THE CONCH

Bachlelor Thesis

INTRODUKTION

Programmet utgick ifrån att skapa ett stadshus på valfri plats i USA, där höga krav på god akustik ställs. I Stadshusen ska främst rummen Court Room, Community Hall och Lobby gestaltas. Det ska finnas förbindelser mellan rummen och utöver akustik ska säkerhet och naturligt ljusinsläpp beaktas förutom att skapa en tydlig konceptuell gestaltning.

VISION

Att skapa ett stadshus där det organiska konceptet ska genomsyra alla aspekter av projektet samt god rumsakustik där koncept och gestaltning får vara styrande. En strävan att lösa varje problem genom att utgå från konceptet och hur man genom detta kan hitta smarta lösningar. På detta sätt kan en röd tråd tydligt avläsas såväl i gestaltning som i funktionalitet.

KRITERIER

För varje central del av byggnaden skrev vi ner ett antal kriterier som vi försökt att utgå ifrån under arbetsprocessen.
Kriterier för Lobbyn var att trappan skulle få ta plats, vara central och vara det som sammanbinder, att ljus ska ta sig in på ett sådant sätt så att byggnaden själv ska vara respektingivande och besökaren är underordnad denna samt ha god akustik.
För Court Room utgick vi ifrån följande kritierier;
Samtliga i salen ska kunna urskilja ett samtal som förs vid normal samtalston i rättgångsområdet, det ska inte upplevas stimmigt på grund av för lång efterklangstid samt att den tekniska lösningen för god akustisk ska genomsyras av konceptet.
För Community Hall ska musik såväl som tal kunna uppfattas och upplevas bra oavsett plats i salen, mikrofon ska inte behöva användas, variabel akustik som styr efterklangstiden och den tekniska lösningen styrs av projektet.

ARBETSPROCESS

Förarbete med Assignment 1-4

Under de första veckorna av projektet arbetade vi i grupper om fyra studenter där uppgiften var att utforska olika delar av en byggnad. Uppgiften med Assignment 1 var att undersöka hur ljus, ljud och termiskt påverkar oss vid olika platser runt om i Göteborg, den andra var att arbeta med olika entrésituationer, den tredje att utforma en fasad med goda kvalitéer och den fjärde att sammanföra de tidigare delarna vi utforskat till en helhet.

Samarbete med akustiker

Efter presentation av resultatet från Assignment 1-4 blev vi tilldelade en student från akustikmastern Sound and vibration. Här började vi det faktiska arbetet med utformandet av stadshuset som utgick ifrån tävlingsprogrammet Acousical Society of America. Med hjälp av akustikern skulle vi styra förslaget mot god akustik, både i rummen, mellan rummen samt insida och utsida av byggnaden – ljud ska varken läcka in eller ut.

RESULTAT

Förarbetet med Assignment 1-4 bidrog till förståelsen för vikten av de olika funktionaliteterna i en byggnad och hur dessa kunde utformas på bästa sätt. I vårt färdiga resultat kunde dock entrésituationen, som vi arbetat grundligt med under förarbetet, bearbetas mer. Fasaden arbetades grundligt igenom men påstods under kritiken likna mer ett skelett än en snäcka, vilket vi håller med om. Detta hade kunnat optimeras genom att minska antalet bågar samt öka bågbredden.
Samarbetet med akustikern, Rebecca Gillie, hade inte kunnat gå bättre. Hon gav oss en djupare förståelse för rumsakustik och såg inte vårt koncept som ett hinder utan snarare en tillgång. Lösningen som vi tog fram, främst vad gällde den variabla akustiklösningen kring hur vi utökade volymen i Community Hall för öka efterklangstiden samt den snäckformade planlösningen som arbetades grundligt igenom med lager-på-lager principen är vi väldigt nöjda med.
Arbetet med projektet planerades väl vilket gav oss goda möjligheter att hinna klart i tid och undvika stress. Samarbetet med Rebecca underlättade arbetsbelastningen då hon var en självklar del av vår grupp och tog lika stort ansvar som vi för projektet. Som konsekvens av detta kunde vi lägga mycket tid på att bredda våra kunskaper i Revit och arbetet med parametrisk design.

