SMART BICYCLE PARKING
Bicycle Parking Solution for the Riihimäki Railway Station Area

The Report on the Executed Project
Mechanical Engineering and Production Technology
FUAS School Riihimäki Campus Summer 2016

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ABSTRACT

Our project was executed within FUAS Summer School and it had been assigned by the municipality of the town Riihimäki. The main objective of the project was to create and present the concept of the bicycle parking that would satisfy the requirements stated by the customer and would be applicable for the further development and improvements. The goal of establishing the new system of bicycles’ accommodation emerged mostly from the current sharp situation concerning vandalizing and stealing of bicycles as well as the lack of properly protected and planned facilities for parking with the sufficient amount of space for housing. As well as this, other issues regarding supplementary systems for electronic bikes determined the necessity of developing the new system of parking.

The tasks which were laid upon our group included the preparation of structured and detailed report concerning the issues related to the created concept. The scope of the report shall have involved information on technical features of the compartment such as dimensions and capacity, utilized materials, algorithms of implementing and using the established system in real circumstances and data on accommodation types and facilities.

The methods of our work and researches mainly focused on proper scanning and investigating the current existing facilities for parking and compiling the beneficial features in order to receive one sufficient concept that would satisfy all the stated requirements. Our group operated with already created engineering innovations and solutions and added certain improvements in order to obtain even better result. In order to document the features of the developed concept, we worked with programs provided by our study institution such as Vertex and Creo.

The result of our project is so that we have managed to develop the concept that covers the demands of the customer and comprises required features. Our group obtains all the necessary technical documentation, including dimensions, 3D model and information on utilized materials and systems.


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Appendix 1 Existing Parking Facilities
1 INTRODUCTION

As it had been stated in the Abstract part, the objective of our group was focused on creating the concept of the innovative and properly planned bicycle parking system that fulfills the particular requirements that had been mentioned by the customer at the outset of the project. The idea supposed that the developed concept shall replace some of the currently existing facilities located in the area adjoined to the railway station of Riihimäki due to their low level of reliability and functionality. The designed system shall contain the controlling mechanisms appropriate for serving the purposes of single-time parking or regular parking as well as the set of arrangements for ensuring the safety of accommodated vehicles. Along with these, the customer highlighted preference to receive the concept that would be designed with accordance to principles of modularity and easiness of reconstruction, widening and rearranging.

1.1 Requirements

Exactly at the outset of the project our group obtained the set of particular requirements from the customer concerning the issues related to the expected concept. Due to the fact, that demands had been stated clearly and in a detailed and structured way, the execution of the designing phase was significantly simplified and reinforced. The major requirements are listed below.

- **Presence of Anti-Theft System** – the current situation concerning bicycle parking facilities in the area adjoined to the railway station of Riihimäki withstands perceptible lack of protecting arrangements for the stored bicycles which leads to occurrences of theft or vandalizing issues. The customer highlighted the necessity of maintaining the sufficient level of security of accommodated vehicles.

- **E-bike Charging Facilities** – due to the gradual growth of the number of electronic bikes, it had been recommended by the customer to ensure the accessibility of stations for charging and maintenance.

- **Innovative Energy Supply Systems** – as an option to maintain the lighting and electronic systems within the compartment, the customer proposed the intention to utilize environmental sources of energy such as solar power and stated the usage of solar panels and smart energy storage as the significant advantage.

- **User-friendliness** – the customer had also mentioned the fact that the smart and effective system of control and access shall not be overcomplicated and it should be appropriate to be utilized by ordinary citizens.

The requirements listed above concern the actual concept and its functional features. However, the customer also mentioned several aspects that shall be included in the final report on the executed project. Those involved information on technical features of the compartment, measures for its maintenance and founding, description of materials and recycling issues and criteria for its implementation in real circumstances.
1.2 Tasks and Activities

Throughout the whole actual execution of the project, our group was focused on several major actions and set of operations. Methods of our work have been arranged so, that any exact separation of tasks has been excluded and each group member obtained the responsibility to contribute to each performed activity of the collaborative work. The main tasks and actions taken within the project are listed.

