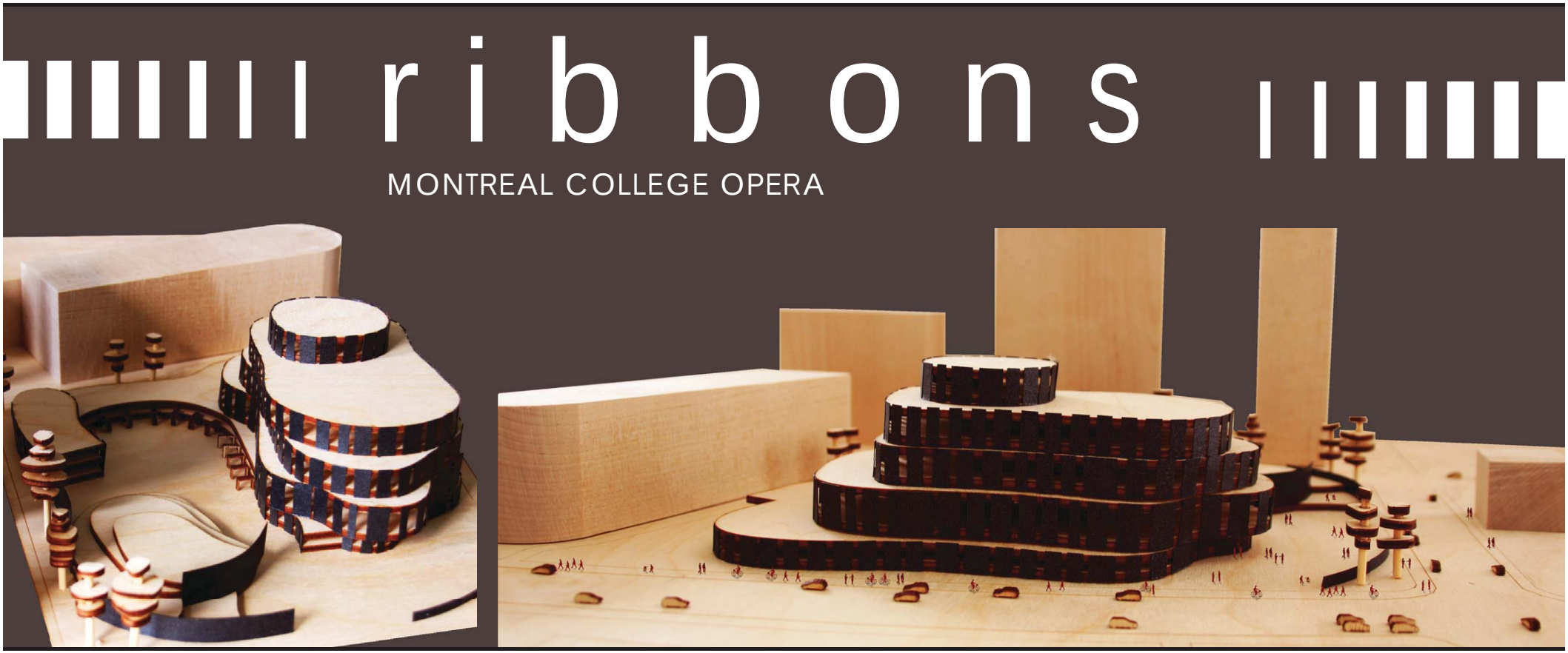
Ribbons

En multifunktionell universitetsopera



Ribbons
Vt 2013
Kandidatarbete AT
Morten Lund

Projektet är ett tävlingsbidrag till en studenttävling anordnad av Acoustical Society of America. Årets program gav uppgiften att rita en opera till ett universitetscollege i Montreal. Operan skulle fungera som en multifunktionell byggnad där man kunde hålla allt från operaföreställningar och konserter till föreläsningar och workshops. Stor fokus i programmet låg på att skapa goda akustiska miljöer. Det var noggrant angivet vilka funktioner som skulle finnas redovisade i operan och arean för de olika rummen var i de flesta fall givet.

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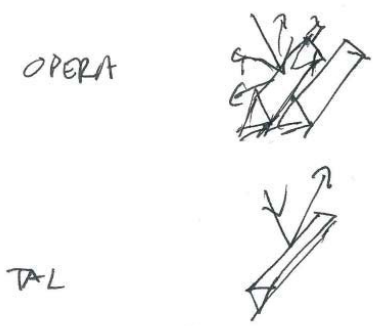
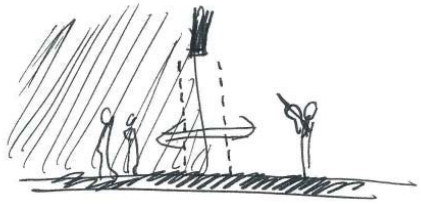
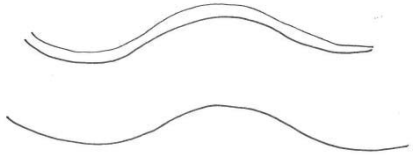
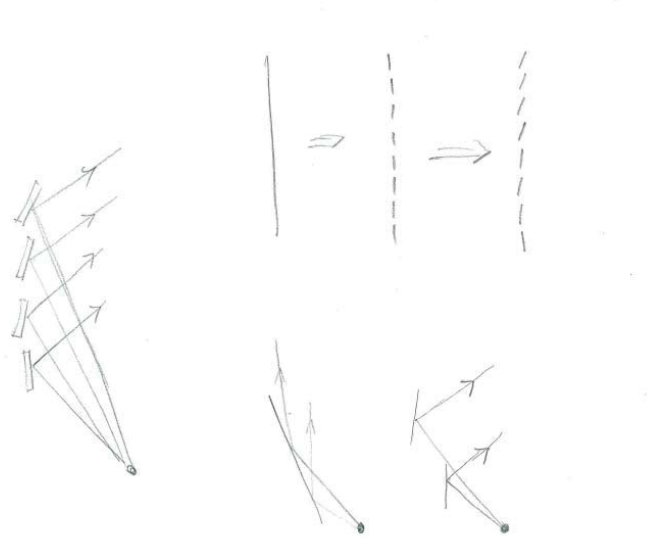
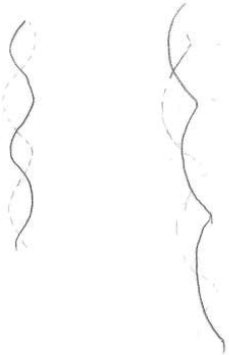
Vi skissade mycket på olika sätt att få akustik och arkitektur att samverka. Viktigt för oss var att operan skulle skapa bra ljudmiljöer i sig själv, utan att behöva många adderade akustiska komponenter. En extra utmaning var salens multifunktionella karaktär, vilken innebar att många delar var tvungna att vara justerbara.

