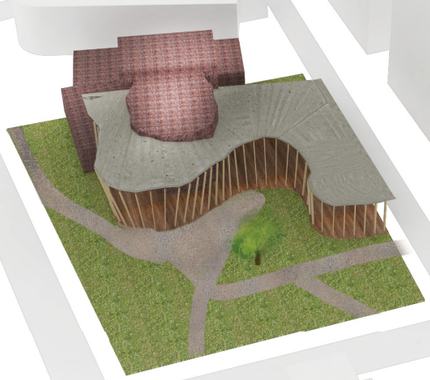
OPERA

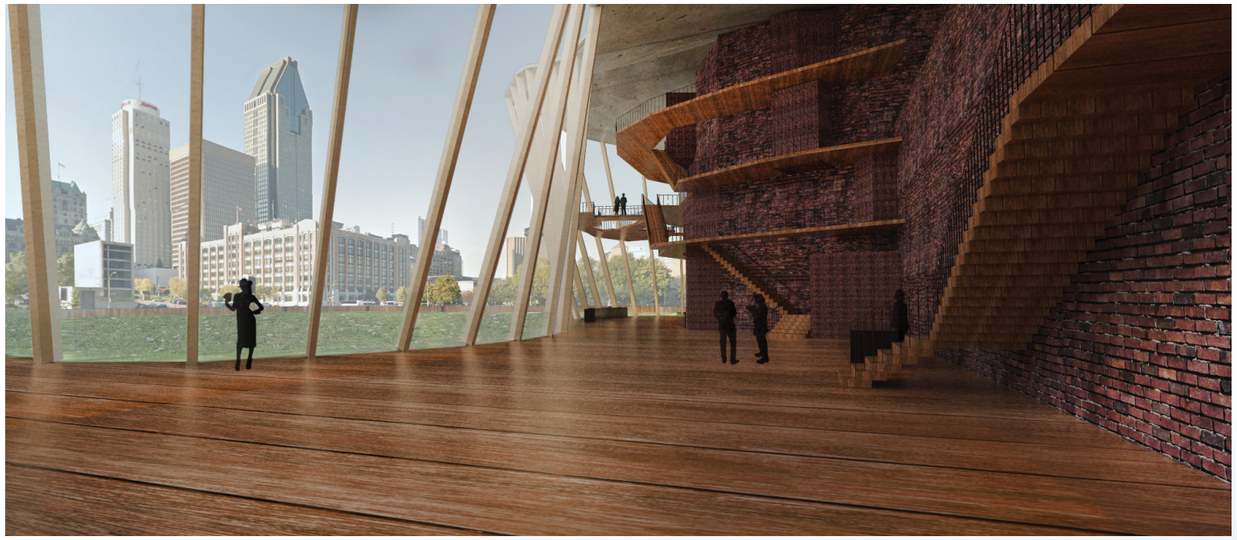
- Student opera in Montreal



Course:	Bachelor project
Time:	Year 3, spring 2013
Teachers:	Morten Lund, Mendel Kleiner
Group:	Samuel Hofverberg, Johan Berggren, Daniel Norberg (acoustic engineering student)
Tools:	Adobe InDesign Adobe Photoshop AutoCAD CATT-Acoustic Google SketchUp Rhinoceros V-ray

Task:

In this project the task was to create a student opera/performance hall in Montreal. The main focus was to design a building assuring a good acoustical environment for visitors, performers and staff as well as to enable acoustical flexibility for a wide range of performance types. The site for the project is surrounded by busy streets near the city center of Montreal, with aeroplanes flying ahead and the railway not far away. The high levels of the surrounding noise was one of the main problems to handle.
The complex was to include an auditorium and corresponding facilities with room for 1.200 people. The backstage area was to consist of dressing rooms and green room for the performers and scene and costume workshops.

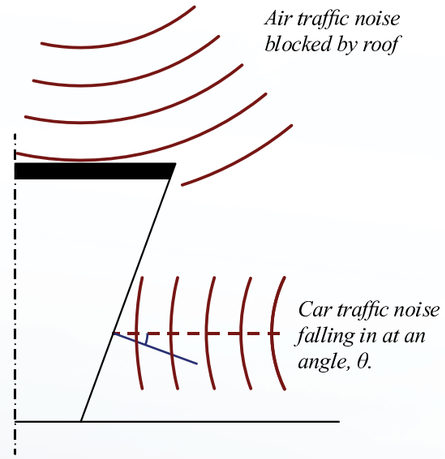


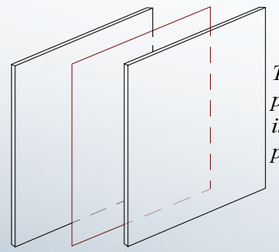
Montreal University Opera, housed inside of a swiveling facade of wood and glass.

