Year	3
Course	Bachelor's thesis in Architecture and engineering & Acoustics
Type of project	Opera house, Group project
Project time	15 weeks
Tools	Handsketch, Rhino, Grasshopper, Enscape, Indesign, Illustrator, Photoshop, AutoCad

Symphony of the trees

University Opera

Agnes Kullberg & Djamila Mamedova

Project

Create an opera house on a university campus that will be used for opera and speeches.

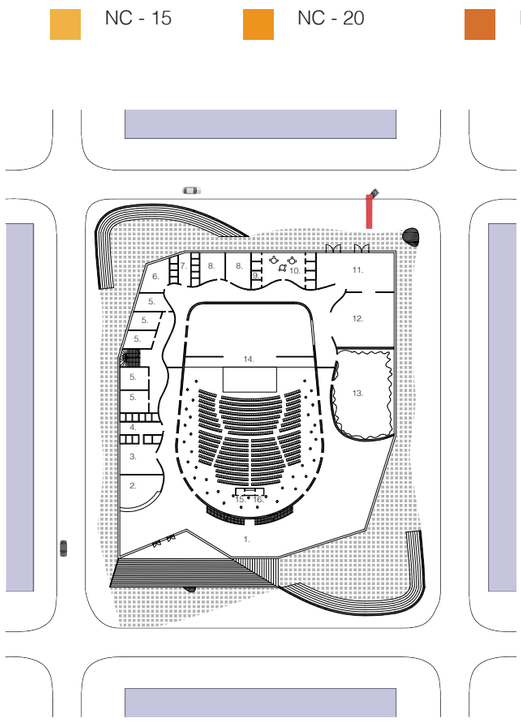
Description

Symphony Of The Trees is a building located on a university campus where the school can use it for speeches and opera performers can practice and host shows. It is of importance that the acoustics of the building are thought of, specifically the room acoustics, sound isolation and noise control. The opera needs to handle noise from the highly trafficked streets around it, therefor an outer shell blocking the outside noise from entering the building is preferable. Inside of the building the scene shop and mechanical rooms are placed close to the auditorium and rehearsal room. To achieve good acoustics in the building, and especially in the sound sensitive rooms, noise criterias are set up and well-isolated walls are used for the auditorium and rehearsal hall.

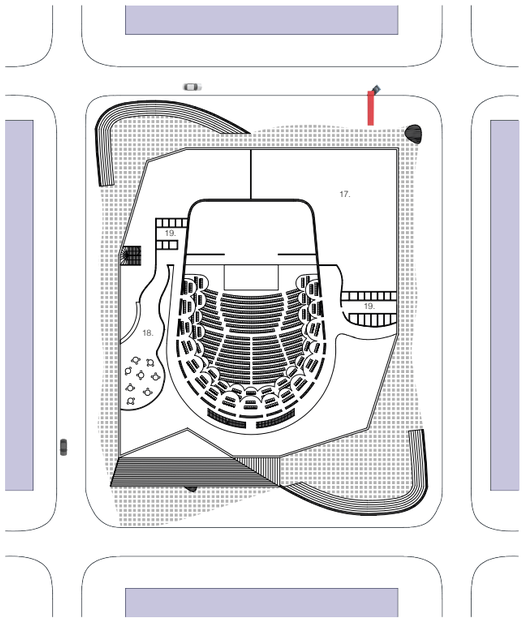
The auditorium needs to host 1200 people in a traditional seating as well as two levels of side and rear balconies. The reverberation time, strength and clarity are mesured to make sure the interior enhances the performances.

The building is designed to feel dynamic in it's choice of materials, design of the outer shell and the pillars with the balconies. In the auditorium the balconies and pillars are made to mimic the feeling of tree trunks with canopies.

A meandering path grows forth beneath curving walls of wood enveloping a rigid glass structure, inviting students and opera visitors to a rhythmic feast for the eyes and ears. The opera hall is adorned by tree like balconies, mirrored in the outside wooden shell. Symphony of the Trees is entered through a massive set of stairs, leading directly into the covered glass structure, which contains both the opera hall, and all of its attached amenities. The double facade acts as the first barrier against outdoor noise whilst also forming covered spaces, such as the speaker's corner, for all students to utilize as an extension of the campus.



PLAN, entrance floor



PLAN, third floor

THE WALK THROUGH PILLARS

The pillars are playfully strewn around the opera hall's edges with glimmers of light passing through, reminiscent of a glorious forest with dwindling lights shining through tree canopies.

