Shipwright's Theatre

Minimal Vibrations

Bachelor Project Architecture & Engineering
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Chalmers University of Technology
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The Project

This project is a collaboration between the AT-program and the Sound and Vibration master on Chalmers. The description of the project follows the Newman Award Fund Student Design Competition.

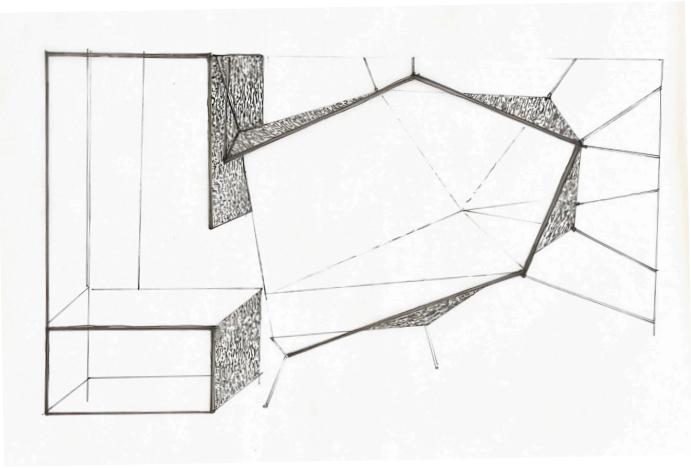
The task was to design a 700-seat theatre hall that combines architectural design with acoustic qualitites. The process included seven iterations with different focuses over an interval of eleven weeks.

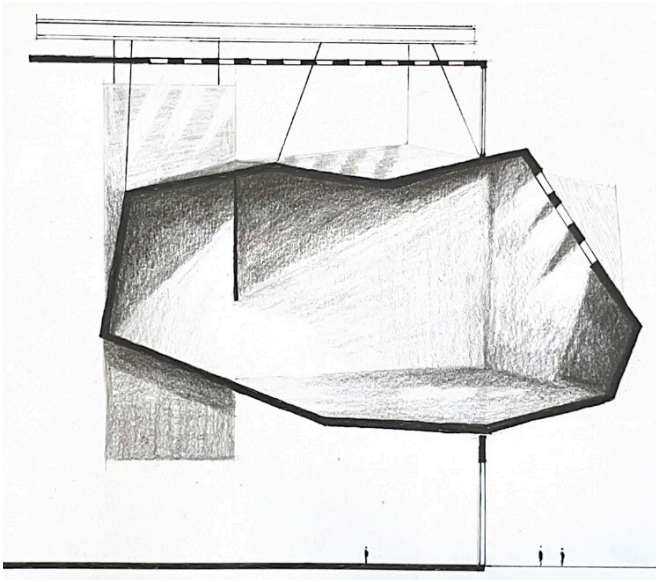
Course	ACEX15 Bachelor Project Architecture & Engineering
Group members	Maxence Grimbert, Amanda Karlstam & Karl Einar Sahlin
Date	May 21, 2025

