CYCLOPHONICS

opera performance hall

PORTFOLIO : KANDIDATARBETE av Miran Sarban - AT3 - VT 2024

ASA COMPETITION

Per tradition, third year bachelor students from the Architecture and Engineering program at Chalmers are encouraged to participate in the 2024 Newman Student Award Fund Student Design Competition, sponsored by the Robert Bradford Newman Student Award Fund and The Wenger Foundation, which was held in conjunction with the 185th ASA meeting in Ottawa, Canada, from May 13-17, 2024.

The competition invited students in architecture, engineering, physics, and related fields to design a 1,200-seat opera performance hall for student use, emphasizing acoustical considerations. Entries could be individual or in teams of up to three students, with registration required by April 8, 2024, and digital submissions due by April 29, 2024.

Designs were judged on technical merit, design vision, innovation, and presentation, with awards including a $1,400 First Honors prize and up to four $900 Commendation awards. The design had to address room acoustics, sound isolation, and noise control, and include detailed plans and sections. Additional requirements included the ability to handle a variety of performance types and manage noise from external and internal sources. The competition encouraged interdisciplinary and multi-institutional teams, with winners announced during the ASA meeting and awards distributed by the end of May.

OUR WORK

This portfolio highlights the collaborative effort by me the author, Miran Sarban, a fellow student by the name of Emma Sander and consult for any matter pertaining to acoustics Gabriel Hoffsten, first year student of the Acoustics Engineering masters program, Chalmers.

Our acoustical idea ended up simply being to envelope the operatic hall in several wrapping volumes and surfaces, buffering the noise from interfering with the acoustics on the inside. We also approached our building as a highly public one, where we invited visitors to enter into the folds of our structure by creating access to the roof.

We had a highly exterior approach, meaning the interior was shaped secondarily to the facade. Post form-finding, the shape that had emerged inspired a likeness to hurricanes. Hence the interior of the opera performance hall also followed suit, with the outer balcony walls shifting inwards and outwards from the wall, with the protruding segments containing the balconies.

The interior and exterior qualities work in tandem, giving rise to a narrative of getting swept into the storm, and eventually ending up in its eye, symbolised by a circular skylight centered in the roof of the opera performance hall.

CYCLOPHONICS

Description of Concept

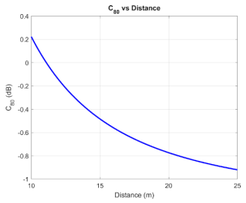
Various wall configurations assist the opera hall in dealing with noise arriving from all cardinal directions as described in the program. The exterior fascade is a constructed out of repurposed planking that has been overlayed, glued together and bent to the desired shape, plausibly described as ribbon-like or vortexial. Similarilty, the glass-walling is also made out of repurposed glass, with wood framing it together in a collaged fashion.

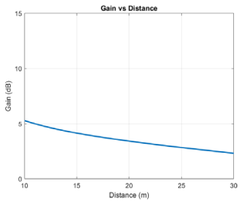
These methods of repurposing give the impression of a structure built out of things amassed from structures in the wake of a passing hurricane, or as if a hurricane has settled down in its skin of debris.

Besides the entrance through the pit. A back entrance has also been devised in order to allow for more discrete and accessible entrances by personell and the like.

Furthermore, the opera hall also features another entrance directly into the first balcony floor, as well as an outside stage in one of its flanks.

Lastly, visitors may travel on top of the structure, and peer down into the glass window opening that's visible from inside the opera.





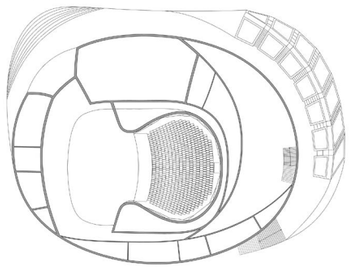
Site Location

Fletcher Opera Theater in Raleigh, North Carolina, home of the Carolina Hurricanes.

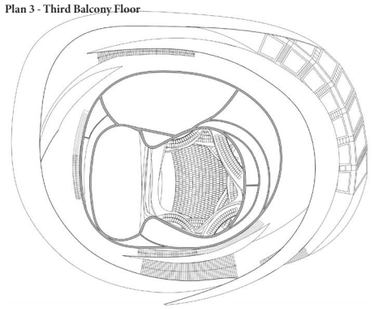
Concept By

Architects - Emma Sander and Miran Sarban
Acoustician - Gabriel Hoffsten

Plan 0 - Pit Floor



Plan 3 - Third Balcony Floor

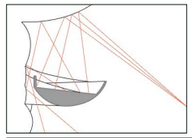


Insulation and Walls

Both the opera hall and rehearsal hall will require soundproofing to meet the NC15 standard. To achieve this, a box-in-box system will be implemented, which entails installing floating walls, ceiling, and floor in both rooms. Additionally, the other walls in the opera will feature other important soundproofing measures, such as a double wall made of wood, to satisfy the necessary sound requirements. The mepfit room will have a floating floor, ensuring further reduction of the noise.

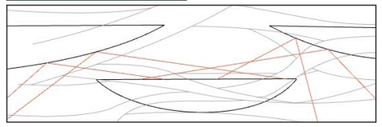
Reflections and time delay (ITDG)

To ensure a delightful auditory experience in the opera hall, the panels and walls are strategically placed to allow for the first reflections to reach the audience after no more than 40 milliseconds. The walls also act as scatterers, allowing the sound to envelop the audience for an enhanced experience. The balconies are open in the back, allowing the sound to travel behind the audience for a more immersive experience.



Electroacoustics

Loudspeakers will be placed at the top of the scene, allowing the sound from the performer to hit the audience at all positions before the sound from the speaker. The speakers will also be able to have a delay on them for an even more optimal sound.



Noise from Traffic to Operahall

With the NC15 inside the korridor the walls reduction value on the octave band 63-4000 hz of [24 37 46 58 49 40 28] must be achieved. This design will exceed those values.

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Environment to Operahall

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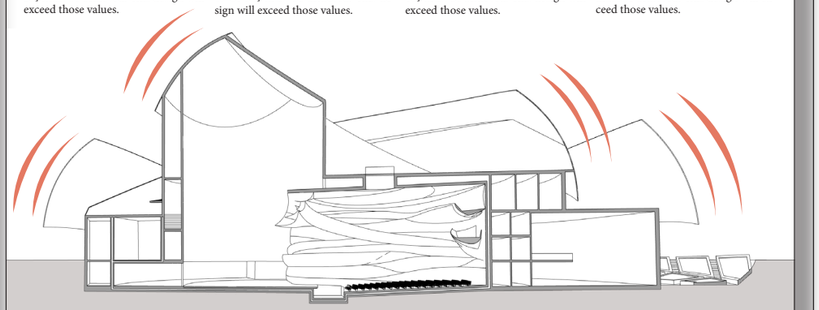


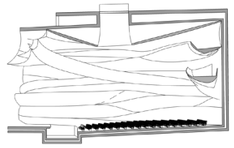
Variable acoustics opera hall

The opera hall is a versatile space that hosts both operatic performances and speaking events. To cater to these diverse events, a variable acoustic system has been implemented. This involves the use of an adjustable ceiling that can modify the volume of the room, as well as cover or expose absorbing materials in order to alter the reverberation time to fit the specific occasion. These adjustments are made electronically prior to the event, ensuring optimal RBT for all performances.

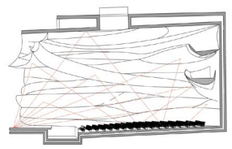
Reverberation Time

The acoustics of the opera halls are carefully adjusted to suit each event. One key feature that enhances the sound quality is the presence of Helmholtz resonators embedded in the walls, which are specifically tuned to absorb at the frequencies 125 Hz and 250 Hz. Additionally, the walls of the opera hall are constructed using wooden materials, which further contribute to the absorption of sound within the space. The rehearsal hall is a spacious room with a similar reverberation time to an opera hall, allowing musicians to prepare optimally.

