



CHALMERS
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Making Bike Parking Better

Planning bicycle parking facilities and layout for the area at Varberg's new train station

Master of Science Thesis in Industrial and Materials Science

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ABSTRACT

Bicycle parking facilities is a highly relevant field within sustainable urban development. If done right it can contribute to increased travels by bicycle which in term contributes to winnings in both health, environment and economy.

The main goal of this project was to give guidance to the municipality of Varberg in the choice of bicycle parking solutions and the layout of the parking areas at Varberg's new train station. This was done by a great variety of methods. The most prominent ones have been observations of existing solutions and bicycle parking areas, surveys that reached out to the potential users and interviews with cyclists in the real context of a station area. Throughout the process, people in the bicycle industry have been consulted as well as urban planners and non-direct users of the bicycle parking.

The result of the thesis is a plan of the layout of the bicycle parking areas at Varberg's new station area as well as recommendations on which products to use. The layout of the area entails: a clear overview, good accessibility for all visitors, a guidance of how to use the different solutions and thus, leading to an orderly looking parking area. Furthermore, another part of the outcome is an individual parking box module that can easily be adapted to the need of securer parking at a specific location.

Keywords: bicycle parking, bicycle infrastructure, urban development, public transport hub

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1. INTRODUCTION

Varberg has a long history as a bicycle city which is linked to that Monark, the world leading bicycle manufacturer in 1930-1940 was founded here and is still operating (Monark, n.d.). An investment in bicycle infrastructure entails that Varberg can live up to its good reputation as a bicycle city.

This master's thesis has been carried through in collaboration with the municipality of Varberg and the *Varberg Tunnel Project*. As a part of a great urban development of the city, a new train station will be built. The municipality of Varberg wanted inspiration and help with finding suitable solutions to meet the need for bicycle parking at the new station that will be ready 2024. New public transport hubs enables planning for increased public transportation through, among other things, more attractive and functional bicycle parking facilities (Boverket, 2010).

45% of the car journeys in Sweden are shorter than five kilometre, a distance one cycles in a quarter of an hour (Spolander, 2014). About 10% of the travellers take the bike to or from Swedish railway stations today, however approximately 40% of the country's population lives within two kilometres of a railway station (ibid.). Thus, the potential to get more people to choose to travel by bike to the train instead of car is great. Increased travels by bike contributes to improved health as well as reduced air pollution and economic benefits (Skog, 2017). Well-functioning bicycle parking can be a crucial reason for choosing the bike as means of transportation (Boverket, 2010).

The existing parking situation for bicycles at the train station of Varberg is chaotic. There is a great number of bicycles and the opportunities to park does not match the number of bikes. Many bikes are parked outside of the intended bike racks and bike theft is the most common crime in the municipality (Berntsson, 2018). The new train station requires solutions for secure and effective storage of bicycles. By 2024 the number of electrical-powered bikes as well as cargo bikes will most likely increase. This in term puts new demands on bicycle parking solutions at the train station.

1.1 AIM

The aim of this project is to give guidance to the municipality of Varberg in the choice of bicycle parking solutions and the layout of the parking areas at Varberg's new train station. To meet the stakeholder needs, existing products will be recommended, and a new product developed. Visual graphics of new parking solutions and the layout are parts of the outcome of the project.

RESEARCH QUESTIONS

The following questions will be answered during the project:

- What are the needs linked to parking of bikes at Varberg's new train station? The future trends in the area of cycling needs to be kept in consideration while identifying the needs. Also, the needs of a wide range of stakeholders and different kind of users should be covered.
- How can the future parking solution get people to park their bike in a correct way? The correct way of parking means using the parking solution in the intended way and not choosing to park the bike at other areas close by.
- Which existing solutions are out there? Which qualities and values can be found in the existing solutions and what flaws and problems are there?
- Could additional value be added to the upcoming parking solutions or to the parking areas in order to make them more attractive?
- What can be done to prevent bike theft, vandalism and to prevent people from feeling unsafe? Safety and security aspects of the design will be looked into together with the effect of the placement and surroundings of the parking solutions.

1.2 SCOPE

Focus is put on the main users, the cyclists. However, other actors such as maintenance personnel are taken into consideration. This project covers a comprehensive view of bicycle parking, from placement and design of the area to specific solutions and services related to cycling. Detailed designs of the future solutions are therefore only briefly covered in this project.

The project is dependent on the work of many actors. For instance, where the areas for bicycle parking are planned to be located and their size have been decided by the *Varberg Tunnel Project*. Other actors have interest in car parking and the accessibility for busses and other means of transportation which may influence the function of the bicycle parking areas.

Another limitation to consider is the money assigned to be used for parking of bicycles. This in term means that a highly complex and technical solution will not be feasible if it is costly. Furthermore, the choice of having underground bicycle parking is already excluded by the municipality of Varberg.

1.3 THE STRUCTURE OF THIS THESIS

The process used in this project is presented right after this section followed by a chapter explaining the importance of a well-functioning bicycle infrastructure. The next-coming chapter presents an introduction to the *Varberg Tunnel Project* as well as information about the stakeholders and their responsibilities of the bicycle parking at the future station. A chapter compiling different bike types and additional equipment which can be attached to them follows. Before moving on to existing bike parking solutions and the insights gathered about them a section about bike theft and secure locking is presented.

Furthermore, additional value that can be added to a bicycle parking solution to increase the user experience is presented, followed by a chapter regarding placement and layout of bicycle parking areas. Before moving on to the final chapters presenting the end result, a section describing the summarised results so far is presented. The results are followed by a discussion of the project, recommendations for further development and conclusions. The structure of the thesis is also illustrated in figure 1.

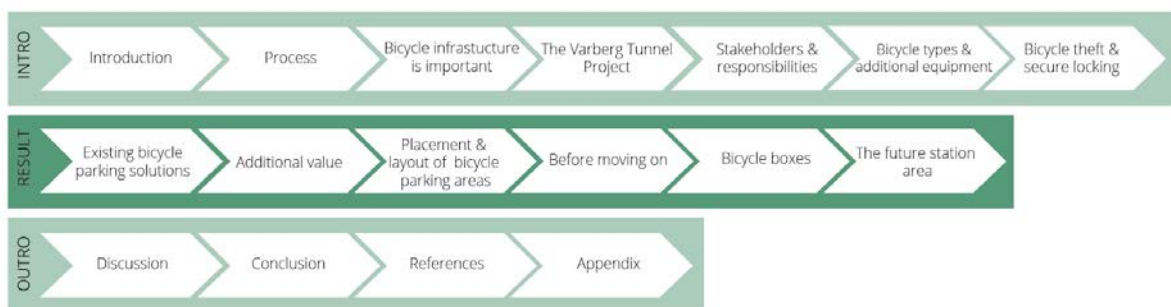


Figure 1. An illustration of the thesis structure

2. PROCESS

Planning, searching, testing, analysing, designing, developing and evaluating have been parts of the process. Since these areas are linked together, the process of this project has been iterative with overlapping phases and trade-off decisions. Even if this chapter is structured into coherent sections describing work phases, the process looked more like the visualisation in figure 2.

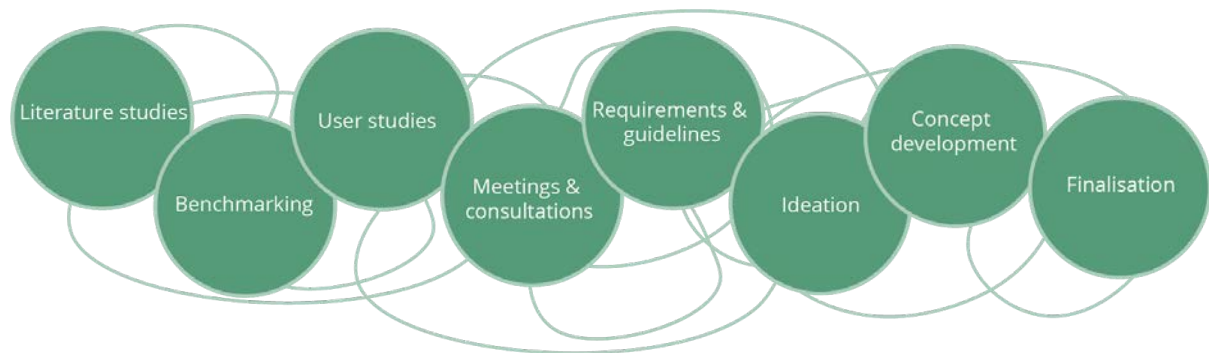


Figure 2. An overview of the process

The process of this project can be divided into two main phases, an exploration phase and a concept generation phase. Both of these are described in the following sections.

2.1 EXPLORATION PHASE

Information about users, stakeholders and existing solutions used for bicycle parking have been gathered during this phase. Factors that determines if a bicycle parking is appreciated and well-functioning or not were also looked into. To get insights about the *Varberg Tunnel Project* and what the new station area is planned to look like was also a major part of this phase.

LITERATURE STUDY

The project was initiated with a literature study in order to gain knowledge about the *Varberg Tunnel Project* and to understand the prerequisites of the project. Documents with information about bicycling and parking facilities from both the municipality of Varberg and other municipalities were a great part of the literature studies. Several cities have their own planning document covering bicycle infrastructure from which information applicable on this project were found.

Issues arisen during the project were partly solved by searching for literature by the use of search engines such as Google scholar, Chalmers Library and Google.

EXPLORING THE FIELD

To gather inspiration for concept generation and get increased understanding of the state of the art, trends and frequently used products, existing designs were explored. Products closely connected to bicycles and bicycle parking were explored together with products in other fields where space efficiency and storage is important, e.g. car parking and storage in warehouses.

Data were gathered by using the search engines Google, Pinterest and Behance. Pictures from study trips and bicycle parking solutions located in Varberg were also used. Since the economy of the project was strictly limited, the street view tool of Google Maps was used for exploring how other cities and countries copes with bicycle infrastructure. As seen in figure 3, pictures and ideas found were printed, sketched or written on paper.

Affinity diagram was then used as a method to organise the information found. By sorting the information and dividing it into categories, insight of different areas to further explore could be obtained. The following categories were found:

- Front wheel racks
- Hanging and vertically parked bicycles
- Storage
- Built in locks
- Information, signs and markings
- Bicycle boxes
- Automatic solutions
- Charging
- Weather protection
- Social value
- Artistic value
- Other additional value
- Multi-story parking
- Bollards
- Garage
- Car parking
- Arrangement of parking areas
- Other



Figure 3. Exploring the field by printed pictures and sketching

Affinity diagram is an analysis method that starts with collected data being studied in detail in order to then, step by step be studied from a more holistic perspective. The result from the data collection is written down on small pieces of paper, where each piece of paper represents one category of data. These are then sorted by different themes that get different names (Bligård, 2015).

WEB SURVEY 1

To get information from the users, a web survey was created and posted in several Facebook groups. Most of the groups had emphasis on bicycling. However, it was also posted in a group that reaches out to inhabitants of Varberg. In total, the survey got 214 replies.

The main purpose of this first survey was to get general insights in people's bicycle habits and attitudes towards bicycle parking. The participants got to answer questions about their bicycle, safety aspects, experiences etc. The entire questionnaire and the answers can be found in appendix 1.

A survey is efficient since it, with the right medium reaches a large number of people in relation to the effort needed. Yet, the questions in a survey must be structured in advance and there is no possibility for spontaneous follow-up questions. Because of this, interviews were performed as a complement.

INTERVIEWS

Two rounds of interviews were performed during the project. Both were semi structured and conducted at the current bicycle parking at Varberg's station. By performing the interviews at a parking area with people that were about to park or pick up their bicycle, the parking solutions and the surroundings could be used as means of communication. In addition to the predetermined questions, follow up questions were asked based on the participant's experiences and opinions.

Questions asked at the first round of interviews covered areas such as the participant's cycling and parking habits, how they lock their bike, how safe they feel leaving the bicycle when it is parked, their thoughts on the current parking area and how it could be improved to better fit their needs. The core questions and the answers of the first interviews can be found in appendix 2. The number of interviews performed were 15.

The questions for the second round of interviews were to a higher extent focused on the future station area, the participants direction of arrival, what parking section they believe they will choose and why. A map of the future station area was used as a communication tool. Only a few of these interviews were performed before it was deemed more efficient to ask these questions by the use of an online questionnaire. However, the effort put in the interviews was not wasted since it gave insights to the structure of the survey.

OBSERVATIONS

Observations were performed to explore how different parking solutions and the design of parking areas affects the behaviour of cyclists. This was done both by observing areas with parked bicycles, and cyclists that parked or picked up their bicycle. By discussing the way bicycles were parked and how the arrangement within a parking area can influence if a bicycle is parked in the intended way, common denominators for well-functioning parking areas could be identified. Also, pitfalls that often leads to incorrectly parked bicycles were found. These findings could later be used when the layout of the future parking area was determined. Observations of cyclists using products designed for bicycle parking gave insights of how cyclists actually act when they park or pick up their bicycle. Advantages and disadvantages of different designs could be identified and the answers concerning behaviour from the surveys and interviews could be validated.

Pictures and notes were taken to document the design of current bicycle parking areas and the insights made when observing parking areas and users. A series of structured observations were performed at study visits during the project. Less structured observations were also performed in everyday life. Based on the outcome from the surveys, the interviews and the observations, personas mirroring people in the target group could be developed with associated use cases.

A **persona** is a description of a fictitious person belonging to the target group the end result is to be designed for. The characteristics of the persona are based on the data obtained from empirical and theoretical studies. The main purpose of a persona is to serve as a tool used to examine whether the result satisfies a representative user's needs and requirements (Wikberg Nilsson, Ericsson & Törlind, 2015).

A **use case** is a description of a fictitious use situation and serves as a complement to the persona. The use case can either describe the current situation or a future, desired situation. A use case can facilitate development work by constantly relate the solution to it and evaluate if it is considered suitable or not (Wikberg Nilsson et al., 2015).

MEETINGS & CONSULTATIONS

Valuable insights have been obtained by meeting people with experience and knowledge within the field of bicycles, urban planning and product development.

Operation and maintenance of a bicycle parking were discussed with Jenny Bergström who is head of the division of Operation and Maintenance of the Municipality of Varberg. Johanna Smedberg, marketing director at Cycleurope contributed with her knowledge about upcoming and ongoing bicycle trends. Recurrent consultations regarding the product development process were held with Pontus Wallgren, project supervisor and Senior Lecturer at the division of Design and Human Factors at Chalmers University of Technology. Also, the following municipality workers have contributed with their expertise; Björn Pihlquist and Emma Cejie - traffic planners, Karin Sjödin - landscape architect, Louise Wallmander - development strategist and Maria Hagelberg - project supervisor, planning architect and project manager for the *Varberg tunnel project*.

STUDY VISITS

Existing bicycle parking facilities were visited through study trips to Lund, Malmö, Kungsbacka, Mölndal, Gothenburg and Katrineholm. These visits gave inspiration to the concept generation phase and enabled observations and exploration of a broad variety of bicycle parking solutions and parking areas. Furthermore, access to three different bicycle box solutions were managed during the study visits. A bicycle fair called *The Swedish Bicycle Show* was also visited, see figure 4. At the fair, companies and organisations with knowledge of bicycles, security and planning of a bicycle parking were met and interviewed.

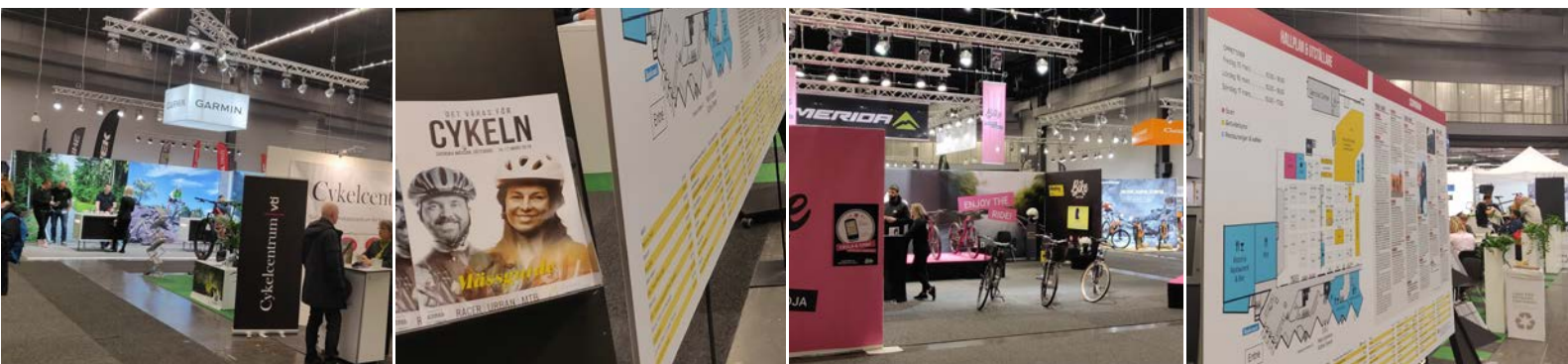


Figure 4. The bicycle fair in Gothenburg

2.2 CONCEPT GENERATION PHASE

The concept generation phase was performed with the information from the exploration phase as a basis. Ideation, risk analysis, a second survey, an in-depth benchmarking, as well as prototyping and visualisation lead the process forward. Requirements and wishes for the upcoming solution have been found and added to the requirement specification continuously throughout the concept generation phase. In appendix 3 the compiled requirement specification can be found. This specification has been used to verify that the recommended and developed solutions meet the stakeholder needs.

Furthermore, sketching was used throughout this phase. Hand-drawn sketches have been used most frequently, but in some cases CAD programs have been used to clarify the communication both externally and internally.

IDEATION

In the concept generation phase, brainstorming and brainwriting were the main methods used for ideation.

Brainstorming is a method used for generating ideas, focusing on quantity rather than quality. A brainstorming session provides possibilities for the project group to get inspired by each other (Wikberg Nilsson et al., 2015).

Brainwriting is carried out just like brainstorming but instead of the project group collaborating during the whole session, the idea generation begins with each person individually documenting their ideas. This method reduces the risk of that the project group affects each other which can create a greater variety of ideas (Wikberg Nilsson et al., 2015).

The brainstorming sessions were carried through with the affinity diagram performed in the exploration phase as a starting point. Creative thinking was triggered by using pictures of the categorised solutions as mediating tools. Sketching and discussion were frequently used to get a good flow in the brainstorming sessions as well as having shorter, predetermined time intervals for each session.

Even though existing solutions were used as mediating objects during the brainstorming sessions, pioneering solutions got room in the idea generation. Different ways of storing bicycles apart from the traditional way have been discussed. For instance, storage of bicycles in several levels and in directions differentiating from the bicycle parking solutions on the market. What parts of the bicycles that are common for all bikes have been investigated to ideate around if other bicycle parts than the wheels could be used as support in a bike stand. For instance, the possibilities to support the bicycle around the saddle, the handle bar or the frame were discussed and ideated around. Thus, the ideation started from a very broad perspective and became more detailed as the process proceeded.

During the project, CAD programs were used to render pictures to be able to communicate the upcoming solution externally. Adobe Illustrator was used to create illustrations both to enrich the report and the upcoming solution. Regarding the layout of the parking areas, Sketchup was the software used to visualise them. However, before using a digital medium for planning the areas, drawings on millimetre paper using coloured paper were conducted, as shown in figure 5.

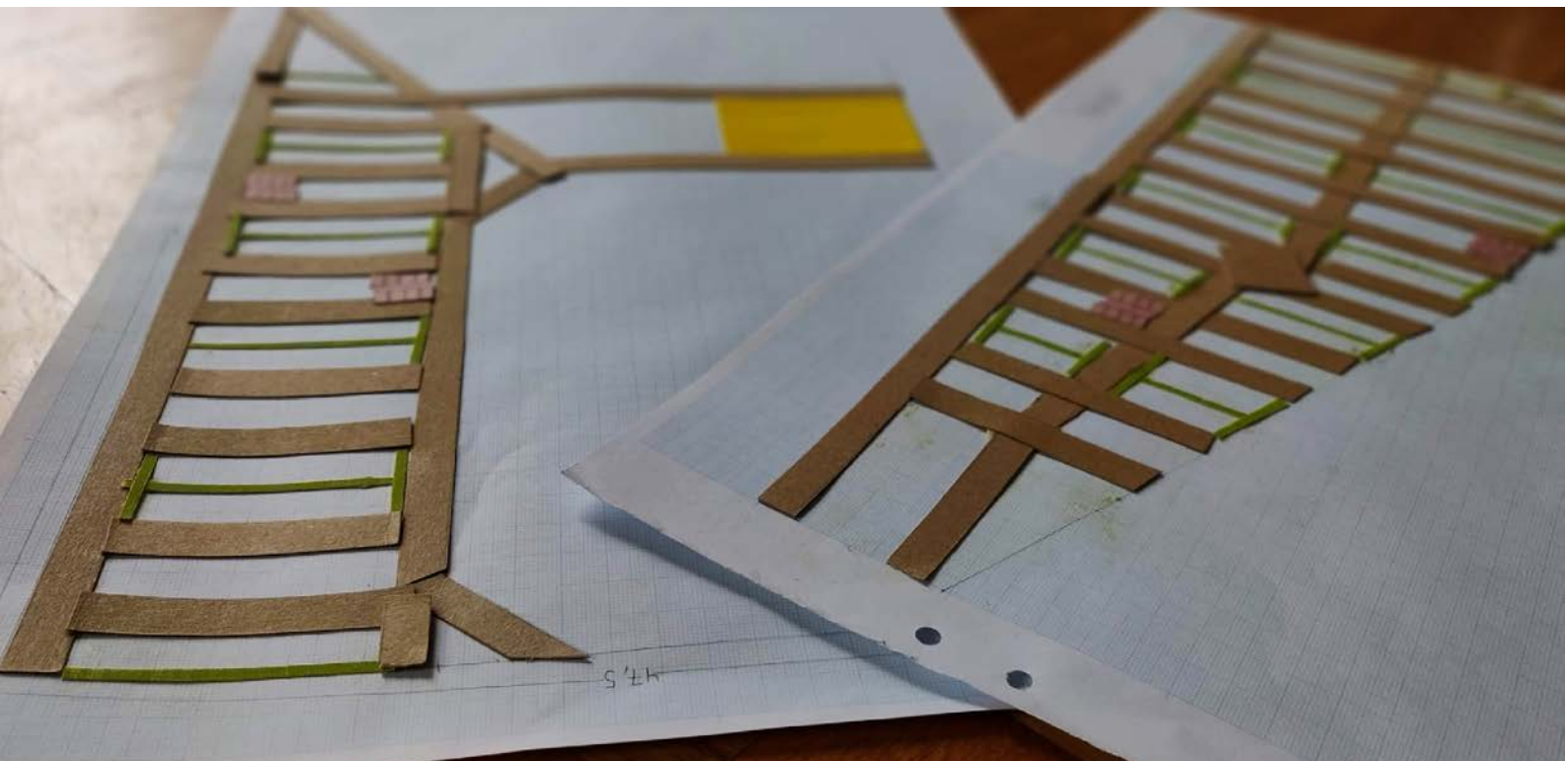


Figure 5. Drawings of the bicycle parking areas

CONCEPT EVALUATION

A variant of a SWOT analysis was performed to examine what strengths, weaknesses, opportunities and threats that were distinctive to existing products as well as ideas that emerged during ideation.

SWOT analysis is a strategic tool for companies that is used in order to improve a business or determine how a new business will perform (Harmon, 2019). To carry out the analysis the following areas are explored:

- Strengths - company specific resources and capabilities that gives an advantage over others
- Weaknesses - finding capabilities that can be improved
- Opportunities - finding new opportunities and trends
- Threats - finding obstacles that must be faced and changes that can threat the business

By exploring these internal and external factors well-grounded decisions can be made and an holistic view of a company can be obtained.

SWOT analysis are mainly not used for products but as a strategic tool for companies. The method was therefore modified to fit product design from a user perspective. The questions asked during the analysis were:

- What strengths and weaknesses does this parking solution have from a user perspective?
- Are there any opportunities to modify the solution in order to make it function better?
- Are there any threats connected to this solution that could make it function in an unintended way?

These questions were also asked with other stakeholders in mind, such as maintenance personnel, pedestrians or the paying actor. The SWOT analysis served as a method to be able to narrow the scope of products taken further into the product development process.

Furthermore, a status meeting with the municipality workers Björn Pihlquist - traffic planner, Maria Hagelberg - planning architect and Karin Sjödin - landscape architect was conducted. During this meeting, the results from the exploration phase was presented as well as what was planned to fulfil during the rest of the project. This meeting served as a way to assure that the result would live up to the expectations of the customer and a way to narrow the scope of the project. Another part of narrowing the scope was calculating the space efficiency of different solutions.

WEB SURVEY 2

With a more focused scope of the project, a second survey could be distributed to gain more in-depth insights from the users. The survey was posted in a Facebook group with inhabitants of Varberg, and only cyclists who sometimes bikes to the existing station were asked to reply. Questions about cycling habits and security were asked as well as questions about specific bike parking solutions. One part of the survey contained questions about the future station area and where the repliers most likely would park. The survey got 90 replies and can be read in appendix 4.

BENCHMARKING

With the results from web survey 2 as a basis, an in-depth benchmarking with focus on individual boxes for bicycle storage as well as arrangement within parking areas were performed. This was done by contacting municipalities using bicycle boxes to get their insights about the solution. Cost, number of parking spots of this kind, occupancy rate and booking systems were areas of interest and was also investigated for bicycle garages across Sweden. Three models of bicycle boxes were observed and used during study visits.

Furthermore, the layout of bicycle parking areas was observed and evaluated during study visits and through Google Maps. Factors that determines whether a parking area is well-functioning or not was the main goal of these observations. Width and placement of aisles within a parking area was examined as well as delimiting elements that can be used to guide the user to the intended way of parking.

PROTOTYPING & TESTING

Prototyping and testing were made throughout the whole project with the purposes to eliminate solutions with major flaws and to be able to further develop solutions with potential. Furthermore, the development of some solutions started from the prototyping sessions.

As seen in figure 6, models of bicycles made out of pipe cleaners were used to internally explain and evaluate solutions in an efficient way. Furthermore, they were used to get a perception of proportions and as mediating tools during discussion.



Figure 6. Bicycle models made out of pipe cleaners used to evaluate solutions

To evaluate and test different measurements of the bicycle box, three prototypes were used: one using sticks and rope, one using a foldable wall, and one using stone tiles, see figure 7-9. The prototyping was limited to usage of material available for free. Measuring existing solutions and bicycles were also a part of the test phase. Among other dimensions, the distance between wheel supports on different models of front wheel racks were measured as well as the width of aisles and the turning radius of cargo bikes.



Figure 7-9. Prototypes used for evaluating measurements of bicycle boxes

To investigate how a parking area could be structured, tests using road tape were executed. Areas on the ground around bicycle racks at Varberg's station were taped according to figure 10-12. The aim was to investigate whether a marked area can lead to a greater number of parked bicycles on a surface not intended for bicycle parking and to evaluate if a marked area can result in that less bicycles are parked outside an intended area. Before the tape was installed, the number of incorrect and correct parked bicycles were documented on the areas during a week. The test lasted for a week and the number of bicycles was documented in the same way as previous the test.

This test was based on Nudging-theory. Nudging is the idea that you can make people behave in a certain way without them noticing the behaviour change or consciously make decisions (Thaler & Sunstein, 2009). Furthermore, it can be shown that if one person is affected by a nudge, there could be a chain reaction, since people tend to do what others do, and once one starts to do it, the rest will follow (Krukow, 2013).



Figure 10-12. Exploring if nudging could be used to affect people's parking habits

3. BICYCLE INFRASTRUCTURE IS IMPORTANT

Well-functioning bicycle infrastructure is beneficial for a society since it has minimal negative impact on the environment, contributes to improved health of the inhabitants, economical savings and peoples' experience of the urban landscape. If the infrastructure of a city is designed to fulfil the needs of cyclists, it makes it easier to get residents and tourists to choose the bicycle as means of transportation. By getting more people to cycle the positive effects will be noticeable both on an individual and a societal level.



Besides the energy it takes to produce and distribute a bicycle the bike only needs the human mechanical energy to function as a means of transportation. Bicycling produces no air pollutants and can therefore help to keep the city air clean. Even if this is not completely true for electric bicycles, the electric power and batteries needed have a far lower environmental impact compared to a car. Congestion can be relieved if less people choose to travel by car. Even noise pollution can be cut since a bicycle is basically silent compared to a car engine. Well-functioning bicycle infrastructure in connection to public transport hubs is of extra importance from an environmental perspective since public transportation is an environmentally friendly way of traveling.

In addition to the environmental benefits, cycling also comes with health benefits. That exercise improves both physical and mental health is no secret and bicycling is an excellent way to include exercise in everyday life.



The positive health effects that comes with increased bicycling results in economical savings on health care (Fishman, Schepers & Kamphuis, 2015). This is not the only economic benefit, Celis and Bølling-Ladegaard (2007) writes that besides savings on health care, the money invested in bicycle traffic and bicycle parking will be paid back many times over when it comes to planning of infrastructure and environmental budgets. Varberg is a city with a growing population and it is required that the infrastructure can keep up with this growth. Today, there are tailbacks during peak hours and the fact that the population is growing is worrying with an infrastructure that is not dimensioned for increased car traffic. Encouraging people to cycle is therefore a great way of reducing the planning time, space limitation and money that will be needed to be spent on solving the traffic problem.

Since every bicycle trip starts and ends with a parked bicycle, the parking facilities is a meaningful component of the bicycle infrastructure. By prioritising bicycle infrastructure and bicycle parking facilities at the station, tourists and residents will identify Varberg as a modern bicycle city that takes cycling as daily means of transport seriously. It will make Varberg an appealing city to commute to or from and it will also favour businesses located in and around the station building.

4. THE VARBERG TUNNEL PROJECT

The city of Varberg is facing a major urban development over the next decade. As seen in figure 13 and 14, a railway tunnel will be built under the city and the harbour will be moved. These two changes will make room for a new neighbourhood named Västerport and a new station area. The bicycle parking issue is a small but yet important part of this large project.

The railway track between Gothenburg and Lund is one of Sweden's most important railway connections (Buerman, 2019). The track through Varberg is one of few sections where there is no double track today and the existing track will therefore be replaced by two underground ones. The distance is about 7.5 km, of which approximately 3.1 km will be located in a tunnel under the city centre. According to the plans, trains will start running on the new tracks in 2024 and the project will be ready in 2025. The project is run by Trafikverket (The Swedish Transport Administration) in collaboration with the municipality of Varberg, Region Halland and Jernhusen.

