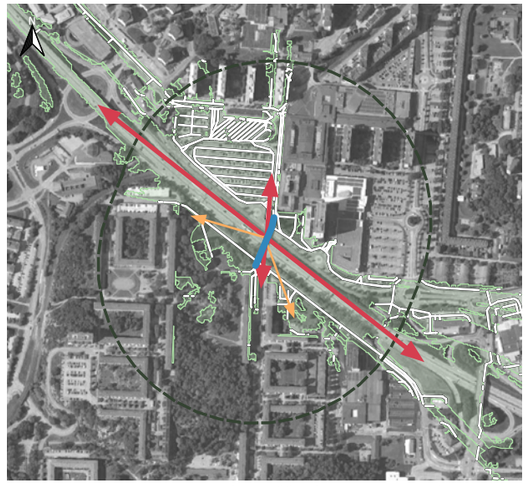


Figure 23: Viewshed analysis and illustrated visual connections. Aerial photo from Google satelite.

3.2.3 Takes from pedestrian bridges in Gothenburg

Gothenburg has far more pedestrian and cycle bridges than most people realise. The main reason for this is that the bridges lack an identity, unlike all bridges that cross water, which all have a name. A name or some other characteristic that makes that particular bridge memorable and recognisable. This is strange, considering that a bridge is really just an extension of a street or a new street, and all streets have names.

The colour scheme of the bridges also contributes to their lack of identity. 59% are grey. Some are painted grey, while others are the natural colour of concrete. The remaining bridges that are painted are painted in a low-saturation colour, almost pastel-like. Colour choices that reflect nature and the colours of the sky, ensuring that the bridges never attract attention or stand out, but rather blend in. Compare this with the major infrastructure project Röde Orm, or Partihallsförbindelsen as it is officially called. A long, winding motorway viaduct that connects several major motorways in Gothenburg. Here, the underside of the bridge was painted in a distinctive red colour, and the colour and shape have resulted in a popular name that everyone knows. Röde Orm. An identity.



Image 4: G-bro Gårda
What purpose does this footbridge serve today? Was it built to connect the office area in Gårda with the 50 or so villas in the wealthy residential area of Överås? Who was the intended user of the bridge, and who uses it today?

It has been difficult to assess the effectiveness of a bridge, as no measurements have been made of, for example, traffic flow in this study. As the context has also changed over the years from new construction to the present, it is difficult to say whether the purpose of a bridge was clearer then, as travel patterns and needs were different. Looking at the bridges today from a subjective perspective, some bridges seem to work better because they appear to be used more, serve a greater and clear purpose and are perceived as more pleasant. The location of some other bridges, based on their surroundings, can be questioned. For example, the purpose of the footbridge in Gårda. From a socio-economic perspective, more in-depth analyses should be carried out in the future to understand the design and location of a bridge. Will it provide the social benefits that are expected and desired? For example, the footbridge at Göta Älv.

If you look at how footbridges and cycle bridges are built, a clear pattern emerges where all bridges seem to be guided by three parameters: traffic engineering requirements, construction and material requirements, and economics. These are three parameters that can all be handled by an engineer. Bridges are usually exactly as wide as they need to be to meet the requirements of the category they fall into. For example, the combined pedestrian and cycle bridge on Inlandsgatan is 4 metres wide. According to the Gothenburg Technical Handbook, a combined pedestrian and cycle path must be 4 metres wide if it can be considered to have (or is planned for) high pedestrian or cycle traffic. This bridge can be considered to have such traffic, given that it is used for commuting by bicycle. The bridge also has a 1.4-metre-high fence and a 0.9-metre-high handrail. All in accordance with the requirements tables from municipal and state authorities. No more, no less. Building in this way, with the minimum possible, creates functionality and is economical, but if you want to build an attractive city, you should consider whether there are other methods.

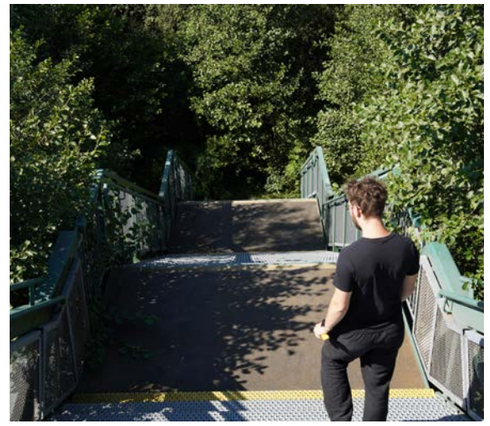


Image 5: G-bro Göta Älv
Replacing a at grade crossing for cars with a footbridge for pedestrians is already questionable. At the same time, removing the road on one side and letting the bridge end in nothing is unbelievable.

All structures where the load-bearing structure is visible can be argued to contain some degree of design. When the same, almost identical bridges are found in several places, one may ask: is this bridge designed and shaped for the location? Or is it just a generic, cheap catalogue design that has been chosen? Shouldn't we devote more time and energy to permanent solutions for the city's urban spaces?

The analysis of materials and design highlights that material efficiency and simplicity are high on the list. All bridges are made of concrete or steel. All steel bridges are also delivered in ready-made segments that are bolted together on site. Bridge supports were constructed on either side of the barrier without affecting traffic, and then, for example, during a night or weekend, the road was closed and the bridge was lifted into place. Space and time efficient.



Image 6: GC-bro Inlandsgatan
The bridge is exactly 4 metres wide, precisely as wide as it needs to be to full fill the municipality requirements.

3.3 A STUDY OF RENOWNED BRIDGES

After studying pedestrian and cycle bridges in Gothenburg, it became clear that there was a need to also study reference projects outside Gothenburg. Specifically, bridges that have been built recently according to modern standards and construction techniques, but also bridges that have attracted attention for their various qualities related to pedestrian and cyclist traffic. These are bridges that can provide inspiration for the design of a new bridge in Älvängen.

3.3.1 THE BRIDGES

DON BURNETT BICYCLE-PEDESTRIAN BRIDGE, CARLIFONIA USA, 2009



Image 7: By R. S. Shaw - Own work, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=13771243

Pedestrian and bicycle bridge, completed in 2009, spanning 10 lanes of motorway and connecting the cities of Cupertino and Sunnyvale in California. The bridge stands out for its simple yet elegant steel structure. It is based on a number of I-beams that have been welded together to form elements that have been bolted together on site. The bridge is not only a link in the urban fabric, but also a social and artistic magnet. It is particularly beautiful at night when the white structure is illuminated, creating a silhouette against the night sky.

FOLEHAVEN BICYCLE AND PEDESTRIAN BRIDGE, COPENHAGEN DENMARK, 2020

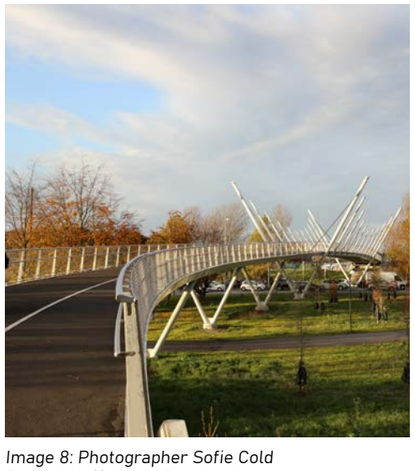


Image 8: Photographer Sofie Cold Ravnkilde // Kragh-Berglund

Pedestrian and cycle bridge in Copenhagen, inaugurated in 2020. Elegant steel construction using the inverted Fink truss bridge design. The bridge creates a gateway for commuters travelling into the city centre. Both cyclists on the bridge and motorists driving under it.

BOORLOO BRIDGE, PERTH AUSTAILIA, 2020-2025

A pedestrian and cycle bridge designed to make it easier for the residents of Perth to choose active modes of transport, thereby reducing car use and traffic in the city centre. The bridge spans the Swan River and is designed to connect with the local Aboriginal historical context and to handle cultural values with care. Cultural symbols have been incorporated through the design of the three towers and the S-shaped pedestrian and cycle path. The structure has been fitted with lighting that enables visual messages to be conveyed through colour and form.

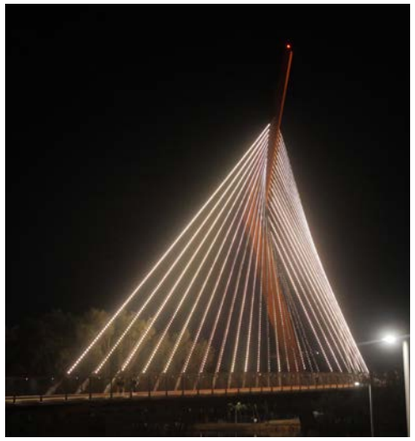


Image 9: By Arthur Taksin - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=157354064

SLAGELSE FOOTBRIDGE, SLAGELSE DENMARK, 2016-2021

A footbridge that connects the community through three branches, linking public transport, neighbourhoods and campus areas through a single structure. The steel structure has a simple and clear design language, inspired by the natural movements of the location, and is characterised by a stripped-down and restrained design that fulfils the principle of least possible without appearing cheap or banal.

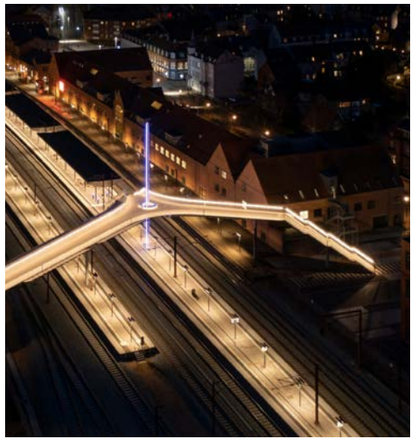


Image 10: Photographer Niels Nygaard // Dissing+Weitling

BICYCLE SNAKE, COPENHAGEN DENMARK, 2010-2014

A bicycle bridge in Copenhagen that connects the city's impressive network of cycle paths, weaving harmoniously through the urban environment. The bicycle bridge has won nine different awards for design and architecture and can be considered one of Dissing + Weitling's most iconic creations.

Simple in design yet elegant, a 75 cm high box girder construction stretches smoothly through the landscape. It runs a few metres above the ground, giving users beautiful views, while the bridge feels low-key and welcoming in its surroundings.



Image 11: By Jakob Munk - A donation from Jakob Munk, one of the founders and owners of this company. I 11asked him for this donation, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=46685719

3.3.2 Takes from famous footbridges Broarna

The pedestrian and cycle bridges studied highlight various aspects as important and popular in the design. The first is the use of lighting design as an important design element. With the proper lighting, it becomes both easier and safer to move around. This is particularly important during the hours of darkness. Light can guide people in the right direction and make the place more welcoming. Lighting design can also make the bridge a destination in itself, just as Boorloo Bridge and Don Burnett Bicycle-Pedestrian Bridge have become, by creating light shows or messages. The Government of Western Australia's website features a schedule of different light shows on Boorloo Bridge.

Another aspect that stands out is smooth curves and a clear differentiation between footpaths and cycle paths. Straight stretches or large horizontal curves create an inviting flow that makes the distance feel shorter and, above all, helps cyclists to move safely and smoothly. This creates a natural flow that makes more people feel comfortable cycling and can contribute to more people choosing active modes of transport. The separation between the footpath and cycle path is created by using clear contrasting markings with line painting, or by painting the entire cycle path in a different colour.