Unfolded State



Folded State



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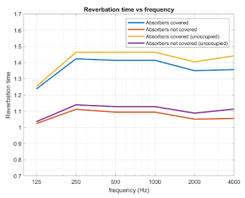
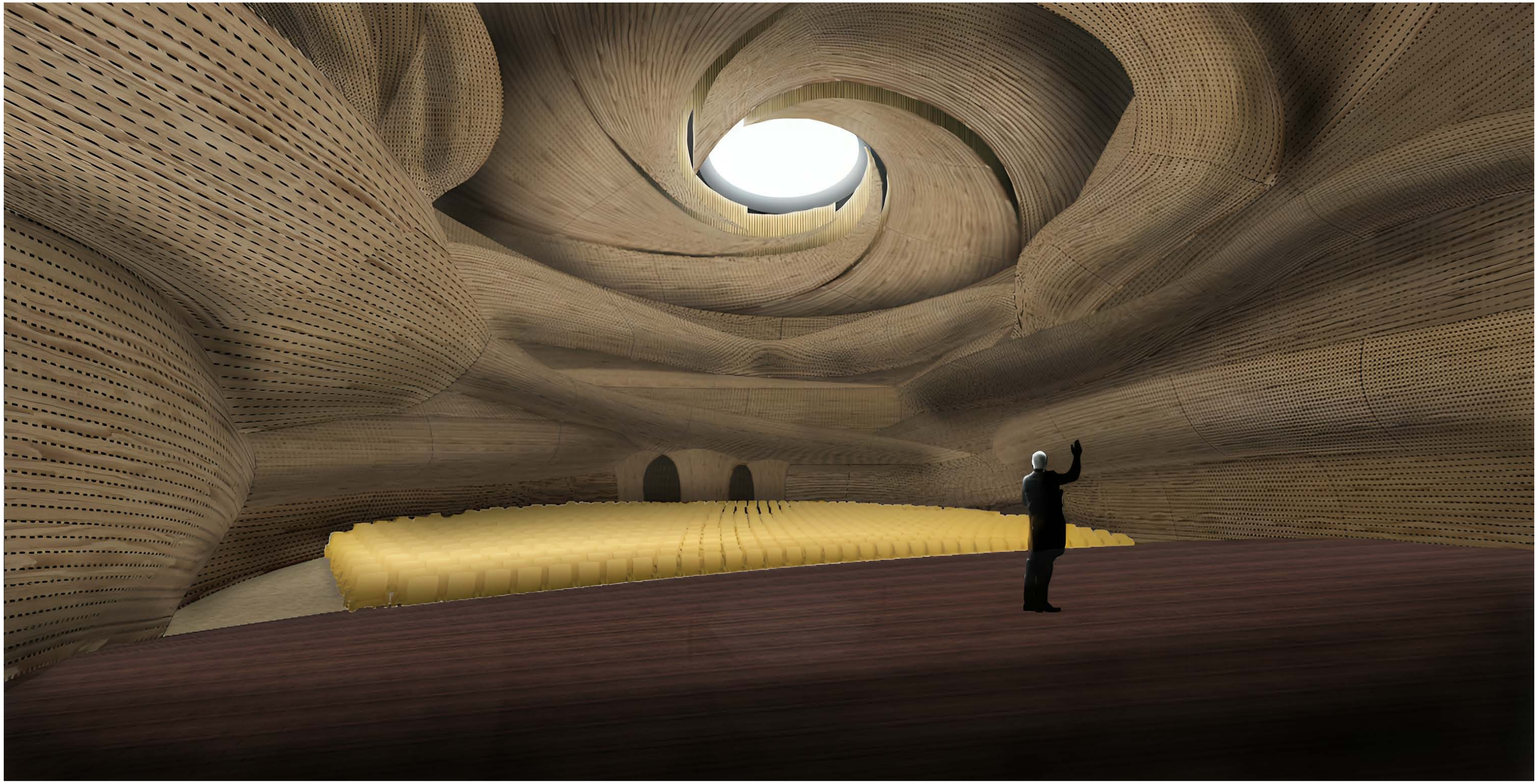
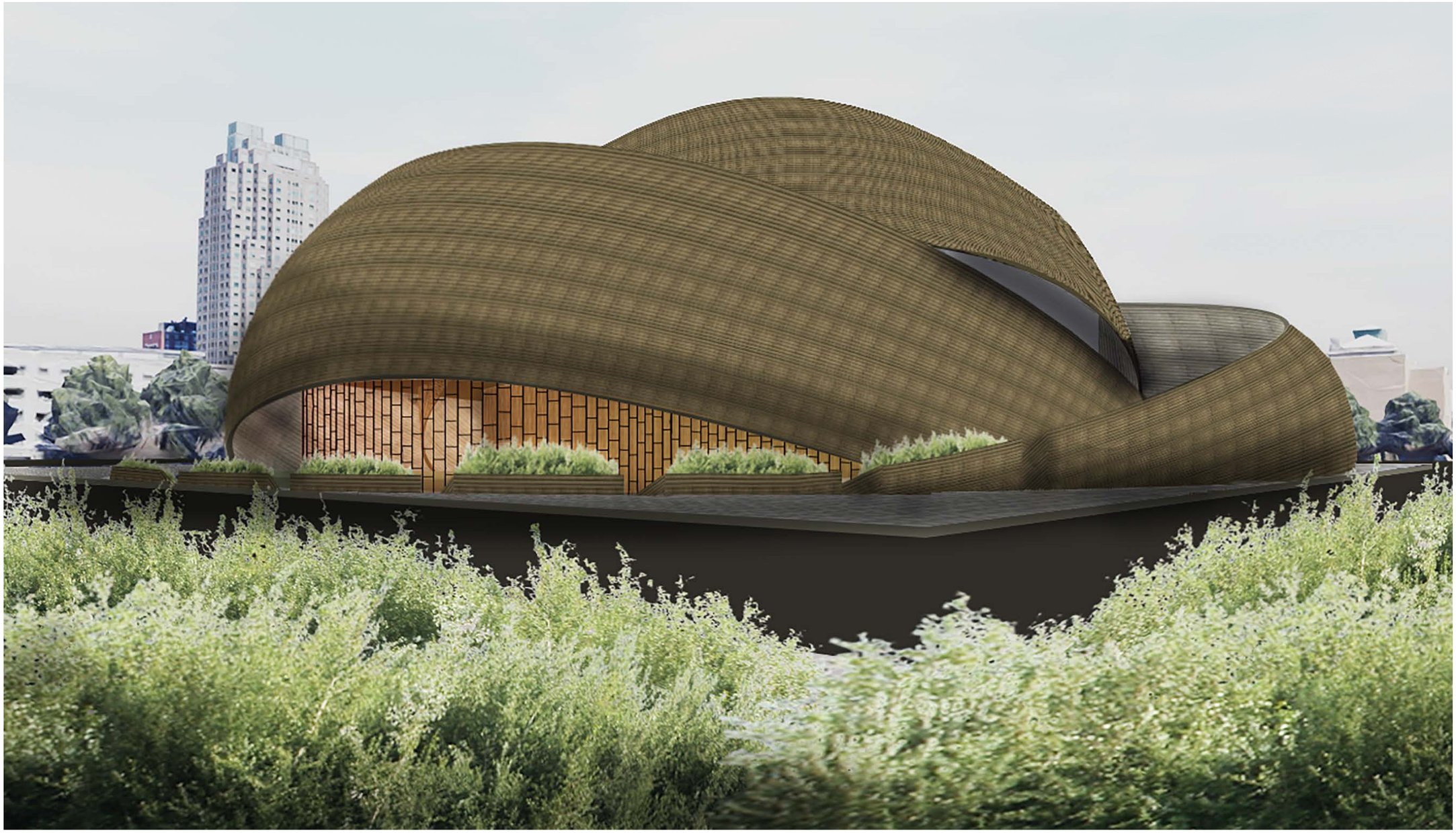


POSTERS



INTERIOR



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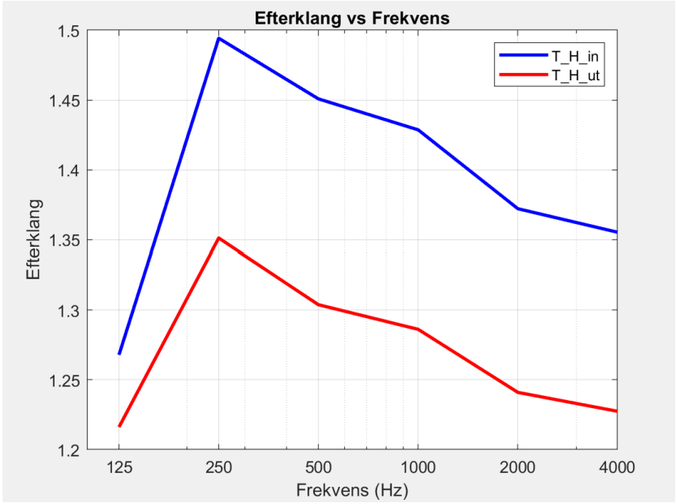

