SHIPWRIGHT'S THEATRE

A Suspended Timber Shell Theatre

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Architecture and Engineering

Course	Bachelor's Thesis - ACEX15
Date	2025 Spring
In collaboration with	Amanda Karlstam & Maxence Grimbert
Supervisors	Peter Christensson, Wolfgang Kropp, Morten Lund & Lukas Nordström

Task

The Bachelor's thesis for Architecture and Engineering students consists of the annual architecture and acoustics competition organized by the Acoustical Society of America and the Robert Bradford Newman Fund. This year, together with master's students from the Sound and Vibration programme, theatres were designed.

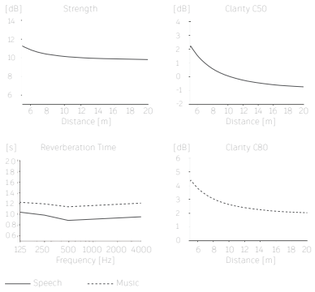
In the competition program, an arbitrary urban location was given, close to a campus with a strong connection to the intended theater. The theatre should be able to accommodate 700 guests. One of the biggest challenges in the project was to manage the given noise levels that surround the program area from all directions. Another aspect of the challenge was to be able to vary the internal acoustics to be able to adapt the acoustic environment to desired values. To succeed in the competition, good acoustic values were required in an architecturally high-quality format with innovation in focus.

Description

Shipwright's Theatre is a suspended timber shell structure proposed to be situated in central Gothenburg. Carrying inspiration from the city's maritime history and ship building culture the theatre graces the edge of the canal. Designed for optimal acoustics, the timber shell theatre hangs in a hall and is carefully suspended in a set of steel arches. The auditorium is primarily protected from outside noise through a glass shield covering the lobby arches. A custom sandwich element acts as a second defence against sound leakage into the hall, designed in a lightweight format, yet acoustically efficient. Structurally vibrations are minimized through the small propagation areas through the tensile bars lifting the hall. Together the structural and acoustical logics give the architecture its unique form and expression.

Exteroir

Result - Competition Posters



Acoustic Concept

Shipwright's Theatre is a suspended timber shell structure that combines exceptional acoustical qualities with innovative architecture. The suspended design eliminates vibrations from entering the hall by structurally isolating it.

The lightweight timber shell along with a protective glass shield, ensures optimal acoustic performance for the 700-seat theatre.

Acoustic Properties

The volume of the proposed theatre hall is approximately 3200 cubic meters, carefully designed to deliver optimal acoustics across a range of performance types. To accommodate both speech and music performances, the space employs variable acoustic strategies. The theatre is mainly designed for unamplified speech, aiming for a suitable 0.9 s reverberation time. The geometry of the hall is tuned for uniform sound distribution, and early reflections from the walls and ceiling ensure clarity and presence.

Location

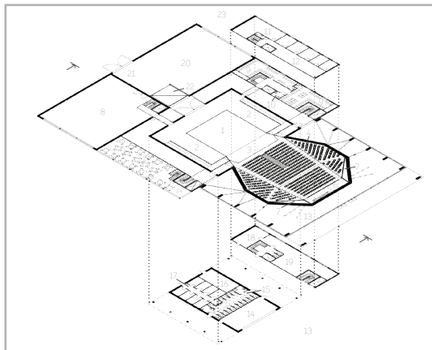
The proposed theatre will grace the edge of the canal in Gothenburg with a modern expression, drawing inspiration from the city's maritime heritage and shipbuilding history.

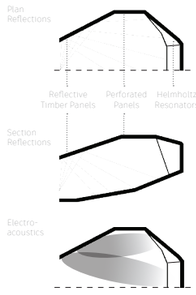
Located in a vibrant area, the theatre will benefit from its central position while effectively resisting noise from the surroundings, such as high-pitched emergency vehicles. The enlightened, hull-like volume can be enjoyed from the lobby, as well as from the park on the other side of the canal.

