

The Singing Glass

Year: 2024
Location: Shibuya, Tokyo
Course: Bachelor's thesis in Architecture and Engineering
Collaboration with Gustav Johansson
and Mårten Muregård (acoustician)

"A new opera house is to be built in Shibuya, Tokyo. The hall will be used in collaboration with the music program at the nearby Aoyama Gakuin University, as well as for professional performances."

The Singing Glass

In the heart of Shibuya, one of Tokyo's most vibrant and culturally important districts, The Singing Glass emerges as a beacon of music, standing over 150 meters tall. In collaboration with the newly founded music program at the neighboring Aoyama Gakuin University, The Singing Glass offers a modern and redefined version of opera, enriching the already prominent cultural scene of Shibuya while simultaneously elevating the rich operatic tradition of Japan to new heights.

The close proximity to both Shibuya Station and the Aoyama Gakuin University will provide the opera house with a young and diverse audience, incorporating opera into the existing nightlife culture in the area, as well as bridging the gap between tradition and modernity.

In The Singing Glass, the opera hall has been elevated high above ground, moving it further away from the loud and sporadic street soundscape. The city noise at that level is more even, and therefore easier to handle. Furthermore, its visitors are offered a splendid view of Tokyo from above, as well as a distinct transition between the busy streets and the main opera hall, allowing the visitors to ascend to a realm of music, detached from the world below.

Wall Construction and Noise Criteria

The glass facade comprises of a double-leaf glass panel - two layers of glass, 9 cm and 7 cm thick, separated by a 15 cm air gap. This configuration significantly reduces sound pollution from the outside, sufficiently to meet demands of NC35 throughout the building.

To achieve NC25 in the opera hall, a doubleleaf wall construction is utilized, consisting of two layers of 25 cm thick concrete, with a 10 cm thick layer of absorption material between them. The inner concrete layer rests on springs to minimize vibrations.

Rehearsal Rooms Explained

The rehearsal rooms are located on either side of the main opera hall. They feature large glass sections allowing natural light to enter. Two layers of the glass facade panels help maintain a noise level of NC25. The walls are constructed from poured concrete and are covered with velour carpets. The acoustics can be adjusted using carpet rolls that can be lowered as needed. Clarity ranges from 5 - 7 dB, with strength varying from 7 - 4 dB at 1 kHz.

Floating Floors in MER-MEPFIT Rooms

The rooms designated for MER and MEPFIT are equipped with floating floors to reduce impact noise. The machinery is placed on spring systems.

Acoustic Configuration in the Opera Hall

The opera hall also features a speech configuration, which can be utilized with electro-acoustic amplification. This system includes speakers positioned above the stage, with all panels flipped to their fiberglass side, covering 70% of the wall area. This setup helps reduce the reverberation time.

Communication and elevator systems

The height of the building results in a highly vertical layout, relying on three elevator systems. A central elevator system transports opera attendees from ground level to the lobby, while the other two connect the lobby to the upper floors of the building. Thus, the lobby serves as a social midpoint of the building.

The floor between the lobby and the parquet serves as a staff level, including dressing rooms, individual practice rooms, a green room, as well as the scene shop. To transport materials to the scene shop, as well as to the stage, an exterior cargo elevator runs along rails on the building facade.

Alternative Orchestra Configuration

The grandeur of Utau Garasu, towering above nearby structures, is echoed within the opera hall, where the orchestra may be seated on the top balcony, allowing the audience to be enveloped by the music. The conductor would then be stationed on a separate balcony above the stage.

The hall offers a reverberation time of 3 seconds, surpassing that of contemporary opera houses. This is achieved by opening the insulated walls to the adjacent rehearsal halls, thus transforming them into echo chambers. This design choice opens new avenues for modern composers to create operas for spaces that can sustain longer sound, a possibility not found in other opera halls.

Flexible Acoustics

The opera hall is however designed with versatility in mind, also allowing a more traditional setup, with the orchestra seated in the pit and a reverberation time of 1.6 seconds.