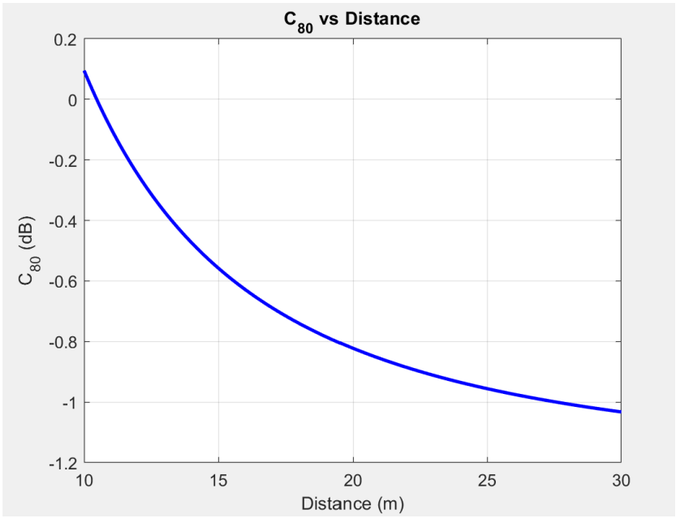

POSTER TEXT+ GRAPHS

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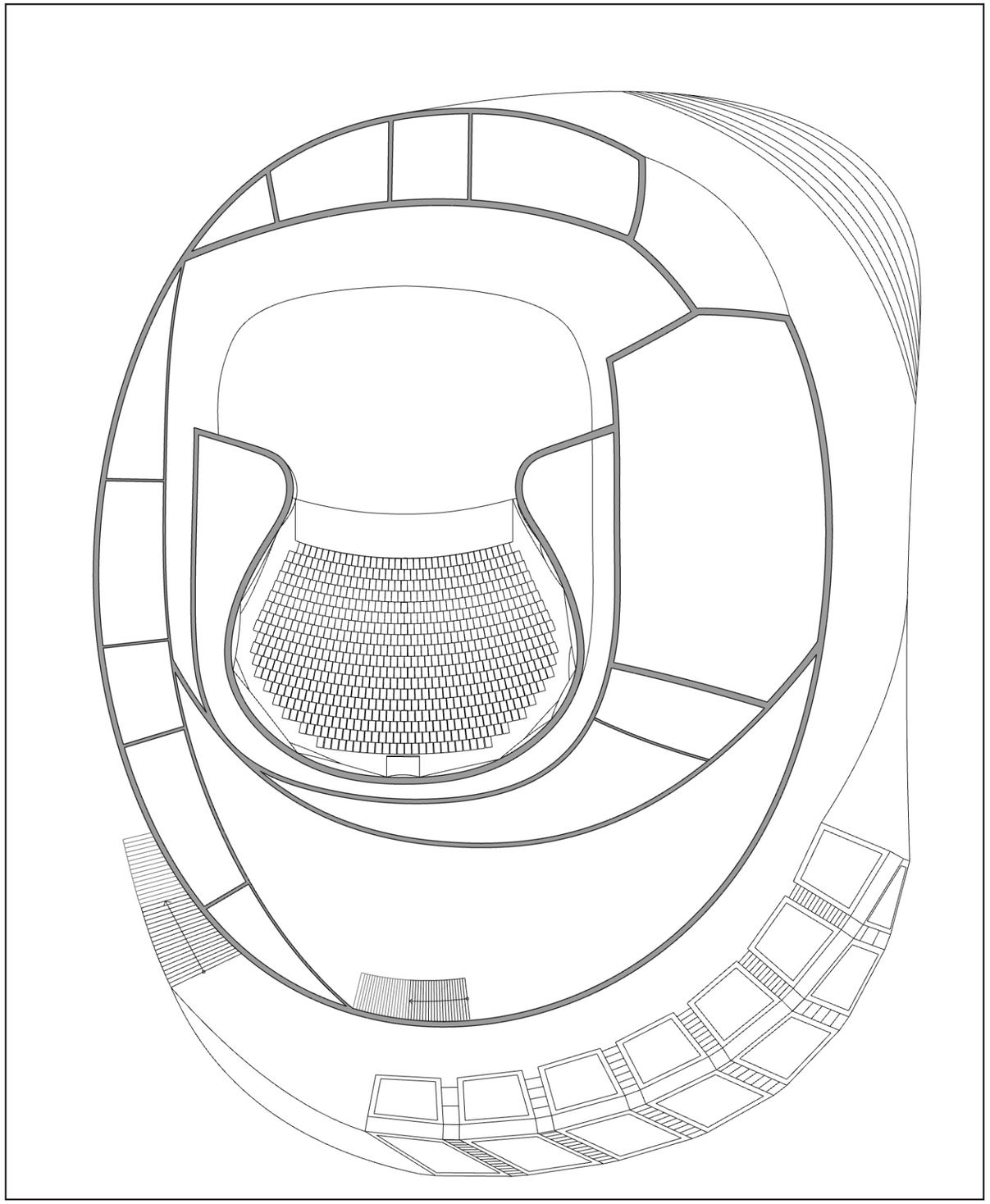
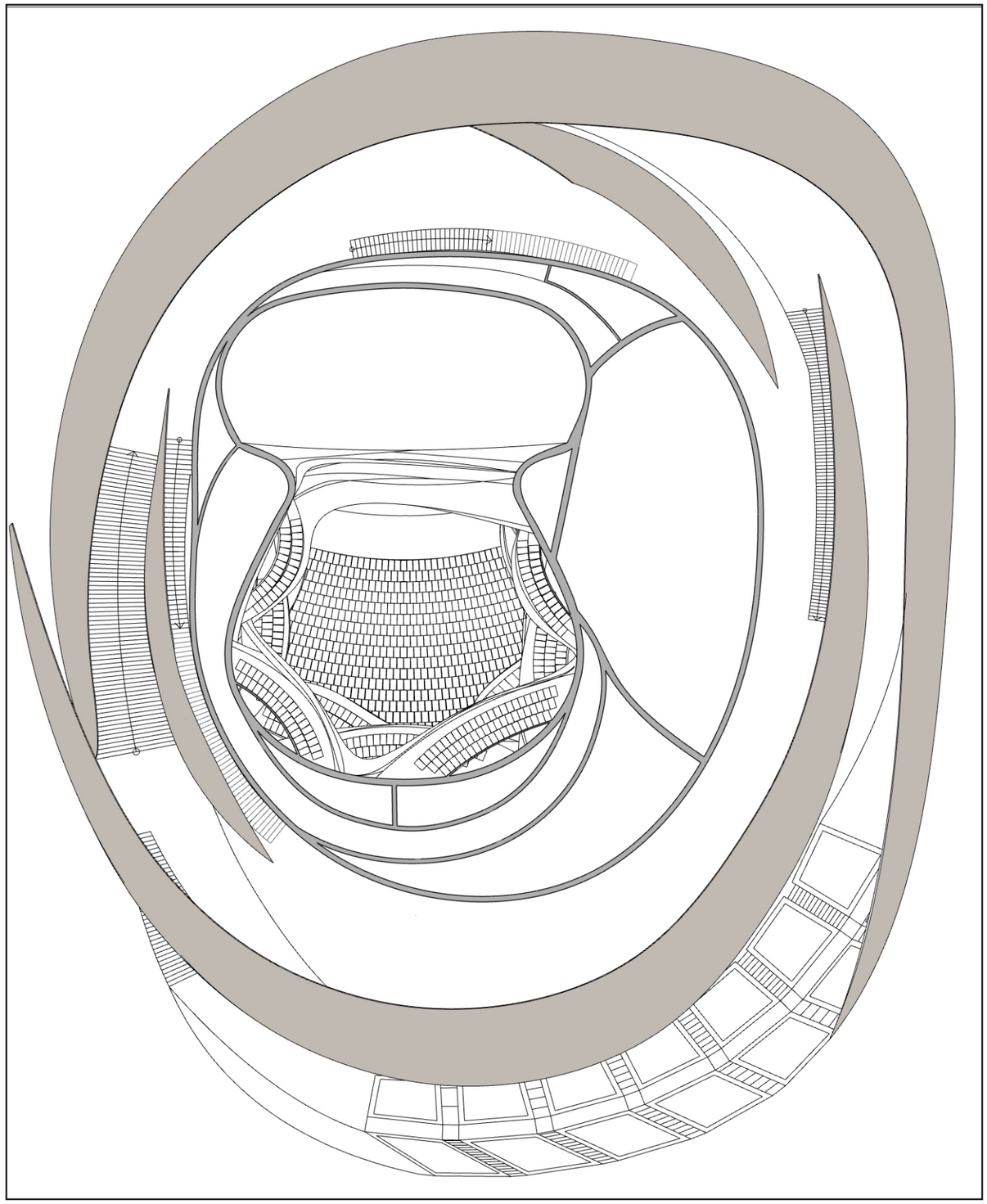
+POSTER TEXT

