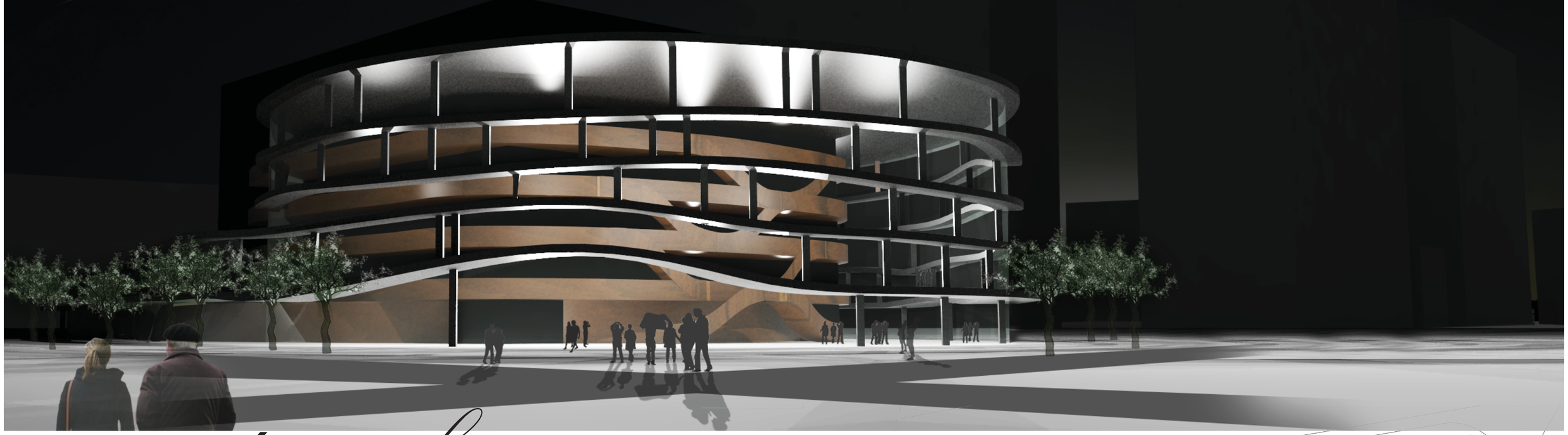
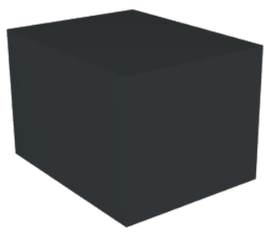
Syfte

Syftet med det här projektet var att utföra en operahall lämpad för både universitetets studenter och stora tillställningar som involverar hela staden. Platsen är belägen i en akustisk svår miljö i Montreal, Kanada, mellan motorvägar, järnvägsspår och flyplatstrafik.

Byggnaden skulle också verka som en naturlig samlingsplats för alla studenter på universitetet, både sommartid och vintertid. Integration mellan studenter och befolkningen som inte har en direkt koppling till universitetet skulle vara möjligt, t ex genom gemensamma tillställningar, utställningar eller restaurangbesök.

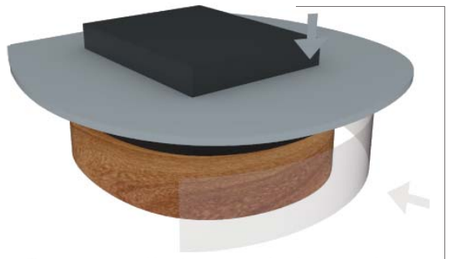


meeting for music



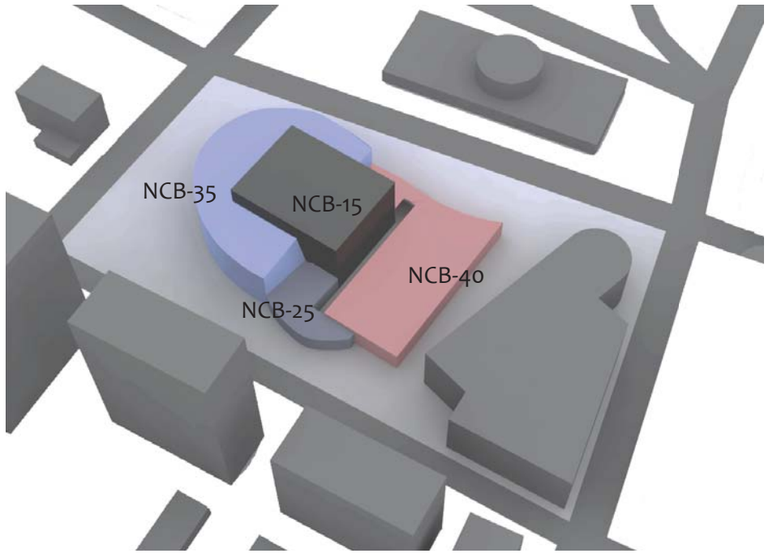
Concrete shell - contains the auditorium, stage and sidestages. The concrete shell composes the primary protection from surrounding noises - for the rooms that are most dependent on sound protection.

Second protection shell - contains all the functional rooms needed in an opera, such as rehearsal rooms, dressing rooms, costume shops, storage and scene shop.



Transparent sound barrier - an extra facade protects the entire building from exterior sound. The thick concrete roof spreads over the entire building and acts as a shield from airborn traffic passing over head.

Isolation by separation



Public

The NCB -35 for the public space is achieved by an isolating double glass facade and a thick concrete roof.