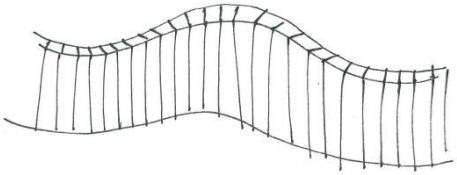












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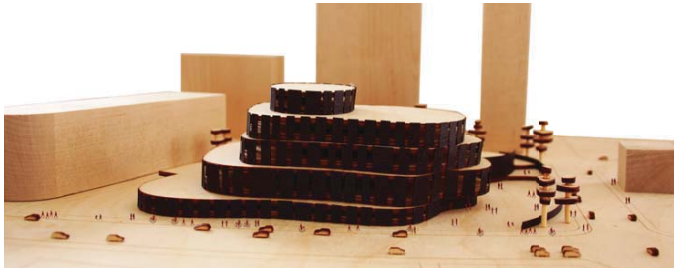
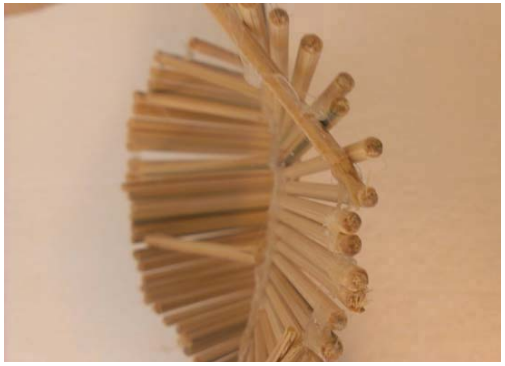


Vi började med att analysera de olika behov som operan skulle kunna fylla och definierade de olika användargrupperna. Den givna tomten analyserades med avseende på rörelser, ljudnivåer, trafik, ljus etc. Vi experimenterade sedan i modellform med olika former och volymer. Vad vi tyckte skulle passa in på platsen var en ganska informell byggnad som också kontrasterade mot de fyrkantiga omgivningarna. Detta, ljudmiljön och flexibiliteten var de punkter vi tog fasta på när vi utformade operan.



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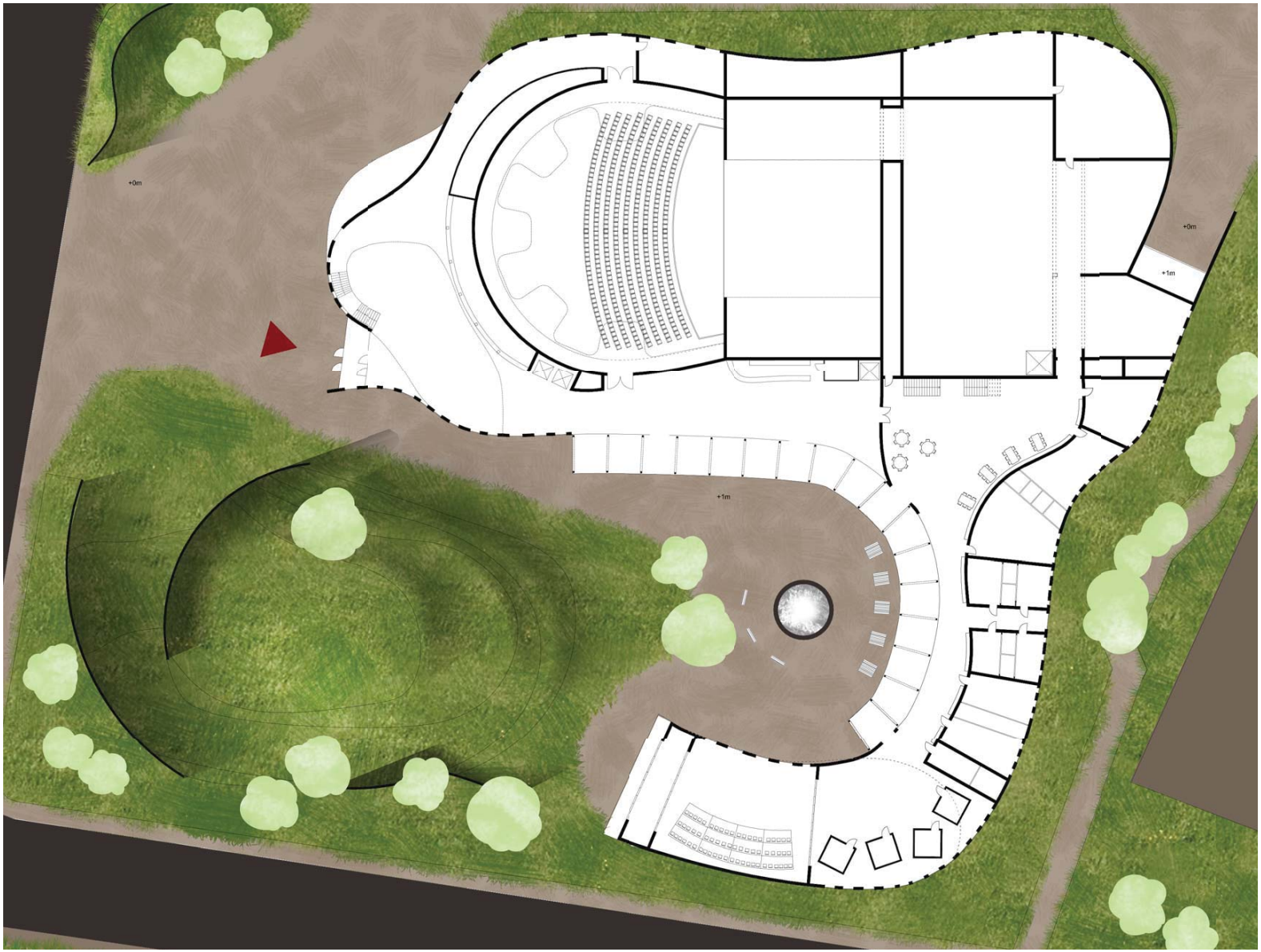


IN CITY CONTEXT

The opera is located in a part of the city dominated by high buildings and busy roads. A welcoming public space integrates the opera with the city and creates a meeting place for students, musicians and the citizens of Montreal. The building and the topography are embracing the visitors and screen the city sound and bustle without creating the feeling of exclusion or isolation. The organic shapes create a contrast to the very square and strict shapes of the surrounding buildings, and will also give a softer and more playful expression.

