BERSÅ

Beneath the leaves: A theatre in bloom

Lisa Davidsson

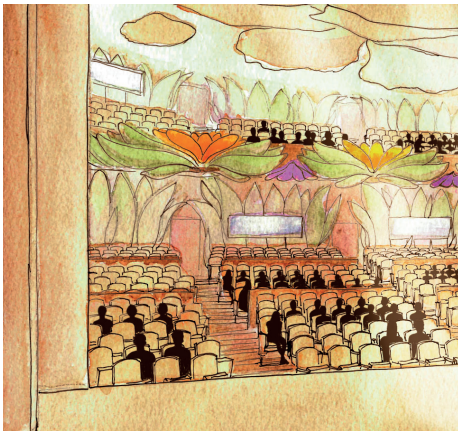
COURSE: ACEX15 VT25 - Bachelor Thesis in Architecture and Engineering
COMPETITION: Newman Award Fund Student Design Competition
SUPERVISORS: Morten Lund, Peter Christensson & Wolfgang Kropp
IN COLLABORATION WITH: Julia Bresin & Wilma Bertilsson

The Bachelor's project task was to design a theatre connected to a university campus. The task was based on a competition announced by Newman Student Award Fund, requiring us to consider both architectural and acoustic aspects of the design. Each proposal was developed by two Architecture and Engineering students in collaboration with a Master's student from the Sound and Vibration programme.

Chalmers University of Technology - Lisa Davidsson - 2025

COMPETITION

The final competition design was presented on three boards, communicating our architectural and acoustic design.



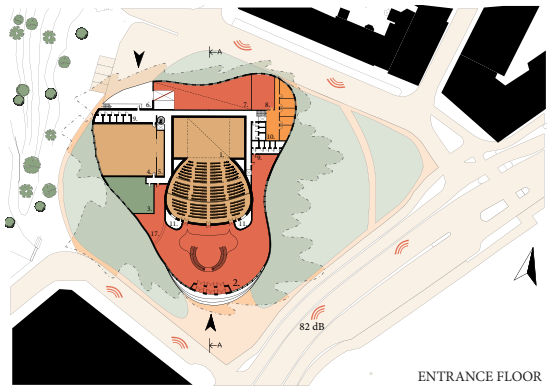
BERSÅ

ACOUSTIC CONCEPT

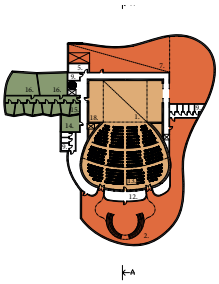
Step into the serene embrace of Berså, where lush greenery forms a natural sanctuary. Inspired by nature, the theater offers visitors a tranquil experience, with intimate, pavilion-like seating that enhances the sense of retreat. Floral and botanical motifs are woven throughout the design, from sculpted façade details to interior elements and the acoustic features of the auditorium. These ornamental flourishes not only enrich the space but also harmonize with the building's Art Nouveau aesthetic, creating an immersive and poetic atmosphere.

SKANSTORGET

We imagine that Berså is situated on Skanstorget, Gothenburg, where its tranquil atmosphere is disrupted by reflections, creating a hotspot of noise from passing vehicles. By integrating the building with its environment and utilizing the natural sound-absorbing qualities of the surrounding foliage, it was possible to introduce a glass façade in the rehearsal room, achieving both tranquillity and a scenic connection to the landscape. To meet the acoustic requirements of the auditorium, the lobby was extended along the auditorium's side, functioning as a buffer that shields the interior from traffic noise. Berså is partly submerged underground, which helps insulate the building from surrounding noise by minimizing the surface area that is exposed to exterior sound sources. By integrating corten steel with a gracefully curved roof, the building functions as an acoustic diffuser, effectively dispersing sound and softening the surrounding noise.



