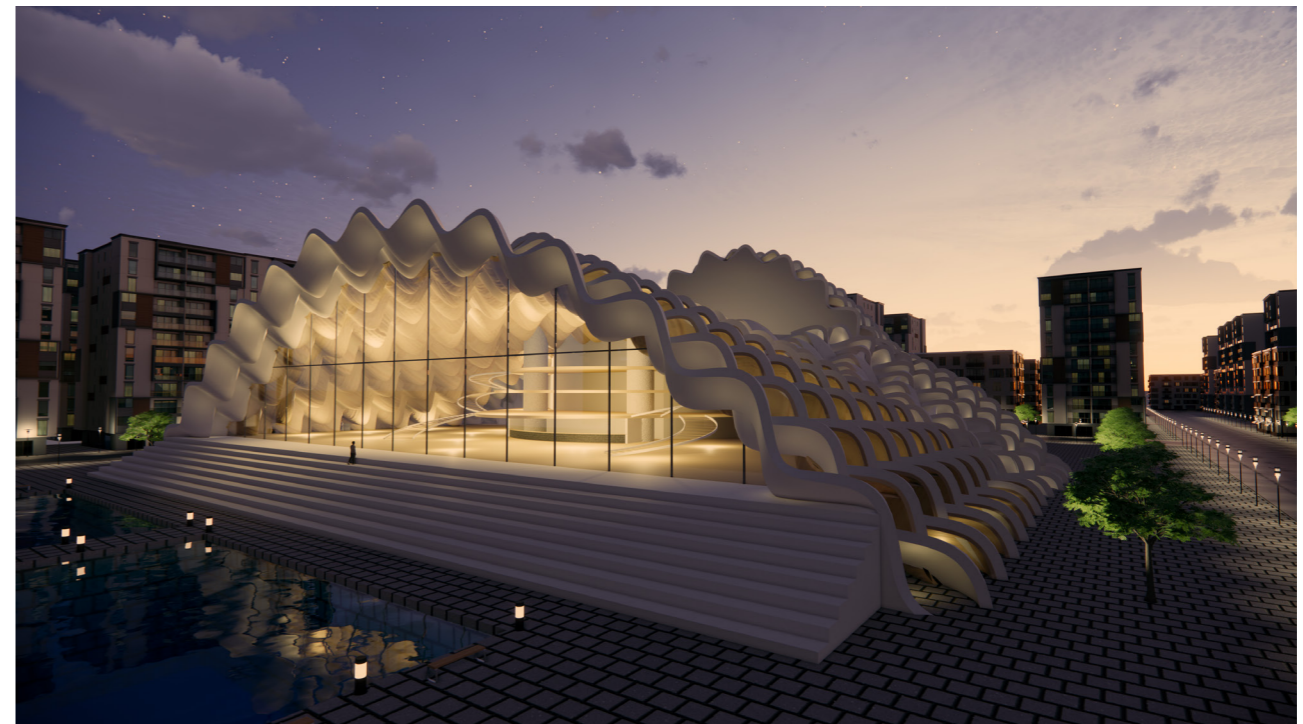


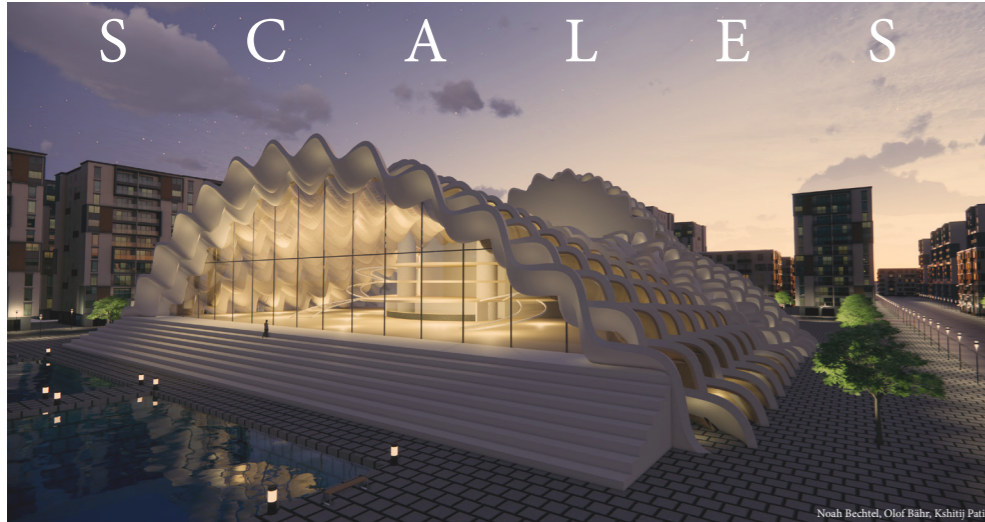
SCALES - A CONCEPT INSPIRED BY NATURE

A new opera house is being built in connection to a college campus in a town center. It needs to house a grand opera hall for the big performances as well as suitable rehearsal spaces for the performers. But how do you build an opera house that can host big events during the nights while still being usable for the college students during the day? And how do you design an opera house that is unique both architecturally and acoustically?

The key to this project is the scale grid. Taking inspiration from the scales of a fish, its double curved surfaces create openings which have been used for acoustic panels and skylights to name a few. This pattern also makes for a secure cover while still creating a connection between the outside and inside wherever you are in the building.

