

WATER FRONT

KURS	Kandidatarbete
STORLEK	15 hp
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HJÄLPMEDEL	AutoCAD Revit SketchUp Rhinoceros Grasshopper V-ray CAT MATLAB Adobe Series

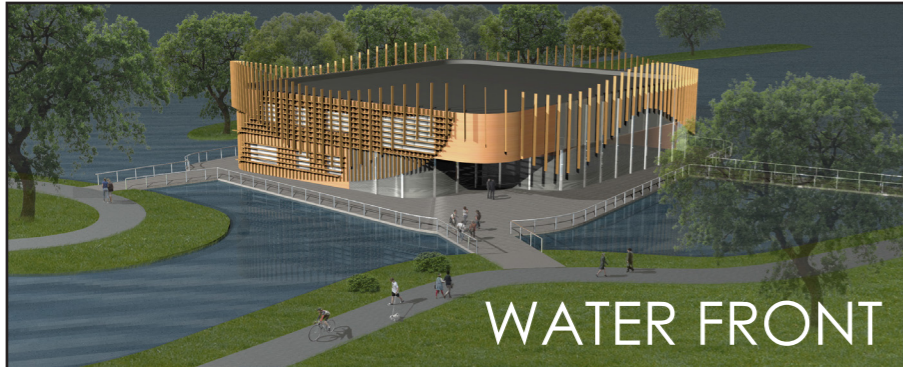
KURSENS PROGRAM

Uppgiften går ut på att designa ett rådhus med tillhörande domstol och kommunfullmäktige i en förort i USA. Rummen skall utformas byggnadakustiskt med hänsyn till att stänga ute buller och vibrationer från en intilliggande spårvagn samt polisstation. Ett annat krav är att de två rummen skall ligga i anslutning till en yttervägg och ha solljusinsläpp.

IDÉ OCH KONCEPT

Kärnan i designförslaget går ut på att använda vatten som en akustisk parameter samt som en del i byggnadens klimatsystem. Byggnaden är placerad i en flod för att undvika vibrationer från spårvagnen.

Med hjälp av vatten ändrar vi efterklangstiden i kommunfullmäktige. Vatten och luftbubblor varierar transparensen in i domstolen. Buller maskeras med hjälp av ett vattenfall. Luften fuktas av vattnet. Flodens botten temperatur kyler byggnaden under varma dagar och värmer under vintertid.



THE CONCEPT OF WATER

The Charles River, between the suburbs of Cambridge and the City Center of Boston, Massachusetts, is the location of the Water Front Building. This is a beautiful place, near to the MIT's main campus and with Massachusetts Institute of Technology, MIT, on the other side of the river. With a ground floor of almost 11,000 sq ft and a height of 80', the floating building will not only be a Community Hall and a Court Room, but a place for the citizens to enjoy the beautiful view of the river. The rounded corners give the building a smooth appearance, and the rounded facade gives the feeling of a road curving along the river. Water is used inside the building to control the acoustics. It is used as a climate system, and we even control the transparency with water.



BUILT TO WITHSTAND FLOODING

With the ongoing climate changes, flooding is more and more frequent which is a problem that many of today's cities must be prepared for. Boston lies in an area with a considerable high risk of flooding. This building proposal floats on the water and is therefore independent of the water level height. The structure is anchored with piles that extend on the bottom of the river. The piles are integrated in the wooden facade and the building can slide up and down along these piles.

WATER AS CLIMATE SYSTEM

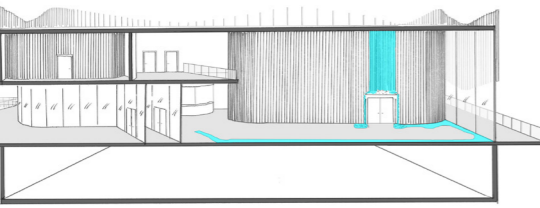
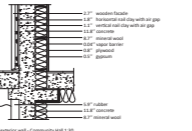
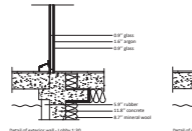
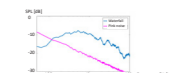
Water is used to control the building's indoor climate by the length of time for temperature change. The heat is absorbed under the building and it is beneficial as it will not be affected by flooding. Since the water temperature in the Charles River is lower than the air temperature during the majority of time of a year it is mostly used as cooling energy for the building. During winter the air temperature can be colder than the water temperature, but water above the heating pipes. So then the bubble wall is instead used to warmen the building. Both the bubble wall and the material in the lobby are connected to the climate system.