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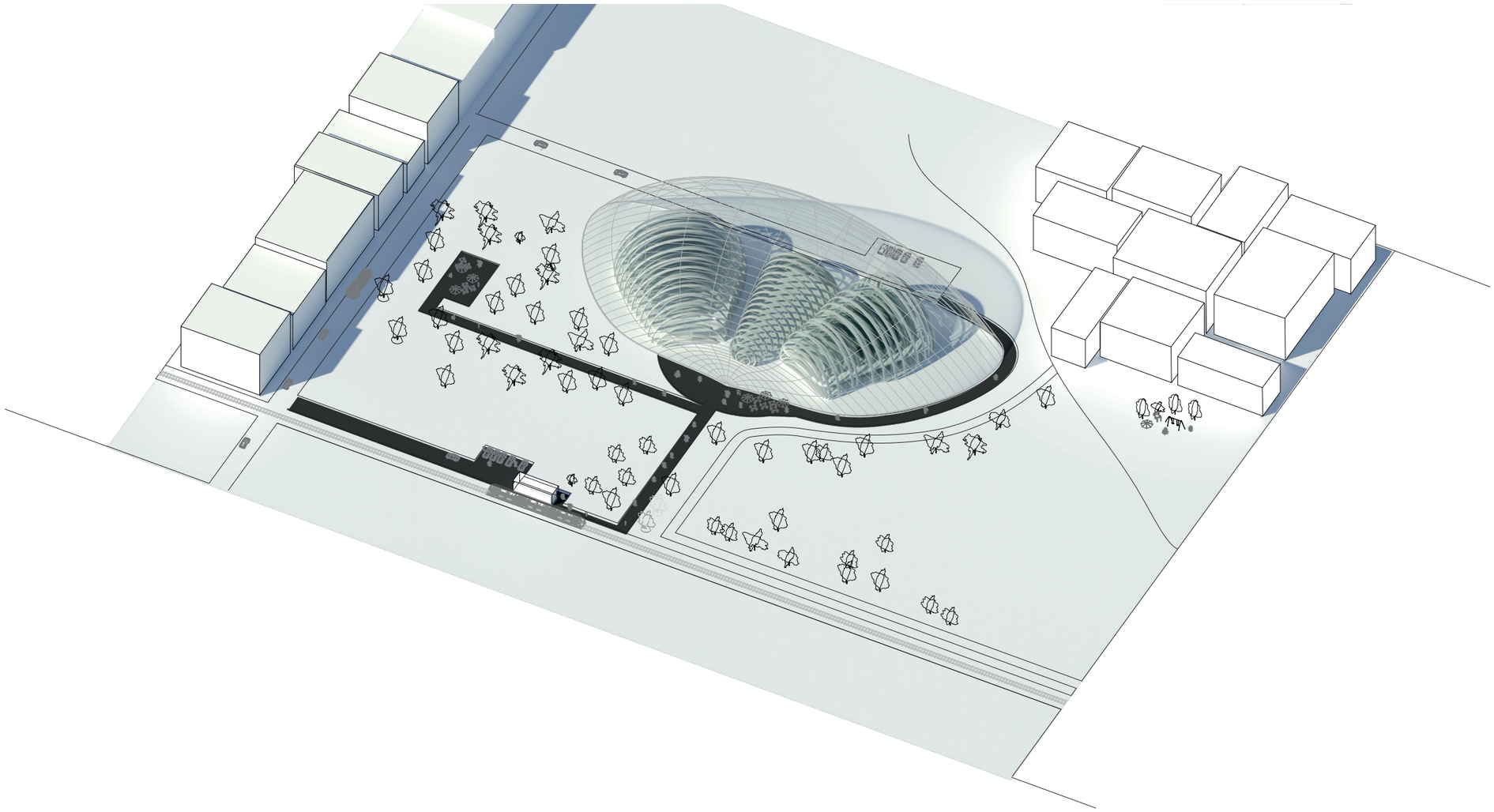
PROGRAM

Sim ac viliaeseris. Fecternicae am hi, C. Uctude id atum ublium praet, cerit; horipicie auterum nihil hortempertaUntelin patu quod in nondest ratiam di poratui deludactam et, nonsignat, condend uctusti, C. Mulium diu morterem sistrud amquam ac trox nunum hacitatus, ninvoc, senatuus, Cati, sesiman timmorbit, C. Ant quidiem, Palariam diussa venteris, nessoludam

CONCEPT

The design was inspired by the shape of a conch shell. The desire was to implement the shape and texture in both the architecture and the acoustical treatment.
The exterior shell texture is desired on the interior surfaces of the chambers to give the users the seashell impression; therefore the smooth interior shell texture is included on the exterior of the building.
The shell concept also inspired the movement of people within the building that can be seen in the floor plans.