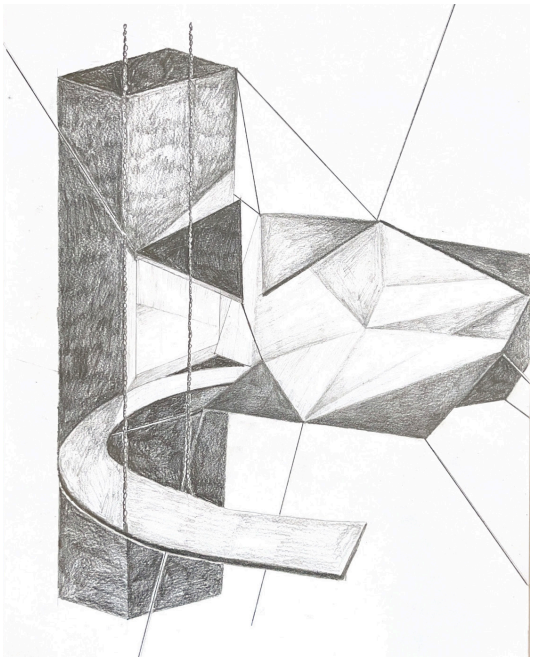
Concept

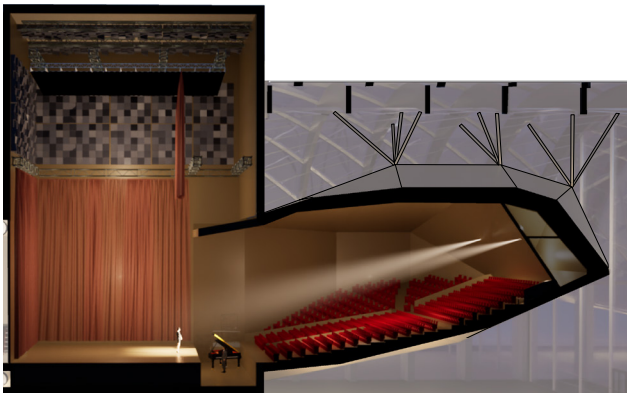
Shipwright's Theatre is a suspended timber shell structure designed to minimize vibrations from the construction. The minimal contact areas between the theatre hall and the construction prevents vibrations from entering the hall.

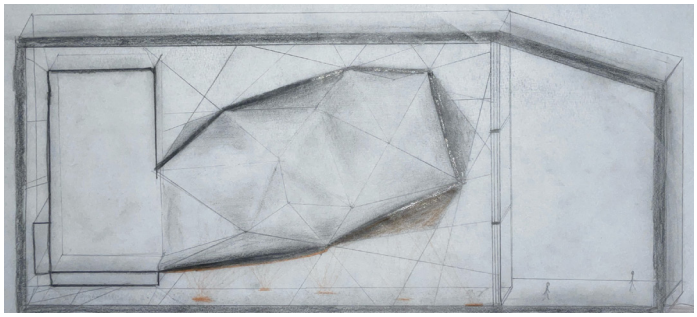
The idea to suspend the hall came up during an early stage of this project, and became our main concept throughout the entire process. We created multiple alternatives for the hall, with different kinds of suspensions, geometries and materials. The final result was a triangulated lightweight timber shell with valuable acoustic properties in both the lobby and inside the hall. Its geometry is optimized to provide each seat with equal acoustic qualities and to achieve the desirable volume.







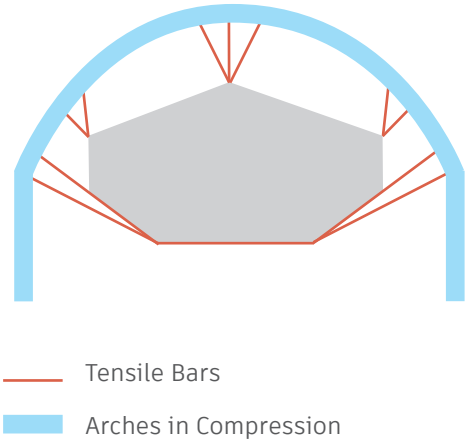


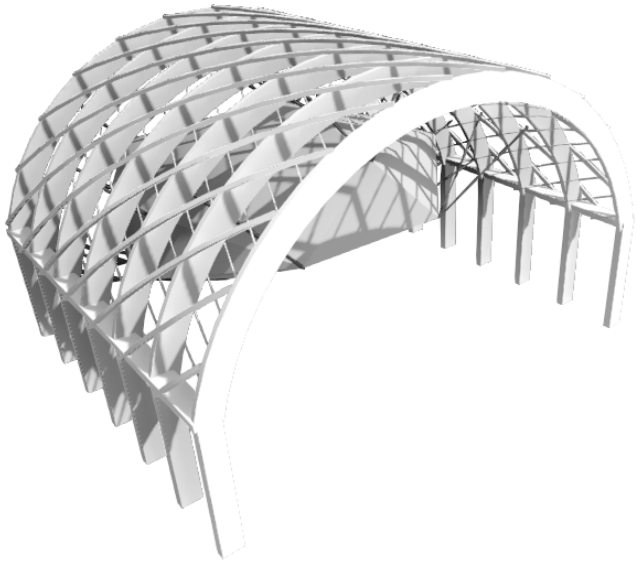


Construction

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.