Giving the students a wonderful place to practice and hone their skills, as well as being a place for gatherings, art exhibitions, dinings and more.

ACOUSTICAL CONSIDERATIONS

The key to effectively blocking out noise is mass, heavier construction means less sound transmitted. The most problematic area of the building is therefore the glass façade, where mass is not an option. It is also the most exposed façade of the building, facing the busy intersection of Rue Peel and Rue Saint-Jacques. The problem is coped with partly by the sheer form of the façade. By the outward tilting the façade is fully shielded from the direct air traffic noise by the heavier, and thus better sound isolating, roof construction. The tilting of the surface will also make noise from traffic on the ground approach the facade at an angle which will contribute to reflecting the sound rather than transmitting it into the building.
Apart from the façade shape the glass is constructed to minimize sound transmission. Two glass sheets are laminated together with an interlayer of polyvinyl butyral (PVB) plastic. Approximate STC rating: 34.



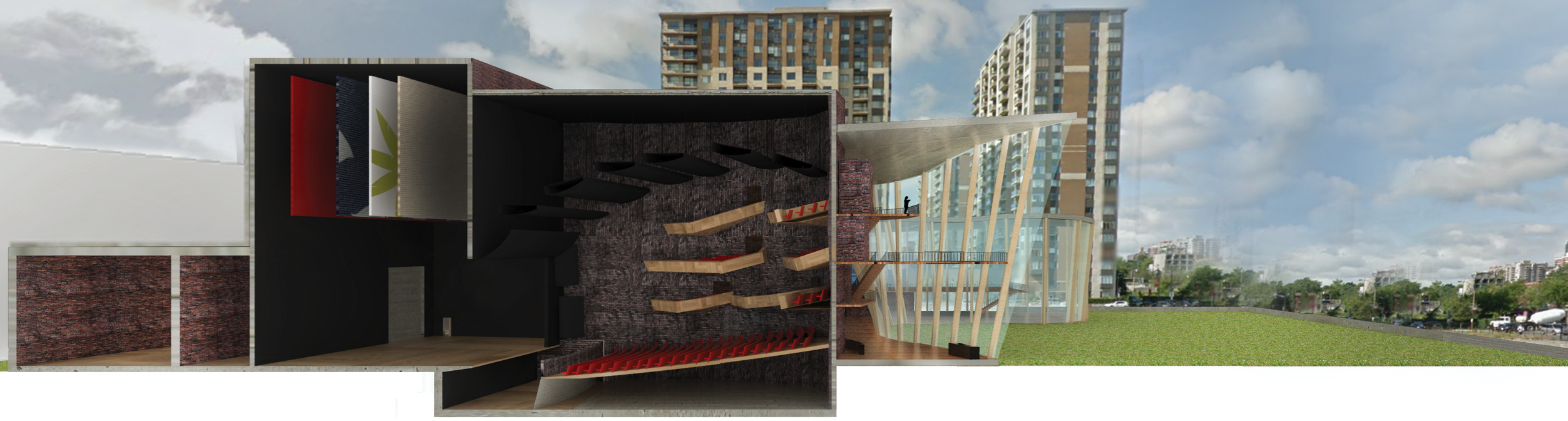


Maximum background noise levels

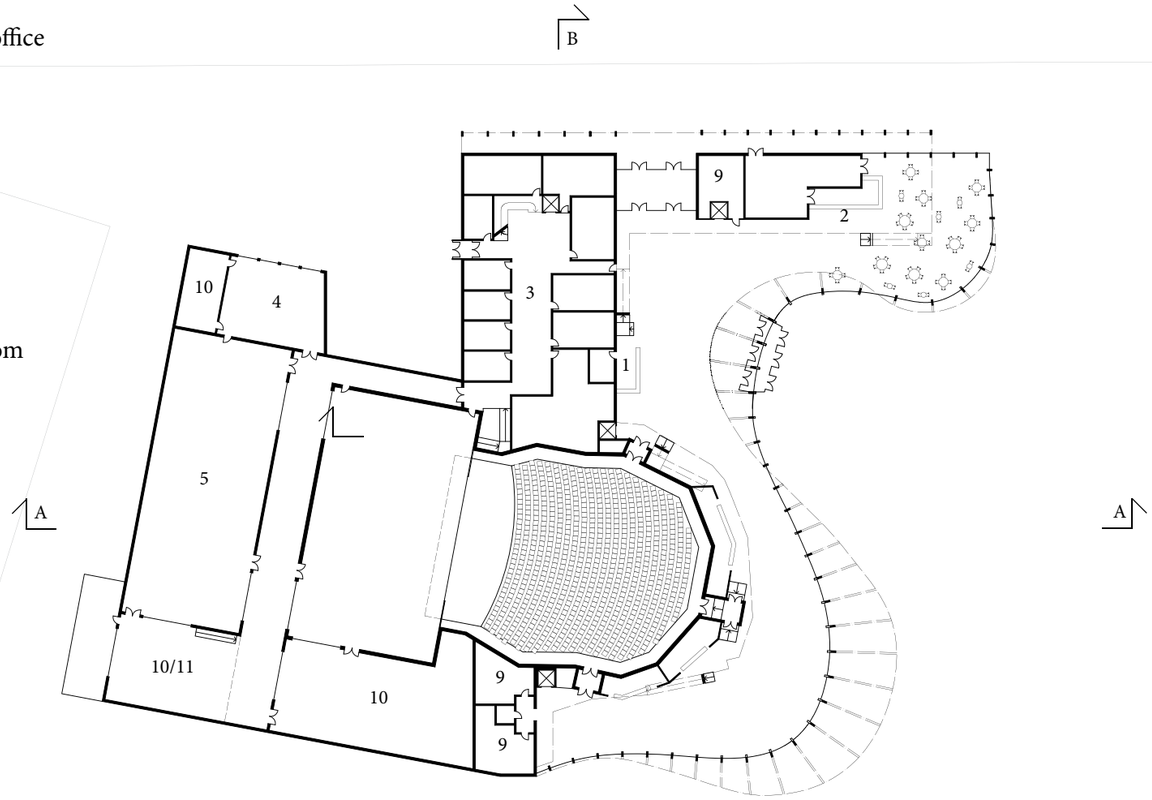
	NC	dB(A)
Auditorium	20	25
Green room	30	35
Reahearsal room	25	30
Individual rehearsal rooms	30	35
Dressing rooms	30	35
Shops	40	40

Surrounding noise levels

	dB(A)
Airplane traffic	60
Car traffic	60
Train traffic	50



1. Reception/Box office
2. Restaurant
3. Dressing rooms
4. Wig shop
5. Scene shop
6. Exhibition area