- To launch and maintain the research aimed to investigate the current situation concerning bicycle parking facilities and to obtain clear data for further operations and development.
- To analyze the received data and to consider what shall be changed in existing solutions, which particular aspects and features might be added to the developed concept, what shall remain and what needs to be reassessed and rearranged.
- To evaluate the idea in terms of its reality and appropriation for existing circumstances and to prepare and calculate all the numeric parameters including dimensions, capacity and costs.
- To document the idea in the form of technical specifications, reports and tables.

1.3 Results

Concluding the performed work for the stated period, we can claim that certain results have been achieved and our group managed to satisfy the set of requirements which had been stated at the outset of the project. The brief enumeration of the outcomes is represented below.

- The concept that comprises several functional systems of controlling, surveillance, protection and energy supply has been developed, evaluated in terms of its realism and appropriation for real existing circumstances and compared to the requirements stated at the outset of the project.
- Written report, compiling all the information on the working process and features of the received outcome has been prepared.
- Technical documentation in forms of 2D and 3D drawing has been created and included in the report in order to ensure the visual understanding of the designed system.
- Necessary beneficial skills required for implementing successful teamwork and cooperation have been gained.

According to the comparative analysis of the outcome and the stated requirements, it has been approved that they are fulfilled in the proper way.
2 EXISTING SITUATION RESEARCH

2.1 Parking Facilities

Before proceeding to the actual research on existing solution and development of the concept, our group launched the investigation concerning the current situation with the bicycle parking. Our group obtained approximate dimensions of existing facilities and carried out relevant calculations in order to evaluate the capacity and the total accommodation possibilities and to define the number of vehicles needed to be housed. Along with this, the parameters of the available territory were measured in order to receive information on which size of further established compartment is suitable. Obtained data on current situation and facilities is given in the table and the photos are presented in Appendix block.

Table 1. The Research on Current Parking Facilities

<table>
<thead>
<tr>
<th>№</th>
<th>System</th>
<th>Area Opportunities</th>
<th>Approximate Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Five prolonged staples are inserted directly into the asphalt and act as the holders for the parked bicycles. Each staple contains places for 14 bicycles.</td>
<td>The system rests on the asphalt rectangle with approximate dimensions of 30x8 meters.</td>
<td>Assuming that number of bicycles matches the planned space, the capacity is approximately 70 bicycles.</td>
</tr>
<tr>
<td>II.</td>
<td>29 poles are installed directly into the asphalt and each pole contains two places for holding bicycles.</td>
<td>The system rests on the same territory as the system I.</td>
<td>Assuming that number of bicycles matches the planned space, the capacity is approximately 58 bicycles.</td>
</tr>
<tr>
<td>III.</td>
<td>The roof-covered compartment with the concrete foundation containing several two-placed poles inserted directly into concrete.</td>
<td>Concrete foundation has approximate dimensions of 2.5x12 meters.</td>
<td>Assuming that number of bicycles matches the planned space, the capacity is approximately 20 bicycles.</td>
</tr>
<tr>
<td>IV.</td>
<td>9 roof-covered compartments, each containing poles for holding 8 bicycles</td>
<td>The whole system rests on the asphalt rectangle with approximate dimensions of 30x3 m.</td>
<td>Assuming that number of bicycles matches the planned space, the capacity is approximately 72 bicycles.</td>
</tr>
</tbody>
</table>

By summarizing four separate approximate capacities of mentioned facilities, we receive the total one which is equal to 220 bicycles. However, exe-
cuted observations and evaluations showed that even during the time peri-
ods of maximum functioning capacity, not all the facilities are occupied
with its determined available number of vehicles. Due to such situation, it
had been decided within the project execution, particularly during the stage
of designing, that the assumed and operated capacity shall be decreased
down to approximately 25% resulting in the defined number of 165 bicycles
roughly. It had also been stated that not all the existing facilities shall be
abolished and deconstructed. On contrary, the bigger part of them remain
intact in order to maintain the demanded capacity in case of sudden upper
deviation of utilized vehicles. (More detailed description of the capacity al-
gorithms is presented in the section Accommodation)