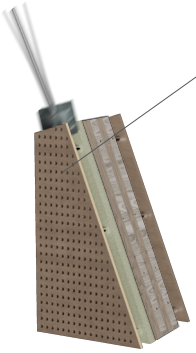


Location

The proposed theatre is located in central Gothenburg next to the canal, drawing inspiration from the city's maritime heritage and shipbuilding history. The enlightened, hull-like volume can be enjoyed from the lobby, as well as from the park on the other side of the canal.

Wall Stage House

160	Concrete
100	Air
100	Foam
80	Concrete

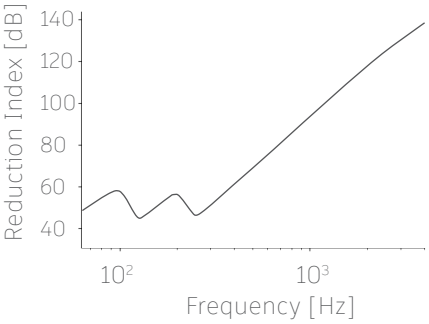


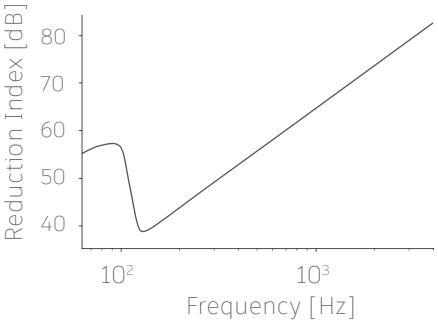
Wall Theatre Hall

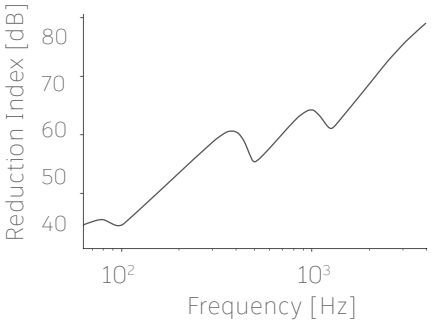
15	Perforated Panel
25	Air
100	Foam
300	CLT
50	Air
	Friction Plastic
25	Timber Panel

Window Lobby

15	Glass
	PVB
15	Glass
100	Air
10	Glass







Wall Prototype

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

The wall elements are interconnected and anchored to tensile bars with minimal surface area. Only limited vibrations can propagate through the walls, and 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.

Entrance

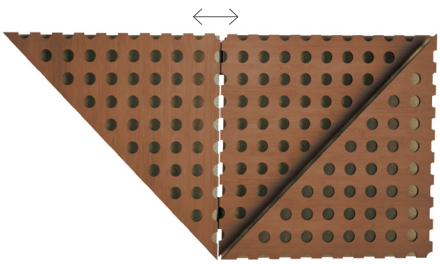
Theatre guests congregate within the lobby, beneath the suspended volume. Shortly before the performance begins, a retractable hatch descends, inviting the audience to ascend into the theatre hall. Prior to the start of the play, the hatch is elevated and acoustically sealed.

Two additional staircases are discretely placed in the wings of the building. Bridges connects the wings and backstage areas with the stage house.

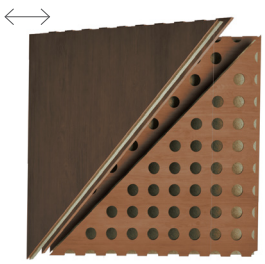
Variable Acoustics

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.

