

The best campus when it rains

A design proposal for blue infrastructure on Chalmers campus Johanneberg



Final project report
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1. Background

In this chapter, the background of the team members as well as the project will be presented.

1.1. The team

All the team members are currently studying their masters at Chalmers, although Jonas as well as Premthip are international students from Germany and Thailand respectively. Jonathan and Maja are Swedish students.

Jonathan studies Design, Construction and Production Management, where the focus lies on management in different phases of the building life cycle. Premthip studies Interaction Design, where it focuses on interaction between human, environment and product. Jonas studies physics, where he has set his focus on computational and statistical physics, specifically stochastic thermodynamics, which studies the energetics of processes happening at small scales, such as in biology. Maja studies architecture with a Bachelor from Architecture & Engineering and is interested in how digital tools can help architects make more informed decisions towards more sustainable buildings and spaces.

As a result of the diverse origin and educational background as well as the even gender distribution, the combined range of skills is broad. Systematical and creative thinking as well as good interpersonal skills are characteristics that summarize the team well.

We are interested in how to increase the incentive among people to reside outdoors in a dense urban environment, even when it is raining. We would like to make the public space more attractive by planning for a livelier environment which allows for a greater number of activities to take place, in a way that also helps solve some engineering/practical issues.

1.2 The project

The task was to come up with a project design for sustainable infrastructure and urban transformation in the Chalmers area, more specifically in the area of Campus Johanneberg. The project requirements were that it must treat three of the five thematic blocks presented during the course – space, flows, information, environment and resources. The selected three blocks – space, flows and environment – were the ones that reflected our interests and background the most. They are summarized below in relation to how it has affected our final project design.

1.2.1 Thematic Block 1: Space

We took with us that movement creates meeting and interaction between pedestrians, cyclists but also vehicles, which in general is good and increases integration. The concept of the multiplier effect that was presented in the thematic block is something we all can relate to on campus, even though it might be slightly less obvious on campus due to the goal-oriented and destination-based movements. The workshop helped us understand this better, as we got to reflect on our own movement patterns. The conclusion that we reached were that there are certain areas (nodes) on campus which are varyingly pleasant to reside on and travel in between based on parameters of our choice. The result got us thinking of possible mitigations in order to improve areas on campus, which has influenced our project design ideas.

1.2.2 Thematic Block 2: Flows

In this thematic block we got a general understanding of the difference between digital and physical infrastructure. Furthermore, the main parameters that are taken into consideration when planning infrastructure, trip generation, trip distribution, mode choice and traffic assignment, were explained.

We discussed the four themes within flows: infrastructure, planning, performance and solutions. Performance is a very important method in order to be able to quantify different types of infrastructure proposals. It can however be difficult and time-consuming. During the workshop we discussed different ways of dealing with the pollution on the campus, and what the problems with implementing certain mitigation actions could be.

New concepts such as mobility-as-a-service, implemented in the campus project MoJo, will influence the way people transport by increasing the opportunity for shared vehicles. This will have an impact on the campus environment and need to be taken into consideration when planning new infrastructure.

1.2.3 Thematic block 4: Environment

During this block, we learned that there are environmental risks both on campus as well as in the rest of the city. We also learned about another environmental aspect that is often overlooked, which is the sound environments on campus, some of which could be considered pleasant and some which could not. Considering the content in the lecture and the current status of the campus, we could immediately point out areas of improvement in terms of flooding and noise by visiting different areas of the campus.

We got to reflect on what makes a good campus environment according to our perspective:

- Provide meeting places
- Calm, focused study spaces (private vs group rooms)
- Flood-resilient (no walking in puddles...)
- Good noise levels in general
- Close to nature/views towards nature
- Close to public transport
- Friendly, welcoming environment
- Having all necessities within walking distance (supermarket, café, drugstore, liquor store, sports facilities etc.)
- Good eduroam coverage
- Outdoor workspaces/encouraging being outdoor/easy outdoor access
- Student-run spaces (Gasquen, student pubs, association rooms etc.)
- Feeling safe at campus
- No vehicles allowed on campus

We developed the design proposals with these aspects in mind.

2. Campus Johanneberg

Chalmers University has facilities at two locations in Gothenburg: Lindholmen and Johanneberg, the latter being the main campus at which the majority of Chalmers' students attend and the one in focus in this report.

2.1. Current infrastructure

On campus, there is a variety of different buildings that have different functionalities and purposes. Apart from educational spaces such as lecture halls, classrooms and group rooms, there are office spaces, libraries, laboratories, student-run spaces, restaurants and other recreational spaces. These spaces are all owned and run by different property owners, the main ones being Chalmersfastigheter, Akademiska Hus and Emils Kårhus AB. This makes the campus an intricate and complex infrastructure of different stakeholders.