Construction

The building is a composition of timber, steel, glass and concrete. A conventional concrete core supports the stage tower and encloses the building's functional areas.

In the spacious lobby, large steel arches embrace the suspended timber volume. A refined composition of steel bars forms a stabilizing grid, while the lobby is enclosed by a double-glass shell. Steel bars are carefully connected to the triangular CLT-panels, providing support for the hall and stabilizing the arch construction.





NC-15
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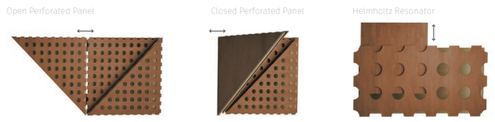


Reflections

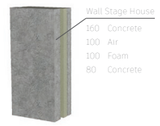
The geometry of the theatre hall is optimized to provide all seats with equal acoustic qualities. Reflective walls are positioned to supply the sides with early reflections, while the ceiling mainly reflects sound to the seats in the back. The maximal distance for direct sound is about 22 meters. Two loudspeakers are placed on each side of the proscenium to supply all seats while avoiding interaction. Directed away from the microphone, feedback to the stage is minimized as well.

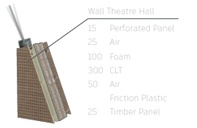
Variable Acoustics

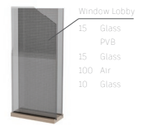
To ensure optimal acoustic performance for both speech and music, a range of adjustable elements has been integrated into the walls. Closable Helmholtz resonators are placed in the back corners, designed to target low frequencies. Foldable perforated panels are mounted on some of the reflective walls, allowing for targeted absorption of mid-frequency sound. Additionally, acoustic foam has been incorporated in the orchestra pit, the stage house and the hall to target high frequencies.

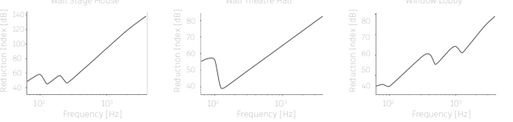
Ascension

Theatre guests congregate within the lobby, beneath the suspended volume. Shortly before the performance begins, a retractable hatch descends, ceremoniously inviting the audience to ascend into the theatre hall. Prior to the start of the play, the hatch is elevated and acoustically sealed, ensuring optimal sound isolation.









Wall Prototype

A custom sandwich panel system has been developed to provide effective sound isolation and minimize vibration transmission, all within a lightweight structure to reduce the suspended load.

The wall elements are interconnected and anchored to tensile bars that link to the arches. Due to the bars' minimal surface area, only limited vibrations can propagate through the walls. Any remaining vibrations are dampened by friction rubber. Thick CLT panels serve as sound insulators, while perforated panels are installed on the exterior to absorb noise in the lobby.

Rehearsal Hall

To replicate the acoustic environment of the theatre hall, perforated panels are installed to absorb sound. The panels consists of holes in various dimensions to target a broad frequency spectrum, and can be flipped to adjust the acoustic properties of the room.

The design prevent flutter echoes by using a strategic pattern of wall absorbers, avoiding any directly opposing reflective surfaces.

The ceiling is fully covered with acoustic foam to effectively control high-frequency sound. The rehearsal also incorporates natural daylight through a high-quality window designed to minimize external noise intrusion.