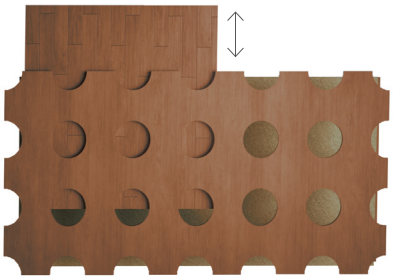
Open Perforated Panel

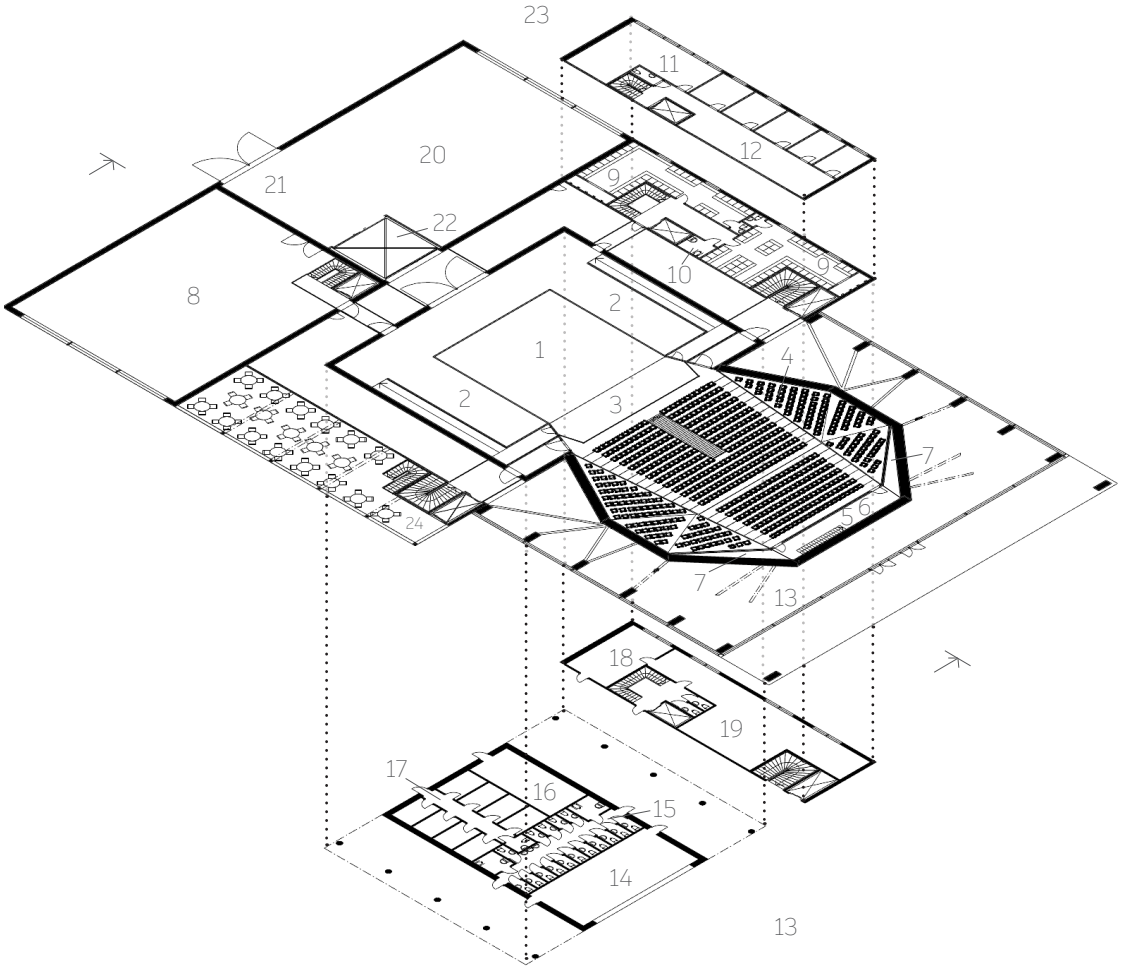


Closed Perforated Panel



Helmholtz Resonator





NC-15

1 Stage
2 Wings
3 Orchestra Pit
4 Audience Seating
5 Audiomix & Lightning
6 Follow Spot Both
7 Helmholtz Resonators
8 Rehearsal Hall

NC-25

9 Dressing Rooms
10 Off-Stage Quick Toilet
11 Green Room
12 Office Space
13 Lobby
14 Reception & Warderobe
15 Toilets
16 Prop Storage
17 Single Dressing Room

