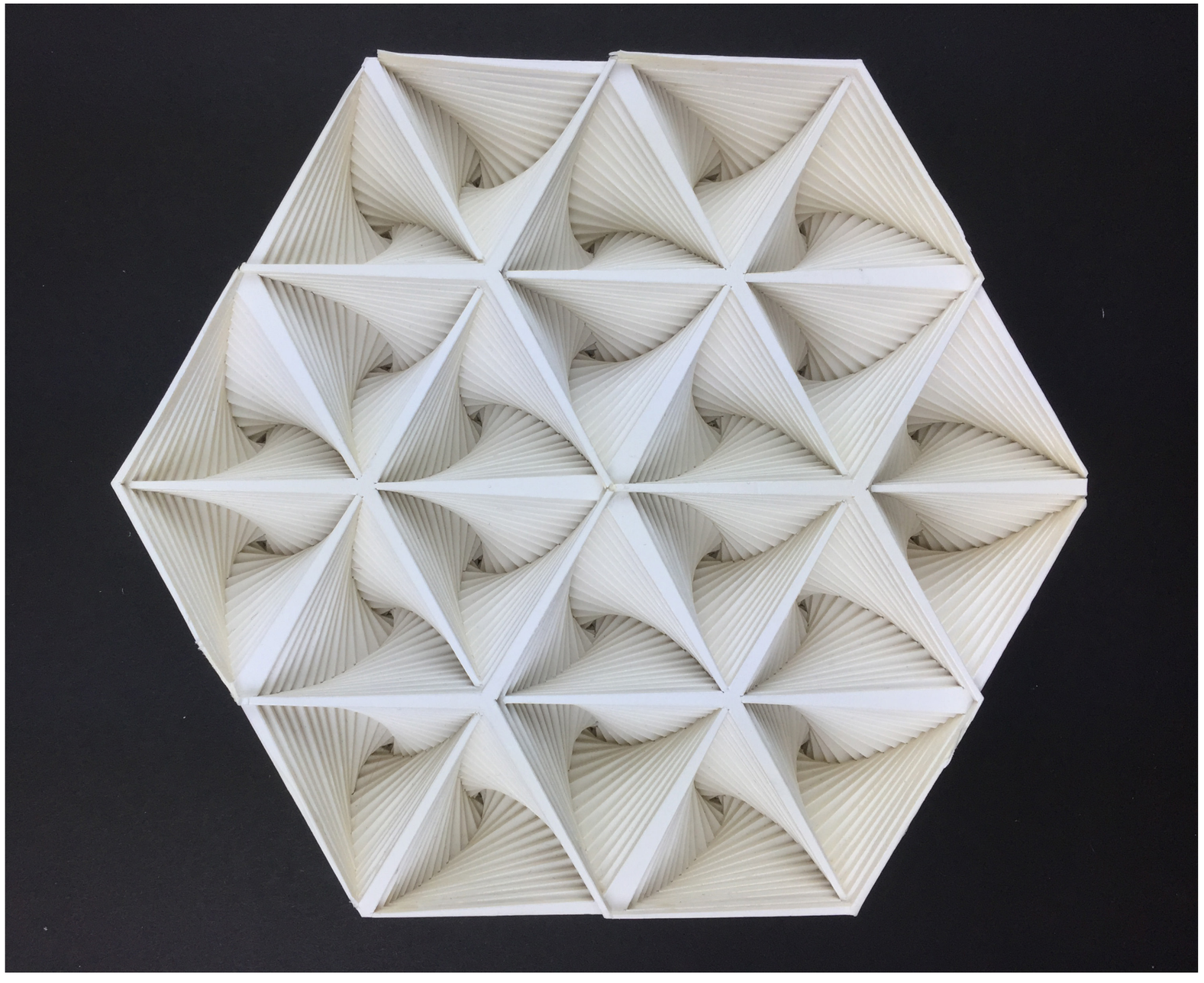
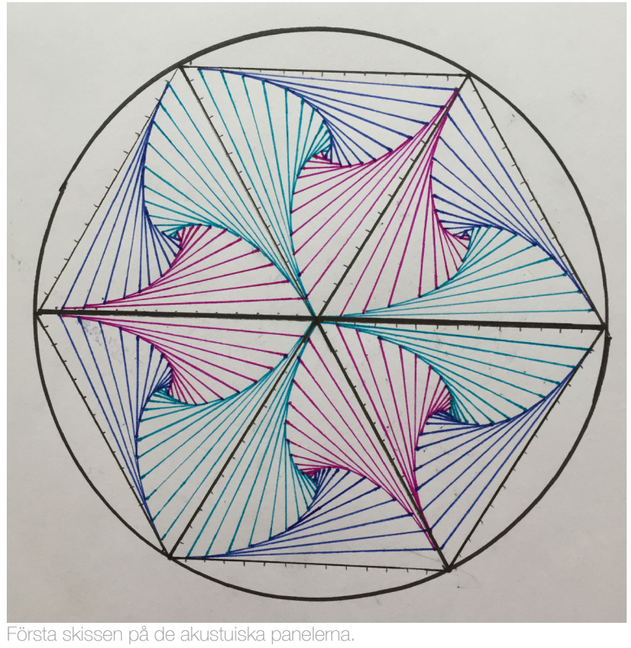


KANDIDATPORTFOLIO

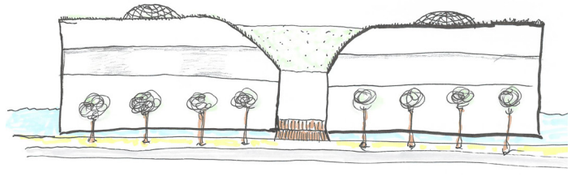
Jonas Carlsson

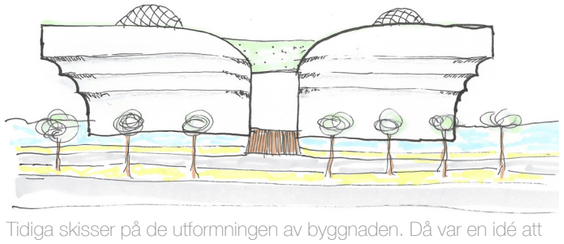
Inledning

Ett kommunhus ska designas med fokus på akustik. Detta projekt görs i grupper om två studenter ifrån Arkitektur och teknik och en masterstudent ifrån Sound and Vibration.
Kommunhuset skall byggas mitt i en större stad, mend tung trafik kring byggnaden. Särskild hänsyn skall tas till trafikbuller och akustiken i två rum inne i byggnaden - en gemenskapshall och en rättssal (Community hall och Courtroom).



Första skissen på de akustuiska panelerna.

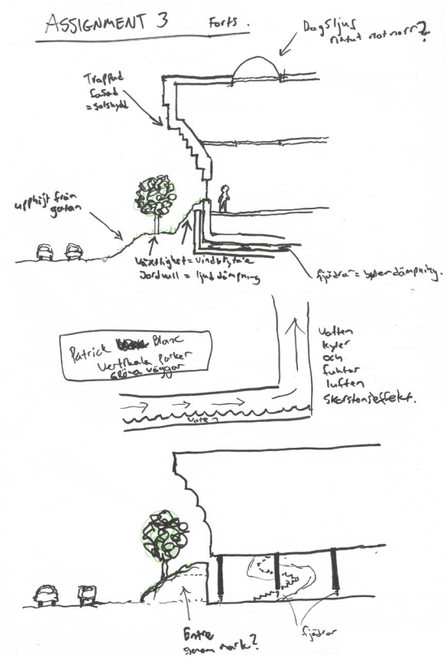




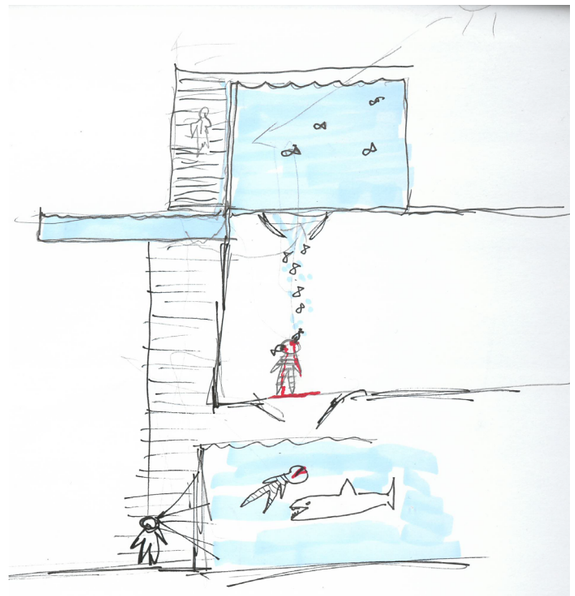
Tidiga skisser på de utformningen av byggnaden. Då var en idé att hela byggnaden skulle flyta på vatten.