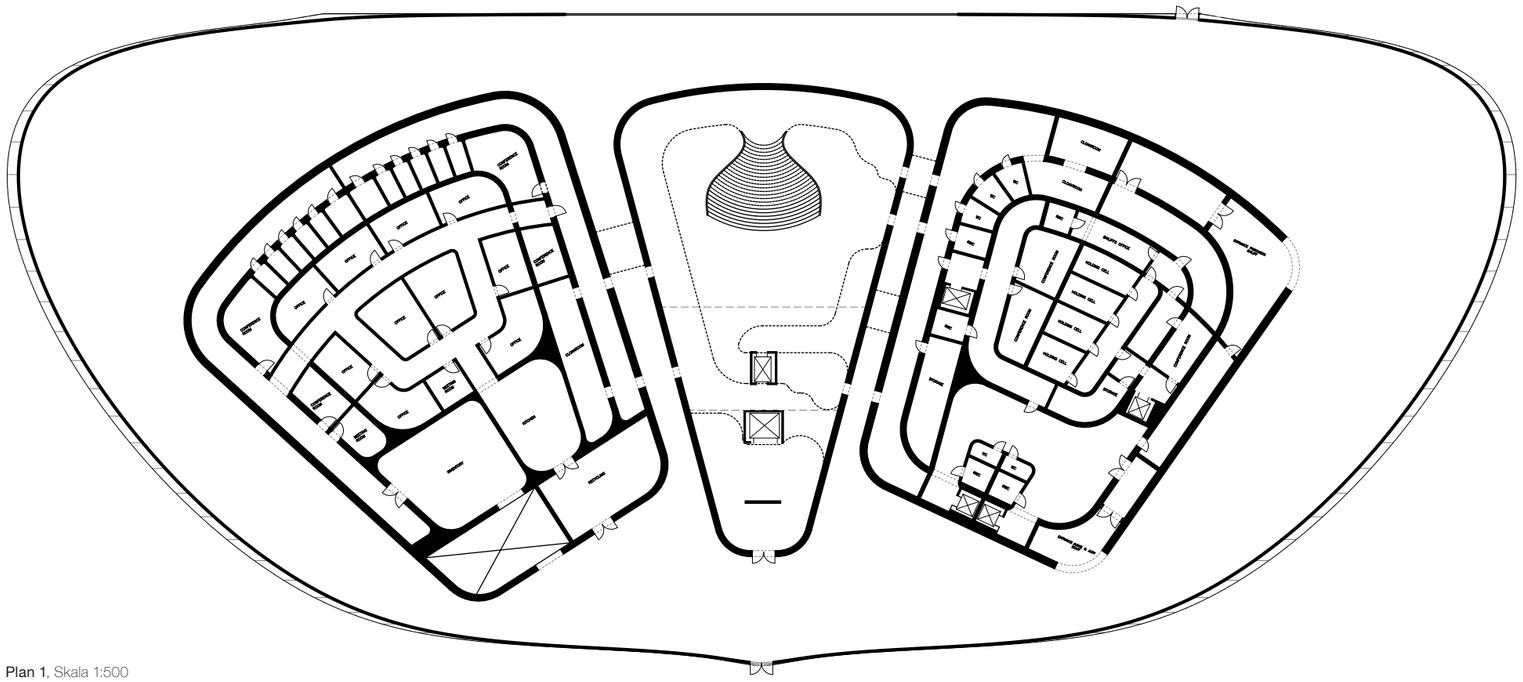


SHELL SHAPE

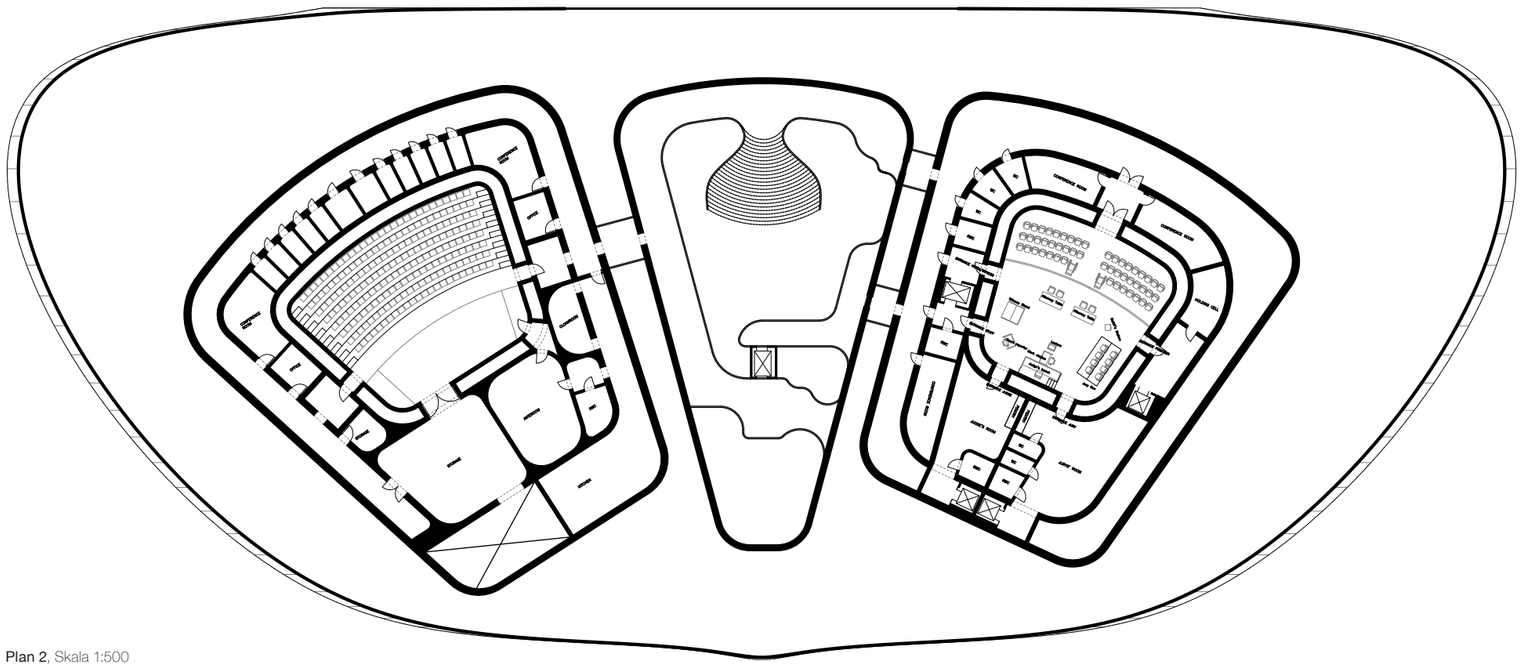
Users of the courtroom and community hall are encapsulated in a conch shell as the walls and ceiling of these rooms are constructed of curved arches. The convex shape of the arches scatters the sound throughout the rooms. The arches are constructed of different materials to create the best acoustic environments and provide natural lighting to the spaces. Glass arches are found spaced throughout the depths of the rooms. The non-glass materials have similar visual characteristics to create a continuous shell impression.