7. Green room
8. Rehearsal room
9. Restrooms
10. Storage
11. Mechanical room



THE LOBBY

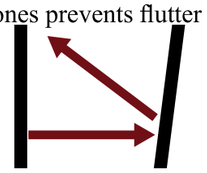
Entering through the glass facade, you come into a plaza that nests the lobby together along with its two main areas. The first main area is the area around the opera hall, and the other is an exhibition area connected to a restaurant.
The exhibition deck is intended for small galleries, poetry readings, music performances etc. The deck can also be used for banquetts and other festivities.
Underneath is a cafeteria/restaurant with its tables spread around in a veck created by the facade. The facades inwards tilt wraps the area in, resulting in making it somewhat distanced from activities in the lobby.
A system of decks and stairs makes for the entrance to the aditorium balconies seats.
The plaza provides an easy and elegant access to the green room and rehearsal area.

REHEARSAL AND GREEN ROOM

The area is connected to both the lobby and the performers dressing rooms.
The rehearsal room has a high celing, strecthing other the adjacent solo rehearsal rooms, wich gives space for letting sunlight in.
For relaxation in between of the reharsals, the green room is situated close by.
The reharsal room is weaved together with both the performers areas and the lobby's exhibtion area. The connection lobby makes the room useful for a variety of occasions such as lectures, workshops and public events.

REHEARSAL ROOM ACOUSTICS

Angled walls in both large rehearsal room and small ones prevents flutter echo.