GROUND PLAN

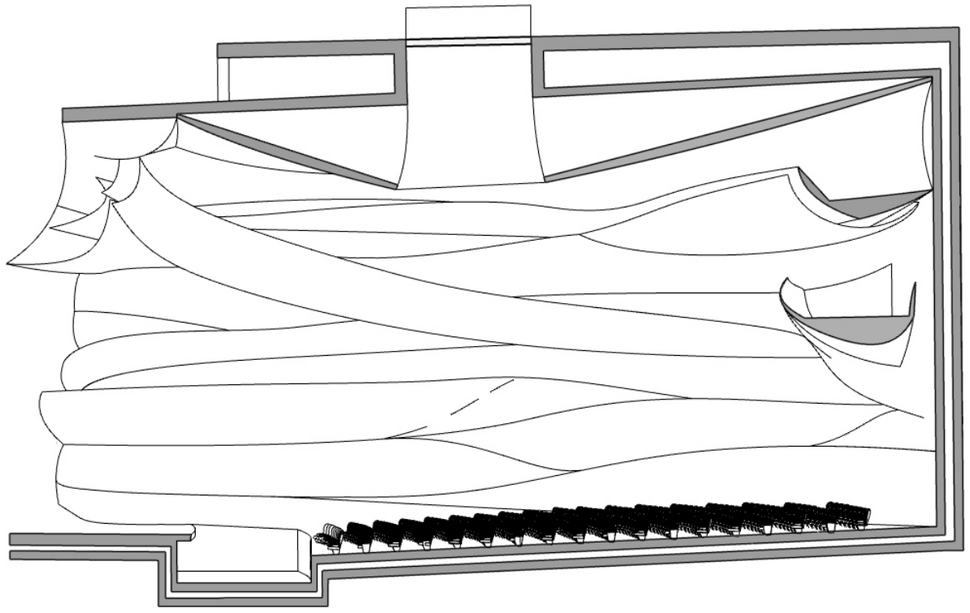


TOP FLOOR PLAN



PLANS

UNFOLDED STATE



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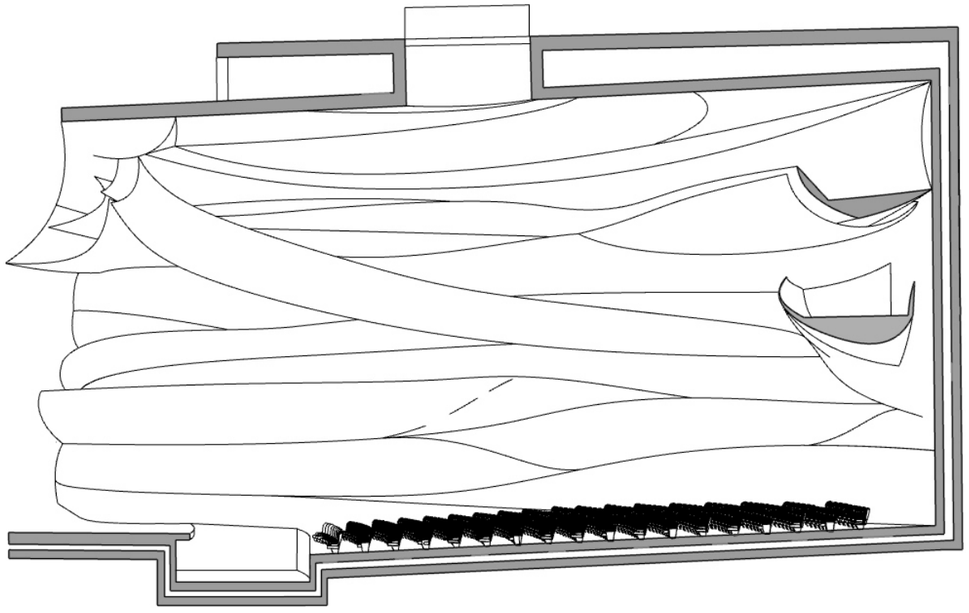
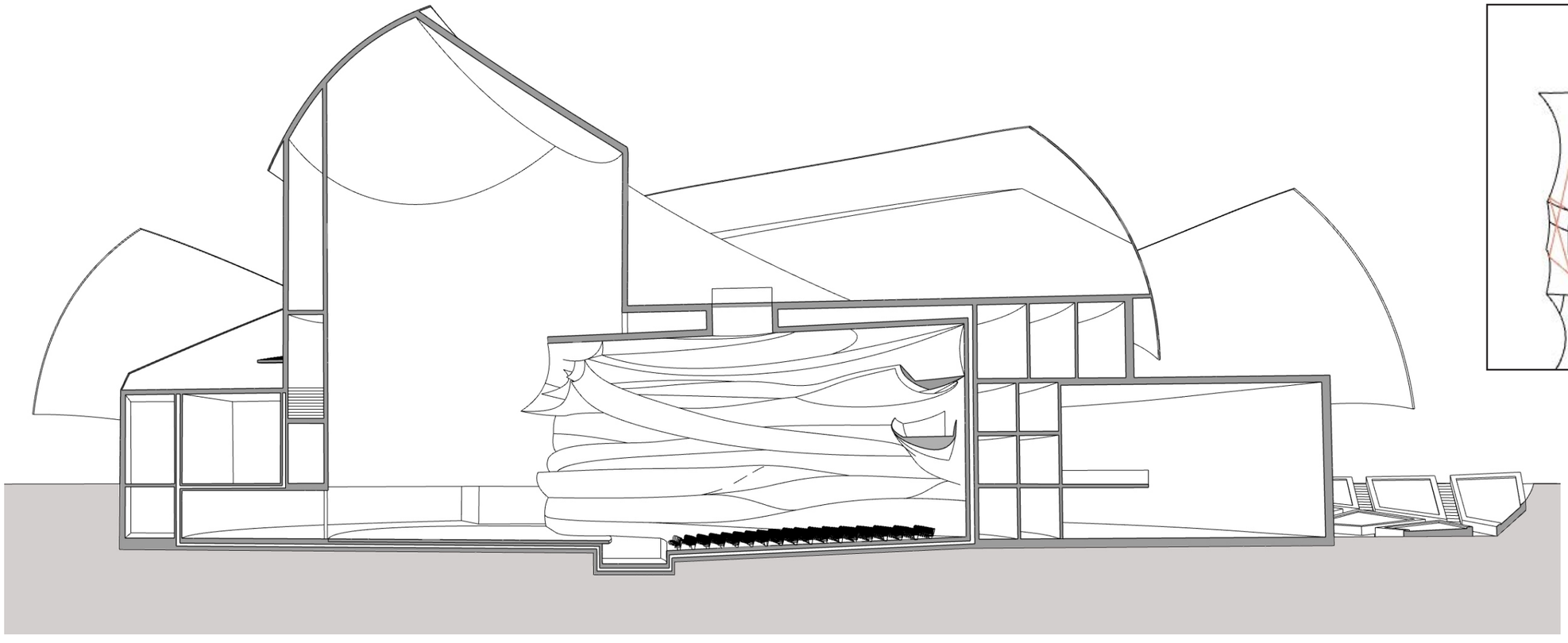
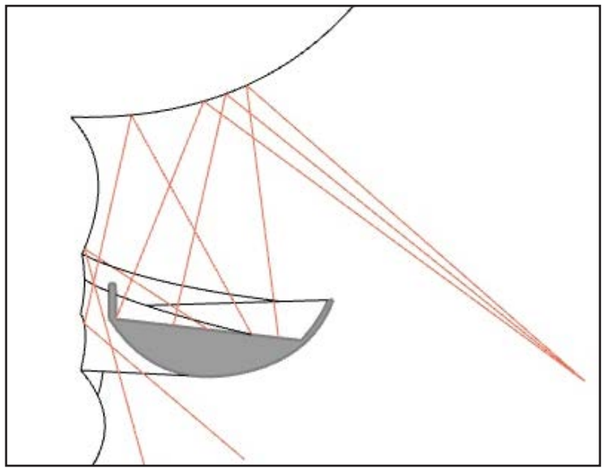


SECTION OF WHOLE BUILDING



BALCONY SOUND REFLECTION VISUALISATION



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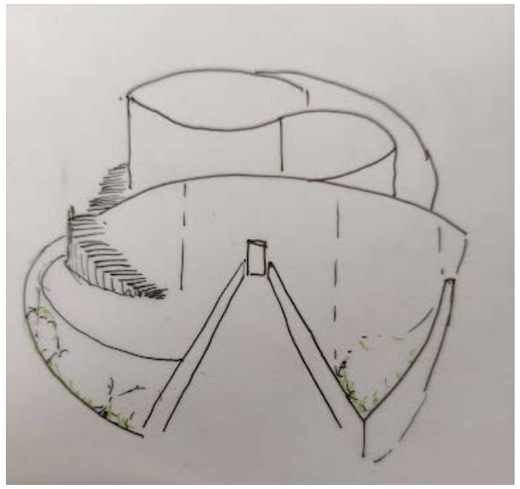
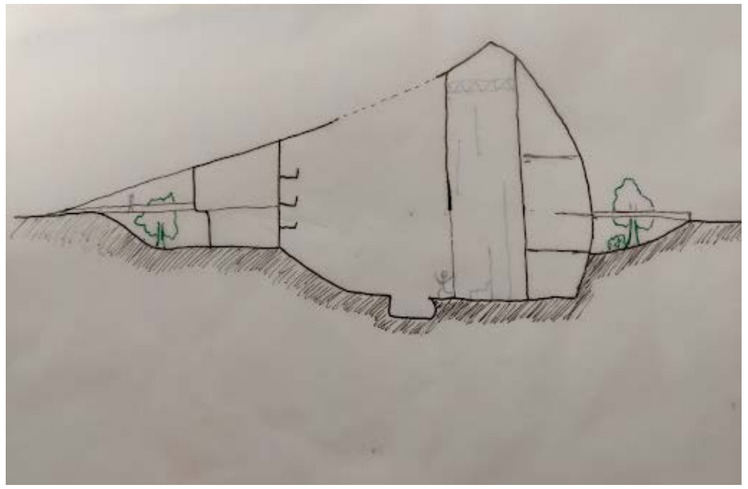
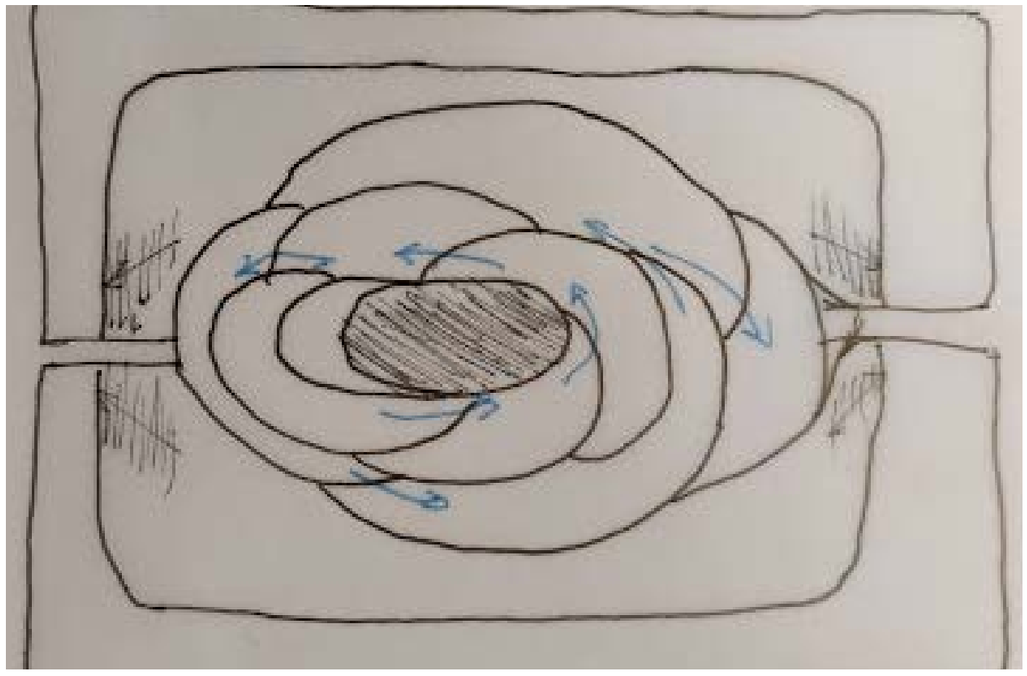