ENTRANCE FLOOR



PARQUET FLOOR

1. Auditorium
2. Lobby
3. Green room
4. Rehearsal room
5. Storage
6. Loading dock
7. Scene shop
8. Costume shop
9. Toilets
10. Offices
11. Spot booth
12. Light control room
13. Audio mix position
14. Wig and make-up
15. Solo dressing rooms
16. Dressing rooms
17. Wardrobe
18. Orchestra pit lift

NC 40
NC 35
NC 25
NCB 15

AUDITORIUM

The auditorium has a volume of 3500 m^3 and the longest distance between stage center and seats is 24 m. The theater's seating spans two levels. With the building partially submerged, the ground floor leads directly to the upper balcony, while the main seating area lies below ground. Seats are arranged in smaller clusters to create intimacy within the large space, allowing visitors to feel gently enveloped, like being nestled among flowers. The auditorium is decoupled from the rest of the building in a room in room design. The resonance frequency of the elastic foundation should be below 10 Hz.

REHEARSAL ROOM

The rehearsal room is decorated with flowers, similarly to the auditorium, that serve an acoustical purpose by absorbing, diffusing or reflecting the sound. The windows of the facade are angled to spread the sound and avoid unfavorable reflections. The dressing rooms on the parquet floor can be used for individual rehearsing. No wall runs parallel to the other to avoid flutter echo.

ROOF REFLECTOR

The flowers in the ceiling are adjustable in both height and curvature. They also serve an aesthetic purpose to let light from the windows through, mimicking light seeping through the treetops of a forest.

REHEARSAL ROOM

Lisa Davidsson

WALL PANELS

The ornamental panels that decorate the interior of both rehearsal and auditorium have acoustical properties incorporated in the design. They consist of three variations with a varied pattern. Larger areas contain the ability to absorb or diffuse to reach the desired reverberation time.

ORNAMENTAL WALL PANELS

ADJUSTABLE REFLECTORS

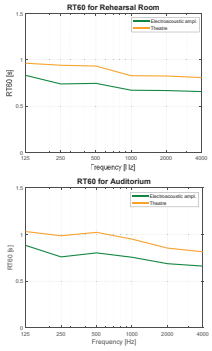
The leaves on the auditorium and rehearsal walls are designed to be adjustable. To adjust sound absorption, the leaves can be opened, closed, or positioned in between, revealing more of the absorbing surface as they open to suit the acoustic needs of amplified and non-amplified performances. A layer of paint is applied on the material to further enhance the ability to reflect higher frequencies while absorbing low frequencies.

OPENING OF REFLECTORS

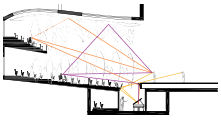
DIFFUSERS

Some of the leaves have a textured surface. They are covered in petals layered on top of the structure. These are placed at the back of the auditorium to subtly scatter the sound, enhancing the acoustic quality of the space by minimizing backward reflections.

DIFFUSER



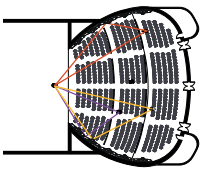
REVERBERATION TIME



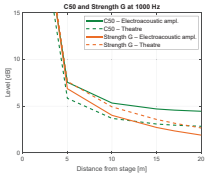
REFLECTION SECTION VIEW

ORCHESTRA PIT

The orchestra pit is a fixed, open space located beneath the stage, measuring 2.5 m in height and 3.5 m in horizontal depth. With a total width of approximately 13 m. The flower panels within the pit are designed with adjustable angles and surface properties, allowing them to both reflect and absorb sound depending on the acoustic needs. These panels help manage internal reflections and guide sound energy out of the pit and into the hall, supporting clarity and balance in the overall sound field. It shares the same reverberant field as the main hall, resulting in a more blended and natural orchestral sound. The geometry supports early reflection paths toward the audience, enhancing clarity and presence. When not in use, the pit is fully closed and used as additional audience seating, while also acoustically isolating it from the hall to meet stricter noise criteria for speech-based events.



REFLECTION PLAN VIEW



STAGEHOUSE

To avoid an influence of the stage house on the acoustic performance of the auditorium, the wall in the stagehouse are highly absorbing. The average absorption coefficient should be at least 0.5 for all walls over the entire frequency range.