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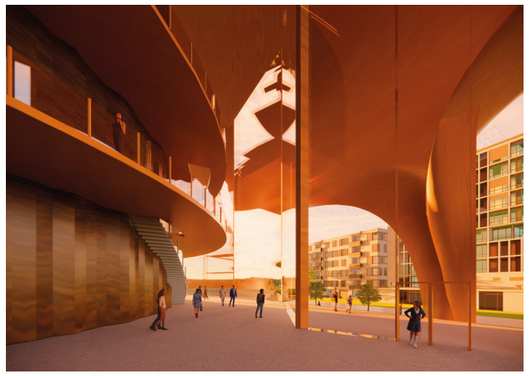

THE LOBBY

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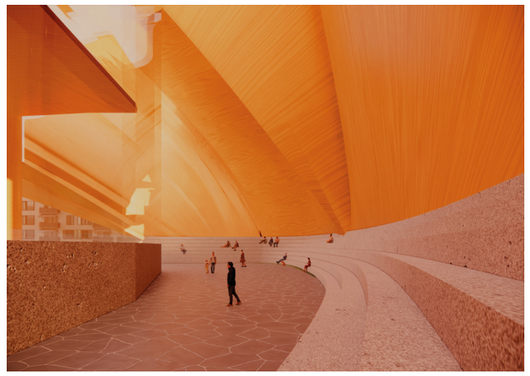
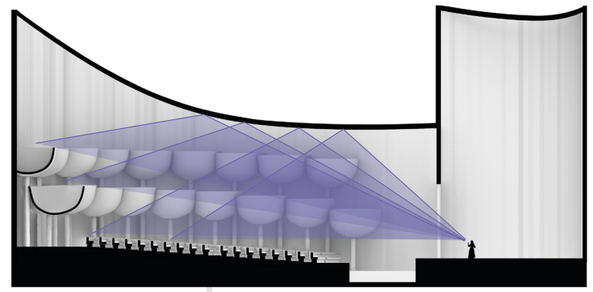


THE SPEAKER'S CORNERS

The outer wooden shell reflects noise whilst its curved faces form protected spaces for students and alike to gather in. Large sittable stairs interact with the shell's curvature, further cementing the outer organic shape of the building.

ACOUSTICAL VALUES

The ceiling is adjustable, ensuring different settings for opera and speech. During a set of classical opera the reverberation time is about 1.5 s. A strength of 3 dB and clarity of 0.5 dB is also achieved. For speech, when the ceiling has been adjusted a reverberation time of circa 1.0s is achieved, as well as a heightened clarity of 3.5 dB for improved intelligibility of the speakers' voice. The Strength is arbitrarily affected, only differing a few decibels.



REFLECTION

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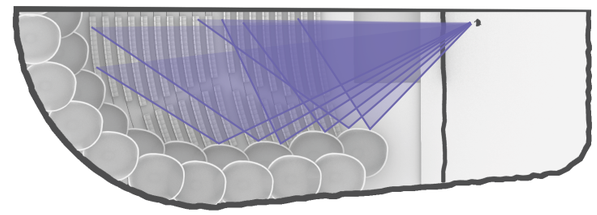
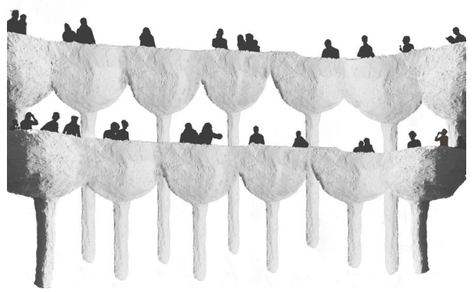


ABSORPTION

The pillars are attached below the balconies, and have Helmholtz resonators, of varying sizes, built in. They absorb frequencies between 50 and 200Hz, lowering the reverberation time at those frequencies.

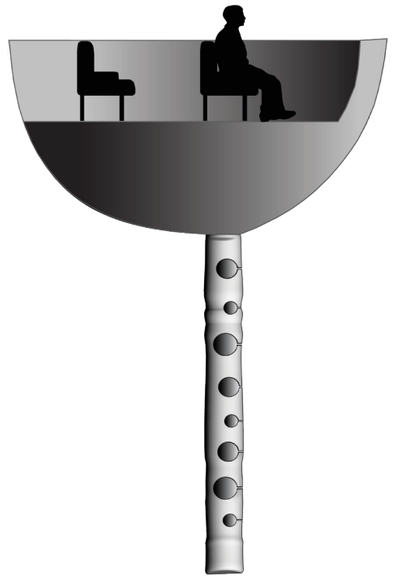
By surrounding the opera hall's edge, lingering frequencies in this range will be removed, increasing the clarity for a better understanding of the opera taking place. The pillars' wavy shape also help diffuse sound.