A result of placing the tracks in a tunnel under the city in combination with moving the centrally located harbour northwest is that large areas of land will be released. This enables for a comprehensive urban development towards the sea. The new district, Västerport, with approximately 2500 apartments is planned to be located in this area. The construction for the double track and the tunnel starts at the end of 2019. The total construction time, including demolition and restoration, is estimated to seven years.



Figure 13-14. Maps showing the urban development included in the Varberg Tunnel Project

4.1 THE NEW STATION AREA



The station area will have a new location, 150 m north of the current station as seen in figure 15. The location of the new station area, in between Västerport and the existing city centre will make it function as an important link between the new and the old parts of Varberg. The large areas are taken up by:

- Car parking
- 1500 bicycle parking spots
- Train platforms below ground
- Station building
- Bus terminal for regional buses
- Bus terminal for city buses

The area will also include greenery, restaurants, seating etc.

In the quality program of the station building written by a project group at the municipality of Varberg it is stated that: “The design of the area should clarify who has priority to which place and who has priority at crossings. The traffic environments should invite to choose to walk, ride a bike or use public transport before taking the car” (Hagelberg et al., 2017. authors’ translation). That car traffic has got a lower prioritisation at the station area compared to cyclists and other means of transportation can be seen in figure 15. Car parking lots are placed further away from the target points of the station area compared to most of the bicycle parking areas.

Figure 15. Map of the future station area and its functions

The area planned for bicycle parking is divided into four sections. One section south of the station building, two sections on the west side of the train tracks, and one section on the east side of the train tracks. The four sections together will store 1500 bicycles on an area of approximately 5400 m². This area excludes the size of the section south of the station building, since it is yet not decided.

Architect firms have received the mission to design Varberg's new station building and station area. This work is in progress and finalised sketches are not yet available. Figure 16-17 illustrates examples of how the platforms could look like and figure 18 illustrates the station building.



Figure 16-17. Renderings of the train platforms (Abako, n.d.)



Figure 18. Rendering of the station building (Okidoki, n.d.)

The municipality of Varberg has chosen four words that will permeate the design of Varberg's new station area. These core values are: vivid, stone, greenery and sea and they represent the character and identity of the city (Hagelberg et al., 2017). Explanatory citations of what these four values represents are presented in figure 19 below (ibid., authors' translation).



Vivid

The energy is flowing through the station area. This is where it happens. Personalised impressions greet the visitor and makes Varberg's inhabitants feel that they have come home. Opinions from the inhabitants are given a place in the design and are presented with playfulness. There is always something new here. Temporary expressions and change live in the area.



Stone

In Varberg, history meets the present and expressions are visualised in form and design. The tradition of stone masonry, naked cliffs and the fortress of Varberg constitute a stable foundation that is reflected through the station area. In Varberg you stand with your feet on the earth. Robust materials and natural stone characterise the area. Raw and processed surfaces are used as exciting contrasts and associate with cultural history, craftsmanship and the beach cliffs.

Greenery

Varberg is warm. There is a relaxed feeling of beach, sand and summer, all year round. Coastal vegetation and sand dunes have made their presence and are interpreted in the design of the area in an informal way. Places and buildings have a friendly and welcoming design. Larger rooms are interspersed with small, quiet, lush places, to breath, to rest, to retrieve strength. The details convey care and arouse curiosity.

Sea

It opens up towards the landscape and the sea. Varberg breathes space, light and possibilities. From the station area one can see target points in the city and the horizon is in the distance. Attractive places in the sun during morning, midday and evening - breathing coastal air and salty winds. Constructions, roofs and buildings convey lightness and brightness. Varberg is water. Lights and sounds from water permeates - it glitters, shines, bubbles, ripples and drops.



Figure 19. The core values of the future station area

5. STAKEHOLDERS & RESPONSIBILITIES

This section contains information about the different stakeholders that will be affected by the future bicycle parking solution. How does the different actors prefer the solution to be, and what is of importance to them?

5.1 CYCLISTS



Cyclists, the primary users of the future bicycle parking solution are a heterogeneous group of people with different requirements of the upcoming solution. There are often conflicting requirements between the cyclists, where some prioritise speed while others highly value security. However, all bicycles are driven by muscle power and cyclists does therefore not appreciate detours or level differences. An example of how disliked level differences are by cyclists can be seen in figure 20, near a construction site in the city of Varberg.

A characteristic of cyclists unique for the location of a station is that almost everyone has a train or a bus to catch, meaning that the time perspective is of increased importance. Complex parking solutions that are time consuming are therefore not appreciated by the majority of these cyclists. A strong incentive to use the bicycle as a means of transport is that it takes the user from door to door, and bicycle parking far from the target point is therefore very disadvantageous for the bicycle infrastructure. At Varberg's station today it can clearly be observed that bikers want to get as close to the target point as possible, see figure 21. Most of the cyclists that park their bike at Varberg's station are commuters that travels to or from Varberg, meaning that the bicycles at the location will be parked during both daytime and nighttime.

Three personas with associated use cases were created to serve as mediating tools during the project. The use cases can be read in appendix 5 and the personas are compiled on the next page.



Figure 20. Level differences are disliked by cyclists



Figure 21. Closeness to the target destination is highly valued

Nerdy Ned



GOALS

- Weather protection for his bike
- Ability to perform simple service on the bike
- Ability to lock both frame and wheels

Age 37

Type of bicycle A hybrid bike and an exclusive racing bike

Reason for visiting the station Comutes with bus from the station to take the bus to his work at Ringhals 30 km north of Varberg.

Distance to/from station 6 km to the station from his home at Södra Näs

Quote "It is important that the parking area is something more than just a place to store the bike"

FRUSTRATIONS

Ned's hybrid bike has become very scratched because it is so crowded between the bikes. The existing bicycle pump rarely works. Ned wants to ride his racing bike to the station, but there is no parking that he consider secure enough.

MOTIVATIONS

Willingness to pay for the parking



Fast parking session



Extra value



Security



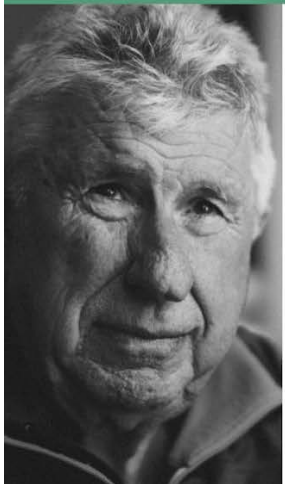
Order



Not important

Very important

Concerned Conny



GOALS

- Secure parking
- Protection against vandalism
- Charging possibilities

Age 71

Type of bicycle A new electric bicycle

Reason for visiting the station His daughter Annie lives in Gothenburg and when Conny visits her he sometimes leaves his bike at the station during night.

Distance to/from station 2 km from station to his home at Karlberg

Quote "I am worried that my bike will be stolen"

FRUSTRATIONS

The frame of the bike cannot easily be locked with the current solution. The bikes are also parked carelessly and very tight and Conny does not want his bike to be scratched.

MOTIVATIONS

Willingness to pay for the parking



Fast parking session



Extra value



Security



Order



Not important

Very important

Stressed Sarah



GOALS

- Proximity to the tracks
- Opportunity to lock the bike quickly
- Fast location of bike

Age 17

Type of bicycle Dilapidated ladies bicycle bought second hand

Reason for visiting the station Comutes with train from Åsa 30km north of Varberg for studies

Distance to/from station 2 km from station to school

Quote "I always arrive 30s before the train"

FRUSTRATIONS

It is cramped at the bike racks near the tracks and Sara does not have time to find another place further away.

MOTIVATIONS

Willingness to pay for the parking



Fast parking session



Extra value



Security



Order



Not important

Very important

5.2 RESPONSIBILITIES & INTERESTS

Apart from the cyclists, there are other actors who are interested in that the bicycle parking facilities work well. As shown in table 1, these actors affects both the demand and the possibilities of offering bicycle parking.

Actor	Responsibility	Impact on number of bicycle parking spots	Influence and interest in the location and design of the bicycle parking
The Swedish Transport Administration - Trafikverket	<p>Trafikverket is responsible for long-term planning of the transport system for road and rail traffic.</p> <p>They should support goals for increased bicycling and are responsible for the national cycle strategy.</p> <p>Collaborates with municipal road managers and develops recommendations for designing bicycle infrastructure.</p> <p>Have ordered Implenia AB to build the tunnel.</p>	<p>Prepares national and regional investment plans.</p> <p>The public transport offering affects the number of travellers and thus the need for bicycle parking at the station.</p>	<p>Owens rails and land.</p> <p>Interest of good customer accessibility.</p>
The municipality	<p>Overall responsibility for planning and land use. Responsible for streets and public place.</p> <p>Maintenance of the future bicycle parking area.</p>	<p>Interested in a well-functioning traffic in the inner city. They want to reduce car traffic and a well-functioning bicycle infrastructure is therefore of interest.</p>	<p>Handles car parking and fees on public land.</p> <p>Owens the land where the future bicycle parking facilities are planned to be located. Locates and maintains cycle paths. Determines the use of public space.</p>
Region Halland	<p>Owens the public transport in Halland county</p> <p>Region Halland have the responsibility to develop a regional traffic supply program.</p>	<p>The public transport offering affects the number of travellers and thus the need for bicycle parking at the station.</p>	<p>Interest of good customer accessibility.</p>
Train and bus operators	<p>Conducts public transport.</p>	<p>The public transport offering affects the number of travellers and thus the need for bicycle parking at the station.</p>	<p>Interest of good customer accessibility.</p>

Jernhusen AB	<p>Responsible to provide services related to public transport as well as to promote and support public transport.</p> <p>Owens the station building and land in the vicinity of the station.</p> <p>Maintains the bicycle parking areas at the existing station in Varberg.</p>	<p>The number and type of activities in the station building affects the need for bicycle parking at the station.</p>	<p>Interest of good customer accessibility.</p> <p>The design of the station building and the design of the station area should match.</p> <p>Owens land in the vicinity of the station.</p>
Private property owners		<p>Customers and staff at businesses in the vicinity of the station can use the station's parking offering.</p>	<p>Interest of good customer accessibility.</p>

Table 1. The various actors at Varberg's station and examples of how they can affect the bicycle parking

At large public transport hubs where the land value is high and alternative uses are attractive, there is a competitive situation about the land. It is therefore important that the actors who have the greatest knowledge about the cyclists' needs and wishes can influence the decisions of the design and placement of the bicycle parking facilities (Boverket, 2010). The conditions of ownership and responsibilities at Varberg's new station are complicated. A well-functioning communication and division of responsibilities between the different actors is vital for the facilities to function as intended.

Furthermore, residents nearby or people who visits the area daily have an interest in an aesthetically pleasing and orderly looking bicycle parking. For these people it is important to consider that elements don't obscure the sun or somehow interferes with the urban environment.

Visitors arriving by foot or other means of transport should not be hindered by the bicycle parking. This can be solved by looking at the flow of people to and from the station and arranging the bicycle parking accordingly. This implicates that different means of transport does not have to interfere with each other and that aisles are attractive to pedestrians as well as cyclists.

6. BICYCLE TYPES & ADDITIONAL EQUIPMENT

The market offers a variety of bicycles and equipment for different types of usage and in a wide price range. Sizes, shapes, and attachments varies, and the bicycle parking facilities should accommodate all types.

6.1 BICYCLE TYPES

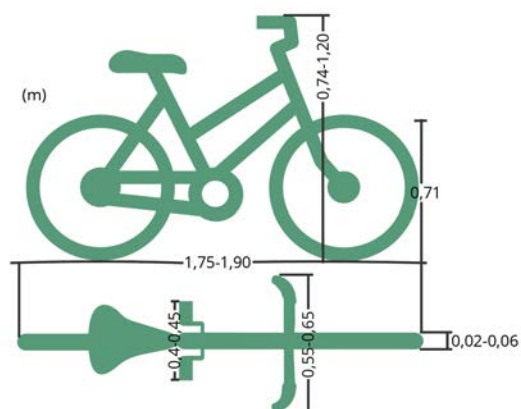


Figure 22. Standard bicycle dimensions

Standard dimensions for bicycles are illustrated in figure 22. To assure that these dimensions are representative they have been gathered from various sources, e.g. R. Lindahl, Commercial Product Manager at Cycleurope (personal communication, March 11, 2019), Örebro kommun (2016) and SKL (2010) as well as actual measuring sessions of bicycles.

LADIES BICYCLE

Broad and soft saddle with the handlebar in a higher position than other bike models. Almost all ladies bicycles have a basket at the front and a luggage rack at the rear end. One should also note that ladies bicycles does not have a top tube compared to for instance men's bicycles which influences how the frame of a ladies bicycle can be locked.

MEN'S BICYCLE

What differs between the men's bicycle from a ladies bike is that the top tube has an almost horizontal placement which influences how the frame of a man's bicycle can be locked. For men's bicycles it is not as common with baskets compared to ladies bikes.

RACING BICYCLE

The racing bicycle does not have any superfluous equipment. In order to reduce the weight of the bicycle, it is often made of carbon fibre, which makes it a bit fragile. The tires of a racing bicycle are thinner than on a standard bicycle. The handlebar is often bent downwards in a loop-like shape. Many racing bicycles are expensive and therefore more prone to be stolen.

MOUNTAIN BIKE

A mountain bike has a sturdy frame, thick tires, a large number of gears and in some cases suspension on the wheels. What is distinctive to mountain bikes that must be considered while parking them is the thick tires and an ongoing trend is that the handle bars are broader than on a traditional bike. Up to 80 cm broad handlebars occur.



HYBRID BICYCLE

The hybrid bicycle is a mix of a mountain bike and racing bike. It is more stable than a racing bicycle and has a more upright driving position. The hybrid is often used for commuting and can be equipped with additional equipment such as luggage racks and bicycle baskets.



ELECTRIC BICYCLE

An electric bicycle does not require any extra space compared to a conventional bicycle. However, electric bicycles are usually more expensive, which puts higher demands on security. They are generally also heavier, which makes it harder to use two-floor solutions or vertical parking.

The fastest growing trends in bicycle types are electric bikes. In the annual trend report of Svensk cykling (2018) it is stated that four out of ten Swedes consider buying an electric bike. Furthermore, the industry predicts an increase sale of 120% during 2019 compared to previous year (ibid.).



FOLDABLE BICYCLE

Foldable bicycles are most commonly used by people who commutes and are using combined transport to get to work or studies. The bicycle can be folded and brought on to the train, bus or tram, meaning that it is not parked that often at train stations.



CARGO BIKE

Cargo bikes are a fast-growing trend in bicycle types. During the bike fair in Gothenburg, several companies selling cargo bikes were consulted and could validate this statement. Furthermore, a bike store that does not sell cargo bikes was visited, and the personnel stated that there is an increased number of customers asking for this type of bike. However, cargo bikes are still a very small part of all the bikes sold across Sweden.

The space required for parking of cargo bikes can be assumed to be at least twice the space for parking of a conventional bicycle and these bicycles also requires a bigger turning radius when being manoeuvred. Cargo bikes are heavy and some have three wheels which makes two floored and vertical bicycle parking less suitable. Cargo bikes are generally also more expensive, which puts higher demands on security.



OTHER ODD SIZED BIKES

Apart from cargo bikes there are other bicycle models on the market which requires more space than conventional bicycles e.g. tandem bicycles, three wheelers and recumbent bicycles. However, none of these models requires more space than a cargo bike and measurements used for parking of these bikes can therefore be used for other odd sized bicycles. Bicycles for children on the other hand have smaller dimensions than other bike models which puts other demands on the bicycle parking.

RESULTS FROM OBSERVATIONS & WEB SURVEYS

In web survey 2 the respondents were asked to respond to what bike type they use when biking to Varberg's station and the presence of each bike type were also observed at Varberg's station from January to May 2019. The results from the web survey are compiled in table 2 below. The observation results matched the web survey results except that the number of electric bicycles were lower than 6,7% and that a few foldable bicycles were parked at the station area.

Type of bicycle	Web survey 2 result
Ladies bicycle	56,2%
Men's bicycle	20,2%
Racing bicycle	2,2%*
Mountain bike	2,2%
Hybrid bike	11,2%
Electric bicycle	6,7%
Foldable bicycle	-
Cargo bike	1,1%
Other odd sized bicycles	-

Table 2. Web survey results

* The low number of racing bicycles does not necessarily indicate that there is no need for parking of this bicycle type at Varberg's station. It could rather indicate that the current parking is not considered secure enough to store this expensive and fragile type of bicycle.

How exclusive the bicycles are makes them more or less attractive to thieves. In web survey 2 the respondents were asked to estimate the value of the bicycle used when biking to Varberg's station. The results are compiled in table 3 below.

Estimated value (SEK)	Web survey 2 result
0-499	3,3%
500-1 999	31,1%
2 000-3 999	21,1%
4 000-6 999	26,7%
7 000-10 999	8,9%
11 000-	8,9%

Table 3. Estimated value of bicycles

When observing the bicycles at Varberg’s station a higher percentage of bicycles with estimated value under 4000 SEK than the web survey results could be observed. However, it is difficult to determine how the respondents have estimated the value of their bicycle. Purchase price, resale value or insurance value of the bicycle have not been specified.

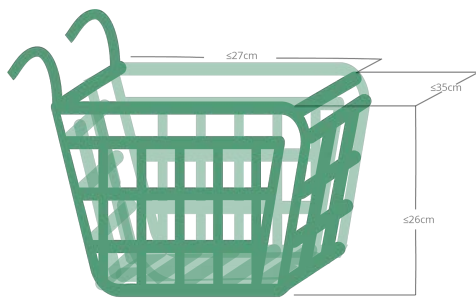
There seem to be an attitude to use a cheaper bike to Varberg’s station since the users does not want to risk getting an expensive bike stolen or vandalised. During interviews, this attitude could be validated when several interviewees stated that they would have used another bike if the parking area were considered secure enough.

6.2 ADDITIONAL EQUIPMENT

Besides from which different bike models that are parked, one also needs to consider which additional equipment that is used on the bicycles since their dimensions can impact the parking solution.

Commuters often have extra equipment on their bikes to make it easier to bring luggage.

Equipment such as bicycle baskets, luggage racks and panniers are common. Luggage racks and



baskets can be placed both at the front and rear of the bike and the baskets can be removable or fixated to the bicycle. Bicycle baskets have dimensions that could affect the bicycle parking solution to a great extent and the most commonly used dimensions for bicycle baskets are illustrated in figure 23. The handlebars of bicycles are usually equipped with a light and a bell, but there is also equipment such as bicycle computers attached to some handlebars.

Figure 23. Dimensions of a bicycle basket

Child seats and bicycle trailers are often used to give children a ride to school or kindergarten. A bicycle trailer can be disconnected from the bicycle but is preferably parked along with or near the bike. The dimensions of a bike equipped with a child seat or trailer are considerably larger than a conventional bicycle, see figure 24-25. This needs to be considered while designing some of the parking spots.

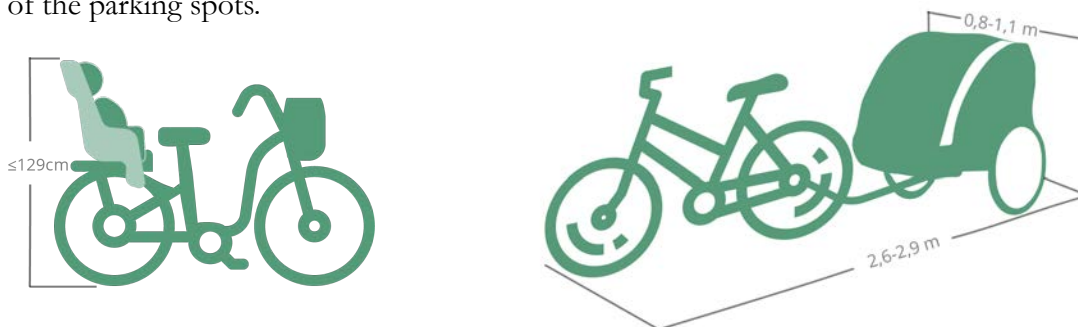


Figure 24-25. Dimensions of child seats and trailers

7. BICYCLE THEFT & SECURE LOCKING

Many users are worried about getting their bicycle stolen. This was found in web survey 2 where the participants were asked how confident they feel that their bicycle remains where they left it when parking it by the station. The participants got to choose a number from 1 to 6, where 1 represents *not confident at all* and 6 *completely confident*. The result is compiled in figure 26.

Interviews performed at the station gave the same indications as the survey, where many cyclists expressed concerns of getting their bicycle stolen. Some spoke about their own experience of getting a bike stolen and some talked about friends that had lost a bicycle at the station area. Another question asked at the interviews was if the risk of theft affects the choice of bicycle. 54% answered that they probably would use another bicycle if the risk decreased and a recurrent comment was that they might use an electric bicycle.

Being worried of getting a bicycle stolen is not a baseless feeling. During 2018, 65 700 bicycles were reported stolen in Sweden (Brå, 2019). The number of stolen bicycles that gets reported in Varberg is about 400-500 each year and it is the most common crime in the municipality (Berntson, 2018). With improved security at bicycle parking areas this number could be decreased. SSF (n.d) states that the risk of bike theft is three times higher if the only lock used is the built-in frame lock, this is compared to if the bike is locked to a fixed object with an external lock. This implies that the design of the parking solution is of great importance when it comes to the possibility to lock a bicycle in a secure way.

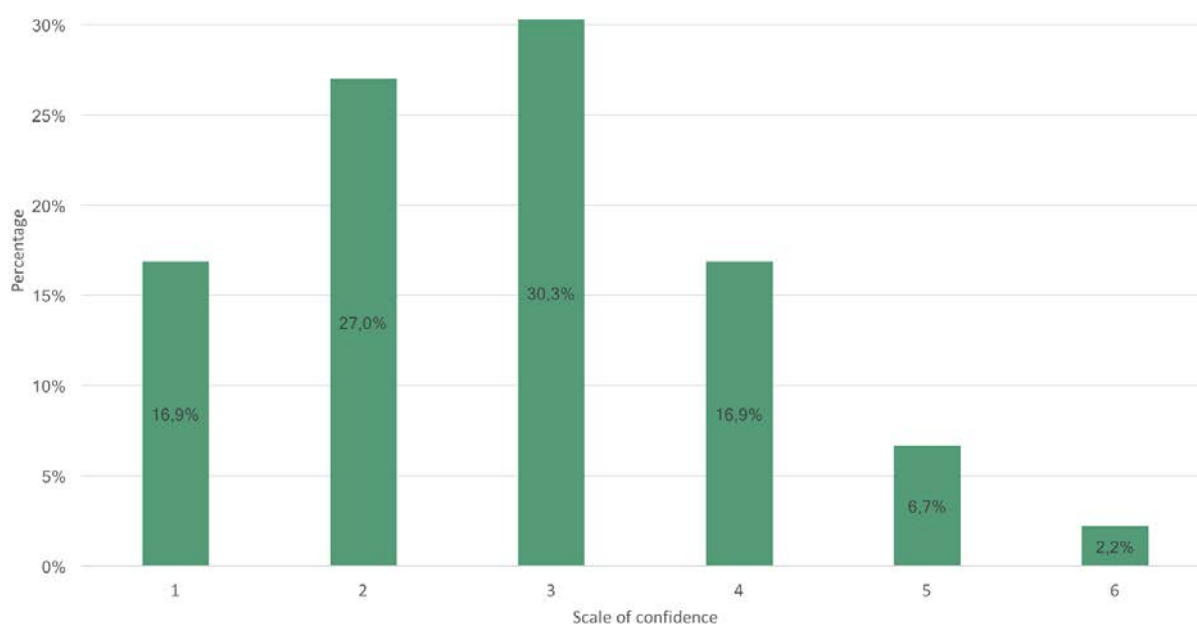


Figure 26. A diagram showing a scale from 1-6 that represents how confident cyclists are that their bike won't get stolen

7.1 SECURE LOCKING

The parking solution must support the possibility to lock a bicycle in a proper way. This means that the cyclist must be able to lock the frame to a fixed object with an additional lock in order to secure the bike (Svensk Cykling, 2017). If the cyclist wants to lock the wheels this should also be possible with the right equipment.

Different types of locks were studied in order to make sure that parking solutions recommended for the future station are compatible with commonly used locks. A summary of locks that are frequently used can be found in appendix 6.

One type of lock that have been found during the project is the ones that are integrated in a bicycle parking solution. Examples of this kind of solution can be seen in figure 27 and 28. The pictures shown are taken in Lund and Kungsbacka. These solutions are equipped with a component that can be attached to the frame lock of the bike and thereby secure the bike to the location. One drawback with locks that are integrated to the parking solution is that the design of the locks is the same for all bikes. A thief must thereby only figure out how to break one type of lock. An advantage is that cyclists that normally only uses the frame lock easily can decrease the risk for losing their bike since the amount of spontaneous thefts probably could be decreased. This type of solution should preferably enable cyclists to use other type of locks as well.



Figure 27-28. Locks integrated in parking solutions



Figure 29. A lock left on the parking solution

The need for a solution with integrated locks can be derived from observations made on existing bicycle parking areas. It has been found that some people leave their lock fastened to the parking solution in order to use it again when they arrive the next time, as shown in figure 29. Some people apparently do not want to bring their lock and one way to avoid this is to leave the lock at the parking.

7.2 OTHER WAYS TO INCREASE SAFETY & SECURITY

Besides enabling cyclists to lock their bike properly there are other ways to increase the experienced safety and security at a parking area.

The requirements for a bicycle parking differ depending on if the cyclist is the owner of an expensive electric bike or a dilapidated bike. It is important to offer parking solutions that suits all users. In order for users to dare to use their expensive bike, a secure parking solution must be offered. This could be solved by having parking options with limited access. Products that fulfils this are garages, bicycle boxes and automatic solutions. An individual box with room for one bicycle shields the bicycle and hinders thieves from accessing the bicycle. Therefore, the user does not have to remove valuable items on the bike. A garage is not as private as a bicycle box, but it is a way to limit the access.

Other ways to increase the safety is to:

- place the parking where there are lots of people in motion
- enable a good overview of the parking area
- install proper illumination
- place surveillance cameras on the area

These are all ways of giving thieves less time and chance to work unnoticed. Furthermore, parking solutions should be surface mounted properly so that thieves cannot steal the entire bicycle rack or bollard even if proper locks are used. To further work with increasing the security, the parking area can be used as a place to spread the message of fighting bike theft.

8. EXISTING BICYCLE PARKING SOLUTIONS

There is a large selection of bicycle parking solutions on the market today. Which parking that is best suited to a specific location depends on many factors, such as:

- access to space per parked bike
- requirements for theft protection
- the bike type in use
- how long time the bicycles will be parked there on average
- the distance to the target location

The most common types of bicycle parking and their use are compiled in the following sections followed by the insights made via digital channels as well as observations, interviews and surveys.

8.1 FRONT WHEEL RACKS

Traditional front wheel racks have in common that they are quick and easy to use and do not require much effort from the user. The most commonly used front wheel racks that only encompasses the front wheel, offers limited safety and lateral support. However, the market does also offer front wheel racks with the possibility to lock the frame of the bicycle onto the rack. This extra feature increases both theft protection and lateral support.

The usability of front wheel racks differs depending on the bicycle type in use. In most cases the width of the tire of the bike in use determines the functionality of front wheel racks. This in term means that e.g. racing bikes with thinner tires and mountain bikes with thicker tires are not stored in an ultimate way in some of the racks.

The bicycles are often placed perpendicular to a wall or the direction of travel when front wheel racks are used. However, if space is limited bicycles can also be placed in an angle towards the direction of travel, most commonly in a 45-degree angle. The traffic office of Gothenburg states that perpendicular parking is considered as easier to survey and more orderly looking compared to angled parking (Koucky, 2017).



The centre to centre distance between the bicycles in front wheel racks are commonly 50 cm. However, according to SKL (2010) a distance of 70 cm is preferred if the occupancy rate is 90% or lower. If the occupancy rate is higher than that there is a risk that bikes are parked between the wheel supports if the distance is 70 cm (ibid.). According to the traffic office of Gothenburg the distance between the bikes for angled parking can be reduced to 40 cm (Koucky, 2017). However, SKL and the Traffic Administration of Sweden recommends a distance of 70 cm for angled parking as well (SKL, 2010). Figure 30 and 31 illustrates the most commonly used distances between the bicycles in front wheel racks.

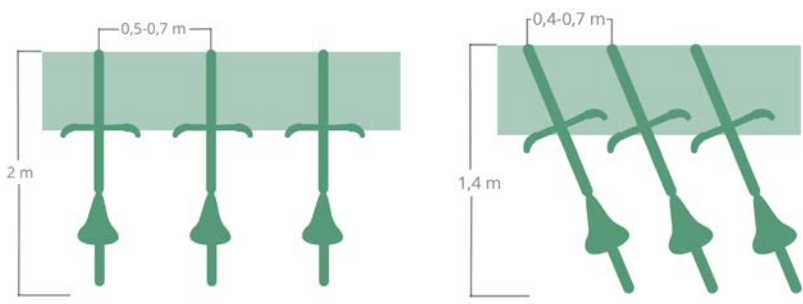


Figure 30-31. Distances between the bicycles in perpendicular and angled parking

Another variant of front wheel rack utilises space in a more efficient way by letting the wheels of the bicycles overlap in a shared area. Figure 32 illustrates how the arrangement of bikes in a model of this kind looks like.

Some front wheel racks on the market offers two different heights of the wheel supports to avoid that the handlebars of the bicycles are tangled together. The wheel supports of these models are placed so that every other is in a higher position resulting in that the distance between each wheel support can be shorter without risking tangling of the handle bars.

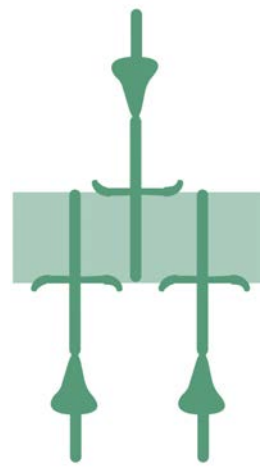


Figure 32. Overlapped placement of bicycles

INSIGHTS

Our observations of the front wheel racks at Varberg’s station showed that bicycles often are placed outside of the wheel supports as shown in figure 33. For the front wheel racks that does not give any lateral support 55,1% of the bicycles were parked outside the wheel supports. The reason for this has several explanations:

- there is too little space between the bikes for the wheel support to be used without risking tangling of the handle bars
- it is considered easier to place the bicycle outside of the wheel support
- the users are worried that wind or other external impact to the bike will damage the wheel
- the parking area is overcrowded resulting in that there is no wheel support available

The wheel supports of the front wheel racks at Varberg's station that offers lateral support are used to a greater extent, see figure 34-35. The percentage of bicycles placed outside the wheel supports are only 15,5%. This is assumed to be due to that using the wheel support in this case gives the user the opportunity to lock the frame of the bicycle onto the rack. The risk of damaging the wheel when using the wheel supports is also reduced when using this rack. However, this rack model has another problem which affects the cyclist with bicycles equipped with baskets at the front end. When inserting and removing these bikes from the wheel support the basket collides with the rack.