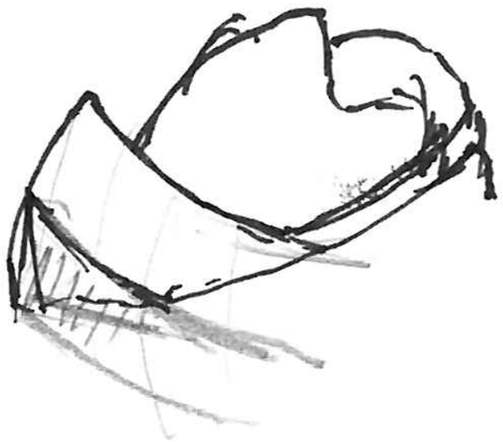
Initial Concept

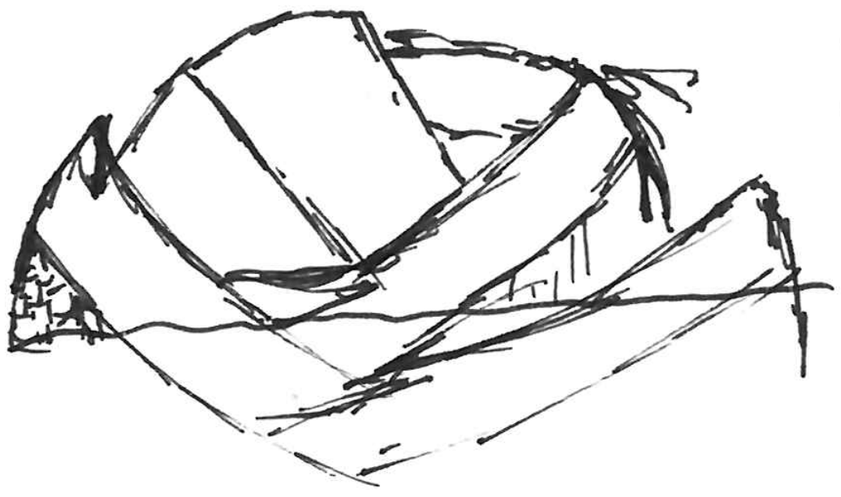
The first presented concept were based on plateus, were we imagined visitors would traverse from one platform to another, ultimately ending up on the roof where the visitor would peer into the opera hall though a circular glass opening.

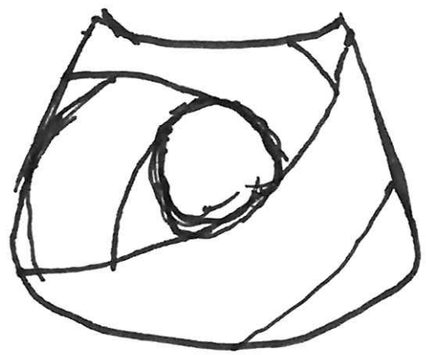
These plateus would doubley serve as entry points into the balconies as well as rooftops and recreational spaces for the visitor.

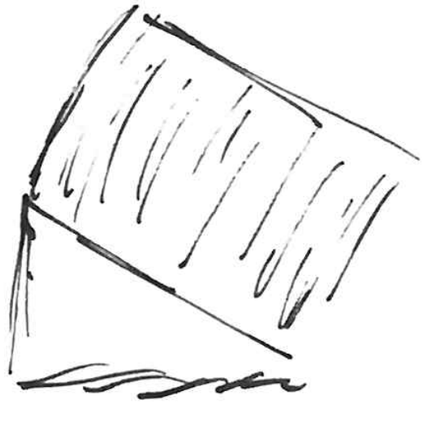
In order to ensure ease of access, the building was buried a couple of floors. A problem that thus arose was how do we allow daylight to reach the bottom floor(s)? Hence we installed a pit, with a overpassing bridge.

FIRST CONCEPT







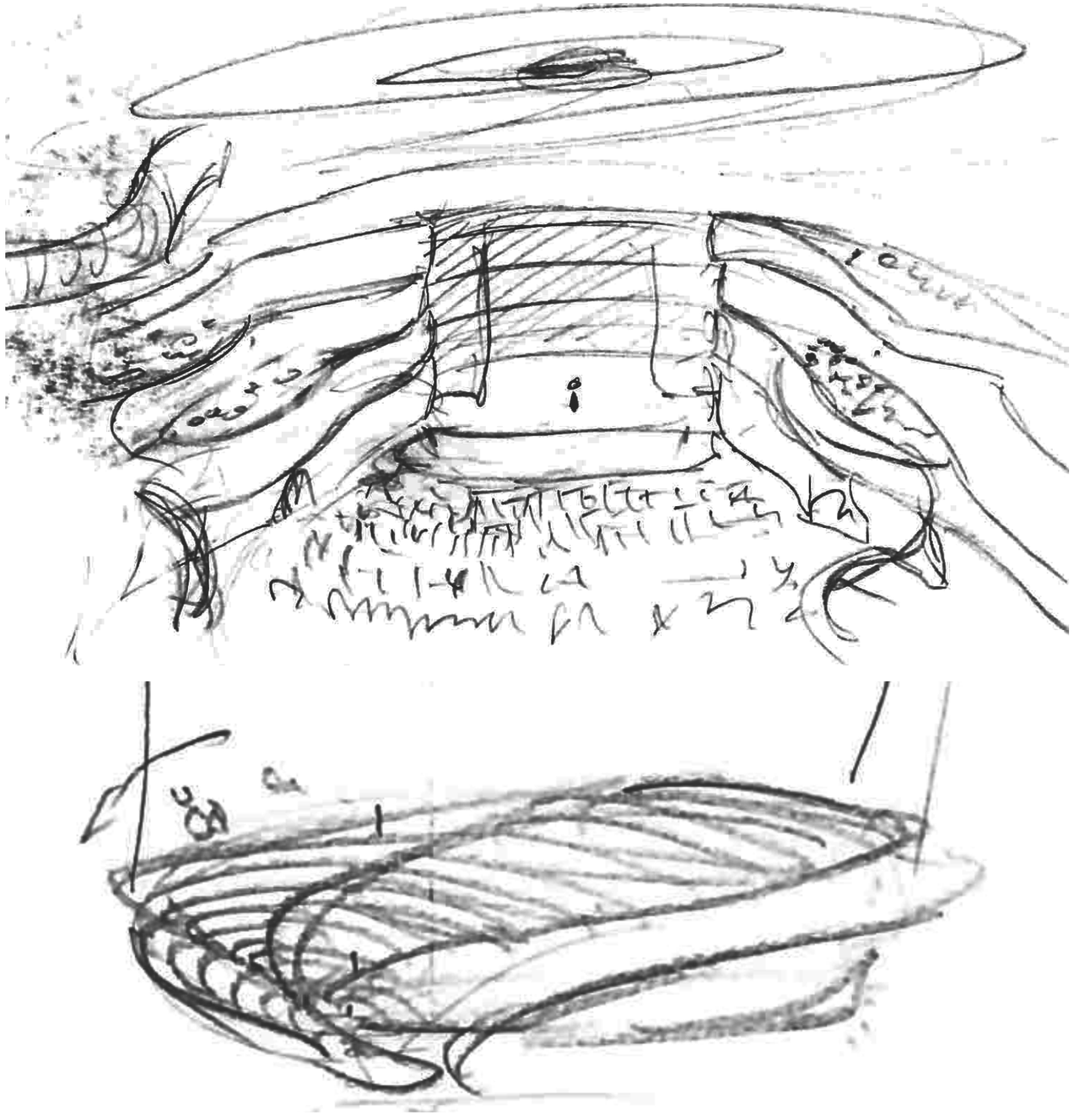


Adding Folds

At some point after having chosen a concept, the folds were drawn up. The initial concept was somewhat overexposed, so we thought these could act as protective covers for the opera performance hall.

Glass walls extending from the botton lining of these - then ribbons or shell walls - were also drawn, and later adjusted.