The seats are made out of leather, aiding in absorbing unwanted high frequencies of range 1000 Hz to 4000 Hz.



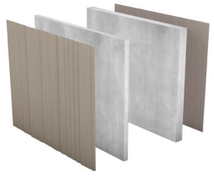
DIFFUSION

The curvy shape and texture of the balconies diffuse the sound of early reflections for audiences further from the stage, whilst a smoother surface towards the front reflects sound rays.



REHEARSAL HALL

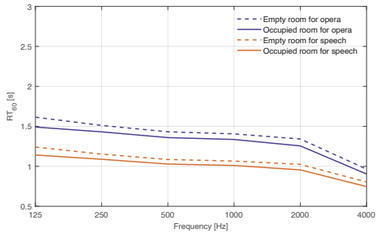
The rehearsal room's floor area is of similar size to the performance stage and enveloped by the same type of undulating diffusion panels. It is important that the acoustics in this room reflects the qualities of the performance hall. However due to its small volume, more absorption was necessary to subdue the reverberation time, but also to create a reasonable strength to avoid an overpowering sound. Cotton fabric has therefore been placed beneath the roof. The reverberation time lies within a range of 0.9 s to 1.1 s, depending on the state of occupancy.

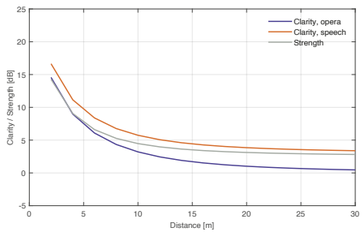


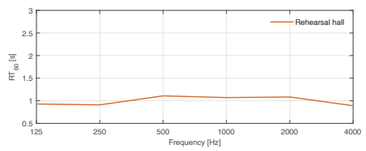
ISOLATION

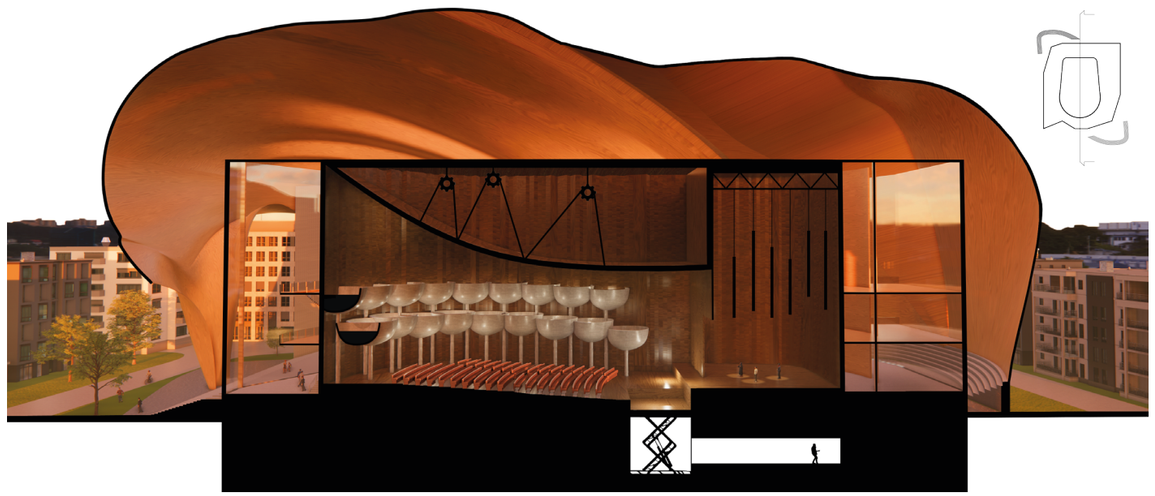
The walls are made up of irregular saddle shaped wood panels, ensuring no surface point is alike for scattering of sound.

The opera and rehearsal hall has a double concrete frame, filled with air to disrupt surrounding vibrations from entering or exiting. A single concrete frame is sufficient for the other rooms, coupled with the double glazed windows in the facade.