*Figure 33.
Bicycles placed outside of the wheel supports*



*Figure 34-35.
Front wheel racks at the current station area that offers lateral support*



As stated earlier there is a risk that bikes are parked between the wheel supports if the centre to centre distance is 70 cm if the occupancy rate is higher than 90% (SKL, 2010). This statement could be validated when visiting the Triangeln station in Malmö at a very congested parking area using 70 cm between the wheel supports. It was also observed that parking between two wheel supports can be avoided to a great extent if a frame locking device is placed between the wheel supports.

It seems to be a great worry that the wheel of the bicycle will be damaged when using the wheel supports. However, obviously buckled wheels as a consequence of this type of rack is uncommon. Anyhow, even small buckles can be devastating for bicycles with thin tires, among other things, the brakes can create unnecessary friction or not work at all as a consequence. Figure 36 displays damaged wheels at a collection point for deserted bicycles which had blown over each other and resulted in an immense pressure on the bicycles in the bottom of the stack.



Figure 36. Buckled bicycle wheels

In Malmö, another type of front wheel rack is used inside of the parking garages as displayed in figure 37. This model of front wheel racks is described in the section above and enables the



wheels of the bicycles overlap in a shared area. The design was found promising concerning space-efficiency, but three major drawbacks were found. First of all, the bicycle rack does not enable cyclists to secure the bicycle frame. Secondly, there is nothing indicating from which direction a bicycle should be parked and thirdly, if one bike falls over there is nothing that hinders the domino effect.

Figure 37. A bicycle rack where the bicycles overlap in a shared area

Many racks are designed to manage bicycles from one direction only. In spite of this, cyclists park their bikes on both sides of the racks. Since the wrong side of the rack does not give any support to the bicycles parked there, they usually look like a row of fallen dominos as illustrated in figure 38. Conclusions drawn from this observation is that it is desirable that racks can be used from both directions or that it is impossible to park bicycles at the wrong side due to some kind of boundary.



Figure 38. Bicycles parked on the wrong side of the rack

8.2 TWO FLOOR SOLUTIONS



Two floor solutions are suitable when there is limited space since they only require approximately half of the space per bicycle compared to front wheel racks. This solution contains moving parts which makes it favourable to install indoors or under a roof to decrease the need for maintenance. Parking on the upper floor is more time-consuming compared to traditional front wheel racks which makes two floor solutions less suitable for short term parking.

The bicycles parked on the upper floor is parked using a rail and some solutions uses a gas spring or a counterweight to reduce the force needed to park the bike. As for front wheel racks, two floor solutions can be equipped with frame locking.

Note that this solution requires higher ceiling height, which needs to be considered in the planning phase if this type of parking will be used. A ceiling height of around 2,8 meters is common (Koucky, 2017). As a result of that parking on the upper floor takes longer time it is an advantage to have broader aisles so that other people can pass during the parking session.

INSIGHTS

Two floor solutions have been observed and used in Malmö and Gothenburg. All two floor solutions observed were placed under a roof and some of them inside parking garages. Many of those placed outside were rusty, broken and squeaked during use. The construction of the two floor solutions observed does not seem robust. Broken parts of the racks could be observed on the ground around the racks at Malmö Central station, see figure 39. One cannot get away from the fact that it is a more complex solution and that moving parts require more maintenance.



Figure 39. Broken parts of a two floor rack in Malmö

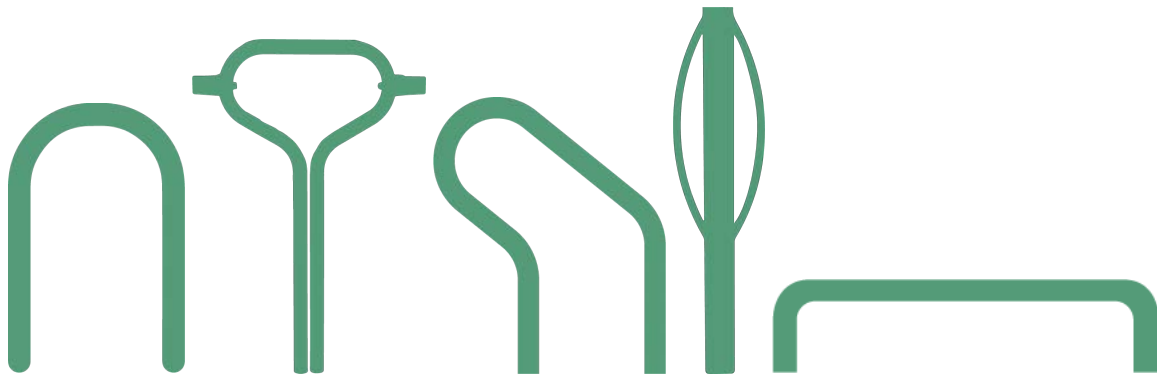
It is heavy to park a bike on the upper floor, consequently it requires some muscle strength of the user. Parking on the upper floor is in other words not for everyone. However, at the visited parking areas there were several different parking solutions which means that after all, it did not exclude people from a place to park their bicycle. As validated by figure 40 at Triangeln, Malmö, people seem to avoid parking on the upper floor if there is room on the ground floor.



Figure 40. People avoid parking on the upper floor if there are available spots on ground level

It happens that bicycles parked on the upper floor are tangled together. To untangle a bike parked on the upper floor the user may need to lower down another user's bike to get access to his/her own bike. This can cause frustration since many users are too short to see how the bicycles are tangled together. Furthermore, dirty water and snow will run down from the bikes parked on the upper floor onto the bikes parked on ground floor. Even though the solution has its flaws, one cannot get away from the fact that it is the most space efficient solution observed.

8.3 BOLLARDS

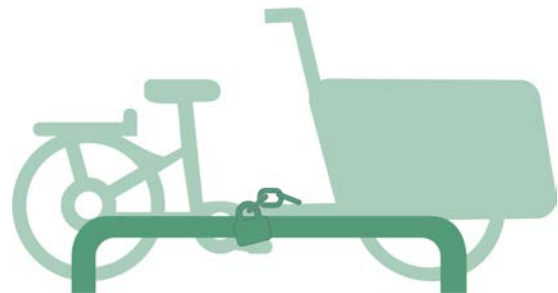


Bollards can have very different appearances. However, most of the solutions on the market have in common that they offer possibilities to lock the frame of the bicycle onto the solution.

Bollards are suitable for short-term parking as well as parking during a longer period of time.

Not all bollards supply lateral support of the bicycle. Consequently, the parked bike needs to be locked with an external lock for the bollard to be useful. To increase the lateral support of the bike, bollards are sometimes used in combination with front wheel racks.

Many models on the market offers several locking points through a hole or a loop and they are very flexible considering the bike type in use. Parking of cargo bikes most commonly uses low bollards to be able to lock the frame of the bike in a good way.



The recommended distance between two bollards vary between different distributors, however around 1m is a common distance. Note that two bicycles can be parked at each bollard.

INSIGHTS

Bollards have been observed in Källered, Mölndal, Kungsbacka, Gothenburg, Lund, Malmö and Varberg. They are very flexible, giving the user great freedom, for better or worse. Due to the fact that bollards are less strict they are usable for a great variety of bicycles and they can easily cope with changes in trends in bicycle dimensions. However, the flexibility of the solution also has its downsides. As seen in figure 41, indications of the direction the bicycle should be placed in and how far ahead it should be pushed are often lacking. This results in that an area using bollards often looks less organised than an area using front wheel racks. Consequently, bollards are not commonly used on large parking areas, rather in one or a few rows along a street or an aisle.

A commonly used type of bollard as displayed in figure 41 is useful for those who want to lock their bicycle with an external lock. Locking is possible at different heights and offers support for the bicycle. However, this solution only offers limited support for those who solely uses the lock built in to the bike. For these users, this model of bollards only prevents the domino effects of bikes falling.



Figure 41. Bollards with no clear indication of parking direction

Low bollards are used for cargo bikes and are mounted with a longer distance adapted for this type of bike. One problem with the more spacious parking spot is that it becomes an attractive parking for conventional bikes as well.

Bollards are not only used for parking of bicycles, they are also used in the traffic environment to separate roads from pavements. Furthermore, the different type of bollards are often installed in close proximity and does look similar to one another. This can confuse users and make it less clear where there is an intended space for bicycle parking as exemplified in figure 42 and 43.



Figure 42-43. Bollard used to separate a road from a pavement mistaken for a bicycle parking bollard

8.4 VERTICAL PARKING



Bicycles can be parked hanging in the front wheel which is useful when there is limited space, but less comfortable for the user since the bike needs to be lifted. Some vertical parking solutions use a spring or a counterweight to ease the lifting of the bike. This solution contains moving parts which makes it favourable to install it indoors or under a roof. The locking possibilities with external locks are limited when using most of the vertical parking solutions on the market which makes them less suitable for use in unlocked areas.

The ceiling height for vertical bicycle parking must be at least 2,2 meters. Most commonly, hanging bicycle stands are mounted along walls with an operating space behind the bikes of at least 1,75 meters (Koucky, 2017).

INSIGHTS

Vertical parking is not a particularly widespread solution and has therefore not been observed other than via digital channels. The lack of vertical parking is believed to be due to the fact that the saved space that is gained from placing the bicycle vertically, after all must be available behind the bicycle during the parking session. There is also a great risk that the cyclist will not use a solution that requires some effort, especially at a station where the time aspect is of increased importance.

8.5 GARAGES

Bicycle parking garages are increasing in popularity across Sweden and are mostly used by those who highly value security. Garages have an increased theft protection, often offers surveillance and also protects the bicycle from weather impact.

To access most of the existing garages the user uses their travel card or credit card, but there are also solutions that are open for everyone. It differs whether the garages are free to use or if there is a fee to be paid to get access to the facilities. Some garages offer the paying users a warranty that a spot will be available. Furthermore, bicycle garages can be integrated to other related services, such as a bike pool or a repair shop.



Bicycle garages can be placed both underground and on ground level. Ground level solutions have the advantage that they are clearly visible while underground solutions need more signs to attract users. On the other hand, underground solutions saves space that can be valuable on ground level. As with other bike parking solutions the placement of the garage in relation to the target point is crucial for it to be used. However, the placement of bicycle parking garages is of an increased importance since they cannot be moved easily.

INSIGHTS

Garages have been observed in Lund, Malmö and Katrineholm as well as via digital channels and by conducting other municipalities. The information gained from municipality workers in cities where garages are used regarding number of parking spots, cost and type of garage is compiled in appendix 7.

A bicycle garage shows that the bike has a natural place in an urban environment and can be a good way for a municipality to profile itself as bike-friendly. Furthermore, building a securer type of parking can become an incentive to use sustainable transportation. More exclusive bikes can be used to the station with decreased worries of vandalism and theft. This in term means that the users consider cycling from further distances instead of using a car (Boverket, 2010). Electric bikes can be stored securely and many garages have electrical outlets that can be used to charge these bicycles. Several garages have lockers, where helmets, clothes and other equipment can be stored.

The door to the garage can be a hassle. It needs to be opened easily without the user letting go of their bike. There is a risk of congestion in the opening if there is only one entrance. Therefore, it is favourable that the user can walk through the garage in one flow. Some bicycle garages use sliding doors, which further increases the accessibility. However, it also increases the risk that unwanted visitors enter.



Two possible issues with parking garages were discussed during the risk analysis:

- Exclusive bicycles are collected in one building. It is possible for a thief to get access to the garage and quite easily steal the more exclusive bikes even though there is surveillance.
- Car parking is free in Varberg which will make cyclists question how the municipality prioritise between different means of transport. Why should it cost to park your bike in a secure way when car parking garages can be used for free?

Garages of glass are used by many Swedish cities, e.g. Katrineholm, Umeå, Växjö, Örebro, Trelleborg, Vänersborg, Huddinge, Sigtuna and Ängelholm. The number of parking spots in these garages varies from 24 to 89 and the parking costs from 50 to 100 SEK per month. There are modular variants available on the market which means that the garages can be expanded if there is an increased need. Garages of glass have the advantage that they are easy to identify as buildings used for bicycle parking and they can be provided with information and marketing about the service. These garages are light and provides a safe feeling since the user easily gets an overview of the area both inside and outside the garage. Figure 44 displays the garage in Katrineholm using the garage called *Flow* from the company *Cyklos*. This garage was visited in order to validate information obtained via digital channels



Figure 44. The bicycle parking garage in Katrineholm using the model *Flow* from the company *Cyklos*

Malmö City have two bicycle garages, one underground at the Central station, displayed in figure 45 and one as a part of a car parking garage in the district Hyllie, displayed in figure 46. Both of the garages are more hidden and requires an increased amount of signage compared to the garages with walls of glass. Malmö City has done a great job with creating clear and modern signage, but one cannot get away from the fact that garages often are perceived as dark and rough places. This problem is reduced when using garages of glass were the user has a clear overview of the surroundings outside of the garage.

The garages in Malmö has one part that is available for everyone where it is free to park and one locked area where a fee is charged to be able to use the facilities. Not many bicycles are parked in the locked part compared to the free area. Thus, the free area seems to be considered secure enough for a majority of the users.



Figure 45-46. Bicycle garages in Malmö central station and Hyllie

In Borås and Lidköping they have invested in other types of garages. In Borås they have a heated garage with shower facilities. This garage is modular just like the garages of glass and can be expanded if necessary. In Lidköping, an area in the station building has been converted into a bicycle parking garage. When rebuilding an existing room, it can be a challenge to optimise it to bicycle parking. However, the cost is often lower and it can facilitate when there is a lack of space in connection to the station. The garages in Borås and Lidköping are indoor environments which puts higher demands on cleaning. Both of these solutions also require more signage compared to the garages of glass but are easier to locate than underground solutions.

In the second survey the participants got to choose one out of three options regarding fees for parking in garages. 60% of the participants answered that they would like to park their bicycle in a garage and 16% answered that they would be willing to pay approximately 80 SEK per month to get access to a garage. The compiled results can be found in figure 47. The amount 80 SEK was chosen since it is in line with what municipalities with garages charge.

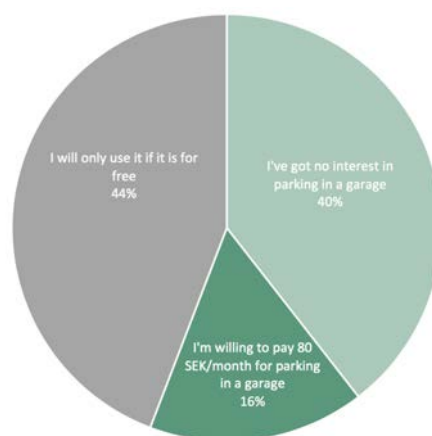


Figure 47. Diagram displaying users' attitudes regarding fees for garages

8.6 BICYCLE BOXES

Individual boxes can be used by those who highly value security and stores their bicycle during a working day, during nights or longer periods of time. The box offers an individual space for each bike which only the owner of the bicycle and maintenance personnel have access to. It thereby protects the bike from both external impact and theft. As with garages this securer type of parking can become an incentive to use sustainable transport and result in that more exclusive bikes can be used to the station.



Access to the existing boxes is often managed with keys or tags and a fee is paid to be able to use the existing bicycle box solutions across Sweden. Most commonly, each box is hired by one user but some systems allow for multiple users of the same box but at different times.

Compared to garages, boxes are more flexible and can easily be moved to another location, and the number of boxes needed at a specific location can be adjusted to meet the demands. Bicycle boxes can easily be implemented in a small scale to investigate if there is an interest in using a safer kind of parking of bikes. The boxes can be used both on ground parking and inside a garage. Furthermore they can be equipped with electrical outlets and possibilities to store helmets, clothes and other equipment.

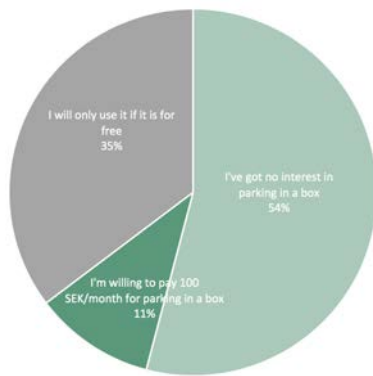
INSIGHTS

Bicycle boxes have been observed in Lund, Mölndal, Varberg and Kungsbacka. To gain further insights about the function of the bicycle boxes, municipality workers in ten Swedish cities have been contacted to give valuable information.

The summarised insights about bicycle boxes in other cities follows:

- Several cities take advantage of the flexibility of the boxes by relocating them if needed or expanding the amount.
- Vandalism is a very small problem.
- The location of the boxes is important.
- Can be cheaper per bike than a garage. Of course, this is dependent on the type and size of the garage.
- The booking system differs. It is most common with personal boxes.
- Some box models cannot store bicycles with a basket or child seat.
- The number of boxes at each city varies from 5 to 40 and the parking costs from 25 to 100 SEK per month.

See appendix 8 for a table of number of boxes, fees and type of box solutions used across Sweden.



In the second survey the participants got to choose one out of three options regarding fees for parking in boxes. 46% of the participants answered that they would like to park their bicycle in a box and 11% answered that they would be willing to pay approximately 100 SEK per month to get access to a box. The compiled results can be found in figure 48. The amount 100 SEK was chosen since it goes in line with what municipalities with boxes charge and since it is legitimate to charge more for boxes compared to garages.

Figure 48. Diagram displaying users' attitudes regarding fees for bicycle boxes

The Pendula box

The *Pendula* solution seen in figure 49-51, places the bicycles vertically inside the box and was observed in Mölndal and used in Kungsbacka. When parking a bicycle in the *Pendula* box, the user drives the front wheel into an arm and then pushes the bike inwards. The arm locks the bike in the wheel and guides the bike towards the roof, thanks to a resilient construction. It was experienced as pretty awkward to get the bike in to and out of the box. However, it became easier after the first attempt. Wooden studs on the ground displayed in figure 51 are meant to function as indications on where to place the rear wheel, however this is not clear and can lead to confusion. The arm that hold the bicycle is wobbly and rattles during use which gives an unpleasant feeling when using the solution.

The locking mechanism was tricky to use due to cavities between the keyhole and the lock case. Another downside with the solution is that bikes with baskets at front or a child seat cannot be stored in the box.

To sum up, the solution is space efficient, however at the expense of user experience and the possibility to survey the area behind the boxes.



Figure 49-51. The bicycle box Pendula

The Aretus box

The *Aretus* solution from *Trafik och MiljöInnovationer* seen in figure 52 was observed and used in Varberg near the harbour. The coastal location of the boxes made them exposed to sandy winds. This resulted in that the ground inside the boxes where full of sand as seen in figure 53. The placement adjacent to a wall and the colour matching the windows of the building made the boxes blend into the environment.

The Aretus box is a modular design and boxes can be added or removed according to choice and they can also be installed on sloping ground. Inside the box there is a rail where the wheel is placed to stabilise the bike. The boxes have a hook on the inside and can be installed with power outlets. In Varberg the boxes are used and maintained by a company who stores bicycles free to use by the employees of the company. The boxes in Varberg used keys to get access. However, this box model can be equipped with different types of electronic locks.



Figure 52. The Aretus box with sand



Figure 53. Sand filled box

The FalcoQ box

The *FalcoQ* solution from *Falco Street furniture* seen in figure 54, was observed and used in Lund. This solution has many similarities to the *Aretus* box and this section does therefore only cover the differences between these two solutions.

Material and colour choice of the two bicycle box solutions are their greatest differences. The boxes in Lund are more conspicuous and livelier in their appearance. Decals enrich the boxes and gives them a modern appearance and they also serve as tools to express the function of the boxes. The green colour used on the boxes is a colour that is often used in the urban environments of Lund which connects the boxes to its location. A pattern of holes on the doors of each of the boxes in Lund makes it possible to detect what kind of bike that is stored inside of the box. The *FalcoQ* solution comes in sections of five boxes. Thus, it is not as easy to adapt the number of boxes according to the demand compared to the *Aretus* solution.



Figure 54. The FalcoQ solution

8.7 AUTOMATIC SOLUTIONS

Fully automated bicycle parking systems are prominent in Japan. Germany, Austria and the Netherlands are other countries using automatic parking systems for bikes. These systems are often installed under ground but there are also solutions above ground in several floors.

The major advantages of automatic solutions are that they are space efficient and theft proof. The cost and complexity of the systems are their main disadvantages.

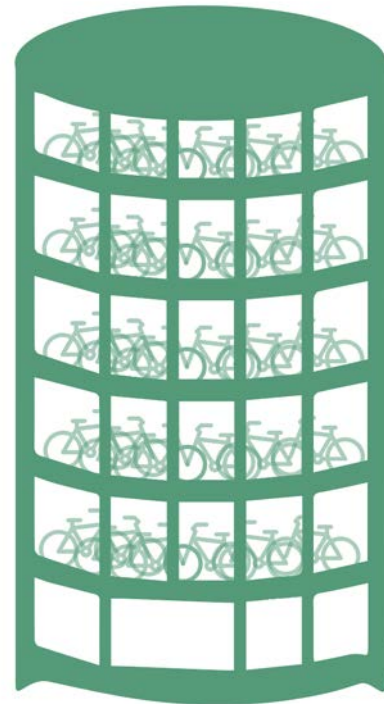
INSIGHTS

Automatic solutions are not particularly widespread and has therefore not been observed other than via digital channels. This type of solution has yet not been tested in Sweden. Stockholm will be the first city in Sweden to install a fully automatic bicycle parking for secure storage.

It will be installed in Ropsten during spring 2019 (Stockholm Parkering, 2018).

During risk analysis it was found that it takes about 13 seconds to receive a bicycle that has been parked inside an automatic solution (Neira, 2017). At train stations where there are rushes, 13 seconds can be a long time if there is only one delivery point. There is a risk that queues arise during peak hours. Other risks found with automatic solutions are their complexity compared to conventional bike racks.

However, an automatic solution shows that a municipality is willing to invest money in bicycle infrastructure. Automatic solutions get rid of bikes from the streets that take up a lot of space and constitute barriers.



9. ADDITIONAL VALUE

By adding additional value to a parking area it becomes more attractive from a user perspective. It also indicates that the municipality cares about cyclists and is willing to spend money on bicycle infrastructure. Since cyclists tend to search for a place to park that is close to their target, adding value to a parking area located further from the target destination is a way to make more people park there. In this section, proposals for how the user value can be increased are presented. The information is gathered from surveys, interviews, observations and brainstorming sessions.

9.1 WEATHER PROTECTION

A sheltered parking offers weather protection for both parked bicycles and cyclists. This is valuable for cyclists that need to spend time next to their bicycle, for locking, putting on or off their helmet, rearranging baggage etc. By protecting the bicycle from rain and snowfall, the bike owner will not have to get on a wet or icy saddle when starting the ride from the station. Another advantage with weather protection is that it gives a decreased need for snow clearance among the bicycles. By adding walls that protects the bikes from wind there is also a decreased risk that the bicycles will fall over and be damaged. The risk that dirt and rubbish is gathered can be decreased by a product that allows wind to flow through it.

A well-functioning weather protection solution can provide a clear separation between the intended parking area and the surroundings which in turn makes it easier to get cyclists to park in the intended way. One thing that should be kept in mind is that it should be easy to link several weather protection sections together into the needed length. If the product is not designed for this, it could confuse the users and make them park in an unwanted way. An example of this can be seen in figure 55. The picture is taken at Källered station and shows a weather protection solution which is not designed for modularisation. The gap this results in apparently tempts cyclists to use it as a parking spot. From a design perspective, it should also be considered if the design invites cyclists to park and lock their bike on the outside of the weather protection construction. Figure 56 shows a bike shelter where the side panels have small holes. Small enough so that a lock cannot fit but big enough to enable people to see through.



Figure 55.
Unwanted gap between two sections



Figure 56.
Bike shelter with small holes on the side panels

There are plenty of different products for weather protection out there. Solutions that are found pleasing are the ones that do not interfere with the overview of the parking area or the accessibility.

Regarding the roof, several choices of material have been found promising. Sedum roof contributes to a green urban area, it collects storm water and favours the ecology of the city. A transparent roof can give a light, airy and open feeling but can be hard to keep clean as seen in figure 57. Tall trees should be avoided close to transparent roofs since this increases the risk for bird droppings which gives the roof an unpleasant appearance. Furthermore, a roof could be utilised as an area for attaching solar panels or to integrate illumination to light up the parking area.



Figure 57. Dirty roof on bicycle shelter

9.2 STORAGE

“I would probably start to use helmet if there were convenient helmet storage possibilities”

Storage facilities in the form of lockers is a convenient way for cyclists to store belongings. In survey 2, 28,9% of the participants answered that they would use lockers if available on the station area, thereby 71,1% answered that they had no need for this type of service. Several of the interviewees answered that they would like to store their helmet and outerwear. One of the participants even answered that she probably would start to use a helmet if there were convenient helmet storage possibilities. Observations also revealed that storage of helmets would be usable for many cyclists, as exemplified in figure 58. Another thing that could be convenient to store is electric bicycle batteries. They are both heavy and expensive. Today, many owners of electric bikes choose to remove the battery and bring it when the bicycle is parked in order to prevent that it gets stolen.



Figure 58. Non-optimal storage of helmet

The location of the lockers could make cyclists willing to park their bike further away from their target destination but there is also a risk that few would use them if the placement makes them too time consuming to use. People mentioned in the interviews that eventual lockers would need to be placed in a way that makes them fast and simple to use. Lockers should therefore be placed in connection to the bicycle or where many cyclists pass, but not necessarily closest to the target destinations.

Keyless lockers ease the use. Ways to avoid keys are to have code locks or locks that are managed by an app. However, a risk with public storage possibilities is that the storage is used for other purposes than the intended ones, for instance criminality. One way to make it safer is to have a transparent front. Also, a master code or similar should exist in order to be able to open a locker whenever.

9.3 CHARGING

Electric bicycles are an up-and-coming trend (Svensk Cykling, 2018) and requires charging in order to assist the user. One relevant question is if there is a need for charging possibilities at the station area.

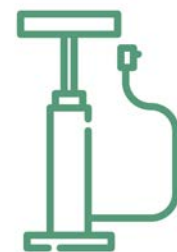
At the bicycle fair in Gothenburg, M. Silberg from Crescent held a presentation about Electric bicycles (personal communication, March 15, 2019). Silberg meant that the travelling distance for a fully charged battery varies from about 25 km and up to 140 km. The broad variation depends on external factors such as the inclination and weather conditions but also the weight of the cyclist and how much assistance that is used. With these numbers and the size and landscape of Varberg in mind it could be seen as unnecessary to offer charging possibilities at the station.

Arguments in favour of charging facilities can also be found. Let's say that a cyclist forgets to charge the bicycle and therefore ends up powerless on the station or that a user is commuting to Varberg and therefore wants to have an electric bicycle at the station. There could for example be a collaboration with the business sector where parking options for business specific bikes can be rented. Employees that commutes to Varberg can then be offered to bike to work on one of the company's bicycles. Electric bicycles could also be a part of a future bike sharing system. Furthermore, other cycle related devices, such as bicycle lamps could also utilize charging.

Today, most bicycle batteries can be charged either when they are mounted on the bicycle or they could be removed from the bicycle and be charged separately. According to Silberg there are no downsides of charging the battery for shorter periods of time or not to unplug the charger even if the battery is fully charged.

9.4 SERVICE

A bike that does not work properly can be both irritating and a safety hazard for a cyclist. Equipping a parking area with a bicycle service station can thereby be a way to increase the user value. Beside the aspect of increased safety, a service station can also add attractiveness and elevated status to a parking area.



A service station is a wide concept that can stretch from a single bicycle pump to a completely manned repair shop. Since the bicycle parking at the station area is the biggest one in the city of Varberg it would be an appropriate location for a store that offers bicycle repairs, bicycle rental, sale of bicycle items and other bicycle related services. Having such business in close connection to a public transport hub could be beneficial since bikes can be repaired during the time the bike owner is away. It could also be a neat way of leasing bikes to tourists arriving by train or bus.



Even if a complete manned store can offer cyclists what they need, a public self-service repair and maintenance station could be a favourable complement. This allows cyclists to perform simple adjustments on their bikes. Things that could be included in the bicycle repair station are tools, chain lube, the possibility to fill up a water bottle and to wash the bicycle. It should be possible to hang a bicycle to ease the bicycle maintenance.

Furthermore, it should be possible for users with less experience of self-service to scan a QR code and get redirected to a website with bicycle repair manuals. To increase the possibility for people to repair their bikes, a vending machine with bicycle related products could be placed in connection to the repair station. The service station should be located where users are able to perform service without disturbing other cyclists or pedestrians. Yet, the location should be visible for both pedestrians and cyclists to make more people aware of its existence and thereby get more people to utilise the product. Important aspects to emphasise when choosing repair station, except from offering the right tools and function, are that the design communicates its function and that the tools are securely attached.

9.5 SIGNS & MARKINGS

Clear signage makes it easy for cyclists to spot a parking area. No matter what direction the cyclist arrives from it should be clear where the intended parking areas are situated. By deliberately designing and arranging signs and markings, cyclists' movement can be affected. It is therefore important that decisions made within this area are well-reasoned. It could for example be useful to direct cyclists to the larger parking areas or make it less tempting to take a shortcut and cross e.g. car parking lots or bus stops.

ORIENTATION WITHIN THE AREA

Signs and markings can be useful to increase the visitors' ability to orient themselves within the parking area. By informing about the target destinations and the facilities that are situated within the station area and where they are located, more people can find and utilise them. Cyclists with special needs, such as the ones that want to use a garage, a bicycle box or park a cargo bike should be able to locate the requested parking. Figure 59 shows a sign located at Triangeln in Malmö. It makes it easy to spot the area and gives information about the facilities that are available.

Own experiences and results from interviews performed indicates that it can be hard to remember where the bicycle was parked. A way to decrease this problem is to place objects that the cyclists can orient themselves after. A too monotonous layout of the parking area could make it hard to remember where the bicycle was parked.