2.2 Foundation Facilities

Before proceeding profoundly to the stage of designing, our group before-
hand considered that in terms of architectural part, the whole concept is go-
ing to be represented in the form of an either sustainable container that is
located directly to the flat surface (Fig. 1) or a compartment that requires
certain foundation before installing the holding framework (Fig.2). In both
cases the requirements include the sufficient level of flatness and rigidity of
the surface, whether this is concrete of asphalt. Directed by this considera-
tions, our group launched the research which was aimed to determine
whether areas adjoined to the railway station of Riihimäki possess the re-
quired features of surfaces. Our observations and measurements showed
that several zones lying in proximity to the railway station are suitable for
acting as the foundation for the concept.

![Figure 1. The Container Acting as the Accommodating Compartment Located onto the Flat and Sustainable Surface.](image)
3 SHIPPING CONTAINERS FACILITY

Shortly after the initiation of the project and proceeding to the phase of designing, our group proposed the concept of accommodating bicycles in the shipping containers. The attractiveness of the idea appeared from the fact, that no special constructive operations and deformations are needed if the container is used as the completed compartment. However, thorough research, that was carried out in order to approve the suitability of the shipping containers led to the opposite effect and particularly to the abolishment of this concept. Considered topic and outcomes of the investigation are designated below.
3.1 Structure and Architectural Features

Two figures, represented above, are given in order to analyze the container as the accommodating facility in terms of its architecture and sufficient level of protection. The executed research showed that in the matters of defense
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against theft and vandalism, shipping containers are at the highest level of appropriateness due to the rigid external coverage with galvanized steel sheets and thick uniform door, acting as one central entrance.

3.2 Sizes and Prices

The research on the containers was carried out at the Russian market due to the fact, that no open sale offerings in Finland had been found. It is expected, that the price in Finland (or any other closer country) is going to be approximately the same, despite the difference in the utilized currency. The prices are given according to the current course: 1€ = 72₽.

Table 2. Research on the Shipping Containers’ Prices and Sizes.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sizes (mm)</th>
<th>Weight</th>
<th>Condition</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length</td>
<td>Width</td>
<td>Height</td>
<td>New From</td>
</tr>
<tr>
<td>40 ft.</td>
<td></td>
<td></td>
<td></td>
<td>280000₽ = 3888 €</td>
</tr>
<tr>
<td>External</td>
<td>12192</td>
<td>2438</td>
<td>2591</td>
<td>Used From</td>
</tr>
<tr>
<td></td>
<td>Internal</td>
<td>12022</td>
<td>2352</td>
<td>83000₽ = 1153 €</td>
</tr>
<tr>
<td></td>
<td>Doors</td>
<td>2343</td>
<td>2280</td>
<td>Used From</td>
</tr>
<tr>
<td>20 ft.</td>
<td>Length</td>
<td>Width</td>
<td>Height</td>
<td>New From</td>
</tr>
<tr>
<td>External</td>
<td>6058</td>
<td>2438</td>
<td>2591</td>
<td>180000₽ = 2500 €</td>
</tr>
<tr>
<td>Internal</td>
<td>5887</td>
<td>2330</td>
<td>2350</td>
<td>Used From</td>
</tr>
<tr>
<td></td>
<td>Doors</td>
<td>2335</td>
<td>2292</td>
<td>55000₽ = 764 €</td>
</tr>
</tbody>
</table>

3.3 Bicycle vs. Container Size Comparison

Figure 5. Comparison of the Standard Sizes of Bicycles and Containers.
Black lines on the both sides of the bicycle (Fig. 5) represent the approximate width boundaries of the container in comparison to the average length of the bicycle. This figure shows that if the initial container with no additional modifications is used as a parking place, there is the problem of non-sufficient amount of space for maneuver and turning the bicycle. According to the research, our group concluded that despite the container demonstrates the significantly high level of protection, its utilization is complicated by the price and size issues.