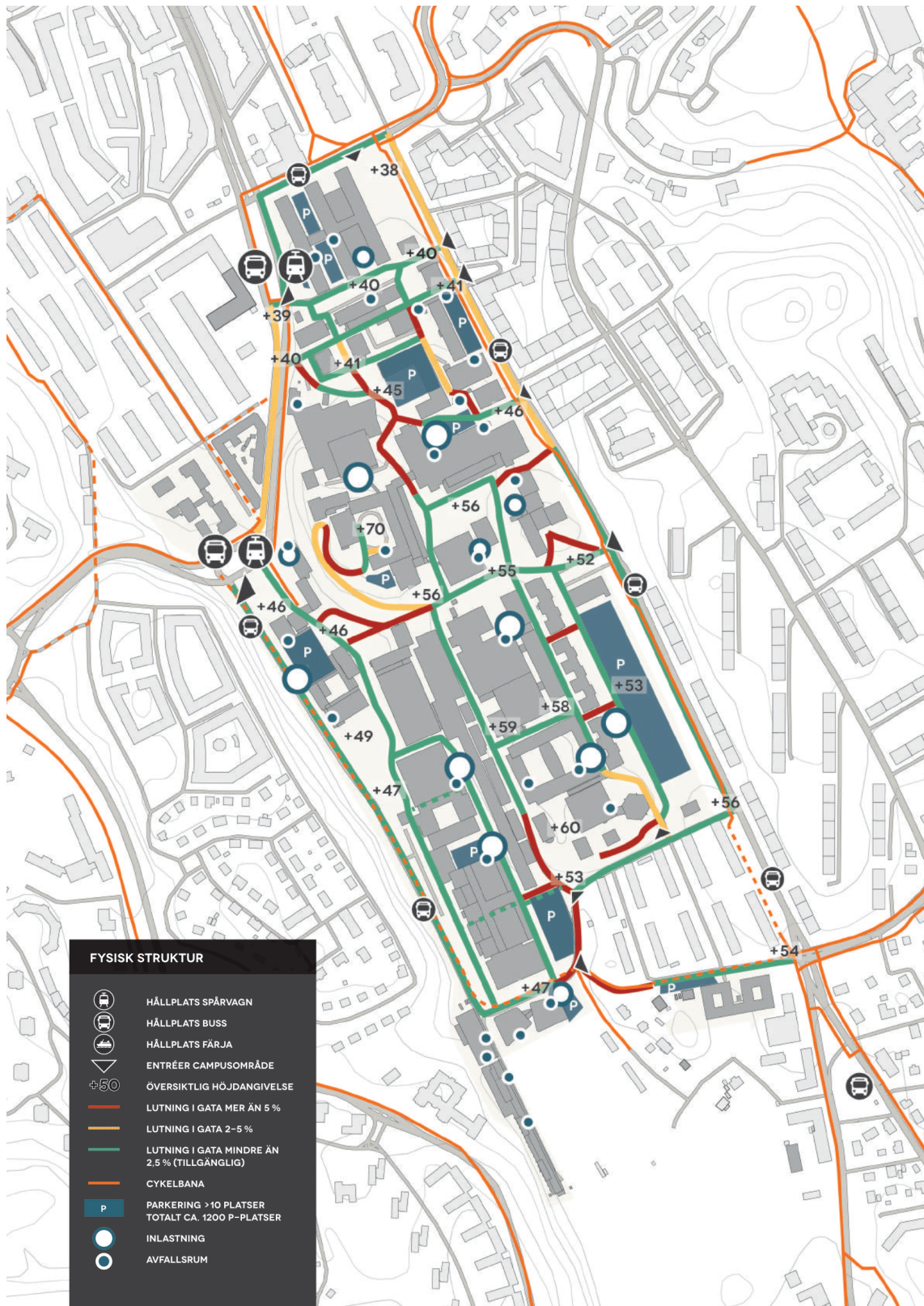


Figure 1. Overview of the current infrastructure of Campus Johanneberg. (Chalmers University of Technology et al 2019, 27).

2.2. Campus development goals

Chalmers campus plan 2019-2050 is a vision document describing the goals for the future development of the two campuses, developed by Chalmers University of Technology, Chalmersfastigheter, Akademiska Hus and Chalmers Studentkår. Four central concepts are mentioned when addressing the campus development goals, three of which are presented below as the fourth one is not publicly available.

1. The campus plan's own vision

Describes a desired future state that serves as a lead motive for the development. The vision says: "Chalmers campus – people and meetings for a sustainable future". The aim of the vision is to "create and spread knowledge, competence and solutions that are beneficial for everyone, the individual as well as the society".

2. Goals which the vision is based on

The vision is based on goals. Once a goal is achieved, a part of the vision is also achieved. The following goals are set for the Campus:

- International knowledge environment at the forefront [Internationell kunskapsmiljö i framkant]
- An integrated part of the city with its own characteristics [Integrerad del i staden med tydlig egen karaktär]
- An attractive habitat which contributes to human well-being [Attraktiv livsmiljö som bidrar till människors välbefinnande]
- Good accessibility with sustainable transports [God tillgänglighet med hållbara transporter]
- A green campus that enhances ecological values [Grönt campus som främjar ekologiska värden]
- Responsible and effective use of facilities, land and other resources [Ansvarsfull och effektiv användning av lokaler, mark och andra resurser]

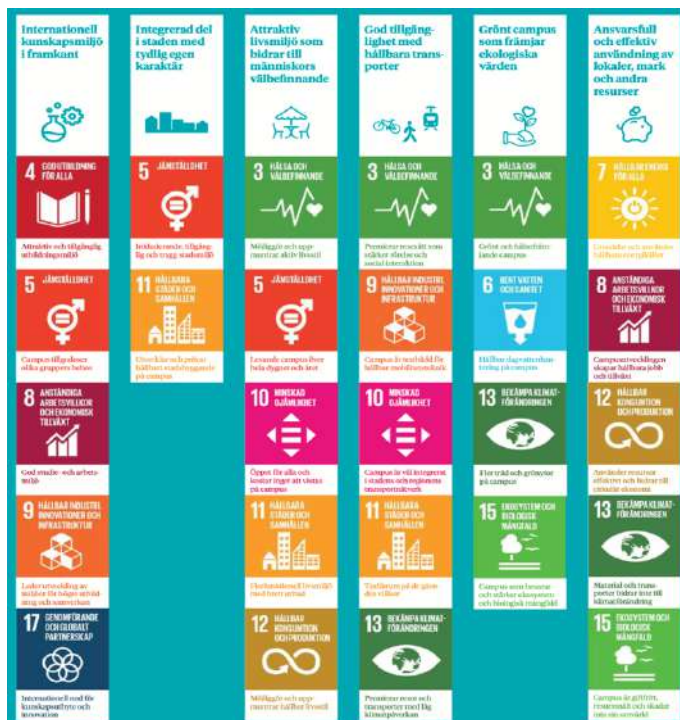


Figure 3. Campus development goals related to the SDG:s (Chalmers University of Technology et al 2019, 23)

As stated in the campus plan, Chalmers plays a central role in reaching the goals and formatting the strategies. Thus, it is much up to Chalmers how well they manage to fulfill their vision. Chalmers has, beside its own set goals, the possibility to contribute to fulfilling the global SDG:s (see figure 3).

3. Strategies to fulfill these goals

The following strategies have been defined in order to reach the goals:

- Clarify different areas and nodes [Tydliggör olika områden och noder]
- Define and establish main paths and meeting places [Definiera och etablera huvudstråk och mötesplatser]
- Meet the city [Möt staden]
- Create green and health promoting values [Skapa gröna och hälsofrämjande värden]
- Develop and make facilities more effective [Utveckla och effektivisera lokaler och byggnader]
- Reward sustainable mobility and logistics [Premiera hållbar mobilitet och logistik]

2.3. Chosen design area

Our chosen project site is the area connecting the Student union building and the SB building.

- The pond outside the SB1 building [A-dammen]
- The green space next to the train wagon [Geniknölen]
- The square outside the SB1 entrance [Lennart Rönmarks plats]
- The bike shed next to Lennart Rönmarks plats
- The path running next to these

The site was mainly chosen due to personal association within the group. Jonathan and Maja both study in the SB buildings and (usually...) walk pass these areas on a daily basis and have noticed that it is an area with lots of potentials. As the campus plan mention these areas as important nodes and paths in the future development of campus, and the pond as a potential stormwater runoff, we felt it was a good spot to develop our thoughts on stormwater management and combine it with improving the spaces themselves.