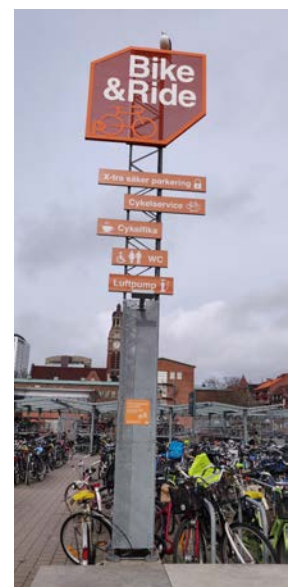


Figure 59. Informative sign at Triangeln, Malmö

MARKINGS AS A WAY OF STRUCTURING THE PARKING AREA

Markings on the ground can frame a parking area and guide the users to park in a correct way. Tests made during the project showed that markings can give an impression of a tidier parking area if a straight line is framing the bikes as validated by figure 60-61. Even if the bicycles are not placed in a straight line the marking gave an illusion of it since it took focus from the bicycles.



Figure 60-61. A straight line gives an impression of a tidier parking

Bicycle related markings can make it clear that a parking area is meant for a certain type of bicycle. Instead of forbidding other vehicles, bicycle signs make it clear that the parking area is meant for bicycles and not mopeds or motorbikes.

Worth noticing is that it has been found that no matter how well a parking area is structured or marked, this on its own will not make people park correctly. Furthermore, a prerequisite for a tidy parking area is that there are enough parking spots. At Varberg's existing station there are yellow lines marking out an area to communicate where cyclists should not park, see figure 62.

There is also a sign that clarifies the lines, see figure 63. When this project first started, it was rarely a bicycle parked within the forbidden area. However, this changed when a bicycle rack located close by was removed. Suddenly people started to place their bikes inside the marked area, probably because they felt that they had no other choice.



Figure 62-63. Yellow lines to communicate where one should not park and a clarifying sign

INFO WITHIN THE PARKING AREA

To ease the situation for cyclists and other visitors of the station information of different types can be shown. Train and bus passengers should be able to receive updated traffic information in real time by digital means. This makes cyclists aware of the time available to catch their connecting means of transportation.

Tourist information about Varberg as a bike city in the form of a map and information about popular tourist destinations that can be reached by bike are also suitable to place at the parking area. Make sure to place the information where it is visible, not behind a bike rack as seen in figure 64.



Figure 64. Tourist sign hidden behind a bike rack

GUIDELINES FOR SIGNS & MARKINGS

Some general guidelines regarding signs and markings have been found:

- Place signs in the flow of traffic so that it is visible for lots of people.
- Avoid that information can be obscured by other objects.
- Encourage and guide visitors instead of prohibit.
- Try to make information as clear and simple as possible. Strive to get the area to speak for itself, for example by providing a good overview. Too much instructions can make it hard for the receiver to get the message.

10. PLACEMENT & LAYOUT OF BICYCLE PARKING AREAS

The planning of the geographical placement of a bicycle parking area and the layout within it are crucial for a well-functioning bicycle infrastructure. A thorough planning phase is important since this is where the future conditions for the parking structure are set and since late changes in a project most often are costly in terms of both time and money.

10.1 GEOGRAPHICAL PLACEMENT

The geographical placement of a parking can be the difference between success and failure. It must be visible in order for cyclists to spot it, it must be located close to the target destination and in the flow of traffic. These aspects will among others be presented in this section.

CLOSENESS TO THE TARGET DESTINATION

A crucial aspect for cyclists when it comes to the choice of where to park is the distance from the parking to the target destination. Bicycle is a means of transportation that allows transport from door-to-door and users prioritise to park close to the target destination. Several guidelines and recommendations of the appropriate distance between a parking area and the target destination can be found. Fritz & Brodén (2010) conducted research during a rebuilding of the public transport hub in Uppsala and found that bicycle parking areas located more than 200 meters from the station had a low occupancy rate while parking areas situated closer were congested. Celis and Bølling-Ladegaard (2008) states that the distance accepted by cyclists depends on how long time the bicycle will be parked. They claim that 0-15 meters is an appropriate distance if the bicycle is parked for a very short time and when it comes to long term parking, a distance of up to 100 meters is acceptable. The Norwegian Transport Administration recommend a maximum distance of 25 meter (Statens vegvesen, 2002).



Three main target destinations for cyclists can be distinguished from the drawings of Varberg's new train station area. These are the train platforms, the station building and the bus stops located both along Västra Vall and at busstorget. Bicycle parking options that are situated in close connection to these three targets are therefore of great importance.

IN THE CYCLISTS NATURAL FLOW

Another important aspect that needs to be considered regarding the placement is where the parking is located in relation to the natural flow of traffic. It is not necessarily the distance from the parking area to the target destination that is the main concern but rather the opportunity of saving time which closeness opens up for. The user should therefore not have to cycle past the target destination in order to get to the parking area. If this cannot be realised there is a risk that the route is seen as a detour and that the user therefore decides to park the bicycle somewhere else than at the intended parking area.



Figure 65 proves the importance of placing a parking area at the right location and to make room for enough bicycles. The three parking areas shown were studied during a study visit in Malmö and their locations are shown in the picture to the lower left. Parking one and two are almost identical and they are placed about 100 meters apart. As seen, parking one is almost empty, while parking two is cramped which shows that the location is of great importance. Parking three mainly shows the importance of offering enough parking spots at the right location. Even though there were no available spots, people did not spend time to search for an available parking spot somewhere else, but instead bikes were parked all around the area.

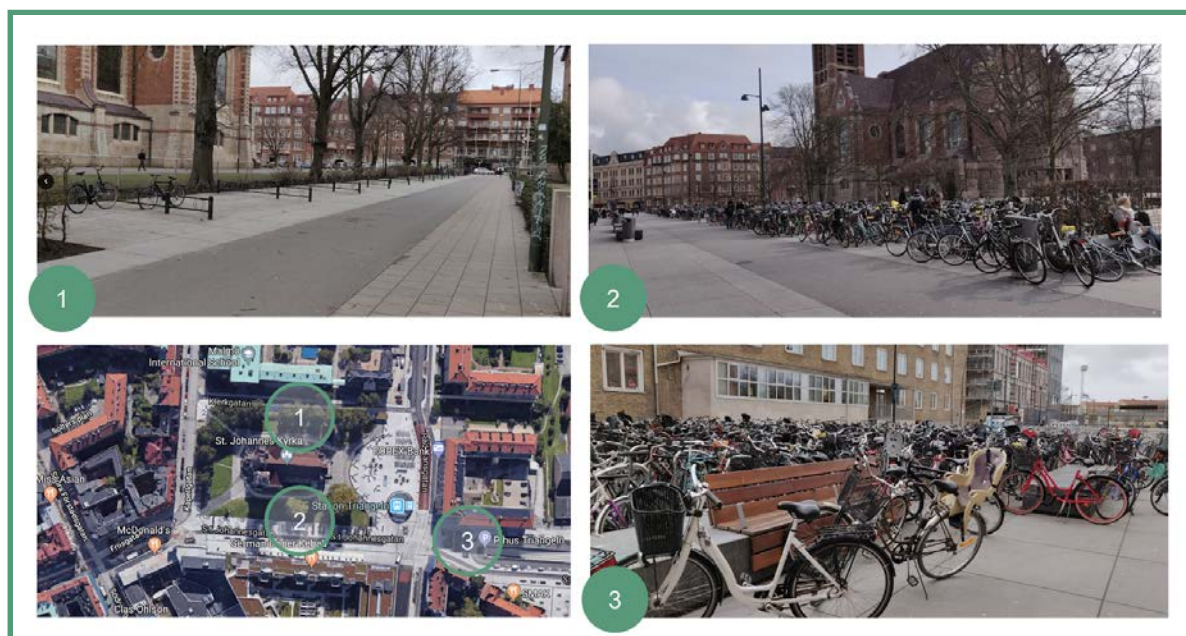
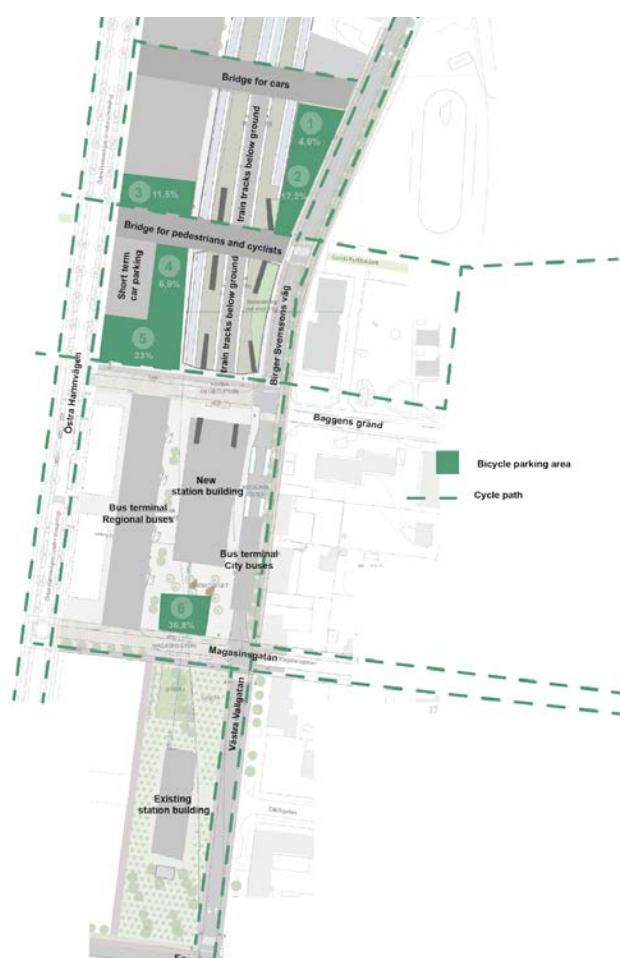


Figure 65. Photos that shows the importance of the placement and size of a parking area

PARKING AREAS AT THE FUTURE STATION

The locations of the parking areas at the future station were already decided when this project started. However, the users level of interest for the different parking areas were found to be a meaningful base for arranging the layout of the parking areas. Therefore, this was explored in survey 2 where the participants got to answer questions about direction of arrival and which parking area they believe they will choose.

The parking areas were divided into six sections, these are marked 1-6 in figure 66. Answers to the question about which parking area the participants believe they will chose are displayed in



percentage next to each parking number. Parking 6, located south of the station building at the entrance square is the most popular parking with 36,8% of the votes. This is unfortunately the smallest parking area. Either this parking must be bigger, very space efficient or an additional parking area should be added nearby. At the moment, it is not decided what will happen with the area north of the existing station building, this would possibly be a good place to arrange more parking spots as a complement to parking 6.

The least popular areas to park are at parking number 1 and parking number 4. To increase the number of people that wants to park at these areas, additional value could be added by e.g. the use of weather protection or by offering a larger distance between the parking spots.

Figure 66. Level of interest for the different parking areas

95% of the participants justified their decision by writing that they chose the parking area that is closest to either the target destination or the direction of arrival. Other reasons for choosing a specific parking was that the participants wanted to park where there are lots of people in motion since that gives an increased feeling of safety. Furthermore, they did not want to pass the area with bus stops and lastly they chose a parking because they believed that there would be few bicycles parked there and that it therefore will be easy to find an available parking spot.

The answers to the question about direction of arrival are compiled in figure 67. Arriving to the southeast corner of the station area is most common, both Västra Vallgatan and Magasinsgatan lead the cyclists to this spot and in total, the survey shows that 66,6% of the people visiting the station by bike arrives at this corner. The second most common direction of arrival is from north on Birger Svenssons väg, 19,5% of the participants chose this option. Only a small proportion answered that they will arrive from Östra Hamnvägen or Baggens gränd.

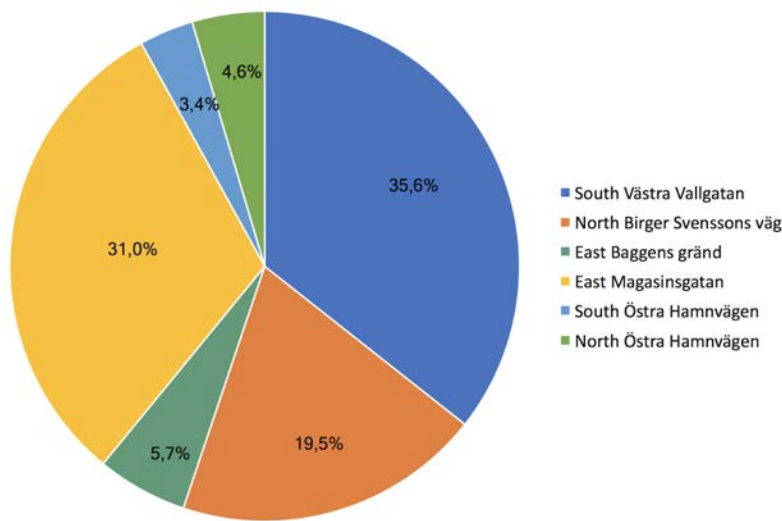


Figure 67. Direction of arrival

In figure 68, the participants choice of parking area is divided concerning direction of arrival. The result from survey 2 gives an indication of the cyclists movement and choices but other aspects must be taken into consideration. The fact that it can be difficult to understand the map and that a major urban development project is ongoing in Varberg could affect the result. Direction of arrival to the current train station was also explored by Sweco in 2014 and their result can be found in appendix 9.

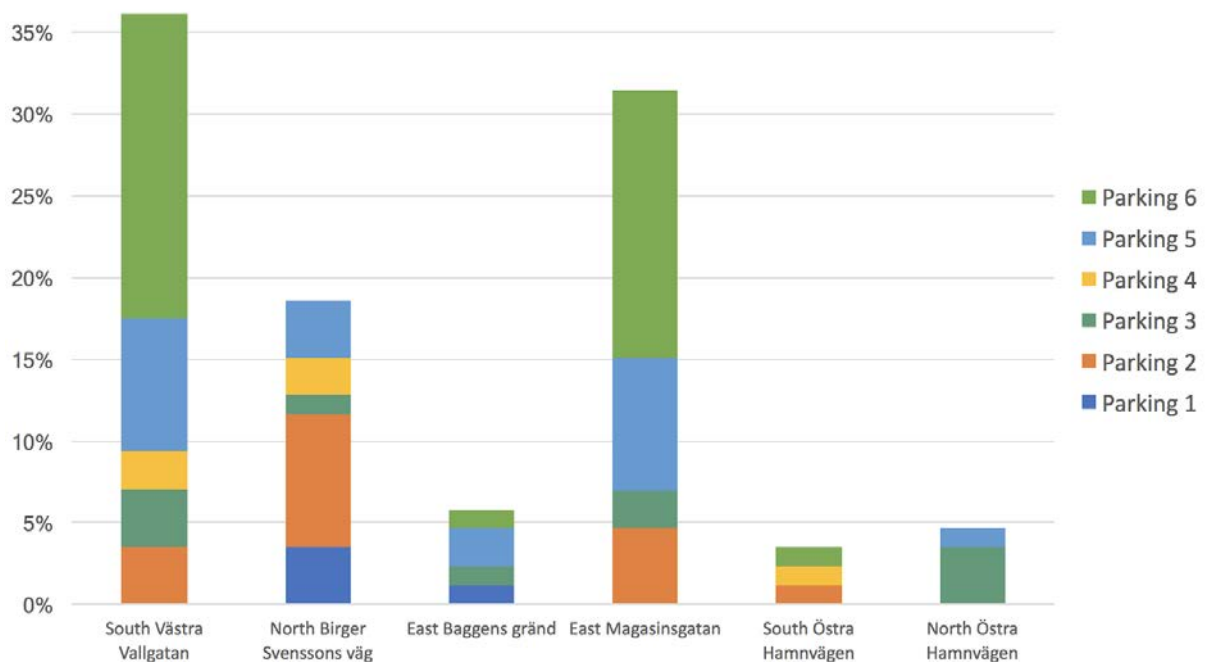


Figure 68. The correlation between direction of arrival and choice of parking area

10.2 LAYOUT FOR PARKING AREAS

Several aspects need to be considered in order to give the users the prerequisites needed for using a parking in the intended way. A significant factor is to find out the needed amount of parking spots and to ensure that adequate space is provided. If there are not enough parking spots it does not matter how well the area is arranged, people will have to park their bikes somewhere else and the result will be a messy parking area. SKL (2010) recommend that the occupancy rate should not exceed 90%. If this number is exceeded more parking spots must be arranged. Further aspects that encourage the users to park in a correct way are the design of aisles and delimiting elements which will be described further in the following sections.

AISLES

There should be direct access to the parking areas from the surrounding bicycle paths. The aisles within a parking area should lead to the target destinations in a convenient way with the possibility to park the bicycle along the way to avoid making the visitors having to take detours. Moving around within the parking area must be easy. Steep ramps, stairs, doors and other obstacles may mean that the facility is not used.

The flow of visitors at public transport hubs depends on the departures and arrivals of trains and busses. When planning the parking area this should be considered. A rather large group of people must be able to pass through the parking at the same time to park or collect their bicycles. To avoid critical issues that this can result in there are a few aspects that need to be taken into account:

- There must be several ways to pass through the parking area to minimise the risk that a single path becomes a bottleneck.
- A single cyclist should not cut off the entire flow of traffic when maneuvering a bicycle.
- Paths within the area must be wide enough to allow two people to pass each other, also when walking with bicycles.
- A cyclist should be able to find a parking spot while still cycling.

BOUNDARIES

Placing delimiting elements in a convenient way can result in a more structured parking for mainly three reasons. Firstly, it gives an indication of the direction a bicycle should be parked in. A delimiting element the same length as a bicycle, placed parallel to the direction of the parked bicycles functions as a guidance to how the bicycle should be parked. Secondly, if bollards are used, a delimiting element perpendicular to the bicycles gives an indication of how far the bicycles should be pushed when parked. Thirdly, delimiting elements can separate intended parking areas from surrounding aisles and traffic. The delimiting elements then functions as a safety precaution since they can hinder cyclists to reverse their bikes out on a busy road. Another safety aspect is that if the bikes are enclosed they will not be in the way for passing traffic such as emergency vehicles, visually impaired people and wheelchair users, amongst others.

The design of the delimiting elements varies considerably. Elements that can be used are for example fences, blocks, hedges, urban furniture and facades, in figure 69 and 70 two different designs can be seen. Notice that a high delimiting element interferes with the visibility and overview of the area and that a low delimiting element can imply a risk of tripping.



Figure 69-70. Two examples of delimiting elements observed in Malmö respectively Lund

Observations made during the project showed that it is common that cyclists use delimiting elements as an arrangement to lock their bike onto, such situations are displayed in figure 71-74. By providing solutions with secure locking possibilities this problem is reduced. The design of the boundaries should prevent this behaviour. This could be realised by using solid elements or elements with small holes where a lock cannot fit.



Figure 71-74. Examples of delimiting elements as arrangements to lock bikes onto

The whole area must be designed to prevent that bicycles are parked incorrectly. Figure 75 shows a proposal of how the future station building could look like. The architect has chosen a fence with vertical bars as a boundary. The second picture, figure 76, taken in Malmö shows a similar looking fence. This type of fence has been found very popular among cyclists and should therefore be avoided.



Figure 75-76. Avoid fences with vertical bars since they are popular to lock bikes onto

10.3 OPERATION & MAINTENANCE

Operating and maintaining a bicycle parking includes sanitation, snow clearance, replacement of broken parts, taking care of vegetation and managing abandoned bicycles. To gain knowledge and understanding of how the design of a bicycle parking area affects the operations needed, J. Bergstöm who is head of the division of operation and maintenance at the municipality of Varberg was interviewed (personal communication, April 9, 2019).

Litter, gravel and old leafs are commonly removed using a blower and broom. In general, it is not the design of the parking solution that determines the effort that is required but rather the number of bikes that are parked. A sweeper is often used around the bicycle parking to gather up the piles of litter that has been gathered. The minimum width that is required for a sweeper is 1,5 meters.

1,5 meters is also the minimum width that is needed for managing snow clearance by the use of a snowplough. Usually it is only the aisles that are cleared from snow, since removing snow in between bicycles is too time consuming. Two ways to ease the snow clearance was discussed with Bergström. These were to mount a roof over the parked bicycles to protected from snowfall and to install underground heating that melts the fallen snow. If weather protection is used it is beneficial if the product is open and allows wind to blow through so that litter is not gathered in corners.

On the existing drawings of the future station area, gravel is chosen as surface material on the areas for bicycle parking. From an operation perspective, this is not the best scenario. Collecting litter with gravel as surface material makes it hard to use a blower, rake and broom without also collecting the gravel and spreading dust. From a user perspective, gravel can be an irritant since

the kickstand does not get a proper grip, especially if the bike is heavily loaded. It also makes it difficult to add markings on the ground and the dust can bother visitors when the weather is windy. Gravel might be beneficial from an economic perspective but Bergström wishes that cost cuttings are not made when it comes to ground surface since it is a minor expense in such a costly project. By not using gravel, the areas for plantations and bicycle parking are separated and easier kept neat. Edge stone is a way to further separate these two areas and thereby make it easier to remove weed in the transition from a plantation.

One of the main concerns that was discussed with Bergström was if it is feasible to have hedges in direct connection to a bicycle parking. Bergström does not experience this as a problem. Even though it requires effort to keep the hedges trimmed and the surroundings neat it is absolutely doable. She was more concerned about all the trees that are placed on the drawings received from the tunnel project. Tall trees are inviting for birds, this in turn can create problems due to bird droppings.

Common pitfalls are that architects often place objects such as bollards, signs and tactile aids in such way that it gets hard to pass with a sweeper or a snowplough. In addition to the extra effort required from the worker it is also a safety hazard since the worker must pay attention both to the fixed objects and people passing. Bergström prefer that grass is not planted where fixed objects are placed, pavers or asphalt is better in such places. Observations made have confirmed that the design of a parking solution to a high extent can influence the maintenance required to keep a parking area tidy, see figure 77 and 78.

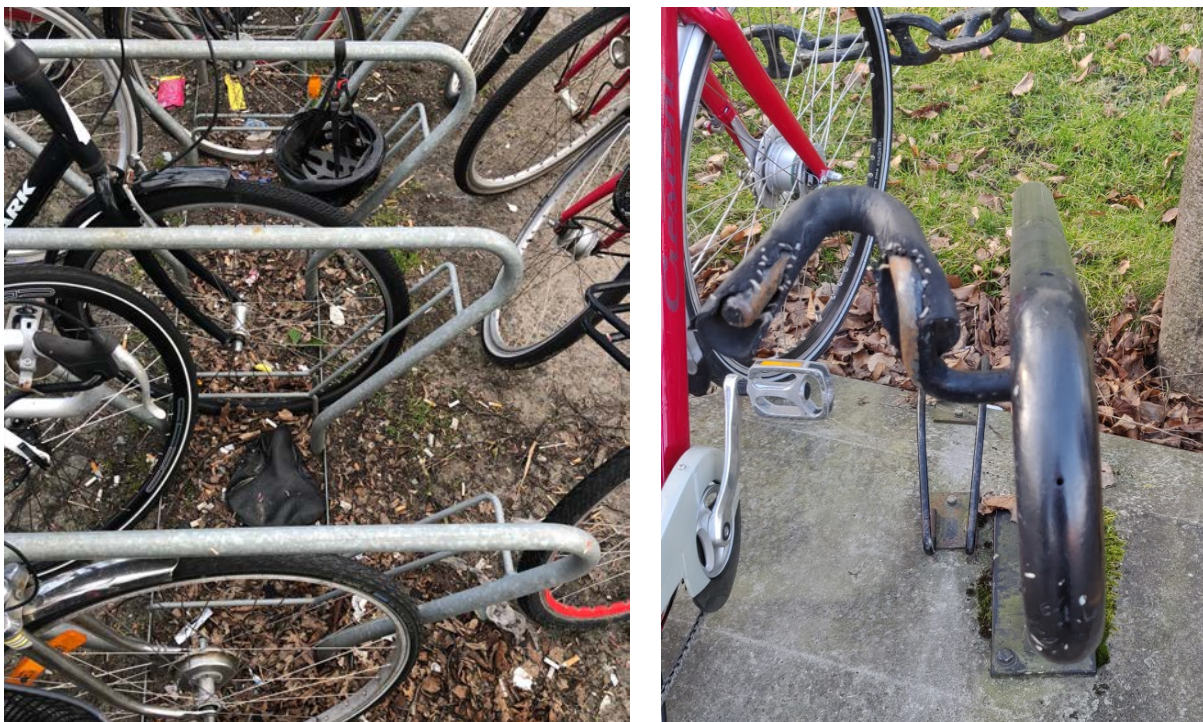


Figure 77-78. Bicycle rack where leaves and litter are gathered and a parking solution where the material is worn out

11. BEFORE MOVING ON

A large amount of bicycle parking designs has been found during the initial phase of the project. Given all the companies and products that targets this area there is no doubt that there is a market for it. The range of products is wide, from simple solutions to complex systems. The initial phase of the project has shown that the simpler solutions are the ones that are most frequently used and there is an abundance of options to choose from in this category. Well-functioning bicycle parking facilities should solve the needs of many different cyclists and one type of solution is therefore not sufficient in a larger parking area such as Varberg's new station.

Bollards offer locking of the frame of the bicycle and is a very flexible solution suitable for a great variety of bicycle types. They give a more open solution compared to front wheel racks and two floored solutions. However, parking areas using bollards have a tendency to look disordered. Clear indications of how to use this kind of solution are often lacking. The majority of the bollards on the market offers low lateral support if an external lock is not used. A new type of bollard will not be developed in this project. However, a solution of this kind will be recommended and the area will be designed so that bollards works in a more orderly manner.

Front wheel racks are easy to use and result in organised areas if there are enough parking spots. The distance between the wheel supports can be a critical issue. A spacious distance between the supports may lead to that a bicycle is parked between the two pairs of wheel supports whereas a smaller distance can entail that the handlebars are tangled together. Furthermore, it seems to be a great worry that the wheel of the bicycle will be damaged when using the wheel support, the problem can be decreased if a frame supporting device is used. In Malmö, an unusual type of front wheel rack was found. This model lets the wheels of the bicycles overlap in a shared area and seem to have great potential for further development. Therefore, this type of front wheel rack will be further explored.

Another parking category is solutions which focus on space efficiency. Space efficient solutions, such as two floor solutions and vertical parking seem to have two things in common. Firstly, they are not user friendly compared to less space efficient solutions and secondly, they hinder the overview of a parking area. The lack of use of vertical parking is believed to be due to the effort it requires from the user and the fact that the saved space that is gained from placing the bicycle vertically, after all, must be available during the parking session. This solution will not be taken further into the process. Two floor solutions were experienced as heavy and awkward to use and users seem to avoid parking on the upper floor if there is room on the ground floor. This type of solution will not be taken further into the process.

The last parking category is securer storage of bicycles. In this category, garages, bicycle boxes and automatic solutions belongs. These solutions were considered particularly interesting for Varberg's new station area since it emerged from the initial phase of the project that an increased focus should be put on the users who prioritise security. People tend to buy more expensive bicycles and the increased sales of electric bikes and cargo bikes proves that people realise the benefits of cycling instead of driving a car. Even so, users are not feeling confident leaving their bike in public places and this hinders some users from cycling to the station or using a more exclusive bike that would fit their needs better.

Parking solutions with increased security such as garages, bicycle boxes and automatic solutions meet the requirement to give the users a secure parking for their bikes but have different advantages and disadvantages. The choice fell on developing a new type of bicycle box due to the reasons compiled below:

- A garage where many users have access does not allow a secure storage of bicycles to the same extent as an individual box does. The fact that only the user and the maintenance personnel have access to each box makes this solution securer. Another advantage with boxes is that nobody sees the bicycle when it is parked inside of the box.
- There is no risk that bicycles fall over each other and get damaged.
- The flexibility of boxes makes them ideal to test how large the need is for a more secure kind of bicycle parking. Installing modular boxes is believed to be a good first step instead of building a garage initially. However, it does not exclude that a garage can also exist.

Automatic solutions also meet what is stated under the first two bullet points. What is doubtful about automatic systems is their complexity and cost as well as the fact that they have not yet been tested in Sweden. In Stockholm an automatic solution will be tested and if the result is positive and there is economy for it, there may be potential for such a solution at the new station area. However, automatic solutions will not be examined further in this project.

The decision to focus on bicycle boxes was also based on the fact that a gap in the market was experienced. No solution on the market within this category was found optimal to implement on Varberg's new station area. However, the market offers several types of garage solutions that can easily be implemented at Varberg's station. Therefore, the garage category will not be further developed but a garage solution will be recommended for Varberg's new station area.

In the additional value category, weather protection, storage, charging, bike service as well as signs and markings have been described. All of these areas are important and the initial phase of the project showed that all of them should be parts of the future parking area. Other products that should be added are recycling bins, illumination and urban furniture for social value. The project's framework has not allowed in depth studies in this extensive category.

Incorrectly parked bicycles and unorganised parking areas lead to inferior accessibility, both for cyclists, emergency vehicles and other visitors of the area. A disorderly looking bicycle parking

can also interfere with a pleasant urban environment. These problems will be reduced by a well thought through layout of the area that guides the user to a correct parking. Furthermore, a well-planned location and design of a bicycle parking area have been found crucial for its functionality.

It was discovered during the initial phase that it is usually not the solutions used on the parking areas that are the main reasons why the parking area is not perceived as orderly. The difficulty lies in installing the solutions correctly and that the design of the area invites for the desired use. Therefore, a great focus during the continued process will be on designing the layout for these areas. However, Parking 6, the most popular parking area according to the respondents of survey 2 will not be taken further in the process. This is because there are too many uncertainties about this area that are beyond the scope of this project. The area is under-dimensioned and the space issue needs to be solved first. There are plans to place a bicycle parking area north of the existing station building and if this will be realised or not affects the design of parking 6. Furthermore, the risk of disordered parking is believed to be great if the number of spots required at parking 6 cannot be offered.

12. BICYCLE BOXES

This section starts with presenting the results from the ideation around bicycle boxes followed by presenting the modular bicycle box concept named *Baxy*. Needs and requirements specific for bicycle boxes can be found in the requirement specification in appendix 3.

12.1 IDEATION

The ideation around bicycle boxes was based on several areas where space efficiency, access and user experience were some of the areas of interest.

The ideation around space efficiency started with different ways of stacking boxes on top of each other. However, two-storey boxes seem to have the same usability problems as two floored bicycle racks and also hinder the overview of the bicycle parking area. Storing bicycles vertically or in other directions were also ideas that were ideated around as other ways to save space. Thus, a box that stores the bicycles vertically needs to be about 2 meters high and hinders the overview of the area which was valued higher than the space efficiency. Since stacking boxes on top of each other or storing bicycles vertically did not seem as favourably ways to save space, the ideation moved on to optimise the shape of the boxes to save space.