TRANSMITTED SOUND

AUDITORIUM

In the auditorium it's consistently below NCB-15 for the whole frequency range. Some external noise, for example traffic, is transmitted through the structure up to around 125 Hz but still meets strict criteria for performance environments.

GLASS FACADE

The glass facade in both the lobby and the rehearsal room are double-layered. The thicknesses of the layers are not the same, resulting in different natural frequencies.

CEILING TO TECHNICAL

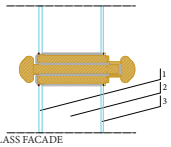
The MEPFIT area is located above the rehearsal room. The floor of the MEPFIT is built as a floating floor. The walls of the MEPFIT room are covered with acoustic lining which also is absorbing. All machinery has to be placed on springs to isolate them from the floors.

ELECTRIC AMPLIFICATION

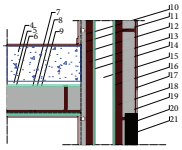
Loudspeakers are integrated into the ornamental flower elements on both the ceiling and walls. They are strategically positioned, some near the stage and others approximately 12 meters away, with a sound delay of 35 milliseconds to ensure even sound distribution throughout the auditorium. To further enhance dispersion, the ceiling-mounted loudspeakers are angled at 45 degrees.

REHEARSAL

In the rehearsal room it's well below NCB-15 across all measured octave bands. Some transmitted noise from MEPFIT is present below 250 Hz, but the overall isolation is sufficient to ensure the suitable acoustic conditions for rehearsal.



GLASS FACADE



CORNER MEPFIT

MATERIAL:

1. 10 Glass
2. Air gap
3. 7 Glass
4. 300 Concrete
5. Air gap
6. 12 Plasterboard
7. 195x45 Latch/ Insulation $600
8. 30 Latch/Air gap
9. 24 Plasterboard
10. Panel
11. 12 Plasterboard
12. 30x30 Latch/ Insulation $600
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15. Air gap
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17. Wood panel
18. 70x45 Latch/ Insulation $600
19. 90x45 Latch/ Insulation $600
20. 100 Mineral wool
21. Paint layer

LOBBY

Transmitted noise in the lobby remains below NC-35 across the full frequency range. Low frequency components from traffic noise are partially transmitted up to just above 250 Hz, but remain well under the set criteria levels for the lobby area.

CONCEPT

Step into the serene embrace of Berså, where lush greenery forms a natural sanctuary. Inspired by nature, the theater offers visitors a tranquil experience, with intimate, pavilion-like seating that enhances the sense of retreat. Floral and botanical motifs are woven throughout the design, from sculpted façade details to interior elements and the acoustic features of the auditorium. These ornamental flourishes not only enrich the space but also harmonize with the building's Art Nouveau aesthetic, creating an immersive and poetic atmosphere.