Ribbons

En multifunktionell universitetsopera

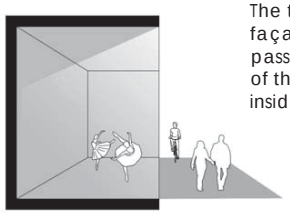
SOCIAL VALUES

A PUBLIC SPACE

The Opera, with its partly transparent façade, gives the people passing by an awareness of the activity going on inside the building. A public space that can be used all year for various activities, such as outdoor performances, picnics, skateboarding, kids playing etc. attract a wide spectrum of different kinds of people. The opera, as an integral part of the city, reach people who normally would not consider a visit, instead of being an excluding area only for a cultural elite.

The opera itself, the topography, greenery, screens and extending parts of buildings embraces the visitors and work as natural sound barriers. The area faces the sun in southwest and offers many different spots to hang out in. Students and workers have a lot of qualitative space for breaks, meetings or reading as the outdoor area continues through a semi tempered arcade and into the nave of the working part of the opera.

The Opera site offers many different activities and therefore attracts a wide spectrum of different people.



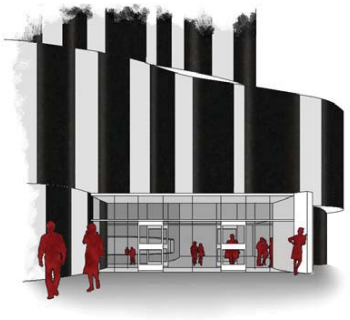
The transparency in the façade gives the people passing by a glimpse of the on-going activity inside.

The Opera site is accessible and offers a lot of good study and meeting spaces and therefore functions in favor of the students of Montreal.

MEETING THE OPERA

Visitors approaching the Opera get a glimpse of the on-going activity inside, through the transparent façade, already before they reach the entrance. To get to the lobby they move through an air lock in an opening in the street level façade ribbon. After the modest entrance the ceiling height rises dramatically and creates a great volume full of light. Here it is possible to move up to the different levels of the auditorium or continue further on in the building.

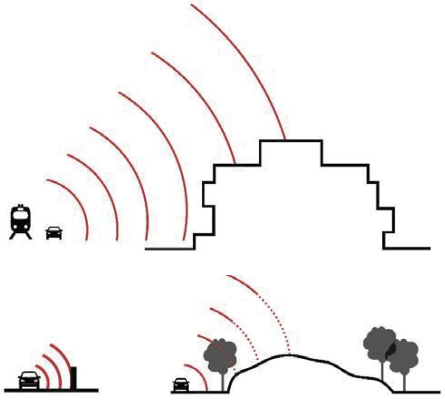
From the lobby it is also possible to walk out in the arcade that moves along the side of the building facing the outdoor area. The arcade connects the main entrance with the relaxation area for the students/actors and offers an agreeable semi-outdoor space.



CREATING A PLEASANT SPACE

The outdoor space of the site is arranged to create a nice environment for picnics, outdoor performances, playing or just relaxing in the sun. This is a space where everyone is welcome and where the public can meet students and the people who work in the opera.

Although background noise at the site is high, the sound environment in the social space outside the opera is pleasant. Noise from faraway sources such as the railroad and highway is reduced by the highest part of the opera building. Nearby sources are screened off by a small hill and low concrete screens. Trees and greenery help to create a peaceful experience for people who spend time in the area.



NOISE SOURCES

The site is located approximately 400 meters from a six lane interstate highway, 300 meters from a four track railroad, 500 meters directly under the flight path from the nearby airport and in the corner of the intersection of the two busy roads Rue Saint-Jacques and Rue Peel.
The Opera building shield the outdoor space located in front of the Opera from the highway and the railroad and reduces the noise with approximately 30dBA. Screens and the topography on the site reduce the sound from the nearby traffic with approximately 25dBA. This creates an agreeable outdoor space with reduced background noise which also can be enjoyed, without the noise from the airplanes, from the semi-outdoor arcade.

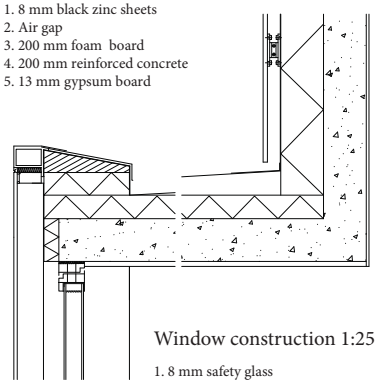
Ribbons

En multifunktionell universitetsopera

THE OPERA IN ITS SETTING

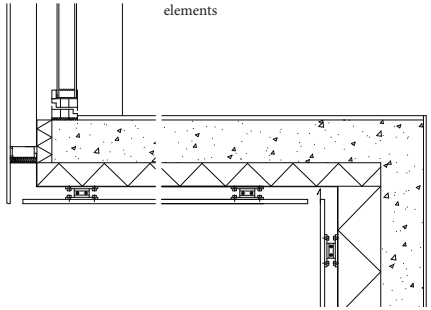
SECTION A - A 1:400

1. 8 mm black zinc sheets
2. Air gap
3. 200 mm foam board
4. 200 mm reinforced concrete
5. 13 mm gypsum board



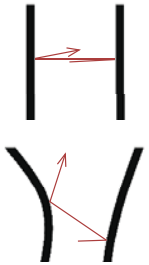
Window construction 1:25

1. 8 mm safety glass
2. 220mm air gap
3. Window with two 4 mm glass sheets, 80 mm space with absorbing elements

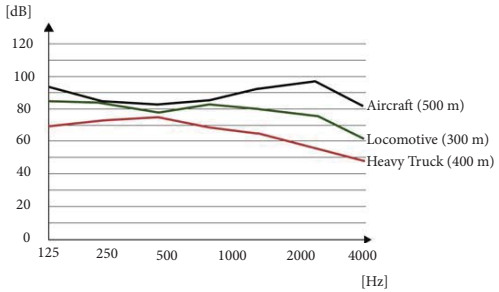


CURVED WALLS

In a square room with parallel walls and right-angled corners unwanted sound phenomenon, such as flutter echo, can occur. The curved walls of the opera significantly reduce the risk of these unpleasant sound patterns in many of the rooms.

