KANDIDATARBETE

a musical LAYERING

| STUDENT DESIGN COMPETITION |TCAA and NCAC 2013|

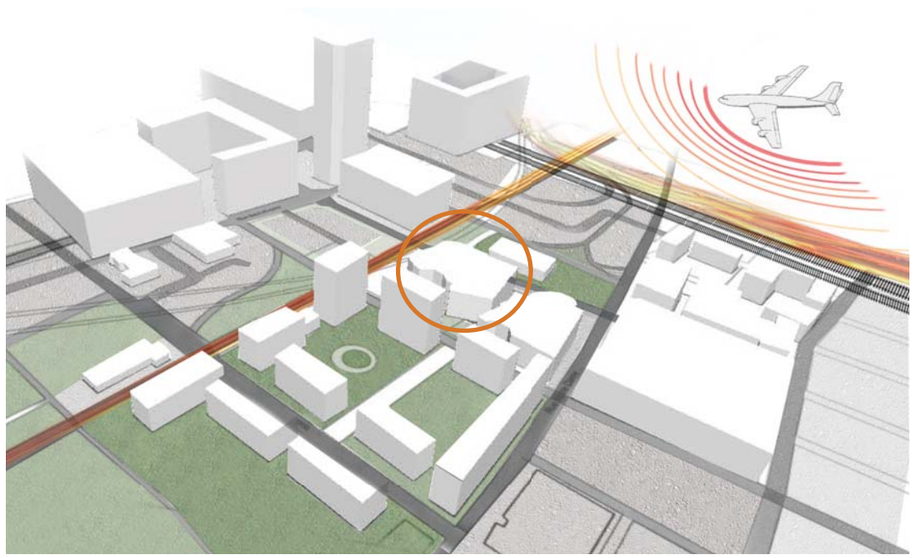
KURS	Kandidatarbete
STORLEK	15 hp
DATUM	Termin 6
EXAMINATOR	Morten Lund

A new venue for Université de Montreal's performing arts and music program is being presented in the industrial and urban environment of Griffintown in central Montreal Canada. In this groupassignment me Emma Blomqvist, Emna Hachicha and Ståle Engvik Ellingsen have with the layering of the building want to captivate the vibrant feel of the location, and its unusual space. It defines the creative use of acoustical design for a wide range of performances.

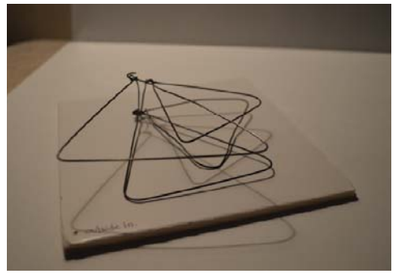
Montreal - CANADA

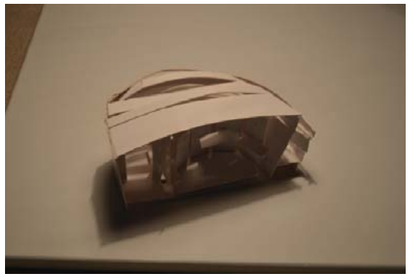
There are many noise sources in the site's proximity. A busy street is located next to the venue, an underground tunnel run beneath the site, and an interstate highway and a railroad are located 350 and 300 m away, respectively. The flight path of Montreal's international airport goes directly over the location at a 500 m height.

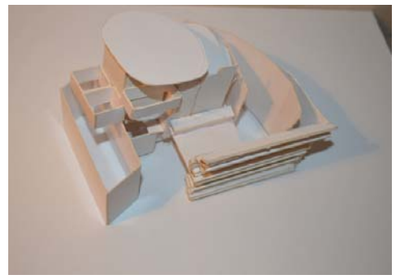
An outdoor entrance area is placed above the tunnel and noise-sensitive areas, such as the auditorium, are located at the other end of the site. Existing buildings screen the site from the highway and railroad, and only noise from aircrafts and the adjacent street is therefore considered. The street's noise contribution is more or less continuous, while the aircraft noise only will occur over short periods. Equivalent and maximum levels are therefore considered for road traffic and aircraft noise, respectively.

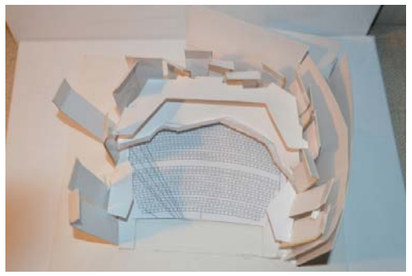


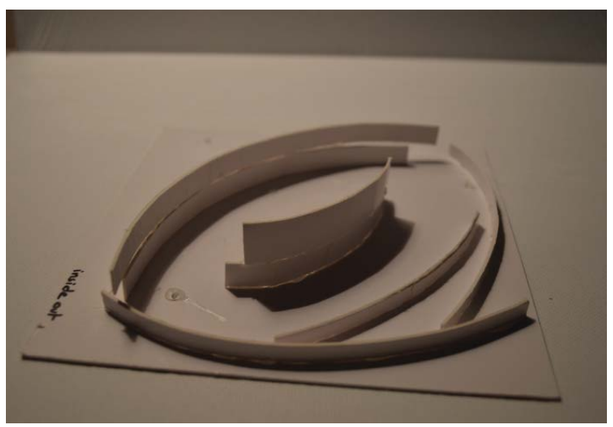
DESIGN PROCESS | movement | vibrance | layering | levels | scattering |