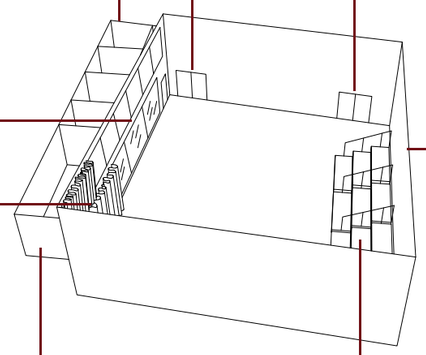


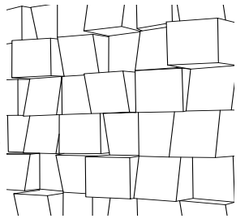
Sound locks prevents disturbing noise from corridor and lobby during practise.

Windows for daylight and mirrors for dance practice

Heavy drapery (800 g/ m2) for flexible absorption and for possibility to cover mirrors and windows.

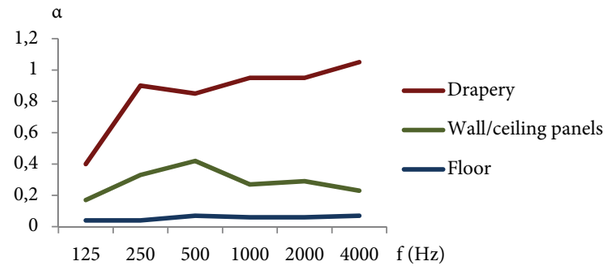
Spacious storage for musical instruments, risers etc.





Diffusive wooden wall and ceiling panels.

Mobile choral risers with different constellation abilities for maximum flexibility.

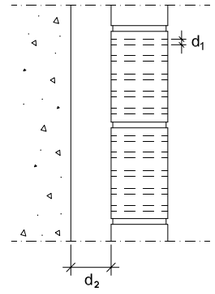


Approximate calculations by Sabine's formula indicates a reverberation time in the rehearsal room around 0,9-1,0 s. These calculations are based on absorption coefficients as shown beside, with the drapery fully evolved and a room volume of 1620 m^3.
Desired RT is around 0,4-0,6 s, but then one should notice that the calculations were done without regard to people occupying the room.

LOBBY NOISE CONTROL

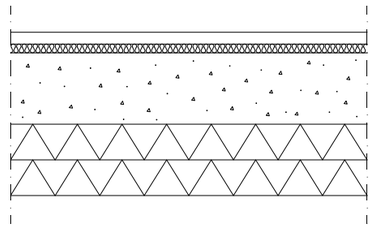
Hollow bricks integrated in lobby walls work as Helmholtz resonators and contribute to loweing the noise level and reverberation time in the lobby.

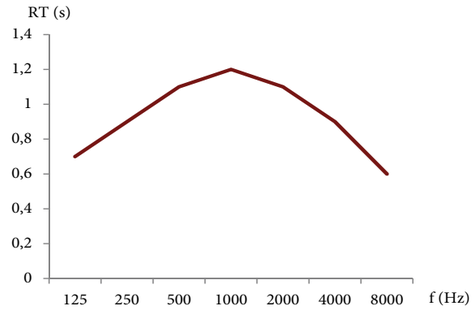
The hole size, d_1, and distance from back wall, d_2, varies to get diverse resonance frequencies and gain absorption over a wider range of frequencies.



50 mm wooden floor
25 mm glasswool quilt
300 mm concrete slab
300 mm insulation

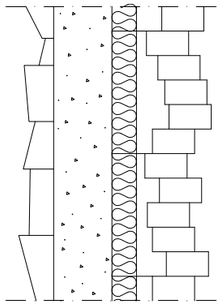
A glass-wool quilt reduces the impact sound of steps in the lobby.





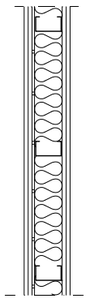
WALL DETAILS

Details to the right are examples of solutions to meet the rooms NC requirements and too assure the possibility of simultaneous activities in different parts of the complex.