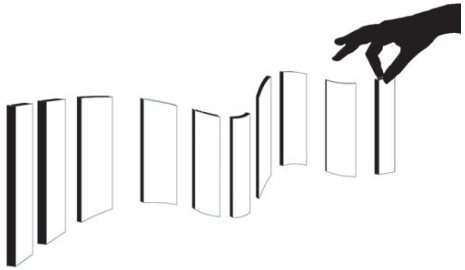


MAXIMUM SITE NOISE LEVELS

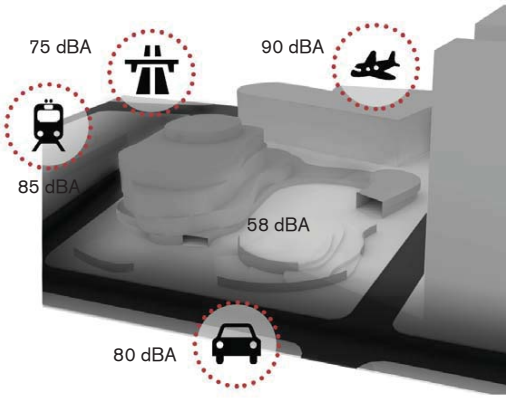


HORISONTAL RIBBONS BY VERTICAL ELEMENTS

A recurring concept throughout the opera is that of ribbons. These ribbons are in turn made up of vertical elements of different width. This way organic shapes are created without using curved surfaces, which is an advantage in the construction phase. The building is unified by using this concept from the exterior to the very heart of the opera.



MAXIMUM BACKGROUND LEVELS



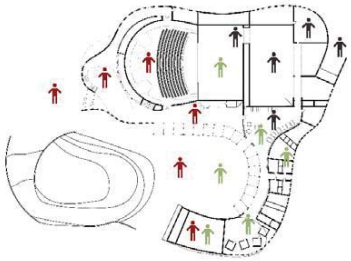
Ribbons

En multifunktionell universitetsopera

ARRANGING THE ROOMS

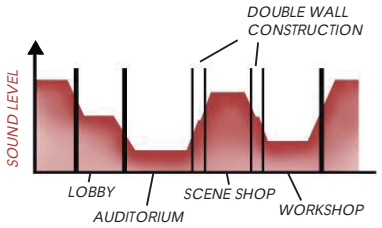
DIVIDING THE BUILDING

The building is divided into three main parts, one for visitors, one for employees and one for actors/ students. This prevents the different users of the building from disturbing each other. Spaces such as the multifunctional rehearsal room and the common area outside the dressing rooms become meeting places.



LAYERS

The noise from roads, railroads and aircraft is gradually reduced by the different layers of the building. The most sound-sensitive rooms are placed either in the core of the building or in parts of the site sheltered by buildings nearby. Less sensitive rooms are placed in the outer zones, creating sound buffering.

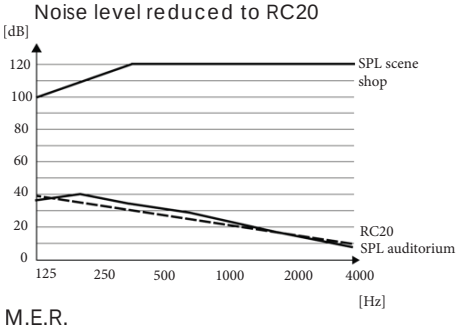


FLEXIBILITY

The building is easy to adapt to fit the different needs of the university. Many activities can take place simultaneously in the building, without disturbing each other. The rooms are flexible to accommodate the preferences of their various users.

TECHNICAL SOLUTIONS

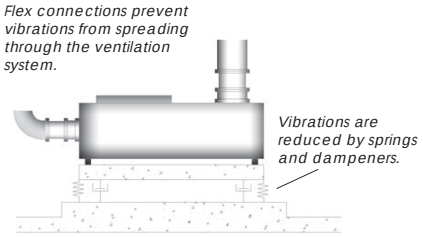
The scene shop is divided from the stage by double walls. They reduce the sound enough to allow for full activity in the scene shop during performances. The ceiling is covered with sound absorbers to keep the noise at at reasonable level.

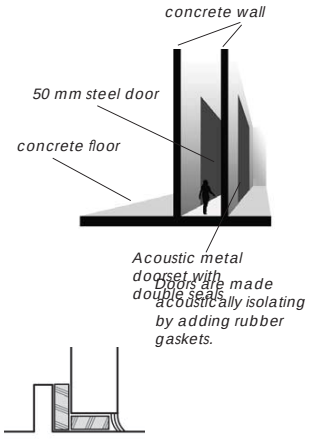


M.E.R.

By placing the M.E.R beneath the scene shop floor, noise does not get transmitted to the more sensitive parts of the building. The ventilation is easy to distribute to all rooms since the M.E.R is placed in the middle of the building.

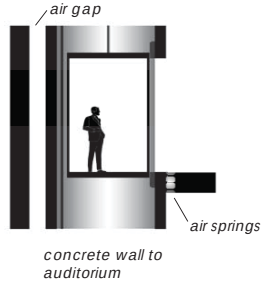
Max sound generated: 100 dBA





ELEVATORS

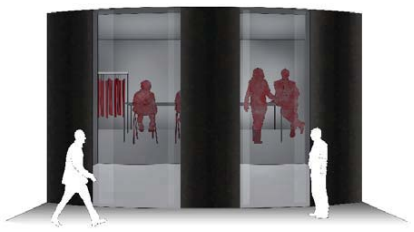
Elevators are separated from load-bearing walls and slabs by air springs which minimize transmitted vibrations. Machinery is placed at the bottom of the elevator shaft.