Performance

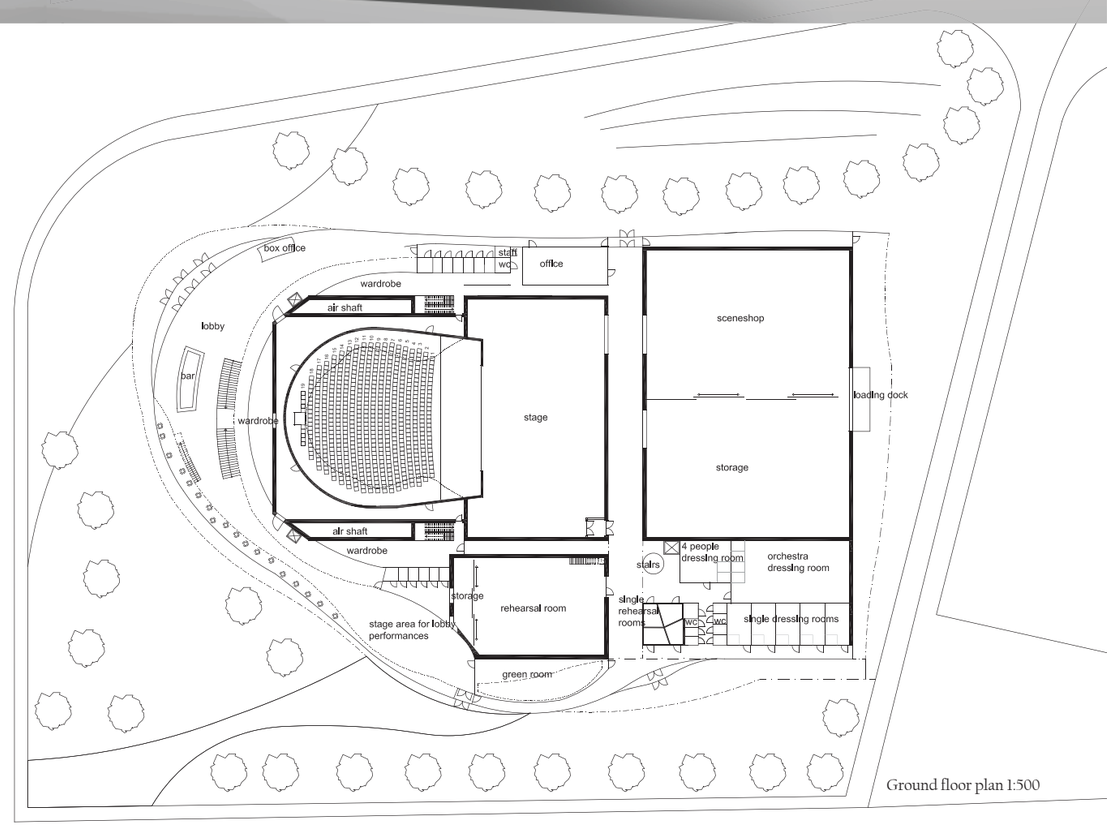
The sound criteria in the auditorium is achieved by double walls and a double roof - all seperated by air space. The space between the walls functions as a noise lock, while the space between the roofs is used for ventilation air.

Multipurpose

The multipurpose zone contains the large rehearsal room and the green room. These are for both private use and for public events. These rooms are situated at the quiet end of both the lobby and the workspace areas - giving it good qualities both acoustically and logistically.

Work/practice etc.

This zone - containing storage, sceneshop, machine room, dressing rooms etc is seperated from the other zones by a wide corridor, minimizing the risk for sound transmission.