In terms of materials and construction, it is clear that steel is the preferred material. Box girder bridges appear to be very popular. This type of construction allows for great design freedom and large spans. Structures that use steel cables, such as cable-stayed bridges, are also popular and allow for long spans. Steel structures allow for a more elegant design than, for example, concrete or wood, and do not limit the design options.

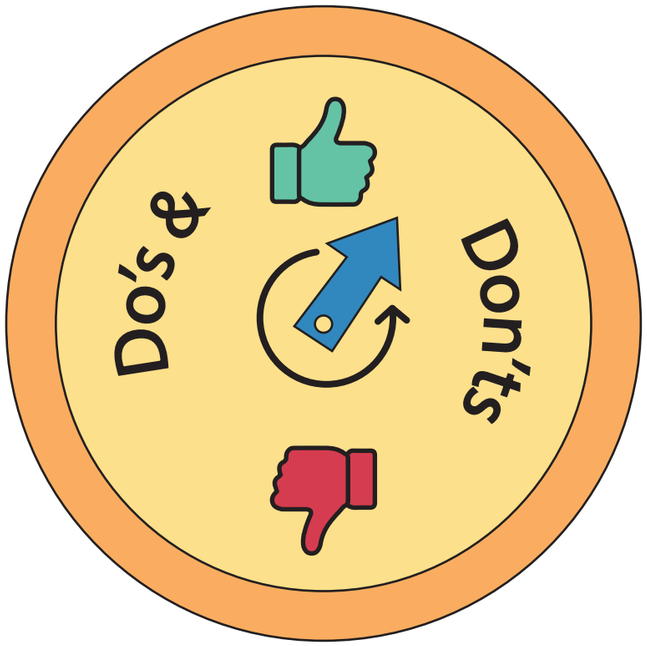
In these bridges, too, it is clear that structures that can be bolted together on site are preferable.

It has also become clear how attractively suicide barriers can be incorporated if they are included in the design from the outset. This avoids the need for all the retrofitting that has been added to bridges crossing high elevations or transport infrastructure. These structures are often as generic as the bridge itself and do not contribute to its aesthetic appeal.

Finally, small design details that connect the place to the local environment can make it feel more personal and recognisable. This creates a sense of ownership for residents. It doesn't have to be anything big, even simple elements can create a strong connection to the identity of the place. This was clearly illustrated by the three supporting pylons of the Boorloo Bridge, which have been given a small, subtle curve or design detail that immediately brings to mind elements of cultural importance to Aboriginal history.

DESIGN PRINCIPLES

4



Design principles

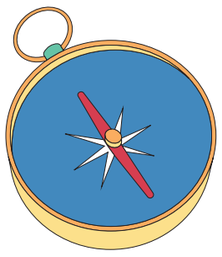
In order to summarise all the lessons learned from the reference projects and create a design template for a new pedestrian and cycle bridge in Älvängen, a number of design principles have been developed. The design principles will guide the design and enhance the aesthetic and functional values when developing a new pedestrian and cycle bridge. Together, the design principles create a bridge with identity.

The principles are based on the characteristics identified in the reference projects and the characteristics or functions that have missing.



Name

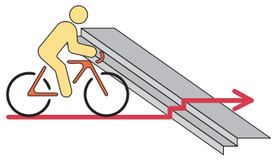
Give the bridge a name. Name the bridge after a person, place or something else that anchors it in its local context. In Frölunda, the local housing company announced a naming competition for its local bridge, where residents had the opportunity to submit suggestions and vote. A name makes it easier to refer to, discuss and remember. It is the lowest level of identity.



Guiding elements

If you can see the bridge from a distance, the barrier is perceived as less significant because you know you can cross it. It becomes easier to navigate, both for local users and visitors.

Use protruding elements or shape the surroundings to create visual connections. Another option is clearly connected guiding elements that lead to the bridge's starting point. The yellow bridge Luchtsingel in Amsterdam painted the nearby pavements yellow as a guiding element.



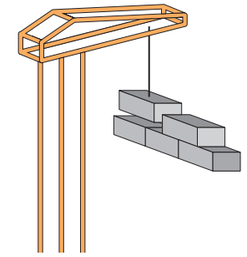
Accessibility and cyclists

All bridges should be fully accessible and allow bicycles. Use ramps or lifts, together with stairs. Stairs are a good option for shortening distances for those who are able to use them.

A bridge that can be cycled across without having to dismount connects the city by enabling commuter cycling. A bridge where you have to dismount works if you only want to connect the two sides of the barrier. Build bicycle gutters into the edges of the stairs, or alternatively stroller gutters that can be used by both.

Simplicity means feasibility

A structure that is easy to build on site reduces construction time and thus the disruption to the public. Steel structures are easy to manufacture elsewhere under controlled conditions, and then transported and lifted into place. Prefabricated concrete structures serve the same purpose, such as the GC bridge in Partille.



Colour scheme

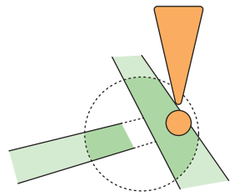
The colour scheme for the bridge should be chosen with respect for its surroundings. However, this does not mean that it should not be visible. Allow the bridge to be seen and attract interest. Use colour to emphasise local connections, construction details or art.



Connect the network

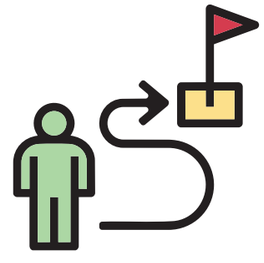
Ensure that all connections to the bridge are well designed and connected to the local network. Do not compromise on the connection point, as this will affect functionality and attractiveness. The bridge should extend beyond the physical structure over the barrier.

Design a temporary connection that does not feel compromised, if the situation requires it. For example, if an area is awaiting development.



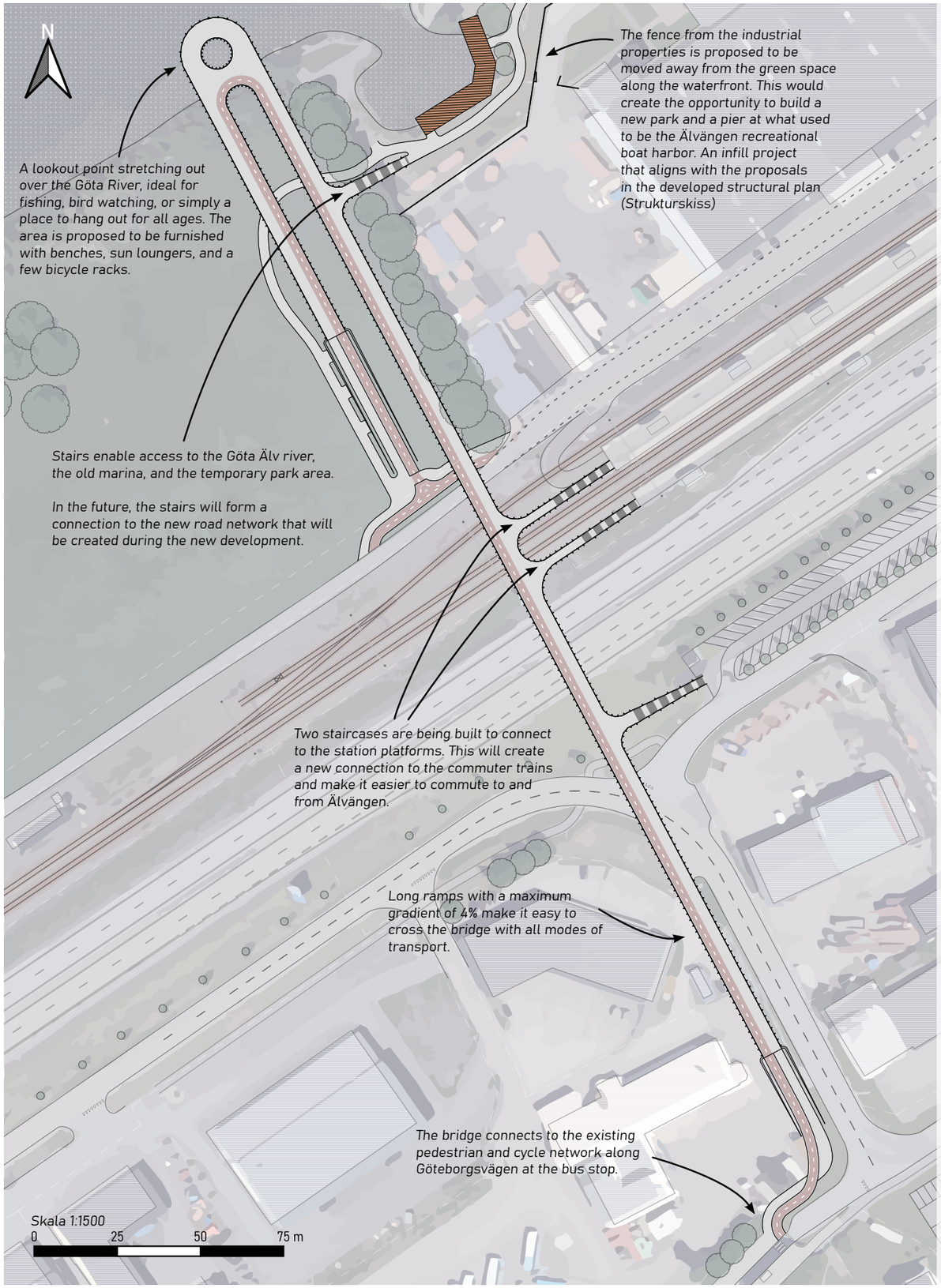
Purpose

Design the bridge based on a purpose that is not fulfilled or competes with anything else nearby. For the bridge to be used as intended, a clearly formulated purpose is required to guide the design, which is more specific than simply making the other side accessible to residents.





PROPOSAL FOR ÄLVÄNGEN 5



BRO11AN

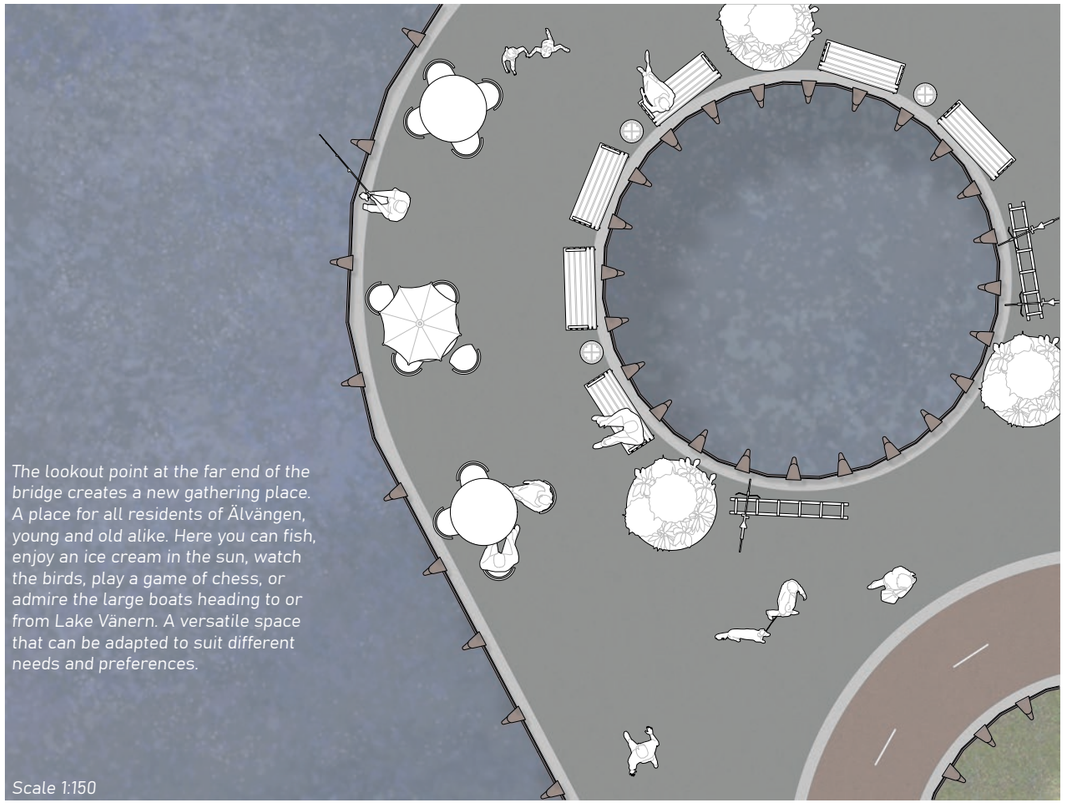
A new pedestrian and bicycle bridge over the Göta River and Fabriksgatan!