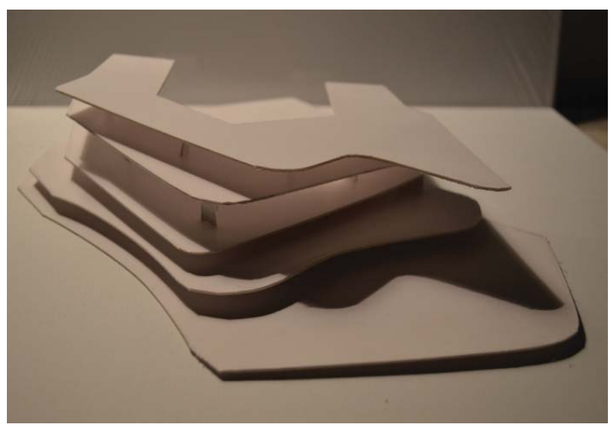








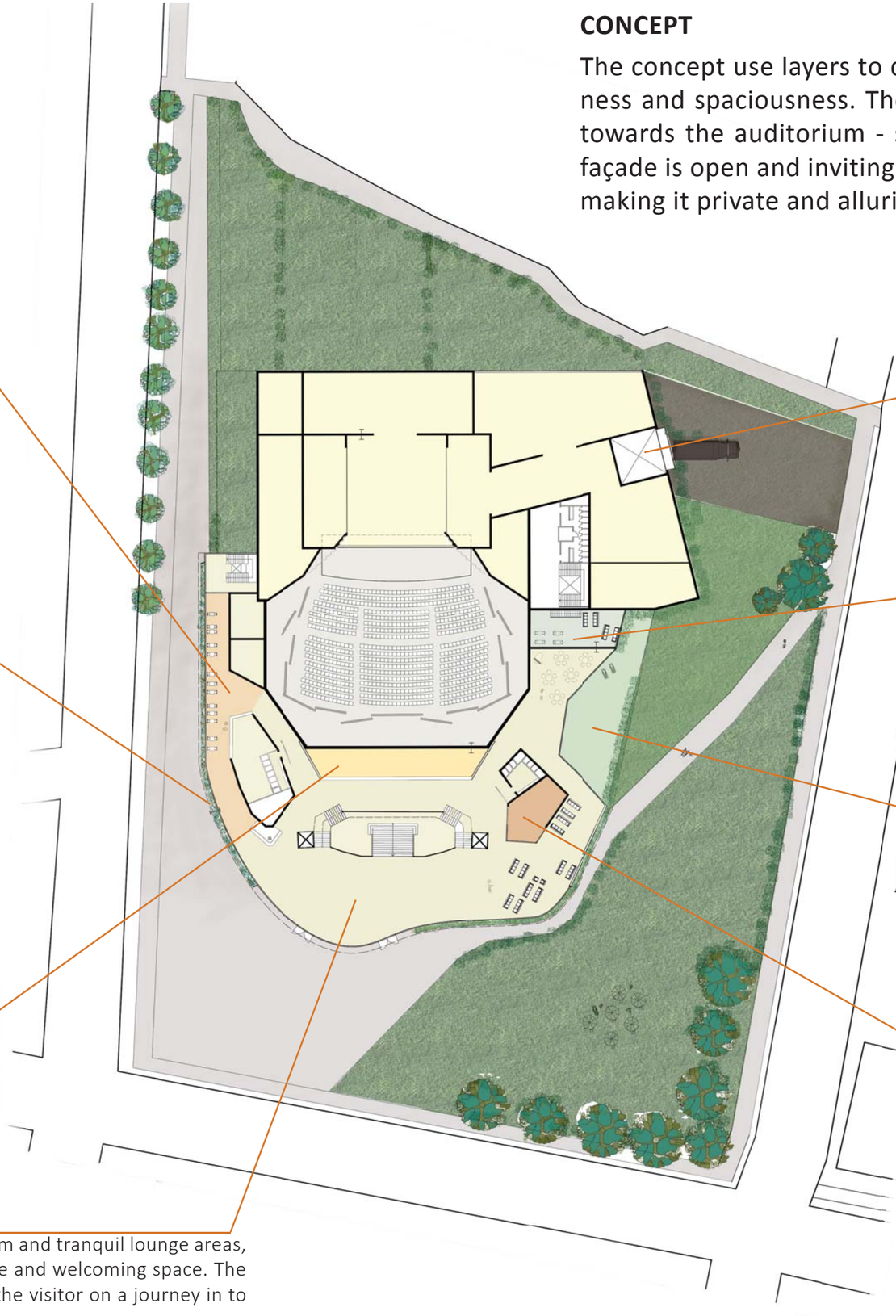




multi purpose
MUSIC VENUE

CONCEPT

The concept use layers to define the building's variations in intimacy, openness and spaciousness. The layers gradually close in as the audience move towards the auditorium - surrounding the heart of the building. The glass façade is open and inviting while thick slatestone walls mask the auditorium making it private and alluring.



RESTAURANT & CAFÉ

A combined restaurant and café have been incorporated in to the building to service visitors and students with refreshments, snacks and light foods. It's a way to stimulate usage of the venue in all hours of the day. The restaurant is a versatile space to cater the different needs of the buildings residents and the neighborhood as a whole.

GLASS FAÇADE

A double glazing façade consisting of thick laminated windows with 150 mm spacing together with stone walls of stacked slate give an industrial appearance in accordance with Griffin Town's past. The thick glass and big spacing give the necessary façade sound reduction. A further reduction improvement is achieved by using different glass thicknesses for the two windows and covering the frame in the air gap with mineral wool. A perforated metal foil covering the mineral wool adds to the industrial look while still being acoustically translucent.

WARDROBE

The main wardrobe on the ground floor functions as a sound barrier. The additional wall and the absorbents of coats, textiles and fabrics help secure optimal acoustics in the auditorium.

LOBBY

A combination of an urban, vibrant restaurant with calm and tranquil lounge areas, together with the many visitor services form a flexible and welcoming space. The lobby is an invitation to a musical experience, taking the visitor on a journey in to an incredible world of song, dance and theatre.

LOADING DOCK

The loading dock is situated on the south corner of the building to isolate noise from sensitive areas in the performance hall. In connection with Rue Jean d´Estrées the loading dock transports gods down to the scene shop, stage and storage with a two story lift.

GREEN ROOM

In the versatile green room extending over two levels, the performers, musicians and employees have a place to relax and unwind. It's located in a near proximity to the stage for easy access and in a quiet part of the building. The nearby staircase leads you up to practice rooms and dressing rooms, or down backstage.