COMMUNICATION

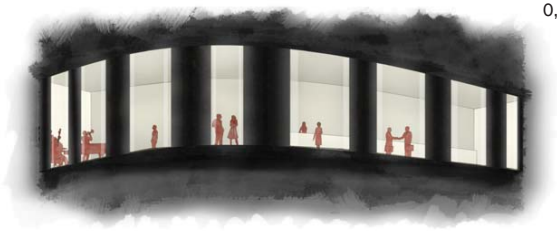
The workshops have large windows to the streets. Through these, passerbys can get a glimpse of how an opera is being created.

Max sound generated in work shops: 90 dBA



GREEN ROOM

The Green Room is located in the center of the building and is easy to access directly from the actor's area and the auditorium. After performances, or at other special occasions, it is natural to invite people to the exclusive area on the second floor. The Green Room provides a bar and a beautiful view of the public space in front of the opera.



RT in Green Room: 0,9 s / 1 kHz

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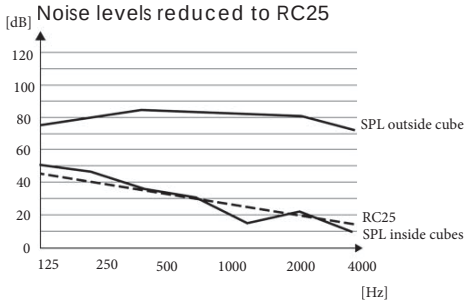
SMALL REHEARSAL CUBES

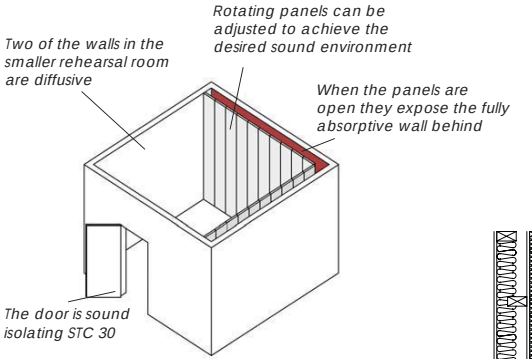
ADDING ATMOSPHERE

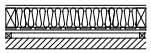
Four cubes provide smaller rehearsal rooms for the musicians. Since they are separated from each other, musicians do not disturb each other when practising. The faint music transmitted to the room outside adds a special atmosphere to the room, which acts as a multipurpose area together with the larger rehearsal room.

Two of the rehearsal room walls are clad with panels that can be adjusted to meet the different preferences of the musicians.

RT in cubes: 0.4-0.6
Sound requirement: RC25

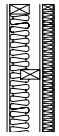






Ceiling construction 1:25

1. 13 mm gypsum board
2. 90 mm mineral wool
3. 13 mm resilient channels
4. 13 mm gypsum board
5. 25 mm air gap
6. 50 mm soundboard



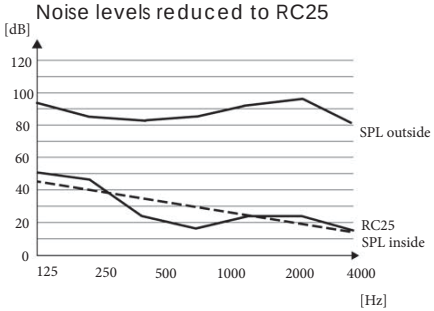
Wall construction 1:25

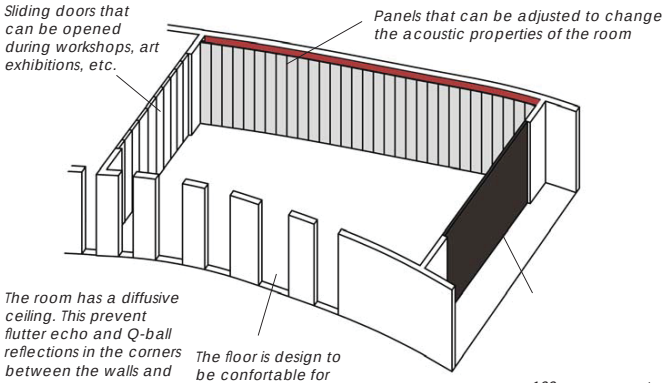
1. 13 mm gypsum board
2. 90 mm mineral wool
   Offset studs, 610 mm CC.
3. 50 mm air gap
4. 13 mm gypsum board
5. 50 mm mineral wool
6. 5 mm wooden panel

CREATIVE SPACES

A ROOM WITH ALL POSSIBILITIES

A university is a place where creativity flourishes. To meet all possible needs of the resourceful students the large rehearsal room is adaptable to be used in almost any way. In addition to rehearsals, indoor performances, workshops and meetings the room can also be used as an outdoor stage or for exhibitions or fairs.

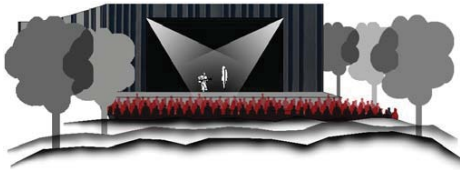




RT in rehearsal room mode: 0,5 s / 1 kHz
RT in performance mode: 1,1 s / 1 kHz

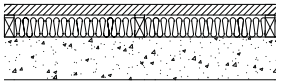
OUTDOOR EVENTS

When the openable wall is lowered, the room becomes a stage. For larger performances, electro-acoustic enhancement can be applied.



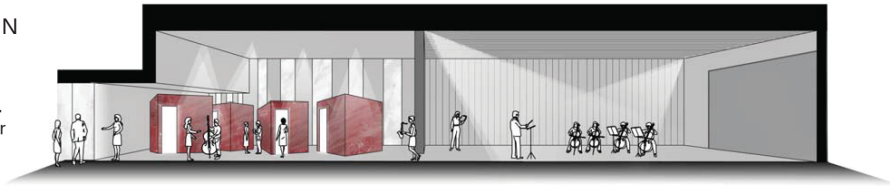
Floor construction 1:25

1. 50 mm wood floor
2. Shock absorbing elastic rubber
3. 100 mm mineral wool
4. Concrete floor slab



A PLACE FOR INTERACTION

When desired, the wall dividing the large rehearsal room from the neighboring space can be opened. This gives a flexible environment for different activities where students, visitors, musicians and employees can interact.