Among a great variety of shapes, four basic designs of the box with potential to further development were generated, see figure 79.

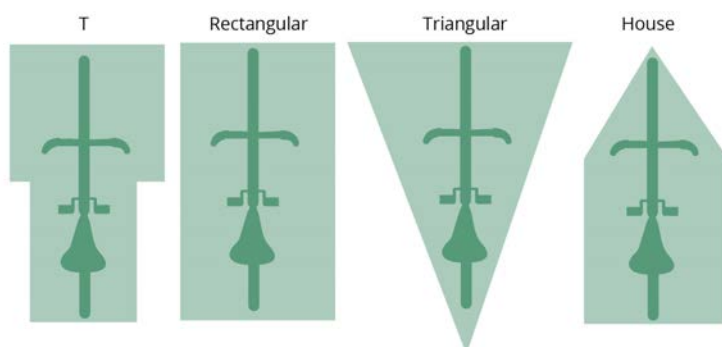


Figure 79. The four basic shapes with potential for further development

The house shape was considered as the shape with best potential to fit the future station area of Varberg. Not only because it takes up least space per bicycle but also since it fits with the arrangement of the parking area. In appendix 10, information about the shape designs and the reasons for eliminating three of them can be found.

When the shape was decided the ideation around different types of opening mechanisms started. A very wide range of ideas were discussed, e.g. swing doors, garage doors, automatic sliding doors and classic doors. Requirements that were important to consider were that the door must be able to be opened from the inside to prevent anyone from being locked inside a box and that the bicycle should be easily maneuvered into and out of the box.

It was also ideated around different type of locking mechanisms. Digital locks are increasing in popularity in a variety of fields. Apps, tags or codes can be used to manage these locks. Apps and codes have the advantage that they do not need administration with keys. Furthermore, it is easier to share a box between different users which goes in line with the sharing trend. A conventional lock with a key have other advantages such as that it is cheap, that the users immediately knows how it works and that it is perceived as reliable.

The following questions were used to trigger the ideation around additional value:

- What additional value could be added to the box to increase to user experience?
- What do people bring with them and what do they want to leave in the box?

From interviews and web survey 1 it turned out that clothes and helmets were the most requested belongings to store. It was ideated around how these belongings could be stored inside the bicycle box as well as the best possible placement of the storage. Lighting inside the box as well as charging possibilities for electric bikes and bicycle lights were also a part of the idea generation around additional value.

12.2 BOXCY

Boxcy, illustrated in figure 80, is a modular bicycle parking box with clear connections to the city of Varberg and the new station area. The low module allows a good overview of the area behind the boxes and its design is in line with the core values of the station area.

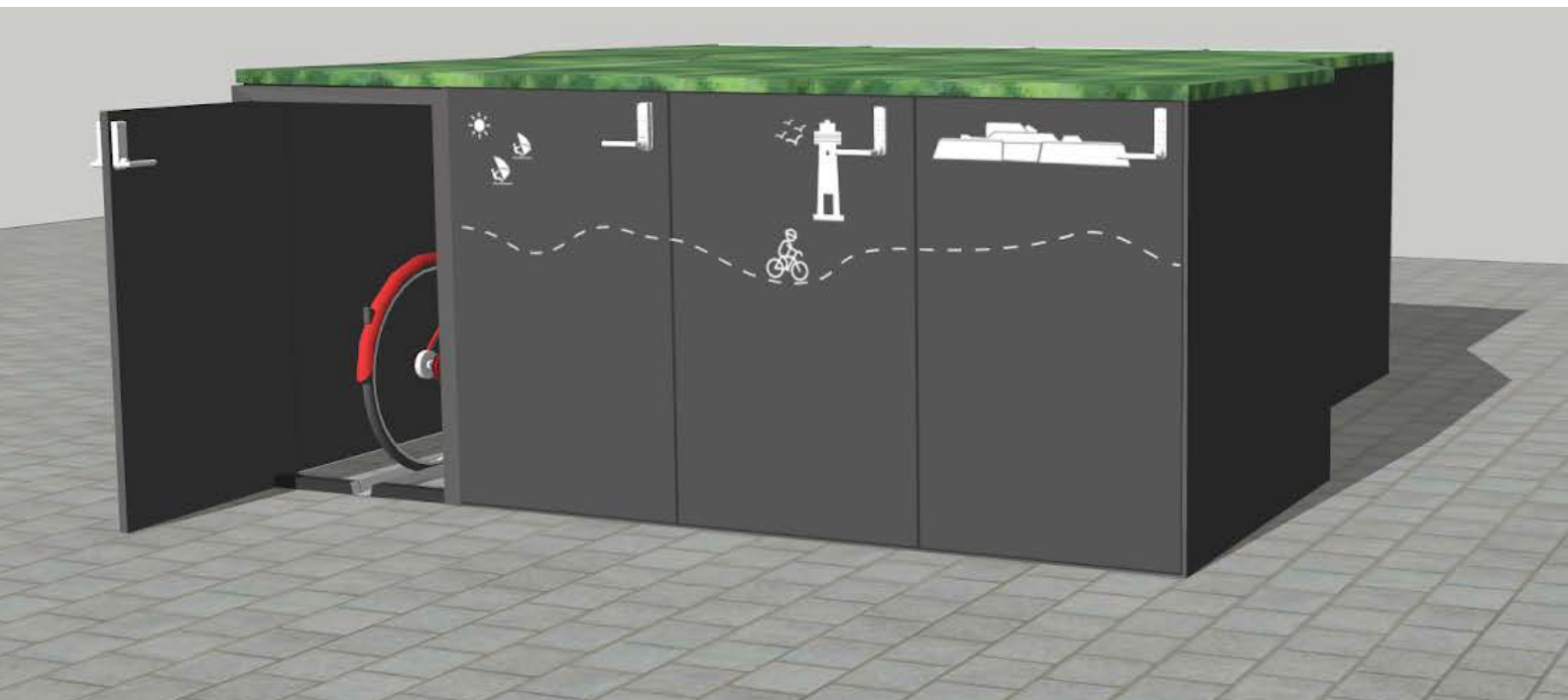


Figure 80. The modular bicycle box Boxcy

SHAPE & CONSTRUCTION

The shape of the box consists of a rectangular and a triangular shape which together measures 75*130*200 cm, see figure 81. This shape allows for the boxes to be placed opposite of each other with an offset so that the triangular shapes are matched. The dimensions of the box are customised to fit all conventional bicycles and bicycles with child seats attached.

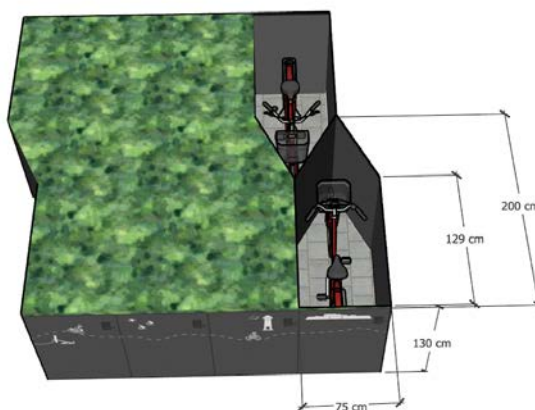


Figure 81. The dimensions of the modules

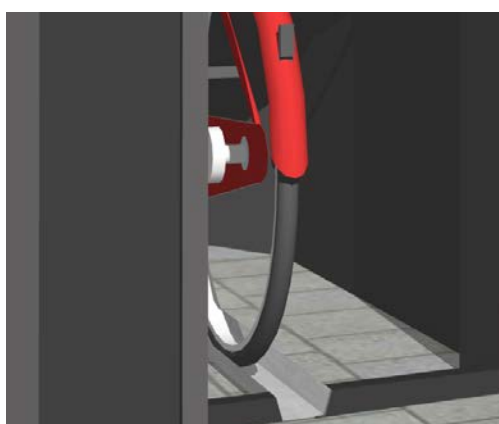


Figure 82. The rail used for stabilising the bicycle

A bicycle is easily maneuvered into and out of the box by a rail which also stabilises the bike inside the box, as illustrated in figure 82. To guide the bicycle and to facilitate for bicycles with coarser tires the sides of the rail are angled outwards. The dimensions of the rail are 3,5 cm high, 6 cm wide at the bottom and 8 cm wide at the top.

MATERIAL & COLOUR

Boxcy is constructed in powder coated, hot-dip galvanised steel plates. It is common that see-through material is used as inner walls to separate the individual boxes. This is not beneficial since it interferes with the feeling of safety that an individual, hidden space for the bike entails. Therefore, Boxcy uses solid walls between the different modules.

Boxcy is powder coated in NCS S 0080-N, a dark, natural grey colour. The colour is suitable for an outdoor environment since it is dirt resistant. *Stone*, one of the core values for the design of the station area was also considered when choosing this particular colour. A special type of rock common in the area called charnockite or *Varberg's granite* was an inspiration source when choosing the colour.



The roof is flat to create a common surface of the modules and on top of the roof, a sedum carpet is placed. Sedum is a plant species that consists of herbs and succulents that are resistant to drought and weather changes. On roofs, the sedum species are often combined with moss to give a lush greenery. Equipping the boxes with sedum roofs creates many benefits to the station area. Large areas at the station will be hard-surfaced to meet the need for bicycle parking. This can cause problems with stormwater management at the

area. Sedum roofs absorb large amounts of water and reduce the risk of flooding during downpours and thus relieve the stormwater system (Stein, 2017). Getting more greenery in the station area, not only follows the core value *greenery* which the municipality has decided on, it also makes the climate more pleasant. Higher humidity and lower noise levels are two of the advantages. But from a sustainability point of view, there are also more advantages, such as that unwanted particles in the urban environment can be absorbed by the vegetation, which species of moss are particularly good at (ibid.).

ADDITIONAL VALUE

Inside the box, a hook is placed to enable storage of belongings such as helmets and clothes, see figure 83. Placing the hook on the long side instead of on the door like many existing solutions enables the user to ensure that their belongings does not get soiled by the bicycle wheel and that the door can be closed without hassle. The hook is in a green colour matching the sedum roof in NCS S 3050-G20Y. A differentiating colour makes it distinguish from the grey wall and it is thereby easier for the user to discover.



Electrical outlets can be added to the box modules. When implementing the boxes only a few need to be equipped with outlets and the number can then be increased to match the need.

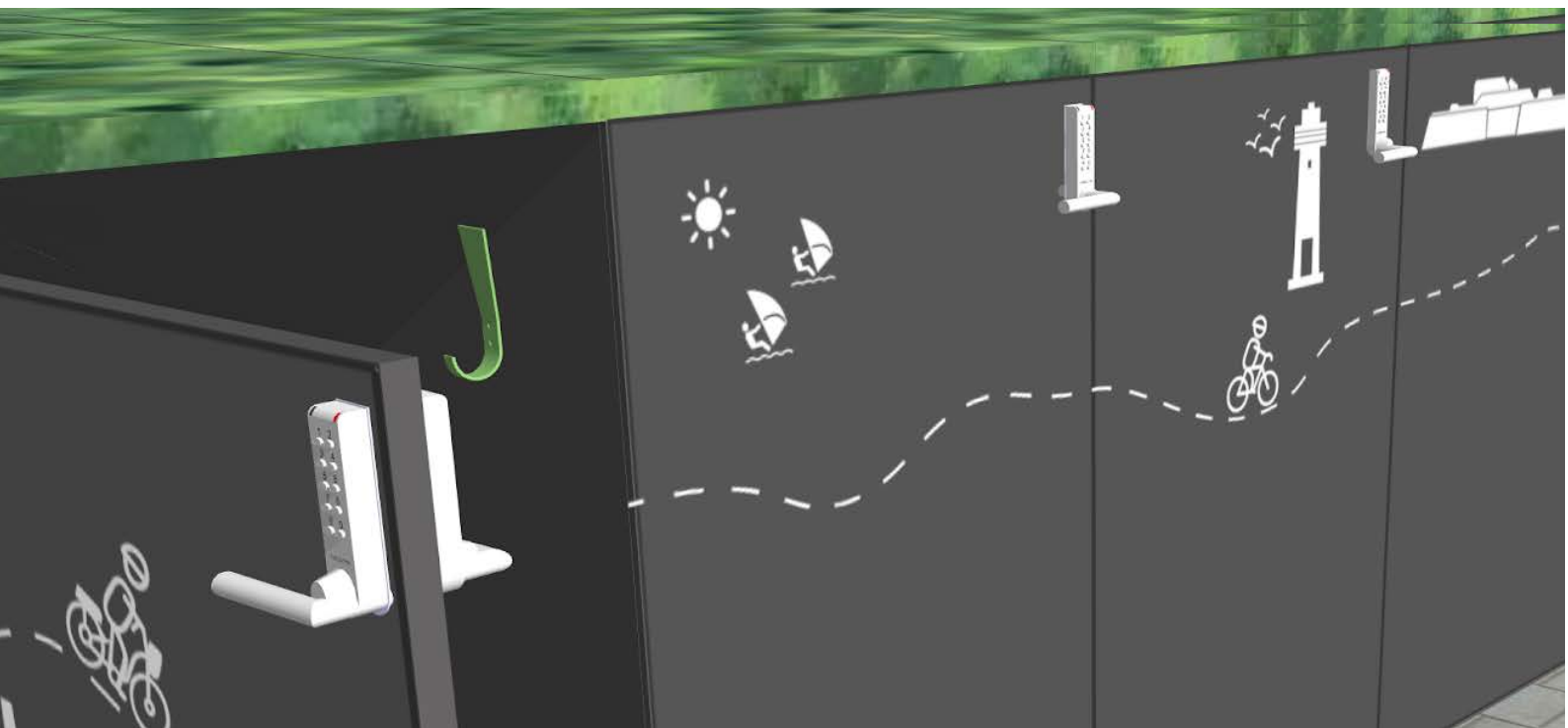


Figure 83. The hook used for storing belongings inside the Boxcy modules

DECALS

Decals are placed on the bicycle boxes as exemplified in figure 84. The decals are designed to express *a bike ride through Varberg* with motives that also mediates the function of the box. Decals picturing a bicycle path will run between the boxes and link them together as one unity. The bicycle path starts and ends at the same height and in the same angle on each box which makes it possible to add or remove boxes without breaking the pattern. Decals with information about how to get access to the boxes will also be added as well as maps of the major bicycle paths in the municipality. Furthermore, the decals will make the box live up to the core value *vivid* in that sense that it gives the boxes a lively expression. Many of the decals are picturing costal motives which goes in line with the core value *sea*.

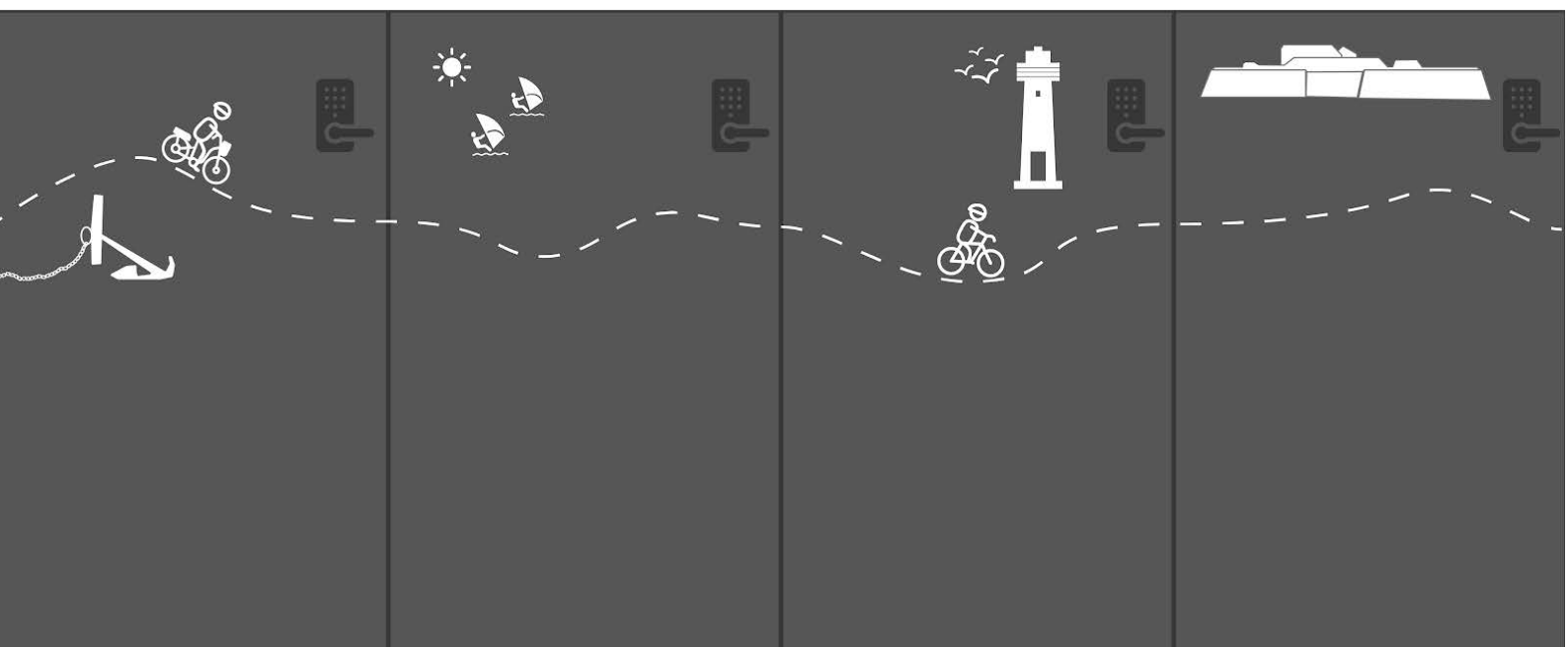


Figure 84. An example of how the decals could look like

ACCESS

Boxcy is equipped with a digital lock that can be controlled either by an app or a code and the door opens in the conventional way with hinges. The lock enables that the box can be shared between different users without the administration of keys or tags. That several users can have access to each box can be beneficial for a sharing service or for companies that want to offer their employees an improved opportunity to cycle to and from work.

The subscription to use Boxcy is suggested to be paid quarterly, since it primarily aims for users who commutes and thereby use the box for a longer period of time. However, a couple of boxes should be available to be used by short-term users who just want to store the bike during a weekend or day in Varberg. The user signing the subscription is responsible for what is stored inside it even if the box can be shared.

13. THE FUTURE STATION AREA

The four core values for the station area are vivid, stone, greenery and sea. For the bicycle parking another four values have been chosen.

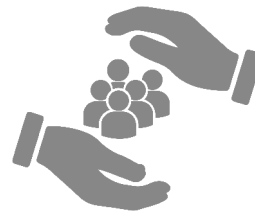
ACCESSIBILITY

The parking facilities should be available and accessible for all people that wants to use them.



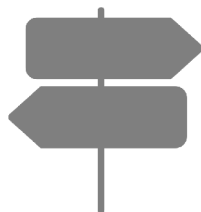
SECURITY & SAFETY

The parking solutions shall enable secure storage of a bike and people should feel safe when visiting the parking.



GUIDANCE

It should not be possible to misunderstand where and how to park. To the extent it is possible, the parking area should be adapted to the user and not the other way around.



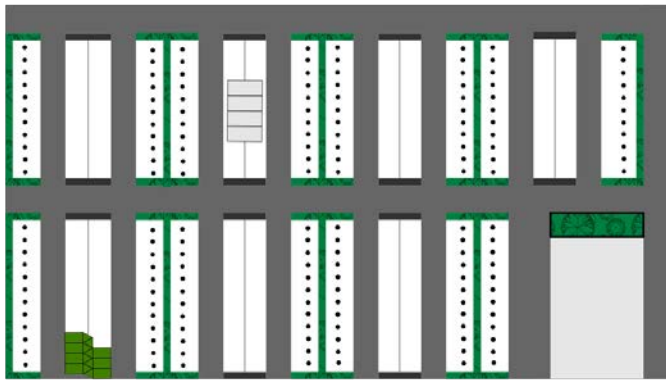
UNIFORMITY

The design of the parking options and facilities should follow a theme to make the area one unit.

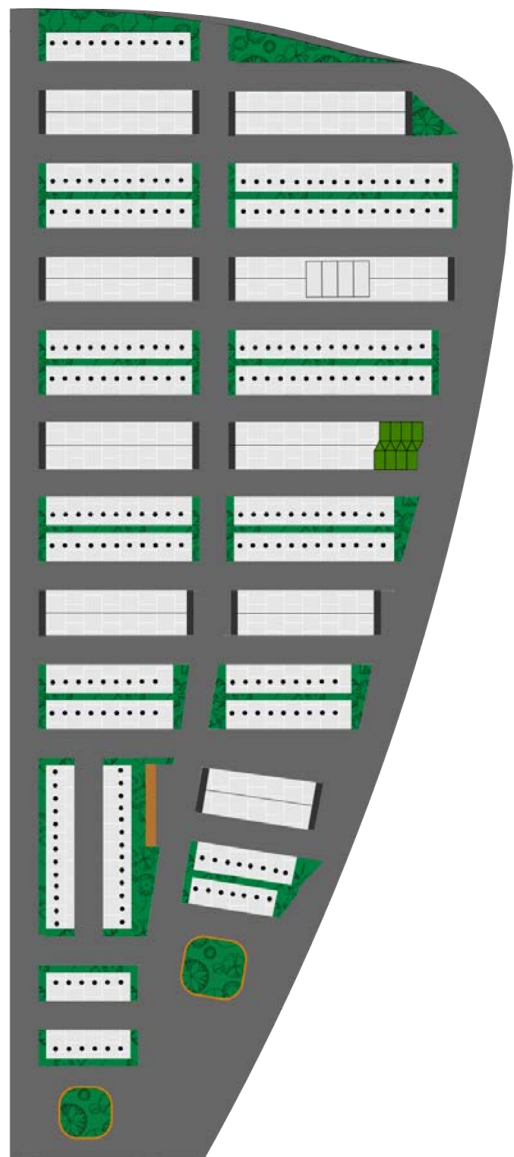


With these eight core values in mind, layout recommendations for the parking areas have been produced. The recommended layouts are visualised in figure 85. In figure 86 the areas are displayed with the surrounding environment. Reasoning for the formation is explained in the following sections together with more specific recommendations. As of now, the parking areas will be called *parking A*, *parking B* and *parking C* according to figure 85.

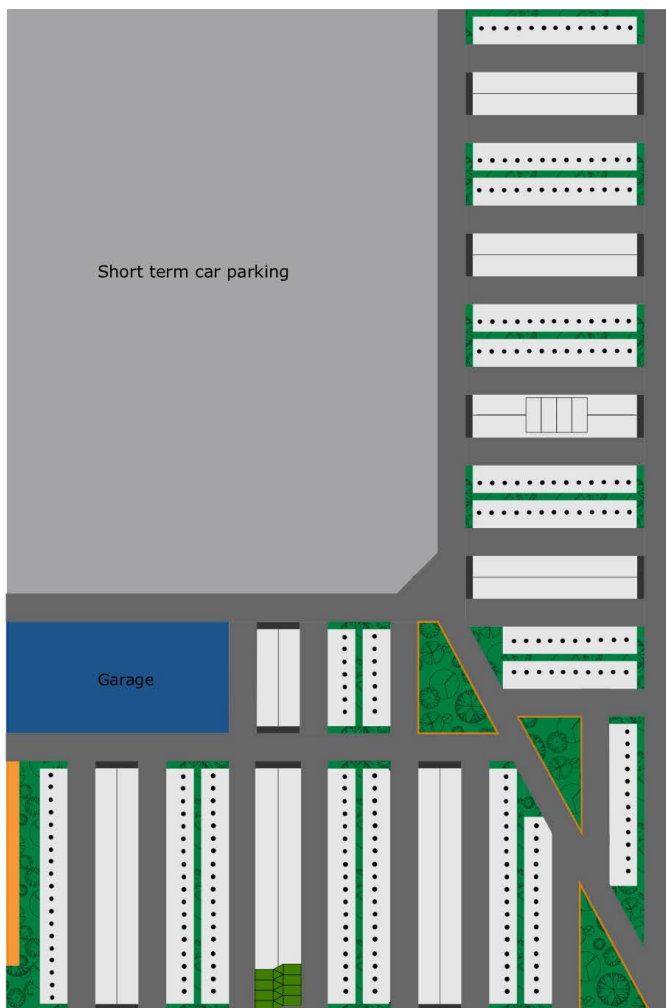
PARKING A



PARKING B



PARKING C



- bollard
- bicycle rack
- greenery
- granite block
- bench
- cargo bike parking
- ◀ bicycle box

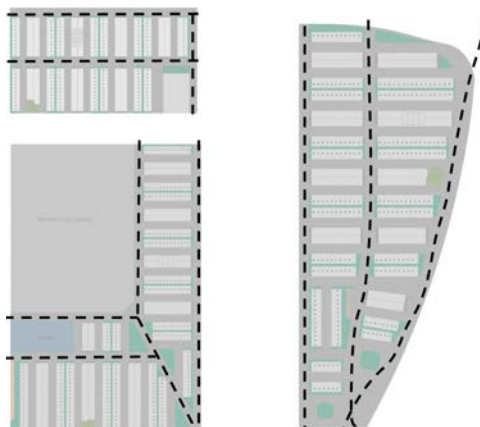
Figure 85. Layout recommendations for the parking areas named A, B and C



Figure 86. Recommended layout for the parking areas displayed with the surrounding environment

13.1 AISLES

Multiple entryways are located at each parking area in order to ease the access, prevent the need for detours and to give the parking areas an open feeling. Cyclists can enter easily from the surrounding bicycle paths since entrances are placed close to corners where parking and surrounding bicycle paths adjoin. Once a cyclist has passed an entrance there are several ways to cross the area, if one aisle is blocked by people there is always another one to choose. The system of aisles has no dead ends which entail that cyclists that have parked or picked up their bike do not have to turn around and walk back the same way again.



Main aisles are located in connection to entryways where lots of people are expected to pass, as seen in figure 87. From the main aisles, aisles with bicycle parking options branch out. The purpose of having main aisles without direct neighbouring parking spots are that bicycles will not be maneuvered for parking at the main aisles. Risk of congestion are thereby decreased and people who want to cross the parking fast can use the main aisle. Main aisles enable cyclists to search for an available parking spot while still cycling without having to stop and wait for someone to park or pick up their bicycle. It also decreases the risk for collisions since aisles for parking are separated from the main aisles.

Figure 87. The system of main aisles

A diagonal aisle is placed between the short term car parking and the southeast corner of parking C according to figure 88. This gives a convenient passage for both cyclists and people travelling by car. When it comes to movement flow it would be preferable to also have diagonal aisles at parking A and B. At parking A, a diagonal aisle would in that case be located from the upper west corner to the lower east corner. The aisle at parking A would start from the upper east corner, crossing the whole area down to the lower southwest corner. However, having diagonal aisles at parking A and B were not found feasible considering space efficiency. Also, since the northern parts of parking B were found unpopular in survey 2 there have been discussions of placing weather protection there. A diagonal aisle would make it hard to fit weather protection in a convenient way since these often are formed as rectangles.

The width of all the aisles are 2 meters, this measurement makes it possible for two cyclists walking with their bikes to pass each other easily. If there is room enough, the main aisles could preferably be wider in order to make these even more convenient to use.

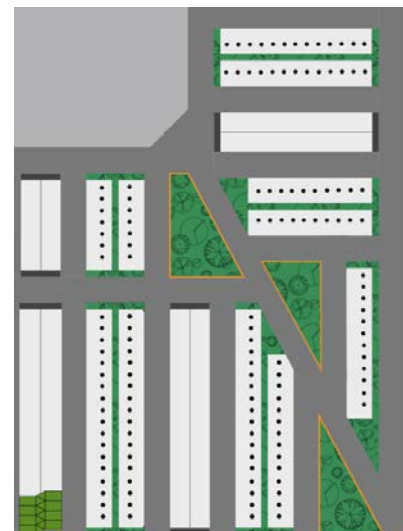


Figure 88. The diagonal aisle at parking C

13.2 GROUND SURFACE

Aisles within the three parking areas are in asphalt, just like the bicycle paths close by. By using the same material the parking gets linked together with the surroundings and the entryways becomes a part of the cyclists' natural flow.

In the drawings of the station area received from the municipality, gravel is used as ground surface for the whole area. Due to the aspects mentioned in section 10.3 *Operation and maintenance* it is recommended that the areas for parked bicycles are covered with pavers instead.

The border that emerge between the aisles of asphalt and the paved areas for parked bicycles gives a clear indication for cyclists where to park their bike. It also gives the parking area a tidy look. That a straight line takes focus from an eventual irregular line of bicycles was found during the tape test performed and through observations of existing parking areas. In figure 89, a bicycle parking where different surface materials are used to mark the area for parking is shown.

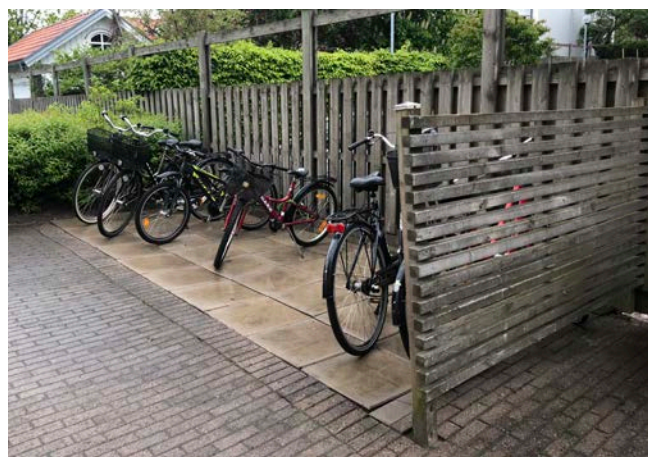


Figure 89. Separating the parking area from the aisle by choice of material

13.3 BOUNDARIES

Different kinds of delimiting elements will be used for structuring the parking, to enclose the bicycles and to guide the users. These are hedges, granite blocks, seating surfaces and flower beds. None of these elements allows cyclists to lock their bikes to them.

Greenery is a core value of the station area and a factor that contributes to a pleasant appearance of a parking area. Space is a limited asset and it is therefore favourable to utilise greenery in a multifunctional way. This is done by having hedges and flower beds as boundaries.