INDOOR/OUTDOOR SPACE

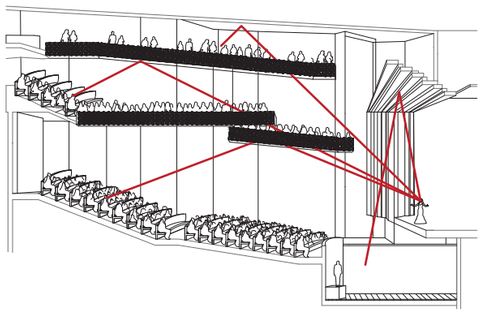
The building's orientation provides the south side with an acoustic shadow. It becomes a natural meeting place where the building merges into the park with a sliding glass façade. The space opens up to an indoor/outdoor musical venue, suitable for Montreals warmer spring and summer months.

GIFT SHOP

The gift shop embodies the spirit of music, both as a service for visitors with a big interest in music and arts as well as for students and local artist to display and sell their work.
As a layering and barrier between the lounge and the active wardrobe/bathroom area, it becomes a natural focal point in the lobby.

performance hall

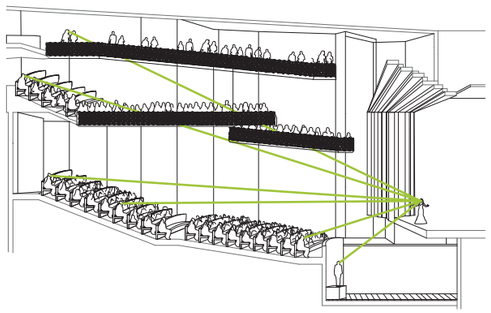
SOUND REFLECTION



The stage reflector and ceiling provide first order reflections to all seats and to the performers on stage and in the pit.

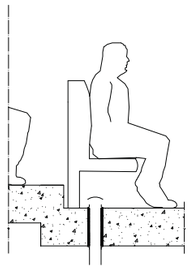
Clarity is important for the listener's word perception. A relatively high clarity for singers on stage makes it a suitable venue for operas where perception of the lyrics is desirable.

SIGHTLINES



All seats have unhindered sightlines to the stage. The balcony fronts consist of a hard reflective surface covered with brass piping for scattering. This gives an old industrial touch.

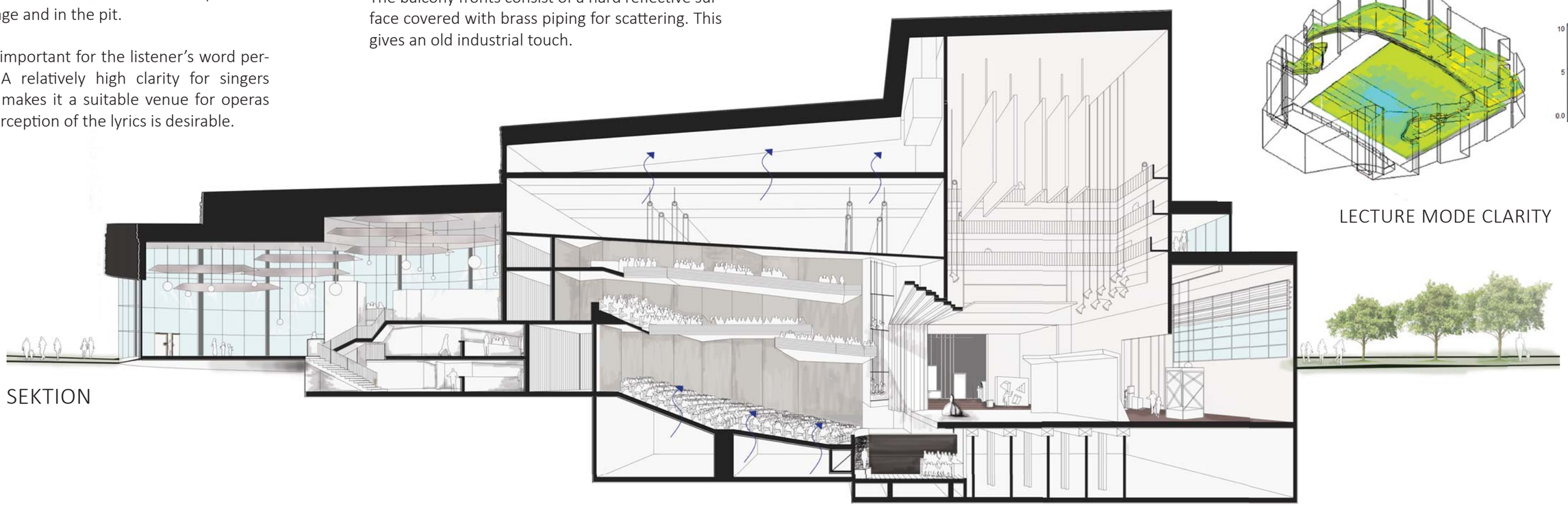
AIR SUPLY



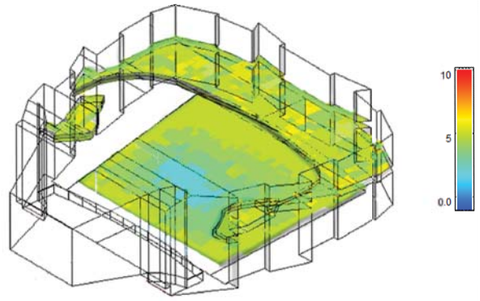
The ventilation machinery and humidifier is located in the mechanical equipment room to avoid vibrations and noise in the auditorium.

WALL REFLECTOR

Irregularities in the inner shell give scattering, contributing to a diffuse sound field and prevent coloration in the reflected sound. Heavy velour curtains on the side and back walls allow shorter reverberation times for lectures along with a lowered ceiling height which decrease the auditorium's room volume.