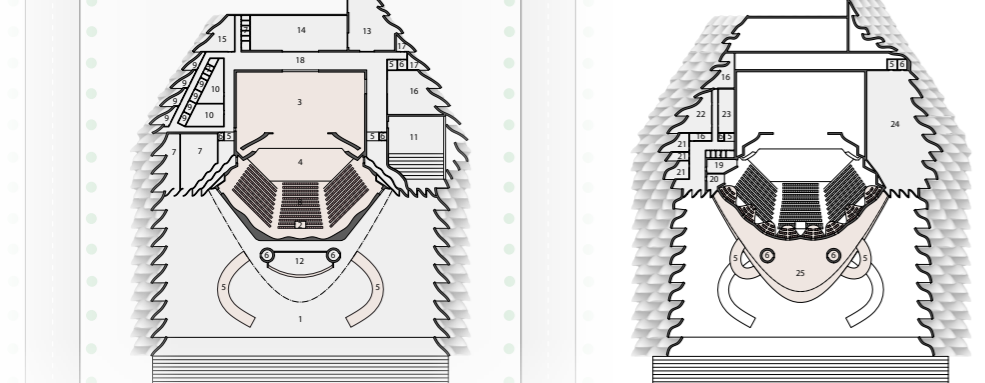


COMPETITION SUBMISSION



Noah Bechtel, Ofot Bahar, Kshitty Patil

A MULTIFUNCTIONAL CONCEPT
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A FLEXIBLE BUILDING FIT FOR A COLLEGE CAMPUS

A large water mirror in front of the opera house creates a welcoming feeling to the building. With plenty of room for socializing and studying around the water, as well as on the steps in front of the building, the entrance situation has been moulded to fit a college campus. A large, open lobby is what is welcoming you after you have entered the door to the opera house, creating an uplifting atmosphere upon arrival.

The opera hall has been placed in the center of the building which allows for easy access from all parts of the opera house at the same time as it acts as a natural blockade between the public lobby and the restricted parts at the back of the house. This separation creates a clear structure for the building, and the design also allows the surrounding rooms to act as a sound barrier, shielding the opera hall from the traffic noise outside.

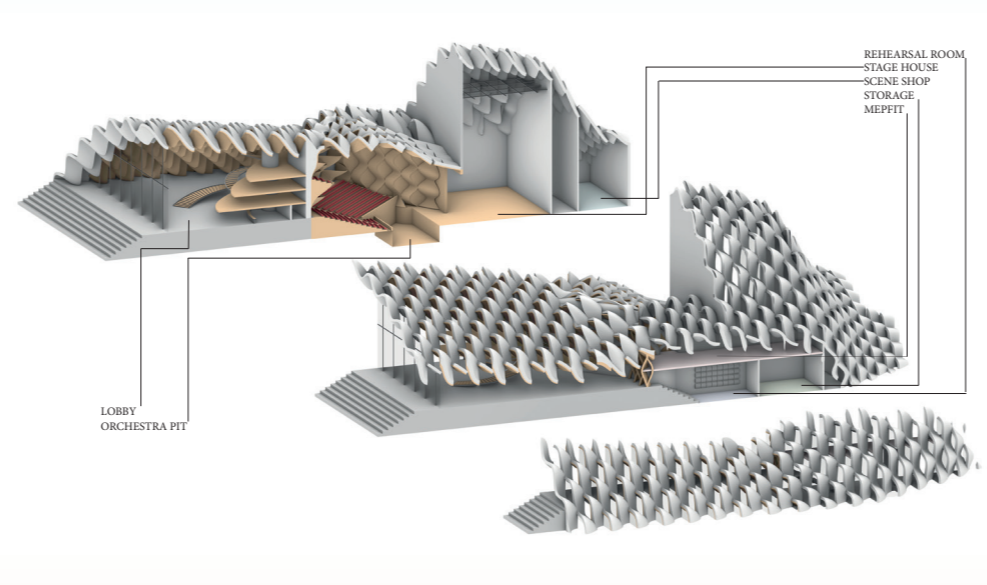
- 1. Lobby
- 2. In-house audio mix position
- 3. Stage house
- 4. Orchestra pit
- 5. Stairs
- 6. Elevator
- 7. Restrooms
- 8. Opera hall
- 9. Solo dressing room
- 10. Chorus dressing room
- 11. Rehearsal room
- 12. Cloak room
- 13. Loading dock
- 14. Scene shop
- 15. Green room
- 16. Storage
- 17. MEIR office
- 18. Circulation
- 19. Lighting and stage manager control room
- 20. Follow spot booth
- 21. Support staff office
- 22. Support staff bench room
- 23. Conference room
- 24. MEPFIT
- 25. Lobby balcony

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

ACOUSTICS OF THE REHEARSAL HALL.
To create good opportunities for rehearsing, acoustics mimicking the opera hall were sought. The achieved reverberation time was a bit lower than in the opera hall, which is preferable to avoid too much sound gain. As for clarity and strength, they ended up at around 2 dB and -0.8 dB, similar to the opera hall. This will ensure the performers get a good environment to rehearse their performances while still being able to leave the opera hall unoccupied. The perfect chance for practicing.