NC-30

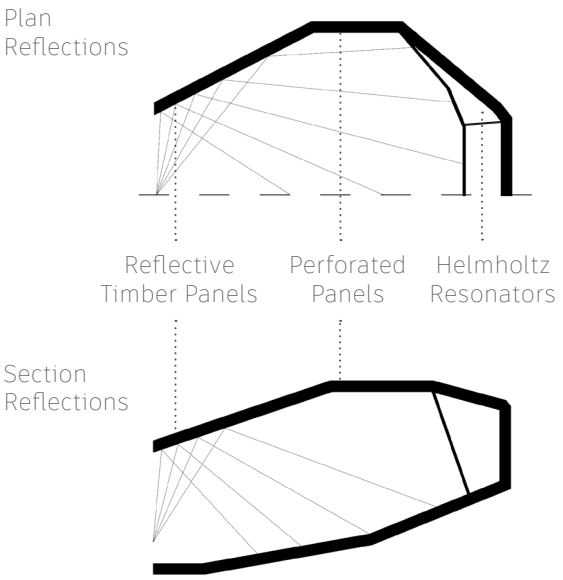
18 Wig & Make-Up
19 Costume Shop

NC-40

20 Scene Shop
21 Loading Dock
22 Industrial Elevator
23 MEPFIT
24 Café/Restaurant

Early Reflections

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.



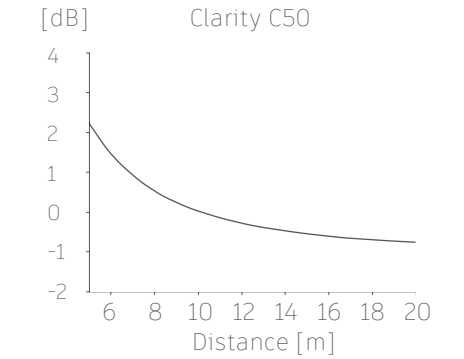
Acoustic Properties

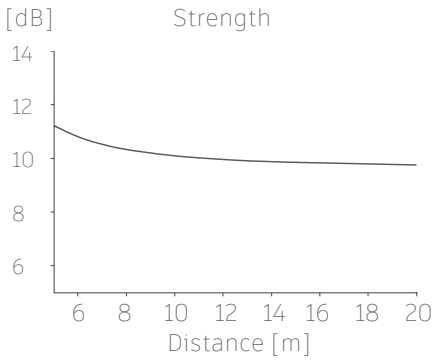
The volume of the proposed theatre hall is approximately 3200 cubic meters, constructed to handle different types of performances. The theatre is mainly designed for unamplified speech, aiming for a suitable 0.9 s reverberation time.

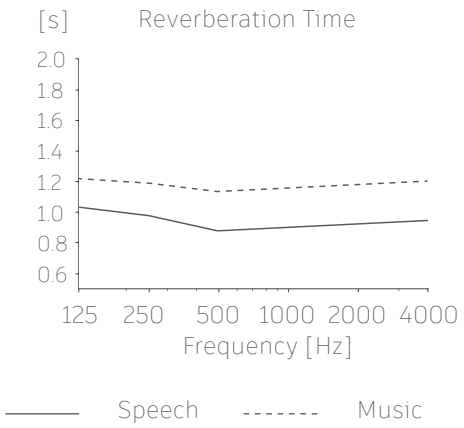
Rehearsal Hall

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.







Reflection

Overall a very interesting project with a process focusing on the three terms; improvisation, iteration and translation. The initial concept to suspend the hall was an improvisation that later on was developed to function, without trying to compromise on the main idea. By introducing grasshopper as a design tool early in the project, we were able to parameterize several parts of the building which made the iterative process very time efficient. We aslo translated our work between different presentation forms such as physical models, drawings, paintings and digital models. Not only did the translations help the design process, but also to communicate our ideas to each other in the group and to others.

Combining architectural design with technical solutions, this project summarizes the three years on the architecture and engineering program, and I look forward to start the architecture master after summer.