SEKTION



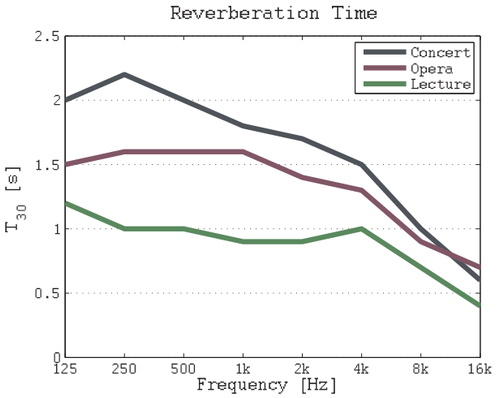
LECTURE MODE CLARITY

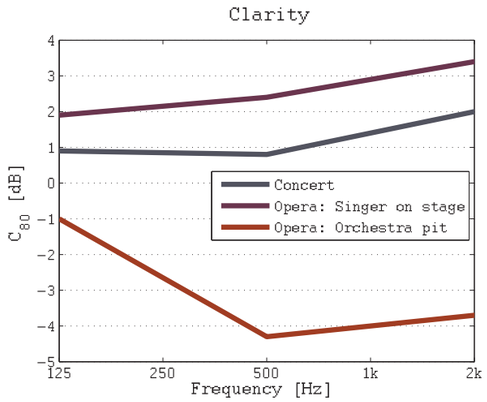
MULTI PURPOSE HALL

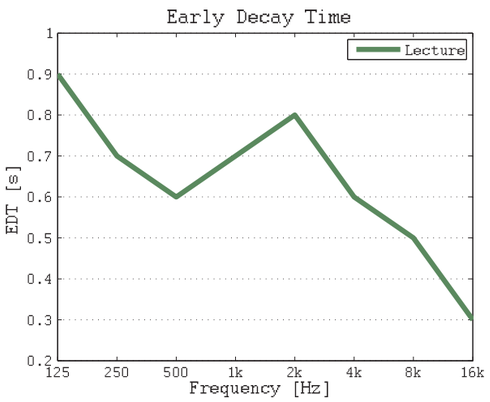
The auditorium has three different acoustic modes: Concert, opera and lecture. It is designed for the background noise criteria RC 15 due its noise sensitive use. A double wall consisting of two thick concrete layers with mineral wool in the cavity is used for the hall's outer shell, and the audience entrance is designed as a sluice with quiet closing doors and absorptive materials in the ceiling and walls to minimize noise transmission from the lobby when the doors are opened.

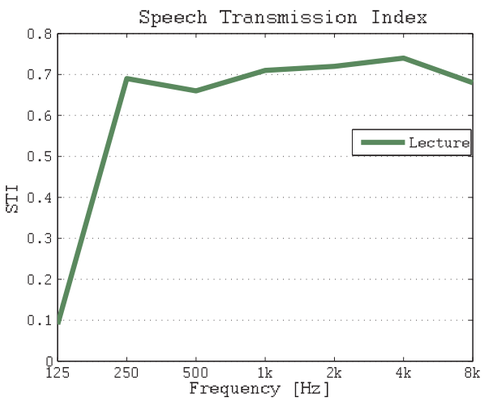
The room formed between the inner and outer auditorium shell will also contribute to the noise reduction from the lobby. A silent ventilation system is also required in order to fulfill the background noise criteria.
Large variations in the acoustical properties are needed for the three modes. A short reverberation time and high clarity is necessary to achieve good speech intelligibility in the lecture mode. The opera and concert modes need longer reverberation times to support the singer and the orchestra.

An adjustable ceiling height and an openable inner shell makes it possible to change the room volume and thereby the reverberation time.
Stacked slate stone of varying depth is used on the inner shell for its scattering properties and rough and industrial look. This surface roughness prevents coloration of the reflected sound together with irregularities in the stage reflectors, ceiling and balcony fronts. A minimum distance of 1.5 meters from the audience seating and the walls give unnoticeable difference in sound arrival time at the listener positions.









AUDIENCE SEATING

Light slipping through the openings in the inner shell guide the audience on their way into the auditorium. Winding balconies in two floors extending from the back to the side embrace the main floor seating and give an intimate feel.
This intimacy is further enhanced by a ceiling height of 15 meters and a maximum distance of 30 meters between the audience and performers. All seats are directed towards the stage, making the angle between the stage and audience less than 30°.

The side balconies are sloping towards the stage, ensuring good sight lines at all seats. Movable seats on the second balcony offer flexibility and allow standing public under graduations and other big events.
The first floor side balconies only overlap the side isles and the lowest under balcony ceiling height is 4.5 meters. This ensures envelopment and spaciousness for all audience positions.

opera LEVELS

MECHANICAL EQUIPMENT ROOM and SCENSHOP

The mechanical equipment room is placed on the underground floor to avoid vibrations spreading in the structure. Sound and vibration isolation is achieved by building it as a “box in box” construction with heavy double walls and floating floor in concrete. Spring-supports isolate vibrating machinery and heavy machinery is supported at the foundation. Piping does not have rigid contact with the walls in the conduit entries in order to reduce vibration transmission, and air-borne sound is isolated using mineral wool and grout seals.

The scene shop is built using the same construction as the mechanical room for maximum sound reduction. Absorbers cover the ceiling and upper parts of the walls to reduce the noise buildup inside the shop. A double door design with heavy sliding doors in separate frames ensures the sound reduction required between the scene shop and backstage.