Examples of hedge species that could be used are Privet or Hornbeam which both are appropriate for a city environment. That these species are stable and dense make them suitable for a parking area since they can handle a bicycle falling over and also prevent that unwanted paths are formed, so-called desire paths. Edge stone encloses the hedges to separate soil from paving and to facilitate the removal of weed, see figure 90.



Figure 90. Edge stone used for separating materials

Greenery is also added by raised flower beds surrounded with seating areas, as exemplified in figure 91. In the flower beds trees could be planted in order to create a height difference at the parking area. Trees could also be added by letting the edge stone surrounding the hedges create a planting area as shown in figure 92. Make sure to choose tree species with small tree tops that does not attract birds.



Figure 91. Plant bed with surrounding seating surface



Figure 92. Tree planted as a boundary element

In addition to greenery, granite blocks are used as boundaries. Even here multifunctionality can be utilised by turning the granite blocks into seating surfaces. Figure 93 shows a design proposal of such urban furniture. In figure 94, a granite block located along Västra Vallgatan in Varberg is displayed. Blocks of this kind are recurrent elements in the city centre.

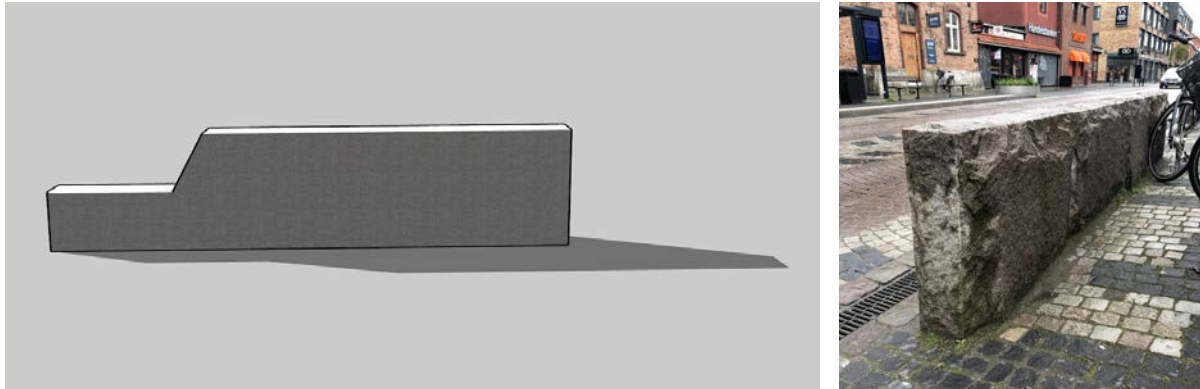


Figure 93-94. Granite blocks as boundaries and seating surfaces

13.4 PARKING OPTIONS

The recommended layout can store about 2 000 bicycle parking spots divided on the different parking options according to table 4.

Parking type	Number of parking spots
Garage	75
Boxcy	24
Cargo bikes	12
Bollards	Parking A: 157 m Parking B: 243 m Parking C: 233 m Number of parking spots of this kind with the distance 0,6 m between each bicycle is 1 055
Front wheel racks	Parking 1: 163 m Parking 2: 118 m Parking 3: 191 m Number of parking spots of this kind with the distance 0,6 m between each bicycle is 787
Total number of parking spots	1 953

Table 4. The number of parking spots of each kind

The number of parking spots exceeds the 1500 parking spots that were requested from the municipality of Varberg. It was decided to not match the requested number but to make room for as many bicycles as possible, without compromise with usability. This was decided since there are some uncertainties, e.g. the number of parking spots at the area south of the station building and whether parking A will be available as a bicycle parking area. In the table above, the area south of the station building is not included in the calculations. Planning for a higher number than needed also makes room for other elements that are required on the area e.g. recycling bins, lighting and a service station. When calculating the number of parking spots, a distance of 0,6 m between each bike and a depth of 2 m were used.

BOLLARDS & FRONT WHEEL RACKS

As mentioned, there are plenty of bollards and front wheel racks available on the market. In general it could be stated that bollards enables the users to lock their bicycle in a convenient way and that front wheel racks focuses on stability. However, there are products that offer both of these functions.

In the second survey the participants were asked to choose what solution they prefer by choosing between pictures of frequently used bollards and frequently used front wheel racks. The result is compiled in figure 95. The main reason for choosing the bollard was that it enables good possibilities of locking the bicycle with an external lock. Participants that chose the front wheel rack mainly stated that they wanted a parking that gives support to the bicycle.

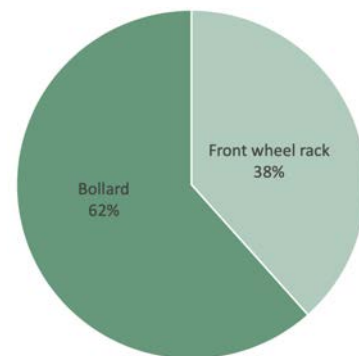


Figure 95. Bollard versus front wheel rack



Figure 96. The recommended bollard (Cyklos, n.d.)

The bollard that is recommended was found and explored during a study visit in Kungsbacka, it is called *Beta* and is from the company *Cyklos*. A picture of the solution can be seen in figure 96. An advantage that distinguish this bollard from others is that it offers lateral support to the parked bicycle through a clamp like device that encloses the seat tube. Users can thereby choose if they want to use the integrated support or place their bicycle next to it, without risking a disorganised looking area. Furthermore, there is a chain that enables cyclists to secure their bike to the bollard by solely using the built in frame lock.

At the parking areas, bollards are placed in rows with surrounding hedges as shown in figure 97. The hedges functions as boundaries and indicates the intended parking direction. *Cykelos* recommend to mount *Beta* with a minimum distance of 0,9 m. At less popular areas, the distance could be increased to improve the usability and thereby invite more cyclists to park there.

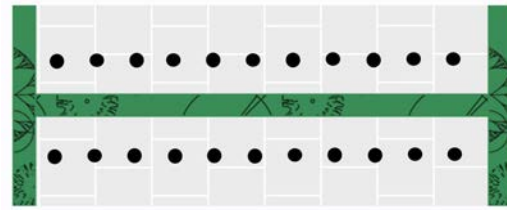


Figure 97. The recommended layout where bollards are used

The recommended front wheel rack is from the company *Smekab* and is displayed in figure 98. Qualities found interesting with this rack are the hoop that enables the user to secure the bicycle frame properly, that the area supporting the bicycle is spread out and that it is intuitive from which direction the bicycle should be parked. This solution has some minor drawbacks that can



Figure 98. The recommended front wheel rack (*Smekab, n.d.*)

be eliminated quite effortlessly. Firstly, the height of the hoop entails that baskets at the front of some bicycles collides with it. It is therefore recommended to lower the hoop. Secondly, the solution could become more space efficient if the wheel supports were placed at alternating heights. To separate the double sided bicycle rack from the aisles, blocks of granite are placed at the ends where the rack meets the aisles.

BICYCLE GARAGES & BOXES

According to survey 2 there are about as many people that prefer garages as boxes and it is therefore found necessary to offer both of these parking solutions. Figure 99 shows the distribution of the participants' answers to the question if they prefer to park their bicycle in a garage or in a bicycle box.

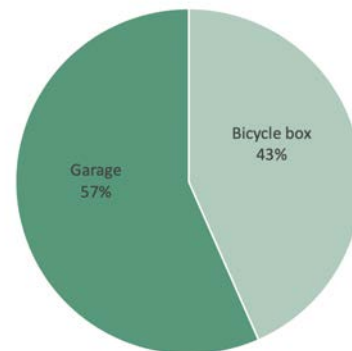


Figure 99. Garage versus bicycle box

Out of the different garages that have been explored during the project, the garage called *Flow* designed by the company *Cykelos*, displayed in figure 100 is recommended for the future station area of Varberg.



Figure 100. The recommended garage called Flow from the company Cyklos

Flow is a modular product that allows a customised size. In the visualisation of the area, a garage that is 128 m² and placed at parking C is shown. This size gives room for about 150 bicycles by the use of two floor stands or 75 if front wheel racks are used (Cyklos, n.d.).

Even if the walls of the garage are made of glass it partly becomes an obscuring object that interrupts the ability to overview the parking area, especially if two floor stands are used. To decrease the unsafe feeling that this can bring it was decided to place the garage in connection to the short-term car parking. The fact that people are picking up and dropping of travellers here makes it one of the places where it is expected to be many people in motion which entails a feeling of safety. Placing it in connection to the bicycle path and road Östra hamngatan is also a way to have a high flow of people in connection to the garage. That it is visible for people passing is believed to make people more aware of the garage.

The Boxcy modules are placed at all three parking areas in groups of eight as seen in figure 101. Spreading the boxes on the area is a way to make them accessible for users no matter direction of arrival. They are placed at less attractive spots since it has been found that cyclists are willing to spend more time to park in exchange for the extra safety.

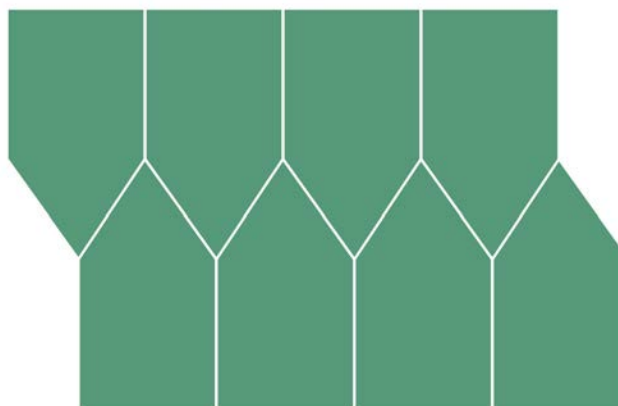


Figure 101. Boxcy modules are placed in groups of eight

This parking solution mainly targets cyclists with expensive bikes such as electric bicycles and racer bicycles. These bicycles have great potential to function as a substitute to a car and by installing boxes, less car parking spots should therefore be needed. This is not only an environmental winning but also favourable concerning space efficiency. Ten Boxcy modules takes up the same space as one car parking spot.

CARGO BIKE PARKING

Special parking sections for cargo bikes are located on both the west and east side of the train tracks. These consists of fixed inverted U hoops that enables owners of cargo bikes to secure their bike with an external lock seen in figure 102.

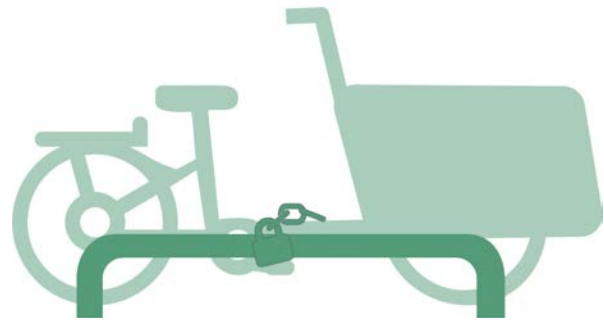


Figure 102. Inverted U hoop

Even if these parking spots primarily are designed for cargo bikes, other odd sized bicycles that does not fit into other parking spots can be parked here. Four squares for cargo bikes are located at each of the three parking areas next to the front wheel racks. The suggested layout is visualised in figure 103. The design makes it possible for cyclists to manoeuvre their bicycle by only pushing it forward, to reverse it is not necessary. The size of each square is 2,5 x 1,10 meter. To avoid that conventional bikes are parked here the squares are located at less popular sections. It is believed that owners of a cargo bikes are willing to park further away since cargo bikes can be seen as a substitute to a car. Placing the cargo bike parking spots in the middle of a parking row also entails a decreased risk for people parking conventional bikes at these spots. To further mediate that these parking spots are meant for cargo bikes there should be an icon of a cargo bike on each square.

The option of having angled squares were also investigated. Yet, perpendicular squared were chosen since they require the same effort regardless what direction the cyclist comes from and since they were found more space efficient.

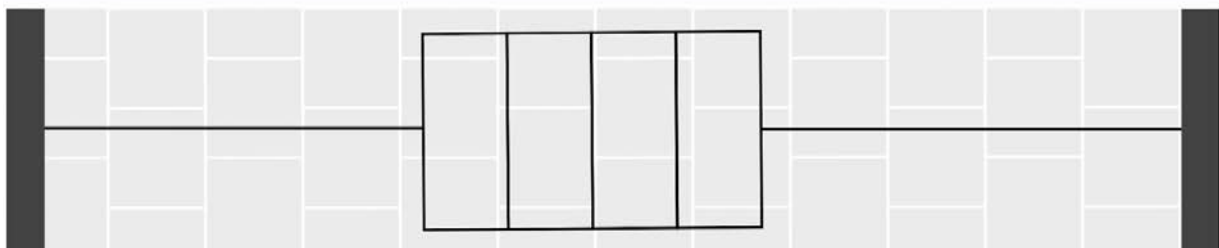


Figure 103. The layout of the cargo bike parking

14. DISCUSSION

In this chapter, the results of the project are discussed as well as the process and the methods used. The results are further discussed in relation to the background and aim of the project. Finally, the recommendations for further development are presented.

14.1 PROCESS & METHODOLOGY

The *Varberg Tunnel Project* is an extensive and ongoing project with many parties involved. Thus, some conditions have changed during the project, e.g. it is not clear if parking A can be utilised for bicycle parking since there is a struggle to make room for enough spots for car parking. At several occasions it has been difficult to grasp what is determined and who is responsible for different parts of the project and the bicycle parking question in general in Varberg. Therefore, time had to be spent on clarifying such questions and waiting for material. For example, it was quite far into the project that a map of the area with the possibility to measure properly could be obtained. The fact that the project is ongoing has meant that complete information of how the area will look like has not been available. In order to develop bicycle parking facilities that fit the holistic picture of the station area, it would be favourable to early on in the project see the design of the station building as well as what type of greenery and surface materials that are planned to be used. With this said it should be cleared that these struggles have arisen because the *Varberg Tunnel Project* is an ongoing project. Maria Hagelberg, project supervisor from Varberg Municipality and other people within the tunnel project have been very helpful with providing the available information.

When this master's thesis project started, the building phase of the tunnel project had already been initiated. Because of this, some parts of the current station area were modified. Consequently, it was difficult to draw conclusions from observations made at the station. For example, the main purpose of the tape test was to investigate whether clear markings surrounding a parking area can cause the cyclists to park inside these. Yet, the result is not perceived to be representative since the number of parking spots did not match the high number of parked bicycles. In other words, cyclists had limited opportunities to park in the desired manner. Valuable conclusions that could be drawn from the test was instead that clear lines can give a tidier impression and that it is difficult to get cyclists to park in a correct way when there is a shortage of space.

To map the needs of the users, surveys, interviews and observations were performed. The first survey was posted in several Facebook groups mainly connected to bicycling. Many interesting insights could be obtained since these people have a great interest in the bicycle infrastructure and thus strong opinions. Even though the results were not found entirely representative for the target group, the respondents put even higher demands on bicycle parking solutions. For example, there were far more who responded that they are owners of a racing bike or mountain bike compared to what is perceived to be representative for the people who cycle to Varberg's

station. The second survey aimed at people who sometimes bikes to or from Varberg's station. To spread the questionnaire it was posted in a Facebook group called *Varberg*, patches with QR codes were set up on the station area and the questionnaire was also shared by users on Facebook. The result from this survey is thus perceived more representative.

When performing the interviews it was found that many people are in a hurry. This was a meaningful insight in order to understand the context of a train station, but it made it challenging to get in-depth interviews. Great focus has been put on asking open questions in order to not lead the participants into a particular track. It is unclear if all of the participants will act in the way they responded, for example if they really would pay for a securer parking option. Effort has therefore been put on validating the answers from the interviews by observations and by exploring real cases, e.g. since cyclists in other municipalities are willing to pay for a bicycle box or a garage, it is very likely that the residents of Varberg also are willing to pay.

The interviewees and respondents to surveys are a heterogeneous group of people when it comes to age, gender and bicycle types. Thus, the needs found are representative for the target group. However, it would be valuable to interview more people who owns expensive bikes, such as electric bicycles or racing bikes, to get more information about the needs regarding charging, safer parking options and the willingness to pay for these.

By the use of prototypes and by talking to people with relevant knowledge, findings have frequently been validated which makes the end result reliable. Specifically, consulting operation and maintenance personnel was found useful for the holistic approach of the bicycle parking issue.

14.2 RESULTS

Initially, the intention was to develop a product for parking of bicycles. As the project progressed and the knowledge within the subject became larger, the scope was widened. It was clear that it is not mainly the parking solution that is the missing link to why a bicycle parking is not perceived as functional, but rather the layout of the area. The project was broadened to include the layout of the parking sections, different types of parking solutions and elements that are required in order to meet the user needs. This resulted in that the project covers larger areas than initially thought. It is believed that choosing a narrower scope would have given a more specific result but with the risk of losing out on important insights as a result.

During the development of Boxcy, the parts of the box were examined separately to produce smart and innovative solutions. The result is a more space efficient bicycle box designed to fit the specific location. Yet, many components of Boxcy are similar to the boxes already existing on the market. This initially felt a bit boring but after validation it was realised that the solutions that were found more innovative also became unnecessarily complicated or demanded too much from the user.

The final subject that is to be discussed is if it is reasonable to charge for secure bicycle parking options. By payment, it is easier to reach out to people that really need securer parking. On the other hand, it sends out the wrong message of how bicycles are prioritised in the city centre. The municipality have decided that the order of priority shall be pedestrians-cyclists-motorists, in that specific order. This is preferred from a sustainability perspective and should therefore be followed. Since car parking is free in Varberg, it is found inconvenient to charge for parking a bicycle. A solution to this issue that is found promising would be to also charge for car parking.

There are many factors that determines if a parking area is well-functioning or not, such as, location, occupancy rate, layout, parking time, the user, target destination and season. By research it has been possible to identify common denominators. Thereby, guidelines for a winning bike parking have been identified and the aim has been fulfilled.

14.3 RECOMMENDATIONS FOR FURTHER WORK

The following recommendations are suggested to further develop, improve and verify the design of the parking solutions and the layout of the parking areas.

- Review how and by whom the rental of boxes and garages should be managed.
- Check if it is possible to enable more than one user to utilise a bicycle box.
- Before the final design of Boxcy is determined, prototypes should be built and user tests carried out.
- Develop new solutions or find existing products for illumination, weather protection, storage, bicycle repair, bicycle pumps, recycling bins and urban furniture.
- Explore if a bike sharing system should be available in the area.
- Further explore if charging possibilities for electric bikes are needed.

During the project, main focus has been put on the areas for bicycle parking. The rest of the station area must also be designed to prevent spontaneous parking to arise where it is not desirable, e.g. along facades or at fences.

For further improvements it could be looked into how the parking areas can be designed for sustainable behaviour. This could include areas such as how to get more people to use helmet and more deeply explore how to get more people to choose bicycle as means of transportation.

15. CONCLUSION

User needs linked to parking of bicycles at Varberg's future station area turned out to be more complex than expected. Cyclists are a heterogeneous group of people with different priorities on solutions used for the parking of bicycles. Consequently, one type of solution is not sufficient to fit the wide range of users. There is an abundance of products on the market used for parking of bicycles and their functionality and usability varies greatly. For the future station it is recommended that front wheel racks, bollards, a garage, bicycle boxes and parking adapted for cargo bikes are available for the users.

It was discovered that many of the existing solutions on the market work well for those who prioritise speed. However, solutions for users who value security higher are not as widespread. The experienced gap in the market was one of many reasons for developing Boxcy, a modular bicycle box for those who need a more secure parking of their bike at Varberg's station. A more secure type of parking for bikes can become an incentive to use sustainable transport. More expensive bikes can be used to the station without worries of vandalism or theft. This in term means that the users may consider to cycle from further distances instead of using a car.

It is claimed that the layout of the area is what plays the major role in how well-functioning a bicycle parking area is. Consequently, the types of parking solutions used is just of one of many factors that influence the function of the area. The layout of the area should guide the user to the correct way of parking, by among other things, provide distinct marked parking spots and a clear overview of the area. In order to prevent parking of bicycles at other locations than the intended one, the architect should think twice before placing objects in an urban environment which may invite to locking of a bicycle.

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APPENDIX

APPENDIX 1 - WEB SURVEY 1

SURVEY QUESTIONS

Hej!

Vi är två studenter från Chalmers Tekniska Högskola som gör ett examensarbete inom produktutveckling. Syftet med arbetet är att utveckla nya cykelställ för Varbergs kommun. Vi vore tacksamma om du vill hjälpa oss i vårt arbete genom att svara på denna enkät. Försök att svara så utförligt som möjligt, även om du anser att viss information är irrelevant eller överflödigt så kan den vara till nytta. Dina svar kommer att behandlas anonymt.

Kön:

- man
- kvinna
- annat

Ålder:

- -17
 - 18-29
 - 30-49
 - 50-64
 - 65-
-

Frågor om dina cykelvanor

1. I vilket syfte cyklar du?
 - a. arbete/skola
 - b. fritidsaktiviteter
 - c. mataffär
 - d. övriga ärenden
 - e. besöka vänner och bekanta
 - f. för att ta mig till tåg/buss
 - g. för motion
 - h. annat
2. Vad får dig att välja cykel som transportmedel?
3. Vad får dig att välja ett annat transportmedel än cykel?
4. Vilket transportmedel väljer du oftast?
 - a. tåg
 - b. buss
 - c. bil

- d. cykel
 - e. moped/motorcykel
 - f. spårvagn
5. Vad för typ av cykel har du?
- a. damcykel
 - b. herrcykel
 - c. juniorcykel
 - d. elcykel
 - e. racercykel
 - f. mountainbike
 - g. lådcykel
 - h. hybridcykel
 - i. övrigt
6. Har du någon extra utrustning på den som exempelvis cykelkorg eller barnsits?
7. Vad brukar du ha med dig när du cyklar?
-

Frågor om cykelparkeringar

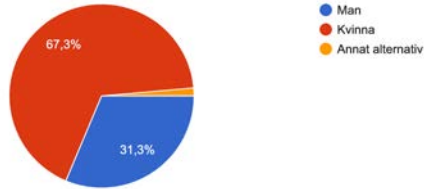
8. Hur låser du din cykel?
9. Känner du dig trygg med att din cykel står kvar där du lämnat den? Varför/Varför inte?
10. Tänk dig att du varje vardag cyklar till en tågstation för att pendla till jobb/studier. Skulle du i detta fall kunna tänka dig att betala för en säkrare cykelparkering?
- a. Om ja. Hur mycket skulle du kunna tänka dig att betala per månad?
11. Brukar du lämna några attiraljer på cykeln när du parkerat den och i sådana fall vad?
12. Vad är viktigt när du parkerar din cykel?
13. Vad är bra med dagens cykelställ?
14. Vilka brister anser du att dagens cykelställ har?
15. Vilka funktioner saknar du på dagens cykelställ?
-

Stort tack för din medverkan!

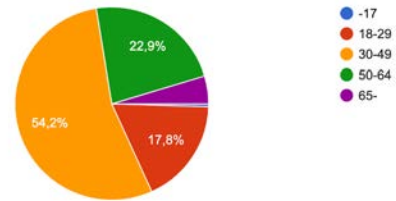
Om du kan tänka dig att bli kontaktad av oss för vidare frågor angående cykelparkeringar så tar vi gärna emot en mailadress eller ett telefonnummer.

SURVEY ANSWERS

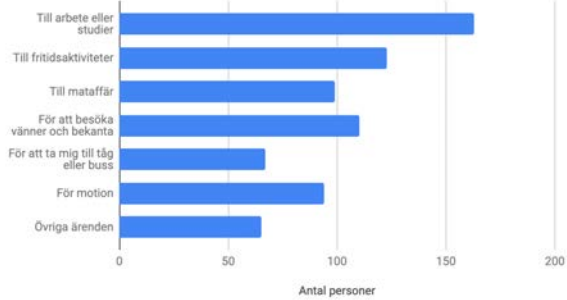
Kön
214 svar



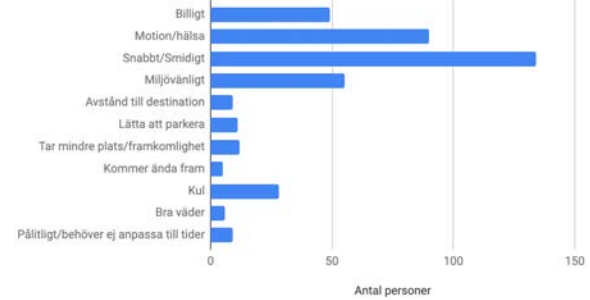
Ålder
214 svar



I vilket syfte cyklar du?



Vad får dig att välja cykel som transportmedel?



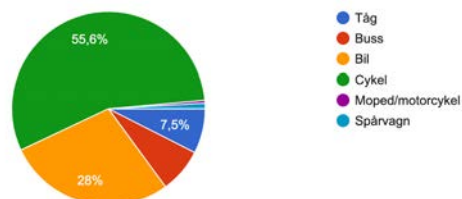
Vad får dig att välja ett annat transportmedel än cykel?

De vanligaste anledningarna till att ett annat transportmedel väljs är:

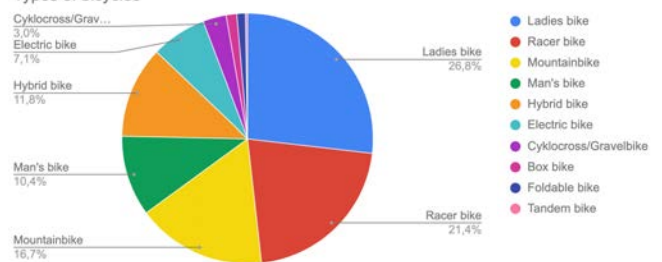
- Längre distans
- Tidsbrist
- Dåligt väder
- Bekvämlighet (mycket packning, barn, hund, passagerare, sällskap utan cykel)
- Stöldrisk
- Ombytesmöjligheter finns ej
- Finkläd
- Trasig cykel
- Dålig infrastruktur
- Stöldrisk
- Sjukdom

Vilket transportmedel väljer du oftast?

214 svar



Types of bicycles



Har du någon extra utrustning på din cykel som exempelvis cykelkorg eller barnsits?

Observera att de svarade inte gavs några alternativ utan fick själva beskriva fritt. Detta betyder att exempelvis utrustning som lampa och ringklocka kanske sågs som självklar och därför inte nämndes.

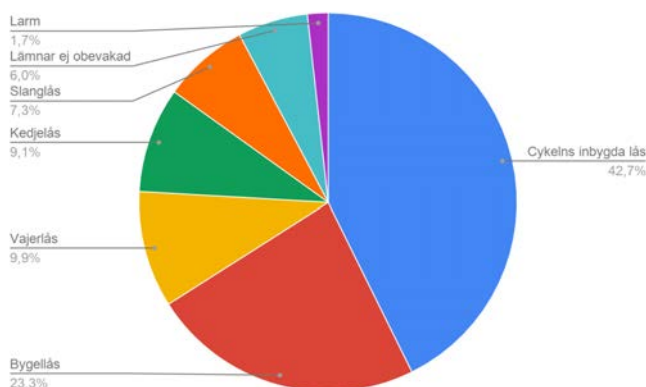
Typ av extra utrustning	Antal personer
Cykelkorg	85
Cykelväska	25
Barnsits	16
Pakethållare	12
Lampa	9
Cykelkärra	8
Cykelkorg bak	4
Cykeldator	4
Skärmar	4
Ringklocka	3
Styrstängsväska	3
GPS	2
Extralås	2

Vad brukar du ha med dig när du cyklar?

Vad som tas med är såklart beroende på syftet med cykelturen men de vanligaste sakerna att ha med sig är:

- Väska
- Barn
- hjälm
- Ombyte
- Mat
- Verktyg för att laga cykeln
- Lås

Hur låser du din cykel?



Ca 25% använder fler än ett lås

Känner du dig trygg med att din cykel står kvar där du lämnat den?

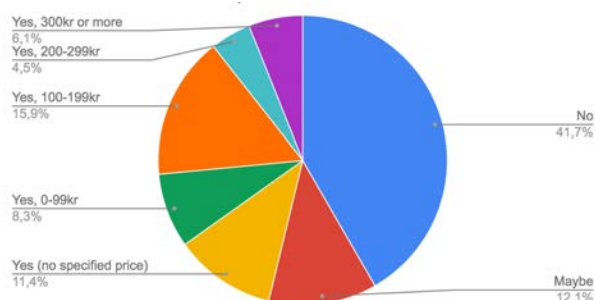
Den upplevda tryggheten beror enligt personerna i enkäten på:

1. Typ av ställ. Om möjligheten finns att låsa fast cykeln på ett bra sätt så ökar den upplevda tryggheten.
2. Tid på dygnet, många känner sig otrygga med att lämna cykeln nattetid
3. Beror på plats, många människor i rörelse ökar den upplevda tryggheten för vissa. Finns även de som endast känner sig trygga då cykeln står inomhus antingen inne på jobbet, i hemmet eller i garage.
4. Beror på typ av cykel, många väljer en skruttcykel om den ska ställas vid ett område där många stölder sker.

Tänk dig att du varje vardag cyklar till en tågstation för att pendla till jobb/studier.

Skulle du i detta fall kunna tänka dig att betala för en säkrare cykelparkering?

● Nej	55
● Kanske	16
● Ja	61
inget specificerat pris	15
0-99 kr	11
100-199 kr	21
200-199 kr	6
300 kr eller mer	8



Brukar du lämna något på cykeln när du parkerat den och i sådana fall vad?

- Många lämnar ibland sin hjälm på cykeln
- Cykelväskor, lampor och cykelkorgar är också vanligt att folk lämnar vid cykeln
- De allra flesta lämnar inte något vid cykeln (vad nu inget innebär i detta sammanhang)

Vad är viktigt när du parkerar din cykel? / Vad är bra med dagens cykelställ?

Viktigt/bra	Antal personer (209 svar)
Väderskydd (tak)	28
Kunna låsa in cykeln (garage, torrt)	5
Att stället är väl förankrat/robust	15
Att det är enkelt att låsa fast cykeln	40
Kunna låsa fast ramen	20
Kunna låsa fram + bakhjul	10
Kunna låsa fast i olika höjder	1
Bra stöd (även utan cykeln egna stöd (4))	23
Plats mellan cyklarna	20
Lediga parkeringar	14
Säkert mot stölder/vandalisering	60
Närhet till målet	24
Upplyst plats	13
Synlighet/uppsyn, mycket rörelse på platsen	20
Komma ihåg vart jag ställt den	1
Att det finns fler cyklar runt om	5
Känns tryggt	1
Snabb och smidig parkering	9
Tillåta olika däckbredd	2
Vill inte behöva parkera under träd (fåglar)	1
Cykeln ska ej vara synlig för förbipasserande	1
Tillgänglighet	3
Cykeln ska ej riskera att bli påkörd	2
Att cykeln inte står i vägen för andra cyklar	3

Vilka brister anser du att dagens cykelställ har?