3.4 Conclusion

The executed research resulted in obtaining exact information on beneficial and challenging features of shipping containers and evaluating its appropriateness for the stated purpose. The list of rewards and disadvantages is presented below.

Pros:

- Rigid and long-lasting materials utilized in manufacturing ensure high protection and safety of stored bicycles.
- The uniform and thick door acting as the main entrance provides opportunities for establishing the central controlling and payment system.
- Easiness of altering the capacity of the whole facility by simply adjusting or removing the certain number of containers.
- No extra foundation or ground preparation is required. The only demand states the presence of sufficient flatness and rigidity of the surface, whether it is concrete or asphalt.
- Easiness of transporting and installation – the container is positioned directly to the ground and is ready to be utilized.

Cons:

- Relatively high price for the single container even if it is purchased with the condition that it had been utilized before.
- The sizes of the standardized containers, and particularly small width, are inappropriate for accommodating sufficient number of bicycles and for maintaining smart and rational area management.
- Certain challenges occurring while looking for market offerings, no public of freely opened sources of purchasing containers.
- In case if the container is acquired not from the Finnish market, extra expenditures related to the transporting are needed.

Despite the fact that the number of pros exceeds the number of negative features, the concept of containers was abolished after executing the relevant research on appropriateness due to serious challenges and issues concerning their price and sizes. As well as this, it was calculated within group collaboration that the number of containers required for providing sufficient total capacity for the region adjoined to the railway station would be as high as approximately 20 – 25 units, which is basically rather unfortunate in terms of area management and costs. Since our group considered two concepts at the outset, we had to proceed to the second one and develop it after the cancellation of the system of containers. The description of the second
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concept, which has apparently become the final solution, is represented in the following section.

4 SUSTAINABLE COMPARTMENT FACILITY

4.1 Brief Description

After abolishing the concept of containers with rather low capacity, our group proceeded directly to development of the next type of facility – the relatively big and sustainable compartment, which requires perceptibly more constructive and founding procedures but simultaneously provides much higher capacity along with the systems of surveillance, control and innovative energy supply. Despite having the preference of the customer to establish the modular concept with several smaller sectors, our group, after several collaborative discussions and researches, decided that the uniform compartment, which is going to act as the bigger module, would be much more beneficial in terms of costs, maintenance and capacity. The total capacity of the system is not going to be determined by one compartment. Instead, several ones can be placed. All the relevant description and documentation of the concept is presented in the following sections. Before proceeding to them, it is necessary to mention, that the idea, which is presented further, is stated as the final idea of our group.

4.2 Construction

4.2.1 Frame of the Compartment

In order to ensure sufficient resistance to loads, the frame of the compartment is constructed of rigid and sustainable cold formed structural hollow section steel tubes of 70x70x5 mm (Fig. 6). The tubes are jointed together by the means of bolts and no extra welding procedures are required.

Specification and Properties:
- Standard: EN 10219-1
- Steel Grade: S355J2H
- Tensile Strength: 470 – 630 MPa
- Minimum Yield Strength: 355 MPa
- Classification: Non-alloy Structural

Figure 6. Cross Section and Dimensions of the Utilized Frame Tube.
4.2.2 Construction of the Frame and Foundation

The joining of construction tubes and establishment of foundation is implemented by the means of bolts. No extra procedures concerning ground preparation and digging are needed and no welding operations are executed. The compartment is founded actually on the asphalt – four bolts penetrating the asphalt are inserted into the support plates creating the rigid foundation for the frame (Fig. 7). Support plates are jointed to vertical frame beams by one thick shaft.