LOBBY

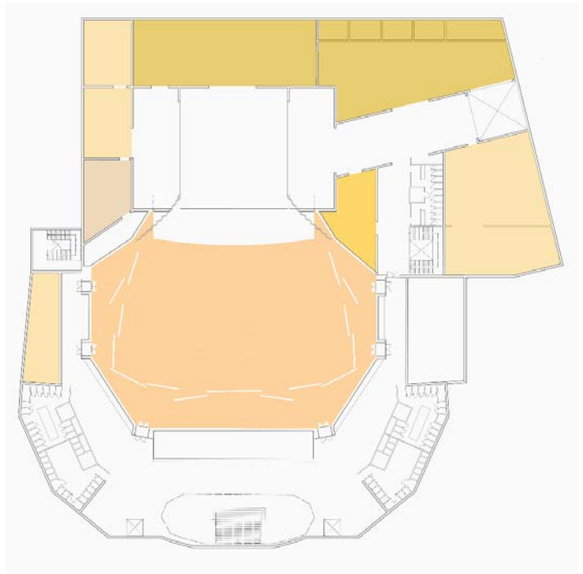
Visitors are welcomed in the spacious lobby with cloud like absorbents floating above amongst thin light fixtures. The porous absorbers are fixed on top of perforated plates and suspended from the lobby ceiling to reduce reverberation time and noise buildup. Theground floor lounge, gift shop, wardrobe and box office are centralized round the staircase and elevators. Toilettes are located away from the auditorium and on all main floors, with the largest one level down serving the main floor.
On performance nights there are several locations to find refreshments. A restaurant situated on the ground floor serve food and coffee and in addition there are several lounge areas with bars and serving carts for socializing.
Linking the venue together, slatestone is featured as a façade as well as an outer auditorium wall and throughout the building. Bringing some of the outdoors and the industrial fell of the neighborhood in to the building makes it an urban, interesting and inspiring space for performances and creation.

REHERSAL ROOM

The rehearsal room serves a multiple of purposes: dance, chamber and choir music, meetings and lectures. Variable acoustics is a necessity in order to accommodate the different requirements in reverberation times spanning from T30 values of 0.6 to 1.8 seconds for meetings and chamber music, respectively.
A ceiling height of 4.5 meters gives a large room volume and longer reverberation time. Acoustic blinds give a scattering wall and can be opened for reduction of the reverberation time along with thick and heavily draped curtains. Scattering is further enhanced by irregularities in the ceiling, proventing coloration of the sound together with non-parallel walls that eliminate flutter echo.
A heavy floating floor prevents impact noise from spreading to adjacent rooms. Double windows mounted in separate frames without rigid connection provide daylight while still accommodating the need for high sound isolation. The window’s sound reduction is further improved by slightly slanting the window glass.

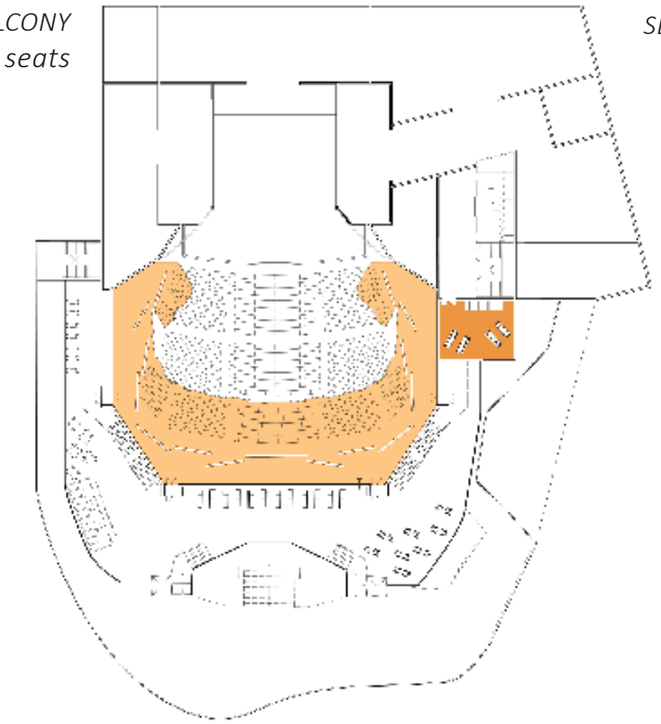
LEVEL-1

MAIN FLOOR
734 seats



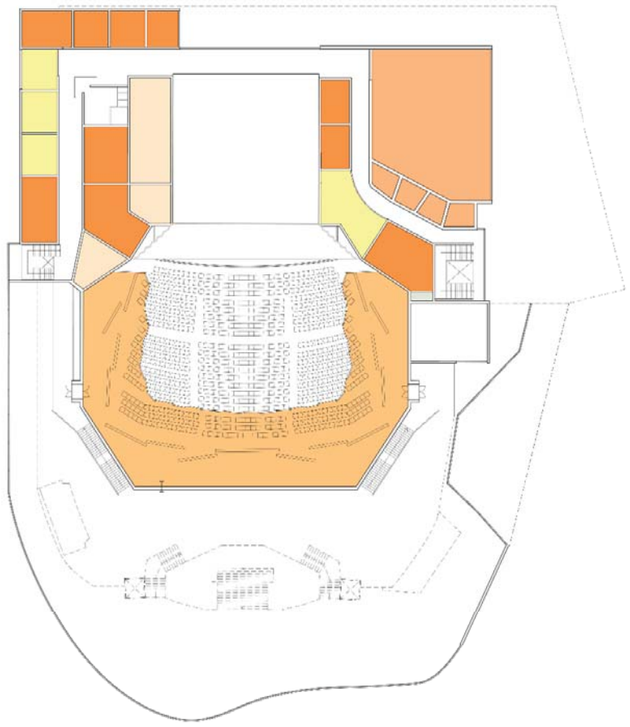
LEVEL +1

FIRST BALCONY
278 seats



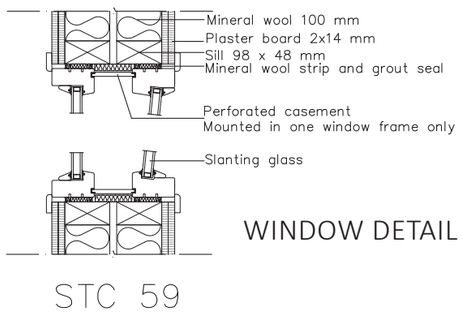
LEVEL +2

SECOND BALCONY
185 seats



Scene shop [RC 40]]
Costume shop [RC 40]
Main floor [RC 15]
Storage [RC 45]
Dressing room [RC 35]
First balcony [RC 15]
Green room [RC 25]
Rehearsal room [RC 20]
Second balcony [RC 15]

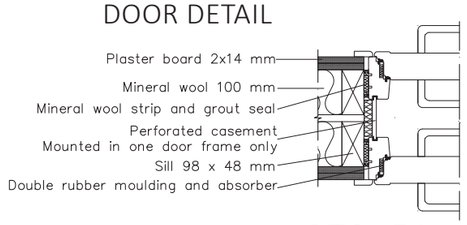
The practice rooms are built using the same “box in box” construction as the rehearsal room.
Scattering is introduced by irregularities on the wall and in the ceiling, and an angled wall to prevent flutter echo. Reverberation time can be adjusted with a thick and heavily draped curtain. Longer reverberation times can be achieved by using an electroacoustic system such as LARES.