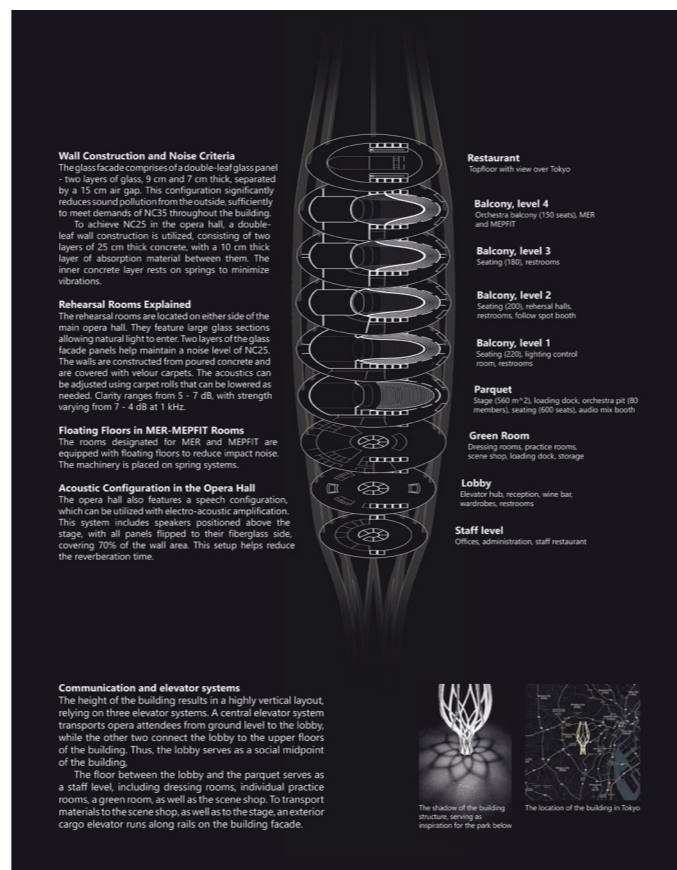
The orchestra pit boasts a lifting mechanism that allows for three different configurations: lowered for a standard pit, mid-height to expand the parquet seating, and raised to stage level to extend the performance space.

Inside the hall are large panels that can rotate both horizontally and vertically. These panels have poured concrete on one side and fiber glass panel on the other, permitting precise acoustic adjustments. Additionally, the slanted beams within the hall have a diffusing surface texture, further refining the sound quality across the venue.

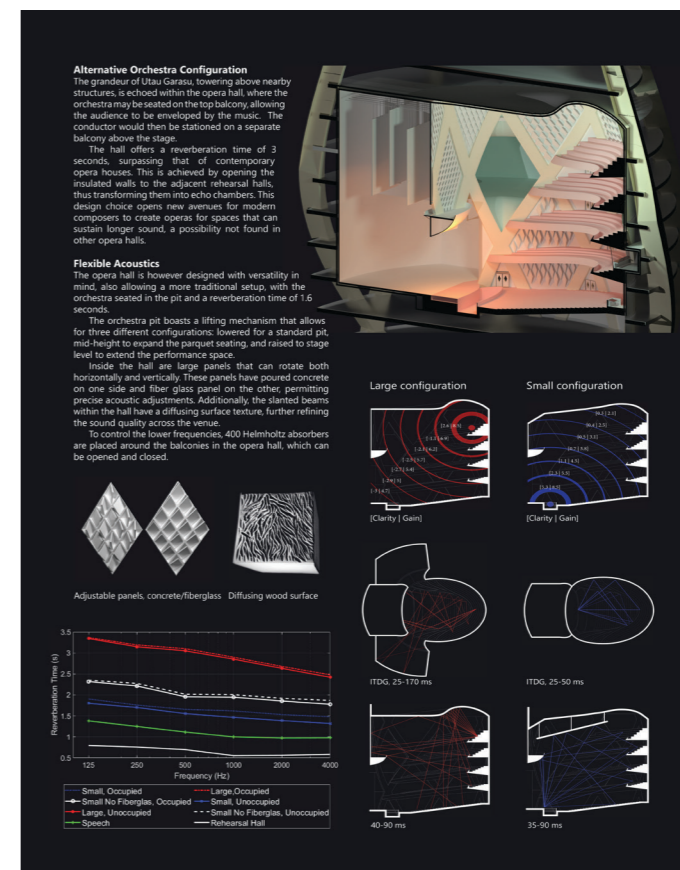
To control the lower frequencies, 400 Helmholtz absorbers are placed around the balconies in the opera hall, which can be opened and closed.