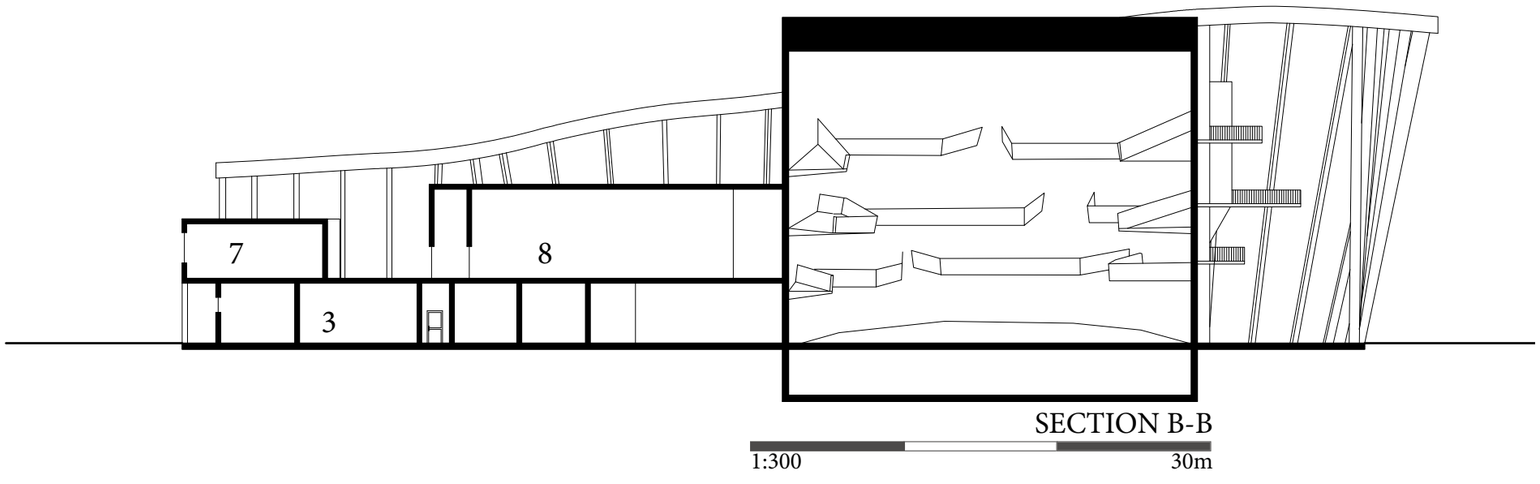
Wall between rehearsal room and auditorium, STC 75

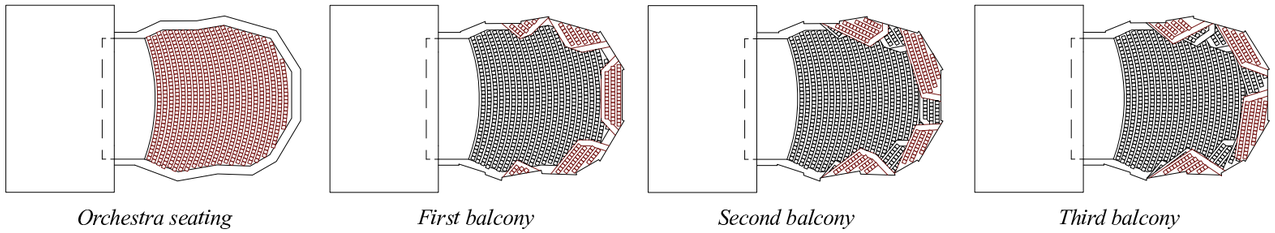
Diffusive wooden panel
190 mm concrete
90 mm insulation
Air gap
Diffusive brick wall



Wall between dressing rooms, STC 60

13 mm gypsum board
13 mm gypsum board
90 mm steel studs
90 mm glass fiber isolation
resilient channels
13 mm gypsum board
13 mm gypsum board



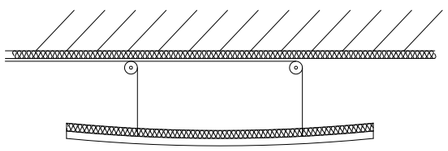


FLEXIBLE CEILING PANELS

The auditorium ceiling is covered with lowerable panels to enable different sound properties for different types of performances. Every panel is individually adjustable in height and incline, with pre-programmed dispositions for opera and concert.

With the panels lowered one will gain earlier reflections and therefore higher clarity. The clarity is important for the song and its lyrics to be heard. The lowered panels will also contribute to shorter reverberation time as the volume of the hall ‘shrinks’.
Sound finding its way up in the space between ceiling and panels will be absorbed by the absorbing surfaces in the ceiling and on the upper side of the panels.

With the panels in their high position one will get later reflections and longer reverberation time.