In the following chapters, a SWOT analysis will be carried out for the project area, in the context of the three chosen thematic blocks: Space, Flows and Environment.

2.3.1. Analysis of current situation

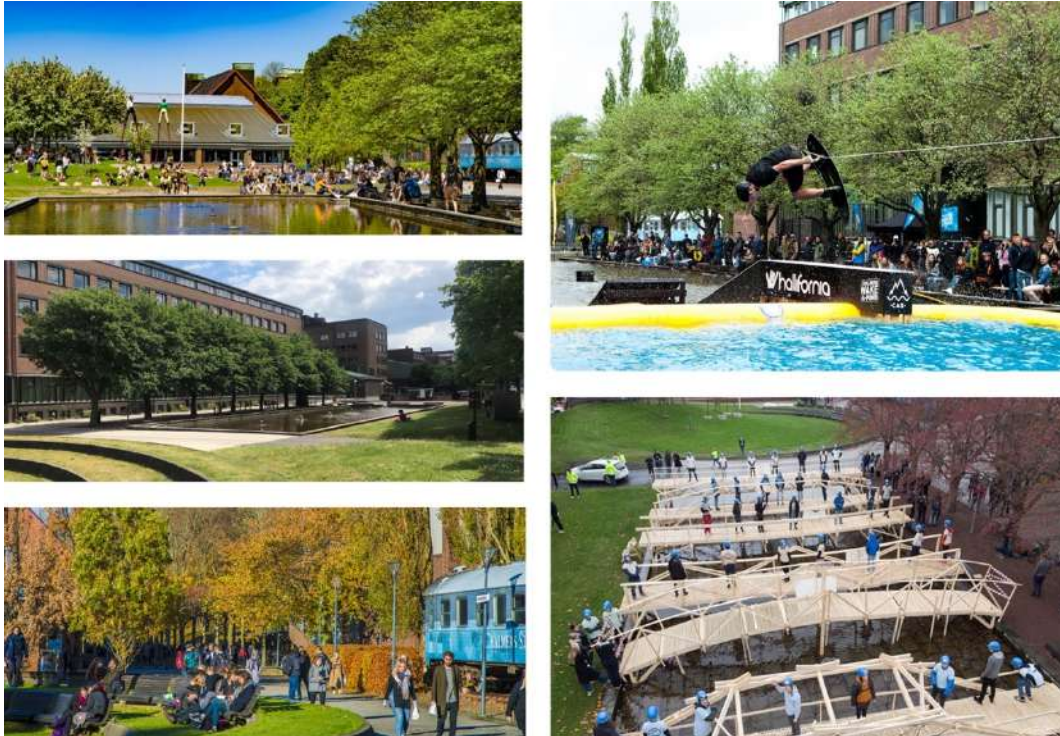


Figure 4. Collage of photos taken around Geniknölen and A-dammen at different times and events. (Google Images)

During thematic block 1, we analyzed and ranked some of the areas on campus that can be considered ‘nodes’, based on a few selected criteria. Note that Node B - The old train wagon, can be considered as the same area as Geniknölen, which is our project area (see figure 5).



Figure 5. Analysis and score of nodes based on selected criteria.

Each of the criteria is based on a score system 1-5, where a high number represents a high score and vice versa.

2.3.1.1. Space Strengths

The areas around A-dammen and Geniknölen are popular to reside in during the summer and the spring. There are numerous activities and events taking place; the wakeboard competition Wake A-Pond, the bridge-building competition Chalmers Structural Design Challenge as well as introduction week activities to name a few (see figure 4). They are also popular places to meet up at to socialize, take a fika or eat lunch. As can be seen in figure 5, Geniknölen received the highest score in Orientation and Hangout spot. It also received a high score regarding safety.

Weaknesses

As can be seen in the photos of figure 4, the areas offer some seating. Geniknölen has a greater number of benches that are more comfortable than the ones currently available at A-dammen. Hence, more people elect to sit there when they want to eat or study. Had there been more and comfortable seating areas at A-dammen, it would make a nicer spot to reside in.



Figure 6. Seating areas at A-dammen.

Moreover, there is no charging infrastructure in place at neither Geniknölen nor the pond that allows for charging of computers, cell phones, bicycles or kick bikes. As can be seen in figure 5, this is not only a weakness at Geniknölen but also at the other nodes on Campus.

Opportunities

Southwest of the pond there is a large area in front of the entrance, called Lennart Rönmarks plats. It is currently not being used for anything, giving a dull impression (see figure 7).

A-dammen is currently empty from October to March, when it just becomes another large, underused area. By developing A-dammen to have functions all year around, the space would improve.

There are many things that could be done to improve the campus environment; adding more greenery, extending the use of the pond, additional seating et cetera. Also, considering it is in front of the Architectural and Environmental and Civil Engineering building, one would imagine that there would be something more aesthetically pleasing on that space to promote Chalmers and the institution.

Geniknölen and A-dammen provides the students with a nice environment to sit in, but it would be greatly improved had there been charging infrastructure in place. Thus, this can be seen as an opportunity.

Threats

If nothing is done, the use of the area will be insufficient and a waste of valuable space. Also, the space does not reflect the innovative environment and sustainable goals of the ACE faculty, which may affect the general perception in a negative way by visitors and passers-by.



Figure 7. The empty space southwest of A-dammen.

2.3.1.2. Flows

Strengths

By studying figure 5, we notice that Geniknölen received a fairly high score in “Flow”, meaning that the area is not prone to congestion. We believe that there is plenty of space for both pedestrians as well as cyclists and kick bikers to travel without interfering with each other and disrupting the flow. As can be seen in figure 8, the path is fairly wide. There is a large flow of people at Geniknölen, especially during the spring and the summer. The high flow of people creates a livelier and more pleasant environment.



Figure 8. The path next to Geniknölen.

Weaknesses

As can be seen in the collage (see figure 4), the path can be quite trafficated, especially in the morning, during lunch and during the afternoon. Moreover, since pedestrians and cyclists are not separated, there is a risk for collision. There is a lesser flow of people at the area around A-dammen, resulting in a feeling of abandonment at times.