FLESHING THE CONCEPT OUT



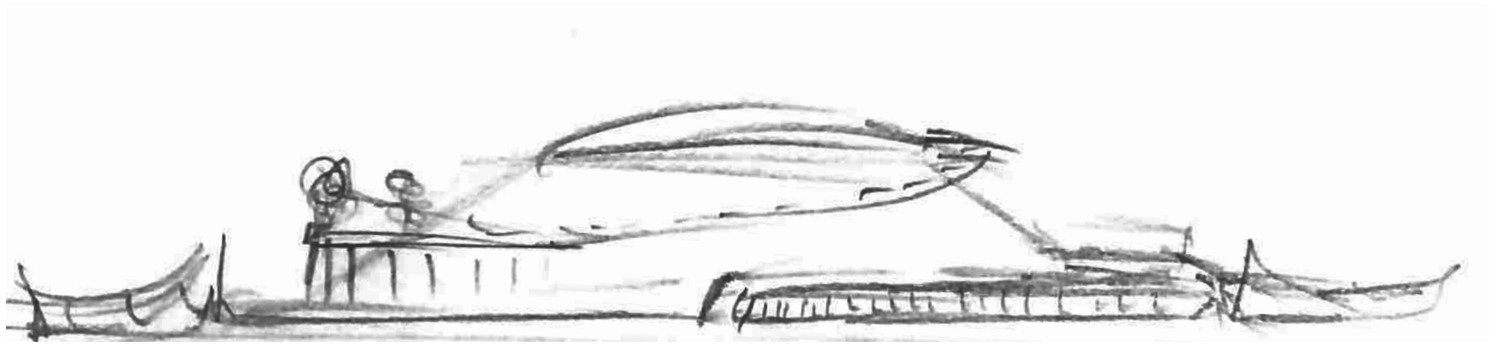
Disconnected Winds

These ideas were simply abandoned since they were deemed not to be cohesive with the hurricane theme exterior. A disconnect was detected.

The top right image wasn't dramatic enough where the sketch was deemed to be too harmonious with the ribbons flowing smoothly on top of one another.

The shape of the balcony to the right was much to disconnected from the rest of the interior, more so leading thoughts to clouds rather than a storm. The balconies were also meant to hang from the roof at first, but was later replaced with an approach where they were cantilevered instead.

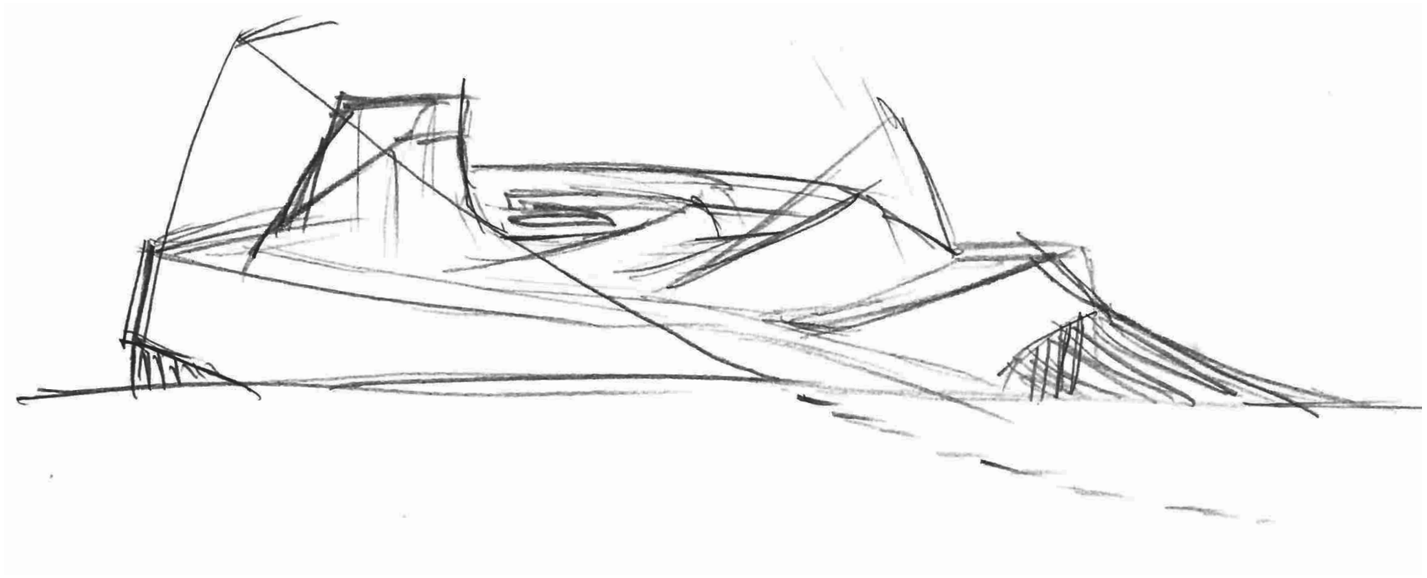
ABANDONED INTERIORS



Cliffside Traversal

A somewhat shiplike version of the plateu idea.

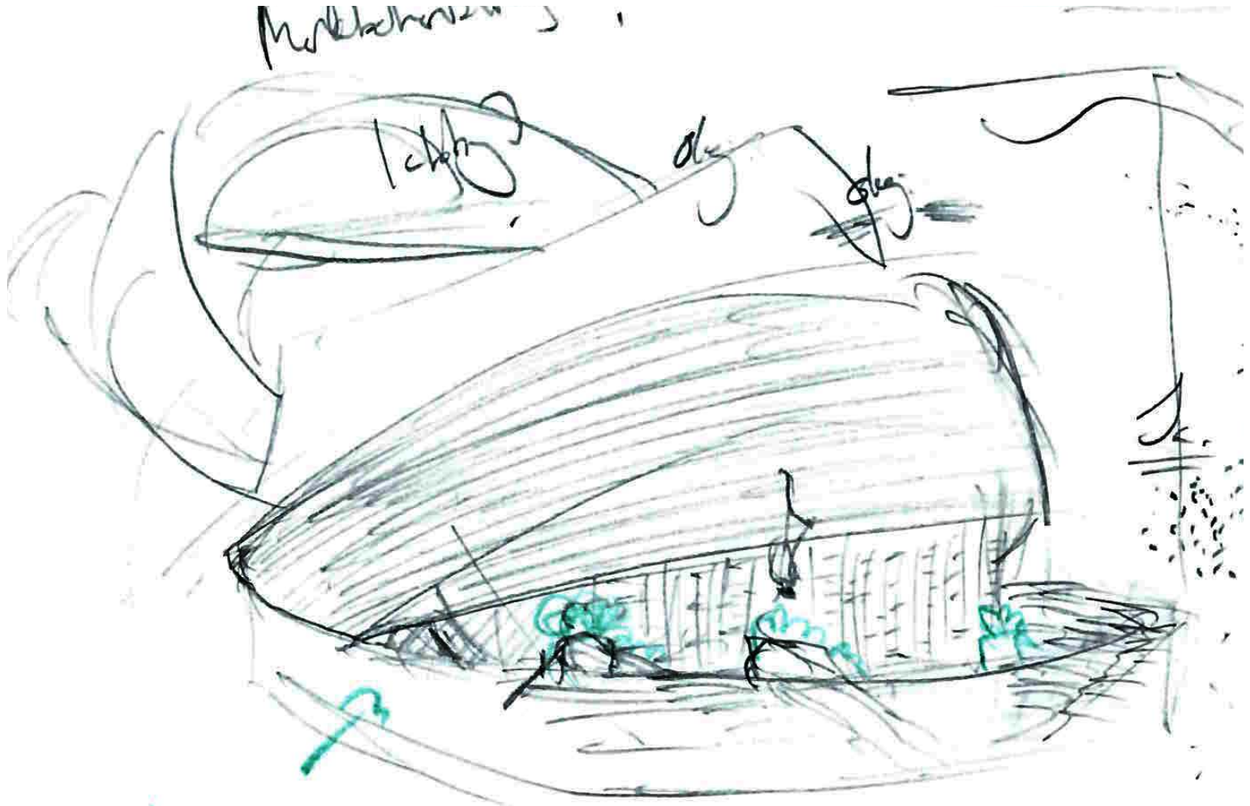
Ultimately ended up quickly abandoned due to the hall being overexposed, drawing being somewhat out of scale (way to large), and not possessing enough levels to create any real interest.