For Älvängen, a steel pedestrian and bicycle bridge is proposed to connect the active community of Älvängen on the south side of the motorway with the old industrial sites and green areas along the river. The bridge has two purposes. It will reduce the barrier currently experienced by making the green areas along the Göta Älv accessible with a new opportunity to cross the motorway and railway, which has a direct connection to the Göta Älv with its lookout point. In a safe, accessible, and attractive way, the new connection will make active modes of travel more appealing. In the long term, the aim and hope is that the new connection will make the old industrial sites attractive for new development and thus act as a catalyst for the development of central Älvängen.

The bridge's location and proximity to the commuter train station platforms provide an opportunity to connect the bridge and the platforms. This proposal would relieve the current solution during rush hour and contribute to a safer connection to the industrial sites than the compromise solution that exists today.

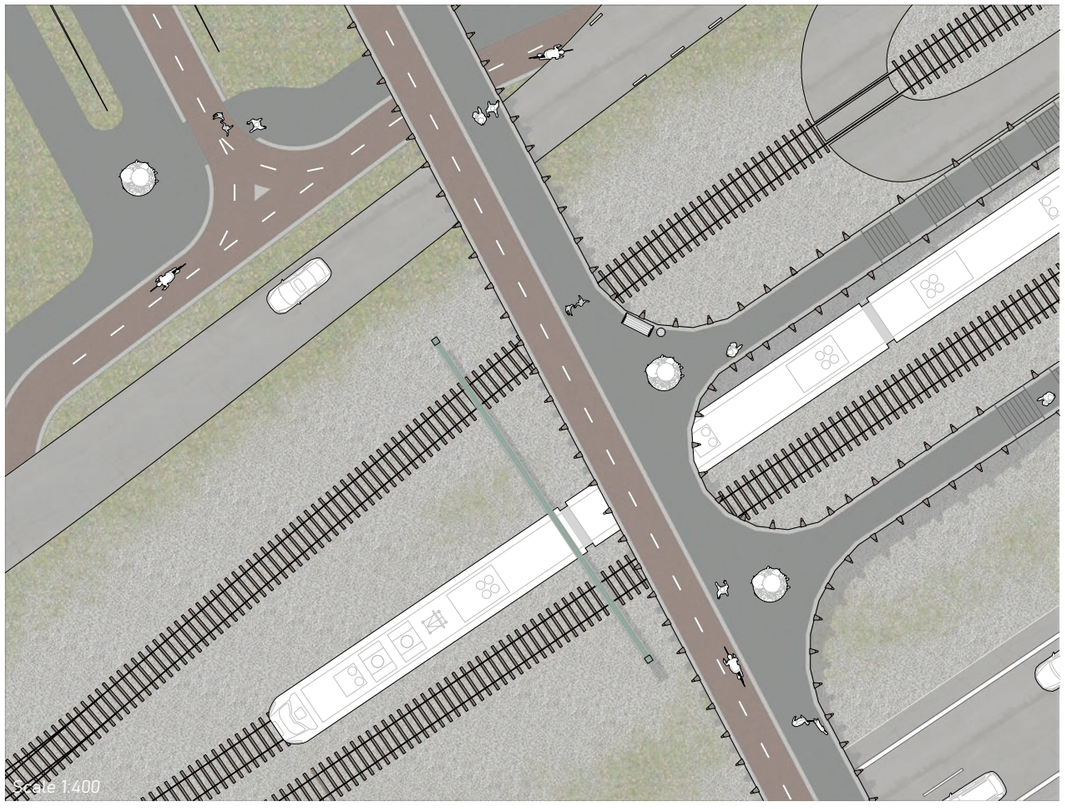
The bridge's design is based on the design principles presented in Chapter 4.

Elevators have been omitted in order to keep construction and maintenance costs down.



The lookout point at the far end of the bridge creates a new gathering place. A place for all residents of Älvängen, young and old alike. Here you can fish, enjoy an ice cream in the sun, watch the birds, play a game of chess, or admire the large boats heading to or from Lake Vänern. A versatile space that can be adapted to suit different needs and preferences.

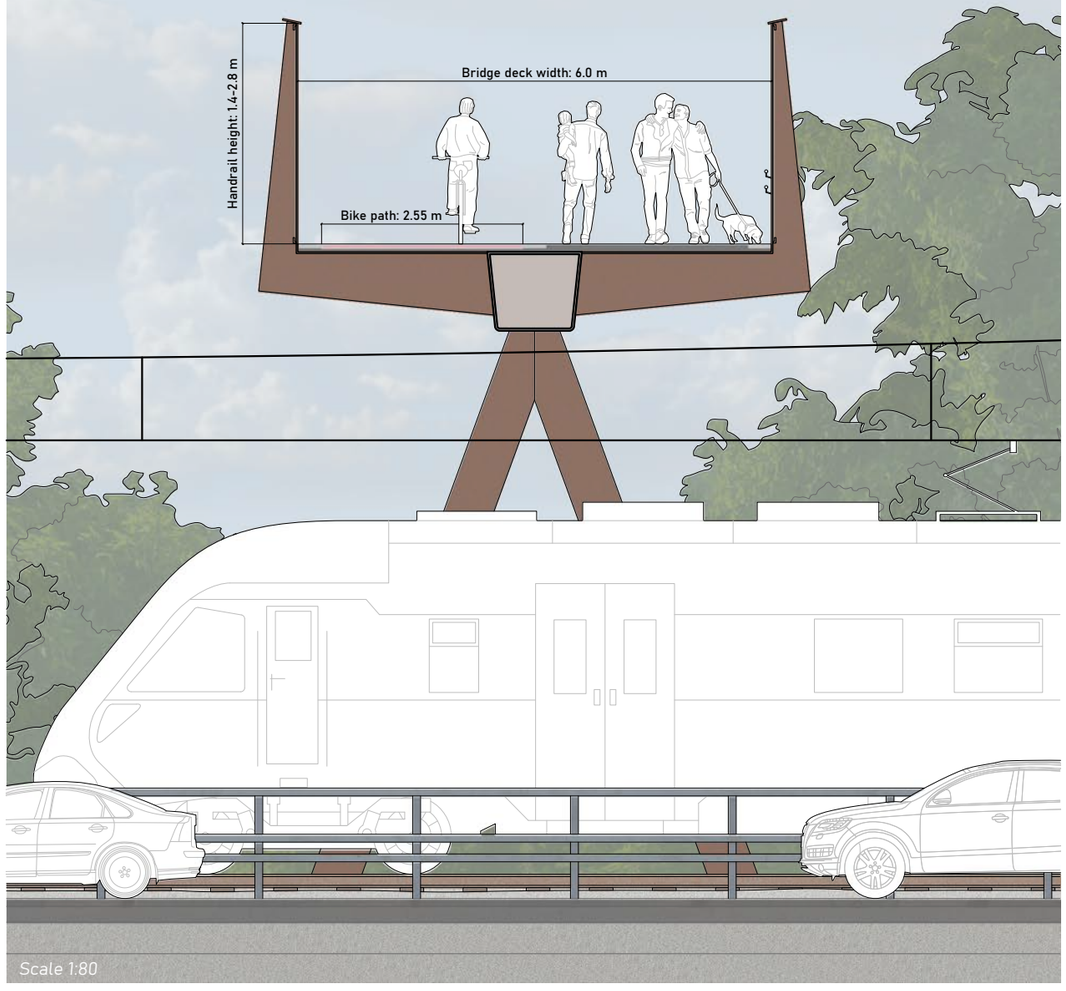
Scale 1:150



Scale 1:400

The bridge is wide enough for three people to walk side by side without encroaching on the bike lane. Similarly, a cyclist can pass another while encountering oncoming traffic without intruding on the space of pedestrians. The slightly uneven design, with cobblestones serving as a divider between the sidewalk and bike lane, provides tactile feedback to both cyclists and pedestrians if they happen to stray onto the other's side.

The supporting arms on the bridge create a reassuring sense of robustness, which is important when crossing the highway and railroad tracks. The arms are designed to be adjustable, allowing for variation in railing height. This is necessary when crossing the highway and railroad, as suicide protection of at least 2 meters in height is required.