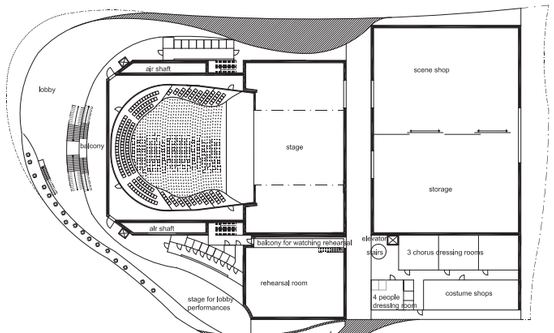


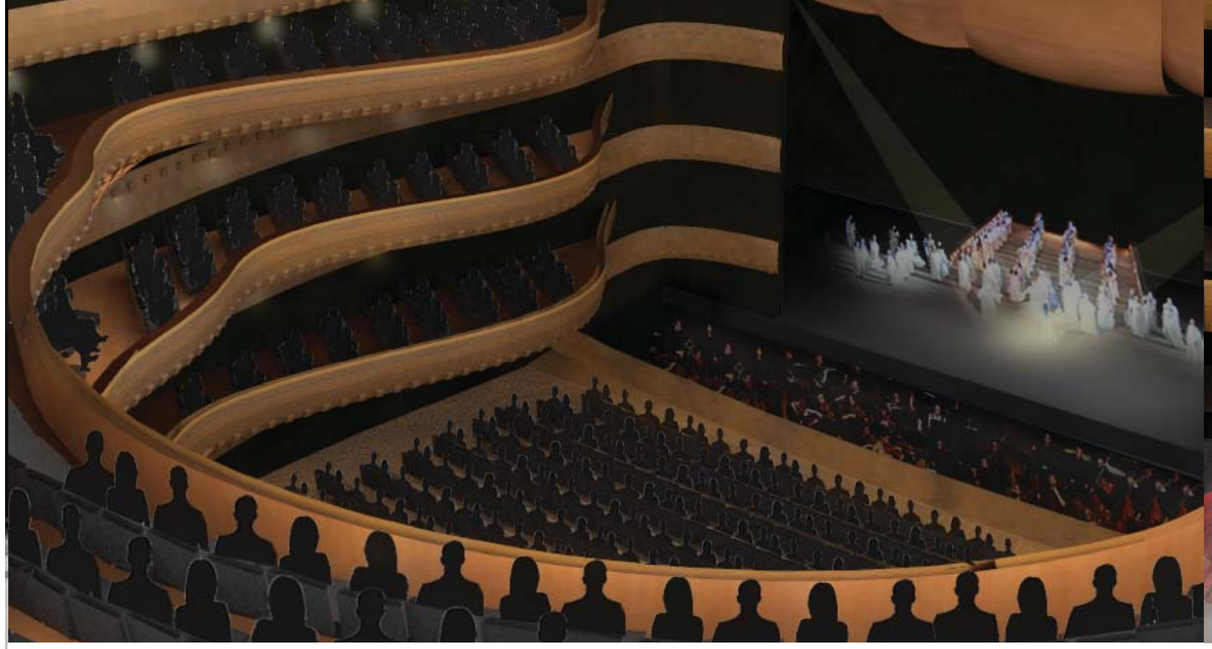
Ground floor plan 1:500

Maximising efficiency of sound isolation

To maximise efficiency of sound protection the building is designed to be sound effective. It is divided into different zones which are seperated from one another. This effectively reduces sound transmission between the zones.

The airshafts on each side of the auditorium are effectively placed outside of the thickest shell wall that embraces the auditorium. Their large cross-section area minimises the noise from the shafts.
The ventilation of the auditorium is practically soundless by air rising up through the floor and continuing through to the ceiling. By having a ventilation opening at each chair, and a seperate used-air chamber over the ceiling, the air velocity is always kept below 2 m/s.

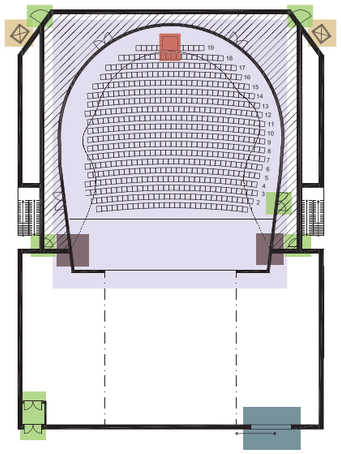




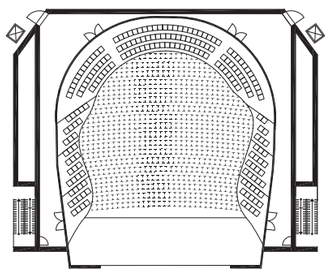
Auditorium

Overview

1st floor, parkett



2nd to 4th floor, balconies

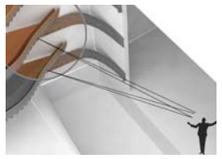


- Free standing auditorium
- Air lock between auditorium and the concrete shell.
- Isolating doors, sealed by magnetic strips
- Free standing elevator shafts
- Decoupled walls to prevent flanking
- Technician sound booth
- Sliding door - sealed, with heavy core

Balconies

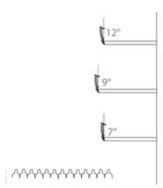
Sinuating balconies

At the front of the auditorium the balcony fronts are bent inwards to provide feedback reflections to the performers on stage.



Balcony front profiles

The balcony fronts are double curved to improve the spreading of sound throughout the auditorium. Their tilting angle increases with the balcony levels to provide all seats with early reflections.

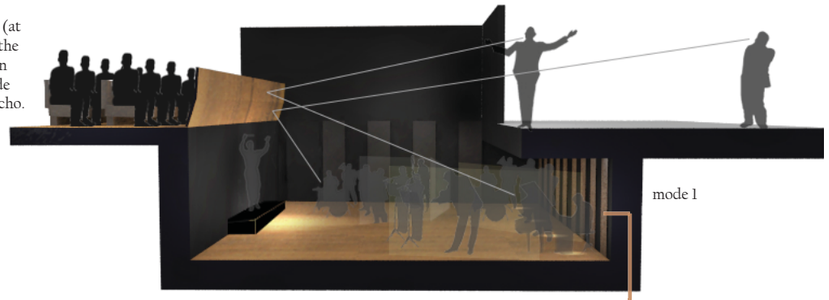


Diffusers

15x15 cm cuboids with a depth of 5 cm are placed on the lower part of the balcony fronts to attain a more even and pleasant distributed sound towards the stall seatings. Integrated in the relief are decorative lighting.

Orchestra pit

The orchestra pit in plan measures 7.5x23 m (at its widest) with 2 m integrated underneath the scene floor. The pit depth is variable between 0 to 3 m with two seperate elevators. The side walls of the pit are tilted to prevent flutter echo.



mode 1

Multiple pit modes

mode 2

mode 3

mode 4

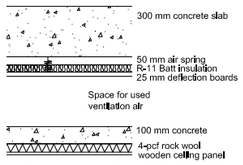
Flexible pit acoustics

Rotatable prisms are integrated in the pit walls making the pit acoustically flexible through its three different surfaces - diffusive, absorbing and reflective. The prisms are evenly distributed on three of the four pit walls. Each side of the prisms measures 60 x 250 cm.