WINDOW DETAIL

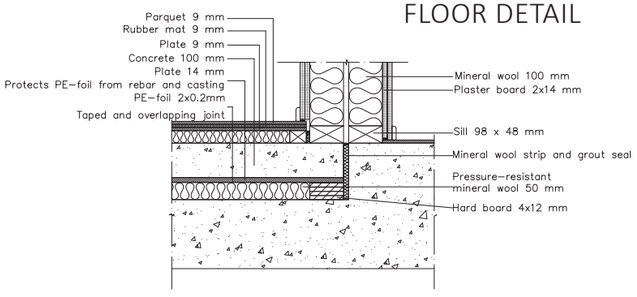
STC 59

DOOR DETAIL

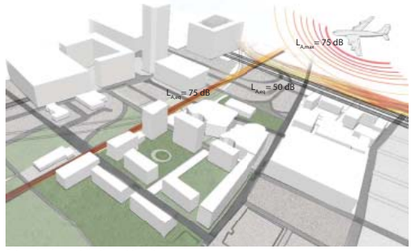


STC 59

FLOOR DETAIL



posters



External noise contributions at the site.

a musical LAYERING

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Sound level map

The concept use layers to define the building's variations in intimacy, openness and spaciousness. The layers gradually close in as the audience move towards the auditorium - surrounding the heart of the building. The glass façade is open and inviting while thick slatestone walls mask the auditorium making it private and alluring.

RESTAURANT & CAFÉ
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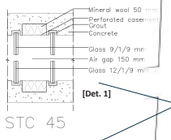

LOADING DOCK
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GREEN ROOM
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Performance Hall

Multi purpose hall

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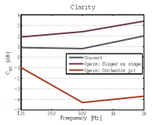
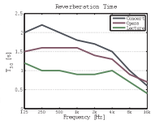
Large variations in the acoustical properties are needed for the three modes. A short reverberation time and high clarity is necessary to achieve good speech intelligibility in the lecture mode. The opera and concert modes need longer reverberation times to support the singer and the orchestra. An adjustable ceiling height and an openable inner shell makes it possible to change the room volume and thereby the reverberation time. Heavy curtains on the side and back walls give adjustable absorption for further reverberation time reduction. Helmholtz resonators in the ceiling under the first side balcony add low frequency absorption, and their distance from the audience ensures that they do not disturb the listener's soundfield. Thick upholstering minimizes the difference in absorption between empty and occupied seats. Acoustic blinds in the room between the inner and outer shell can be opened for absorption when it is not used as a reverberation chamber, making it more pleasant.

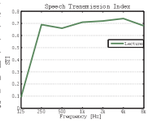
Stacked slate stone of varying depth is used on the inner shell for its scattering properties and rough and industrial look. This surface roughness prevents coloration of the reflected sound together with irregularities in the stage reflectors, ceiling and balcony fronts. A minimum distance of 1.5 meters from the audience seating and the walls give unnoticeable difference in sound arrival time at the listener positions.
Loudspeakers for special effects are hidden behind the stage reflectors.



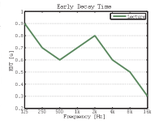
Clarity is important for the listener's word perception. A relatively high clarity for singers on stage makes it a suitable venue for operas where perception of the lyrics is desirable.



Short reverberation times for speech are obtained by lowering the ceiling height and adding absorption with curtains on the side and back walls. The room between the inner and outer auditorium shell is used as a reverberation chamber for the long reverberation times in the concert mode.



A speech transmission index of approximately 0.7 for all frequencies above 250 Hz in lecture mode make it suitable for speech.

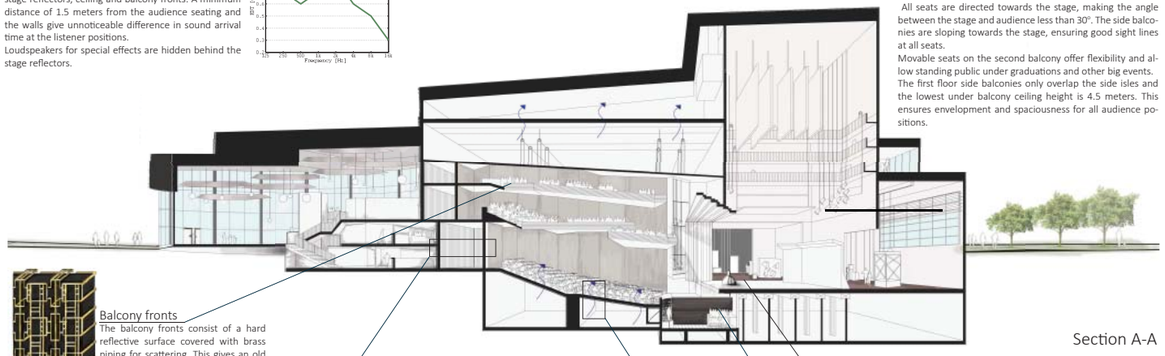


An average early decay time of 0.7 s for 500-2k Hz give suitable clarity for speech.

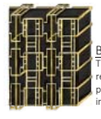
Audience seating

Light slipping through the openings in the inner shell guide the audience on their way into the auditorium. Winding balconies in two floors extending from the back to the side embrace the main floor seating and give an intimate feel.

This intimacy is further enhanced by a ceiling height of 15 meters and a maximum distance of 30 meters between the audience and performers.
All seats are directed towards the stage, making the angle between the stage and audience less than 30°. The side balconies are sloping towards the stage, ensuring good sight lines at all seats.
Movable seats on the second balcony offer flexibility and allow standing public under graduations and other big events.
The first floor side balconies only overlap the side isles and the lowest under balcony ceiling height is 4.5 meters. This ensures envelopment and spaciousness for all audience positions.