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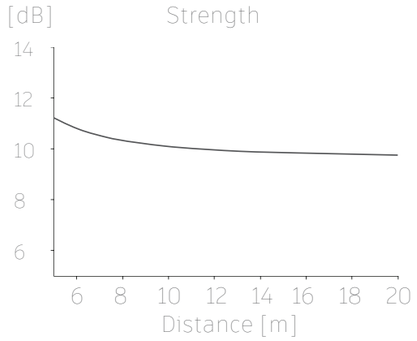
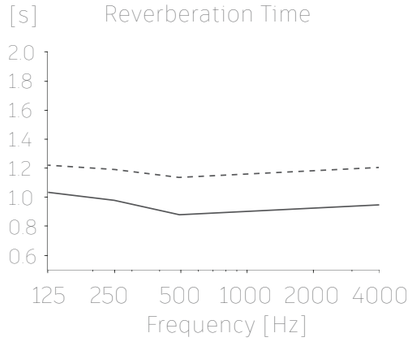
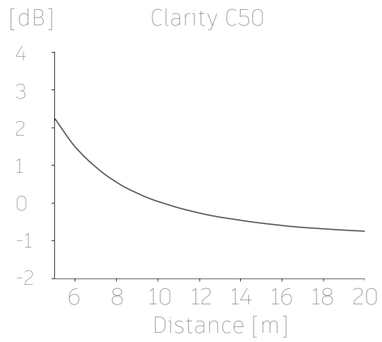
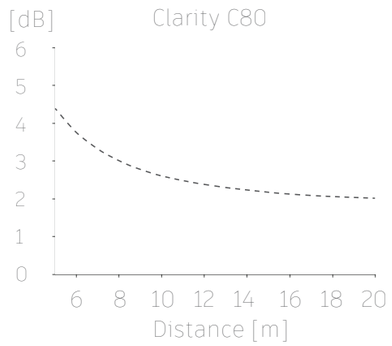
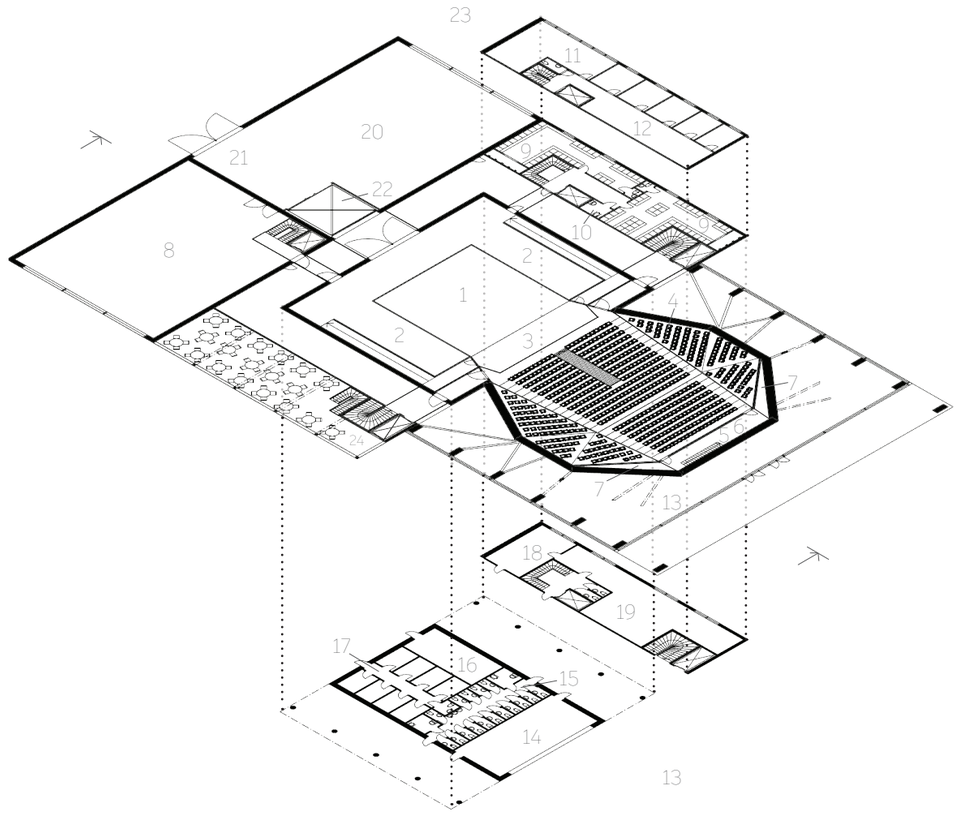