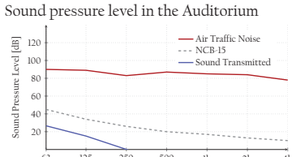
Roof acoustics

The entire building is covered by a concrete slab roof with additional vibration isolation through batt insulation hanging on springs.

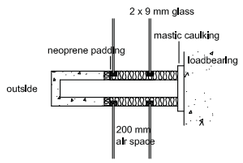
The auditorium has an additional sound isolating roof of a concrete slab and rock wool. The space between the two roofs where the used up ventilation air is held serves as additional sound isolation.



Sound pressure level in the Auditorium

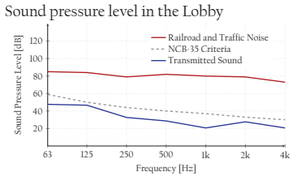


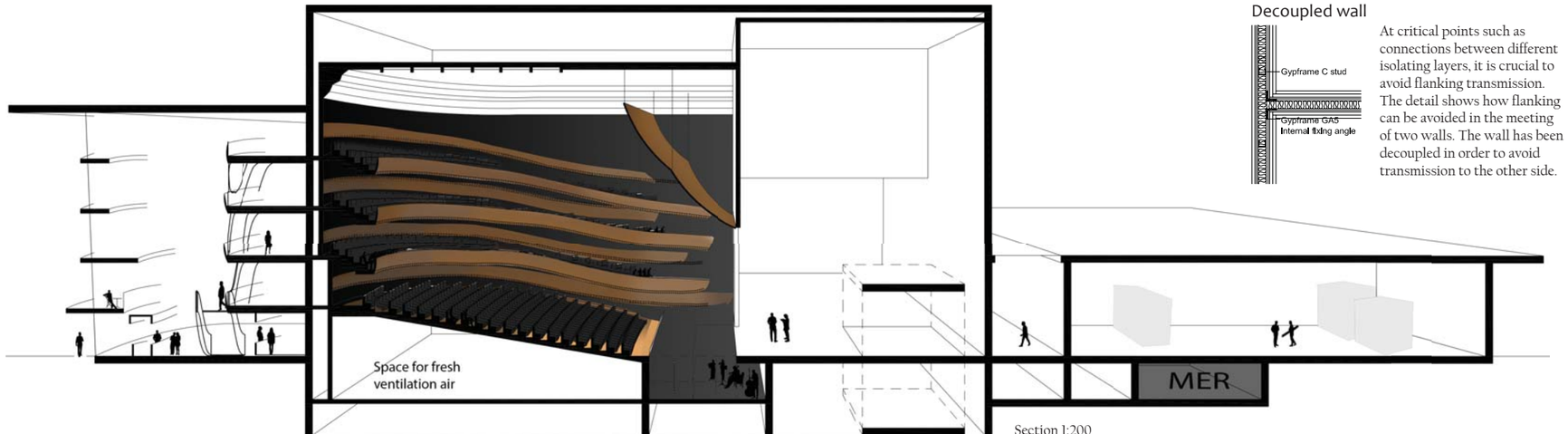
Glass facade



The glass facade, the third protecting shell around the building, is an important sound reducer, especially in the lobby. The detail above describes the glass facade with one of the facade bands through it.

Sound pressure level in the Lobby

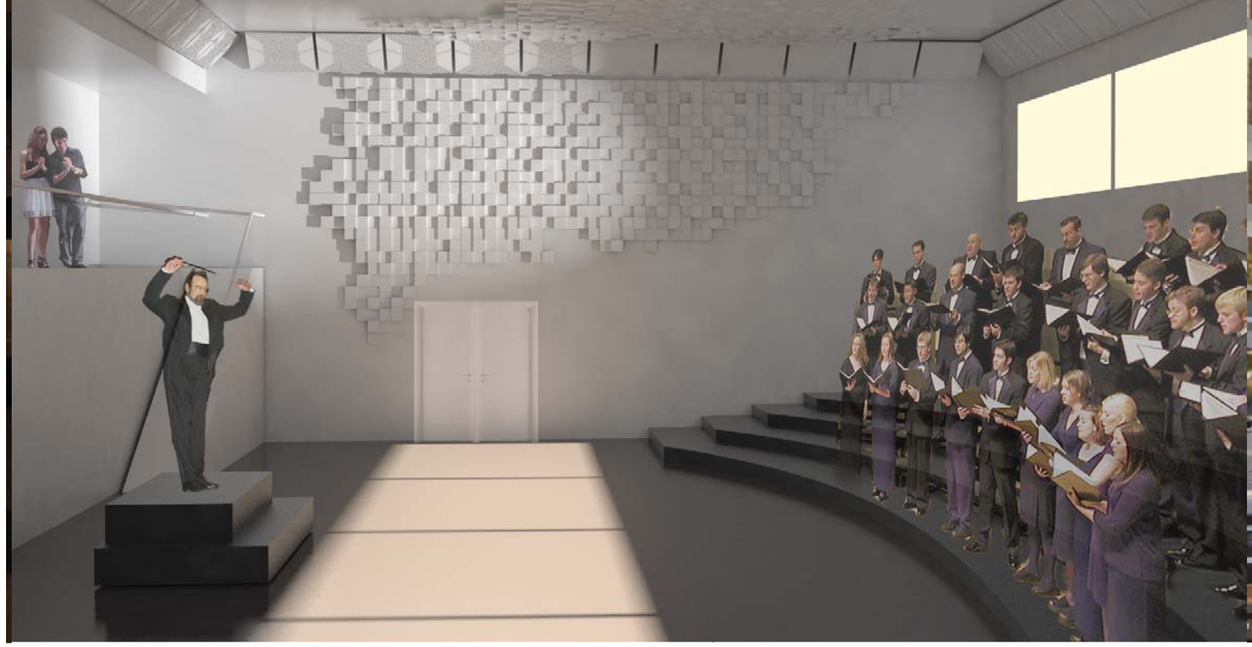




Section 1:200

Decoupled wall

At critical points such as connections between different isolating layers, it is crucial to avoid flanking transmission. The detail shows how flanking can be avoided in the meeting of two walls. The wall has been decoupled in order to avoid transmission to the other side.