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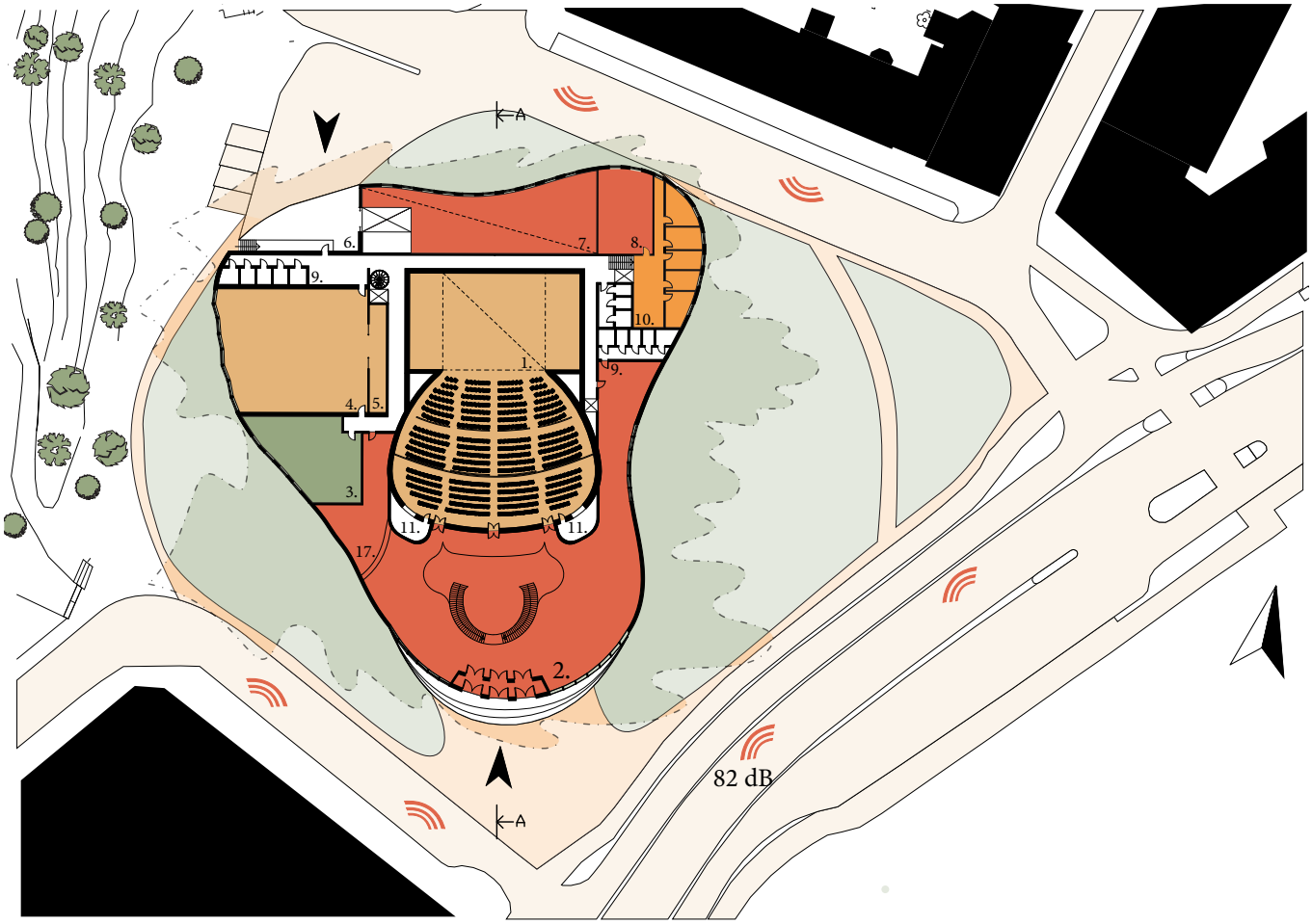

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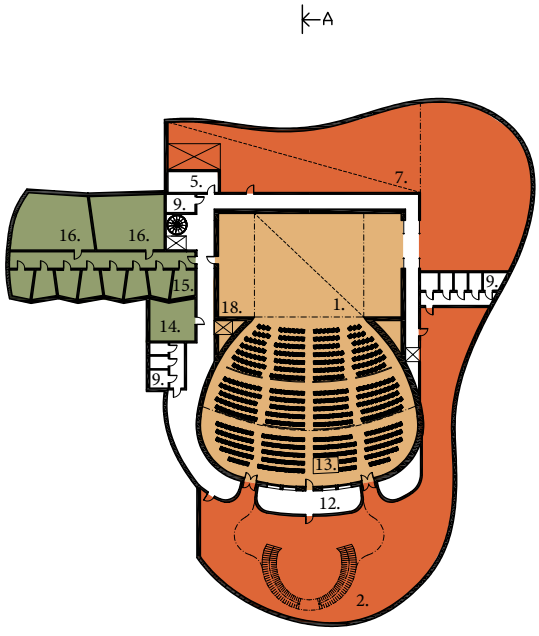