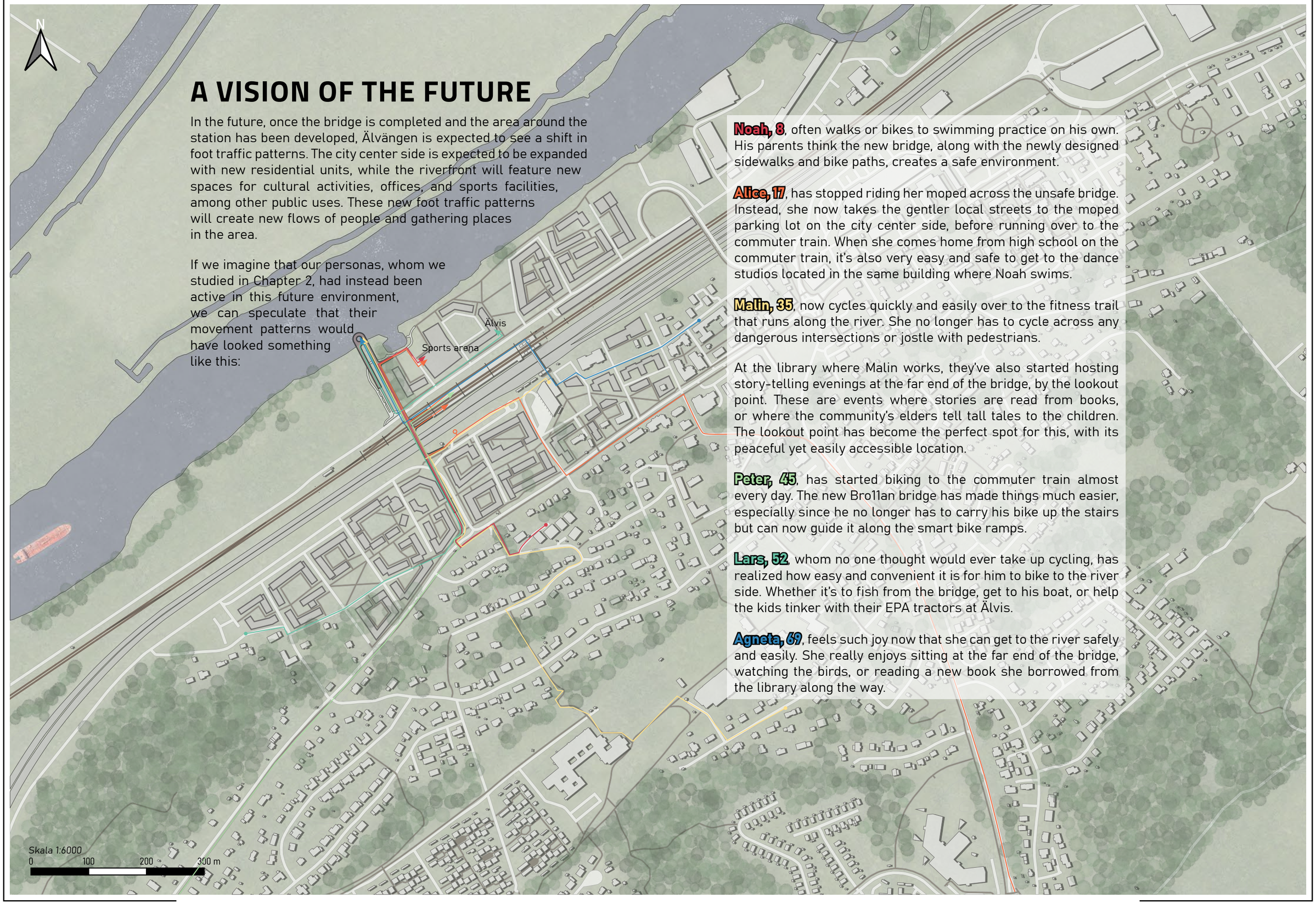


Scale 1:80

A VISION OF THE FUTURE

In the future, once the bridge is completed and the area around the station has been developed, Älvängen is expected to see a shift in foot traffic patterns. The city center side is expected to be expanded with new residential units, while the riverfront will feature new spaces for cultural activities, offices, and sports facilities, among other public uses. These new foot traffic patterns will create new flows of people and gathering places in the area.

If we imagine that our personas, whom we studied in Chapter 2, had instead been active in this future environment, we can speculate that their movement patterns would have looked something like this:



Noah, 8, often walks or bikes to swimming practice on his own. His parents think the new bridge, along with the newly designed sidewalks and bike paths, creates a safe environment.

Alice, 17, has stopped riding her moped across the unsafe bridge. Instead, she now takes the gentler local streets to the moped parking lot on the city center side, before running over to the commuter train. When she comes home from high school on the commuter train, it's also very easy and safe to get to the dance studios located in the same building where Noah swims.

Malin, 35, now cycles quickly and easily over to the fitness trail that runs along the river. She no longer has to cycle across any dangerous intersections or jostle with pedestrians.

At the library where Malin works, they've also started hosting story-telling evenings at the far end of the bridge, by the lookout point. These are events where stories are read from books, or where the community's elders tell tall tales to the children. The lookout point has become the perfect spot for this, with its peaceful yet easily accessible location.

Peter, 45, has started biking to the commuter train almost every day. The new Bro11an bridge has made things much easier, especially since he no longer has to carry his bike up the stairs but can now guide it along the smart bike ramps.

Lars, 52, whom no one thought would ever take up cycling, has realized how easy and convenient it is for him to bike to the river side. Whether it's to fish from the bridge, get to his boat, or help the kids tinker with their EPA tractors at Älvis.

Agneta, 69, feels such joy now that she can get to the river safely and easily. She really enjoys sitting at the far end of the bridge, watching the birds, or reading a new book she borrowed from the library along the way.

Local and historical connection

A local and historical connection is established through the integration of rope elements into the bridge railing. The rope elements can be manufactured at the rope-making museum in Älvängen. Through workshops held at the museum, local residents and their families can participate in creating the rope elements, fostering a sense of ownership and community involvement.

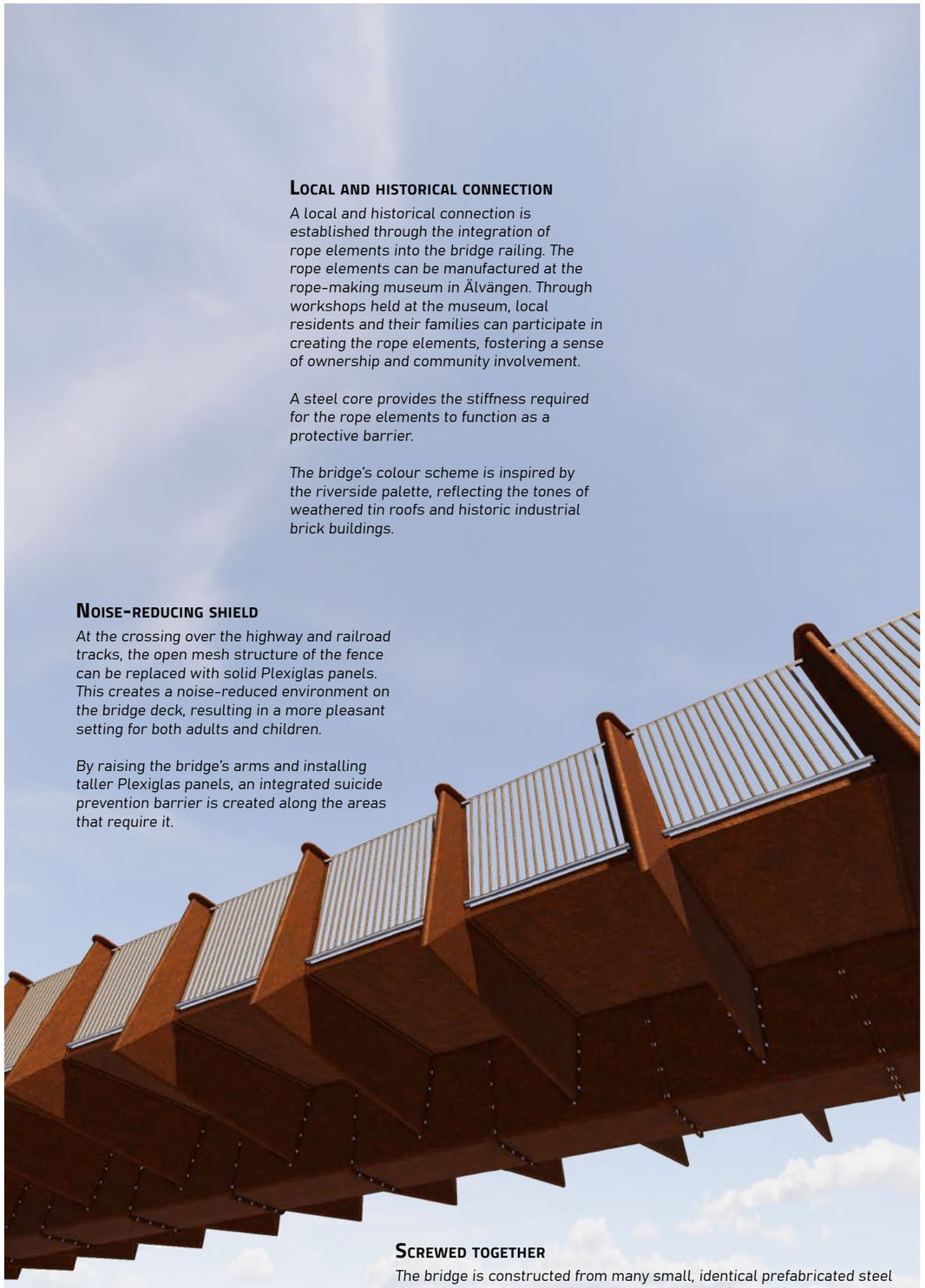
A steel core provides the stiffness required for the rope elements to function as a protective barrier.

The bridge's colour scheme is inspired by the riverside palette, reflecting the tones of weathered tin roofs and historic industrial brick buildings.

Noise-reducing shield

At the crossing over the highway and railroad tracks, the open mesh structure of the fence can be replaced with solid Plexiglas panels. This creates a noise-reduced environment on the bridge deck, resulting in a more pleasant setting for both adults and children.

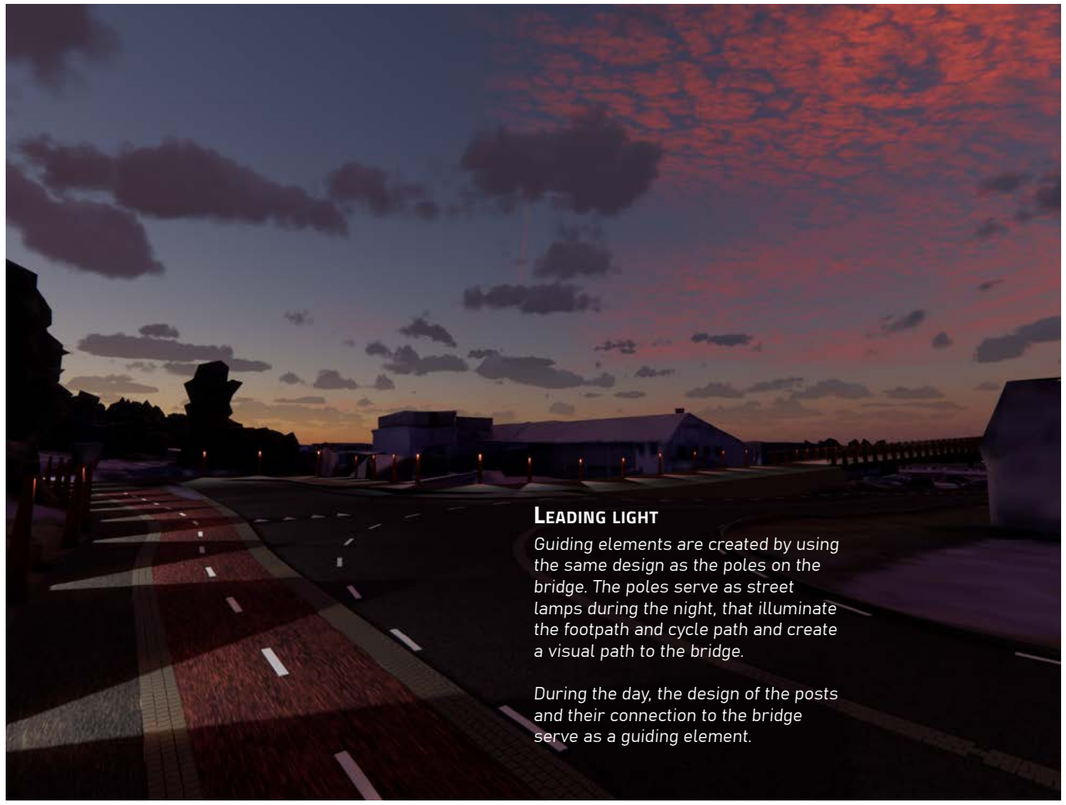
By raising the bridge's arms and installing taller Plexiglas panels, an integrated suicide prevention barrier is created along the areas that require it.