WATER AS A MASKER

While entering the lobby, you will be met by a calm and relaxed atmosphere. To reduce noise from the highly trafficked road of traffic, noise and the nearby sound insulation from stepping, water is used in the lobby in the area where the audience waits before entering the Community Hall. A waterfall above the entrance to the Community Hall continues in a small stream through the lobby. The flowing water acts as a sound masker and makes it possible for you to enjoy conversation without being disturbed by people next to you, or the noise from outside. The resulting noise level is 30 which is equivalent to the noise criterion of libraries in NC-40.

VIBRATION ISOLATION

The soil type of Boston is called Fines, which is a well drained sandy soil with high density. For structure born sound the impedance of water is around a factor of 10 by water soil, water to a decent vibration isolation for a floating building in combination with 4" resilient material outside the concrete foundation below water surface, the vibration isolation will be sufficient.



SECTION A-A



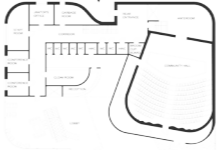
COMMUNITY HALL

ENTERING THE COMMUNITY HALL

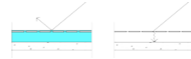
The 200 spectators enter the Community Hall through a waterfall. Right after they have passed the waterfall, they will see the bottom of the waterfall reflected in a glass ceiling. A slight rise in light through the water, which creates beautiful light effects in the entrance to the Community Hall. The first thing the audience notice when entering the Community Hall is a huge water mirror in front of the stage.

WATER AS REFLECTOR

In the ancient Greek amphitheaters, the archaic use of stone reflected the sound and made it possible for the audience further back to clearly hear what was being said or sung on the stage. This method is also used in the Community Hall, but with water instead of stone, and by having all the audience surrounding the stage not being further than 40' away. The 400 sq ft water mirror, on top of a perforated metal sheet, makes it possible to easily change the reverberation time and clarity between music and speech, just by tilting up or tilting down water.



GROUND FLOOR 1:100



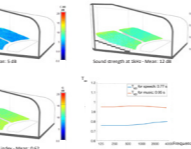
ACOUSTICAL CRITERIA

REVERBERATION TIME: For music events, the water mirror works as a reflector and we get a reverberation time of 0.55 seconds. This is an excellent environment for broadcasting, and radio stations will heavily benefit from recording in this environment for broadcasted performances.

SPEED OF TRANSMISSION INDEX: Just by tilting up the 0.5" thick water layer above the perforated metal sheet, sound will be absorbed and we will get a reverberation time of almost 0.2 seconds shorter than before. This leads to a very good STI and a productive environment for political debates, lectures and theater.

STRENGTH: When the water mirror is empty, it is a part of the stage, and it is possible to hold people on it. It debars them to be kept a great strength. On one in the audience will be further away than 40' from the stage.

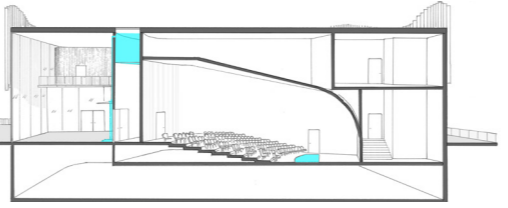
CLARITY INDEX: The shape of water waves in the near wall of the Community Hall will absorb unnecessary diffusing patterns of the sound. The wave shapes and surrounding in size to give the hall a rich and wide acoustics. The wood points will be easily reduced and the standing waves will not be as prominent as if the wall was flat.



ACOUSTICAL DESIGN

The design of the community hall is a classical shoe box design with a few contemporary additions. The focus lies in combining smooth and rounded corners with sharp edges. With a 10° angle of the ceiling, and walls that are tapered from the stage on an angle of 100°, the absorption of the sound through the room is modest. The room has wooden material on the floor and on the ceiling, and the surrounding walls are double layered with a concrete wall on the outside, followed by insulator and plaster on the inside. The total thickness of the wall is 2' reaching nearly to a STC-60. With an area of 2,000 sq ft and a volume of 14,000 cu ft, the Community Hall gives the people in the audience around 1.17 (1 person and 40 sq ft) per sqm. This approaches the Noise Criterion value of NC-20 in the Community Hall.