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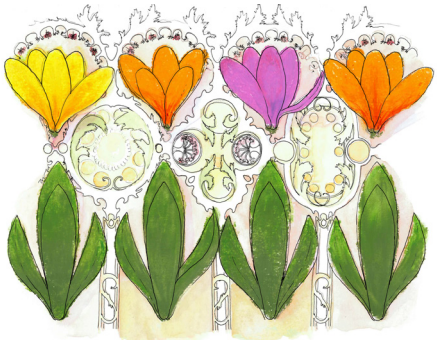

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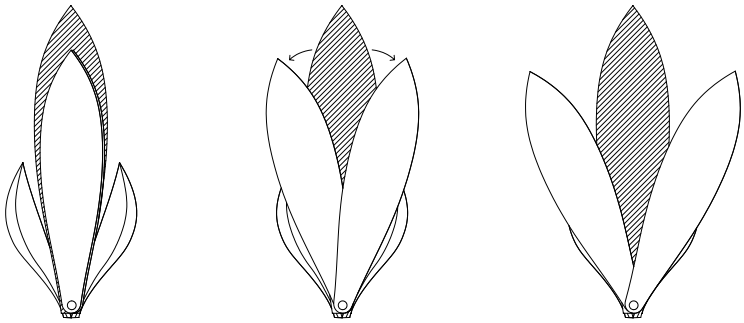

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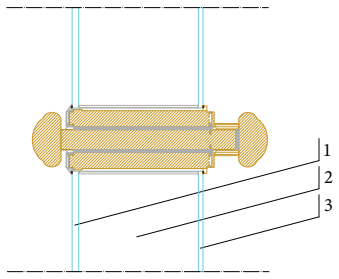

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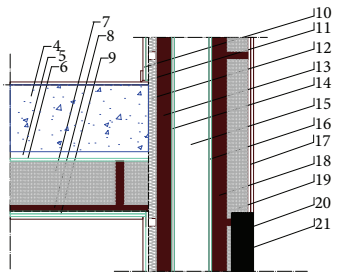

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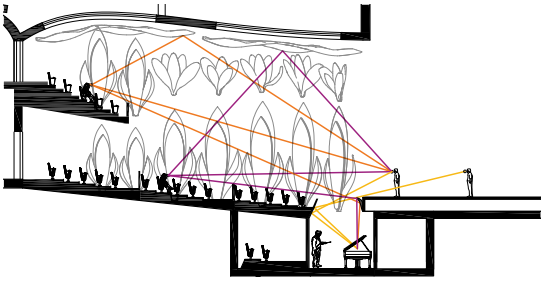
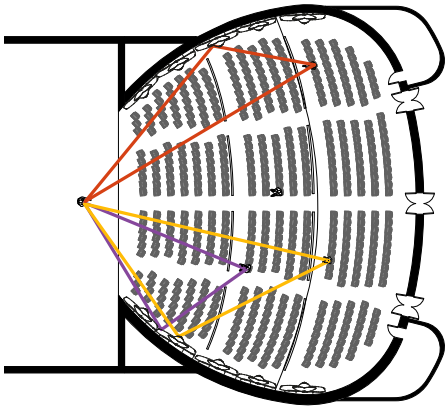
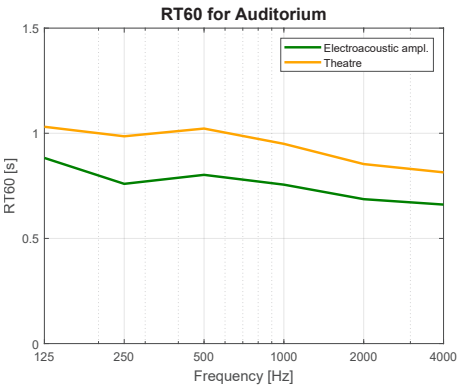
ACOUSTICAL PERFORMANCE