NOISE SHIELDING GLASS WALLS
To shield the rehearsal room from the traffic noise outside, two sets of double-paned glass walls have been constructed. The glass panes have different thicknesses to avoid amplification of resonance frequencies, and between the panes absorbent material was placed. The two sets of glass walls, combined with the scale grid outside of them, create three layers of sound barriers towards the busy street outside, while still allowing natural light to fill the rehearsal room.

FLEXIBLE REHEARSAL ROOM
A rehearsal space designed to fit an orchestra of up to 80 people has been incorporated into the building. The room also houses a seating area which allows the space to be flexible and fulfill various functions, meaning the room can double as a lecture room or hang out place if necessary. This also creates a difference in elevation, creating the opportunity for the conductor to be clearly visible for the entire orchestra or for a choir to be arranged appropriately.



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Considering the MEPFIT-rooms sensitive location, placed directly above the rehearsal space and sharing a wall with the opera hall, precautions around its construction had to be taken. To solve the issue, the box-in-box concept was applied for the MEPFIT-rooms, meaning the rooms were put on springs to absorb the vibrations from the machines. This also creates an airgap to add another layer of isolation between the MEPFIT-rooms and the other spaces.

A LOBBY WITH A VIEW
The large, open lobby welcomes all visitors without feeling cramped. It creates a busy atmosphere on nights when there is an event, but becomes an appealing study area during the days. Students can sit inside the semi-private niches created by the scales or enjoy the view from one of the lobby's three balconies. These areas also double as cozy lounges where the visitors of the opera can relax between acts.



A UNIQUE OPERA HALL
The soft, overlapping curves of the scale grid creates a stunning experience inside the opera hall. With skylights integrated in the overlappings in the ceiling, natural light is able to fill the hall during the day, while also creating an impressive shadow play. During the night the warm light from inside the hall elevates the contours of the scales, making them stand out. It creates a majestic framing for the opera hall, while not taking focus from the performance.

REVERBERATION TIME
With help from the variable acoustic panels, different modes for different performance types have been created. The main focus has been on the opera mode, however, it is possible to adjust the hall to a speaking mode as well, making the hall flexible and multi-functional.

VARIABLE ACOUSTIC PANELS
To be able to adapt the acoustics of the opera hall, adjustable acoustic panels were created. These consist of reflective panels which can be folded open to expose the inside of the scales. The inside is covered in porous, absorbent material to help bring the reverberation time down if necessary. With all of these panels open, the reverberation time can be as low as 1.1 seconds, appropriate for speeches.

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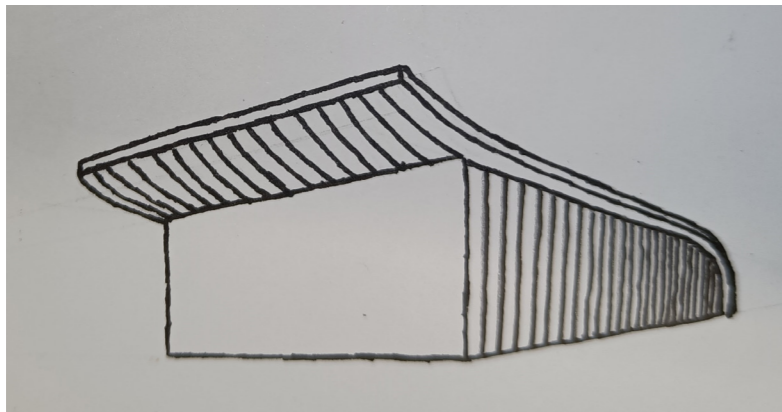
ITDG AND EARLY REFLECTIONS
With the many different surfaces, the reflections were integral for the design of the opera hall. To create a good and similar experience for everyone, especially those sitting in the center, the angles of the reflecting wall panels and skylights were adjusted to steer the sound to all parts of the opera hall. Combined with a sloped ceiling, good values for all visitors were achieved.

The final values for the initial time delay-gap range between 20 and 25 msec throughout the opera hall, with the shortest value measured along the side walls and the longest value measured in the center of the opera hall. These values ensure a good and even performance throughout the entire opera hall, with a natural sound reaching all seats.

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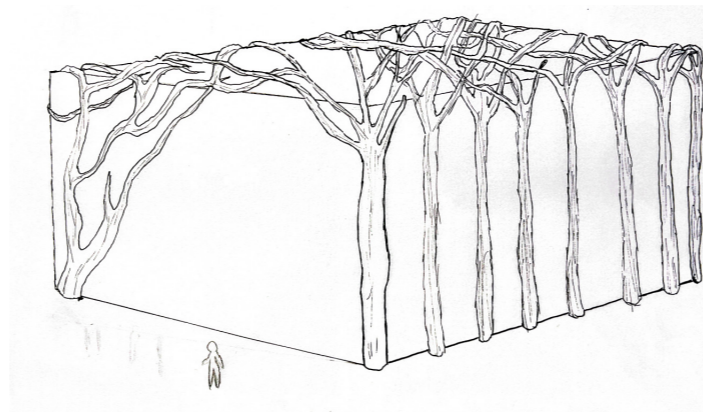
CONCEPTS

The first part of the project was to come up with three different concepts for the opera house. This was to inspire the acoustics that we were to collaborate with later on as well as creating a chance to brainstorm ideas. In the end, three different concepts were invented, who differed both visually and acoustically.