Along the exterior wall, a window placed high lets a lot of natural light into the room. In addition to the vertical wooden facade, horizontal lines, ground level height into the room, both from above but also from reflections in the water. To make the window as efficient as possible, a light sensor glass is installed. The glass carries of ages, and the total thickness of the window is 2" reaching nearly to a STC-60. With an area of 2,000 sq ft and a volume of 14,000 cu ft, the Community Hall gives the people in the audience around 1.17 (1 person and 40 sq ft) per sqm. This approaches the Noise Criterion value of NC-20 in the Community Hall.



SECTION B-B



COURT ROOM

ACOUSTICAL DESIGN

The shape of the Community Hall is applied also in the Court Room, with a proper wall behind the audience, and a ceiling that makes the wall behind the judge and the witness stand. To reduce the noise from the judge and the witness stand, there is a mechanical space between the Mechanical Equipment Room and the Community Hall that acts as a big air gap in double layered wall. Large principle is used in between the Electrical Equipment Room and the Community Hall. Both room have floating floors, leading to a guarantee of maintaining a NC-20 in the Community Hall. In the Court Room, there is no problem for NC-20 to be high because of the distance.

MECHANICAL ROOM PLACEMENT

The Mechanical Equipment Room and the Electrical Equipment Room are located on the 17' floor, as far away from the Court Room as possible. Both rooms have walls with a thickness of 12", that makes them of noise. As well as thick walls, there is a mechanical space between the Mechanical Equipment Room and the Community Hall that acts as a big air gap in double layered wall. Large principle is used in between the Electrical Equipment Room and the Community Hall. Both room have floating floors, leading to a guarantee of maintaining a NC-20 in the Community Hall. In the Court Room, there is no problem for NC-20 to be high because of the distance.



17' FLOOR 1:100

ACOUSTICAL CRITERIA

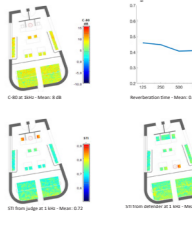
REVERBERATION TIME: To keep the reverberation time short, the materials are designed to be 0.100 behind 0.5 seconds of absorption. This is accomplished by a thin layer of gypsum on the walls and the ceiling, and carpet on the floor. To maintain a balanced sound in the whole room, room absorbers in terms of perforated walls are added at the benches in front of the jury.

CLARITY INDEX

No one in the audience will be further away than 30' from the judge, leading to high energy of direct sound. There are also absorbent material surrounding the audience to reduce visual points. These considerations lead to a sufficient C80.

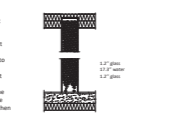
SPEED OF TRANSMISSION INDEX

The air will control the judge's bench with an efficient reflector of the sound from the judge, leading to a high STI for everyone in the room when speaking.