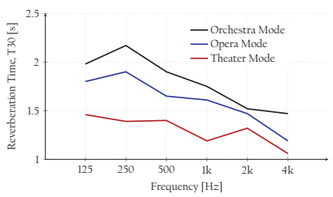


Flexibility in the Auditorium

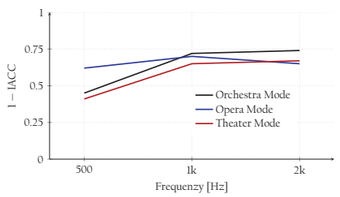
Flexible acoustics played the primary role in the design of the auditorium.

A wide variation of performances ranging from opera and concerts to conferences is possible without the use of sound reinforcement.

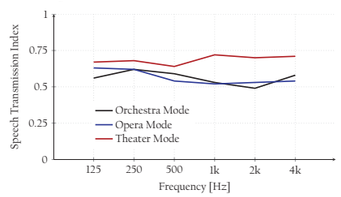
Reverberation Times



Envelopment in the center of the stall



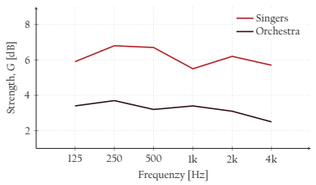
Speech Transmission Index



Opera mode

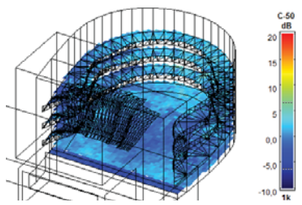
In opera mode the orchestra is lowered into the pit to provide a balanced sound level between musicians and singers.

Balance between singers and orchestra

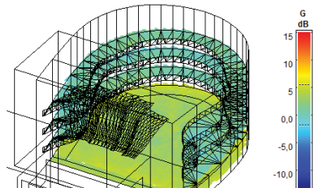


The design of the auditorium and its double curved balconies enables early reflections to all seatings. This results in an overall great clarity and enables the audience to understand the opera singer.

Clarity for one singer on stage without orchestra

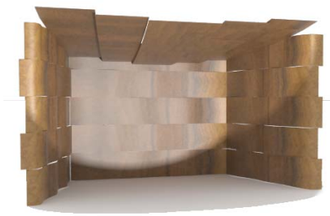


Strength in Opera mode



Orchestra mode

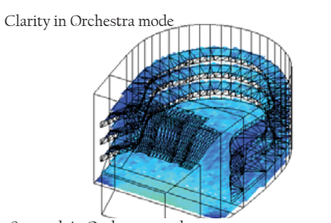
Orchestra shell



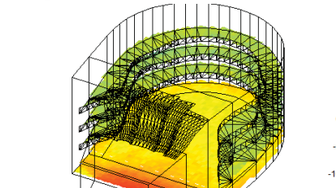
The orchestra shell is made of double curved, form pressed wooden panels. The wavy sides connect to the bands in the auditorium while the roof blends in nicely with the refelector over the proscenium.

When not in use the different sides are easily folded away to the sides and parts of it raised up into the stage tower.

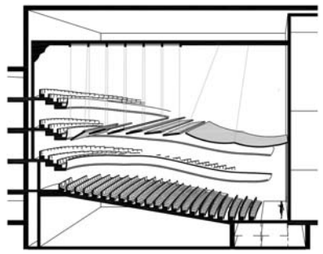
Clarity in Orchestra mode



Strength in Orchestra mode



Speech mode



In speech mode the auditorium roof is lowered in sections. The tilting of these sections can be varied in order to recieve optimum speech reflections.

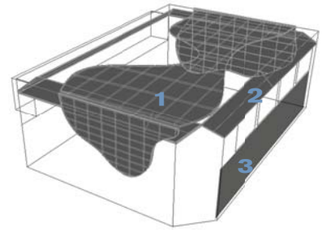
The orchesterpit is altered to mode 4. Half of the orchestra pit is covered with extra seating to move the audience closer to the speaker. The speaker is standing on the other half of the pit, with the stage procenium closed behind him providing additional sound reflection.

The proscenium reflectors are rotated to a horizontal position and provide reflection patterns spreading the sound to the back of the auditorium.

Rehearsal spaces

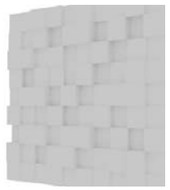
Large rehearsal room

The rehearsal room is daylighted with an inner ceiling height of 7 m. It has a balcony from which you can watch the rehearsals. The balcony can be reached both from inside the rehearsal room and outside from the 2nd floor. The rehearsal room is provided diffusers, absorbers and flexible curtains to enhance its



1 wall/roof diffusers

1-10 cm irregularities scatters the sound around the room and prevents flutter echo. The relief pattern covers 50 per cent of the roof area

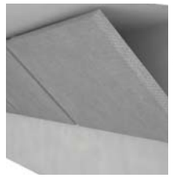


3 curtains

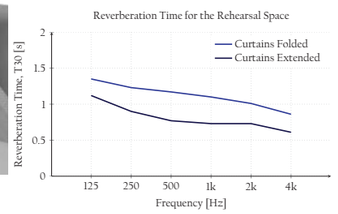
To ensure flexibility of the acoustics in the rehearsal room curtains are installed. Depending on the type of rehearsal the reverberation time can be altered by extending the curtains.