Screwed together

The bridge is constructed from many small, identical prefabricated steel elements that can be easily transported to the site. On site, the structure is bolted together into longer segments that can be lifted into place.

This minimizes the impact on the surrounding area during construction and reduces the time the work affects the highway and railroad



Leading light

Guiding elements are created by using the same design as the poles on the bridge. The poles serve as street lamps during the night, that illuminate the footpath and cycle path and create a visual path to the bridge.

During the day, the design of the posts and their connection to the bridge serve as a guiding element.

Contrasting finish

To create a clear and safe separation between cyclists and pedestrians, the asphalt on the cycle path is coloured in a reddish-brown tone. Colouring the asphalt ensures that the contrast remains visible over time, unlike road markings, which tend to fade with age.

Use of lighting

The bridge is illuminated by recessed lights in each post on the bridge. The dense placement of the posts creates even lighting across the entire bridge, contributing to a soft feeling during the hours of darkness. The recessed lights in the posts are designed so that direct light never dazzles pedestrians, cyclists or motorists driving on the roads under the bridge.





DISCUSSION & REFLECTIONS 6

The purpose of this work has been to investigate how Älvängen can develop a proposal that actively works to reduce existing and future barrier effects. As the author of Divisive connections (Eldijk, 2023) writes, the problems with infrastructure barriers are complex, and a multidisciplinary approach is needed to develop solutions that work better than the existing ones we have historically built. Based on architectural values, this work has investigated what a solution might look like where design is prioritised over construction, traffic engineering characteristics and economic values, which have historically been given higher priority. The proposal should therefore not be seen as a final solution for Älvängen. It needs to be itterated based on other disciplines, although it can be considered a good starting point.

The lessons and insights gained from this work have been numerous. It has been clear that in many cases, both in Sweden and abroad, work on solutions to reduce barrier effects has begun long after the barriers were created. This has meant that very large and dramatic measures have often been necessary to overcome the problem, which is costly and expensive. That is precisely why it has been interesting to work with Älvängen, where the barrier effect can be considered small today, but risks multiplying in future development plans. How can we work preventively, rather than with mitigating measures?

In Sweden, as described in chapter 1.1, the Swedish Transport Administration is responsible and manages the regional infrastructure, which includes motorways and railways. It has become clear in the course of the work that the interests of the state have been prioritised and that interdisciplinary cooperation between the Swedish Transport Administration and the municipality is not working very well. The footbridges that span the regional transport network are not expensive and can often be classified as 'the bare minimum'. Perhaps this is because the municipal budget is limited? Disciplines and interests beyond the Swedish Transport Administration does not seem to have been considered equally important. The issue of cooperation between the City of Gothenburg and the Swedish Transport Administration is also reinforced by the fact that the national road database contains very incomplete information about footbridges and cycle bridges in the Gothenburg area. Often, none at all.

Two footbridges have also been revealed in Gothenburg, numbers 21 and 49 on the map, where the purpose and economic benefits of number 21 in particular can be questioned. The railway was rebuilt at the site and a level crossing for cars (which fulfilled the purpose of allowing service vehicles to reach a remote municipal technical facility) was removed. The project involves creating a new access road from another location, and the facility (to which unauthorised persons are not to have access) has erected fencing. Despite this, a new footbridge over the railway is built. A footbridge that is currently completely unused. Along the same railway line, a few kilometres to the north, another level crossing is being removed. However, car access is needed to some businesses in this area, so the Swedish Transport Administration built a new concrete bridge over the railway. But the level crossing is also being replaced with a new footbridge in the same place, whose access points are completely wrong and not connected to anything. Why couldnt the two bridges be combined? Both footbridges feel like a waste of resources.

Perhaps the most important lesson that can be learned from studying a number of reference projects is the importance of one or more identity-creating characteristics. These can be unique design elements that generate conversation among the general public, or something as small as a name. The invented name for the bridge in Älvängen, Bro11an, is a play on words intended to create something that is easy to remember and alludes to the location. In Swedish, 11 can be pronounced with a slight dialect as 'Älva', a reflection of the river to which the bridge connects. Had the project been built, it is suggested instead that the local population should be involved by creating a naming competition. In this way, local roots and a sense of ownership can be strengthened.

A study of pedestrian and cycle bridges in Gothenburg revealed that there is much room for improvement. Many of the footbridges are only suitable for pedestrians, as stairs are the only way to access them. In some places, the stairs or ramps do not connect to a footpath or cycle path, but lead straight out onto the street. This could be compared with connecting a local street perpendicular to a motorway, which is something you just don't do, right? One of Gothenburg City Council's key principles is that the city should be accessible to everyone. So why is the city not reviewing the existing environment, and when it does so on rare occasions, why does it still get it wrong? The Ludvig Tingström footbridge (bridge nr 5) was rebuilt in 2024 because it needed to be extended. When new construction was carried out, it was built to the same accessibility standard as when it was originally built, meaning only accessible by stairs. The city argues that the entire bridge will 'probably' be replaced when the area is developed, something that has been said about the area for almost 30 years.

What was also noted by the bridges in Gothenburg was that when the purpose seems to be to connect the city through commuter cycling, there is a cycle path and ramps. When the bridge is intended to simply connect the different sides of the barrier, there is usually no cycle path. Shouldn't there be a requirement that all bridges have a minimum width of three metres, which is Gothenburg's own minimum requirement for combined footpaths and cycle paths, instead of the minimum measurement of 2.5 metres that applies to ordinary freestanding footpaths? Gothenburg's residents should be able to decide for themselves which route to take and which mode of transport to use, instead of the city deciding for them through varying degrees of accessibility.

The work also aims to highlight the importance of working with visual connections to barrier-reducing solutions. When a barrier-creating structure clearly exists, it is important that the bridging structure, such as a bridge, is clearly visible. If you know that there is a barrier, but you can also see that there is a way to cross it, the psychological perception of separation can be reduced. It is therefore wise to work with visual connections from the surrounding area to the bridge itself or the connection points that link the bridge to the street network.

One consideration regarding the bridge proposal for Älvängen is that the load-bearing structure has not been dimensioned and would most likely need to be modified. The highway and railroad limit the possible locations for bridge supports to a few points, resulting in long spans that place high demands on the load-bearing structure. These demands mean that the bridge's design is more influenced by technical considerations than by aesthetic ones. In this proposal, aesthetic aspects have taken priority over technical ones. In reality, more bridge piers and a stronger load-bearing structure over the highway and railroad are likely to be needed.

The "Connect the network" design principle has proven more difficult to implement in this project than initially anticipated. Specifically, the spot on the riverside where the bridge lands and meets Fabriksvägen. How do you connect a newly built bike path to a bike path that doesn't exist? It creates a transition point that is difficult to design in a way that feels well-thought-out. Should the bike path end with a turning circle, just like for cars? Or should it simply continue out onto the surrounding area, which in this case is a narrow private street?

The remaining design principles have been easy to implement. Name? Make one up! Guiding elements? Create guiding elements through simple visual connections that draw on characteristics found in the bridging structure. Accessibility may be space-intensive, but it can always be solved. It's a matter of cost. Simplicity in construction and implementation can be achieved through structured and interdisciplinary collaboration with all involved parties from the start. Color schemes are resolved by involving a creative person in the project. Purpose is determined at the beginning by asking, "Why is this needed?"

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7.1 Images & Figures

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APPENDIX

+A

+A.1 Use of AI

+A.2 Overpass Turbo Query

+A.3 QuickOSM Query

+A.4 Photographic documentation of footbridges in Gothenburg

+A.1 Use of AI

This project has primarily used AI as a tool to improve language and wording. DeepL has been used for this purpose. ChatGPT has been used to engage in discussion and has been useful in the project in creating a better understanding of concepts, situations and complex problems. ChatGPT has also been used to find sources and information.

ChatGPT has been used on occasions when code language needed to be written.

AI has not been used to generate final text from scratch or any image material.

Examples of questions asked to ChatGPT are:

“Is this sentence clearly written? Highlight anything that could be improved in bold and provide suggestions in brackets. Do not edit the original text.”

“Explain what SCAFT planning is and refer to the sources you have used for your summary.”

“There is a footbridge at the shopping centre in Frölunda. It crosses the motorway. Can you find out if it has a name?”

“Write a query to OverpassTurbo that searches for freestanding footbridges in Gothenburg.”

+A.2 Overpass Turbo Query

To identify different elements in data from OpenStreetMap (OSM), the website Overpass Turbo (https://overpass-turbo.eu/) was used. By combining different keys with specific values, it is possible to identify different characteristics in the built environment.

Query 1 requested pedestrian and cycle bridges in general. Query 2 requested pedestrian and cycle bridges that are not located within 10 metres of car bridges in order to exclude ordinary bridges with pedestrian and cycle paths running alongside them.

The data in OSM is georeferenced, usually to a point on the specified element where the information is stored. Therefore, errors sometimes occur in different queries when requesting data within a specific area. Some manual intervention has been made to the data provided by Overpass Turbo. As a result, some errors may occur.

Chat GPT was used to translate normal text into code language for the various queries used in Overpass Turbo.

The queries used are:

Query 1:

```
[out:json][timeout:25];

// Gång- och cykelbroar i det synliga området
way
  [“bridge”]
  [“highway”~”^(footway|cycleway|path)$”]
  ({{bbox}});
out body;
>;

out skel qt;
```

Query 2:

```
[out:json][timeout:25];

// Hitta noder på bilbroar
way[“bridge”][“highway”~”^(motorway|trunk|primary|secondary|
tertiary|residential|unclassified|service)$”]({{bbox}})
  ->.car_ways;
node(w.car_ways) -> .car_nodes;

// Hitta gång-/cykelbroar som inte ligger nära bilbroarnas noder
way[“bridge”][“highway”~”^(footway|cycleway|path)$”]({{bbox}})
  (around.car_nodes:10) -> .close_to_car;
way[“bridge”][“highway”~”^(footway|cycleway|path)$”]({{bbox}})
  ->.all_footcycle;

// Ta bara med gång-/cykelbroar som INTE ligger nära bilbroar
(.all_footcycle; - .close_to_car;);
out body;
>;

out skel qt;
```

+A.3

QuickOSM Query

To create a street network in QGIS, the QuickOSM plugin in the programme was used to retrieve map features based on specific keys.

For the pedestrian and cycle network, the key “highway” was searched for, which contains data on roads and footpaths. The search was further specified with the following specific values.