Process

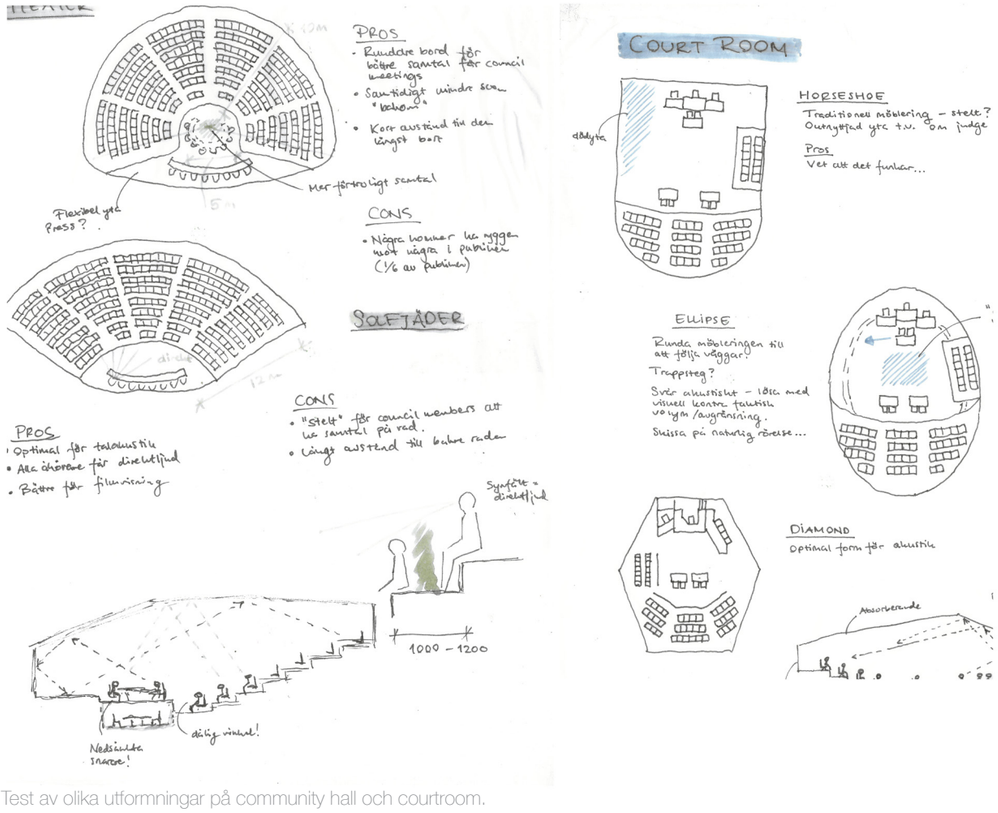
Designen på de akustiska panelerna tillkom tidigt i processen av en slump när jag satt hemma med min son och testade med linjal och färgpennor hur man kan skapa organiska former med hjälp av raka streck. Så fort jag såg mönstret kunde jag även se hur det kunde tillämpas i tredimensionell form.
Utformningen av community hall och courtroom tillkom via ett antal iterationer av runda eller halvrunda former. När dessa var klara i 2D, så var det ingen diskussion utan vi ville utmana oss själva genom att dubbelkröka ytorna och skapa sfäriska eller äggformade rum. Detta mynnade efter en hel del 3D-modellerande ut i de slutgiltiga snäckskalsformerna.
Dessa former gjorde också att vi såg ett konceptuellt mönster i projektet, skalen. I slutändan ledde detta till kopplingen till hörselsnäckorna (Cochleae).
Tidigt bestämdes också att vi inte skulle jobba med renderingar utan att vi ville jobba med en fysisk modell som vi skulle fotografera. Tyvärr blev tiden för knapp för att bygga den fullständiga byggnaden, så de två rumsmodellerna fick läggas in i bilder från den digitala 3D-modellen. Men resultatet blev mycket bra och hjälpte oss att komma vidare till ASA:s tävling.



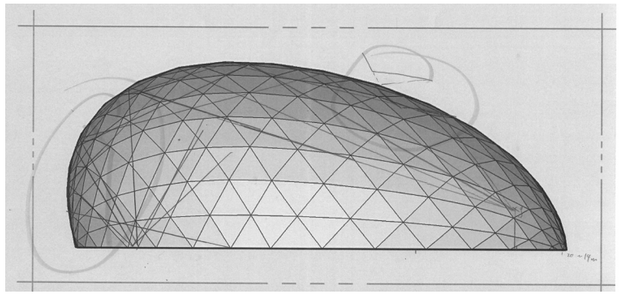
Tidiga skisser på de utformningen av byggnaden.



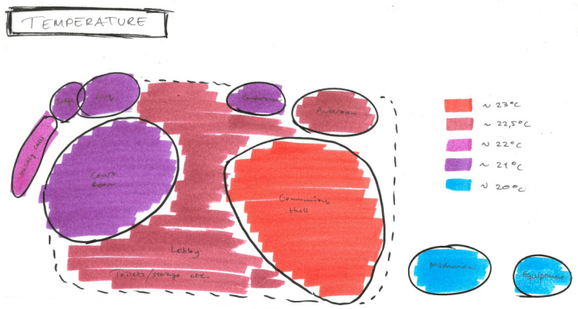
När idéerna tog slut skissade vi på en tank för pirayor och hajar som kunde ta hand om de dömda. Det var denna skiss som fick vår akustiker Lucas intresserad av att arbeta ihop med oss.



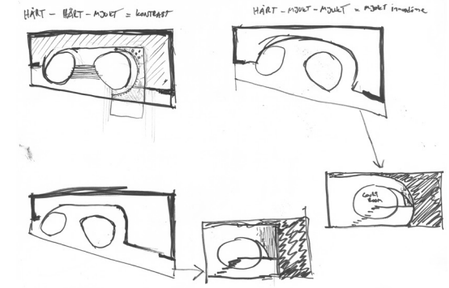
Test av olika utformningar på community hall och courtroom.



En av de första modellerna vi testade i CATT-Acoustics för att bedöma kustiken i court-room.



Temperaturdiagram över de olika rummen i byggnaden.



Skisser på hur resten av byggnaden skulle möta de runda formerna av community hall och courtroom.

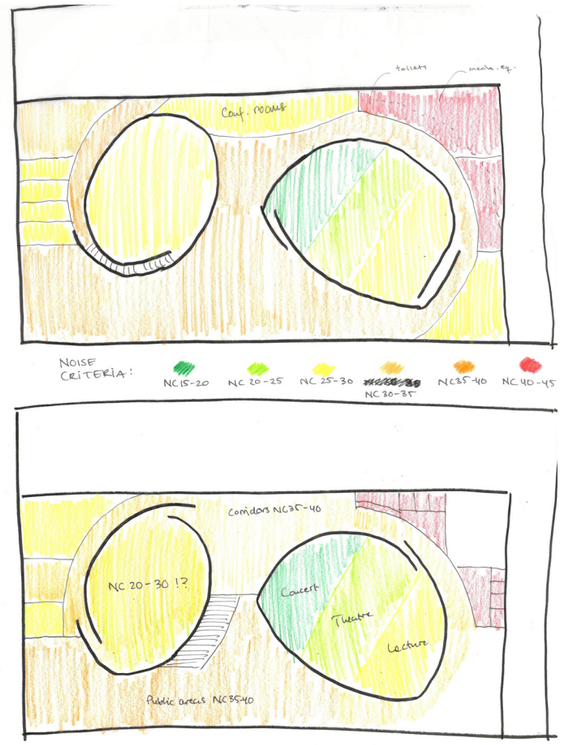
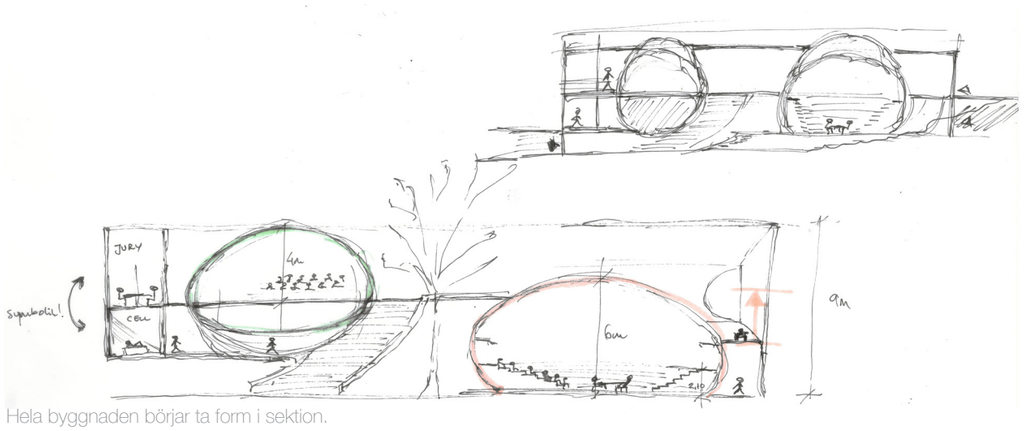
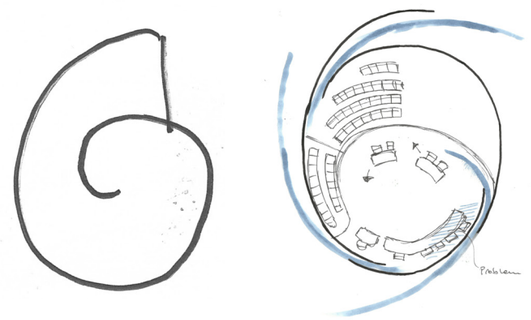


Diagram över noise criteria i de olika rummen.