THE SITE

The location of the municipal building is the center of a suburban area. The entrance of the building opens to a city park, allowing residents of the city to be connected with the government. The park also serves to decrease the city noise from the neighboring streets, the tram, police and fire station slightly at the building facade. The glass facade of the Conch allows the users of the building to remain connected with the city they serve.



Plan 1, Skala 1:500



Plan 2, Skala 1:500

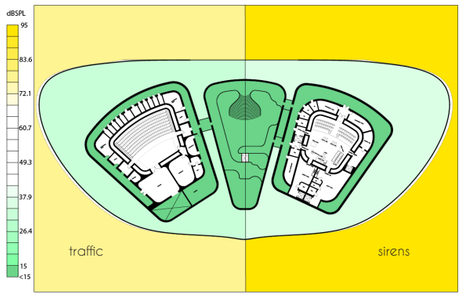
SECURITY

The different users of the court space enter the shell at different positions and have secure paths to their respective spaces through shell layers.
The same sort of division is applied to the community hall as can be seen in the floor plan.

NOISE AND VIBRATION CONTROL

EXTERIOR NOISE REDUCTION

The glass facade of the shell allows natural light into the building and into the interior chambers through the glass shells. Double glass panes of different thicknesses and different air gaps anchored in absorbent material are used on both the exterior and interior windows. This reduces the noise transmitted into the building over a wide range of frequencies. Through each shell layer, the noise level from the exterior is diminished more and more.

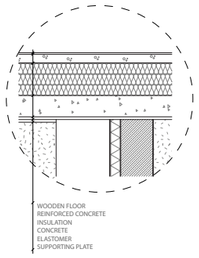


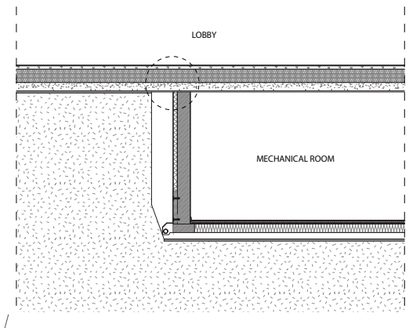
VENTILATION

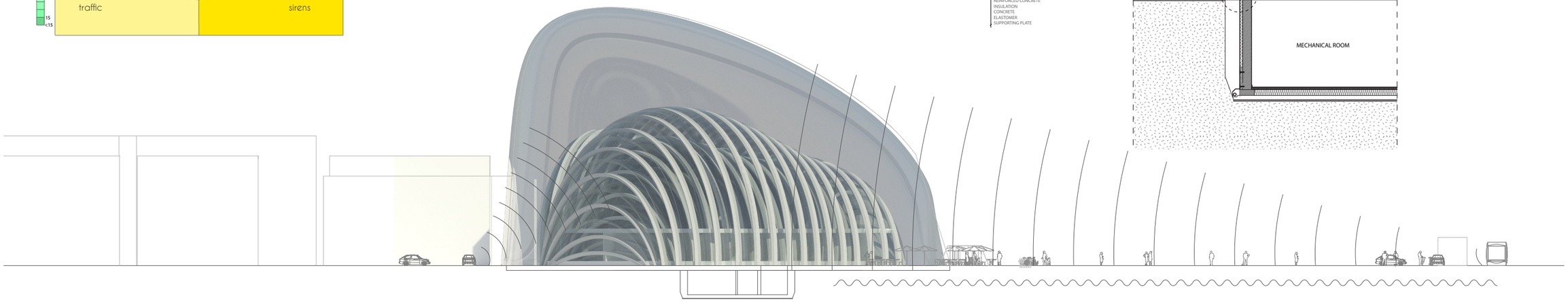
From the air intake on the northern side of the building, the air is sent to the mechanical room in the basement for handling.
Wide air ducts are installed in the Conch to reduce the velocity of air in the ducts therefore reducing the sound pressure level generated, while maintaining the necessary flow rate to provide a comfortable environment. Additionally the ducts are lined with insulation, to reduce the level of any noise that is generated. Silencers are used where needed around bends in the ductwork.
The central location of the mechanical room provides symmetry to optimize the functionality of the system.