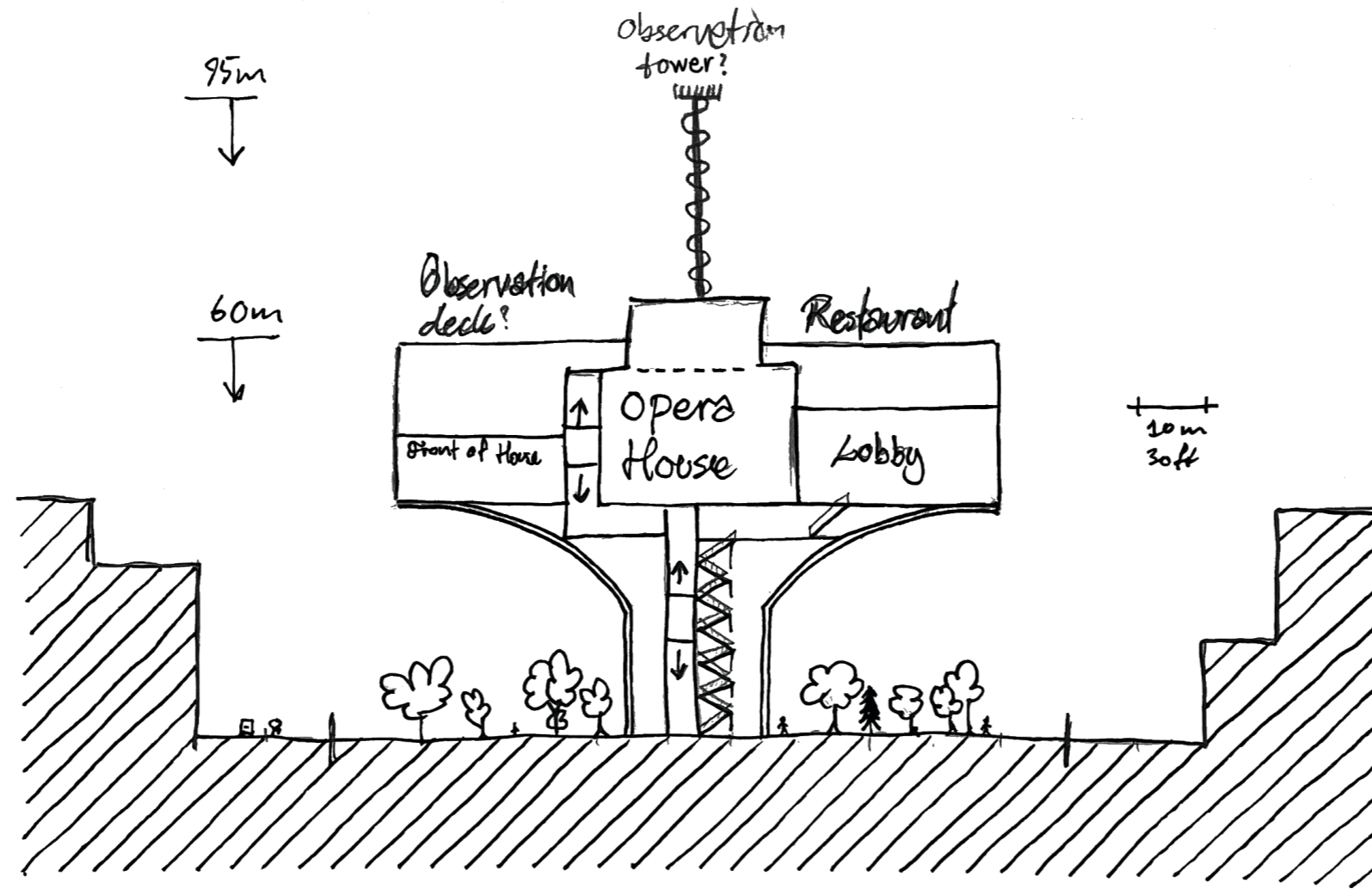
Exterior



Interior

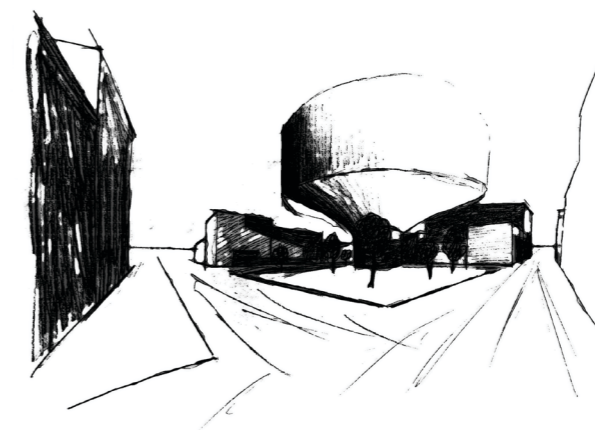