‘highway’=’residential’ or

‘highway’=’steps’ or

‘highway’=’unclassified’ or

‘highway’=’service’ or

‘highway’=’living_street’ or

‘highway’=’track’ or

‘highway’=’path’ or

‘highway’=’cycleway’ or

‘highway’=’footway’ or

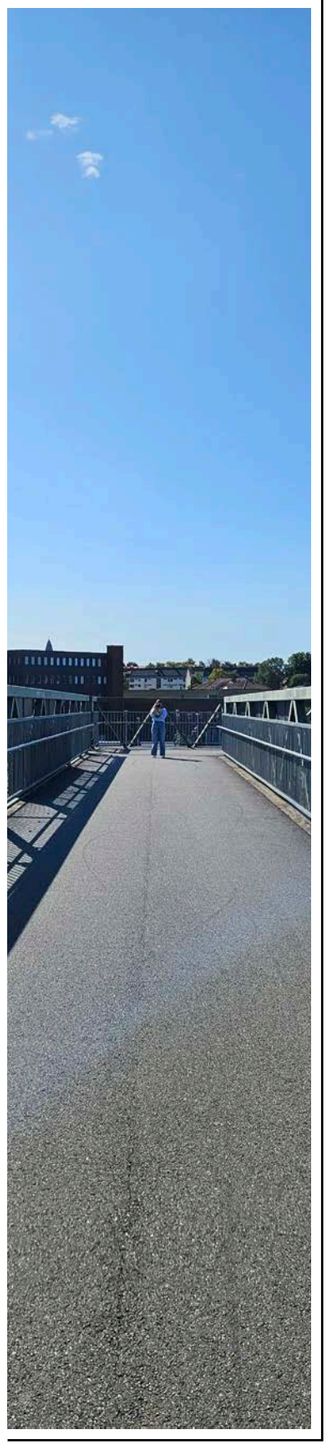
‘highway’=’pedestrian’ or

‘highway’=’tertiary’ and ‘bicycle’=’yes’

+A.4

Photographic documentation of footbridges in Gothenburg

The following appendix contains photographic documentation of a number of pedestrian and cycle bridges identified in Gothenburg. The photographs were taken in August and September, 2025.



A big thank you to my friend Elli, who helped me photograph and document the bridges!

Thesis name: **02. PB-BRIDGE INLANDSGATAN**

Real name (if found): -
Geolocation: *57°42'42"N 11°55'58"E*
Year built: *2014/2015*

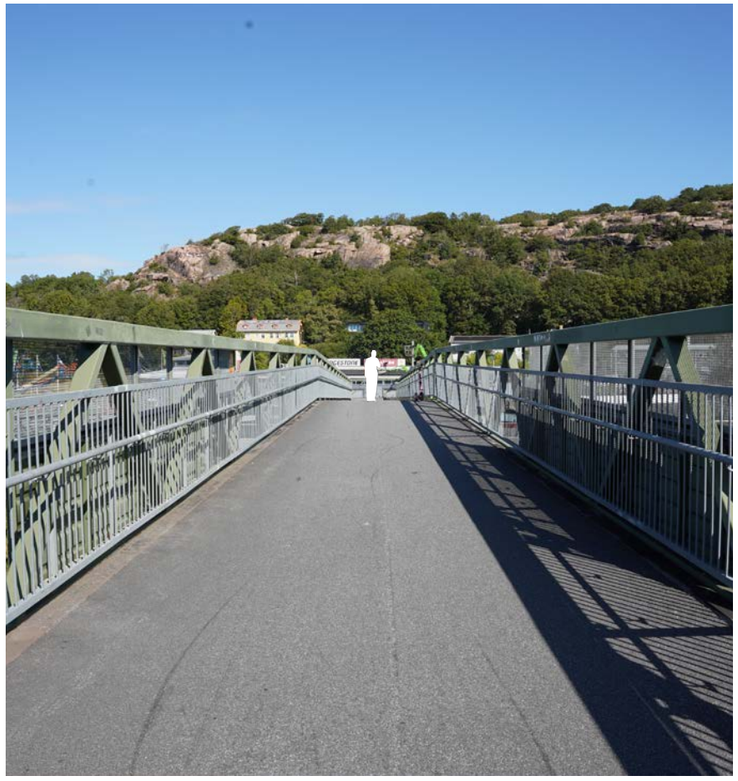
Main construction material: *Steel*
Structure: *Truss bridge*
Stairs or ramps: *Ramps, both stairs and ramp on south side.*
Separated bike and pedestrian paths: *No*
Bridge deck width: *390 cm*
Designed elements: *None*

Other information: The bridge spans Lundbyleden and Hamnbanan, connecting Hisingen and Rambergsstaden with Lindholmen. Both areas have residential and office buildings. Lindholmen is predominantly offices and schools. Volvo is a major player in Rambergsstaden.

Overview



Axial view



Railing



Bridge deck



North side towards Rambergsstaden



Underbody and structural design



South side towards Lindholmen



Structural connections



Seperated traffic merges



Nature taking over



Thesis name: **03. P-BRIDGE GAMLESTADEN**

Real name (if found): *Fåfängan*
Geolocation: *57°43'27"N 12°00'47"E*
Year built: *Unknown, before 1958*

Main construction material: *Steel*
Structure: *Truss bridge*
Stairs or ramps: *Only stairs*
Separated bike and pedestrian paths: *Only pedestrian path*
Bridge deck width: *200 cm*
Designed elements: *New part of the bridge have a designed look and patterns*

Other information:

The first part of the bridge, which was replaced in 2019, was built over the railway before 1958. When the motorway was built, sometime between 1965 and 1977, the bridge was extended.

The bridge is believed to have been built so that industrial workers living in Härlanda and Bagaregården could walk to their jobs in Gamlestaden, primarily SKF.

Overview



Axial view



Underbody and structural design



Entrance from Brämaregården



Transition from old to new



Railing



Bridge deck



North side in Gamlestaden industry



South side towards Brämaregården



South connection to street network



Thesis name: **04. P-BRIDGE GÅRDA**

Real name (if found): -
Geolocation: 57°42'03"N 11°59'42"E
Year built: *Unknown, between 1968-1971*

Main construction material: *Steel*
Structure: *Vierendeel bridge*
Stairs or ramps: *Only stairs, but there are gutters for bicycles and strollers*
Separated bike and pedestrian paths: *Only pedestrian path*
Bridge deck width: *200 cm*
Designed elements: *Arguably, the cross-braces in the bridge's construction enhance its aesthetics*

Other information: A footbridge stretching across the E6 motorway and connecting Överås (Örgryte), a privileged wealthy area, with Gårda and Heden. The purpose, need and location are unclear.

Overview



Axial view



Railing



Bridge deck



West side in Gårda



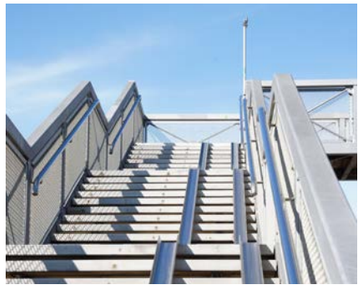
Underbody and structural design



East side in Örgryte



Gutters for bicycles and strollers



Wooden deck



Adapted footing



Thesis name: **05. P-BRIDGE BRÄMAREGÅRDEN**

Real name (if found): *Ludvig Tingströms gångbro*
Geolocation: *57°43'03"N 11°57'07"E*
Year built: *Unknow, between 1968-1973*

Main construction material: *Steel*
Structure: *Vierendeel bridge*
Stairs or ramps: *Only stairs, but there are gutters for bicycles*
Separated bike and pedestrian paths: *Only pedestrian path*
Bridge deck width: *175 cm*
Designed elements: *None*

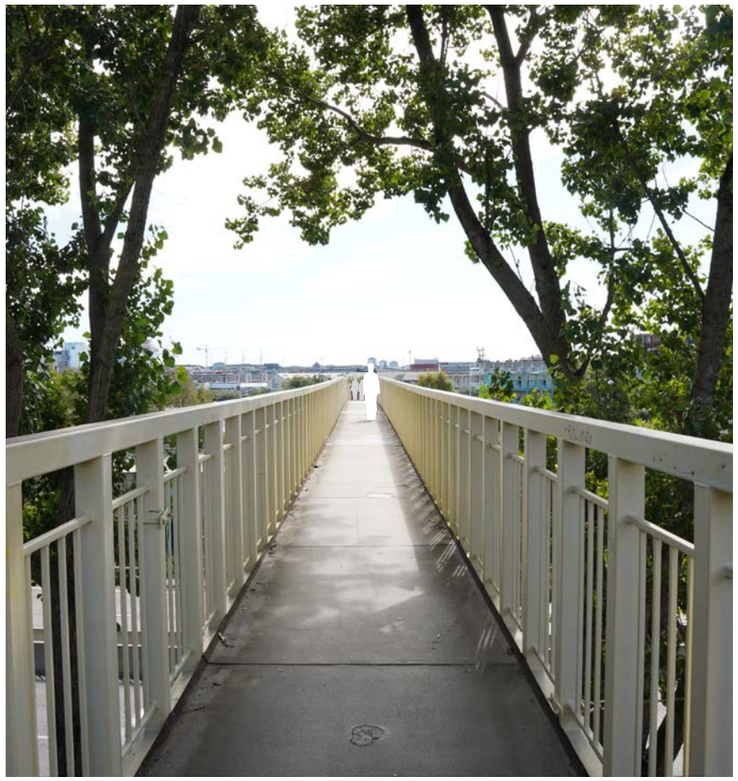
Other information: A footbridge connecting residential areas in Brämaregården with what used to be the port industry in Frihamnen. Today, Frihamnen is an undefined area that is expected to be developed with offices and housing.

The bridge was extended in 2024 to also bridge the new tram line. Voices and a "Göteborgsförslag" have been submitted to the city to make the bridge accessible.

Overview



Axial view



Railing



Bridge deck



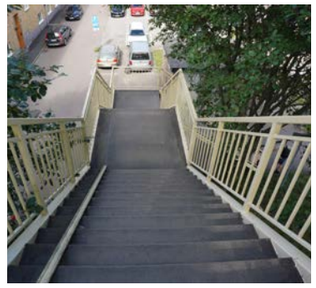
East side in Frihamnen



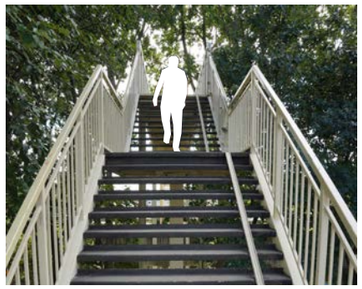
Underbody and structural design



West side in Brämaregården



Gutters for bicycles. but not strollers



Contrast in cosiness



Change in dimension



Thesis name: **07. PB-BRO HÖGSBOHÖJD**

Real name (if found): -
Geolocation: *57°40'48"N 11°54'33"E*
Year built: *Unknown, between 1959-1968*

Main construction material: *Concrete*
Structure: *Beam and slab bridge*
Stairs or ramps: *Ramps*
Separated bike and pedestrian paths: *No*
Bridge deck width: *240 cm*
Designed elements: *None*

Other information: The bridge spans high above Högsboleden, connecting the residential area of Grimmered with the industrial area of Kungsten and onward to Sandarna.

There is no other concrete bridge in Gothenburg that looks like this in terms of its load-bearing structure, but the railing is identical to other pedestrian and bicycle bridges from this period.

Overview



Axial view



Railing



Bridge deck



North side towards Kungsten / Sanna



Underbody and structural design



South side towards Grimmered



A little rust



Bridge deck assembly



Sneak peek through vegetation



Thesis name: **09. PB-bro Frölunda**

Real name (if found): *Topasbron*
Geolocation: *57°39'00"N 11°54'37"E*
Year built: *Unknown, between 1963-1967*

Main construction material: *Concrete*
Structure: *Slab bridge*
Stairs or ramps: *Ramps*
Separated bike and pedestrian paths: *Yes*
Bridge deck width: *400 cm*
Designed elements: *Mosaic on the inner sides of the footbridge*

Other information:

In 2024, the municipal housing company Bostadsbolaget (which owns the apartments adjacent to the bridge) announced a competition to name the bridge, which had been nameless for nearly 60 years.