MECHANICAL ROOM

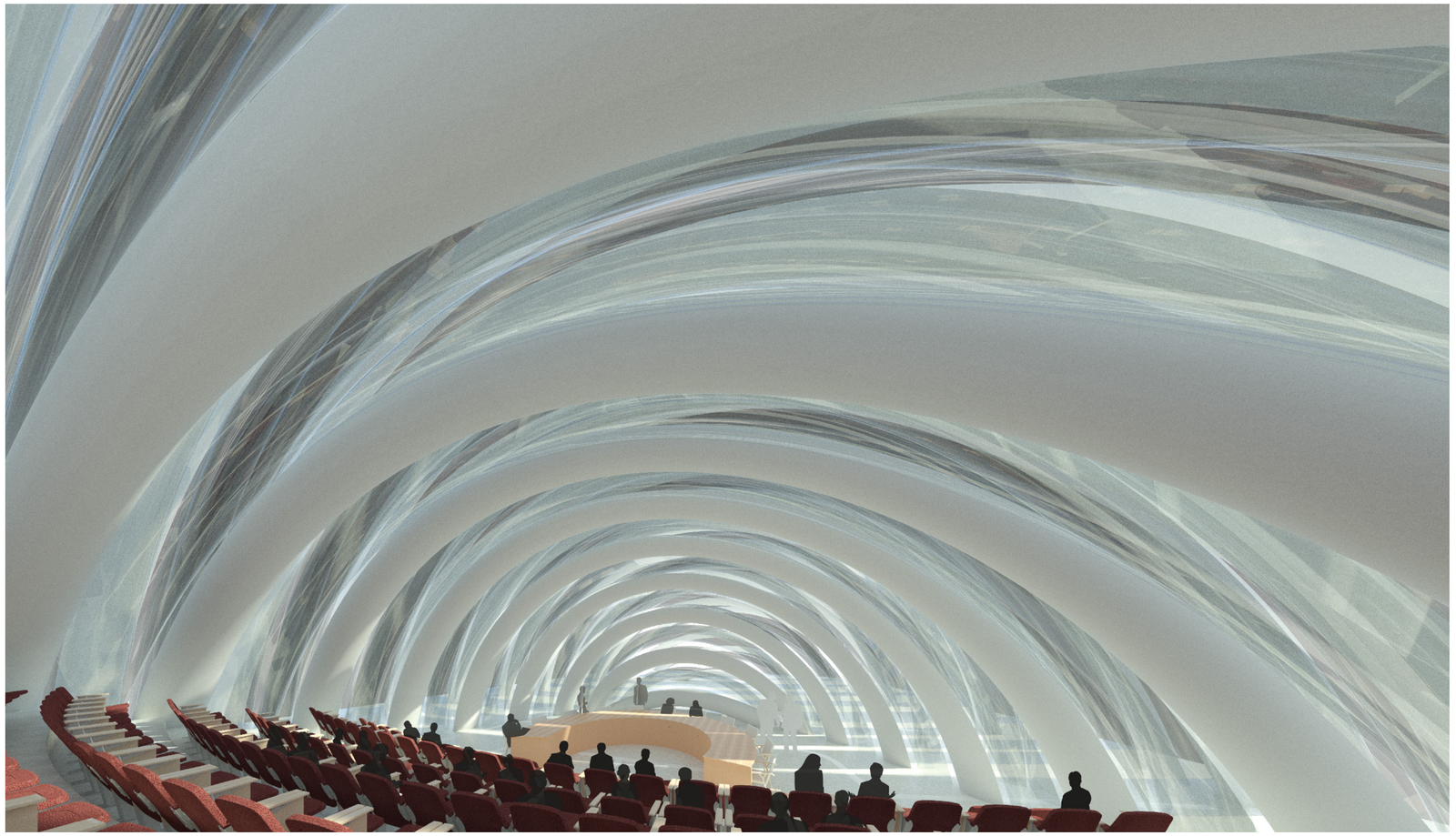
The Conch is isolated from the vibrations of the light rail and the mechanical room through the use of an elastomer material. Point decoupling is implemented at the ceiling of the mechanical and electrical rooms and the base plate surfaces not supported by the basement are covered entirely with the material.
The resonance frequency of this elastomer shall be 15 Hz or less, to ensure very little energy is transmitted above this in the audible range.
The compressors housed in the mechanical room and the transformers in the electrical room should not generate a sound pressure level in the lobby greater than 35 dB. Appropriate absorbers are placed in the room to meet this requirement.