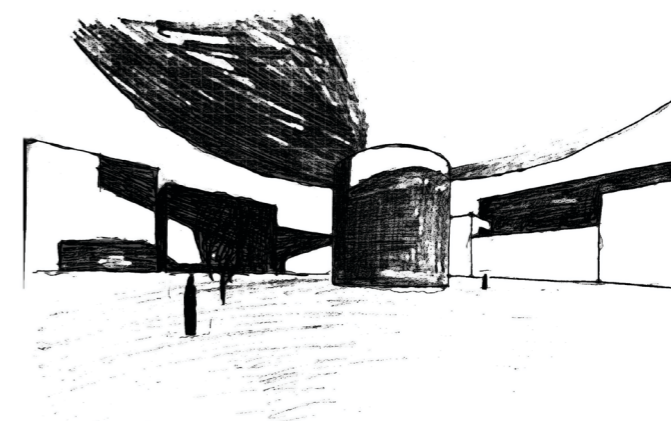
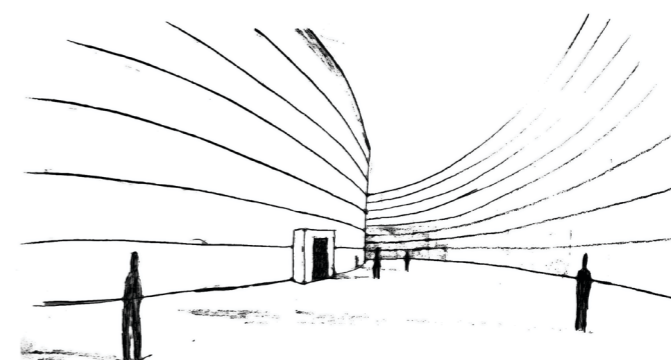