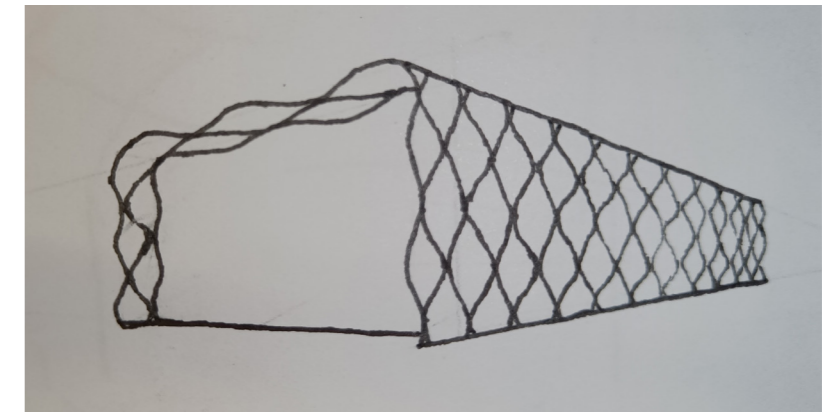
DIFFUSE

The first concept centered around using different types of diffuser panels to create an aesthetic effect and bring depth to the building elements. A free-flowing roof sheltered the opera house and the inside of the ceiling was covered with diffuser panels to create attraction.



FOREST

The second concept was to mimic a forest where the supporting structure was made up of trees and branches, which were on full display. With a lot of absorbing material this was supposed to be a calm environment that allowed for a special kind of opera.

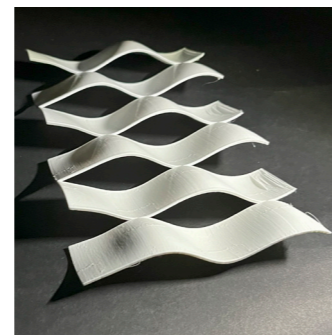
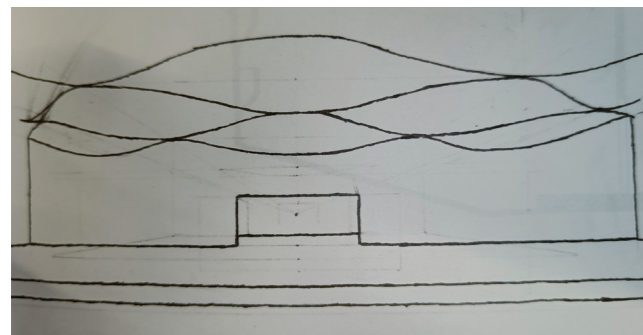
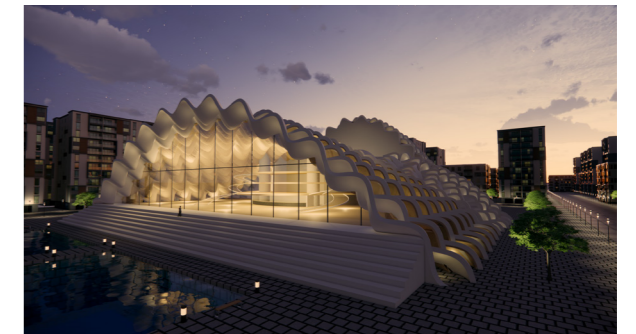
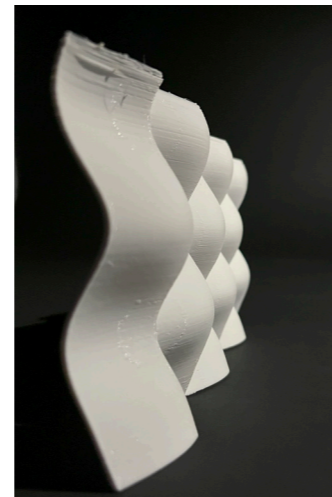
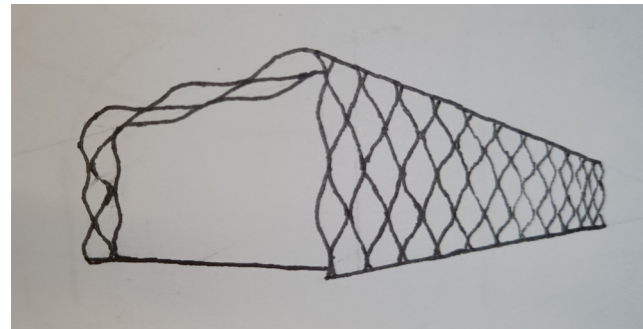


SCALES

The final concept, and ultimately the one that was chosen for the project, was the scales concept. With this concept there was a clear uniqueness which allowed for interesting spaces and curious acoustics. With this concept all the boxes were ticked.

PROCESS

This project was kept in the concept stage for a long time. The work process centered around maximizing the usage of the scales pattern and new ideas for what could be incorporated into it were created continuously. It was not until the very last part these ideas were concretized into a building. This structure really helped to work with the concept and making sure it was continuous throughout the building.



The first part of the process was to create the concept. The scales pattern was designed and it was applied all over the conceptual building. Thoughts for what both the outside and the inside could look like were created and ideas for how the pattern could be used were starting to come. The project had begun.