Opportunities

It would be beneficial to integrate the two areas, Geniknölen and A-dammen, to a greater extent. By doing so, the benefits from each of the two areas can be experienced by the ones residing there. By making the environment around A-dammen more pedestrian-friendly, a higher flow of people would be achieved, which could possibly relieve some of the stress from the current path and improve the overall Flow score.

In the campus plan, the path is planned to be a “primary path”, connecting the SB buildings and Johanneberg Science Park with the rest of the campus. This means more people might be passing by in the future.

Threats

If nothing is done, there is a risk that A-dammen remains secondary to Geniknölen in terms of Hangout spot. It will also result in that the beauty of A-dammen is not fully utilized and appreciated since the flow of people isn't really connected to it.

2.3.1.3. Environment

Strengths

The area around Geniknölen has many attributes that makes it a good area in terms of the environment. Besides providing a green environment for students to reside at, Geniknölen also fills a function when it comes to stormwater capture. As can be seen in figure 9, the area is a designated stormwater capture surface by the municipality of Gothenburg.



Figure 9. Designated stormwater capture surfaces outlined in green in the area within and outside of campus. (Göteborgs stad 2020)

Geniknölen is in the campus plan for 2050, proposed to get “developed green areas/park spaces”, and A-dammen is proposed to be “blue structure, stormwater management etc”. Thus, proving the importance of the area.

Furthermore, the area around A-dammen is enriched with trees, which provides shelter from the sun on hot spring and summer days and a feeling of being in the nature even on campus (see figure 10).



Figure 10. The trees next to A-dammen.

Weaknesses

Considering the current layout of the pond, there is no possible way for the water that flows on the ground to access the pond (see figure 11). The capturing of stormwater is therefore limited to what can be gathered from the sky.

As seen in figure 12, the current direction of the flow is directed toward Sven Hultins gata as well as Geniknölen. This means that the water will travel on hard surfaces and create puddles (see figure 13) leading to little to no absorption and more stress on the municipal sewage system.



Figure 11. The enclosing barriers hinders water from flowing in the pond.



Figure 12. Water surface flow and direction in case of 100 year rain. (Göteborgs stad 2020)



Figure 13. Puddles on the hard surfaces next to Geniknölen.

Opportunities

By making it possible for the surface runoff water to access A-dammen, it could act as a more efficient capture and storage area during heavy rainfall, leading to a stress relief on the sewage system. This would also mean that the path next to Geniknölen would be less prone to puddles.

Threats

If the rain intensifies more than expected - which is not impossible - the campus could suffer from severe water damage if the water is not taken care of. The students who attend Chalmers would also suffer from wet feet, adding to the negative perception of rain.

3. Process

After we decided to pursue our design toward the topics of Space, Flows and Environment, we gathered information from literature and interviews in order to complete our analysis and design starting points. We then had some creative brainstorming sessions where we sketched on different ideas before using digital tools to visualize our final proposal.

3.1 Gathering of literature

The literature gave an insight and general information that we can use as a reference and inspiration.

Rain Gothenburg – The greatest city in the world when it’s raining

The aim of the investment is, with the rain as a starting point, make Gothenburg even more attractive to live in, conduct business in and to visit. By working with this, the international perception of Gothenburg will be that it is a successful and creative city.

The general concept is to provide infrastructure that accommodates for the rain and turns it into something enjoyable instead. Another pressing factor is the increasingly more evident climate changes, which we would very much like to protect ourselves from as well as the city environment.

The number of hard surfaces within dense cities are increasing, putting more and more stress on the sewage system having to take care of more and more day-water. This can lead to dirty water being released into the ocean which is harmful in many ways. Also, the increasing hard surfaces leads to a less pleasant environment.



Figure 14. A visualization of a “Rain playground”.

The playground is one of the projects developed by Rain Gothenburg and is a pedagogical example of how one can address issues connected to climate change and at the same time provide the inhabitants a nicer environment to reside in and that changes the general perception of rain.

To summarize, the following aspects of Rain Gothenburg can be identified:

- Make use of the rain, see it as a resource.
- Create environments where one can reside despite rainfall, no matter the age.
- Create environments that benefit the society, both regarding social aspects but also environmental.

Water square Rotterdam

We also searched for a related project which we could use as an inspiration for our design. We came across one project in the Netherlands called “Water square Rotterdam”.

A once empty, monotonous square now holds three large rainwater collection ponds which, when the weather is dry, can be used as amphitheaters, basketball and volleyball courts, or skateboarding rinks. The project included the installation of three pools which fill up when it rains. However, for a good part of the year the pools are dry and can be used as recreational spaces.



Figure 17. Water square in Rotterdam, the Netherlands. (Public space 2020)

3.2 Gathering of empirical data

We tried to shape our project and to define what is the problem for our target group by sending out questionnaires to 11 people (see appendix A). We aimed to understand their issues regarding rains and solve them with our design solution.

Questionnaire: These are four questions regarding to activities when it rains:

1. What do you do outside when it is raining?
2. What would you like to be able to do, that you cannot do at the moment? Why can't you do that, and how could you potentially solve that?
3. Do you enjoy some aspect of the rain, if yes, why, if not, why?
4. Is there any place where you like to reside when it rains? What attributes make this place appealing?

Our interviewee characteristic is a student at Campus Johanneberg, who we see as the main users of our design area. In addition, we received feedback from our teachers during the midterm presentation.

Summary of Survey

- They do not enjoy activities in the rain because it is wet and uncomfortable.
- If going outside, it is about getting from point A to point B as efficient as possible.
- They do enjoy the rain from a protected space.
- They do enjoy the sensorial aspects of rain: the smell, the view, the sound.

After having developed our design proposal, we sent out the visualizations (see figure 20-22) to the same respondents with a follow up question, receiving seven answers.

5. In relation to your previous answers, do you feel we have addressed your concerns? If yes, in what ways? If no, what could be improved?

3.3 Creative group sessions

Lastly, in the ideation phase, we did a brainstorming session to generate initial ideas to present and get a feedback during the midterm presentation. Then, our ideas were elaborate based on the issues addressed by the respondents and teachers. We also did a spatial and functional analysis of the project area, with ideas of solutions (see figure 18 and 19).