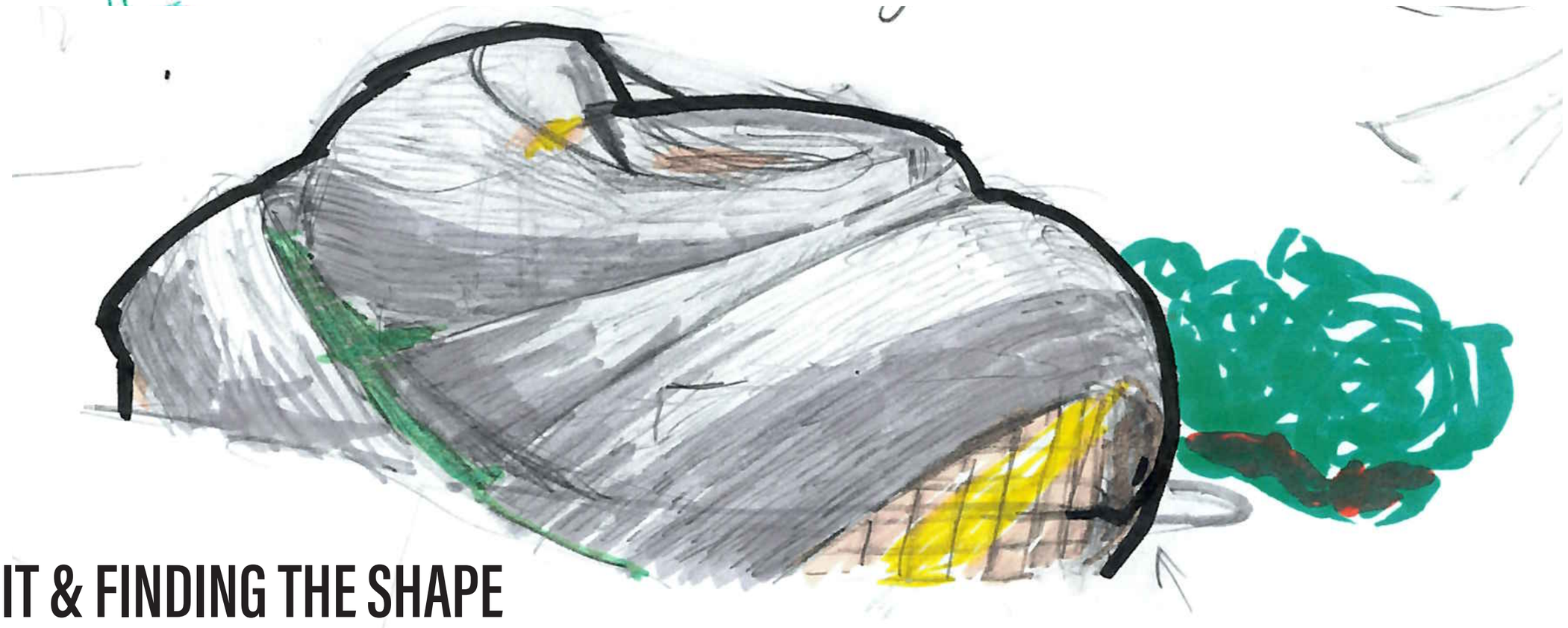


Hanging Bridge

Finding the shape, lines protruding from walls facing this text was thought to potentially carry the bridge, but didn't find consensus. Volume was also somewhat to flattened.

EXPLORATION





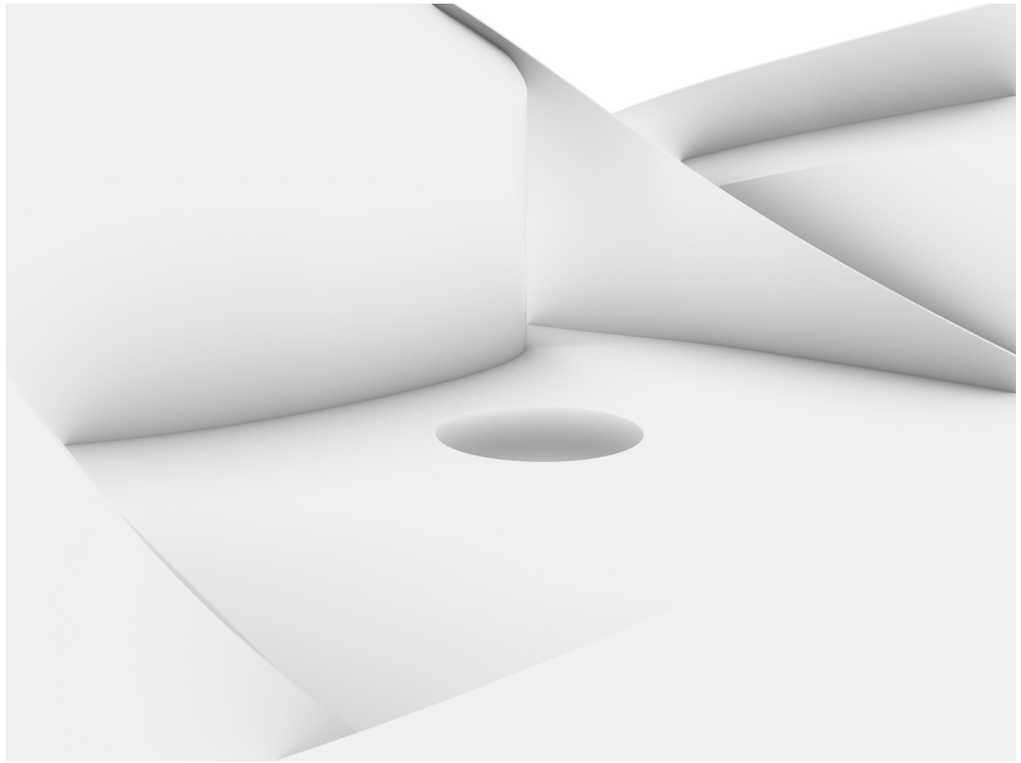
THE PIT & FINDING THE SHAPE

Homing In

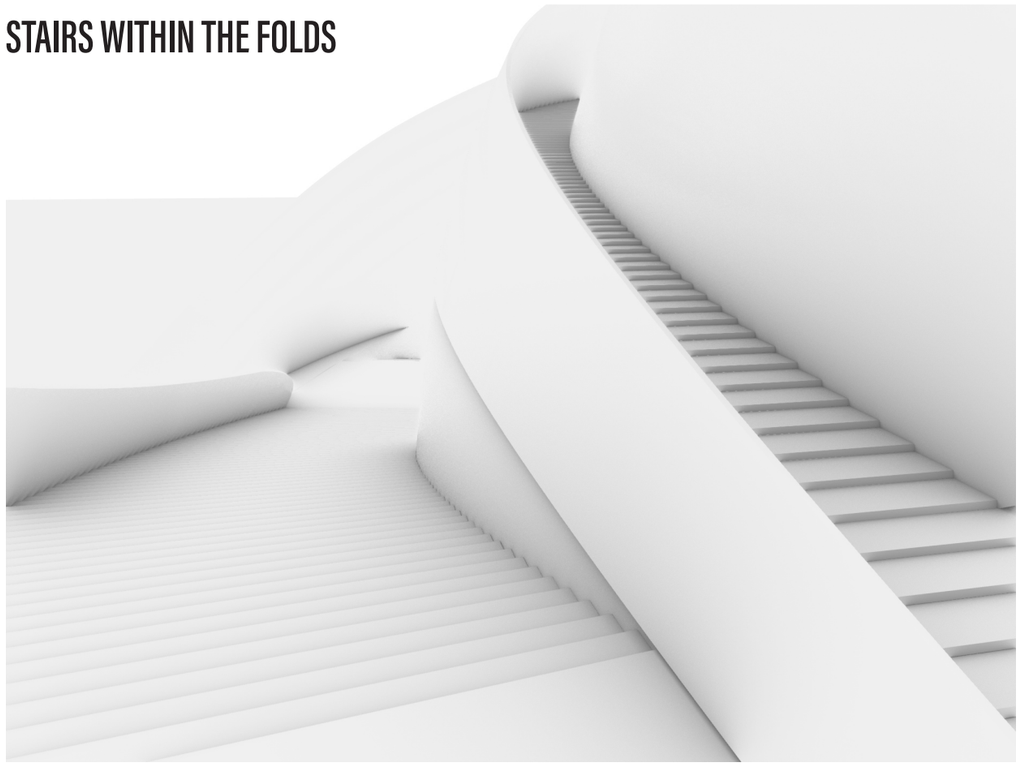
Closing up on the final shape, the colorful drawing deals somewhat with material and its placement, as well as the structures scale. The glass fascade is grided, *hooded* and collaged, more so in the rendering than here, and the hard exterior walls are off overlayed planking, which was better communicated and given shape in the rendering as well, although somewhat absent the preferred linearity shown here. The space between the folds are colored green, not yet fully decided on.

The initial straight bridge has here been traded for one that curves along the glass facade, following the sweeping theme. Running above the pit, which has been segmented into several descendable pathways. A relic yet present in the sketch are the scribbled statues, which were quickly veto'd out.