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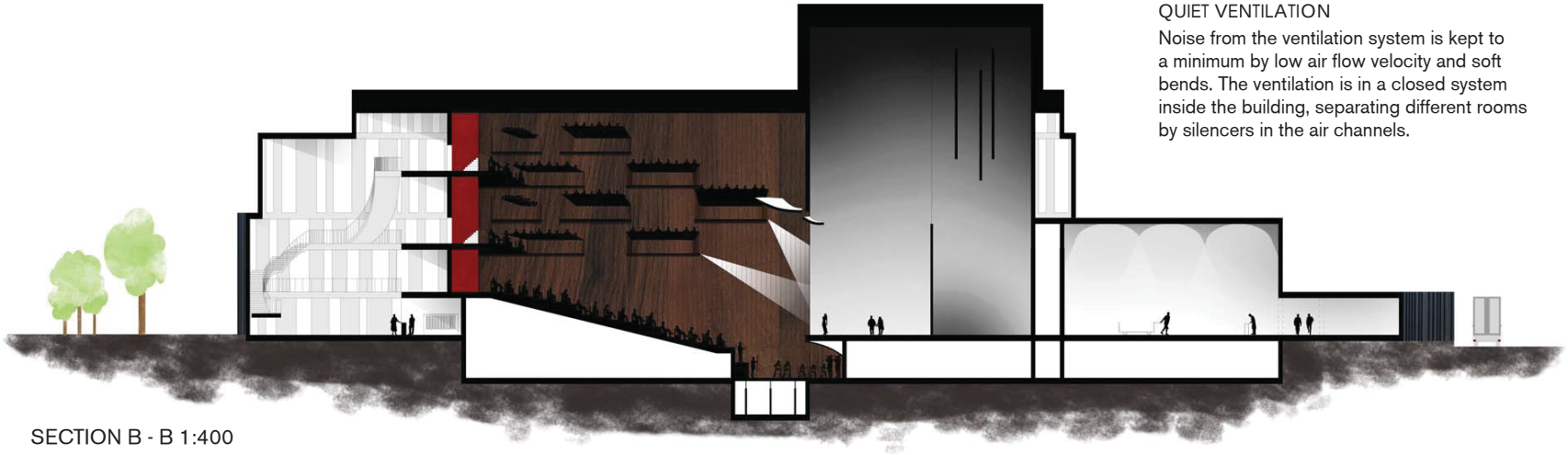


SECTION B - B 1:400

QUIET VENTILATION

Noise from the ventilation system is kept to a minimum by low air flow velocity and soft bends. The ventilation is in a closed system inside the building, separating different rooms by silencers in the air channels.

HOW THINGS ARRIVE

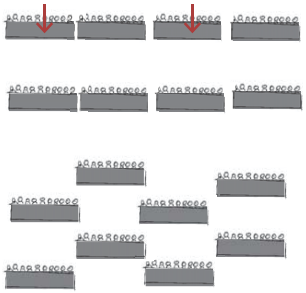
The loading dock is on the same floor as all the main functions of the opera. The access is easy to all rooms. The noise from the loading dock is reduced by a concrete wall. The building to the east of the plot will therefore not be too disturbed.

Max sound at dock: 95 dBA
Sound reduced by barrier.

GOOD ENVELOPMENT

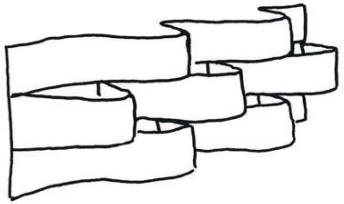
SEPARATED BALCONIES

The balconies are divided into smaller segments and displaced vertically. This gives small separated balconies which results in good envelopmental sound. The connection to the orchestra is good and there is no segregation between the different seats.



GROWING OUT FROM THE WALL

The walls of the auditorium are one unit where absorbers, diffusors, reflectors and balconies are integrated. Balconies are pulled out from the wall in a way that gives a good view from every seat. This gives direct sound and improves speech intelligibility.



HOW TO REACH THE BALCONIES

CAPACITY: 1180 seats
BALCONIES: 420 seats on 20 balconies
ORCHESTRA: 760 seats

SOUND TECHNICIAN

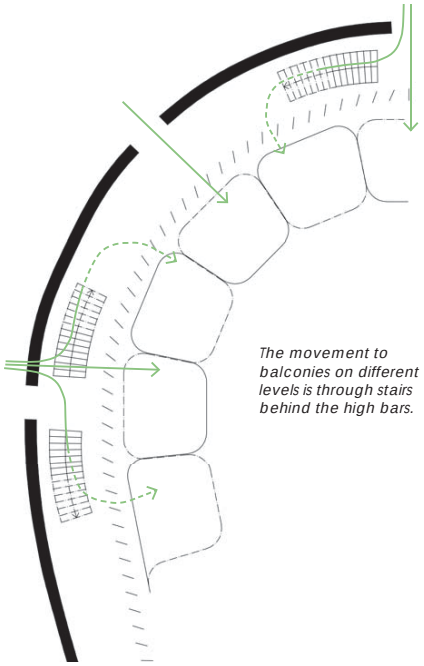
The sound technician sits inside the auditorium, at the back of the orchestra.

CHAIRS

Chairs are designed to have the same sound properties whether they are occupied or not.

MATERIALS

The walls and the balconies in the auditorium are of dark stained wood. This creates, together with the red velvet chairs, an ambient atmosphere.



The movement to balconies on different levels is through stairs behind the high bars.

Ribbons

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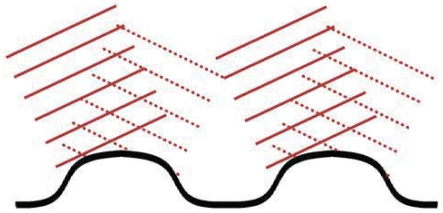
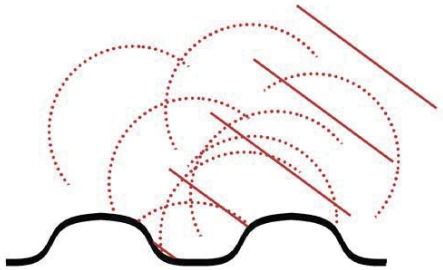
REFLECTIONS



Reflective for high frequencies



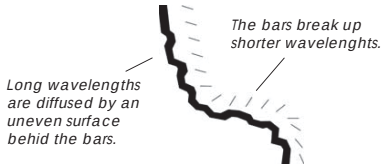
Diffusive for low frequencies

ENVELOPMENT DATA

To illustrate the envelopment of the hall, values for the Interaural Cross Correlation and Lateral Energy Fractions are shown below. Values are averages from 17 different seating positions throughout the auditorium.