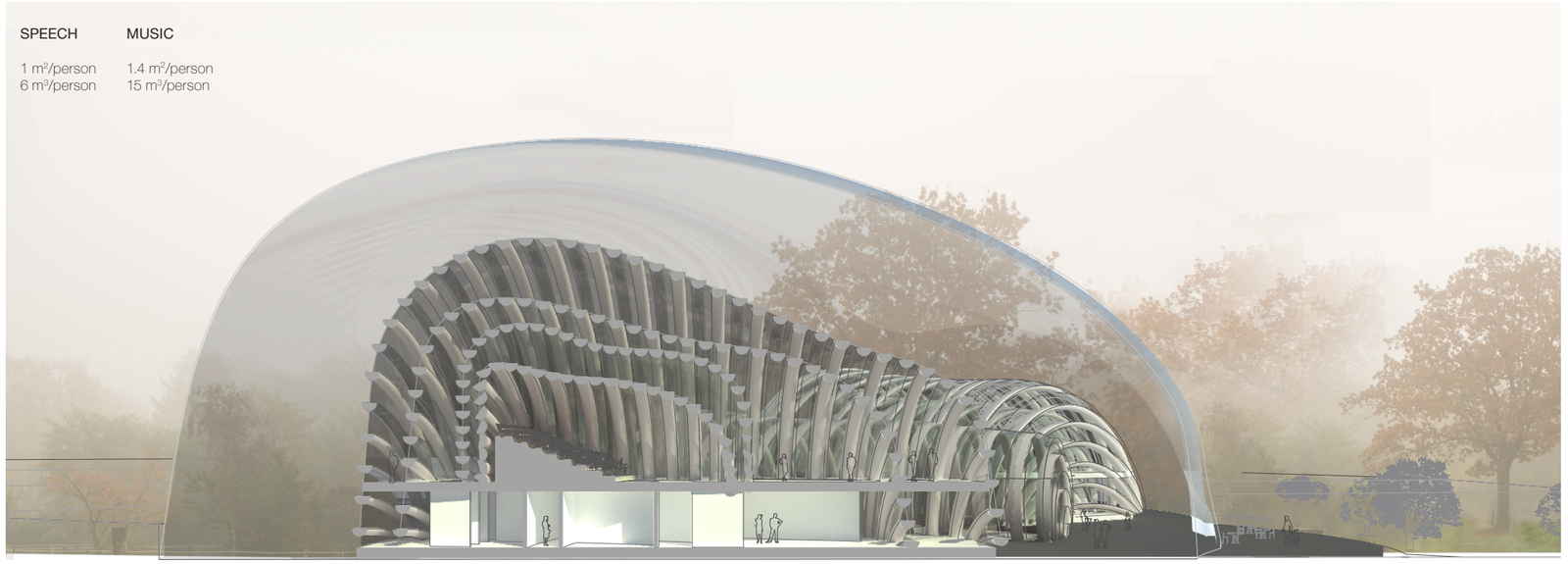
COMMUNITY HALL



DESIGN CONSIDERATIONS

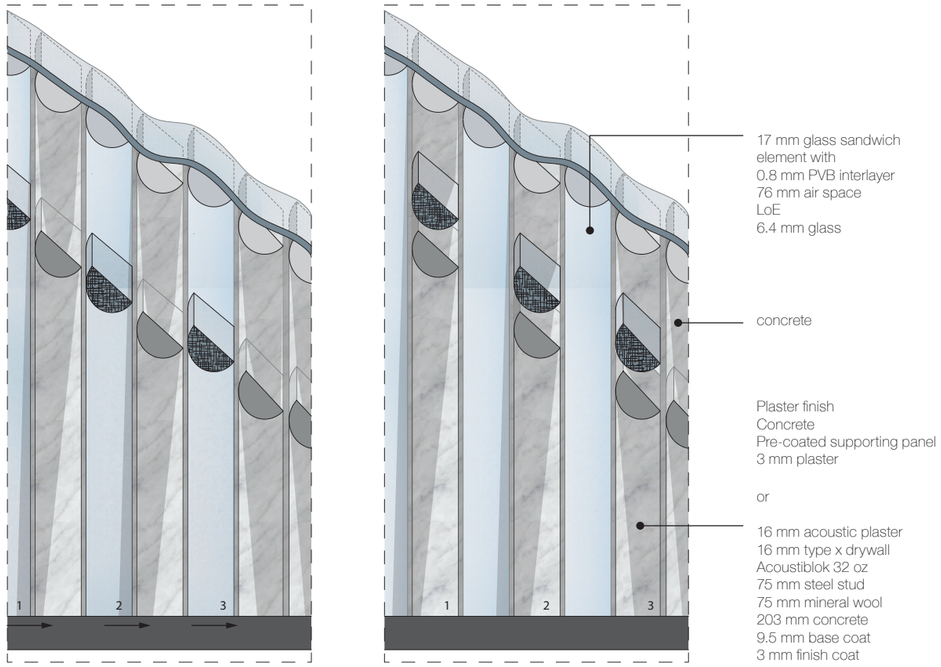
An audience has different expectations about how a music hall or meeting hall should sound. For a meeting space, the speaker should be heard clearly and localized to their speaking position. Music is expected to reverberate around the room making the listener feel included in the event. As the community hall is to be used for both meetings and musical performances some physical changes to the space can be made to better adapt the acoustics to the event.

For both meetings and performances good sight lines from each audience member to the stage area is important. This is ensured through the raked seating.



VARIABLE ACOUSTICS

The interior shell of the community hall is constructed of glass and plaster arches. At the rear of the stage and along the audience the arches are hard plaster, while the rear arches of the audience are constructed of a more absorbent acoustic plaster to prevent strong late reflections. For musical performances each glass arch is moved behind the smaller arch toward the stage from it opening up the volume of the room to a larger shell constructed of glass and concrete arches. This larger volume increases the reverberation time of the space making music more lively



17 mm glass sandwich
element with
0.8 mm PVB interlayer
76 mm air space
LoE
6.4 mm glass

concrete

Plaster finish
Concrete
Pre-coated supporting panel
3 mm plaster

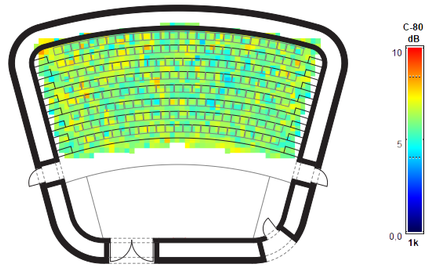
or

16 mm acoustic plaster
16 mm type x drywall
Acoustiblok 32 oz
75 mm steel stud
75 mm mineral wool
203 mm concrete
9.5 mm base coat
3 mm finish coat