Such a complex pattern were difficult to visualize though, so a digital model was created. Even still, it was difficult to imagine what it would look like in real life, which is why a physical prototype was printed. With the physical model there was a chance to analyse and reflect upon how the pattern would be conceived from different angles.

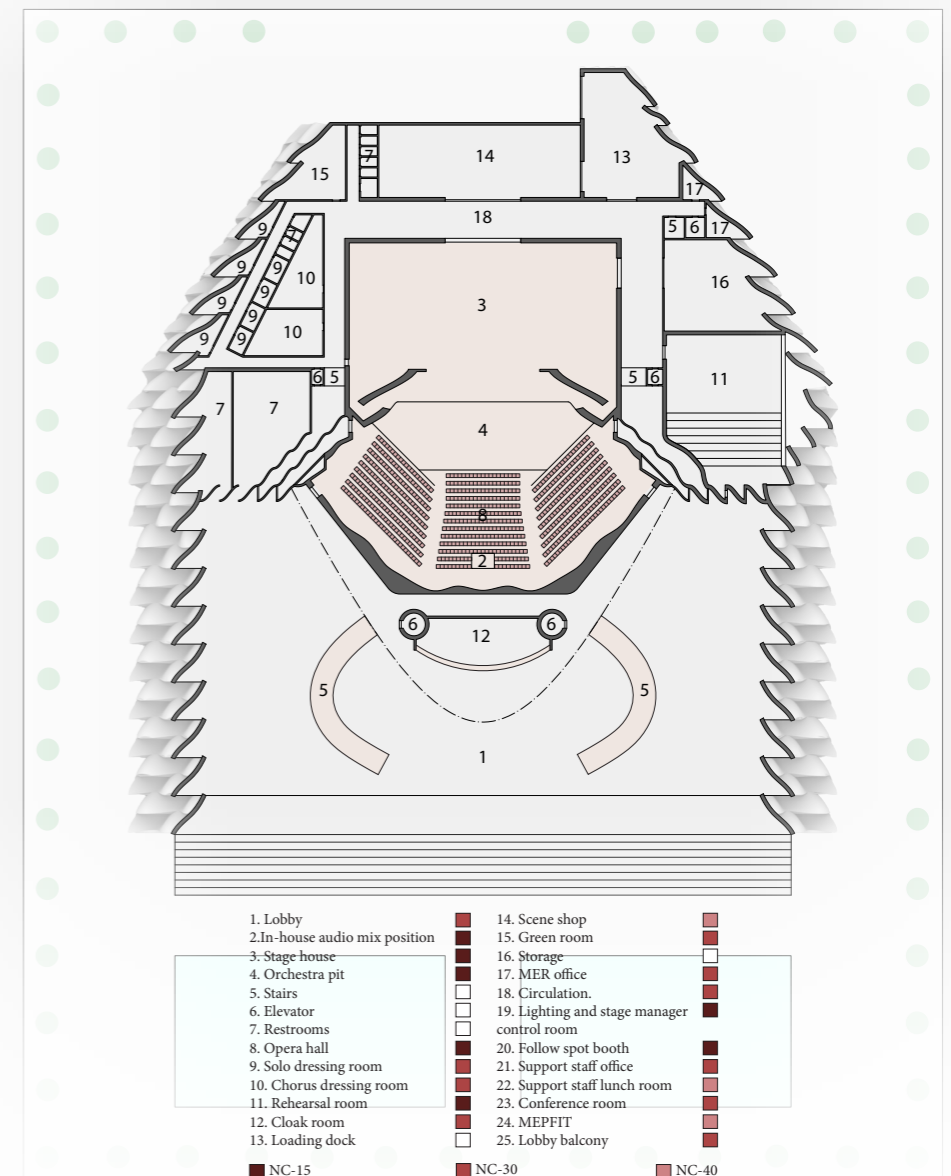