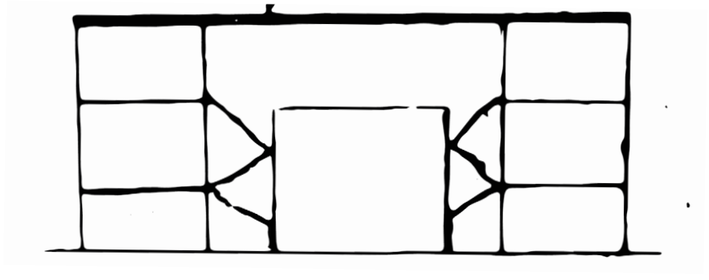




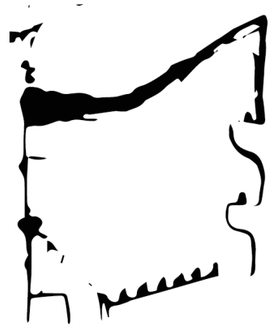


PROCESS

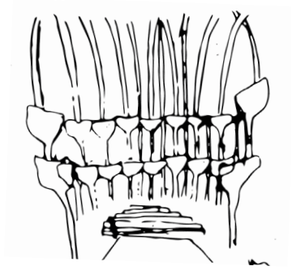
We wanted a glass facade that would show the floors and stairs. The concept for the balconies originated from pictures of trees and caves which then generated these sketches. To make the outer shell feel synchronized with the auditorium, the facade is organic.



First proposal of the building with the auditorium in the middle box surrounded by glass windows.



Section of the auditorium, showing the shape of the roof and balconies.



Perspective looking out from the stage.

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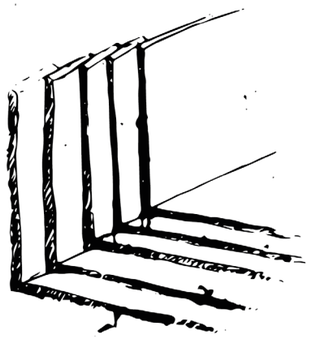
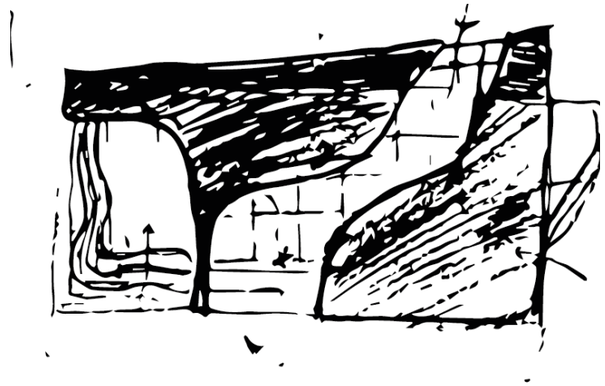


The concrete staircase that bends 90 degrees and continues into a wall.



A sketch of the front facade. It aims towards being organic and connect with the pillars inside of the auditorium.

Through out the project there has been design iterations followed by a critique. My opinion is that these iterations were helpful and pushed us to create concepts and ideas, that we could then evaluate during the critiques. We created concepts for both the inside and the outside which sometimes was problematic when we tried to converge these ideas. There was a time pressure which did not allow us to be investigative and instead make fast decisions, this was unfortunate for the design process.

The majority of the design process consisted of making charcoal drawings and hand sketches which enabled us to work fast and have discussions. We also made physical models and digital 3D-models with the help of a parametric tool.

SYMPHONY OF THE TREES

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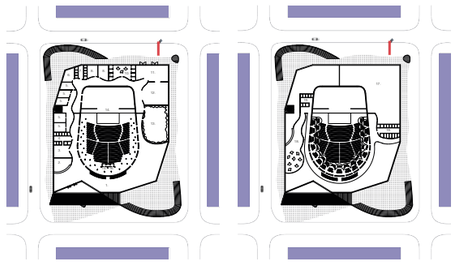
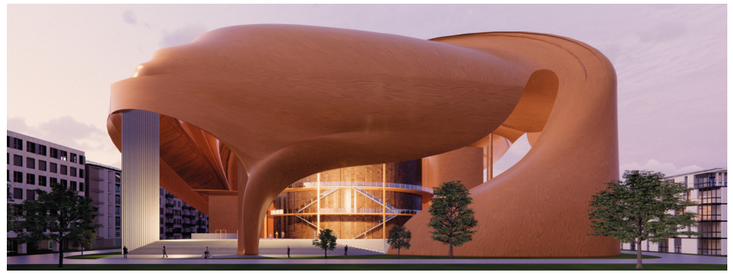