Speech Music



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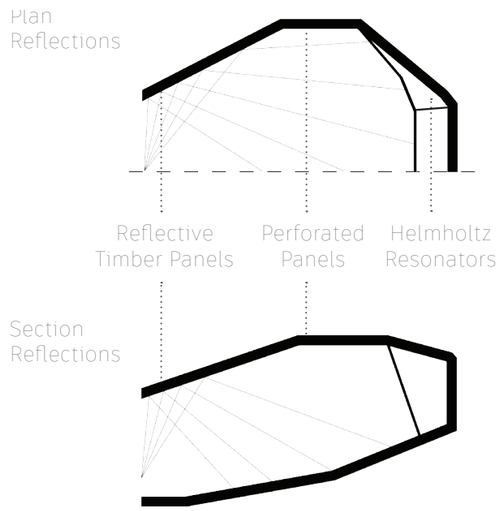

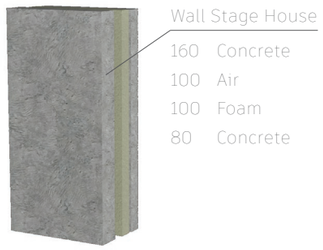

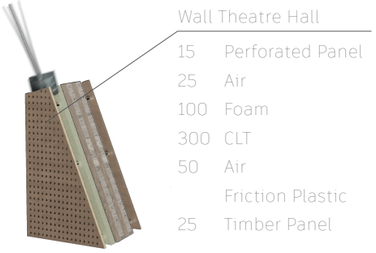

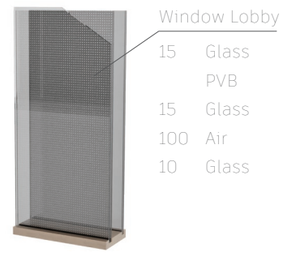

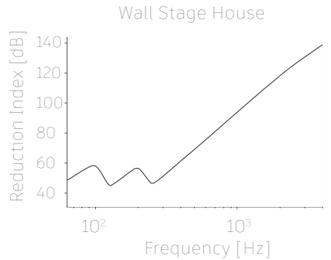

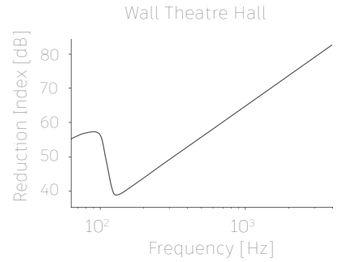

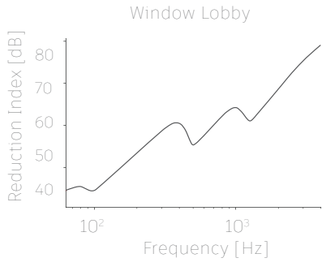

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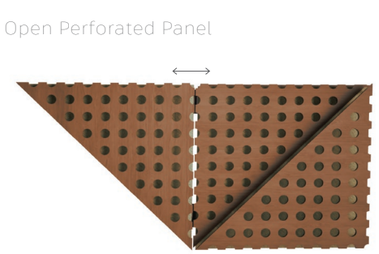
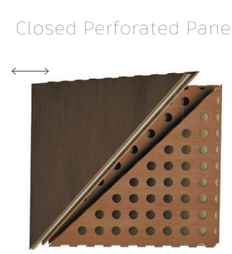
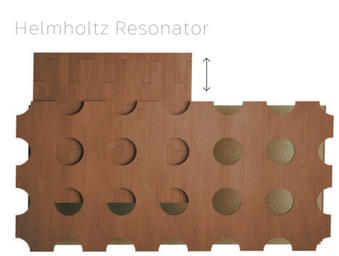
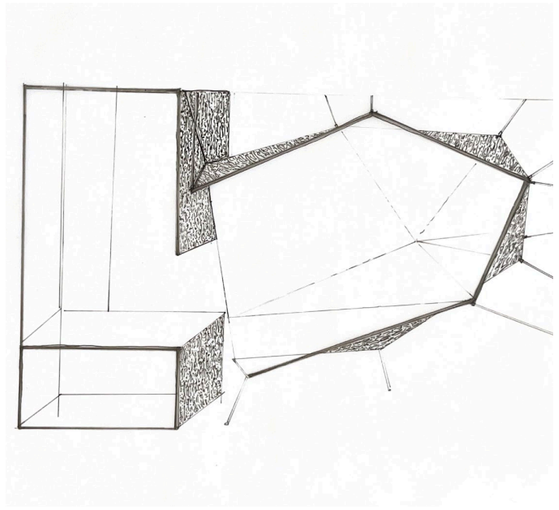