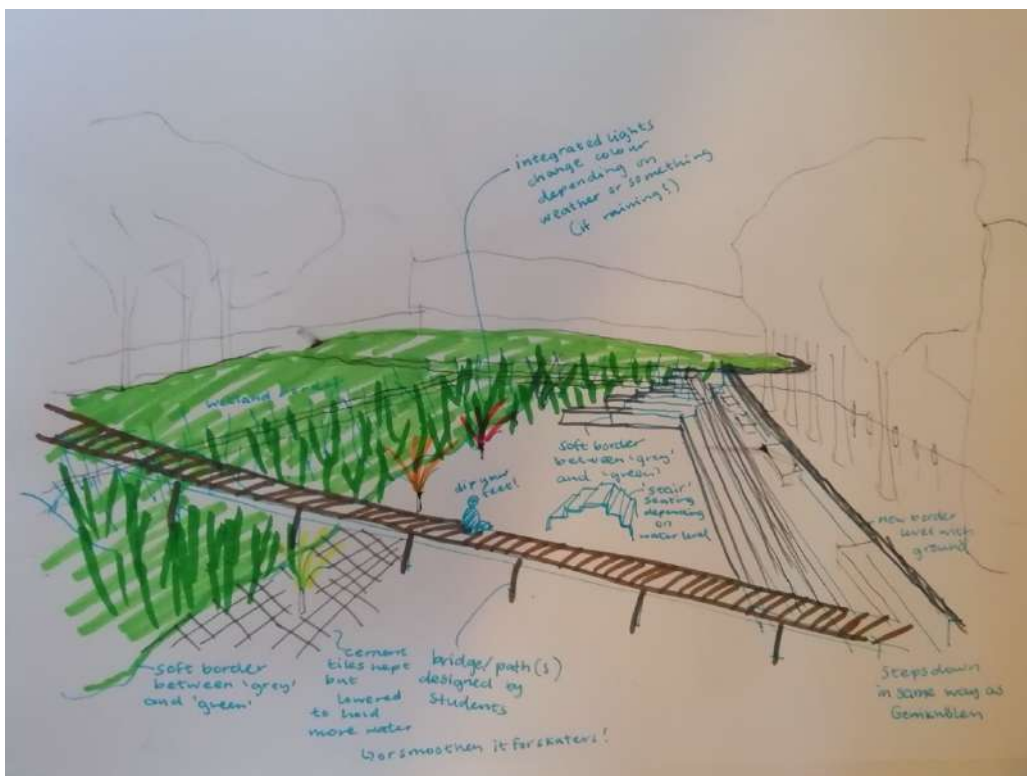
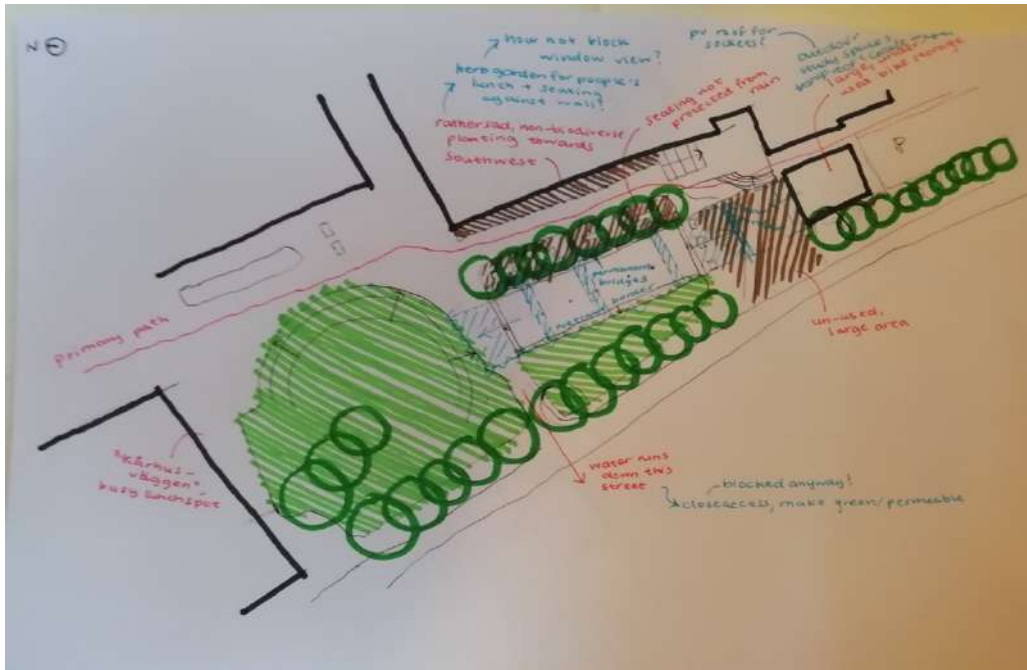


Figure 18 and 19. Plan view sketch and perspective of the design area with analysis and proposed solutions.

3.4 Tools

To visualize our ideas, we created our prototypes using Sketchup, Photoshop and iMovie. We combined our sketches with real environment pictures in order to relate it to our users. It will help them to have a clear understanding of our purpose and to evaluate our design proposals.

4. Proposed solutions

In this chapter, our proposed solution will be presented. The solution is divided into three design elements, each which will be presented individually in the context of the three chosen thematic blocks and their respective SWOT analysis. Each element will also be described in relation to the themes of Rain Gothenburg, the campus development goals, the UN sustainable development goals and the concerns addressed by respondents in the interviews. Lastly, we will reflect on whether the proposed design has been successful in the context of all the thematic blocks and the goals from Chalmers, UN and our respondents.

We summarized our design goals as follows:

- In accordance with the campus plan of 2050, the path in our chosen design area should be a “green path”.
- In accordance with the campus plan of 2050, A-dammen should include stormwater management.
- In accordance with our respondents, the area should provide a space sheltered from rain, where they still can experience the sensorial aspects of rain: the smell, the view, the sound.

In the SWOT analysis of our design area, the following three main needs for change were identified:

1. The separation between Geniknölen and A-dammen.
2. The unused space southwest of A-dammen.
3. The functionalities of A-dammen and the areas next to it.

4.1. Element 1: The path

This design element focuses on the transformation of the path connecting Geniknölen to the SB buildings. It includes several sub-elements; an implementation of different ground patterns that only become visible when it is raining; a balcony seating along the façade of the architecture library with a green roof on top; and more greenery along the path itself.





Figure 20. Before and after implementing our design elements to the path.

Space

The design proposal will result in a livelier environment with added seating areas and possibilities to reside outdoors even during bad weather. Furthermore, the balcony can be accessed from the ACE-Library, extending and connecting it to the outdoor environment. While sitting on the balcony, the students can interact with fellow student walking by and enjoy the scenery which A-dammen provides.

Flows

When it is raining, one tends to look down when walking and cycling. The patterns can be designed to separate pedestrians from cyclists, thus improving the flow but also the safety.