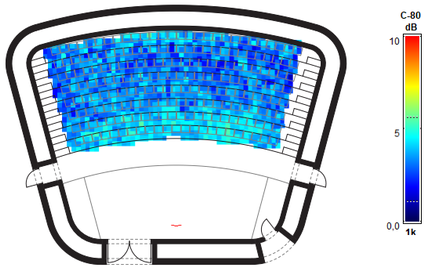
ACOUSTICAL QUALITY

The high speech transmission index values between 0.64 and 0.71, coupled with the clarity values between 4 and 8 and a reverberation time below 0.8 are a strong indication that the audience will hear and be able to understand spoken word very well in this configuration. When the shells are moved opening up the larger hall volume, the reverberation time increases by about 0.25 seconds to an ideal time for small musical acts. The clarity also decreases encapsulating the audience in the music.

CLARITY

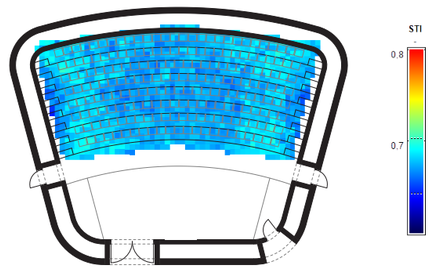


SPEECH



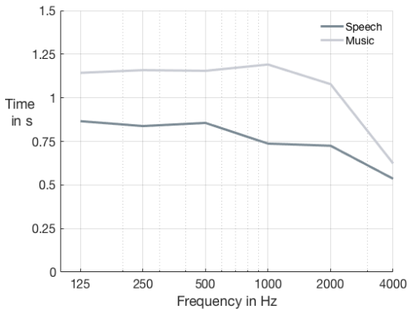
MUSIC

STI

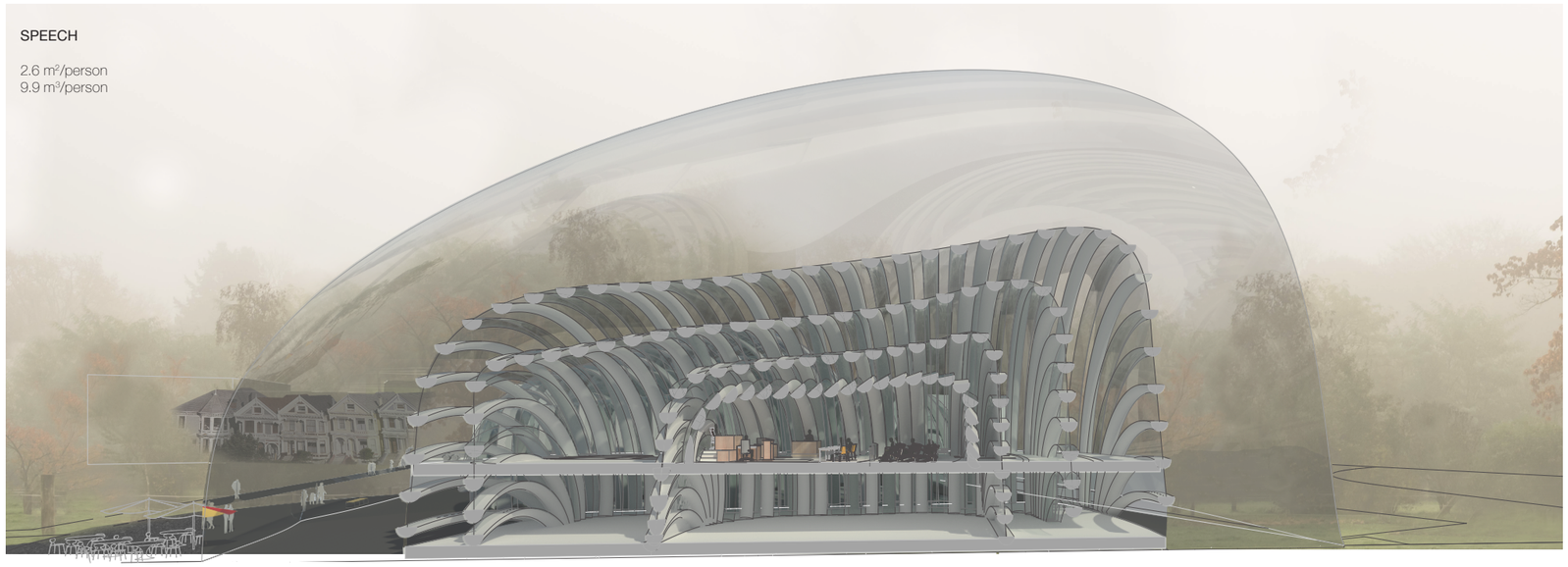


SPEECH

REVERBERATION TIME



COURTROOM



DESIGN CONSIDERATIONS

In the courtroom the arches behind the judge are constructed of concrete, providing strong reflections to support the speakers in the litigation area. Along the sides of the hall, the non-glass arches have a plaster surface over which absorbs some sound energy, so that the later reflections do not decrease the ability to hear clearly. The back arches of the court are constructed of acoustic plaster which is even more absorbent. The different absorption properties allow good strength and clarity to be achieved at the various listener positions.