![Figure 7. The System of Foundation and Connection to Asphalt.](image)

**Specification and Properties of Bolts.**
- Name: Socket Head Countersunk Screw
- Material: A2 Stainless Steel
- Standard: ISO 10642
- Thread Diameter: 12 mm
- Thread Pitch: 1.75 mm
- Socket Size: 8 mm
- Utilized Length: 120 mm

![Figure 8. Socket Head Countersunk Screw. Shape Demonstration.](image)

4.2.3 Roof Construction and Materials

The carried research on appropriate materials for the roofing of the compartment resulted in choosing Multiwall Polycarbonate Sheets. Such conclusion was made due to several beneficial features of Polycarbonate Sheets.

- **High Light Transmission** – due to its semi-transparent structure, Polycarbonate Sheets provide natural lighting opportunities and prospects for conserving energy during seasons with sufficient amount of solar bright.
- **Thermal Insulation** – the structure of the panels contains air spaces between the layers of Polycarbonate which ensures enhanced thermal insulation which carries high importance in terms of accommodating bicycles and keeping normal functioning of electronic systems in the circumstances of low temperatures.

- **Weather Resistance** – the utilization of Polycarbonate Sheets is optimal for Finnish climate conditions as they withstand temperatures ranging from -40ºC up to 120ºC as well as hail-stones, rainfalls, heavy snows and ice formations.

- **Easiness of Installation** – Polycarbonate Sheets are installed onto the skeleton frame with the utilization of profiling racks and bolts. The roofing system is extremely mobile and available for reconstruction in case the capacity and the size of the compartment is decided to be altered.

- **High Strength** – Even though the roof is composed of plastic panels, they possess a very high level of strength and resistance to physical influences, including attempts of breaking and vandalizing.

![Figure 9. The System of Installation of Roofing Panel to the Frame Skeleton.](image)

The profiling racks utilized for fixating Polycarbonate Sheets are interconnected to the frame structural steel tubes by the means of bolting. No extra complicated procedures are required. Two types of holding racks are used to position the Polycarbonate Sheets – U-profiled ensuring the middle connection and H-profiled located at the edges of construction to cover open channels. Considerations concerning the material of racks resulted in choosing polycarbonate due to its significantly high weather resistance, rigidity and easiness of cutting/utilization.

![Figure 10. Roofing System. Demonstration of Profiling Racks.](image)
In order to ensure the appropriate reinforcement of roof in cruel climatic circumstances and to guarantee the sufficient protection from precipitation, it was decided during the collaborative discussions to utilize thicker panels with the standardized system of strengthening. (Fig. 11) In order to provide sufficient retreat of fallout water and to restrict its accumulation on the roof, the upper framework is constructed at the certain slope and the Polycarbonate Panels are laid at the same angle. (Fig. 12)

Figure 11. Cross Section of Roofing Panels. Reinforcement System Demonstration.

Figure 12. Side View of the Roofing. Demonstration of the Slope for Precipitation Retreat.

4.2.4 Wall Coverage and Materials

Collaborative discussions concerning the developed compartment stated that the presence of walls is essential due to the mentioned sharp situation with bike thefts in the investigated region. It was necessary to keep the balance between sufficient protection and affordable costs. Returning back to the requirements denoted by the customer, it was also preferred to provide opportunities for the natural lighting, meaning that roofing and wall coverage shall be partly or fully transparent. Researches held to find suitable solution resulted in choosing mesh, manufactured of galvanized steel with power coated surface. (Fig. 13)

Figure 13. Traditional Steel Mesh. Demonstration of Planned Wall Coverage.
Such specific choice of material emerged from its high appropriateness to the stated purpose. Polyester powders are thermosetting resins that are applied electrostatically to the steel surface and stove at temperatures around 180°C. This technology produces very uniform coatings that have an attractive architectural finish with excellent atmospheric weathering characteristics. In combination with hot dip galvanized coatings, the powder coated product ensures maximum durability for steel components, which will generally provide over fifty years of rust-free life span in most architectural applications. Because of its long rust-free life span, the material is at the highest level of appropriateness for our purpose. Along with this, rigid steel coverage decreases the probability of thefts and vandalizing occurrences.