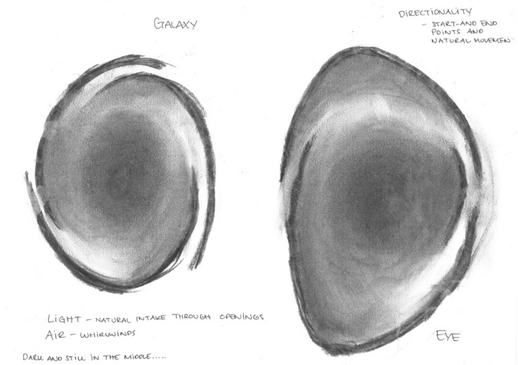
En prototyp till en annan akustisk panel som skulle kunna ändra form, även denna uppbyggd av raka pinnar.

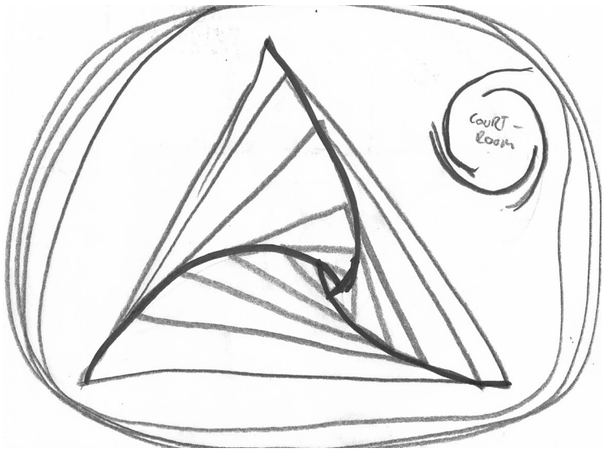


Hela byggnaden börjar ta form i sektion.

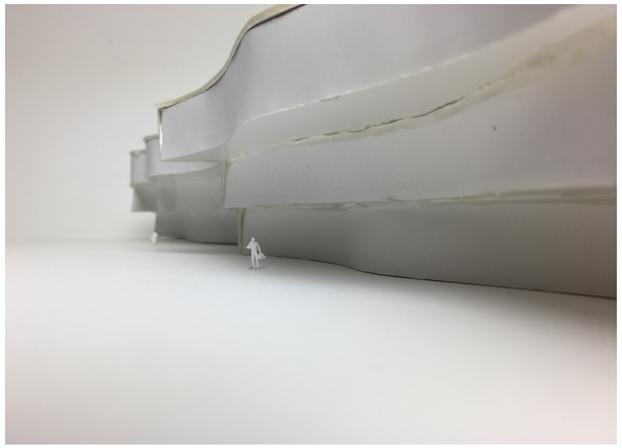


Snäckskalen börjar ta form

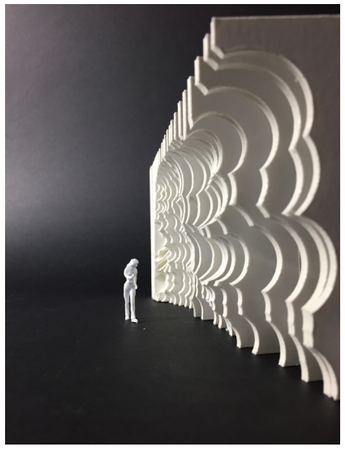




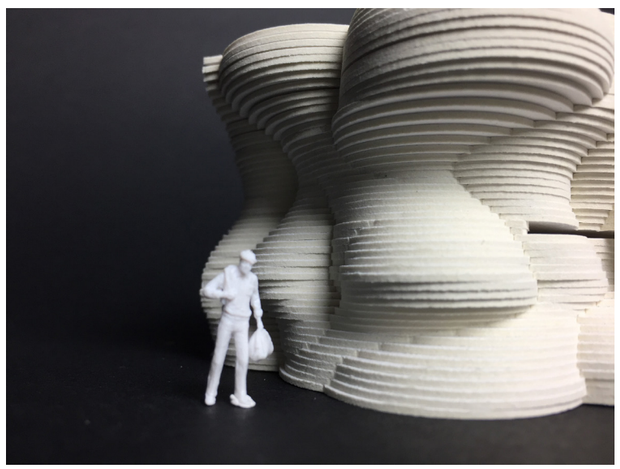
De svepande formerna in till de båda rummen återfinns i de triangulära akustikpanelerna .



Skissmodell över eventuell fasadutformning.

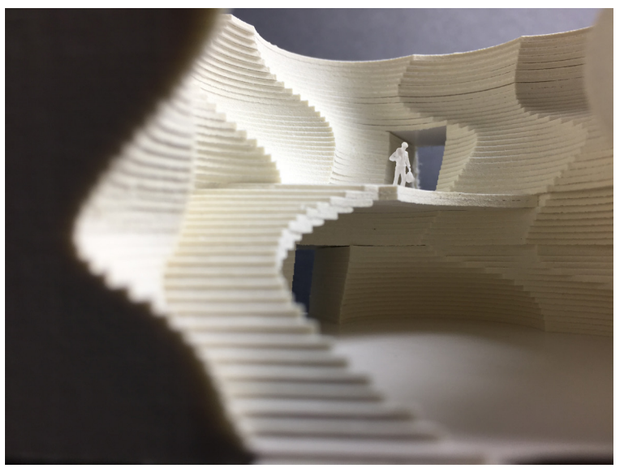


Skissmodell över eventuell fasadutformning.

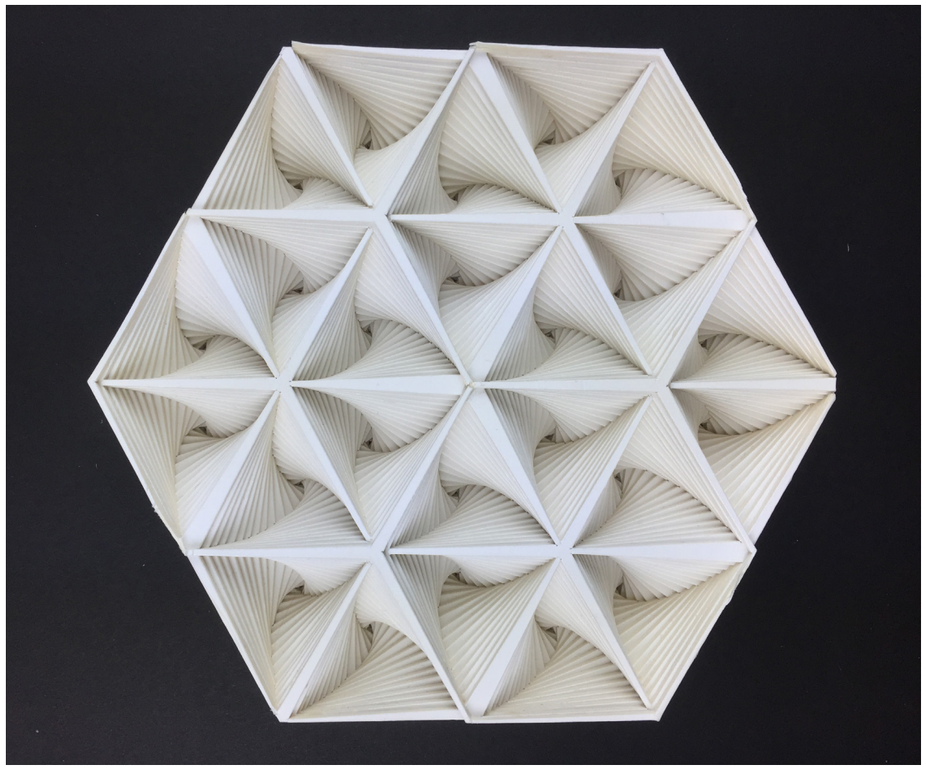


Skissmodell över utformning av innerväggar.

Skissmodell över hur man gör entré till byggnaden.