The winning name was Topasbron, on the grounds that Topasgatan begins where the bridge ends.

Overview



Axial view



Railing



Bridge deck



North side with towards the shoppning center Frölunda Torg



Underbody and structural design



South side towards Ängås



A guiding sign with the bridge name



Mosaic



Bike lane ending in open space?



Thesis name: **10. PB-bro Frölunda 3**

Real name (if found): -
Geolocation: 57°38'49"N 11°55'14"E
Year built: *Unknown, between 1975-1977*

Main construction material: *Steel*
Structure: *Vierendeel bridge*
Stairs or ramps: *Ramps*
Separated bike and pedestrian paths: *No*
Bridge deck width: *290 cm*
Designed elements: *None*

Other information: A simple footbridge, which is also accessible to cyclists, connecting the terraced housing estate along Toftaåsgatan with Frölunda.

The bridge seems to be popular with graffiti artists, who tag it with permanent marker, which is then washed off by the local council. Over and over again.

Overview



Axial view



Railing



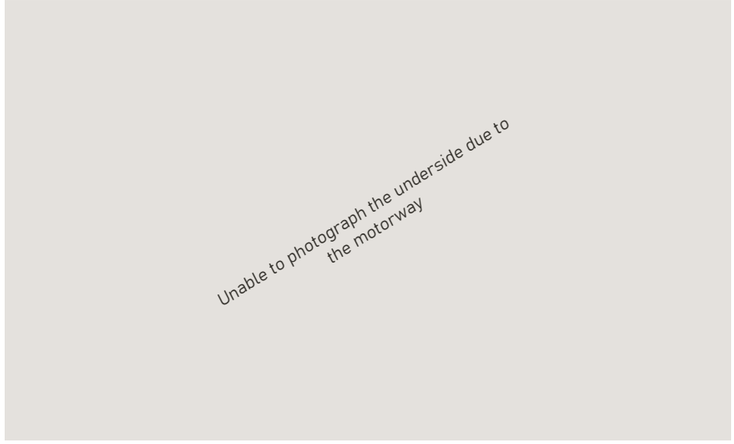
Bridge deck



North side towards Frölunda



Underbody and structural design



South side towards Toftaåsagatan



Man made disired path towards the bridge



Railings covered in graffiti tags



Parts of the bridge have been cleaned



Thesis name: **17. PB-bridge Partille**

Real name (if found): -
Geolocation: *57°43'49"N 12°06'36"E*
Year built: *Estimated around 1982–1985 when the residential area was built*

Main construction material: *Concrete*
Structure: *Concrete beam bridge*
Stairs or ramps: *Both*
Separated bike and pedestrian paths: *No*
Bridge deck width: *300 cm*
Designed elements: *None that can be seen from a distance*

Other information: Bridge designed to separate pedestrians and cyclists from the busy road between Partille and Landvetter. Inspired by SCAFT planning, which was popular in the 1970s.

Overview



Axial view



Underbody and structural design



Cast pattern in concrete



Technical detail



Railing



Bridge deck



East side towards Partille



West side towards Björndammsterrassen



Ramp and stairs to bus stop



Thesis name: **19. PB-bro Askim 2**

Real name (if found): -
Geolocation: 57°37'48"N 11°55'56"E
Year built: *Unknown, between 1974-1976*

Main construction material: *Steel*
Structure: *Vierendeel bridge*
Stairs or ramps: *Both*
Separated bike and pedestrian paths: *No*
Bridge deck width: *Unknown, approx 240 cm.*
Designed elements: *None*

Other information: A footbridge over the motorway, strategically positioned to serve the bus stop. It connects the residential areas in Askim and provides access to the bus stop.

It has a twin bridge at the next bus stop, spanning the same motorway.

Overview



Axial view



Underbody and structural design



Missing part for rain water drainage



Person using the bike ramp



Railing



Bridge deck



East side



West side towards the ocean



Bicycle rack underneath the bridge



Thesis name: **21. P-BRIDGE GÖTA ÄLV**

Real name (if found): -
Geolocation: 57°46'01"N 12°00'23"E
Year built: 2011-2012

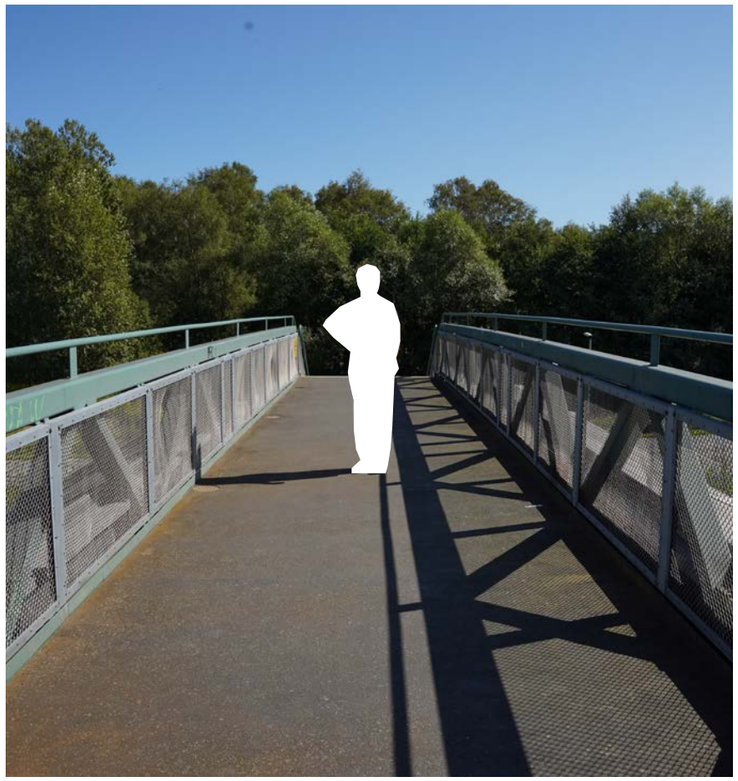
Main construction material: Steel
Structure: Truss bridge
Stairs or ramps: Stairs
Separated bike and pedestrian paths: Only pedestrian path
Bridge deck width: 300 cm
Designed elements: None

Other information: Why this bridge exists is unclear. According to the documents that have been found, it was built to replace a level crossing when the railway was rebuilt in 2011. The level crossing led to a municipal facility to which a new car accessible road was built from the other side. On this side, where the bridge is located, the facility is enclosed by a fence. There is only a stepped path leading 20 metres down to the Göta Älv river, nothing else.

Overview



Axial view



Railing



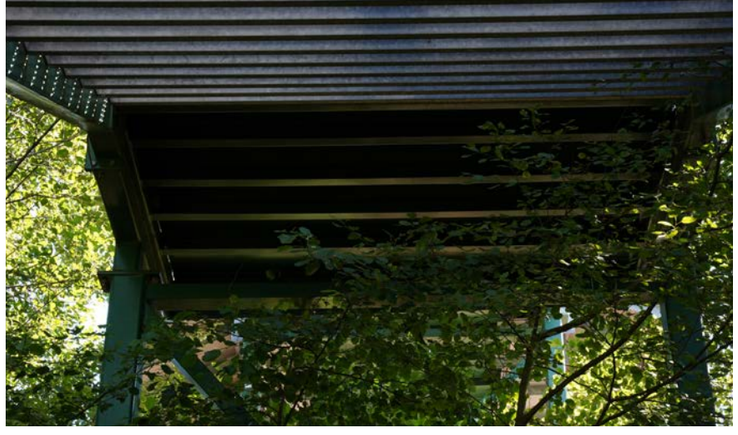
Bridge deck



West side towards nowhere (Göte Älv)



Underbody and structural design



East side towards Hjällbo



Destruction



Nature is approaching



The road to nowhere



Thesis name: **24. PB-BRIDGE HJÄLLBO**

Real name (if found): -
Geolocation: 57°46'24"N 12°01'23"E
Year built: *Unknown, between 1970-1972*

Main construction material: *Concrete*
Structure: *Slab bridge*
Stairs or ramps: *Ramps*
Separated bike and pedestrian paths: *No*
Bridge deck width: *410 cm*
Designed elements: *None*

Other information: Located in the northern part of Hjällbo, the bridge connects different residential areas on the western and eastern sides of Hjällboplatsen, the thoroughfare that runs straight through the neighbourhood centre. The bridge has clear links to SCAFT planning, which was popular in the 1970s when many million programme areas were built. The eastern side of the bridge connects to Hammarkullen.

Overview



Axial view



Railing



Bridge deck



West side connection



Underbody and structural design



East side towards Hammarkullen



Desired path and poor drainage



Railing detail



Stone paving under the bridge



Thesis name: **29. PB-BRIDGE LÄNSMANSGÅRDEN 2**

Real name (if found): -
Geolocation: 57°43'41"N 11°53'38"E
Year built: *Unknown, between 1962-1966*

Main construction material: *Concrete*
Structure: *Beam and slab bridge*
Stairs or ramps: *Ramps*
Separated bike and pedestrian paths: *No*
Bridge deck width: *230 cm*
Designed elements: *Yes, the underside is softly shaped and the railings are painted.*

Other information: The bridge connects Svartedalen on the east side with Länsmansgården/Biskopsgården on the west side. Possibly an early example of SCAFT planning. 80 metres south of the bridge, there are pedestrian crossings at the public transport stop, allowing pedestrians to cross both the road and the tramway.

Overview



Axial view



Railing



Bridge deck



West side connection



Underbody and structural design



East side connection



Handrail detail



Railing detail



Desired path for a quicker connection



Thesis name: **34. P-bro Amerikaskjulet**

Real name (if found): *Erik Johannessons Gångbro*
Geolocation: *57°41'59"N 11°55'56"E*
Year built: *Unknown, between 1988-1990*

Main construction material: *Steel*
Structure: *Truss bridge*
Stairs or ramps: *Stairs*
Separated bike and pedestrian paths: *No*
Bridge deck width: *190 cm*
Designed elements: *None*

Other information: A pedestrian bridge built to allow people who work at "Amerikahuset" to walk there without having to take a long detour.

On one side of the bridge, there is a bike gutter on the stairs to make it easier to move bicycles, but not on the other side.