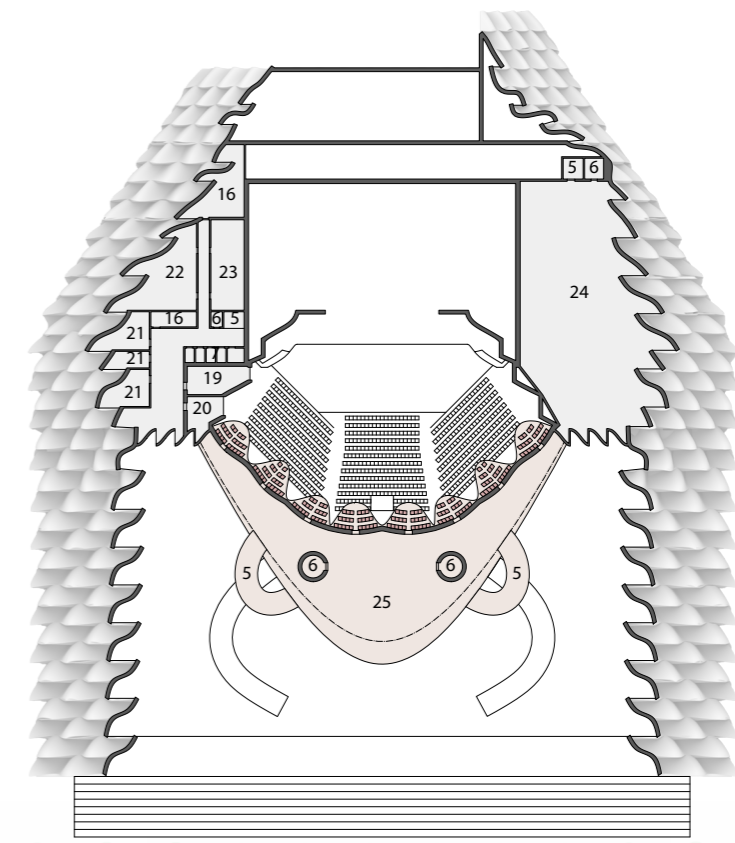
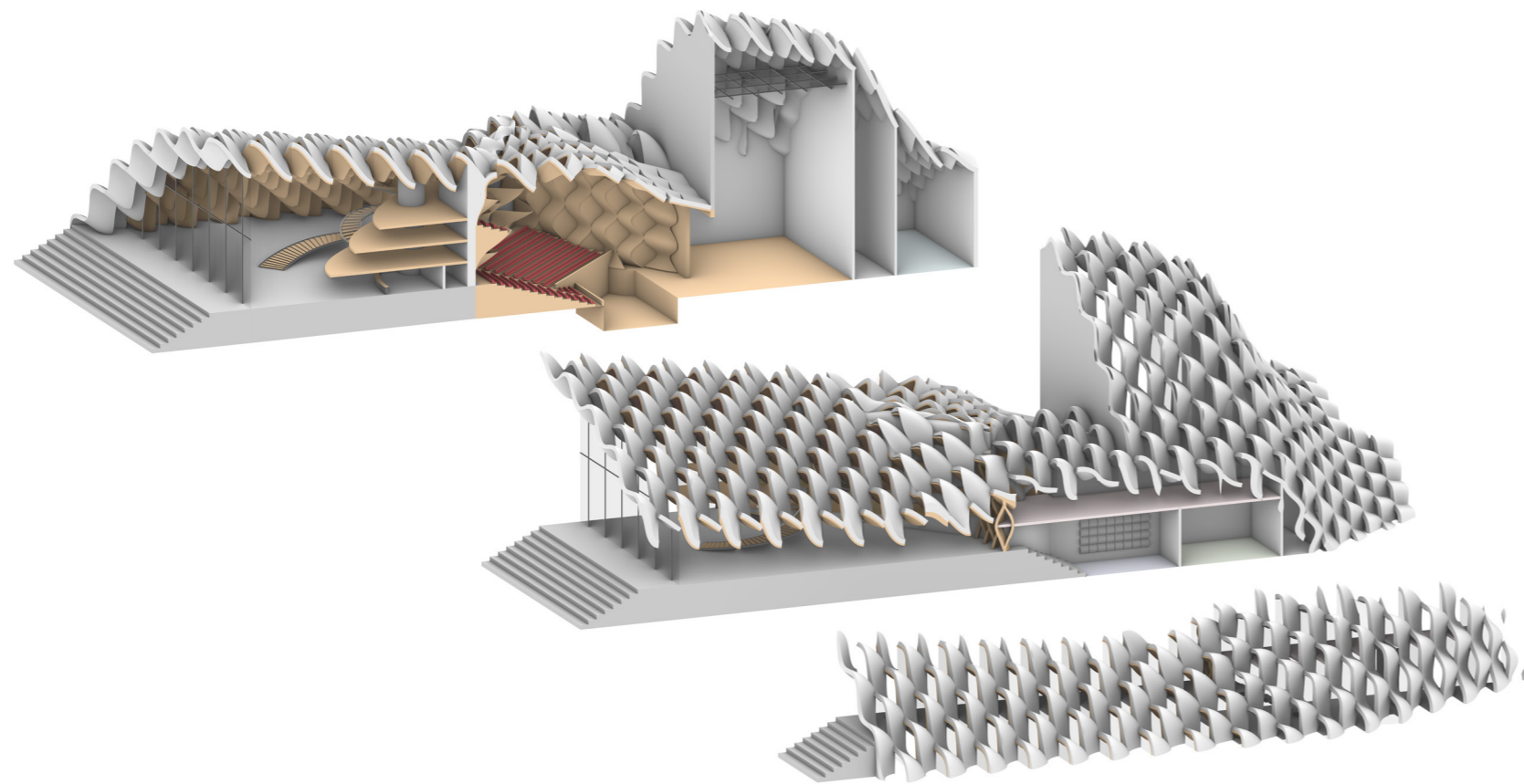
The next part of the process was to experiment with how the pattern could be used to integrate different functions. Models were constructed to evaluate how various acoustical elements could fit in the pattern. The openings in the spaces were also analysed based on what they could be used for, such as skylights and study areas.