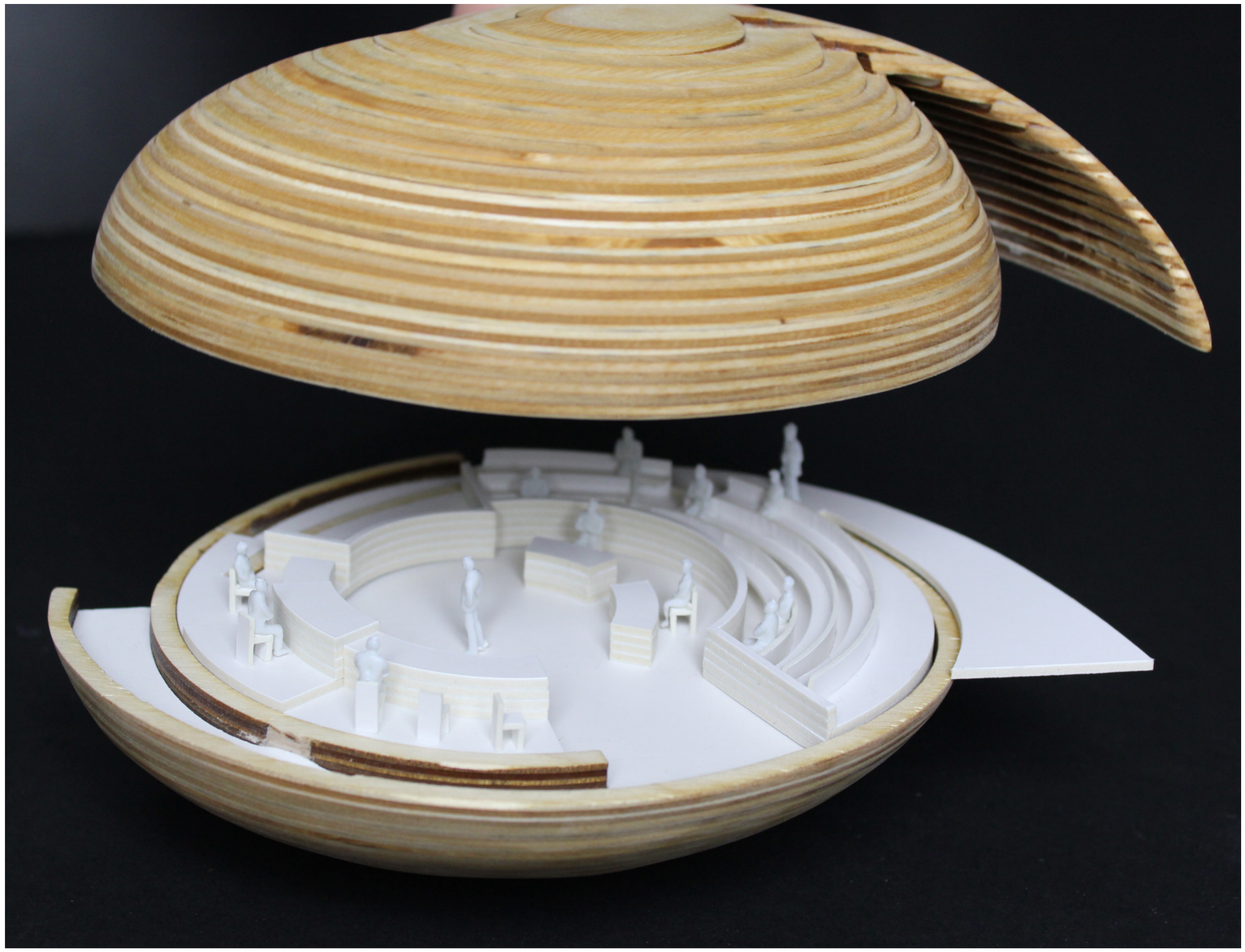


Skissmodell över foajén.

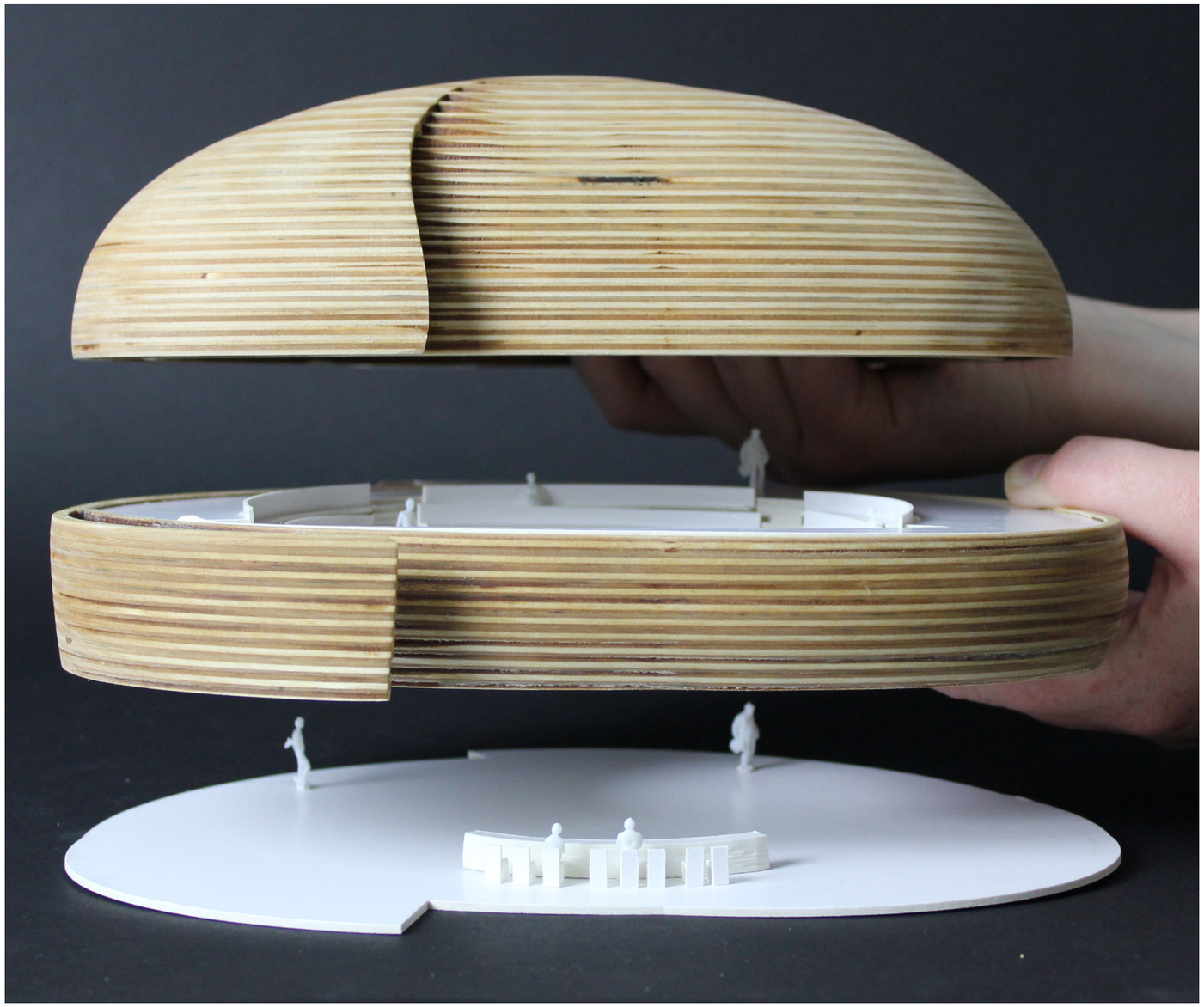


Prototypen ovan är inte bara en ljudabsorbent, den kan även öppna och stänga sig. Då den öppnar sig ökar även volymen av rummet och därmed skapas större efterklang. Vi valde att lägga stor fokus på rörelsen in i byggnaden och ur detta sprang den snäckformade formen på de båda rummen. Tidigt i projektet hade vi bestämt att vi ville arbeta med modeller och resultatet av detta arbete syns i bilderna ovan.

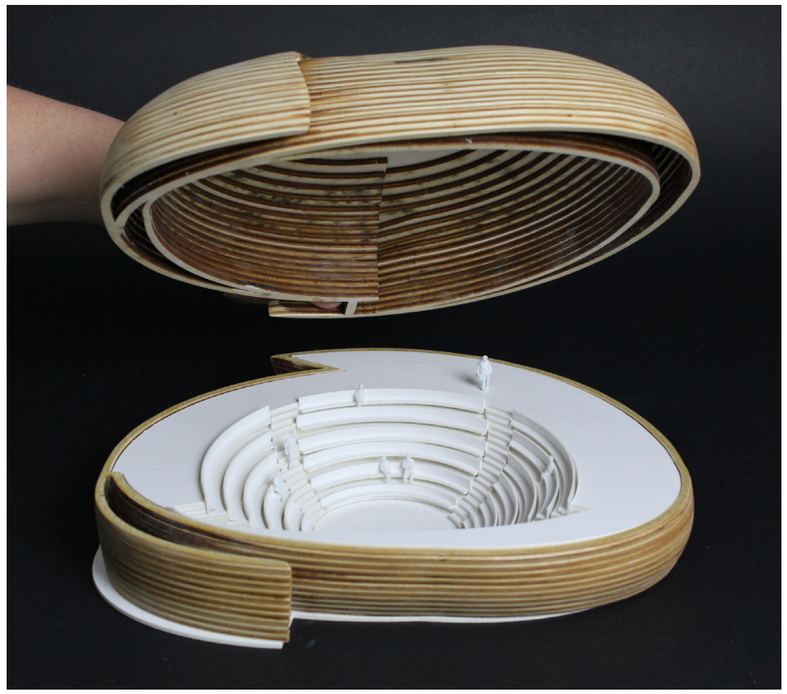
Modell av rättssal till vänster och gemenskapshall till höger