Brister	Antal personer (188 svar)
För få parkeringar	24
Trångt mellan cyklarna	60
Bra stöd/stabilitet saknas	12
Risk att cykeln (hjulet, framgaffeln) skadas om cykeln välter	17
Kan ej låsa fast ramen	38
Kan ej låsa fast ram + hjul	7
Kan ej låsa fast cykeln till platsen	5
Externt lås krävs	1
Får ej plats med lastcykel	2
Rörigt	4
Många "kvarglömda" cyklar tar upp plats	5
Osäkra (dåliga lås och skymda platser)	15
Saknar väderskydd	10
Går bara att parkera från ett håll	1
Ställen sitter ej fast i marken	3
Däck får ej plats i den avsedda skåran (för bredd och för smalt)	7
Tvingas backa ut på trafikerad gata	2
Övervakning saknas	1
Ställen är dåligt placerade	4
Ställen är oflexibla	2
Förhindrar snöröjning	3
Svårt att hitta sin cykel	1

Vilka funktioner saknar du på dagens cykelställ?

Saknade funktioner	Antal personer (157 svar)
Skonsamma mot cykeln	1
Väderskydd	25
Inbyggt lås (app, digitalt)	16
Möjlighet/enkelhet att låsa fast ramen	32
Möjlighet att låsa fast båda hjulen	5
Möjligheten att låsa fast både ram och hjul	5
Bättre låsmöjligheter	9
Möjligheten att låsa in cykeln en och en	4
Bra stöd/stabilitet	8
Plats, ställen är för trånga	11
Plats för lastcykel	4
Ordning	1
Borttagning av gamla cyklar	2
För få parkeringar	3
Platseffektivitet	4
Laddare till elcykel	3
Olika varianter av ställ	1
Högre säkerhet (säkert lås, begränsat tillträde, övervakning)	9
Luftpump	2
Parkering från båda hållen	1
Möjligheten till snöröjning	2
Lättare att parkera	1
Avgränsningar mellan cyklarna	1
Belysning	1
Ställ som sitter fast ordentligt i marken	2
Underjordiskt cykelställ	1
Hjälmfack	1
Inga	8
Vet ej/se ovan/ej svarat	80

APPENDIX 2 - INTERVIEW

INTERVIEW QUESTIONS

1. Hur ofta cyklar du till stationen?
2. Brukar du alltid parkera på samma ställe?
3. Hur kommer det sig att du valde att parkera just här?
4. Hur tycker du att cykelparkeringen fungerar här vid stationen?
 - a. Vad är bra/inte bra med dagens parkeringar?
 - b. Vilka funktioner saknar du på dagens cykelställ?
5. Hur låser du din cykel?
6. Hur trygg känner du dig med att din cykel står kvar här när du kommer tillbaka?
7. Hur påverkar stöldrisken på stationen ditt val av cykel?
8. Lämnar du något vid din cykeln när du parkerat den?
 - a. Hade du velat lämna kvar något vid cykeln som du ej gör pga att du är rädd för att det ska bli snott?
9. Hade det underlättat med skåp i närhet till cykelparkeringen?
 - i. vad hade du i så fall lämnat där?
10. Vad tycker du om idén att kunna parkera din cykel i ett cykelgarage eller i en enskild cykelbox?
 - a. Hade det påverkat ditt val av cykel?
 - b. Hade det påverkat dina cykelvanor? Hade du till exempel i större utsträckning parkerat din cykel över natten på stationen?
 - c. Om det skulle kosta pengar att parkera cykeln säkrare, skulle du då kunna tänka dig att använda tjänsten eller tror du att du hellre hade valt att parkera utomhus?
 - d. Hur mycket skulle du kunna tänka dig att betala isf?

INTERVIEW ANSWERS

Intervju nummer	Kön	Ålder	Datum och tid
1	Man	40-45 år	6/2, 16.00
2	Man	20-25 år	8/2, 12.00
3	Kvinna	20-25 år	8/2, 13.30
4	Man	55-60 år	8/2, 13.30
5	Man	35-45 år	8/2, 13.30
6	Kvinna	30-35 år	11/2, 13.30
7	Kvinna	50-55 år	12/2, 8.00
8	Kvinna	50-55 år	12/2, 8.00
9	Kvinna	25-30 år	13/2, 15.30
10	Kvinna	30-35 år	13/2, 15.30
11	Kvinna	35-40 år	13/2, 15.30
12	Kvinna	45-50 år	15/2, 15.30
13	Man	25-30 år	18/2, 15.30
14	Man	55-60 år	18/2, 15.30
15	Kvinna	20-25 år	20/2, 13.30

Intervju nummer	Fråga 1. Hur ofta cyklar du till stationen?	Fråga 2. Brukar du alltid parkera på samma ställe?	Fråga 3. Hur kommer det sig att du valde att parkera just här?
1	Varje vardag	Alltid samma (baksidan av taxihuset).	För att det går snabbt att parkera och för att parkeringarna ligger nära spåren.
2	1 dag per vecka	Har tre platser som jag gillar: 1) Utmed gaveln till stationshuset 2) Precis bakom taxihuset 3) Så långt bort mot engelska parken som det går.	Mitt val beror på vart jag ska efteråt. Ska jag hem efteråt så spelar det inte så stor roll. Ska jag till mamma eller stan brukar jag stå närmare engelska parken. Spelar ingen roll vart jag kommer ifrån, vart jag ska ta mig när jag kommer tillbaka är det viktiga.
3	Varje vardag	Oftast närmast engelska parken. Väljer det som är närmast och snabbast.	Det är nära och jag kommer från det hållet.
4	Varje vardag	Nästan alltid samma pga varifrån jag kommer. Ska gå snabbt.	Närheten till spåren och varifrån jag kommer.
5	Varje vardag	Oftast samma ställe. Ställde alltid i de ställen som nu är avstängda för att de är de enda som möjliggör fastläsning av framhjul och ram.	Närheten till tåget (nu när det inte finns något ställ med bra fastläsningsmöjligheter). Jag prioriterar att kunna låsa fast både framhjul och ram framför att ha nära till perrongen.

6	Ganska ofta, nästan varje vardag. Beror på vädret.	Ja, kommer från öst och parkerar cykeln på vägen till tåget.	Ja, kommer från öst och parkerar cykeln på vägen till spåret.
7	Varje vardag, får skjuts om det är dåligt väder	Ja, ungefär. Parkerar alltid vid parkeringarna vid taxihuset men exakt vart varierar lite, det beror på vart det finns plats.	Kommer från sydost så detta blir på vägen.
8	4 dagar/vecka	Brukade parkera vid ställen som nu är avstängda. Ställer mig alltid vid de södra parkeringarna eftersom jag kommer därifrån.	Jag vill inte gå en omväg för att parkera.
9	I princip varje vardag	Brukar alltid parkera vid de nya cykelställen.	Kommer från tångaberg och vill kunna låsa fast ramen.
10	Varje dag just nu. Det är lite olika vart jag jobbar men periodvis så pendlar jag.	Parkerar på olika ställen vid taxihuset. Brukade tidigare parkera vid parkeringarna som nu är avstängda. Visste inte om att det finns nya parkeringar.	Det är smidigt eftersom jag kommer från Västra Vallgatan.
11	Cyklar några dagar i veckan.	Brukade parkera vid de avstängda ställen men parkerar nu vid de nya, norr om stationsbyggnaden, istället.	Cyklar från Breared så egentligen är parkeringarna vid taxin närmare men väljer de nya ställen eftersom det finns mer plats och eftersom det går att låsa fast cykeln i ramen. Tycker dock att det är svårt att komma till de nya parkeringarna eftersom vägen är avstängd vid Engelbrektsgratan/Västra Vallgatan.
12	Varje vardag	Ja, men nu när det är avstängt så blir det lite olika.	Varifrån jag kommer påverkar.
13	3 dagar/vecka	Alltid samma (baksidan av taxihuset).	Närmast, jag kommer från Västra Vallgatan.
14	Varje vardag	Alltid samma (baksidan av taxihuset).	Närhet är det viktigaste.
15	Varje vardag	Alltid någonstans vid taxin.	Kommer från biblioteket så det passar bra. Det går alltid att hitta någonstans att ställa cykeln.

Intervju nummer	Fråga 4. Hur tycker du att cykelparkeringen fungerar här vid stationen? Vad är bra/inte bra och vilka funktioner saknar du på dagens cykelställ?	Fråga 5. Hur låser du din cykel?
1	Bra att det är nära spåren men jag hade gärna haft tak över cykeln.	Låser fast min cykel längst långsidan av stället i ramen och brukar kvar låset.
2	Nära till perrongen vilket är bra. Fri - laglös på ett sätt som är trevlig. Finns alltid platser, finns ingen som säger hur du ska stå. De rensar aldrig bland cyklarna. Laglöst är också en nackdel. Inget vind/väderskydd. Välta cyklar är ett problem > Om en välter så välter alla. Inget tillvaratagande på plats. Skulle kunna finnas mer innovativa ställ som tar tillvara på platsen. Jag har en stor cykel. Fällorna hade kunnat vara bredare. Ofta trångt för min cykel. Idéer: Utnyttja höjden.	Ramlåset.
3	Det är bra som det är nu men det är väldigt trångt.	Extra slanglås med kod, använder ej ramlåset så ofta.
4	Ja, det ser ni väl?! ;) Cyklar ligger ner och det är väldigt trångt.	Ramlåset.
5	Bra att det rensas på cyklar men det kunde göras oftare. Många skräpcyklar. Det vore trevligt om pumpar fungerar till alla cyklar, den som finns nu funkar inte till min cykel.	Bygellås. Vill låsa fast både framhjul och ram men hade bara låst fast i framhjulet eftersom cykelstället inte möjliggjorde fastlåsning av ramen.
6	Ibland är jag rädd att jag inte ska få en parkering men det finns alltid någon plats även om det är trångt. Vill sätta in hjulet i hjulhallaren men om det står en cykel på varje sida så får jag inte plats.	Ramlåset.
7	Det är bra att det är nära. Hjulknäckerställen är mindre bra. Cykeln står väldigt ostabilt.	Ramlåset.
8	Det är bra att det är nära till tågspåren men det är ganska kaosigt. Fler parkeringar behövs. Det är oftast för trångt för att kunna ställa in hjulet i skåran. Det är svårt att låsa fast cykeln med ett extralås eftersom man inte kommer åt stället.	Ramlåset.
9	Bra, tycker att det är skönt att parkeringarna är så nära. Det är väldigt bra att det är upplyst, både för att man själv känner sig trygg och med tanke på stöldrisken. Det är trångt vid parkeringarna nära spåren men inte vid de nya där jag brukar parkera. Skåp vore bra, skulle vara skönt att kunna hänga in regnkläder. Det skulle säkert vara fler som väljer att cykla om det finns möjlighet att duscha på stationen. Jag skulle nog inte själva duscha dock.	Bygellås.
10	Det är smidigt eftersom jag kommer från Västra Vallgatan och kan parkera på väg till spåret. Trångt och få parkeringar lediga. Parkeringarna skulle behöva rensas på gamla cyklar lite oftare. Det är bra att det är nära till spåren. Tror att det skulle vara bra att utnyttja höjden för att kunna öka parkeringens kapacitet.	Ramlåset.

11	Pratar om att det kan vara kvarlämnade lås i vägen när man ska parkera cykeln i cykelställen. Tycker att det är dumt att det bara är parkeringar på en sida av vissa ställ. Skulle vilja ha tak som skyddar cykeln mot regn. Det är väldigt trångt och styrena slår i varandra. Skulle gärna vilja ha tvåvåningsställ, använde det i Göteborg en period och tyckte att det var lätt att se cykeln eftersom det inte var så många cyklar på översta raden. Det kanske inte är för alla att parkera på översta raden eftersom det kan vara lite bökigt att få upp cykeln men kan man få upp några cyklar så frigör det ju lite utrymme.	Två lås, ett bygellås som fungerar på samma sätt som ett vanligt inbyggt cykellås och ett slanglås med kod.
12	Trångt. Ser skräpigt ut, Behöver vara mer uppstyrt. De som går ska ej bli störda eller behöva gå runt.	Slanglås.
13	Nära, vilket är bra med det är alldeles för fullt.	Ramlåset.
14	Närhet till spåren är bra. Hade gärna haft tillgång till en pump.	Ramlåset.
15	Man får alltid plats någonstans med det är trångt, speciellt vid ingången till parkeringarna vid taxiområdet.	Ramlåset.

Intervju nummer	Fråga 6. Hur trygg känner du dig med att din cykel står kvar här när du kommer tillbaka?	Fråga 7. Hur påverkar stöldrisken på stationen ditt val av cykel?	Fråga 8. Lämnar du något vid din cykeln när du parkerat den? Hade du velat lämna kvar något vid cykeln som du ej gör pga att du är rädd för att det ska bli snott?
1	-	-	-
2	Lite orolig, hör ofta om folk som säger att de blivit av med sina cyklar. Här är en enkel plats att sno med många lättillgängliga cyklar. Vet inte om det är värre här än på någon annan station dock. Ett mer sofistikerat cykelställ kanske inte inbjuder till stöld på samma sätt.	Om jag hade haft en dyr cykel hade jag velat ha den mer försäkra.	Nej.
3	Jag känner mig trygg både natt och dag, ingen skillnad från andra parkeringar i centrum.	Påverkar ej.	Nej.
4	Jag anser att det finns en hög stöldrisk.	Hade eventuellt haft en finare cykel. Har funderat på att köpa en elcykel men skulle nog inte vilja ställa den vid stationen och tycker att det är bra med motionen som en vanlig cykel ger.	Cykelkorg på sidan, har fått sitta kvar (säger detta med lite förvåning).

5	Jag känner mig trygg när den är fastlåst, annars inte.	Så länge som jag kan låsa fast cykeln ordentligt (hjul och ram) så påverkar det inte.	Hjälm lämnas fastlåst med bygellåset.
6	Jag känner mig trygg. Har bott i New York innan och där kände jag mig inte lika trygg.	Den påverkar inte.	Nej.
7	Ganska trygg.	Har haft en annan cykel men hjulen blev stulna, nu har jag en postkodlotteriet-cykel.	Nej.
8	Jag känner mig trygg eftersom jag inte har en så fin cykel.	Skulle kanske ha en finare cykel om stöldrisken var lägre. Hon berättar om en kompis med en mer exklusiv cykel som fick cykeln stulen på stationen.	Hade kanske velat lämna hjälm.
9	Jag känner mig inte så trygg men har köpt en fin cykel och vill använda den. Jag vet andra som blivit av med sina cyklar här.	-	-
10	Känner mig trygg.	Påverkar ej.	Nej.
11	Känner mig ganska trygg.	Ja, lite. Jag väljer att inte byta sadel på cykeln eftersom jag tänker att ingen vill sno en cykel med trasig sadel.	Brukar lämna hjälmen om det inte regnar.
12	Jag känner mig trygg.	Påverkar ej.	Hjälm.
13	Känner mig trygg, längre ifrån vägen känns säkrare.	Påverkar ej.	Nej.
14	Jag känner mig trygg.	Jag väljer att ha äldre cyklar.	Nej.
15	Jag känner mig trygg under dagtid men inte nattetid (läser alltid till platsen om cykeln ska stå övet natten).	Påverkar lite.	Nej.

Intervju nummer	Fråga 9. Hade det underlättat med skåp i närhet till cykelparkeringen? Vad hade du i så fall lämnat där? Hade du kunnat tänka dig att betala för att kunna låsa in dina grejer?	Fråga 10. Vad tycker du om idén att kunna parkera din cykel i ett cykelgarage eller i en enskild cykelbox? Hade det påverkat ditt val av cykel? Hade det påverkat dina cykelvanor? Ex, hade du i större utsträckning parkerat din cykel över natten på stationen? Om det skulle kosta pengar att parkera cykeln säkrare, skulle du då kunna tänka dig att använda tjänsten eller tror du att du hellre hade valt att parkera utomhus? Hur mycket skulle du kunna tänka dig att betala isf?
1	Nej, det viktigaste för mig är att det går snabbt.	Jag hade inte använt ett garage eftersom jag anser att det skulle ta för lång tid.
2	Nej, isåfall träningskläder.	Bra idé. Speciellt för de som har dyrare cyklar. Om det kostar pengar då vilket jag antar att det gör. Jag kan inte tänka mig att betala för en sådan lösning.
3	Nej men det är säkert bra för folk som reser och besöker Varberg över dagen.	Nej.
4	Nej, tar bara med det jag jag behöver till jobbet.	Hade kanske velat använda ett cykelgarage om jag haft en finare cykel och skulle då kunna tänka mig att betala strax under 100 kr/mån för tjänsten.
5	Nej, det ska gå fort.	Jag hade nog inte använt garage.
6	Nej.	Jag skulle ej använda garage även om det fanns.
7	Ja, det hade kanske fått mig att börja använda hjälm om jag har möjligheten att låsa in den i ett skåp.	Med den cykeln jag har idag skulle jag ej använda ett garage. Om det finns ett garage skulle det kanske göra att jag skulle våga ha en finare cykel och därför använda garaget men jag hade inte velat betala för det.
8	Då skulle det behöva vara i anslutning till cykeln. Isåfall skulle jag lämnat hjälm.	Jag hade kunnat tänka mig att ha cykeln i ett garage. Hade kanske gjort att jag haft en finare cykel. Beredd att betala ca 200 kr/mån.
9	Skåp vore bra. Skönt att kunna hänga in regnkläder.	Bra idé. Skulle vara bra att lägga in hjälm och regnkläder i en cykelbox. et inte om jag skulle kunna tänka mig att betala.
10	Nej.	Jag prioriterar tillgänglighet och snabbhet och skulle därför inte parkera i ett garage.
11	Ja, det vore bra att kunna hänga in reflexväst, lampor, hjälm och regnkläder. Hade kunnat tänka sig att tillgången till boxar ingår i pendlarkortet.	Skulle absolut ha valt att ställa in cykeln i ett garage om möjligheten fanns. Skulle kanske inte använt det varje dag eftersom jag ibland har bråttom. Närhet till tåget är viktigt, skulle t. ex. inte använda ett garage om det låg för långt bort. Om garage fanns skulle hon kunna tänka sig att köpa en bättre cykel, typ en elcykel. 200 kr om året skulle jag vara redo att betala om jag bara skulle använda det lite då och

		då. För att använda det 5 dagar i veckan skulle jag kunna tänka sig att betala 100 kr/månad.
12	Nej.	Nej "kommer alltid 30s innan tåget".
13	Nej.	Nej.
14	Nej.	Nej.
15	Nja, hade kanske använt det ifall det inte tog så lång tid. Hade isf kanske lämnat hjälm.	Inte i dagsläget. Om jag hade haft en elcykel så hade jag kanske velat ha det.

APPENDIX 3 - REQUIREMENT SPECIFICATION

GENERAL SPECIFICATIONS
Usage
There must always be available parking options. If the occupancy rate exceeds 90%, additional parking spots must be added
It must be clear to the user in what direction the bicycle should be parked
The user should understand how to use the different parkings solutions without need for instruction
The solutions should support the bike upright, without the need of a kickstand
The parking solutions should enable the users to park in a time efficient way
Design
The solutions should aesthetically fit into the surroundings
The solutions and the layout should match the core values of the station area
It should be clear where the bike parking starts and ends
The solutions should accommodate a variety of bicycles and additional equipment
The solutions should be space efficient
The materials used should have longevity features appropriate for the location
The user should easily be able to identify the parking solutions as a bike parking
The parking area should be easy to overview
Safety
The solutions should not interfere with the surrounding traffic
100% of the parking spots should enable locking of the frame of the bicycles
The solutions should prevent parked bicycles from overbalancing
The area surrounding the bike parking should be well lit
Bicycle stands should be well anchored to the ground
Empty racks must not pose a tripping hazard for visually impaired people
The solutions should not scratch or damage the bike
Operation & maintenance
Aisles should be at least 1,5 meter wide to enable the use of a snowplough and a sweeper
Hard material should be used as ground surface material
Boundaries should be used to separate plantations and ease the removal of weed
The choice of material should be easy to maintain
Place object in a way so that it is easy to maintain the area

Placement

Parking areas should be located close to existing target destinations

Parking areas should be located at highly visible locations and be easy to spot

Parking areas should not be disturb other visitors

Bicycle parking areas should be located closer to the target destinations than areas for car parking

Parking options with higher value should be placed at less popular areas

The parking solutions should be mounted according to the instructions

The layout of the parking area should be arranged to decrease the need for signage

Sustainability

Use material with low environmental impact, consider the whole lifecycle

Minimize manufacturing bets

Eliminate the use of toxic lacquers and chemicals

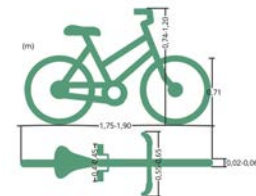
Reduce the impact from transport

Allow replacement of components

Design to be able to reuse parts

BOXCY

The box should accommodate storage of bicycles with dimensions according to the figure, as well as bicycles with baskets at front.



The product should be modular

The box should be movable and it should be possible to adjust the number of boxes to fit the existing need

It should be easy to rent a box and the price should be affordable

It should be easy to insert a bicycle into the box and to take it out

The box design should not interfere with the possibility to overview the parking area

The door should be possible to open from the inside

It should not be possible to see a bike that is stored in the box

The user should be able to store belongings in the box, such as helmet and outerwear

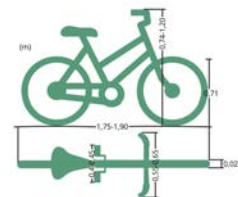
The box should be designed to enable charging of electric bicycles, if this is found necessary in the future

CARGO BIKE PARKING

The cargo bike parking should accommodate parking of bicycles with dimensions according to the standard models.

FRONT WHEEL RACKS

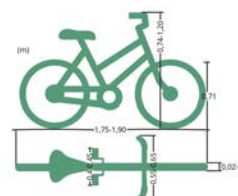
The front wheel rack should accommodate parking of bicycles with dimensions according to the figure, as well as bicycles with baskets at front and child seats.



The front wheel rack should provide lateral support to minimise strain on the wheel

BOLLARDS

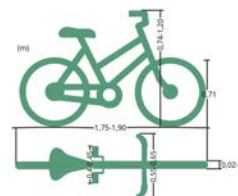
The bollards should accommodate parking of bicycles with dimensions according to the figure, as well as bicycles with baskets at front and child seats.



The bollards should provide lateral support even if an external lock is not used

GARAGES

The garage should accommodate parking of bicycles with dimension according to the figure, as well as bicycles with baskets at front and child seats. Preferably it should also be room for a couple of cargo bikes in the garage.



The user should be able to get an overview of the area both inside and outside of the garage

It should be easy to get access to the garage and the price should be affordable

There should be several entrances into the garage to avoid congestion

The garage design should preferably not interfere with the possibility to overview the parking area

The garage should be designed to enable charging of electric bicycles, if this is found necessary in the future

APPENDIX 4 - WEB SURVEY 2

SURVEY QUESTIONS

Hej!

Vi är två studenter från Chalmers Tekniska Högskola som gör ett examensarbete inom produktutveckling. Syftet med arbetet är att utveckla nya cykelställ för Varbergs kommun. Vi vore tacksamma om du vill hjälpa oss i vårt arbete genom att svara på denna enkät. Försök att svara så utförligt som möjligt, även om du anser att viss information är irrelevant eller överflödigt så kan den vara till nytta. Dina svar kommer att behandlas anonymt.

Kön:

- man
- kvinna
- annat

Ålder:

- -17
 - 18-29
 - 30-49
 - 50-64
 - 65-
-

Frågor om dina cykelvanor

1. Hur ofta cyklar du till tågstationen?
 - a. Flera gånger i veckan
 - b. Flera gånger i månaden
 - c. Flera gånger per år
 - d. Mer sällan
2. I vilket syfte parkerar du oftast din cykel vid stationen?
 - a. För att åka vidare med tåg
 - b. För att åka vidare med buss
 - c. Jag bor i en annan stad, pendlar till Varberg och har därför en cykel ståendes vid stationen
 - d. Jag cyklar aldrig till stationen
 - e. Annat
3. Vad för typ av cykel beskriver bäst den cykel du brukar använda när du cyklar till stationen?
 - a. damcykel
 - b. herrcykel
 - c. juniorcykel
 - d. elcykel

- e. racercykel
- f. mountainbike
- g. lådcykel
- h. hybridcykel

4. Uppskatta din cykels värde

- a. 0-499
- b. 500-1 999
- c. 2 000-3 999
- d. 4 000-6 999
- e. 7 000-10 999
- f. över 11 000

5. Hur trygg känner du dig med att din cykel står kvar när du parkerat den vid stationen?

1 2 3 4 5 6

Väldigt otrygg Helt trygg

Frågor om olika typer av parkeringar

6. Nedan följer olika påståenden, välj det alternativ som stämmer bäst in på dig



- Jag vill låsa fast cykelramen med ett separat lås



- För mig räcker det att låsa cykelns inbyggda lås



- Om det skulle finnas förvaringsboxar i anslutning till cykelparkeringen så skulle jag använda dessa
- Jag har inget behov av att använda en förvaringsbox



- Jag kan tänka mig att betala ca 80 kr/månad för att parkera min cykel i ett cykelgarage
- Jag vill gärna parkera min cykel i ett garage men bara om det är gratis
- Jag har inget behov av att parkera min cykel i ett garage



- Jag kan tänka mig att betala ca 100 kr/månad för att parkera min cykel i en enskild box
- Jag vill gärna parkera min cykel i en cykelbox men bara om det är gratis
- Jag har inget behov av att parkera min cykel i en cykelbox

7. Vilken av följande cykelparkeringar föredrar du?
a. Varför föredrar du denna typ av parkering?



Pollare



Framhjulsställ

8. Vilken av följande cykelparkeringar föredrar du?
a. Varför föredrar du denna typ av parkering?



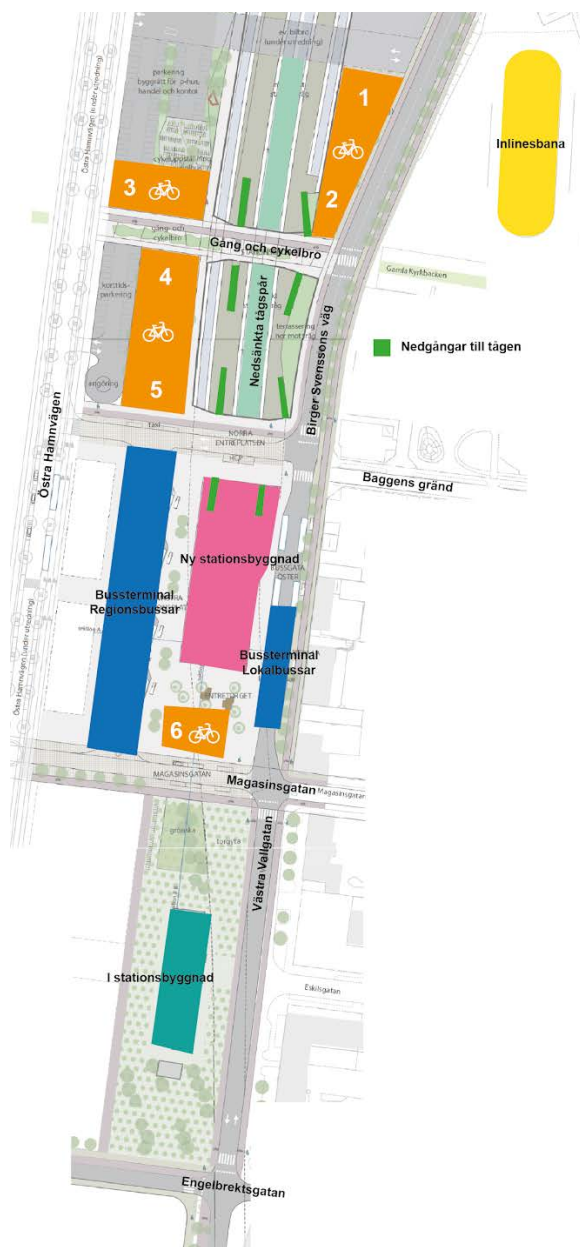
Cykelbox



Cykelgarage

Det framtida stationsområdet

9. Vilken cykelväg tror du att du kommer att komma ifrån till den framtida stationen?
- Söderifrån på Västra Vallgatan
 - Norrifrån på Birger Svenssons väg
 - Österifrån på Baggens gränd
 - Österifrån på Magasinsgatan
 - Söderifrån på Östra Hamnvägen
 - Norrifrån på Östra Hamnvägen
10. Vid vilken av parkeringarna 1-6 skulle du helst parkera din cykel? Antag att parkeringarna ser likadana ut.
- Varför passar denna parkering dig bäst?



11. Vid vilken av parkeringarna 1-6 skulle du i andra hand parkera din cykel? Antag att parkeringarna ser likadana ut.

- Varför passar denna parkering dig näst bäst?

12. Om möjligheten fanns, skulle du vilja parkera din cykel på något annat ställe än parkering 1-6? Isåfall vart och varför vill du parkera just här?

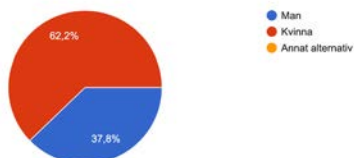
13. Övrigt att tillägga som du tycker är viktigt att ta hänsyn till vid utformningen av cykelparkeringarna

Stort tack för din medverkan!

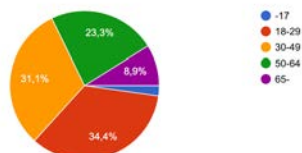
Om du kan tänka dig att bli kontaktad av oss för vidare frågor angående cykelparkeringar så tar vi gärna emot en mailadress eller ett telefonnummer.