Acoustics

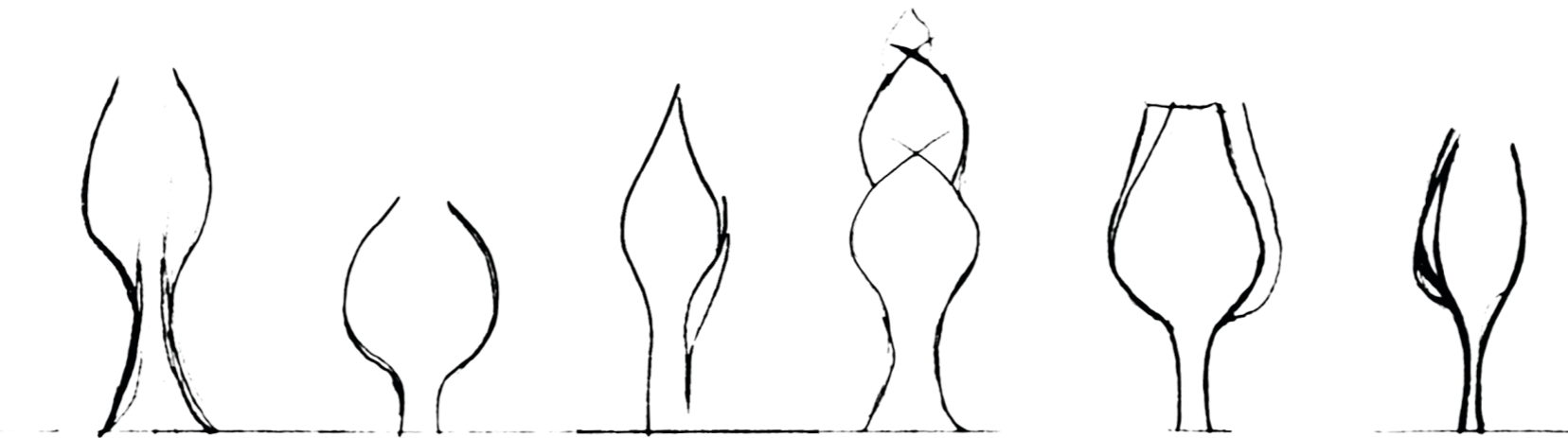


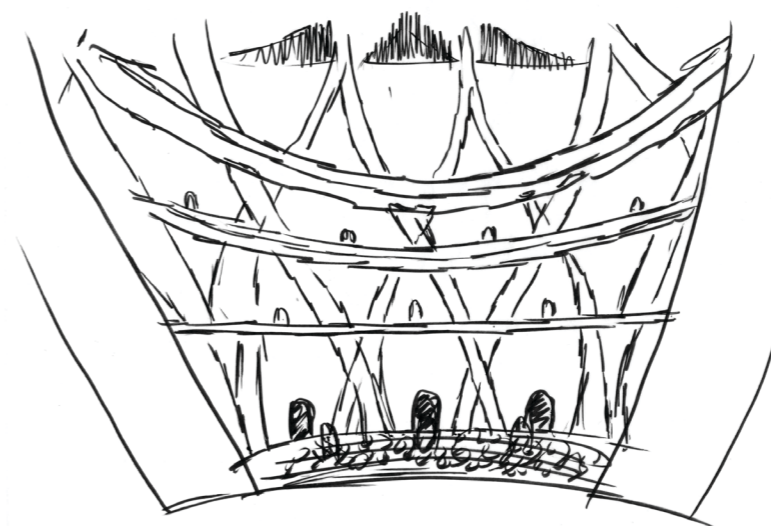
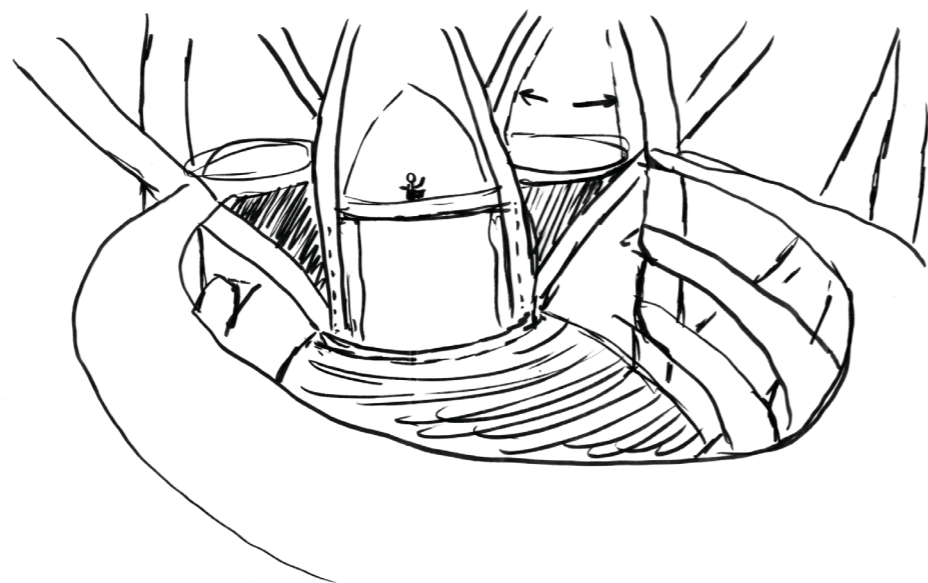
In the beginning of the project, Gustav and I came up with three very different concepts for the project. One of these concepts was the so-called Water Tower, which was a manifestation of the idea of elevating the opera hall itself from the ground, to move it further from the city noise originating at street level. Essentially, it would be a cylindrical opera house resting on a single column, within which all elevators and staircases would be located. The opera hall itself would be located in the very center of the building, to shield it from exterior noise.