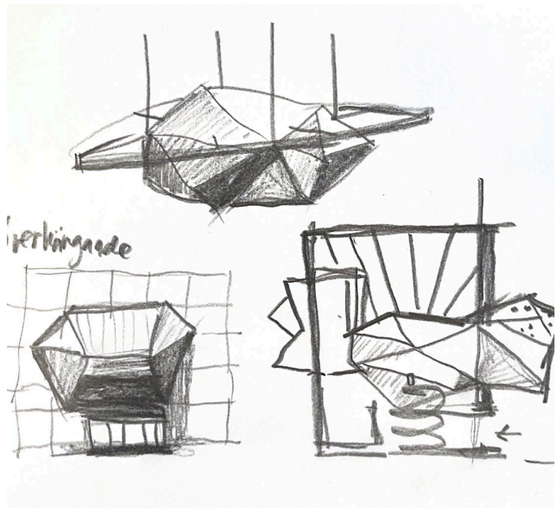
Improvisation

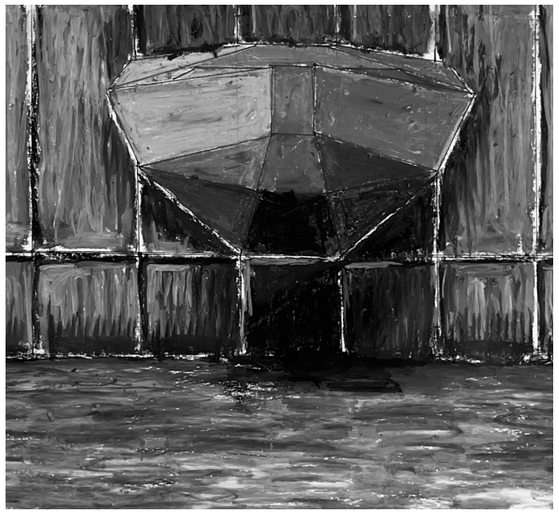
In the beginning of the project, we took an early interest in suspended structures. We liked the architectural concept and its structural challenge, a textbook example of an Architecture and Engineering program project. The diversity of the theme *Suspension* allowed us to create multiple drafts of how a theatre could be experienced. The first ideas were often conceptual, drawn in almost a fantasy style. Then we had to in one way or another translate wour architectural pictures into a realistic structural design. At the mean time we were investigating the context of where the building should be placed, and we managed to find a connection between relating the theatre to its surroundings with a suitable method of bearing. We took an interest in how ships are built and repaired and how large and heavy boats can be suspended in shipyards. The conceptual idol of an industrial shipyard also connected the buildings story to the city's maritime history.

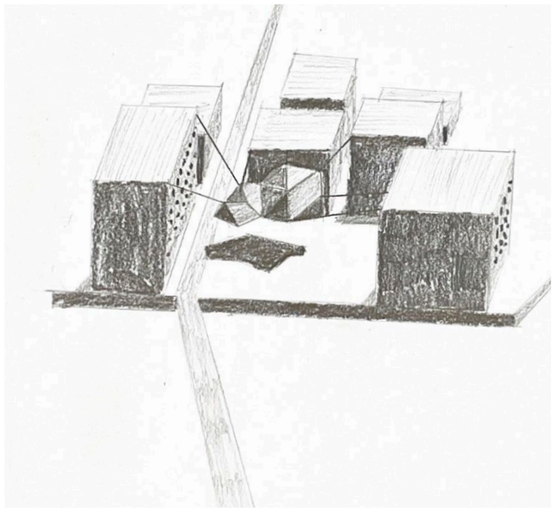


Itteration

During the course, we were regularly asked to present our projects to an audience. The structure of the course gave us the opportunity to test our ideas on external people. The format of repeatedly presenting the project within a relatively short time helped clarify the core of the project more and more. This, together with feedback and questions that arose during the presentations, helped us navigate the project. Setting clear frameworks for iterating the project proved to be an effective method for developing it.