Modell av courtroom



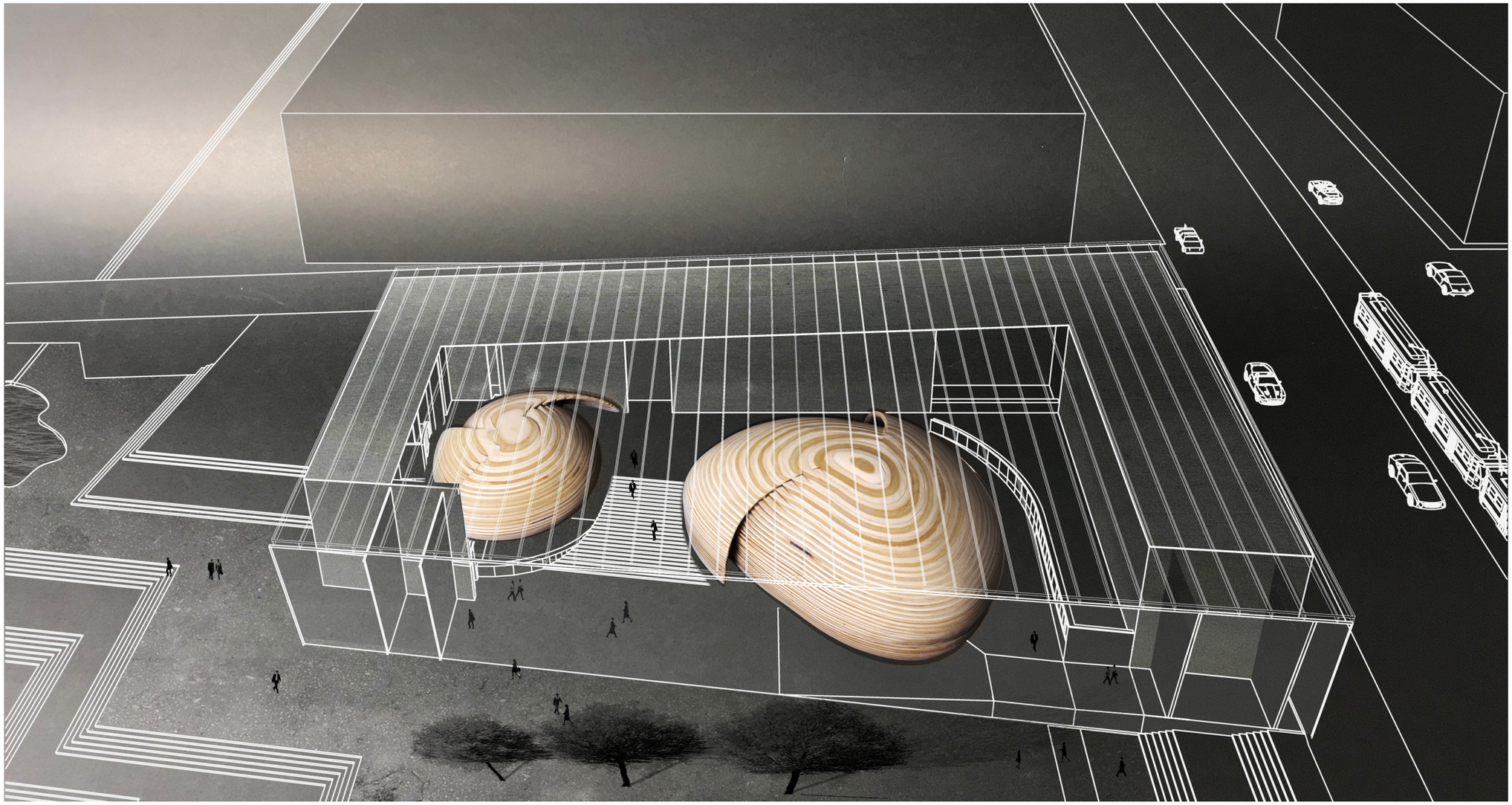
Modell av community hall



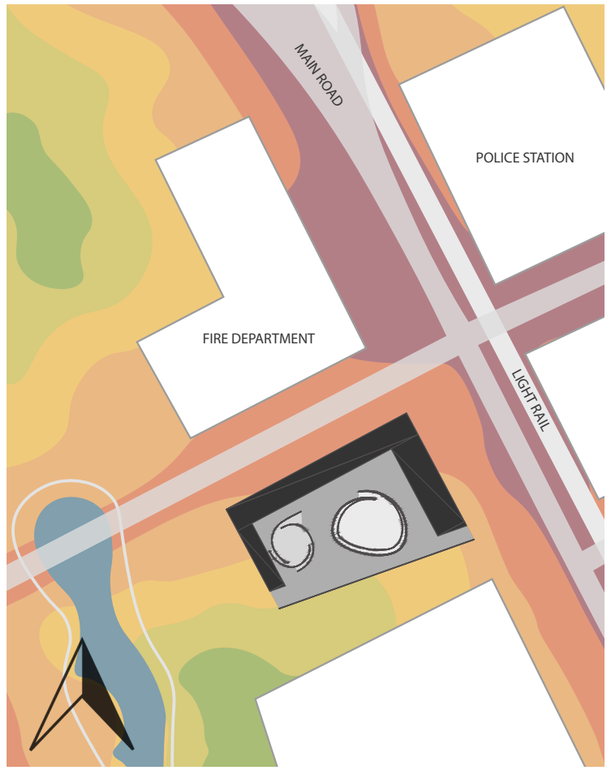
Reflektion

Jag har under kandidatarbetet utnyttjat iterationsprocessen som användes under optimerade strukturer för att testa idéer, mest genom modellbyggande. Samarbetet med Lina har fungerat väldigt friktionsfritt och det kändes som att vi balanserade varandra mycket bra. Hennes styrkor innan projektet var helheten och mina var snarare detaljerna och under projektets gång har jag lärt mig mycket från hennes metodiska arbetssätt och efterforskningar. Detta var nånting som jag tog med mig redan till nästa projekt (samhällsplanering) vilket fungerade mycket bra. Det har varit en lärorik kurs då man insett hur komplex en byggnad faktiskt är när man ska ta hänsyn till saker som klimatsystem, akustik, ljus, arkitektonisk utformning, hållbarhet och ett väl fungerande koncept, utan att göra avkall på nånting för att framhäva nånting annat.
Jag tyckte också att det var en otrolig bekräftelse att vårt projekt valdes som ett av tre projekt som skickades vidare till “Acoustical Society of America Student Design Competition 2018”.

COCHLEAE



Cochlea, the best protected part of our ear, is a vital element for human communication and understanding. This shell-shaped organ, sensitive even to the smallest pressure fluctuations, collaborates with the different parts of the ear to translate sound pressure into intelligible words. Similar to this collaboration, the new municipal building Cochleae protects its sensitive interior, while fluid shapes inspired by the physical form of the shell invite public participation in the daily events of the municipality. The same way the cochlea in our ear is vital to human sound perception, the Cochleae is a vital organ for the city, providing an arena, a meeting point and an implementation of democracy.



Noise map showing the assumed maximum sound pressure levels L_{max} of the surrounding sound sources acting on the Cochlea and the resulting indoor noise levels.