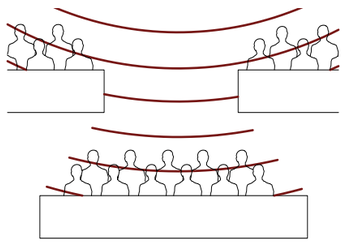


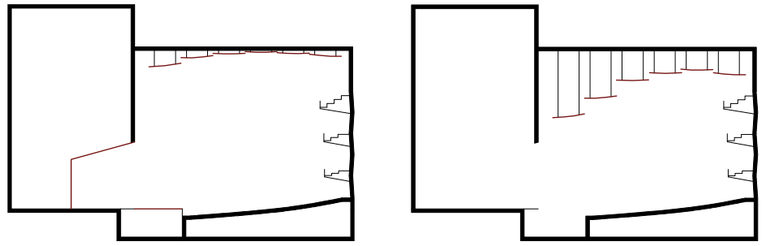
WALLS

In order to create a diffusive sound the auditorium walls are unevenly tiled, creating both local and global irregularities for wide frequency range scattering.

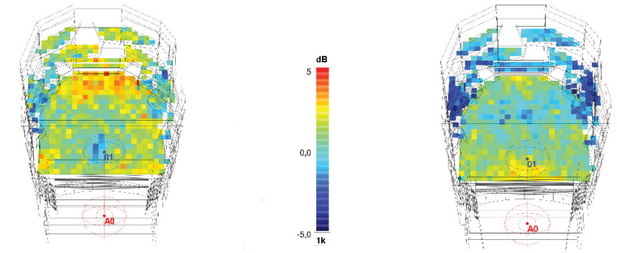
BALCONIES

The balconies are broken up into smaller boxes and scattered along the auditorium walls. This constellation allows the seats to be straightened up towards the stage, resulting in better visual contact with performers on stage.
From an acoustical point of view the broken up balconies enable sound reflections from the ceiling to reach down to lower balcony levels through the gaps.

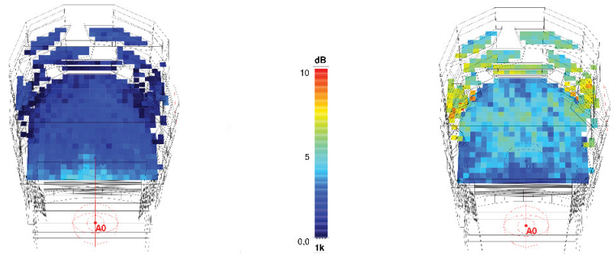




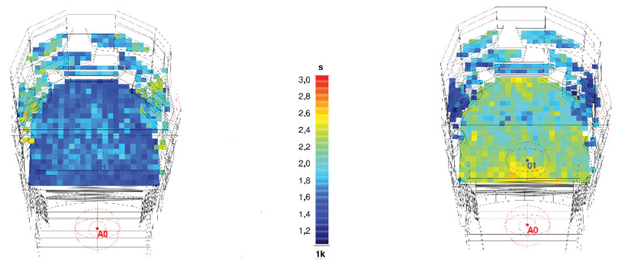
OPERA MODE CONCERT MODE

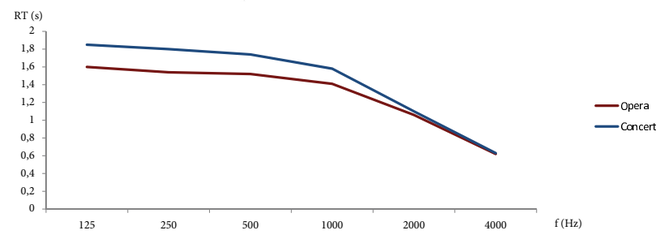


CLARITY, C_{80}



STRENGTH, dB(A)





REVERBERATION TIME, s

REFLECTIONS

Overall I am pleased with the intentions of the project, though I would have liked to develop many of these intentions further and go a lot more into details. I like the large lobby indirectly divided into smaller areas designated for different purposes. I like the irregular, somewhat cave-like, auditorium and think it would be an experience to watch an opera ora a play there.

I would have liked to work more with the building's meeting with the surroundings, the entrance situations and the public space around the opera. I also think many of the intentions and thoughts would have gained from an easier read presentation material, with simple schematic illustrations of e.g. movements and intended activities.

It has been interesting to work together in a group, especially as one of the group members was an acoustic engineering student and worked more as an acoustic consultant. I think these kinds of interdisciplinary relationships during the education are good preparations for the working life.

In this project I think I have learnt most about acoustics and acoustical design, but I have also further developed my knowledge about designing large public buildings and trained my skills in the software used.