4.3 Accommodation

During collaborative discussions our group decided that guaranteeing high capacity is one of the key priorities. It was determined that along with standard facilities for keeping bicycles, innovative mechanisms and systems would be implemented. The development resulted in establishing two types of vehicle storage arrangements within the compartment. Altogether, according to executed evaluations, the total capacity of one unit is seventy-two bicycles. The developed types of accommodation described and presented below.

4.3.1 Two-tire Bicycle Racks

The research of the current existing parking systems led to the detection of the beneficial and user-friendly innovation which is commonly utilized in Europe. The discovered system is the set of two-tire bicycle racks. (Fig. 14)

Figure 14. Schematic 3D Model of Two-tier Bicycle Rack.
Such of type of system for accommodation was chosen due to the several beneficial features.

- Easy to use upper tier using stainless steel bearings for long life and minimum maintenance.
- The bicycle is held stable in the wheel channels with locking bars for additional security.
- Accommodates all cycle types (mountain bikes, town bikes etc.).
- Bicycle frame and wheel can be chained for security.
- Cycle is well supported when being stored.
- Lower rack has a sloping wheel channel, so the user does not have to bend between the levels.
- Can be extended infinitely.
- Robust construction, hot dip galvanized.
- Easy lift gas strut fitted so lifting the bike up on the rack requires minimal force from the user.

According to the planned dimensions of the developed compartment (More detailed documentation is presented in further sections), there is sufficient space for positioning 28 two-tier racks, altogether resulting in 56 spaces for bicycle storage.

Figure 15. Side View of the Two-tire Rack and Related Functional Dimensions.
The need for manufacturing of the system is excluded due to its free availability at the international markets. The shape, construction and dimensions (Fig. 15, Fig. 16) are generally standardized despite the existence of several different companies providing such structures.

Considering the need circumstances for positioning the single rack comprising places for two bicycles, two main requirements shall be fulfilled. Those are presented below.

- Minimum height shall be 2400 mm – satisfied. Explanations on general dimensioning is going to be presented in the further sections.
- Flatness of the underlying surface – satisfied. The compartment is planned to be constructed on the flat asphalt zone located in the region adjoined to the railway station of Riihimäki.

As it had been mentioned above, the system of two-tire racks is not the only parking facility presented within the compartment. However, it provides the major part of the total capacity by storing 56 bicycles at once. The second system that is supposed to accommodate the rest of the planned number is represented and described in the following section.

### 4.3.2 Ground Staples

The second system installed into the compartment is the set of staples which are fixed to the ground by the means of bolts and ground plates. The system of fixating is particularly similar to those implemented for establishing the frame of the compartment.
Bolts used for installation of staples are presented in the earlier section (Fig. 8). The only technical difference from mentioned models is the decreased length from 120 mm down to 50 mm.

- Manufactured from mild steel with appliance of galvanized finish. Such combination of materials ensures sufficient rigidity of construction and its resistance to corrosion as well ultimate life period.
- The total number of installed staples is 8. According to this, provided capacity of the system is planned to be 16 bicycles. Summarizing with the capacity of system above, we receive the facility available to accommodate 72 bicycles in total.
- No extra complicated procedures are required for installation of staples – the staple is simply located to its position and bolted directly to the asphalt.

4.4 General Dimensioning and Structure

This section is aimed to compile materials from above mentioned parts concerning the structure, materials and the accommodation system and to represent the way they are united within the concept. Also, this part provides general dimensions of the structure and gives the description of the internal space management.
Comments related to the Fig. 18, defining the necessary aspects concerning arrangement of the accommodation systems and the technical features of the compartment.