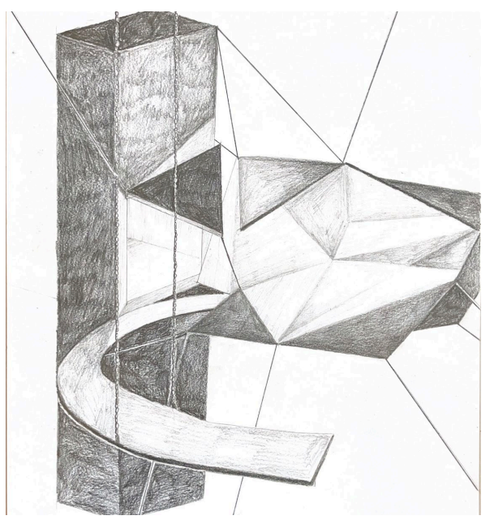


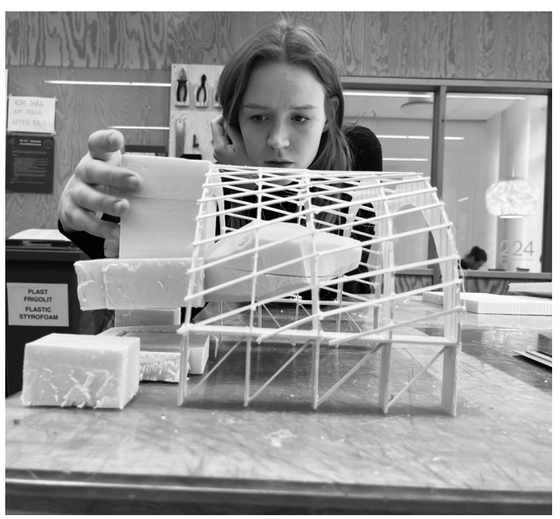




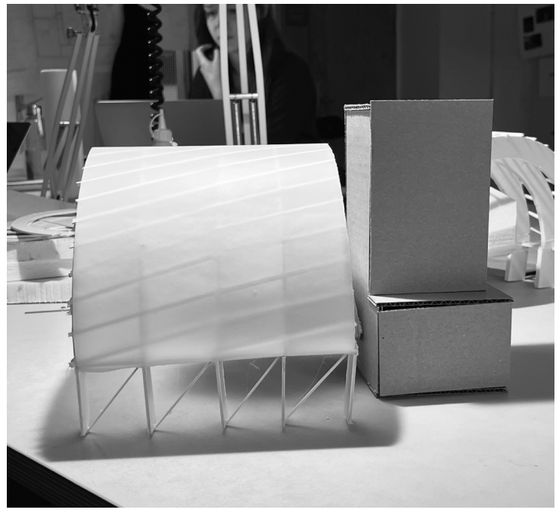
Translation

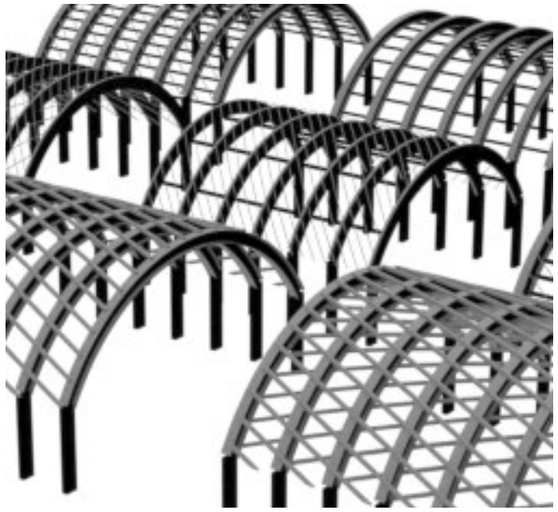
During the project we realized that the BA-project is not only about creating the most beautiful, green and realistic theatre. But primarily to find a concept that speaks to people and that the real challenge of the BA-project is to honor the concept throughout the process. To succeed, you have to in some way or another convince people of your idea. Especially when technical demands dispute the concept. We learned that translating your idea through different forms of mediums, in order to evoke affection, is a powerful method to justify the idea. This especially implies in a fictive format where there is no right or wrong and when you have to compromise between different professions.