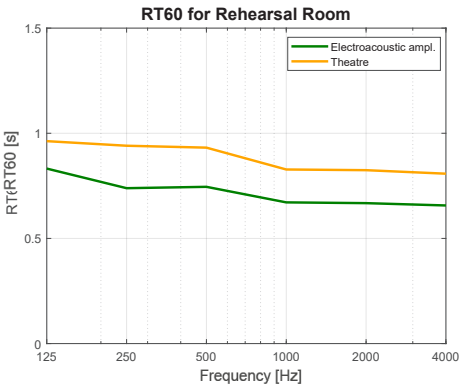


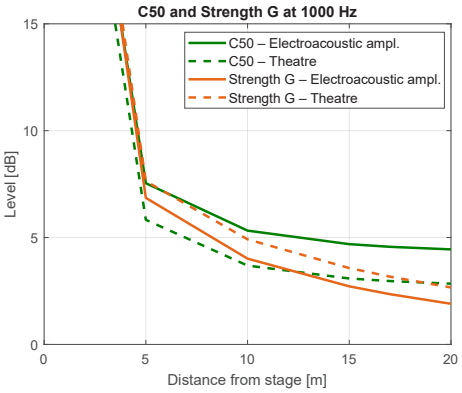
REFLECTIONS SECTION VIEW



REFLECTIONS PLAN VIEW

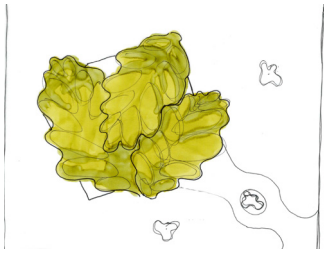




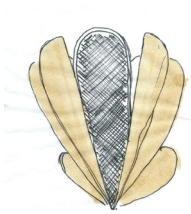


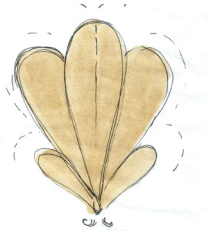
PROCESS

Iteration 1

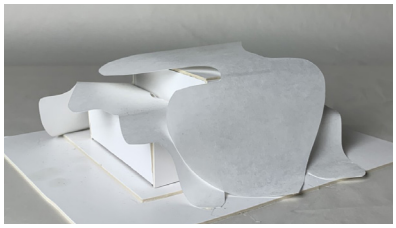


Iteration 2

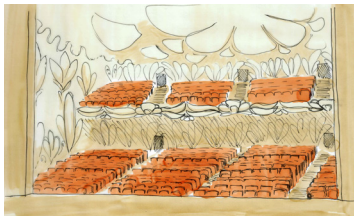




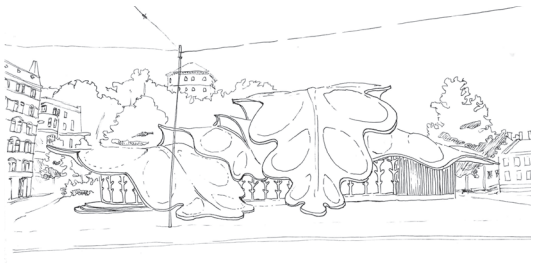
Iteration 3



Iteration 4



Iteration 5



An iterative approach
The process of iteration has been a great way to develop the project, and it's been very rewarding to see our printed boards evolve through many stages, while also receiving a lot of feedback along the way.

Aside from overall changes in between assignment-iterations we continuously used an iteration technique during the development of the project. By layering see-through sketchpaper we were able to quickly evolve ideas. Using this tactic we created an idea of the floorplan, the perspectives, the shape of our acoustic prototypes and the overall design of our posters. Because we had our hand-drawn versions to fall back on we could easily alter the vision in between iterations with the help from classmates' comments during the gallery-critics.

Improvisation
Using flowers as decorative and structural elements was one of our earliest concept ideas, and an idea that stuck with us throughout the entire project. What's interesting, though, is that through improvisation, our architectural concept evolved into an acoustical concept. The number of possibilities for the shape of flowers are endless, which meant that the shapes had a large potential of adaptability because of its organic nature. Therefore we could utilize the flowers' flexibility in a way that would allow us to adapt the space to almost any acoustic situation we wanted, as long as we carefully thought through our decisions.