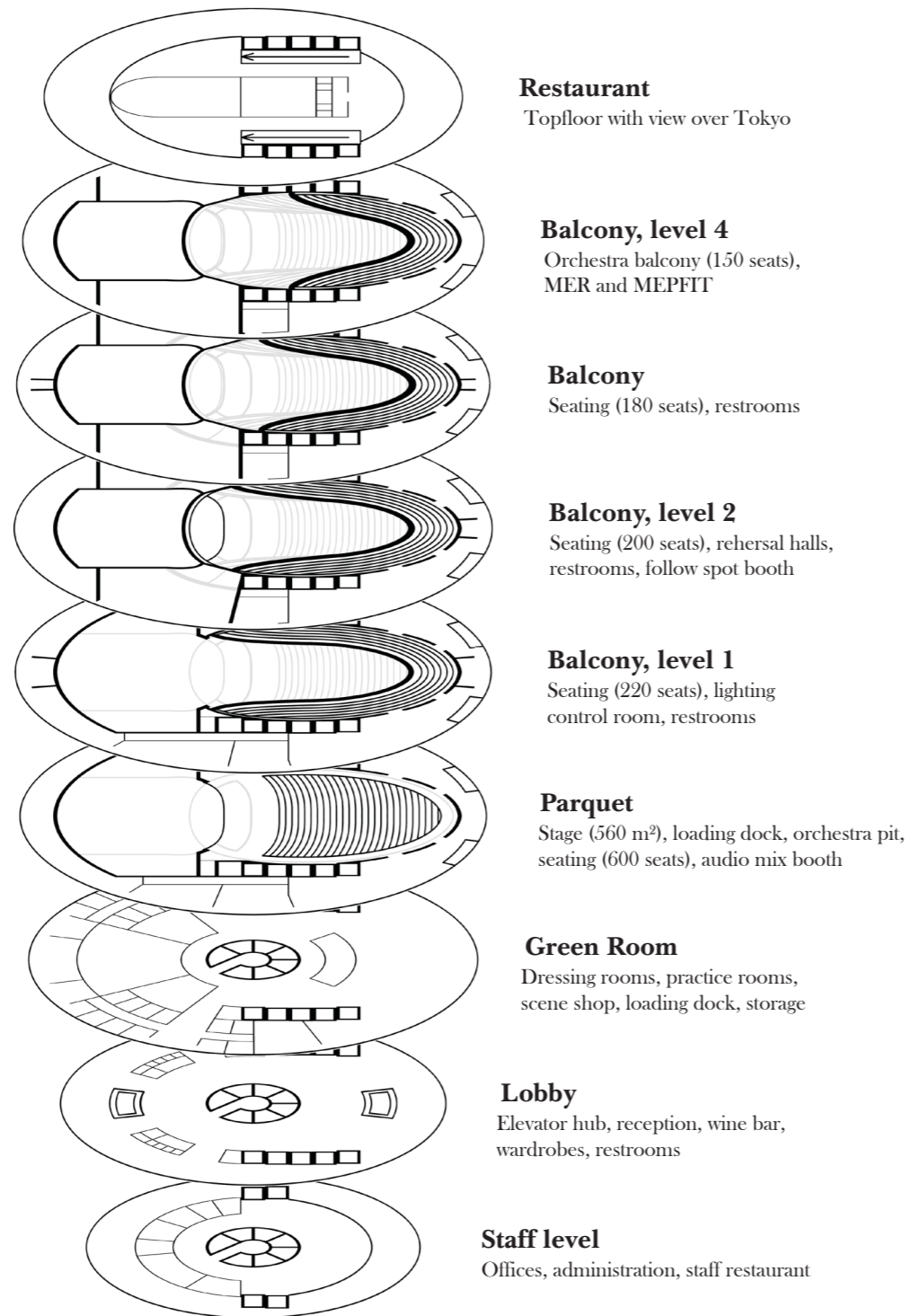
In many ways, this concept remained prominent throughout our entire design process, and even though our final design differs from the early sketches of the Water Tower shown to the right, the core ideas of this concept can still be found in our finished project.



The reason for changing the shape of our opera tower was to allow more daylight to reach the ground around the base of the building. The upper part of the Water Tower would cast a large shadow, and make the area beneath fairly dark and unpleasant, which we wanted to avoid. Therefore, we tried to create a more slender shape for our tower, which led to several different ideas inspired by tulips, lightbulbs, and champagne glasses.