1-IACC Opera(orchestra): 0,52
1-IACC Concert: 0,50
LF Opera(orchestra): 0,3
LF Concert: 0,24

WALLS BESIDE PROSCENIUM

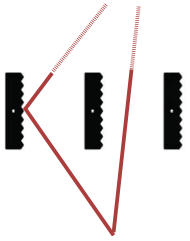


FLEXIBILITY

INTEGRATED ACOUSTICS

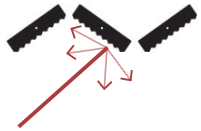
To be able to easily switch between different acoustic modes the auditorium has a transformable wall structure. The wall consists of vertical wood panels, which have one reflecting side and one diffusive side with flutings. By turning these panels it is possible to change the wall's structure and meet the acoustical requirements for different events.

The panels also work in a visual aspect as the audience enters the auditorium. On their way to their seats they walk in the space between the panels and the inner absorptive wall. The passage's expression differs depending on the coming event and gives the audience an awareness of the acoustics. Through the gaps between the panels the spectators get a sense of the auditorium ambience. This creates a gradual entrance and gives a new dimension to the auditorium.



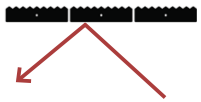
Absorbing surface

The space behind the panels is two meters deep and has a highly absorptive wall and ceiling, therefor when the panels are fully opened the wall functions as an absorber.



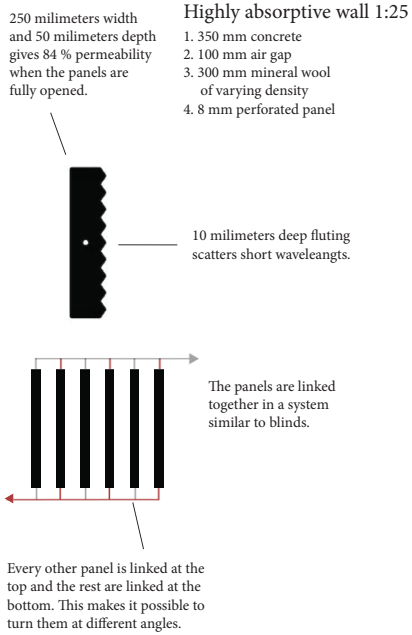
Diffusive surface

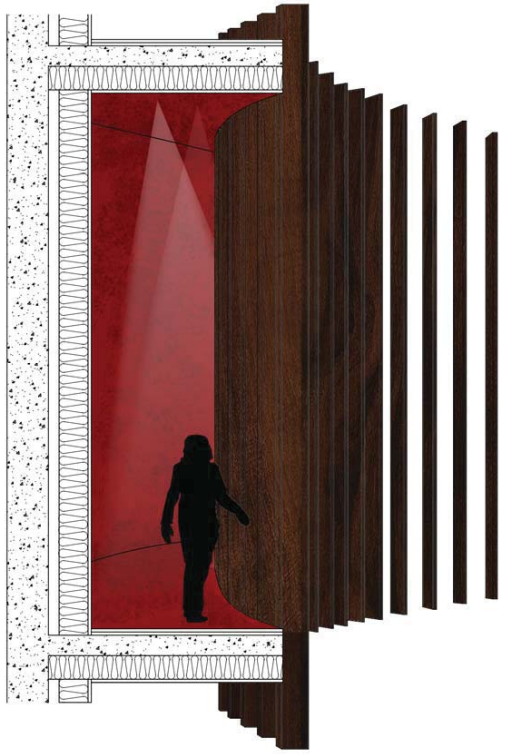
Set at an angle, with the fluted side facing the auditorium, the panels function as a diffusive wall for short and medium wavelengths



Reflective surface

Fully closed, with the plane surface facing the auditorium, the panels function as a reflecting wall.





MULTIFUNCTIONAL HALL

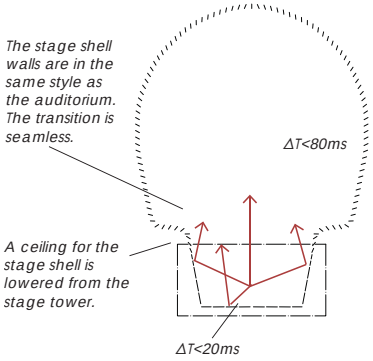
An important part of the auditorium design is the multipurpose function of the room. The flexibility ensures that the visitor is given an outstanding experience, whether it is an opera, concert or theatrical performance.

SPEECH MODE

By reducing the amount of diffuse and late reflections the speech intelligibility is increased. This is done by adjusting the walls so that they permit sound to the absorptive surfaces behind, effectively reducing reverberation time making the hall suitable for performances such as musicals and plays.

SEAMLESS STAGE SHELL

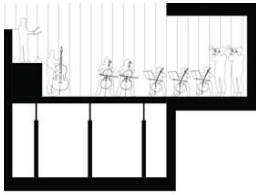
In order to ensure that low frequencies are fully reflected, a rigid and heavy stage shell, ordered from Wenger, is used. Using curved surfaces the sound is diffused and spread more evenly across the auditorium.



ORCHESTRA PIT

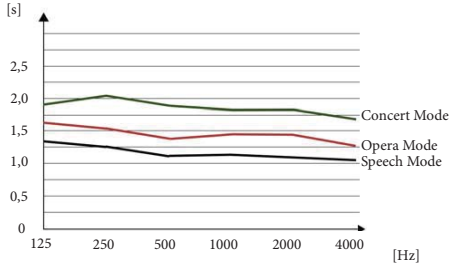
The sound absorption by the musicians, together with the slanted side walls of the pit, break its symmetrical geometry and prevents flutter echo.