2 diagonal absorbers

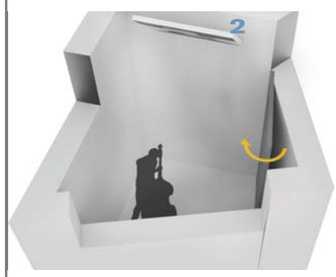
The absorbers are mounted diagonally in the ceiling ends, this orientation enhances the acoustic effects and absorbs even the very low frequency sounds. The absorbers are completely covered in white fabric and blend in to its surrounding surfaces.



Reverberation Time for the Rehearsal Space



Practice rooms



The small rehearsal rooms have differently angled walls in order to prevent flutter echo. One of the walls has a seperately attached diffusing panel which the musician can adjust to suit her own needs.

The small rehearsal rooms also have diagonal absorbers along the top edge of the walls, as described above.

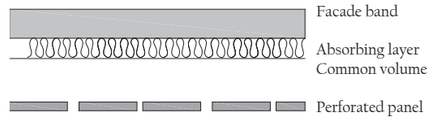
Lobby

The space between the transparent facade and the wooden sound protection layer becomes the lobby with beautiful stairs leading up to the balconies from where the visitors reach the dark and mysterious black box - the concrete shell containing the auditorium.

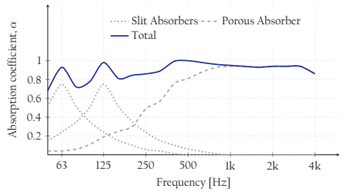
Absorption

The facade bands function as slit absorbers throughout the interior of the lobby. These are tuned to two different octave bands, 63 and 125 Hz, and together with porous absorbers in the ceiling this provides an even absorption through the frequency range of interest.

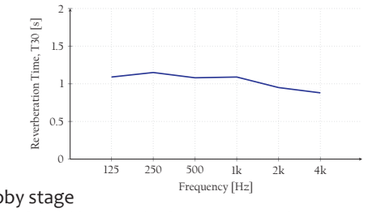
Slit absorbers



Combined absorption of slit absorbers and porous absorbers



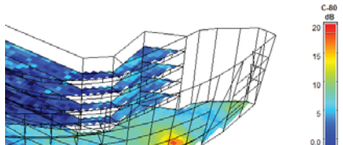
Reverberation time



Lobby stage

A part of the lobby is suitable for spontanius performances, an area created by a bottle neck in the floor plan. The balcony ceilings there are reflective rather than absorbing to ensure listening quality. There is room for placing seats on the ground floor near the stage and the balconies above serve as room for standing audience.