Section A-A

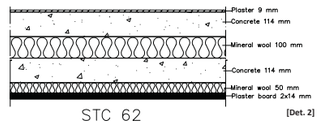


Balcony fronts
The balcony fronts consist of a hard reflective surface covered with brass piping for scattering. This gives an old industrial touch.

Opera Shell

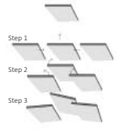
Exterior Opera Shell

Wall detail horizontal

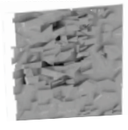


Interior Opera shell

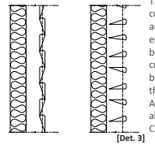
Concept of the wall deplacement



Wall reflektor



Absorbers blinds



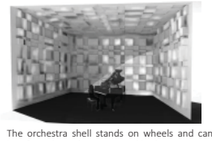
The concept of layers is reflected in the thick double concrete wall and the interior wall surrounding the auditorium, acting as outer and inner shells. The outer shell isolates the auditorium from the rest of the building both visually and acoustically. A volume is created between the two shells and acts as a reverberation chamber when sound is allowed to travel through adjustable openings in the inner shell.
Acoustic blinds on the outer shell give variable sound absorption in the volume between the two shells. Closed blinds create reflective and scattering walls giving a strong and diffuse reverberant sound field when used as a reverberation chamber, while open blinds make it a pleasant space for the audience.

Irregularities in the inner shell give scattering, contributing to a diffuse sound field and prevent coloration in the reflected sound. Heavy velour curtains on the side and back walls allow shorter reverberation times for lectures along with a lowered ceiling height which decrease the auditorium's room volume.

Air supply

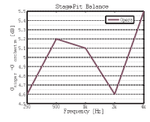
The ventilation machinery and humidifier is located in the mechanical equipment room to avoid vibrations and noise in the auditorium. The chimney effect is used for a silent air exchange in the auditorium, feeding fresh air through valves under the audience seats and let old air out through the ceiling. Large cross sections are used for the ventilation ducts, making sure the air velocity does not exceed 2 m/s. Mufflers with non-fibrous absorbers are used for prevention of sound transmission through the ducts. The humidifier ensures the correct air humidity for the singers.

Stage Shell



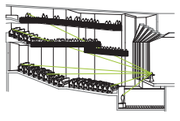
The orchestra shell stands on wheels and can be disassembled into four plates that are stored in the stage tower. A rough surface consisting of rectangles with large variations in size and depth give both horizontal and vertical scattering. It is built as a sandwich construction with an asphalt core to prevent sound absorption. The same finish is used for the shell and the stage reflectors to make them merge together.

Orchestra Pit



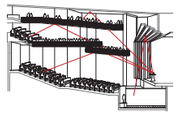
The orchestra pit is divided into two separate floors that can be raised and lowered. The sidewalls can be tilted to help send out sound to the auditorium and at the same prevent flutter echo in the pit. The curved wall behind the conductor has the same finish as the orchestra shell so that the different orchestra sections hear each other. Loud sections are shielded by movable barrier when necessary.

Sightlines



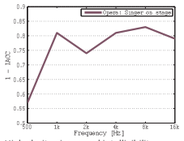
All seats have unhindered sightlines to the stage.

Sound reflection



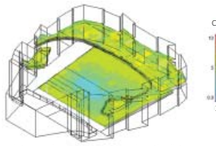
The stage reflector and ceiling provide first order reflections to all seats and to the performers on stage and in the pit.

Envelopment



High clarity gives good intelligibility.

Lecture mode Clarity



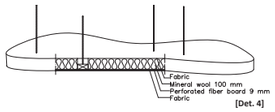
Low interaural cross correlation gives the listener a sensation of being enveloped by the sound.

Lobby

Visitors are welcomed in the spacious lobby with cloud like absorbents floating above amongst thin light fixtures. The porous absorbers are fixed on top of perforated plates and suspended from the lobby ceiling to reduce reverberation time and noise buildup. Theground floor lounge, gift shop, wardrobe and box office are centralized round the staircase and elevators. Toilettes are located away from the auditorium and on all main floors, with the largest one level down serving the main floor.

On performance nights there are several locations to find refreshments. A restaurant situated on the ground floor serve food and coffee and in addition there are several lounge areas with bars and serving carts for socializing.

Linking the venue together, slatestone is featured as a façade as well as an outer auditorium wall and throughout the building. Bringing some of the outdoors and the industrial fell of the neighborhood in to the building makes it an urban, interesting and inspiring space for performances and creation.

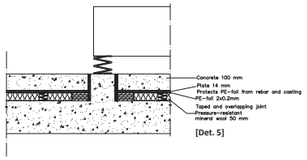


[Det. 4]

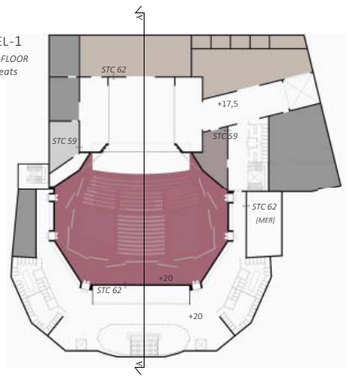
Mechanical Equipment Room and Scenshop

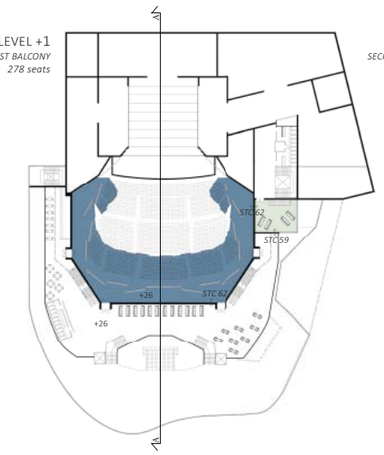
The mechanical equipment room is placed on the underground floor to avoid vibrations spreading in the structure. Sound and vibration isolation is achieved by building it as a "box in box" construction with heavy double walls and floating floor in concrete. Spring-supports isolate vibrating machinery and heavy machinery is supported at the foundation. Piping does not have rigid contact with the walls in the conduit entries in order to reduce vibration transmission, and airborne sound is isolated using mineral wool and grout seals.