NC - 15 NC - 20 NC - 30 NC - 40

1. LOBBY
2. RECEPTION
3. WARDROBE
4. RESTROOMS
5. OFFICE
6. GREEN ROOM
7. RESTROOMS
8. CHORUS DRESSING ROOMS
9. SOLO DRESSING ROOMS
10. OPEN MEETING ROOM
11. LOADING DOCK
12. SCENE SHOP
13. REHEARSAL HALL
14. AUDITORIUM
15. LIGHTNING AND STAGE CONTROL ROOM & FOLLOW SPOT BOOTH
16. IN-HOUSE AUDIO MIX POSITION
17. MEPFIT-ROOM
18. CAFÉ
19. RESTROOMS



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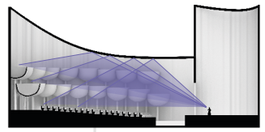

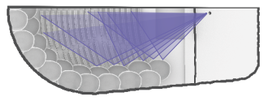

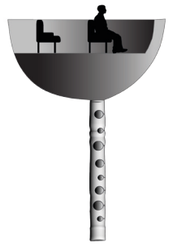

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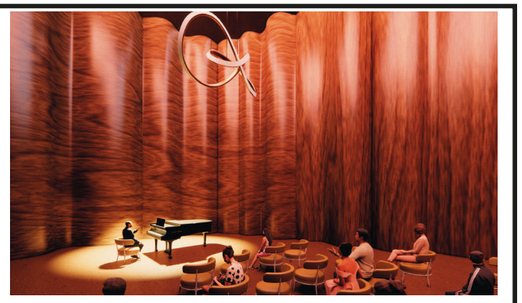

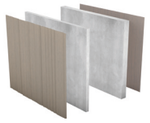

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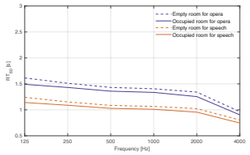

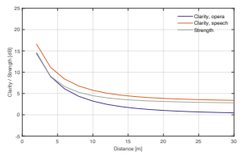

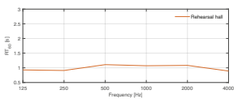

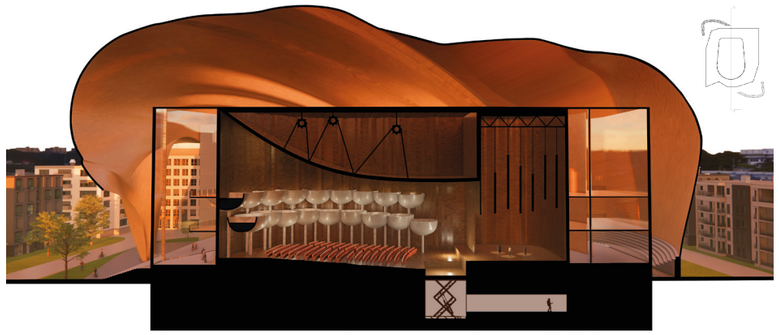

POSTERS

REFLECTION OF THE PROJECT

The auditorium was well designed, and in retrospect, the pillars and balconies can be seen as a prototype that can be used in similar spaces to achieve good acoustic values due to the built-in Helmholtz resonators. The outer shell, however, was less well thought out and is therefore not as integrated with the rest of the building. It serves its purpose in connecting the opera with the campus, but it is an aspect we would have liked to develop further.

The opera does also not have a specific location. A location was not a part of the program, but it is something we should have chosen. We adapted our project so that the focus would be on the buildling itself and how it meets the university campus instead of the site.

Throughout the project, we have strived to make choices with sustainability in mind. We primarily used wood, but also concrete for the foundation, pillars, balconies, and the staircase outside the entrance. Given that concrete is a less environmentally friendly material, we explored sustainable concrete options, such as concrete created by microorganisms and CORNcrete. However, these are still under investigation, making it difficult to implement them at this time, as the building needs to be durable for many years.

REFLECTION OF THE PROCESS

This project inspired me to broaden the perspectives of my future work and professional career in architectural design in several significant ways. Firstly, working within different disciplines was educational. Throughout this process, I functioned as an architect, engineer, and acoustician, enriching my understanding of how to integrate the essential components of a building effectively. Secondly, collaborating with an external acoustician was an important experience and collaboration. I learned that an architect's role must be adaptable and open to other disciplines, such as acoustics, to ensure that the design goes hand in hand with these elements. Finally, working in pairs and having iterations towards the final design compelled me to make quick decisions and be receptive to my partner's ideas and concepts. This experience was highly educational and reinforced the importance of collaboration and flexibility in architectural design.