Finally, it was time to design the building. With the ideas in the back, all that was needed was to create a volume that could house these. Different shapes were considered, but the scales pattern was prevalent throughout. In the end an arch was constructed, creating both an interesting aesthetic as well as a helpful supporting structure.

THE BUILDING

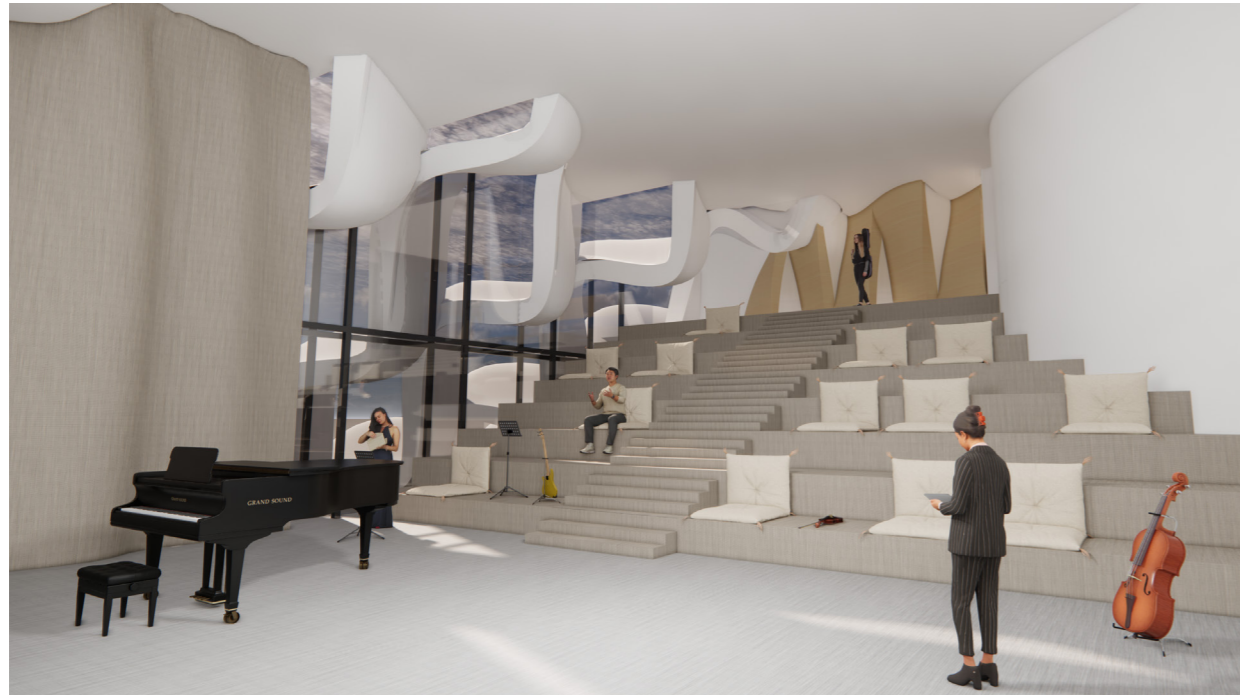
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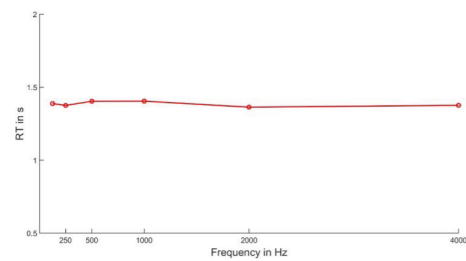
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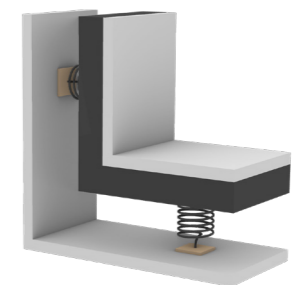
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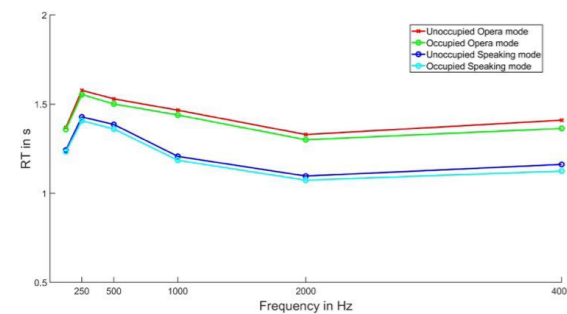
OPERA HALL