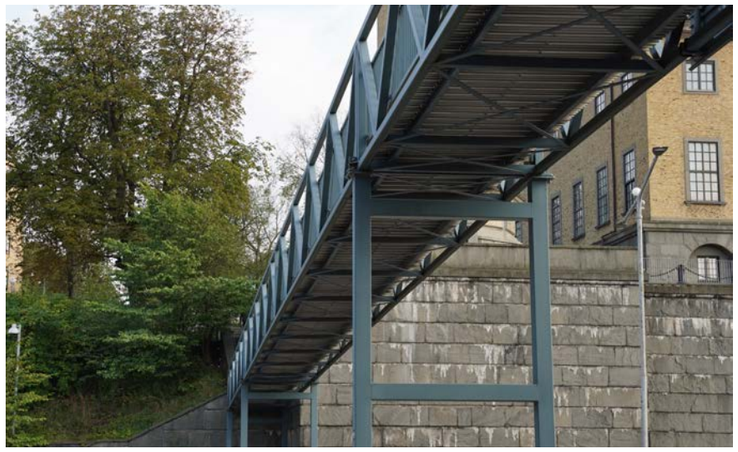
Overview



Axial view



Underbody and structural design



Neglected steps



Bridge deck assembly



Railing



Bridge deck



East side with Gårdstensskolan



West side towards Gårdsten



In need of a wash



Thesis name: **35. PB-bro Gråberget**

Real name (if found): -
Geolocation: 57°41'26"N 11°55'11"E
Year built: *Unknown, between 1973-1974*

Main construction material: *Concrete*
Structure: *Concrete beam bridge*
Stairs or ramps: *Both*
Separated bike and pedestrian paths: *No*
Bridge deck width: *Unknown, approx 300 cm*
Designed elements: *The exterior of the bridge is decorated with a painted mural*

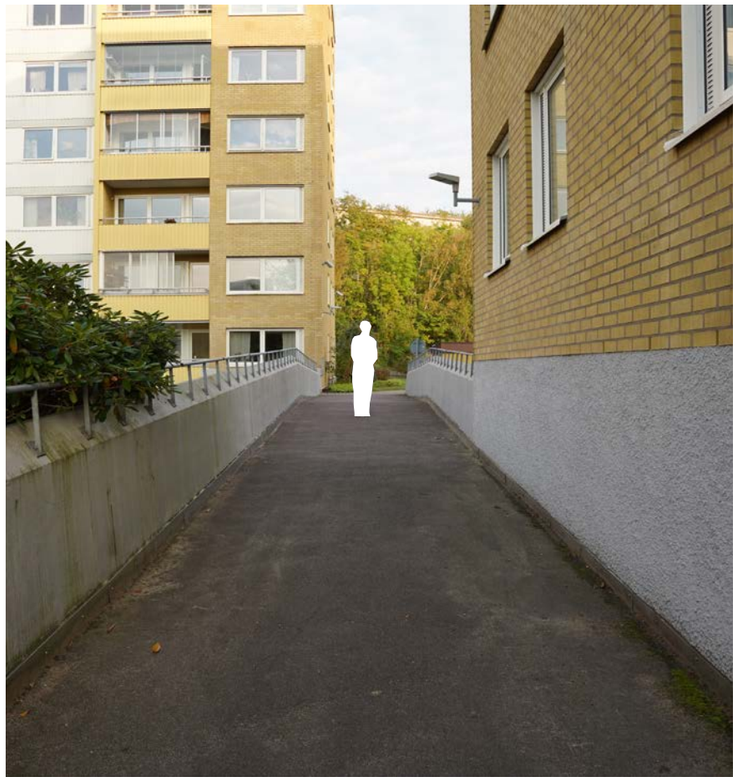
Other information: A small, simple pedestrian and bicycle bridge connecting two courtyards within the same residential complex.

It is clear that the bridge is part of the overall housing project and was included in the original design specifications.

Overview



Axial view



Railing



Bridge deck



East side



Underbody and structural design



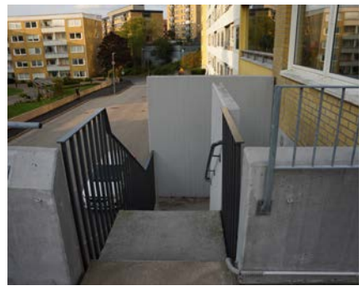
West side



Mural painting



Tiny staircase



Tiny staircase



Thesis name: **38. PB-bro Tynnered**

Real name (if found): -
Geolocation: 57°39'03"N 11°54'19"E
Year built: *Unknown, between 1981-2004*

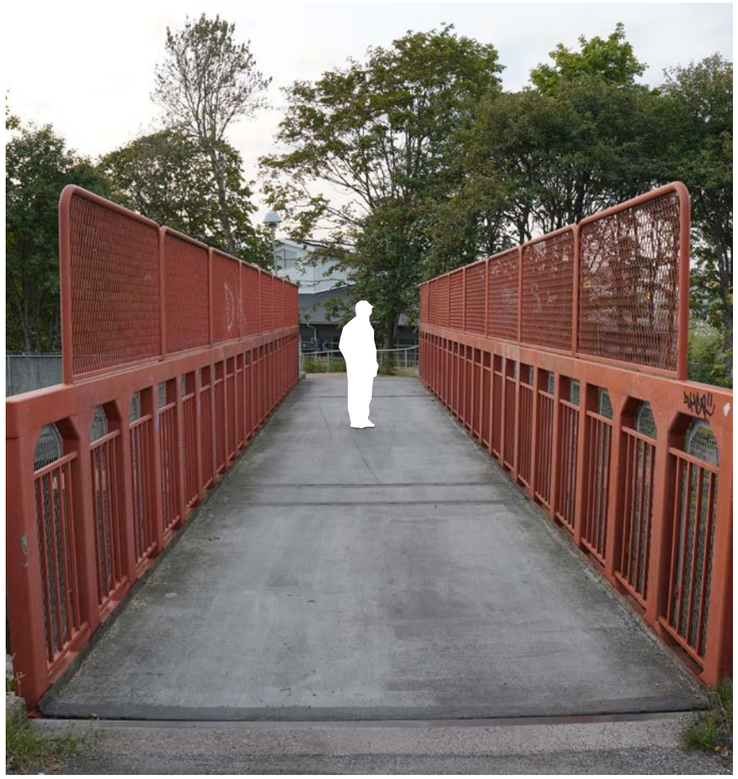
Main construction material: *Steel*
Structure: *Vierendeel bridge*
Stairs or ramps: *Ramps*
Separated bike and pedestrian paths: *No*
Bridge deck width: *290 cm*
Designed elements: *None*

Other information: A short bridge connecting the residential areas that have been separated by the tram tracks. The railings have clearly been extended retroactively to meet modern safety standards regarding the tramway's overhead wires. The same type of railing that the tramway had in stock was used.

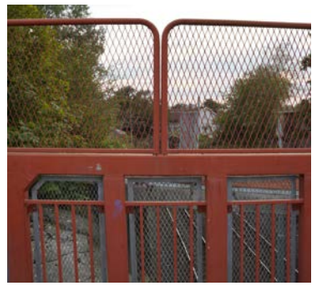
Overview



Axial view



Railing



Bridge deck



South side towards Topasgatan



Underbody and structural design



North side towards Pingstkyrkan



A little rust



Railings installed as an afterthought



Tram about to pass underneath



Thesis name: **44. PB-bridge Angered 2**

Real name (if found): -
Geolocation: 57°48'07"N 12°02'32"E
Year built: *Unknown, between 1972-1975*

Main construction material: *Steel*
Structure: *Vierendeel bridge*
Stairs or ramps: *Ramps*
Separated bike and pedestrian paths: *No*
Bridge deck width: *240 cm*
Designed elements: *None*

Other information: The bridge was built before anything else existed in the area, shortly after the large new road was constructed. At that time, the road was twice as wide as it is today. There used to be a smaller country road connecting the agricultural properties. Today, the bridge is probably used a lot, as the temporary premises of Gårdstensskolan (grades 4-9) have been located next to the bridge since 2019. Most of the pupils are believed to live in the Gårdsten million programme, which is located up on the hill.

Overview



Axial view



Railing



Bridge deck



East side with Gårdstensskolan



Underbody and structural design



West side towards Gårdsten



A little rust



Bridge deck assembly



In need of a wash



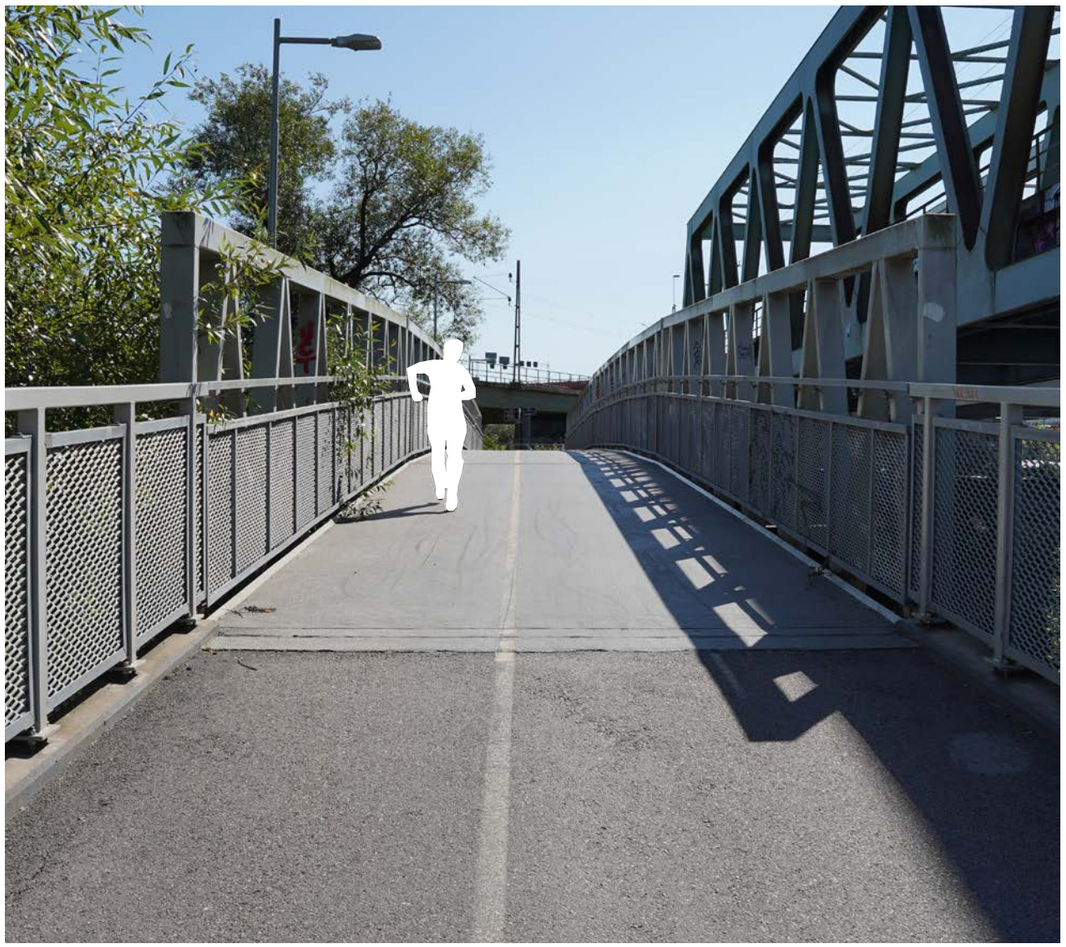
Thesis name: **70. PB-BRIDGE GAMLESTADEN**

Real name (if found): -
Geolocation: *57°43'34"N 12°00'07"E*
Year built: *2017*

Main construction material: *Steel*
Structure: *Truss bridge*
Stairs or ramps: *Not needed, ground level*
Separated bike and pedestrian paths: *Yes*
Bridge deck width: *400 cm*
Designed elements: *None*

Other information: Connects the Slakthusområdet area, continuing towards Hisingen, with Gamlestaden and eastern Gothenburg. The purpose is clear, as it forms part of the commuter cycle network. However, it is unclear why it was needed when, in 2014, three years earlier, a new bridge with similar characteristics was built 55 metres south of this one.

Overview



Axial view



Railing



Bridge deck



North side



Underbody and structural design



South side towards Gamlestadens torg



Meeting between railings



Bigger brother truss bridge



South side towards Partihallarna



Thank you!