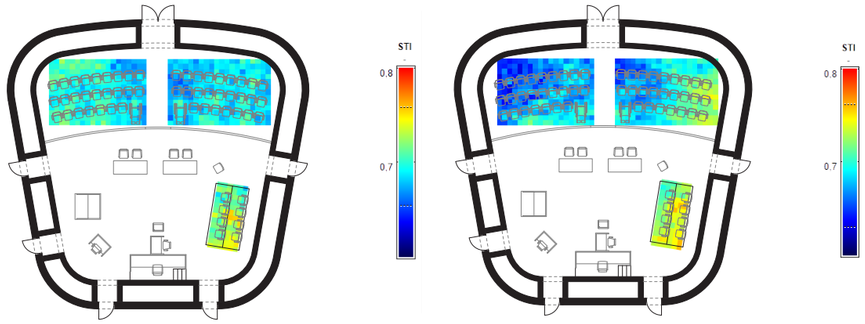
SPEECH PRIVACY

The attorney-client conference rooms and jury room are protected from sound transmission into the courtroom via 2 shell layers of different thicknesses providing the necessary sound isolation at all frequencies of speech. This ensures that speech privacy needs are met. The space between the layers of non-glass shells includes absorbent material to prevent resonances in the volume. The glass shells are constructed in the same technique as the shells on the building exterior with an STC of 58. Additionally, heavy doors are used between the spaces and the spaces are serviced by ventilation ducts with silencers between to prevent sound transmission via these paths.

COURT COMMUNICATION

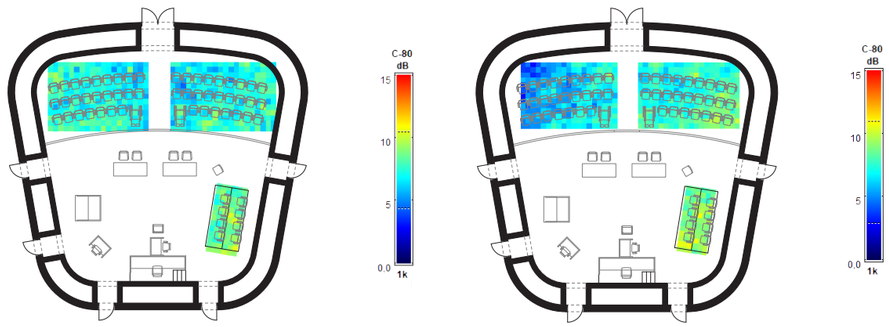
Within the courtroom it is critical that the judge, jury, and witnesses hear each other clearly. A high Speech Transmission Index is one indication of how well spoken word will be heard. In the courtroom, the jury positions all have good values above 0.68 when the speaker is the judge or the witness. Additionally, the spectator positions in the courtroom all experience a good STI as well.
The high values of clarity (around 4 and above) and strength between the critical positions of the judge, witness, defendant and prosecution indicate that the critical communication in the court will be well perceived.

STI



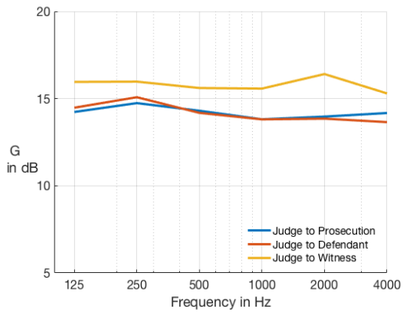
JUDGE WITNESS

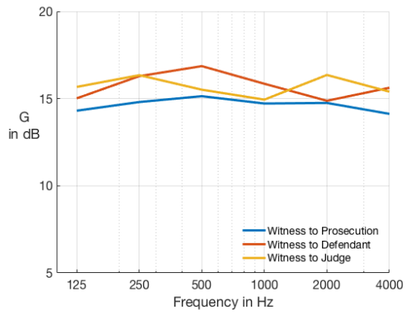
CLARITY

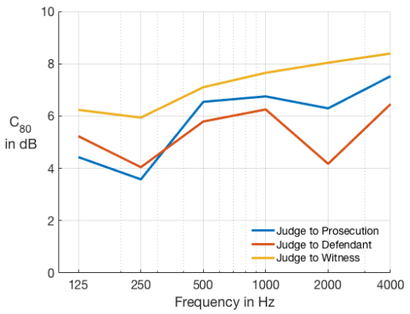


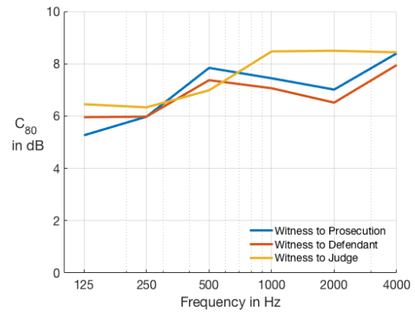
JUDGE WITNESS

SOUND STRENGTH









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