Translating between different modes of representation
For this project, translating between different types of representation was very important, both for us to understand our structure and how it works, and to communicate the design we envisioned. With the Art Nouveau style, and the amount of ornamental details we used, especially in the auditorium and rehearsal room, we felt that it was hard to capture the feeling we wanted using only digital renders. We tried, but the renders felt like they lacked detailing and personality. So, we decided to draw the final perspectives by hand, which communicated our design much better. In other parts of the project, like plans and detail drawings, we used digital methods to clearly show the needed details. In the section drawing, we actually combined techniques. By creating a three-dimensional section and adding a layer of hand-drawn ornamental elements in the auditorium, we managed to convey a realistic atmosphere throughout the theatre.

One challenge we faced during the design process was the roof. We both had a clear idea of the look we wanted, but struggled to visualize and communicate how it would actually work. At that stage, building a physical model of the building gave us invaluable insights and helped us translate our vision into a drawing that could clearly communicate the design.

REFLECTION

Architectural quality
It was very exciting to bring together everything we've learned over the past three years into a single project, combining 3D-modelling, sketching, technical drawings, and physical model making. Julia and I collaborated in a way that allowed us both to use our strengths, which was essential to the final result. For example, I focused more on 3D-modelling and computational drawings, while Julia produced most of our hand-drawn visuals.

I am pleased with the outcome of the project. The proposal is quite unconventional, and through our collaboration, we ended up with a theatre very different from what I first imagined. The form might make it unlikely to be built, but working with organic shapes and being encouraged to think beyond the ordinary was incredibly rewarding. It also felt valuable to follow our concept consistently from start to finish.

Integration of technical disciplines
Berså is a very colourful building where aesthetics and acoustics are tightly integrated. Since our concept is based on organic motifs, flowers and leaves, it made sense to use colour both on the exterior and interior, inspired by the shades found in real plants. The colours of the exterior were chosen to blend into the surrounding environment, with lots of red nuances. Inside, we introduced natural light through the auditorium roof, where it filters in through flower petals, mimicking the feeling of sitting inside a berså.

What was especially interesting about our concept was how easily adaptable it was for the room acoustics. The ornamental flowers and leaves could be adapted in shape, size, material and angle to achieve the desired acoustic qualities. This flexibility meant we could tune the space without compromising the architectural idea.

Leadership
Throughout the project, Julia and I naturally took turns leading different parts of the process, depending on what needed to be done and who was best suited for the task. If this project were to be built in real life, it would require strong leadership and close coordination between many disciplines, due to the tight integration between architecture, structure and acoustics.

Sustainability
A key sustainable element in our theatre is the use of ornamental flowers and leaves that cover the walls of the auditorium and rehearsal room. These would be crafted by local artists using recycled or reclaimed materials, supporting both ecological and social sustainability. Our aim was to use reusable materials throughout the building and design a structure that is as material-efficient as possible to minimize the building's environmental impact.

Interdisciplinary collaboration
The interdisciplinary approach used in the Bachelor´s project was fun and eye-opening. It's easy to fall into familiar ways of communicating, especially within the AT-programme, where we often assume others understand our visual language and terminology. However, I think that working with, and getting feedback from, the Sound and Vibration-students made the final project more accessible to people outside the field of architecture. But, of course, there were challenges. At some points during the process, different ways of structuring work caused frustration, but it was solved by setting clear deadlines, and by encouraging open communication. In the end, the diversity of the perspectives definitely made the project stronger.

Future
I am very pleased with the decision to study Architecture and Engineering, because I have developed both my architectural and analytical abilities. I have also learnt to view projects from different perspectives, through combining constructive and materialistic knowledge with the architectural design process, to achieve sustainable and aesthetically pleasing projects.

During my studies, it has been interesting to work in an environment where thinking interdisciplinary is strongly encouraged. It has inspired me to continuously challenge technical solutions in the future, to find new ways to meet the needs of tomorrow.

In the future, I plan to pursue a Master's degree in structural engineering. This project made it clear that I want to work in a role where I can solve complex structural problems, like the roof in our design, without compromising the architectural design.