Environment

The roof above the balcony is green, thus improving the ability to capture and stall rainwater. In addition, the roof filters heavy metals that may come with the rain from the copper roofs.

Rain Gothenburg

The design proposal addresses the main aspects of Rain Gothenburg in the following ways:

- Make use of the rain, see it as a resource
 - It makes use of the rain by making it into something to experience – to listen to and to watch.
- Create environments where one can reside despite rainfall, no matter the age.
 - It provides a sheltered space.
- Create environments that benefit the society, both regarding social aspects but also environmental
 - It benefits social aspects as it allows for more social interaction outdoors.

Campus development goals

The design proposal relates to the campus goals in the following ways:

- International knowledge environment at the forefront
 - The new balcony space along the façade facing the library provides a space sheltered from the rain. It can be accessed from the library to facilitate short outdoor breaks from intense study sessions in the library, improving the health situation for the students.

- An attractive habitat which contributes to human well-being
 - The long seating also provides a sunny lunch spot towards the southwest, relieving the existing and very popular seating along “Kårhusväggen”. It also creates a more accessible outdoor lunch spot for the students in the SBI building as it is very close to their main study spaces.
- A green campus that enhances ecological values
 - The green roof provides added greenery which not only filters but also stalls the polluted water from the copper-roof on the Architecture building during rainfall.
- Responsible and effective use of facilities, land and other resources
 - The design makes use of the now unused space.

Sustainable Development Goals

The design proposal relates to the SDG:s in the following ways:

- Clean water and sanitation
 - The green roof provides a filtering function to clean the rainwater from heavy metals from the existing copper roofs, helping improve the SDG of clean water and sanitation.
- Climate action
 - The green roof stalls the rainwater, leading to less stress on the sewage system, thus also reducing the risk of releasing dirty water into the ocean.

Respondents

The design proposal addresses the main themes of the respondents in the following ways:

- The respondents desired more places to sit and reside outdoors when it is raining without getting wet.

4.2. Element 2: The outdoor study space

The bike shed standing there today is large, dark and under-used. The design element proposes to transform the bike shed into an outdoor study space to experience the sensorial aspects of the rain while still being sheltered.



Figure 21. Before and after implementing our design elements to the outdoor study space.

Space

The design proposal will completely transform the space by opening up the northern part towards the pond. This will create an easier access to the area and make it look more welcoming. By changing the function of this rather large structure from a bike shed to an outdoor study space, the space will allow for more people using and visiting it throughout the day, increasing chances of interaction.

Flows

By taking away the function of the bike shed, there might be a lack of bike parking. This can easily be solved in other places though. The fact that the shed is barely used indicates that people do not see the need of a covered bike parking spot.

Environment

As for now, this design element does not affect the environment to a larger extent.

Rain Gothenburg

The design proposal addresses the main aspects of Rain Gothenburg in the following ways:

- Make use of the rain, see it as a resource
 - It makes it into something to experience – to listen to and to watch.
- Create environments where one can reside despite rainfall, no matter the age.
 - It provides a sheltered space.
- Create environments that benefit the society, both regarding social aspects but also environmental
 - It benefits social aspects as it allows for more social interaction outdoors.

Campus development goals

The design proposal relates to the campus goals in the following ways:

- International knowledge environment at the forefront
 - Creates an environment which allows students to study outdoors, which benefit their health and their learning.
- An attractive habitat which contributes to human well-being
 - Creates an environment where students can come to take a break and reduce stress. Thus, contributing to human well-being.
- Responsible and effective use of facilities, land and other resources
 - The current use of this space was poor. By implementing our design proposal, the space is better used. The green roof is also a way of handling an important resource, namely the water.

Sustainable Development Goals

The design proposal relates to the SDG:s in the following ways:

- Industry innovation and infrastructure
 - The outdoor study space could become a test bed for future outdoor study spaces on campus.
- Climate action
 - By reusing an existing structure, we reduce the need for new materials, thus reducing the impact on the environment.

Respondents

The design proposal addresses the main themes of the respondents in the following ways:

- The current roof is made of metal which enhances the sound of the rain, something that was appreciated and sought for by the respondents.

4.3. Element 3: The pond

This design element proposes to transform A-dammen into a stormwater basin. That would mean to lower the current border of the pond to match the street level and make the pond deeper in steps of 0.5 meter to house integrated seating. The pond will be prolonged to meet the edge of Geniknölen on one side and the edge of the outdoor study space on the other. In addition, the basin would be made narrower to house more grass areas and wetland plants on the west side of the pond. Wooden, pedestrian bridges would be added to cross the pond.



Figure 22. Before and after implementing our design elements for the pond.

Space

By prolonging the pond to connect to both Geniknölen as well as the new outdoor study space, we get rid of large, under-used areas and create a more integrated space - we “develop the green space” as mentioned in the campus plan.

The water square will also offer seating areas in a higher degree than the current layout. By creating several steps down to the pond, we provide more seating areas and greenery regardless on the height level of the water.

The new, permanent bridges crossing the pond should be designed and built by ACE students, perhaps in relation to Chalmers Structural Design Challenge. This would be a great entrance and physical representation of the innovation and multidisciplinary that ACE wants to stand for and would be so not only for a week every year – but all year around!

Flows

By prolonging the pond, we minimize the spaces for crossing from the SB building to Sven Hultins Gata. This is solved by the bridges crossing the pond at several places. These bridges could be positioned where the need for crossing is the most, thus making the flows as efficient as possible.

Environment

The main function of the design proposal is to create a water square with the ability to capture stormwater runoff. By capturing stormwater runoff, the stress on the municipal sewage system could be reduced. Added greenery would have the same effects. The current layout separates A-dammen from Geniknölen, which the proposal aims to remove. By doing so, the area of stormwater capture which is now limited to only Geniknölen will be extended.

Rain Gothenburg

The design proposal addresses the main aspects of Rain Gothenburg in the following ways:

- Make use of the rain, see it as a resource
 - The rain gets collected to become an aesthetic feature.
- Create environments that benefit the society, both regarding social aspects but also environmental
 - The added greenery relieves the municipal sewage system. It also benefits the living conditions for animals and insects of different sorts.
 - The added seating provides more spaces for interaction.