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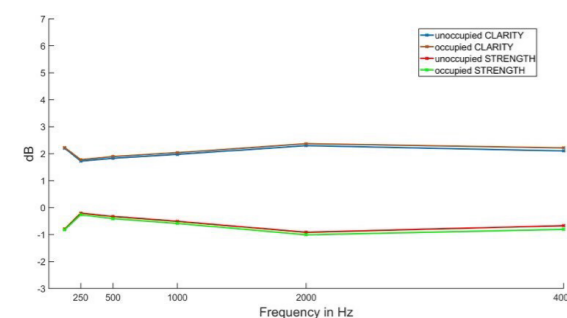
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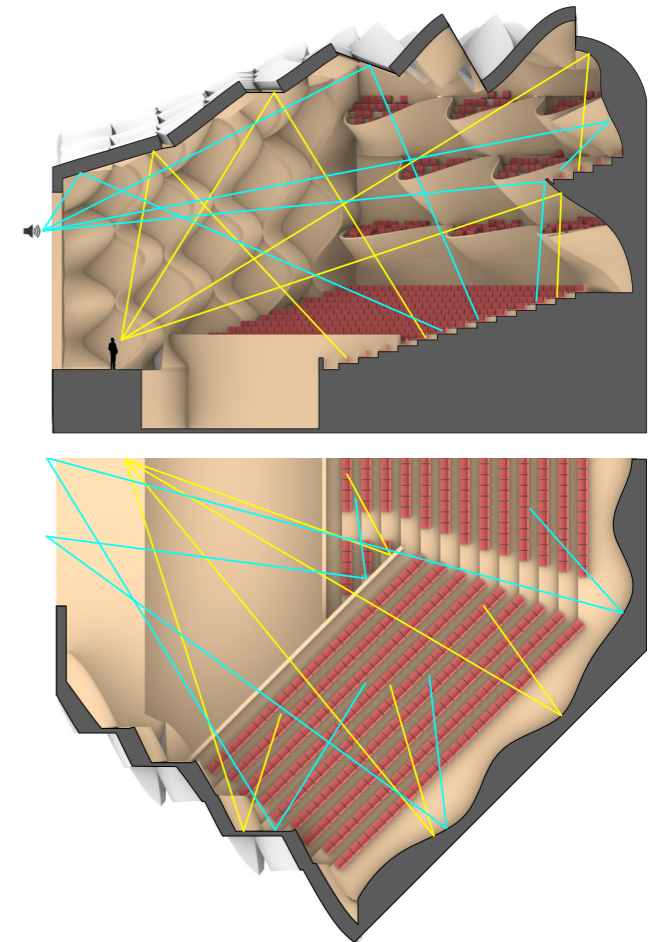


CLARITY AND STRENGTH

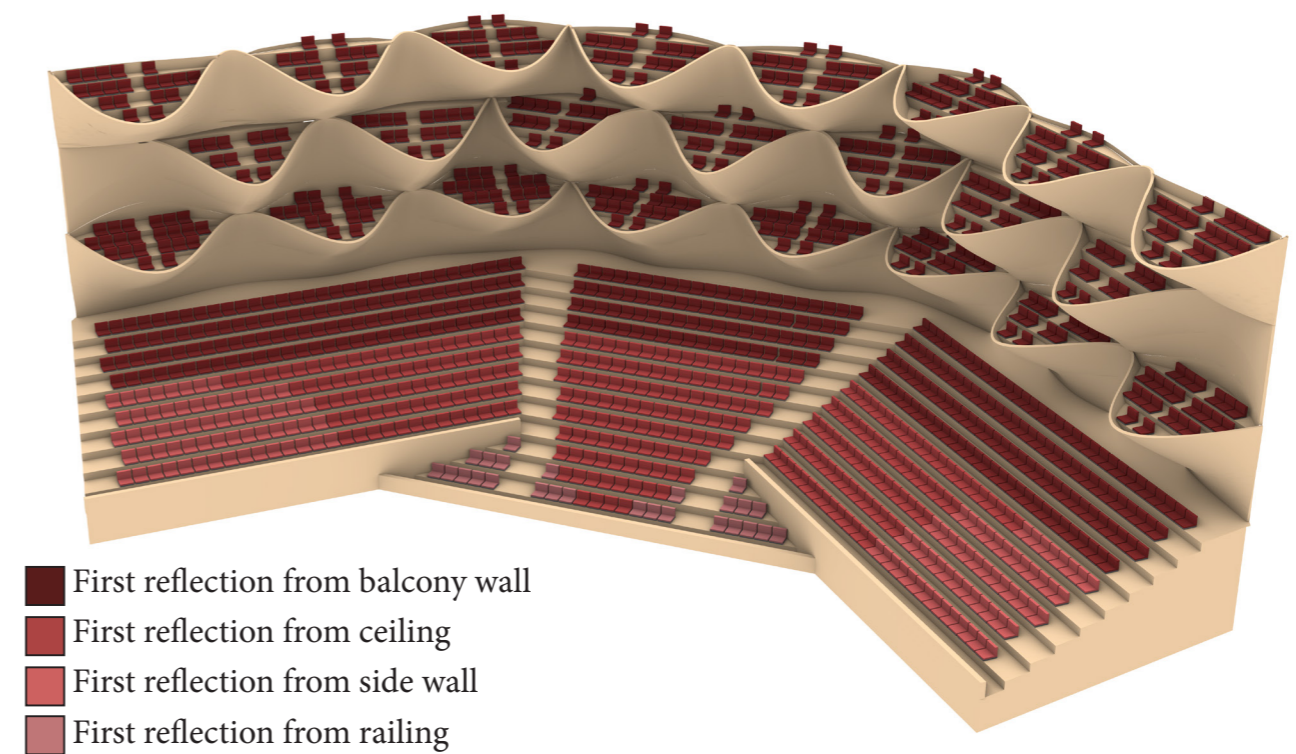
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REFLECTION

The final product was a unique opera house with a strong concept. It has some flaws, such as that the pattern creates spaces where birds can build nests, but overall it was inspiring to work in a way where the concept completely decided the design. Although a lot of wood was used in the building, it would have been nice to have more time to explore how this could have been built with more consideration for sustainability. There was an idea of how glulam beams could have been used, but with a lack of time it could not be tested.

In the end I am happy with the opera house. It resulted in an unusual building that would have been cool to experience in reality. The strong concept came with great obstacles, but also great opportunities. The best part of the project has been exploring these opportunities and trying to push the limit for what is possible with the pattern. It has been an interesting way to work that has inspired me for future endeavours.