Exterior noise levels

- > 90 dB
- 75 - 90 dB
- 60 - 75 dB
- 45 - 60 dB
- 30 - 45 dB
- < 30 dB

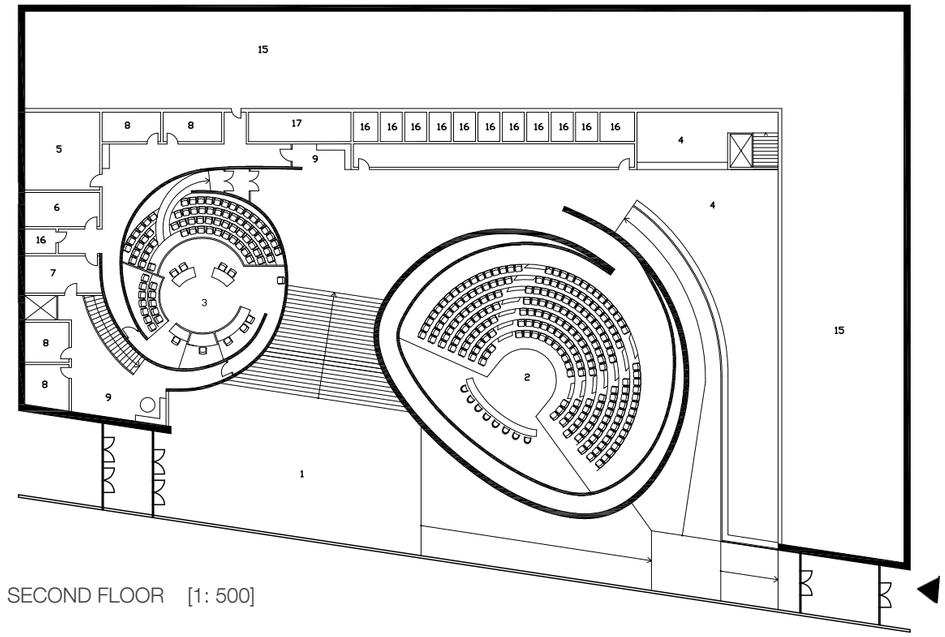
Interior noise criteria

- Noise Buffer
- NC 35
- NC 25
- NC 15

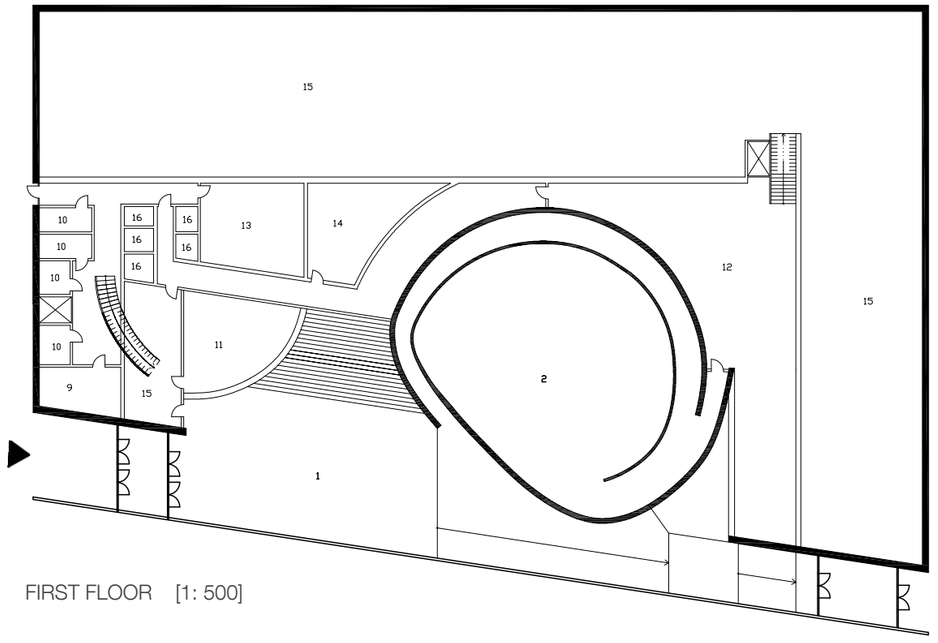
THREE PROTECTIVE SHELLS

The massive structure close to the streets works as a protective shell from airborne noise both from the street, the light rail, and the police and fire departments. A double layered glass roof protects the lobby from the environment but also provides the lobby with light. All noise sensitive rooms are located on the averted side of the building, facing the public square and adjacent recreational area.

The courtroom and the community hall are both constructed with double shells. In the court-room, the outer shell is used to create natural openings, thus providing separate entrances for legal practitioners, prosecuted and the public. The community hall uses the double shell structure to provide the room with varying acoustical settings, especially designed to suit music as well as speech. The sound insulation of these sensitive rooms is provided by an acoustically shape-optimized, double leafed lightweight ceiling in the outer shell of the community hall, and in the inner shell of the courtroom.



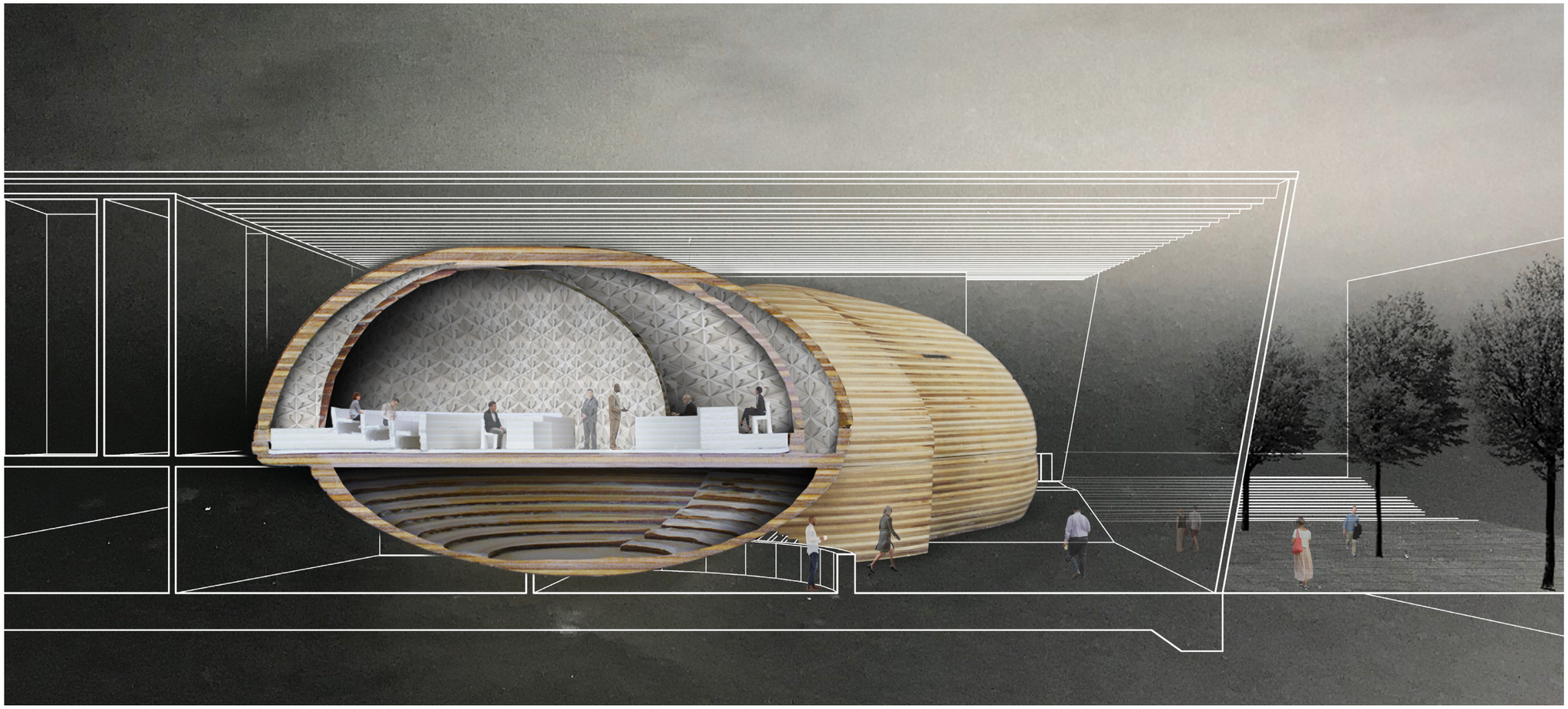
SECOND FLOOR [1: 500]



FIRST FLOOR [1: 500]

1	CENTRAL LOBBY	10	HOLDING CELL
2	COMMUNITY HALL	11	RECEPTION AND COAT ROOM
3	COURT ROOM	12	ANTEROOM
4	CAFÉ	13	MECHANICAL EQUIPMENT
5	JURY ROOM	14	ELECTRICAL EQUIPMENT
6	JUDGE'S CHAMBER	15	OFFICES
7	BAILIFF'S OFFICE	16	RESTROOMS
8	CONFERENCE ROOM	17	STORAGE
9	WAITING ROOM		