The hydraulically operated pit floor can be raised to provide more audience seating.



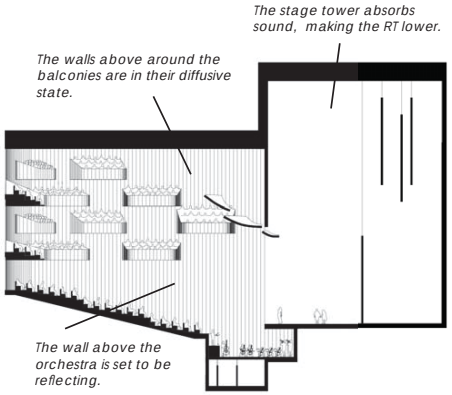
RT Orchestra pit: 0,4 s / 1 kHz

RT DIFFERENT MODES

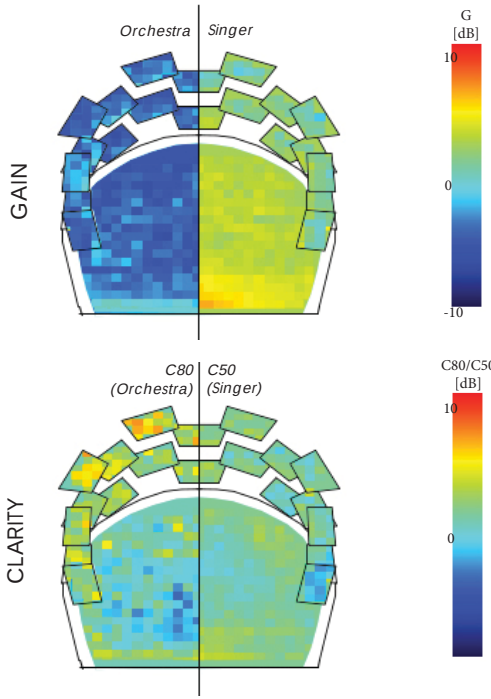


OPERA MODE

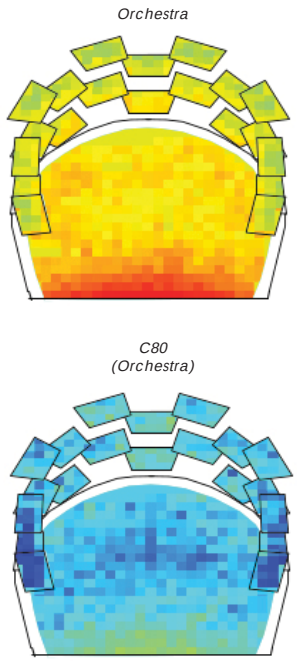
To balance the singer and the orchestra the reflectors, placed in front and above the stage, can be divided into smaller sections. The walls surrounding the pit are made highly diffusive ensuring that the sound is evenly distributed across the hall. The singer is aided by adjusting the walls, making surfaces that can give rise to early reflections reflective.



OPERA MODE

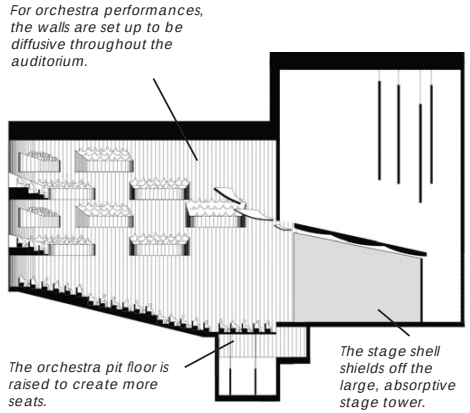


CONCERT MODE



CONCERT MODE

The walls and balconies of the auditorium diffuse the incoming sound and ensure it is evenly distributed across the seats of the hall. As the balconies are offset sideways at each level, large airspaces are created above them allowing sound to arrive from many different directions.



Ribbons

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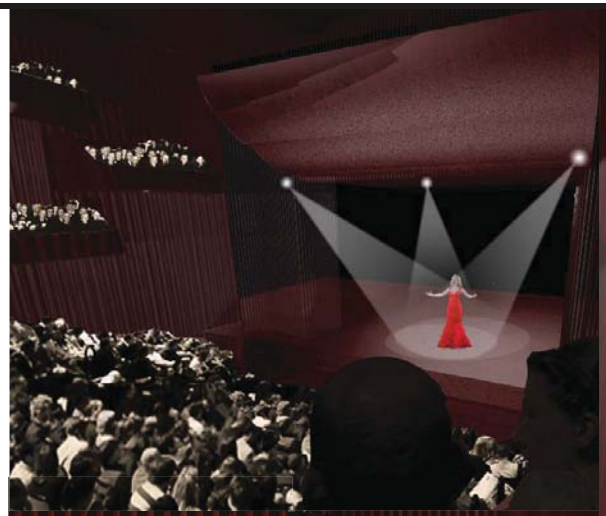
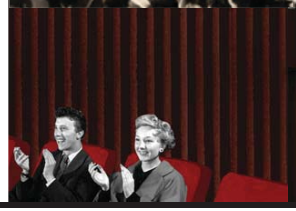
THE OPERA HEART

Playing with shapes, the flexible auditorium inspires students, workers and audience. Transformable walls integrate absorbers, diffusors and reflectors, creating a flexible auditorium offering tunable acoustical properties for different events, all equally important. The auditorium is the heart of the opera, and by combining the acoustical impression with a visual one, it offers all spectators an experience of the same high quality. The seats in the balconies, as well as those in the orchestra, give an enveloped sound and offer good sightlines. This makes the auditorium into one entity with all seats having the same perceived value.

ribbons 3
MONTREAL COLLEGE OPERA





Slutresultatet blev en öppen och välkomnande opera med många kvalitéer. Särskilt nöjd är jag med hur vi behandlade utomhusytan till att bli en trevlig plats att vistas och en del av operan. Vi har också tidigt gjort undersökningar av byggnadens akustik som har bidragit till en fördelaktig utformning av rummen och deras förhållande till varandra. Dessutom har vi funderat mycket på vilka områden och rörelser som kan finnas i operan. Planen tror jag därför fungerar mycket väl både ur logistiska och akustisk synvinklar. Det jag gärna skulle arbetat mer med är visualiseringar och materialval.