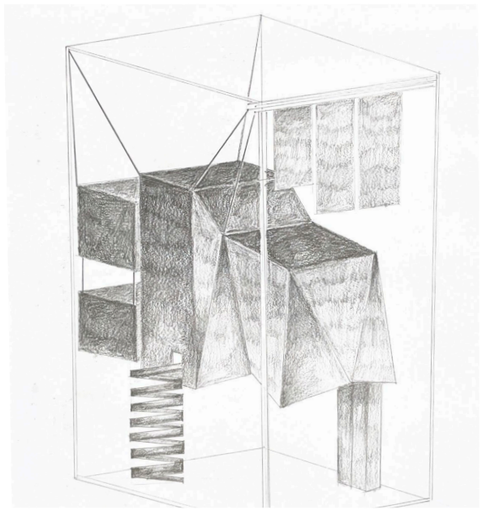
Translation is not only important to formulate the concept towards an outside viewer, but it is at least as important inside of the group working on the project. By creating clear and impactful pictures, models or drawings, can the concept be efficiently shared. It is simply not enough to only discuss the concept, since we all imagine different things. By physically showing each other the concept, the project becomes more clear and in unison.

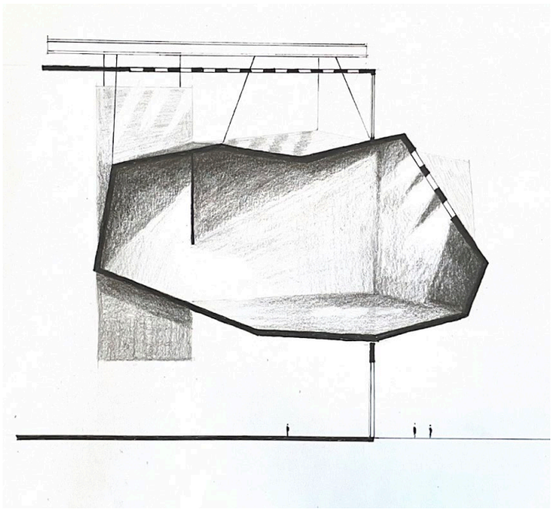




Architecture and Engineering

Of course, there are clear advantages to pursuing a traditional engineering program or a classical architecture degree. But after three years in the Architecture and Engineering program, I have come to appreciate the importance of understanding and managing all the disciplines involved in building design. This is a skill that typically takes years of professional experience to develop.





The program has equipped med with a holistic perspective, enabling me to leas construction projects and navigate conflicts where technical requirements challenge architectural visions. I have realized that structural challenges if fact is only architectural opportunities.

Naturally, over the course of my studies, I have developed a strong set of architectural ambitions and dreams. But recently, another question has taken up more and more of my attention: At what cost are we building?

Before starting this education, I had little interest in environmental issues. That has changed profoundly. We live in a time when our exploitation of the planet is clearly unsustainable, yet we live in a time when we have more resources than ever before to build in sustainable ways. In Sweden and nearby regions, major shifts in the construction industry have already taken place. Still, the world at large has a long way to go.

Looking back, I feel a sense of regret for having, at times, let architectural ambitions overshadow sustainability in my thesis and earlier projects. Learning to see beauty in the small-scale and the environmentally responsible is a lesson I will carry forward, to help build a more sustainable future.