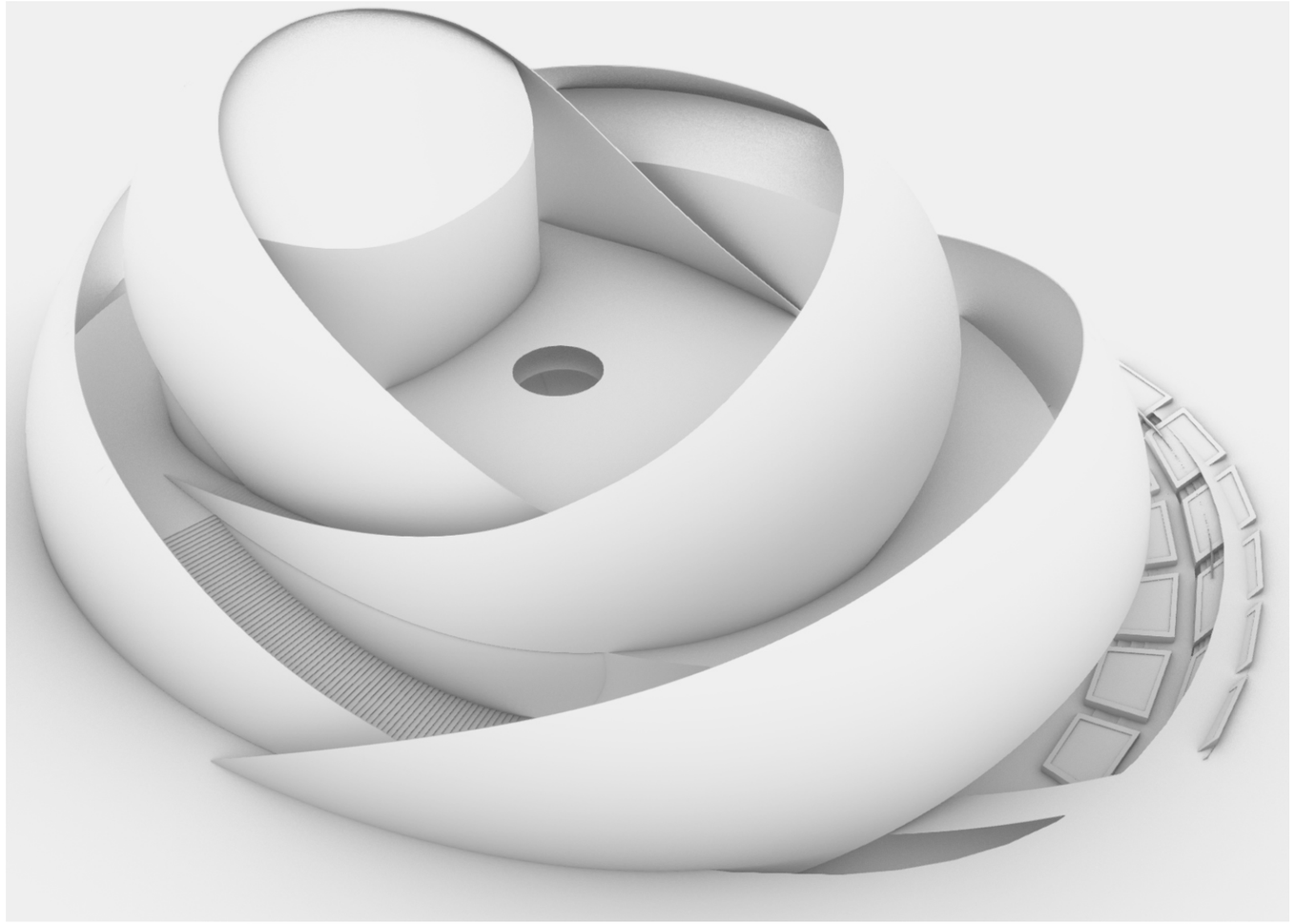
GATHERING PLACE AT THE HIGHEST POINT



STAIRS WITHIN THE FOLDS



BIRDS-EYE VIEW OF BASE MODEL

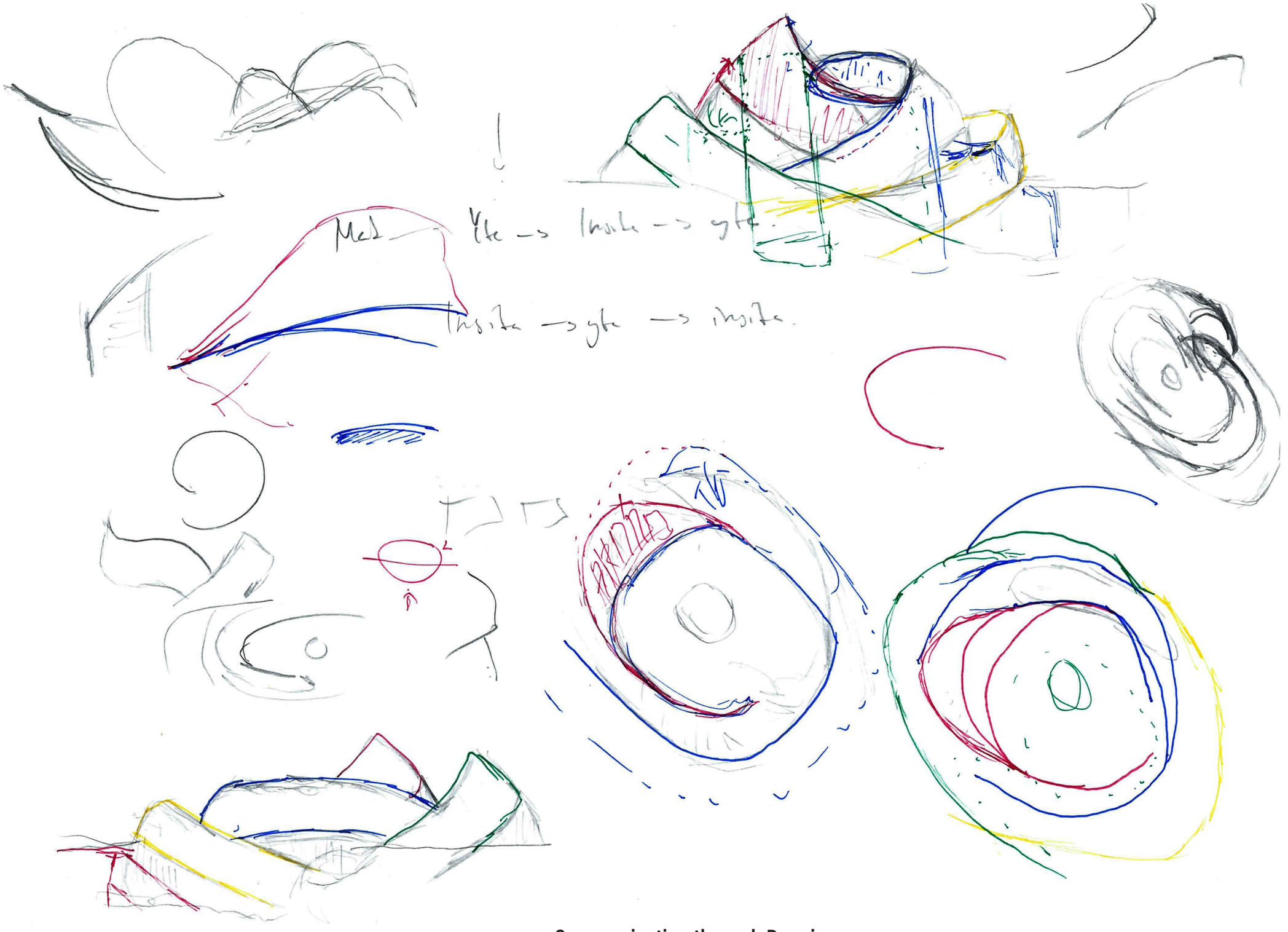


Rhino and Grasshopper

Alternating between working by hand in Rhino and by script in grasshopper, several different stair and ramp solutions were crafted to be variable and flexible in its implementation. The seating arrangement was also patterned in grasshopper, although not displayed here.

I was especially fond of the ramp+stairs mix that helps the visitor descend into the pit, where the resting places of the ramp intersect with the several stairs along the way.

MODELLING



COLORED LINES

Communicating through Drawings

In order to make out what shape was which during the modelling process, colored lines helped clarify what curves were the same from different angles.

The Framework & Iterative Process

The approach of firstly shaping the facade and designing the interior was not surprisingly a quite stressful one, since it led to a lot of uncertainty due to being a process of making a building in which we weren't quite used to. Although challenging, I do not regret having taken such an approach, since I find I enjoy projects where the end result somewhat surprises you.

Critiques

Early on we received some questions regarding how the interior and exterior were connected, which we tried addressing in a rework.

The means of which we dealt with the noise criteria seemed sensible, but not wholly convincing, never exactly clarified why. I suspect it has to do with how the interior walling of the opera performance hall is wholly covered in absorbtive material, which may give rise to some effects beyond my understanding.

From a broader viewpoint, the flow, graphs and visualisation of the project left a lot to be desired. A lack of cohesion was pointed out in the elements in the posters, as well as difficulty orienting oneself/getting a feel of the actual project beyond the two renderings.

A more convincing narrative and display pertaining to 1. the visitors experience and 2. the cyclical reuse of materials from ruins left in the wake of a hurricane would've made the proposal a lot stronger and convincing.

The description of the exterior walls weren't properly communicated by its rendering, this was a fall-out of a lack of familiarity with the method at that time.

Techniques

A lot of traditional sketching, modelling in Rhino and grasshopper, use of photoshop using screenshots of the models as a base for the renderings..

Importing a 3D model of the location was achieved through a mix of renderDoc, google maps and Blender per a tutorial found online.

Our acoustician mainly used matlab as well as the sourcing of different charts to pick material and run analysis.

Evaluation

Most of the criteria of the competition addresses the values desired in the interior. We did take these criteria account but it was far from our main focus.

Our own criteria was one of creating a public place of interest, and one that was good to our own standards. I do like our project more than I dislike it, although there are quite a few reasons I am not entirely happy with it, but none a reason I that cannot be amended through further work, or addressed in future works.

REFLECTION

CHALMERS

UNIVERSITY OF TECHNOLOGY