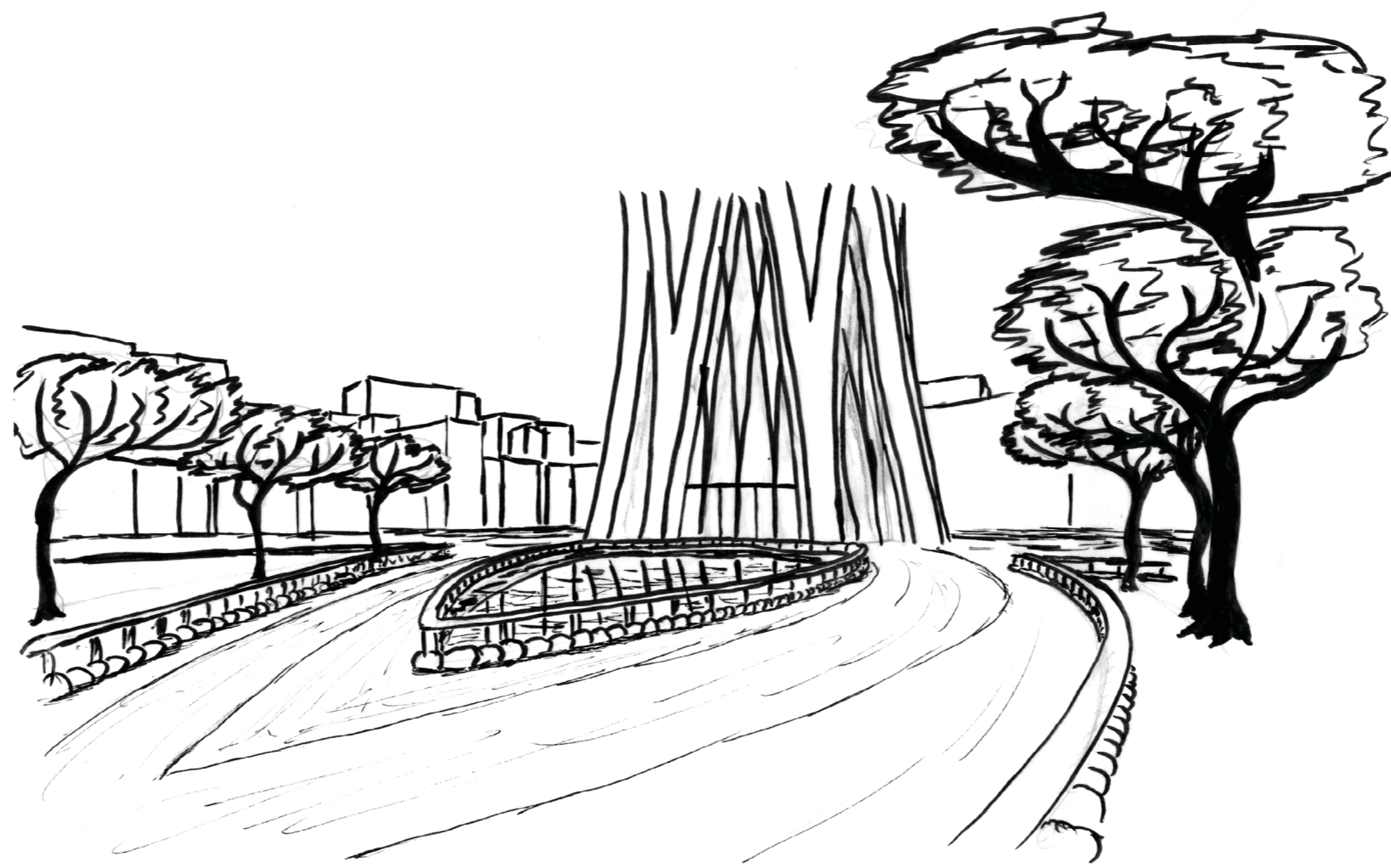


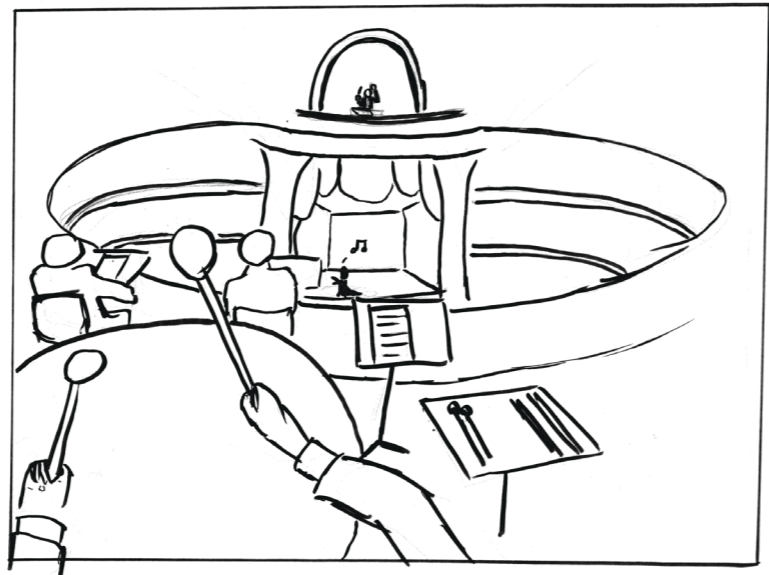


Since we wanted to keep the tower as narrow as possible, the obvious choice was to divide the contents of the building into as many different floors as possible, using the height of the building to our advantage. As a result, the opera hall alone occupies five floors of the buildings. Other room functions, such as the lobby and the green room, are located on different floors.

The elevators located in the center of the building cannot go through the opera hall, for obvious reasons. Therefore another two sets of elevators are located along the sides of the opera hall, to allow travel between the upper floors of the building. This is why the lobby is located about 60 meters above ground level, serving as an elevator hub.

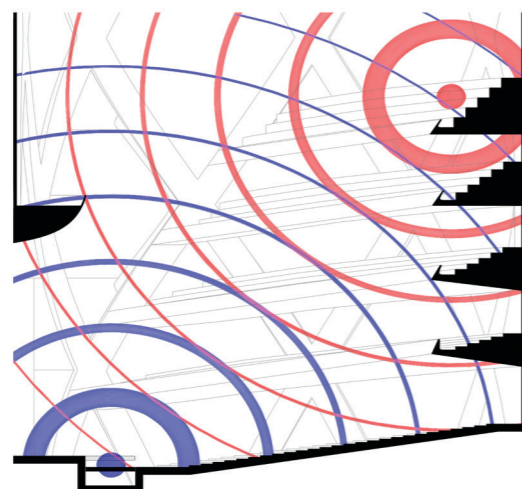
The area around the tower has been designed as a tranquil park, to create some sort of transition between the busy city streets and the musical experience within the opera house. The shape of the park derives from the shadows that would be cast from the main load-bearing structure of the building, if a light source were to be placed at the top. The result is a flower-like pattern, with eight shallow water ponds surrounding the tower, reflecting the light from the building at nighttime.





Another one of our three initial concepts was an acoustic one. We envisioned an opera hall where the orchestra would surround the audience, to create a sense of envelopment. This concept was aptly named “Surround”, and similar to the Water Tower, the essence of this concept remained throughout the project.

To get an even sound level across the opera hall, where all instruments are heard from every seat in the audience, we wanted an unconventionally long reverberation time in the hall. Our acoustician Mårten agreed to this, and suggested the use of openable echo chambers to create very flexible acoustics. This echo chamber could perhaps have been located above the audience, but instead we decided to utilize the already existing rehearsal hall to increase the total volume of the opera hall, and therefore the reverberation time.



In practice, these echo chambers might not work the way we would like them to. The more Mårten looked into how this setup would work, the more unclear it seemed. Echo chambers in opera halls aren't very common to begin with, and those that exist are usually located either above or behind the audience. Since our echo chambers are located next to the stage, the sound from an orchestra located on the top balcony would need to travel a long way to reach the echo chambers, and then be reflected back to the audience. The result may be more of an echo than a reverb. Nevertheless, the concept is very fascinating, and has been interesting to explore as thoroughly as we have.