Campus development goals

The design proposal relates to the campus goals in the following ways:

- International knowledge environment at the forefront
 - Addressed by creating new places to study outdoors but also taking important study-breaks, which enhances the learning.
- An integrated part of the city with its own characteristics
 - The developed pond could attract more visitors such as nearby residents, not only students on campus.
- An attractive habitat which contributes to human well-being
 - The proposal creates sensorial experiences that enhances the sound and views of the rain and water.
- A green campus that enhances ecological values
 - More greenery and a more natural habitat for animals can enhance the ecological values that the campus creates.

- Responsible and effective use of facilities, land and other resources
 - By extending the pond in a northern direction we can make better use of the unused space between A-dammen and Geniknölen. By doing to, we also increase the capacity of stormwater basin which will benefit the campus as well as the city in case of a heavy rainfall. The design also makes use of the collected water, providing a nice environment for people to reside in and for animals to live in.

Sustainable Development Goals

The design proposal relates to the SDG:s in the following ways:

- Clean water and sanitation
 - The water that is led to the pond is naturally filtered and cleaned.
- Industry innovation and infrastructure
 - The stormwater basin provides a showcase to be implemented in many other places.
- Climate action
 - The pond works as a stormwater capture zone, which addresses the issues regarding the climate changes.

Respondents

The design proposal addresses the main themes of the respondents in the following ways:

- The design creates a view towards water all year around, creating a sensorial experience asked for by the respondents.

4.4 Evaluation of proposals

The evaluation of the design proposals is based on how well they address the goals stated in the campus plan and by the UN. The evaluation is also based on the main identified Rain Gothenburg aspects and the respondent's opinions.

Even though not all proposals address all the goals and aspects, we consider them to have a sufficiently large positive impact to motivate the designs. They all provide the following location attributes:

- Providing meeting places
- Flood-resistant
- Good noise levels in general
- Close to nature/views towards nature
- Friendly, welcoming environment
- Outdoor workspaces/encouraging being outdoor/easy outdoor access

After completion, the respondents were yet again contacted and asked to assess the design proposals based on their previous perception of the project area.

Summary of respondents

- They are concerned with the safety of the wooden bridges.
- If they walk from an opposite direction, they cannot understand the word on the ground, but would rather prefer patterns instead.
- They might get wet from the rain, if we do not have a side protection at the study place.
- It is a pretty dark place for the study area.
- They generally like the idea of developing the pond, although they still would not want to be there when it is raining because the lack of shelter.

- They generally like the balcony with roof along the façade as it creates a place sheltered from the rain and is easily accessible from indoors.

5. Conclusion and reflection

Reflection on design proposal

The design proposal is limited in its depth and the number of iterations it went through. This was mainly due to the time constraints and coordination difficulties mentioned in the reflection of the process. Some ideas that were brought up during the creative brainstorming sessions did not have time to be implemented into the final design proposal, such as lighting and accessibility, which were two things brought up by the respondents when looking at our design proposal.

Furthermore, we could have included the stakeholders of this design proposal more in the process. By investigating the property owners of the spaces of our design area and asked them about their input, the proposal would have gained more depth and realism.

We could have developed the environmental features for the outdoor study space more, by adding greenery and examples of how the rainwater from the roof could be led to pond – which also would have developed the Space aspect and provided more sensorial experiences.

The rainworks on the path could have been developed to include more patterns rather than text, as we did in previous sketches of the design.

Impact of proposed solution

Global impact:

- Just as the water square in Rotterdam, mentioned in chapter 3.2.1, our proposal is a fairly new concept that has not been implemented at very many places. It could therefore serve as an example of a solution on a global issue – dealing with stormwater.

Economic impact:

- The economic impact is not something that we have taken into consideration during the design work. We can, however, imagine that the delay and storage of stormwater could lead to cost reduction in terms of sewage maintenance.

Environmental impact:

- The proposal would relieve the municipal sewage system.
- The proposal would add more green and blue areas to the site which would increase biodiversity.

Social impact:

- The proposal creates more seating areas for meeting and socializing, between Chalmers users as well as non-Chalmers users.
- The proposal creates an outdoor study environment that could create new ways of interacting in an educational environment.

Potential ethical aspects

The proposal does not touch upon any major ethical conflicts. It does not intrude on anyone's privacy or discriminate towards a specific user group. If the design proposal was taken further, issues regarding accessibility could potentially be investigated more – such as access to the bridges or the pond stairs if being elder or disabled.

Recommendations for the future

Further investigations and research should be carried out to measure the economic and environmental effects of the design proposals. As of now, the effects are speculative and in order to increase the incitement to apply them elsewhere, there needs to be concrete evidence of their positive effects.

Reflection on the process

Generally, we have been able to work in an effective way considering the circumstances regarding COVID-19. We have conducted most of our meetings using online services and without any major technical issues. We have used an online collaboration platform which has allowed us to work together but at the same time allowing us to work individually.

The biggest obstacle in the course has been time constraints. Given that all the members of the team come from different programs and year, it has been difficult to coordinate schedules. The lack of physical meetings might also have resulted in a less collaborative process. We only had one physical brainstorming session which was very rewarding, but perhaps not enough.

In the end, the design proposal was a very architectural and/or spatial intervention. This made it easier for Maja and Jonatan to contribute with design solutions, having experience in this area from their education. In a future project, to fully embrace the multidisciplinary knowledge, perhaps the design should have been in a field where everyone felt that they could contribute equally.

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Figure 1, 3.

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Figure 4.

Collage from Google Images.

Figure 9, 12.

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Figure 17.

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Appendix A

Question number	Question
1	What do you do outside when it is raining?
2	What would you like to be able to do, that you cannot do at the moment? Why can't you do that and how could you potentially solve that?
3	Do you enjoy some aspect of the rain, if yes, what, if not, why?
4	Is there any place where you like to reside when it rains? What attributes make this place appealing?
5 [after design]	In relation to your previous answers, do you feel we have addressed your concerns? If yes, in what ways? If no, what could be improved?