- Eight figures of same shape and size drawn with dashed lines represent eight ground staples for holding 16 bikes in total.
- The functional dimension which is not given in the document is the vertical distance between two neighbouring staples = 1000 mm.
- The entrance to the compartment is located at the side which has the dimension of 10510 mm.
- The skeleton of horizontal and vertical stripes drawn with dashed lines represents the frame for roofing of the compartment.
- Two-tire racks have not been included in this document due to the certain difficulties in preparing 2D drawings for them. In order to resolve it, it was stated in the document, which space is given to the two-tire racks. They are positioned along the wall of size 10760 mm. Total number is 28.

After the proper review executed by all the group members, it was approved and ensured that the designed compartment is able to fit in the required systems of accommodation and provide sufficient capacity.
4.5 Controlling and Surveillance System

Due to the fact that our group does not possess professional skills in IT-technologies, we could only briefly develop the controlling system, which is basically going to be represented as the vendor machine interconnected with the electronic lock of the main door. Its features are given below.

- The central entrance to the facility is going to be protected by the electronic lock.
- The vendor machine will be able to provide access to people willing to park their vehicle in two different manners depending on the regularity of parking.
- In case if the person regularly parks his bicycle before, for example, heading to the train in order to get to work/university, then he has the opportunity to purchase the membership card for a period of a year (or any other programmed) in order to get free access to the compartment.
- If, on contrary, the person is aimed to park the bicycle only single time due to certain circumstances, the machine provides him the opportunity to purchase the one-time ticket for a rather low price.
- The opportunity of installing the alarm, that turns on in case attempts to break the lock are take, is considered as rational and useful for the concept.

As well as the installation of the vendor machine, our group regarded the system of surveillance cameras as an effective mean of ensuring sufficient level of security. According to the plan arrangement, several cameras will be located in the corners of the compartment and powered either by batteries or electricity from the municipal energy supplying system. Such choice of relatively complicated scheme of cameras and the ticket/gate machine emerged from the fact, that the current situation concerning bicycle thefts in Riihimäki is rather sharp and the proper protection for vehicles is required.

4.6 Energy Supply and E-bike Charging Facilities

At the outset of the project our customer highlighted the preference to utilize innovative and environment-friendly energy sources, particularly solar panels. Due to the special design of the roof with its slight slope (Fig. 18) the installation of solar panels is possible. However, due to climatic conditions of the region, utilization of batteries according to their purpose can be implemented only within few months. After several discussions our group decided on arranging the algorithm which is presented below.

- Solar panels are going to be installed on the constant basis even though their utilization is restricted by climatic issues.
- In order to maintain smart power management, energy storage system will be installed within the compartment in order to supply electricity towards cameras and the system of the entrance.
- Even though the energy storage system and solar panel will be installed, the compartment still will be connected to the municipal system of energy support in order to exclude any power-lack emergencies.
Produced and stored energy is going to power the E-bike charging station, which is proposed to be installed next to the edge holding staple, so that the person obtains the possibility to charge his vehicle at the same time when it is parked inside the compartment.

5 CONCLUSION

Throughout the whole project our main task, as technical students, was to find and develop the proper solution for the stated problem. In order to reach this goal, our group executed regular reviews and discussions in order to detect whether we are keeping along the track and implement our work in a way that is leading to satisfactory results. Also, we systematically held an analysis which was aimed to show if our concept covers all the requirements stated and if the priorities had been chosen correctly. The presented report was prepared in order to describe the system we developed and our path in general. According to our reviews of requirements and demands, we personally consider that we were able to deliver the concept that we were expected to give. Hopefully, the ideas presented in the report will be found beneficial and appropriate for execution in real circumstances.

Thanks to our customer for the clear and understandable requirements and tasks.

Special thanks to our supervisor for regular support and motivation.

ASTI Parkers.
SOURCES


Bikedock Solutions. The Traditional Sheffield Bike Stand. https://www.bikedocksolutions.com/product/the-traditional-sheffield-bike-stand


EXISTING PARKING FACILITIES.

The related information is presented in the Table 1.

I.

II.
III.

IV.