SURVEY ANSWERS

Kön
90 svar

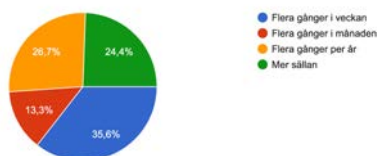


Ålder
90 svar



Frågor om dina cykelvanor

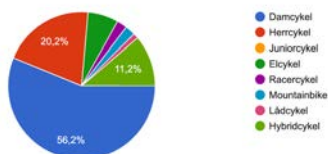
Hur ofta cyklar du till tågstationen?
90 svar



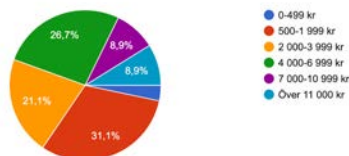
I vilket syfte parkerar du oftast din cykel vid stationen?
90 svar



Vad för typ av cykel beskriver bäst den cykel du brukar använda när du cyklar till stationen?
89 svar

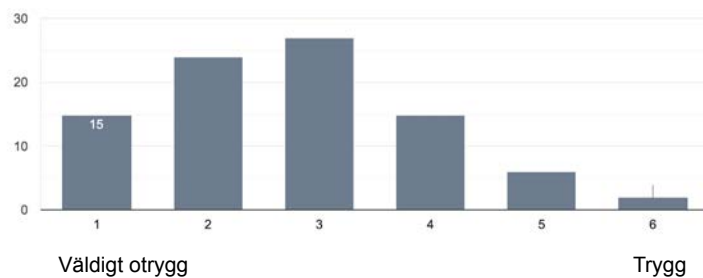


Uppskatta din cykels värde
90 svar



Hur trygg känner du dig med att din cykel står kvar när du parkerat den vid stationen?

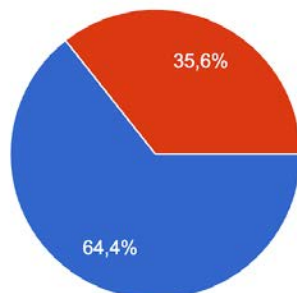
89 svar



Frågor om olika typer av parkeringar

Fastlåsning av cykeln

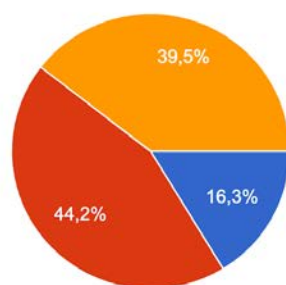
87 svar



- Jag vill låsa fast cykelramen med ett separat lås
- För mig räcker det att låsa cykelns inbyggda lås

Cykelgarage

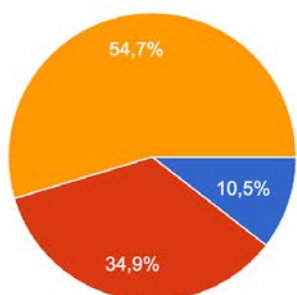
86 svar



- Jag kan tänka mig att betala ca 80 kr/månad för att parkera min cykel i ett cykelgarage
- Jag vill gärna parkera min cykel i ett garage men bara om det är gratis
- Jag har inget behov av att parkera min cykel i ett garage

Cykelbox

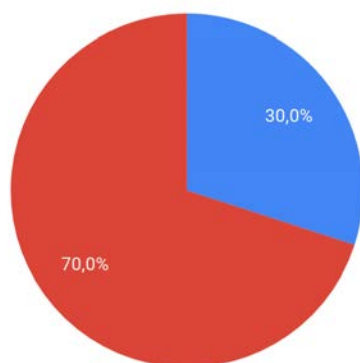
86 svar



- Jag kan tänka mig att betala ca 100 kr/månad för att parkera min cykel i en enskild box
- Jag vill gärna parkera min cykel i en cykelbox men bara om det är gratis
- Jag har inget behov av att parkera min cykel i en cykelbox

Förvaringsboxar

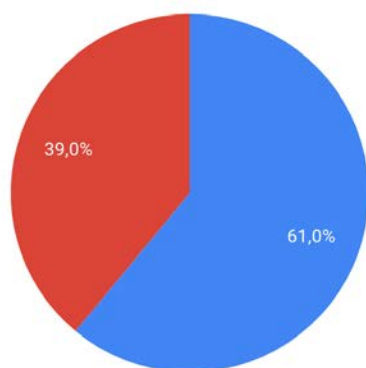
83 svar



- Om det skulle finnas förvaringsboxar i anslutning till cykelparkeringen så skulle jag använda dessa
- Jag har inget behov av att använda en förvaringsbox

Vilken typ av cykelparkering föredrar du?

87 svar



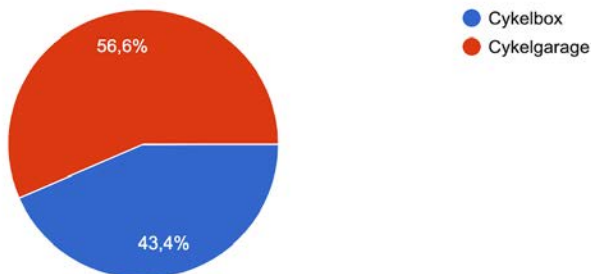
- Pollare
- Framhjulsställ

Motiveringar	
De som föredrar framhjulsställ	De som föredrar pollare
Passar min cykel bättre	Framhjulet blir inte skevt
Cykeln står lättare upp och välts inte om det blåser mycket ut.	Låser man fast cykeln i nån form av pelare/lyckstolpe så är det svårare att sno med sig den. Jag ställer aldrig min cykel i ett framhjulsställ. Har gjort det misstaget innan och den blev stulen.
Känns som om det är lättare att låsa med kedjelås om man har framhjulsställ.	För att det både är säkrare att låsa fast den med eget lås i en rejäl stolpe och att det finns utrymme omkring cykeln vilket saknas på vanliga framhjulsställ
Cyklarna faller inte lika lätt.	Smidigare och man kan låsa fast ramen.
Van vid det	Går bra att låsa med extra lås.
Tycker den är bäst!	Passar min cykel bäst då jag har en låda framtill
Enkelt att använda	Säkrare och större flexibilitet
Mer platseffektivt. Med pollare har folk en tendens att felparkera.	Viktigt att det går att låsa fast ram och bakhjul i ett fast objekt.
Enkel, minska risken att cykeln ramlar	Mindre trångt. Finns ingen av dem som attraherar mig.
Står stadigt	Smidigt med fastlåsning

Jag vet inte hur pollare fungerar	Den ramlar annars
Lättare att parkera	Säkrare att låsa fast
Mest van vid det	Underlättar låsning
Smidigt	Kan även användas för att låsa ramen med separat lås
Då slipper man använda "benstödet" på cykeln	Enklaste
Cykeln står stadigare i vår blåsiga stad.	Enklare
Mer strukturerad	Enkelt
Står stabilt	Lättare att låsa fast i cykelramen
Lätt och smidigt om den inte har stöd	Framhjulet kan bli skevt i framhjulsställ
	Det är smidigare att låsa cykeln med kedja i ett sådant cykelställ
	För att kunna låsa fast ramen
	Luftigare runt omkring.
	Enklare att ställa in och få ut cykeln. Många framhjulsställ ger även ofta bara möjligheten till låsning i framhjul. Pollare ser dessutom mycket stilrenare ut än större framhjulsställ.
	Vill inte att förhjulet ska bli snett
	Lättare låsa ramen
	Bra att låsa fast i.
	Enkelt att låsa fast cykeln med extra lås
	Då kan man välja om man vill låsa fast sin cykel eller inte
	Enklare att använda extralås
	Vill inte knäcka hjulen
	Den verkar OK!
	Lättare att låsa fast större delen av cykeln
	Du kan låsa med kabellås runt ramen enklare

Vilken av följande cykelparkeringar föredrar du?

76 svar



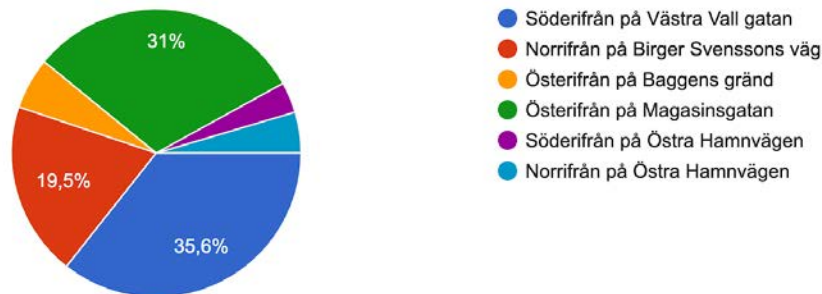
Motiveringar	
De som föredrar cykelbox	De som föredrar cykelgarage
Fullt tillräckligt för de få gånger jag cyklar till stationen	Enklare att komma åt.
Min cykel står i sitt eget garage vilket borde betyda att den är svårare att stjäla.	Bara en känsla att det är mer skyddat. Men båda alternativen är bra.
Enkelt att parkera	Verkar mer bekvämt
Vet inte, ser säkrast ut	Tak
Ger möjlighet att välja en annan (dyrare) cykel samt förvaring av kläder, skor och hjälm.	Säkrare. Men det måste finnas gott om utrymme till granncykeln.
Ingen annan har tillgång till min cykel	Box verkar krångligare, trixigare, tar längre tid.
Lättare att hitta sin cykel	Enkelt
Väderskyddad och inlåst separat ökar säkerheten ytterligare. Cykelgaraget är däremot snyggare så boxarna behöver göras om så de blir en snygg detalj i gaturummet.	Behöver få plats med cykelvagnen också. Skönt med tak när man ska ta på hjälm, hänga på väskor, låsa upp cykeln osv.
Verkar säkrare. Man har sin egen box till sin egen cykel.	Ser inte lika trångt och bökgig ut
Enskilt	Bökgigt att få in en stor cykel i box
Lätt och bra! Ingen som kan förstöra den	Enklare. Cykelboxen känns mer tidskrävande.
Känns säkrare	Säkrare
Mer stöldskyddat	Torr cykel
Kan lämna hjälm mm	Snyggare. Mer cyklar på mindre yta.
Blir mer ordning	Känns lättare
Tar inte så stor plats	Enklare
Cykeln står i en egen box	Tryggt, torrt och översiktligt
Känns säkrast för cykeln	Lätt tillgänglig och skyddar vid frost.
Färre som har tillgång till min cykel	Boxarna är fula
Tar mindre plats	Ser finare ut!
Känns mer säkert.	Väderskyddat
Lättare att få ut cykeln.	Verkar som fler cyklar får plats?
Vet ej	Snabbare
Då kan ingen ta den	Verkar vettigare

enskilt	Går bra att låsa med extra lås
	Skulle finnas alternativet att betala/gång i undersökningen för de som inte reser frekvent. Box/garage skulle innebära ett snyggare sätt att förvara cyklarna än som idag.
	Säker och stabil. Kan låsa fast hela cykeln
	Det är ju stängt!
	Har inte provat någon av dem, så kan inte uttala mig

Det framtida stationsområdet

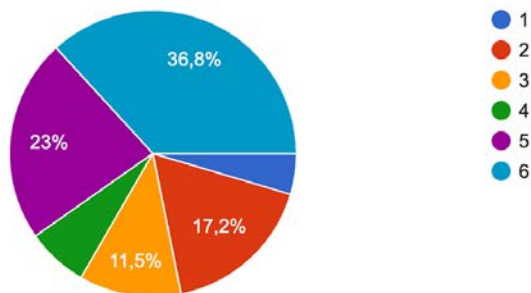
Vilken cykelväg tror du att du kommer att komma ifrån till den framtida stationen?

87 svar



Vid vilken av cykelparkeringarna 1-6 skulle du helst parkera din cykel?

87 svar



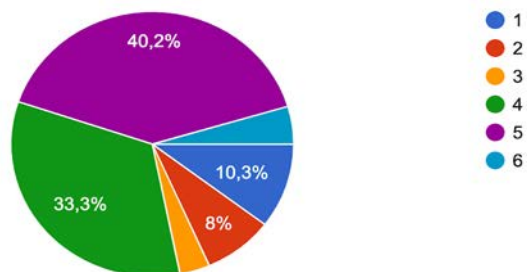
Motiveringar
1
Jag kommer från det hållet när jag cyklar in till stationen. Så parkering 1 är närmast.
Ligger åt norr där jag kommer ifrån.
2
Nära spår och stationsbyggnad när man kommer norrifrån på Birger Svenssons väg.
Ligger närmast från gatan jag cyklar på.
Närmast

Närmast
Närmast nedgångarna och påvägen jag kommer från
Närmast nergången
Närmst spåren
Rätt riktning för hemfärd
Ser ut att vara närmast nedgången till spåren. Jag ser bara en nedgång på kartan.
Ser smidigast ut enligt kartan
Ser ut att vara den närmast tågen
3
Jag kommer cyklande norrifrån på östra hamnvägen och är alltså närmast och även närmast övergången.
Säkrast. Mest folk där. Trygg.
Närmast
Ligger bäst till
Närmast
Närmast
Tror att det kommer vara mindre cyklar där.
4
Lagom avstånd norrifrån
5
Nära en nedgång till tåget!
Närmast hemifrån och nära nedgångar till tågen
Närmast stationen
Närmast söder och tågen
Kortast väg
Närmast magasinsgatan
Läge
Närmast nedgången till spåret.
Tror att det blir närmast
Så nära som möjligt.
Nära till spåren och stationshuset
Närmast
Närmast stationen
6
Kommer från söder
Närmast
Närmast vägen jag kom/åker tillbaka på
Det är därifrån jag kommer
Närmast
Närmast
Närmast då jag kommer från det hållet
Närmast stationen samt jag kommer söderifrån.

Närmst där jag kommer ifrån och närmst stationen.
Det är därifrån jag kommer
Det är första cykelparkeringen
Närmaste
Kommer från det hållet.
Kommer i från Magasinsgatan.
Närmast
Närmast
Närmast
Närmast hemåt söderifrån och närmast stationen
Närmast mot färdriktningen
Närmaste för min cykelväg
Närmst
slipper trassla mig förbi bussterminalen
Närmst från mitt hem och nära tågspåren
Skulle finnas alternativet spelar ingen roll. Valde 6 pga närmast. Kanske bra med flera utspridda för att inte få alla på samma ställe

Vid vilken av cykelparkeringarna 1-6 skulle du i andra hand parkera din cykel?

87 svar



Motiveringar	
1	
	Ligger näst närmast gatan jag kommer från.
	Näst närmast
	Näst närmast nedgångarna, men ändå på vägen jag kommer ifrån
	Näst närmast, på vägen
	Näst bäst för hemfärd
	Ser ut att vara näst närmast nedgången till spåren. Jag ser bara en nedgång på kartan.
	Näst bäst
	Den kommer först.
2	
	Näst längst åt norr.
	Näst närmast

3
Närmare
4
Närhet till nedgång spår.
Nära gångbana
Näst närmst spåren
Nära
Den är näst närmast och ligger nära övergången.
Trygg.
Smidigt för mig!
Nära nedgång till spår
Nära tågen
Kunde lika gärna svarat 3
Näst närmast
Tror att det blir närmast
Näst närmst.
Näst närmast
5
Ser ut att vara den som är 2:a närmast
Lagom avstånd norrifrån
Nära
Närmast vägen jag kom/ åker ifrån
Näst närmst
Näst närmast
Näst närmast stationen och jag kommer söderifrån.
Näst närmst där jag kommer ifrån och närmst stationen.
Näst närmasta
Den är den som efter den som ligger först.
Näst närmast
Näst närmaste parkering från där jag kommer
Näst närmst från mitt hem och nära tågspåren
Näst närmast.
Närmast hemåt söderifrån och närmast stationen
Näst närmast mot färdriktningen
Närmst
Närmast nedgång
6
Näst närmast en nedgång till spåret.
Ligger bra till. Undkommer stressen när man går av tåget. Tror att flest kommer att ställa cykeln vid 5 och 4 och det blir därför lugnare.

Om möjligheten fanns skulle du vilja parkera din cykel på något annat ställe än parkering 1-6?

De utmärkta platserna fungerar alldeles utmärkt.
Hade kunnat parkera på vilken som
Helst inte
I direkt anslutning till spåren
Ja
mellan nya stationsbyggnaden och nedgångarna till tågen
Närmast nedgången till tåget
Om det är närmare. Jag parkerar gärna nära ;-)
Utanför biblioteket, för att det är för mycket cyklar vid stationen och då är det lättast att gå en kort bit
Vet ej
Vid nedgången till tågen.
Vid nedgången till tåget
Övriga delar av staden beroende vad jag ska göra

Övrigt att tillägga som du tycker är viktigt att vi tar hänsyn till vid utformningen av cykelparkeringarna

Allt e bra i denna enkäten
Att det finns ett hållbarhetstänk i material, att de är snyggt designade och att de lätt hålls snygga och hela.
Att det finns tillräckligt många o att det inte är för trångt
Att det får plats mycket cyklar på liten plats. Kolla hur uppsala löst cykelparkering med tvåvåningsställ.
Att det skulle finnas en identifiering av cyklarna som står där. Efter en vecka skulle de tas om hand av polisen och hämtas ut där. Alltså inga mängder av oanvända gamla cyklar som skämmer området.
Att där finns många parkeringar så att man inte behöver leta när man kommer och ska med tåget och kanske har lite bråttom.
Att parkeringen är utformad så att det är lätt att hålla ordning och lätt att komma åt sin cykel. Idag kan det vara si och så med det.
Cyklar måste rensas bort regelbundet. Var 5e år är för sällan. Innan cykelparkeringen på nuvarande station gjordes om så var det uppskattningsvis ca hälften av cyklarna som bara stod där och aldrig användes.
Eftersträva ett mer ”rent/snyggt” intryck jämfört med idag. Garage/boxar med engångskostnad som möjlighet eller parkeringar utspridda på fler platser för ett bättre intryck
Ej anlägga den mindre ytan för cyklar nr 6. Kommer att bli cykelröra.
Inte för undangömd.
Kostnad för att parkera en cykel skulle vara otroligt offputting
Lättillgängligt är viktigt
Mer plats åt varje cykel. Bort med värdelösa framhjulsställ där det ändå inte får plats så många cyklar som det finns platser. Kan bilar få utrymme så kan cykeln få det.
Möjlighet till låst laddning
Möjligheten att kunna låsa fast sin cykel i ramen är viktigt. Att ha en del cykelboxar skulle även öka möjligheten för folk att cykla med till exempel racercyklar eller liknande vilket ökar pendelmöjligheten. På

racercykel kan du pendla bra mycket längre sträckor än med "vanlig" cykel. En variation runt om området vore det bästa.
Möjligt med laddning av elcykel
Ni nämnde betala per månad men garaget va bra om man kan betala per dag! För de som inte pendlar ofta
Servicemöjligheter, ex pump
Ska gå snabbt och enkelt att ta sig från cykel till spår
Större area till parkering 6!
Säkerheten är viktigast.
Tak över cykeln.
Tak över cykelparkeringen är viktigare än inläsningsmöjlighet. Servicestation för att exempelvis pumpa däcken vore bra.
Upplyst så att risken minskar att någon gör åverkan på cyklarna.
Vara nära nedgång till spåren. Kunna komma till och från dem från många håll så att man inte står i vägen för varandra. Upplyst och tryggt för att minska risk för stöld. Finnas plats för cykelvagnar.
Önskvärt med pollare och tak, behöver ej vara cykelgarage.

APPENDIX 5 - USE CASES

STRESSED SARAH

Worst case scenario - Sarah does not find her bicycle when she arrives with the train. Once she finds it, several bicycles have overturned in the wind and are stacked on top of her bike. Sarah needs to remove all the bikes before she can access her own bike. It has rained and when she cycles away, it leaks water from the broken saddle and her pants get wet.

When Sarah is about to catch the train home to Åsa again after a long school day, all the parking spots closest to the tracks are occupied. Now that Sarah can not park her bike where she usually does, she knows that she will have struggles finding it tomorrow when she arrives with the train.

Best case scenario - The bike is parked properly where Sarah left it. The distances between the bicycles are sufficient for Sarah to easily access her bicycle to get to school. The bike has been parked in a sheltered area and the pants do not get wet when she bikes towards school

When the school day is over and Sarah will catch the train again, she easily gets an overview if there are any available parking spots close to the tracks. There are several vacancies and Sarah cycles there, smoothly parks her bike and catches the train with a couple of minutes margin.

CONCERNED CONNY

Worst case scenario - When Conny arrives to the bicycle parking area, the bicycles are parked in a mess and Conny therefore has difficulties to enter the area. Once he enters the parking area there is no vacant space where the bike can be locked in both frame and wheel. Conny turns around and tries to find another spot to park his bike. Finally, he locks the bike with a u-lock on to the rail that separates the train tracks from the station area. He is a little ashamed not to park on a designated bicycle parking but he priorities security. When Conny is about to collect his bike after a weekend with her daughter, there are marks on the lock that indicates that someone tried to steal it and the battery to his electric bike is vanished. Conny feels sad and considers whether he should start driving his car to the station instead.

Best case scenario - Conny bikes towards the train station's bicycle parking area and feels calm about leaving the bike there. He knows that the risk of getting a bicycle stolen is almost non-existent where he chooses to park. He parks the bike in his usual place where it is separated without risk of getting it scratched.

Conny leaves his helmet on the handle bar because he has no use for it again until he comes back to the bike on Sunday afternoon. When Conny is home from Gothenburg, the bike stands neatly in the same place as he left it and in the same great condition.

NERDY NED

Worst case scenario - It is raining and Ned is wearing rain clothes during his bike ride. It is dark and the bike lights are needed for Ned to feel safe during the bike ride. The batteries of the lights are discharged during the cycle trip and Ned becomes frustrated because the bike ride home from the station also requires lights. All racks with possibilities of securing both frame and wheels are occupied and Ned is forced to put his bike inside the narrow sea of bicycles. When the bike is parked, he needs to get rid of the wet rain clothes and store them somewhere. He gets them off in the rainy parking lot and puts the wet clothes in the backpack before he can enter the bus.

Best case scenario - Ned feels confident with riding his exclusive racing bike to the station. Once there, he parks his bike in a secure place. He does not feel worried that the bike will be neither vandalized nor stolen. It is raining heavily this morning but since there is a dry place where Ned can remove his wet clothes and store them, he sees no problem with a little rain. The lights that have been discharged during the cycle trip can be charged at the station, which means that he can feel safe when cycling home.

APPENDIX 6 - COMMONLY USED LOCKS

Frame lock

A frame lock is a basic security device that is integrated in almost any bike. Since the lock is integrated it enables the possibility to lock the bike anywhere as long as the key is brought. When the frame lock is secured it hinders use of the bike but a thief can still carry the bike away and thereafter destroy the lock.



U-lock



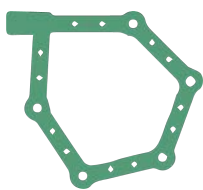
The U-lock is a construction with a rigid U-shaped metal ring and a crossbar. It enables the user to secure their bicycle to an object and it thereby makes it harder for a thief to steal the bike. The thickness of the object that the bicycle is secured to is a limitation since the lock is rigid. An advantage with the rigid construction is that it can be hard for a criminal to fit a tool, such as a hacksaw or bolt cutter around the metal ring.

Cable, wire and chain locks

Cable, wire and chain locks are more flexible compared to the U-lock. A flexible lock makes it easier to enclose an object but it also makes it easier for thieves to fit tools around the lock. There are both longer and shorter designs of these type of locks. Longer ones can pass through both wheels, the frame and an immovable object with the same lock. Other locks are shorter and can therefore not secure both wheels. Some cable, wire and chain locks have an integrated locking mechanism while others must be used in combination with another lock. Generally, cable and wire locks are more lightweight compared to chain locks.



Folding locks



A folding lock has a higher flexibility than the U-lock but it is not as flexible as cable, wire or chain lock. Compared to the U-lock it is more lightweight and more compact when folded and it is therefore easier to transport.

APPENDIX 7 - GARAGES ACROSS SWEDEN

Location	Number of parking spots	Type of garage	Cost
Växjö	62	garage with walls of glass	80 SEK/month
Örebro	50	garage with walls of glass	80 SEK/month
Trelleborg	62	garage with walls of glass	80 SEK/month 400 SEK/6 months 800 SEK/year
Ängelholm	75	garage with walls of glass	50 SEK/month
Katrineholm	38	garage with walls of glass	60 SEK/month
Umeå	24	garage with walls of glass	50 SEK/month
Huddinge	42	garage with walls of glass	100 SEK/month
Vänersborg	30*2	garage with walls of glass	50 SEK/month
Sigtuna	89	garage with walls of glass	80 SEK/month
Lidköping	32	In existing building	80 SEK/month
Malmö Hyllie	900 for free in unlocked area 100 in locked area	Part of a car parking garage	Locked area 80 SEK/month 400 SEK/6 month 800 SEK/year
Malmö Centralen	1500 for free in unlocked area 700 in locked area	Underground garage	Locked area 80 SEK/month 400 SEK/6 month 800 SEK/year
Borås	90	Stand alone building	50 SEK/month 500 SEK/year

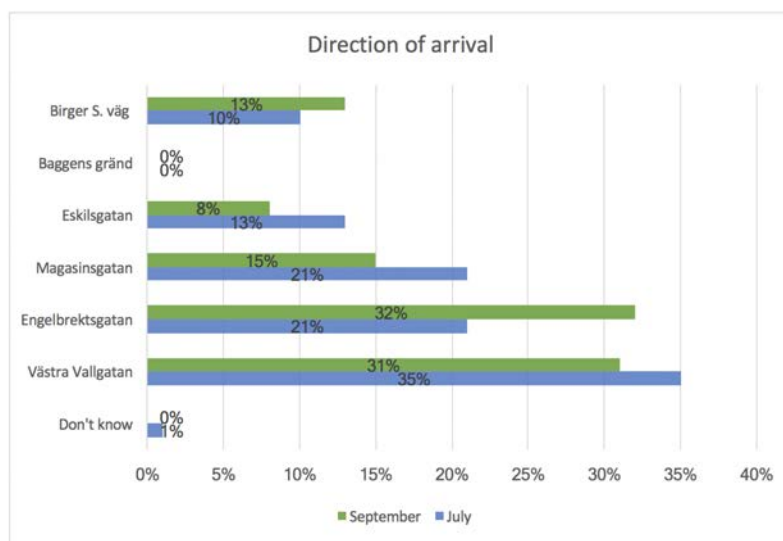
APPENDIX 8 - BICYCLE BOXES ACROSS SWEDEN

Location	Occupancy rate	Type of solution	Cost
Borlänge	16/16 are rented and they have cues. States that they probably could rent over 30 boxes.	Pendula	12months 600SEK 6months 300SEK 1month 60SEK
Höör	35/40 are rented	Pendula	12months 600SEK 6months 300SEK 1month 60SEK
Helsingborg	Ramlösa 100% Rydebäck 25% Påarp 50 % Maria 75%	Pendula	12months 600SEK 6months 300SEK 1month 60SEK
Stockholm	100% at many locations. Note that we move them to a new location if there is a low demand.	Aretus Soppenstock Falco Q from Falco Street furniture	-
Lerum	The occupancy rate varies, depending on season. Have just started to oversee the occupancy rate during a whole year.	Falco Q from Falco Street furniture	-
Jönköping	Jordbron 29/29 Rosenlund 3/10 Huskvarna 2/20 (has just opened the rental application)	Different solutions from <i>Trafik och Miljöinnovationer</i>	4months 100SEK

APPENDIX 9 - CYCLISTS DIRECTION OF ARRIVAL TO THE CURRENT STATION

Sweco investigated the direction of arrival by performing interviews at Varberg's train station in 2014 on the behalf of Jernhusen (Leuftstadius, 2015). They asked the visitors of the station that arrived by bike from which direction they arrived, the result is shown in the table below.

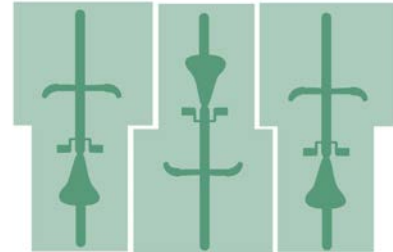
Engelbrektsgatan, Magasinsgatan and Eskilsgatan are parallel streets located east of the station. These three streets are together the most common travel routes to the station area. Västra Vallgatan is located south of the station and this street is also a common direction of arrival. Only a small part of the cyclists arrives to the station from Birger Svenssons Väg located north of the station.



APPENDIX 10 - BICYCLE BOX SHAPES

THE T-SHAPE

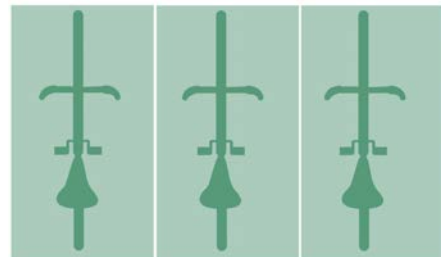
In the T-shaped box, the bicycles are reversed into the box and the various modules are placed in every other direction to save space. This means that the T-shape is optimised for use from two directions and is not as space efficient when mounting against a wall. This shape was later eliminated due to that the handle bars have a large variation in dimensions and the shape is dependent on their measurements. There is a great risk that some bicycles will not fit and it is not so flexible for changes in bicycle trends.



Area per bicycle: $0,75*1+0,5*1=1,25m^2$

THE RECTANGULAR SHAPE

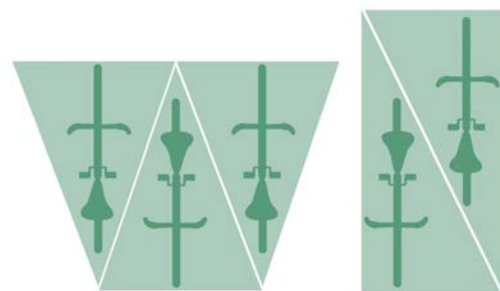
The rectangular shape is the simplest design and can favourably be placed against a wall. Thus, operation from one direction is possible. This shape is not adapted to the dimensions of a bicycle, consequently each box occupies unnecessarily much space and was therefore eliminated.



Area per bicycle: $0,75*2=1,5m^2$

THE TRIANGULAR SHAPE

In the triangular shaped box, the bicycles are reversed into the box and the various modules are placed in every other direction to save space. This means that the triangular shape is optimised for use from two directions and is not as space efficient when mounting against a wall.



The triangular box modules can have different designs. Either a right-angled or an equilateral triangle can be used. The two solutions have different pros and cons. The right-angled triangle requires that a box module is unnecessarily longer than a bicycle to be able to fit two modules together. The equilateral triangle requires an unnecessarily large width at the front, which also means that a door would need a large turning space. Both of the shapes were eliminated due to their cons.

Area per bicycle: $1,24m^2$

THE HOUSE SHAPE

In the house shape the various modules are placed in every other direction to save space. This means that the house shape is optimised for use from two directions and is not as space efficient when mounted against a wall.

The module is designed to allow for both reversing into the box or placing the front wheel of the bike in the triangular shape.

Area per bicycle: $0,75 \cdot 1,29 + ((0,75 \cdot 0,71) / 2) = 1,23 \text{m}^2$