Question	Respondent 1	Respondent 2	Respondent 3
1	Nothing in particular unless I have to. Take walks, even though I get wet sometimes.	Stay inside and open a window.	Wear rain clothes or hiding inside. If im working outside with something important I don't mind the weather,
2	Nothing in particular.	Mountainbike without having to spend time cleaning. Living in an apartment isn't ideal for handling dirty bikes, Communal bike washing station outside the apartment.	I would like to earn money somehow...
3	Doesn't see the rain as a hinder, although it's not funny to get wet when you don't want to get wet.	Enjoy it when not having to leave the house. Sound and smell are soothing.	I like the sound of the rain, especially in the evening when im lying in bed and hear the rain on the roof.
4	Sit in the couch, watch movies with hot chocolate.	Balcony or porch because it gives the benefits of being inside(shelter) while still being outside and experiencing it.	I like to be in a cabin, or somewhere cozy.
5			

Question	Respondent 4	Respondent 5	Respondent 6
1	I prefer to stay indoors if it rains. I do however not have a problem if I'm out running and it's raining.	Use an umbrella; mainly transporting myself from point a to b (places sheltered from the rain, that is).	Usually when I'm on my way somewhere, or if I'm exercising outdoors.
2	You can do most things, it's just less nice. But BBQing is hard because the fire is put out. Solve – BBQing under a roof.	To walk without my shirt when it's raining, that way keeping it dry. Would need to move a few thousand km south for that to work in November, though.	Don't feel hindered to do something just because it rains, but a promenade in headwind and side rain in November is not very nice...
3	I don't like any rain because you get wet and cold.	It depends on the circumstances. When I'm inside, I like it. When I'm prepared for it and dressed accordingly, I can enjoy it outside as well. Summer rain can be really great. And really heavy downfall - who doesn't like extreme weather? What I don't like, though, is getting caught by surprise by it - which happens more often than not.	50/50, it depends on the kind of rain! And if it's cold outside and how much wind there is. Side rain is never fun.
4	I don't mind being indoor behind glass, it's still very pretty to see the rain!	In the sea or a lake (during the summer) - when you're already wet you might as well add some extra drops. Otherwise, I like structures and sculptures that are collecting or actually using the rain in some way to create an experience or display. Similarly, streams and temporary water falls that are formed in the nature are very appealing; moving water in any form, really.	I love bathing in a lake or the sea when it rains! You experience the water differently then I think. Usually, the water feels warmer. Another nice thing is being under some kind of roof protection and hear the rain and smell it. It's also nice to sleep in a tent when it's raining.
5	I said I prefer to stay indoors when it is raining, and I guess you considered that by using the bike parking as a study space.	Great quote on the path - it's about attitude above anything else! I also like the small pathways across the water, bringing you closer to it in a playful way. My only concern is how you protect the wood from getting slippery when wet - from the illustrations you get the feeling that it's more or less 50/50 that you'll manage to get across the pond without falling into it (although that's maybe the point?). Additionally, the plants introduced by the pond contributes a lot to a "natural" feeling, in that way making the water site more attractive. Me like. My final comment is that the adaptations and changes you've suggested clearly contribute to making it a more attractive place when it's raining - but also when the	

		sun's shining. Thus, by designing for rainy conditions, you've enhanced the place overall! Well done!	
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Question	Respondent 7	Respondent 8
1	With a hat on my head and with my hands in my pockets I may not even notice it.	I go inside.
2	Experience the sound, smell, and view of rain when I work at my computer - Do not want to risk getting my computer wet. But with proper weather protection, like a small glass roof or something big as a conservatory, it would properly not be a problem.	I'd like to travel, but I need money, company and there are corona restrictions.
3	The non-rhythmic sound of rain hitting a surface and the smell of wet dirt are very relaxing and enjoyable, it enhances the refugee experience. At least when it is not too intense. Also to watch the sudden flow of water, formation of puddles, and how it all drains away are always enjoyable and an awe-inspiring reminder of all the natural systems that we are a part of.	I like the sound of it, as long as I am inside.
4	Being outside under a roof or shelter and experience the rain without getting wet myself. Preferably sitting with a blanket and a hot cup of coffee.	Fireplace, comfy sounds.
5		<p>I think is a cool idea to create a pattern on the ground</p> <p>The pond is no different in the existing pond for me.</p> <p>When it is a heavy rain and wind day, I might get wet anyway.</p>

Question	Respondent 9	Respondent 10	Respondent 11
1	I prefer not going outside.	Depends on how heavy the rain is. If it not too much I still travel to my destined place.	If unsheltered: move, walk from point A to point B under an umbrella, walk with raingear on. If sheltered, possible to reside longer, sit under a roof or a tree.
2	Cannot travel because of the COVID? And I can't do anything about that.	I didn't get the question.	Making an excursion or a longer walk, sitting outdoors where it is unsheltered, sit in the forest when it is wet. Solve: get better raingear, use outdoor sitting pad, use umbrella, find a sheltered spot to sit.
3	I enjoy the rain when it is warm and bright,	Well, in India I used to like it more as the	I enjoy rain, as long as you are sheltered from getting wet and cold (raingear/umbrella/roof/staying indoors). The

	<p>the spring. But if it's rain plus wind and low temperatures, no.</p>	<p>weather would be cooler than usual. But here I don't like rain for any reasons just good that there's a rainbow sometimes.</p>	<p>sound and smell of rain is very nice, especially in the summer, and it is nice when the greenery gets watered and lush.</p>
4	<p>Museum and movie theatre used to be a perfect place in rainy days for me. Because usually after you spend several hours there, and the rain stops. And rainy days make you feel sad and down. Those places can make me focus.</p>	<p>I would like to sit in a cosy and warm place with some hot drink when it rains.</p>	<p>Underneath a shelter of some sort to protect you from getting wet, but that can still give you the positive effects (smell, sound). Underneath a canopy roof or a dense tree is nice.</p>
5	<p>I prefer the colour pattern more than the boring word pattern.</p> <p>The pond might be a good place in the summer.</p> <p>I think it might be too cold to work in the study area without a side protection</p>	<p>If I walk from another direction, I won't understand what the pattern means.</p> <p>I like the pond. I would go there when it is sunny but still don't want to go there when it is rain. However, I will sit at the study space because the sound might increase my productive work.</p>	<p>Looks like a nice feature for biodiversity at the campus. It is a nice thought to showcase where the water goes, it would have been nice to showcase how the water travels from gutters to the pond as well. Not so sheltered for spending time there when it rains though, it looks quite wet to sit in the greenery and the bridge looks a bit slippery when wet, so I wouldn't cross it a rainy day. But for sunny days it looks like a nice spot. Nice idea with a sheltered balcony outside the library – that library needs shading as well so it is a nice double solving of problems. I would rather sit here under the shelter and look at the pond when it rains than sitting next to the pond in the open. Maybe the canopy roof could go even further out so you don't get wet feet. The outdoor study space is also a sheltered space to sit outdoors in the rain without getting wet. I think I prefer the solution along the facade, because here you have to run through the rain to reach the shelter, and I think that place is pretty dark and not as nice being next to the parking lot. It feels a bit unprotected to sit there. It would be a nice sound on the roof though when it rains. Extending the pond could be a nice feature.</p>