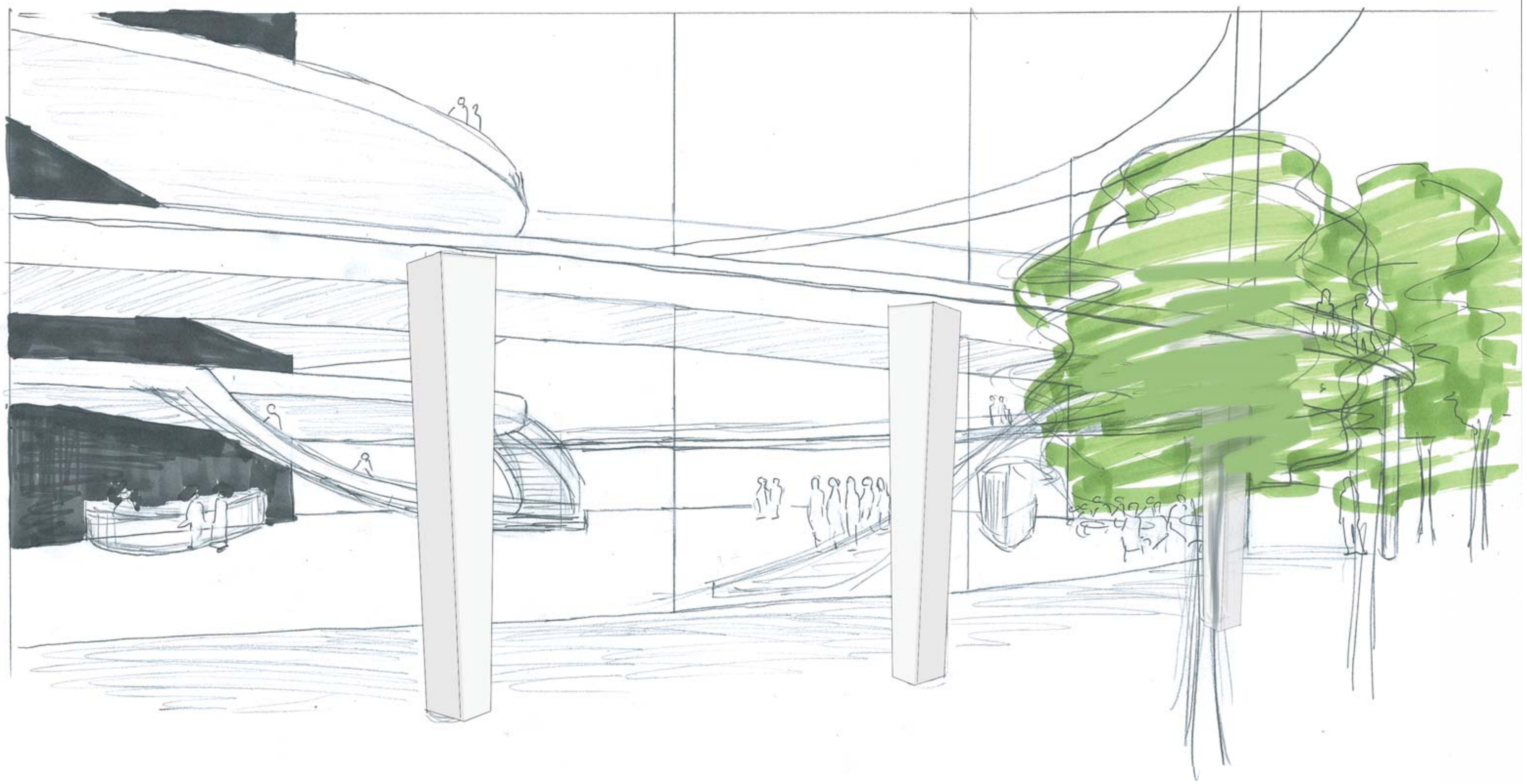
Clarity

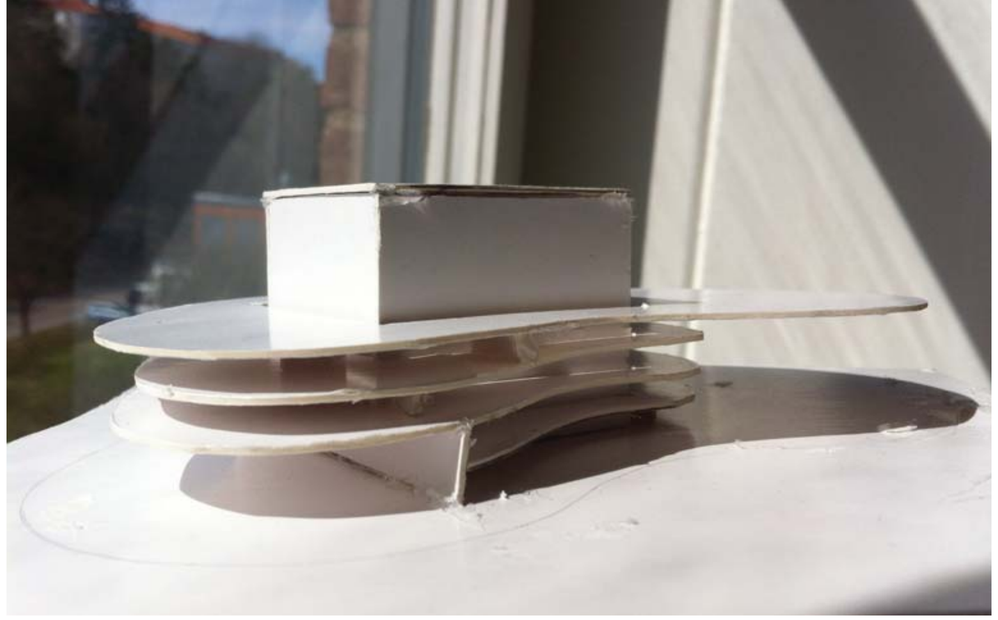


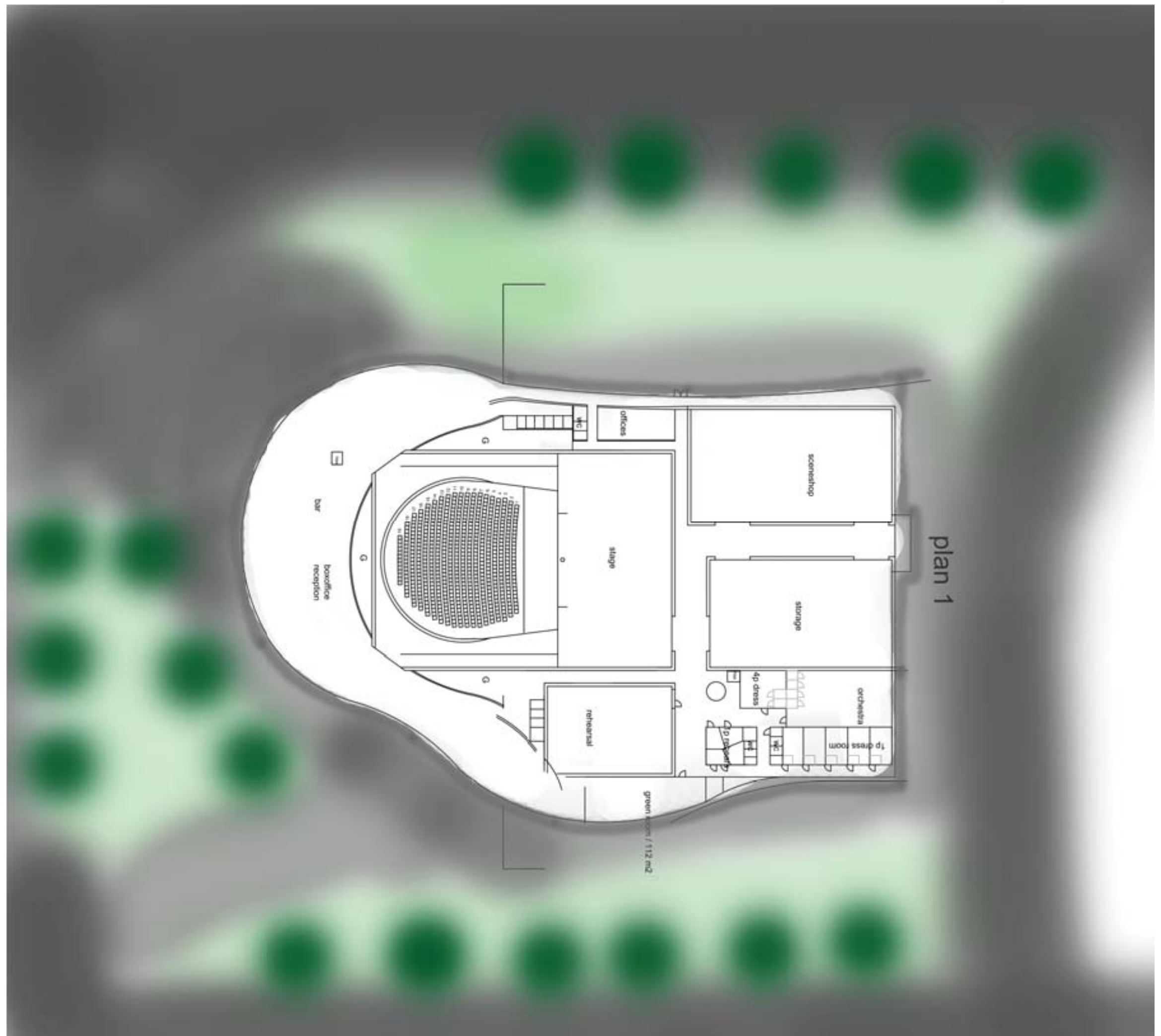
Reflektion

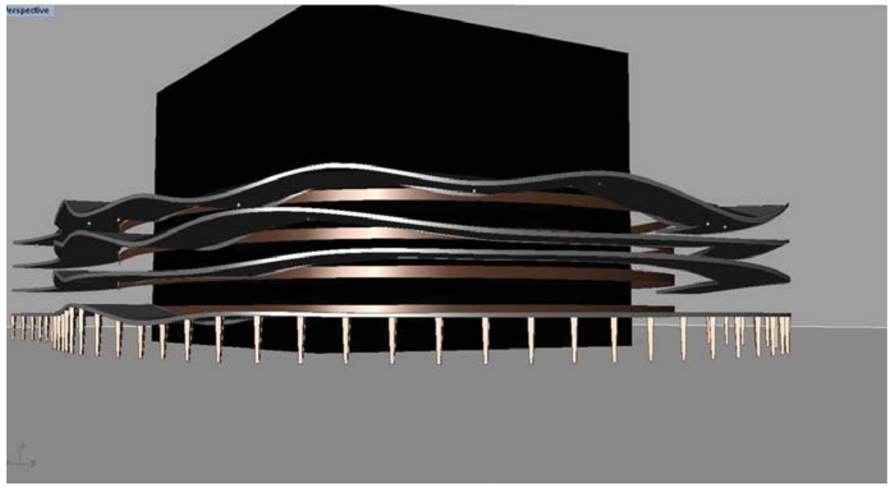
Vi började det här projektet med en klar idé om hur studenter och lokalbefolkning skulle inkluderas och involveras i byggnadens liv och funktioner. Under tidens gång tappade vi bort helhetstänket och fokuserade mer och mer på små detaljer, framförallt inom akustiken som i slutändan inte syntes i presentationen. Även om jag tror att detaljer senare är väldigt viktiga för ett projekts lyckande så önskar jag ändå att vi behållt kocepttänket längre in i projektets gång.