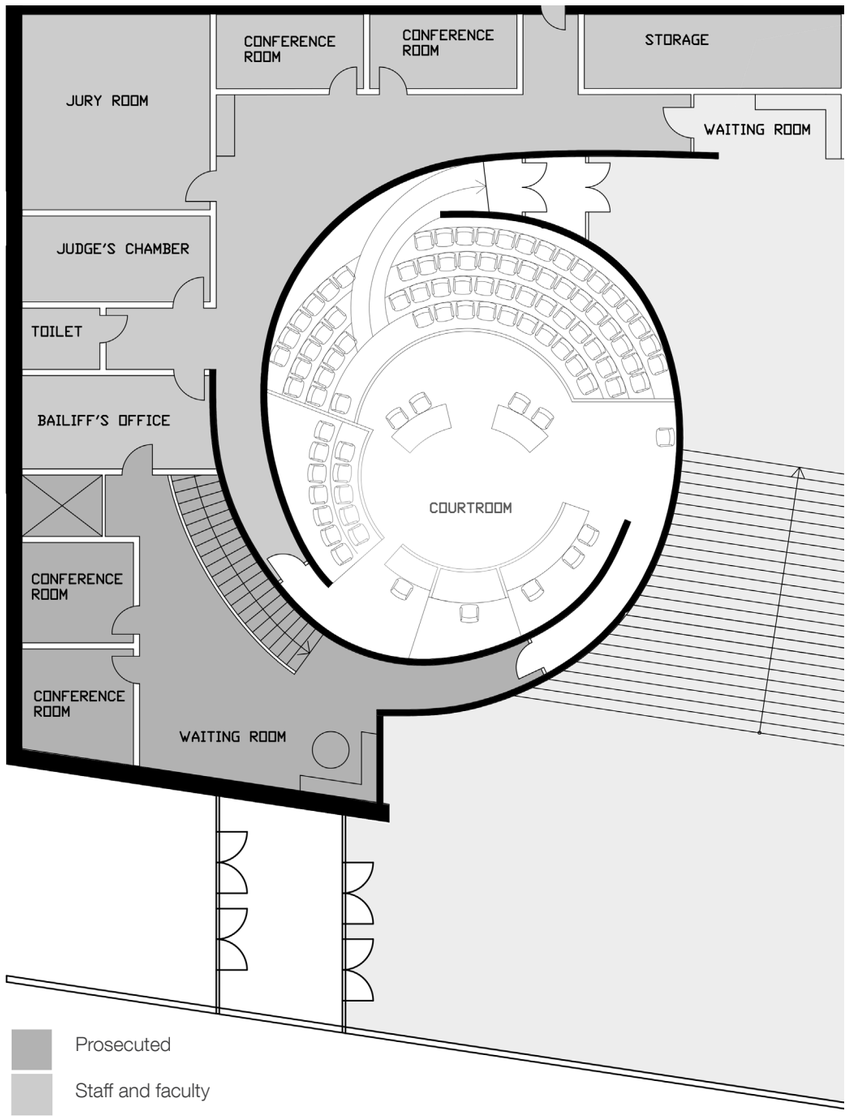
Courtroom



WALK THE BUILDING

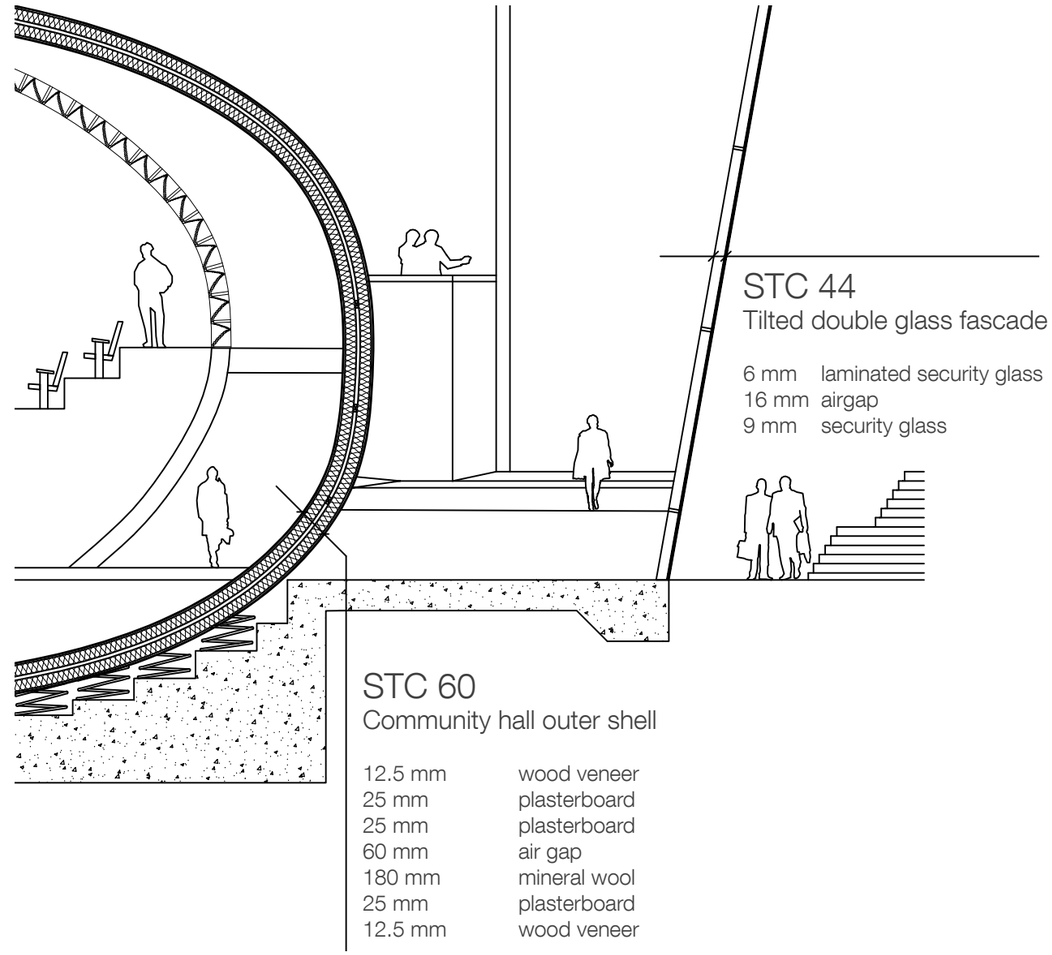
Following the pedestrian walkway that stretches from east to west across the site, the noisy suburban landscape slowly transforms into a calm public square, wedged in between the municipality building and the adjacent convention center. The movement along this wedge is mirrored within, as an interior ramp connects the busy street with the recreational area on the western end of the site. The tilted glass facade deflects direct sunlight and provides a first view of the two shell-shaped rooms of the community hall and the court room.

Upon entering the building from its main entrance, the change of scene is immediately apparent. Though still a public space, the reduced background noise creates a sense of seriousness and anticipation. The pavement of the exterior plaza leaks in through the glass facade and leads the way up the broad staircase, at the end of which both shells open to allow access to the rooms within.



ACCESSIBILITY AND MOVEMENT

To avoid unexpected meetings between e.g. witnesses and prosecuted, and to provide judges and jury members with access to surrounding offices, there are three different entrances to the courtroom. Holding cells are located on the main floor, with a staircase and elevator connecting them to conference rooms and entrance to the courtroom above. Further conference rooms, judge's chamber and jury room are connected to additional offices, as well as having their own entrance to the courtroom. Witnesses can enter either through the offices or through the public entrance, depending on the security level of the current court case. A wall separates public spaces from private ones, and the bottom floor is, apart from the lobby, closed for public access.



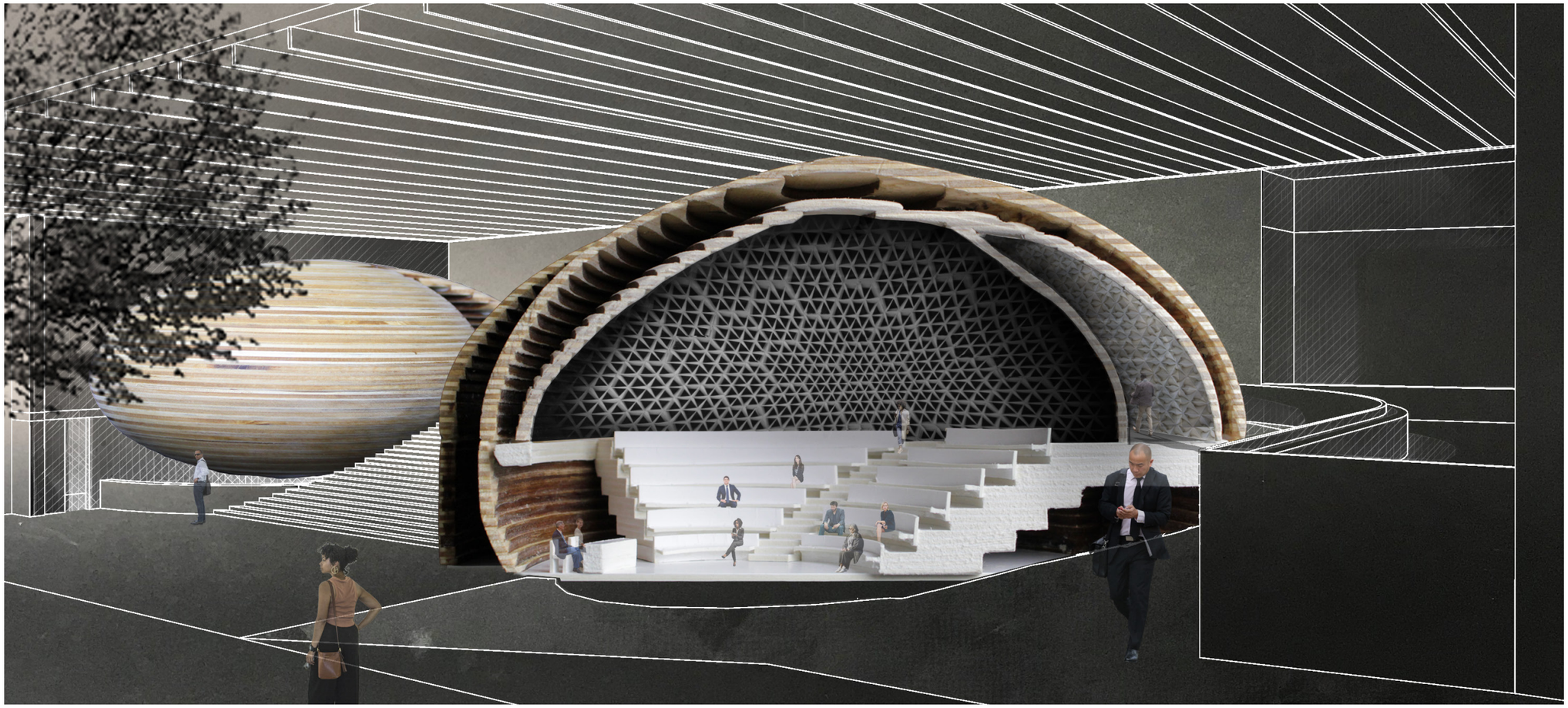
Section detail of the community hall, shell structure and double glass fascade [1:100]

NOISE AND VIBRATION CONTROL

The building is situated in a downtown area with heavy traffic along two sides of the site. Police station and fire departments are located north-east of the site, and on the other side of the main street there are plans to construct a light rail. The shape and size of the building have been designed to minimize the negative impact of sound and vibration from surrounding noise sources. Light and air is brought into the building from the silent side - towards a small lake southwest of the site.