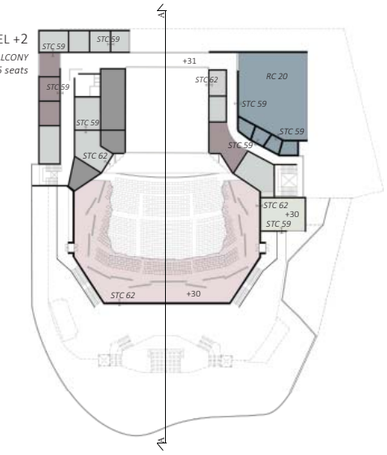
The scene shop is built using the same construction as the mechanical room for maximum sound reduction. Absorbers cover the ceiling and upper parts of the walls to reduce the noise buildup inside the shop. A double door design with heavy sliding doors in separate frames ensures the sound reduction required between the scene shop and backstage.



[Det. 5]







Scene shop [RC 40]]
Costume shop [RC 40]
Main floor [RC 15]
Storage [RC 45]
Dressing room [RC 35]
First balcony [RC 15]
Green room [RC 25]
Rehearsal room [RC 20]
Second balcony [RC 15]

Rehearsal room

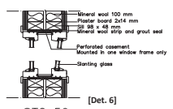
The rehearsal room serves a multiple of purposes: dance, chamber and choir music, meetings and lectures. Variable acoustics is a necessity in order to accommodate the different requirements in reverberation times spanning from T30 values of 0.6 to 1.8 seconds for meetings and chamber music, respectively.

A ceiling height of 4.5 meters gives a large room volume and longer reverberation time. Acoustic blinds [Det. 3] give a scattering wall and can be opened for reduction of the reverberation time along with thick and heavily draped curtains.

Scattering is further enhanced by irregularities in the ceiling, proventing coloration of the sound together with non-parallel walls that eliminate flutter echo.

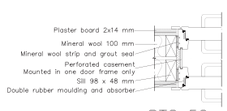
A quiet environment is especially important for choir music, giving the background noise criteria RC20. This is obtained using a "box in box" construction that reduces both airborne sound and flanking transmission. A heavy floating floor prevents impact noise from spreading to adjacent rooms. Double windows mounted in separate frames without rigid connection provide daylight while still accommodating the need for high sound isolation. The window's sound reduction is further improved by slightly slanting the window glass.

window detail



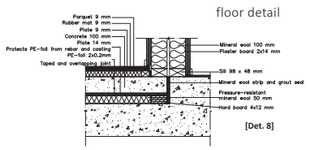
[Det. 6]
STC 59

door detail



[Det. 7] STC 59

floor detail



[Det. 8]

The practice rooms are built using the same "box in box" construction as the rehearsal room. Scattering is introduced by irregularities on the wall and in the ceiling, and an angled wall to prevent flutter echo. Reverberation time can be adjusted with a thick and heavily draped curtain. Longer reverberation times can be achieved by using an electroacoustic system such as LARES.

REFLEKTION

"Efter avslutandet av ett stort projekt känns det som om inget kunde gjorts annorlunda, eller att allt kunde ha varit annorlunda om bara ett tidigt beslut hade ändrats.
I vårt projekt har focus legat mycket vid själva akustiken och designen kring denna samt miljön/platsen och dess omgivning. Detta har satt tonen för hela processen som helatiden varit ett sammarbete mellan 3 individer. Ett grupparbete först där just ordet samarbete är nyckelordet. En övning i att formulera sig enkelt, tydligt och korrekt och att utnyttja samspellet mellan oss till att skapandet. Allt en utmaning i sig utöver det för oss grundläggande arkitektoniska i projekterandet.

Att för första gången få samla de kunskaper vi lärt oss under de snart 3 åren på arkitektur & teknik till ett så betydelsefullt projekt som kandidaten. Jag känner nu att cirkeln har slutit sig med de mål och önskningar som funnits sedan starten. Vi har blivit nyckelspelaren, mitten pusselbiten och bron mellan världarna av arkitektur och ingenjörskonst.
Sedan har projektet inte alltid lockat fram de bästa sidorna och det har varit många timmar av slit och stress. Nu i efterhand om jag hade fått möjligheten att arbeta vidare med projektet så hade jag valt att utveckla konceptet mer. Förtydliga och kanske tidigt valt en mer tydlig inriktning/profil och sedan framhävt detta mer.

Jag skulle vilja vidareutveckla våra idéer om platsen och dess betydelse i staden. Göra tydligare planer och illustrationer för grönytor/entrésituation och över samspellet mellan den existerande bebyggelsen och byggnaden, och även lyfta fram platsens kvalitéer som den bärande idén och koncept. Den viljan att inte göra en ikonisk byggnad, men istället skapa en transparens och öppenhet genom bl.a. den uppbrutna skifferfasaden med dess indirekta ljusinsläpp, föll bort något ur presentationsmaterialet. Med det focus och de besluten som tagits kan vårt projekt ses som lätt anonymt och lagom, och efter det arbete som lagts ned och med de tankar och idéer som funnits bör det arkitektoniska materialet varit mer informativt.
Jag är otroligt stolt över mitt kandidatarbete och anser själv att det är det bästa arbete jag gjort (hittills). Bland många andra tävlingsförslag är vårat genomarbetat med en nu djupare förståelse för akustik/planering och arkitektur.

Tillslut en så har jag även fått en insikt i världen utanför skolan, här där det hålls en skyddande kappa över oss elever. Att nu ha blivit granskad och kritiserad, synad i sömmarna och kommit ut på andra sidan fortfarande inspirerad och motiverad känns otroligt bra. Min lärdom är att detaljer är viktigt och vikten av planering, noggrannhet och struktur har inte gått mig förlorad. "

/Emma Blomqvist maj 2013