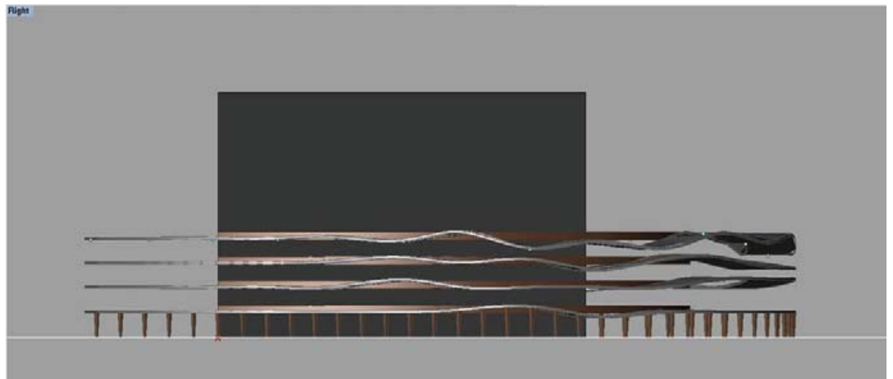
I början av projektet var idén att människor skulle kunna röra sig på svepande band runtom byggnaden och kunna blicka in i de olika delarna av byggnaden. Då det blev svårt att motivera en så lång bana runt byggnaden och vi inte riktigt hittade en lösning på problemet fokuserade vi istället på andra saker och lät detta hamna i bakgrunden. I dagsläget skulle jag arbetat mer med denna frågeställning för att kunna skapa en unik opera som gör användarna entusiastisk och engagerad.






plan 1
offices
sceneshop
bar
boxoffice
reception
stage
storage
rehearsal
4p dress
orchestra
1p dress room
green room / 112 m2


Perspective


Right