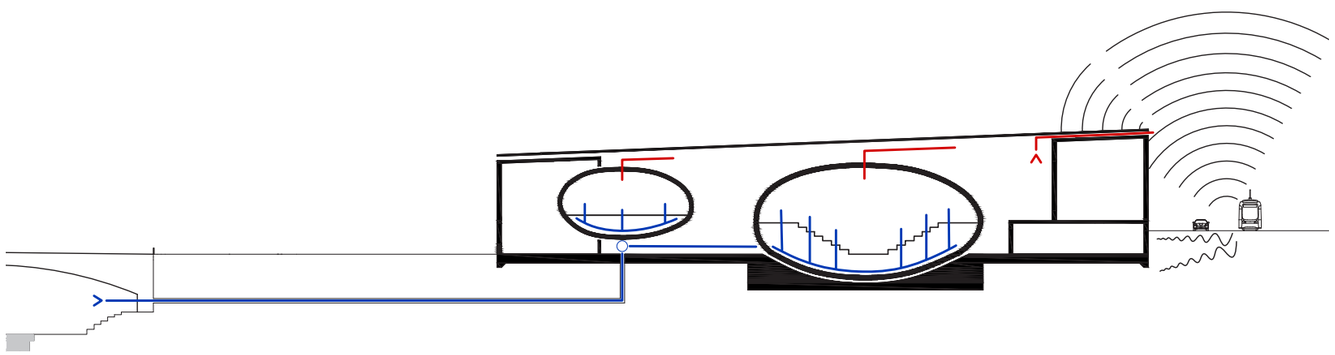
Heavy walls (STC 60) and subordinated rooms are placed along exterior walls facing the streets, protecting the lobby and the enclosed rooms from external noise. The tilted double-glass facade (STC 44) and non-parallel walls create a wedge-shaped plaza south of the building. This limits flutter echo and reduces noise entering the plaza as well as giving the building a more transparent appearance. The community hall is mounted on hydraulic springs with a permanently elastic layer to protect it from vibrations. The air-gap in between the shell and the foundation is big enough to avoid air coupling between the two structures.

Community hall



DYNAMIC INNER SHELL

The wall of the community hall is separated into two shells. The shape of the inner shell and its triangles provide, when closed, the optimal conditions for speech. When the room is used for musical performances, the triangles are opened. This way the outer shell steps into operation. It consists of hard reflective surfaces which provide the perfect amount of reflection and scattering for music performance. The volume of the room increases from 1 936 m^3 (68 370 ft^3) to 2 487 m^3 (87 828 ft^3), thus increasing the reverberation time of the room.



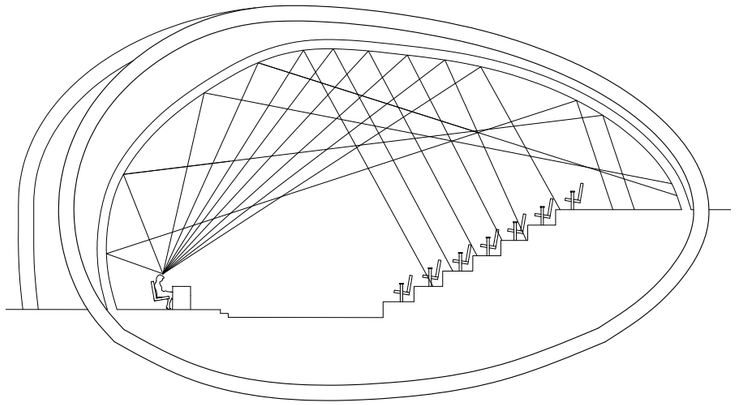
Combined HVAC, traffic noise and vibration section. Blue lines are air intake and distribution, red lines are air exhaustion. Vibrations and traffic noise are reduced by the tilted roof, unsensitive room functions as noise buffers, and the elevation difference.

ACOUSTICALLY TRANSPARENT

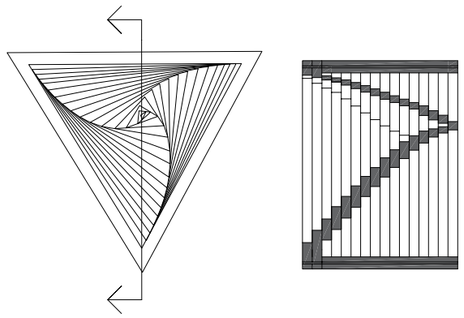
The triangular grid consists of panels with three different acoustical principles; micro-perforated absorbers, resonating panels and reflecting panels, all in wood optic, adjusted for the optimum frequency range. With carefully calculated distribution of reflective and absorbent materials, excellent acoustical properties can be achieved at every position. The structure of each triangle provides the correct scattering for speech.

For musical performances, the triangles are opened. The absorbent parts are hidden, and the outer shell provides both a bigger room volume and reflective surfaces to achieve optimal conditions for small orchestras and chamber music. The grid of the inner shell add scattering to the sound field and is otherwise acoustically transparent.

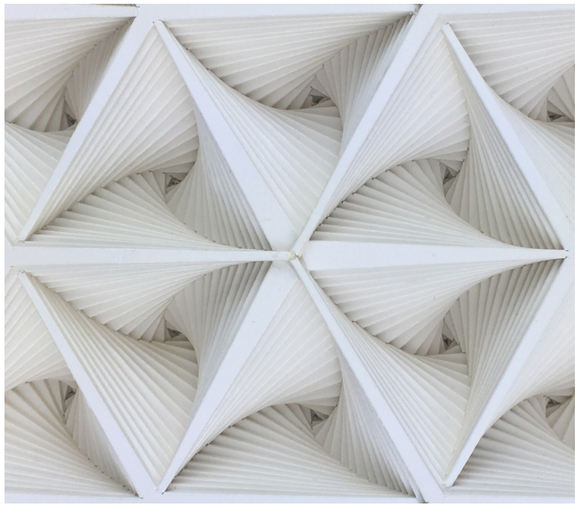
The triangulated surface of the inner shell opens in a fluid, rotating motion. Selected triangles may remain closed, in order to fine-tune the acoustical properties of the room.

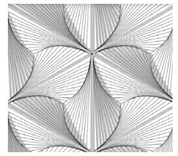


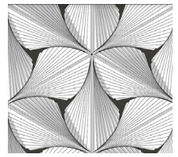
SPEECH - CLOSED INNER SHELL

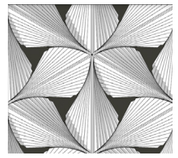


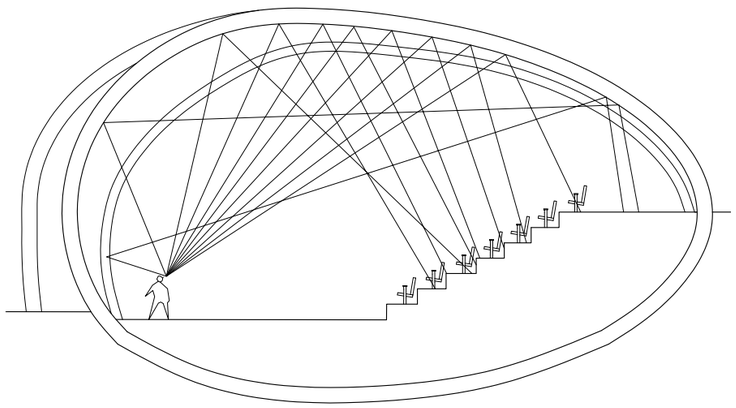
Section detail, closed triangles [1:10]



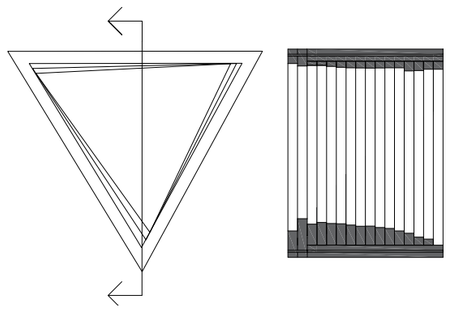




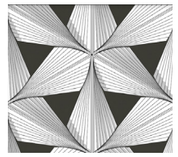


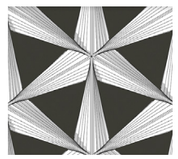


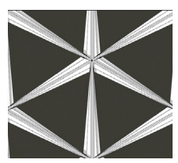
MUSIC - OPEN INNER SHELL



Section detail, open triangles [1:10]







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