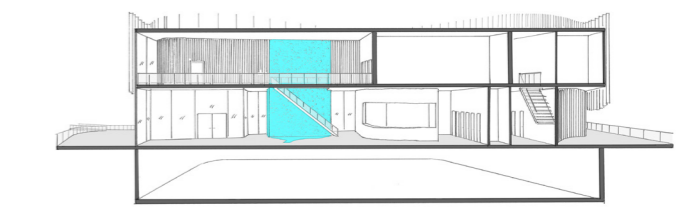


BUBBLE WALL ADJUSTS TRANSPARENCY

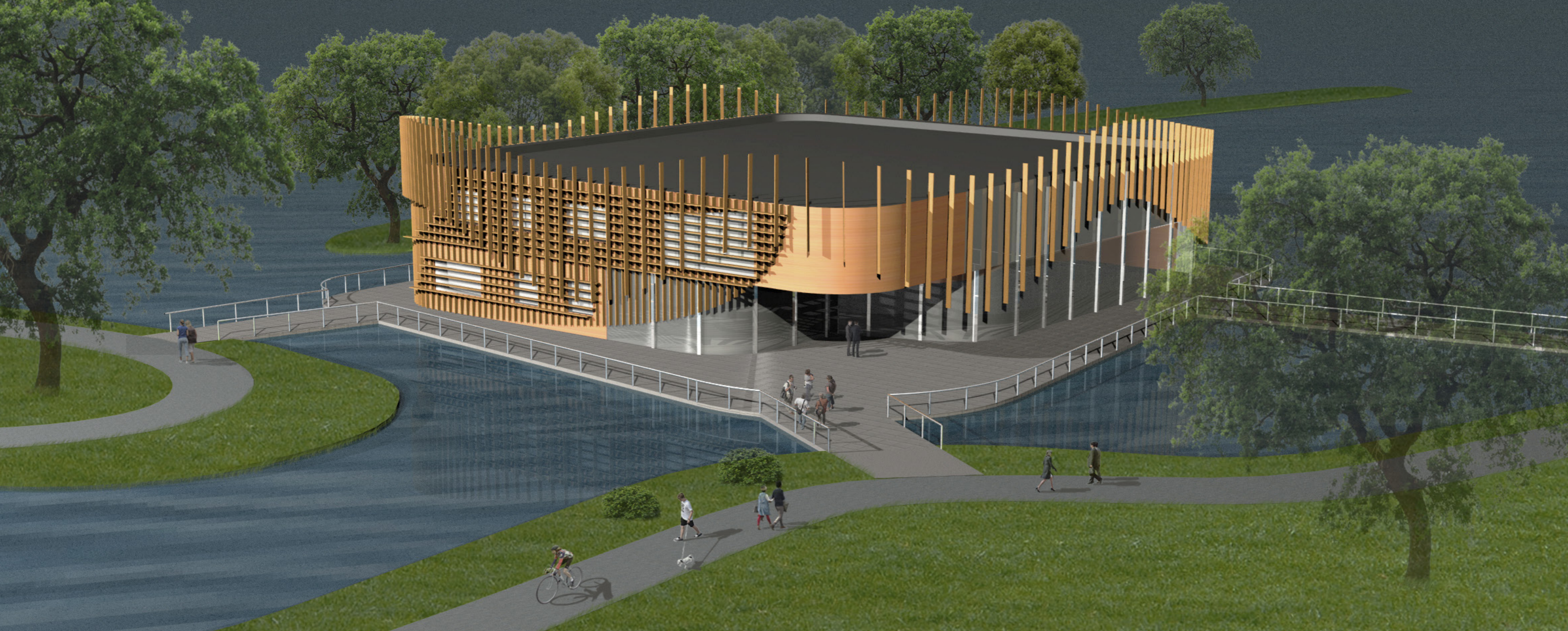
Behind the jury along the interior wall is a glass wall filled with water. This wall of water can vary the transparency in the Court Room with the air bubbles. During daytime, when light is in progress, the bubbles are turned on, and it is not possible for the people in the building to see what is happening in the Court Room. In the evening, the bubbles are turned off, or there is only a few of them, and it is possible to see through the wall into the Court Room. The Court Room does not become the same room for nobody can see, but it gets a connection to the rest of the building. The bubble wall gives all the same view to the lobby, where it becomes a beautiful artwork. All the water in the lobby gives you a feeling of arrival. The water comes down the waterfall, floats with the stream towards the bubble wall, and then up again through the bubble wall, and on to continue.



Detail of bubble wall 1:10

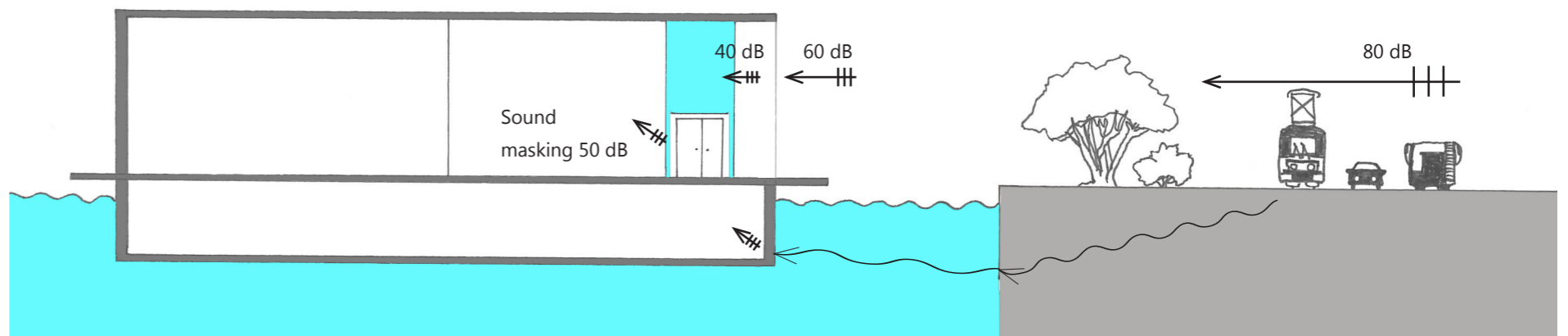


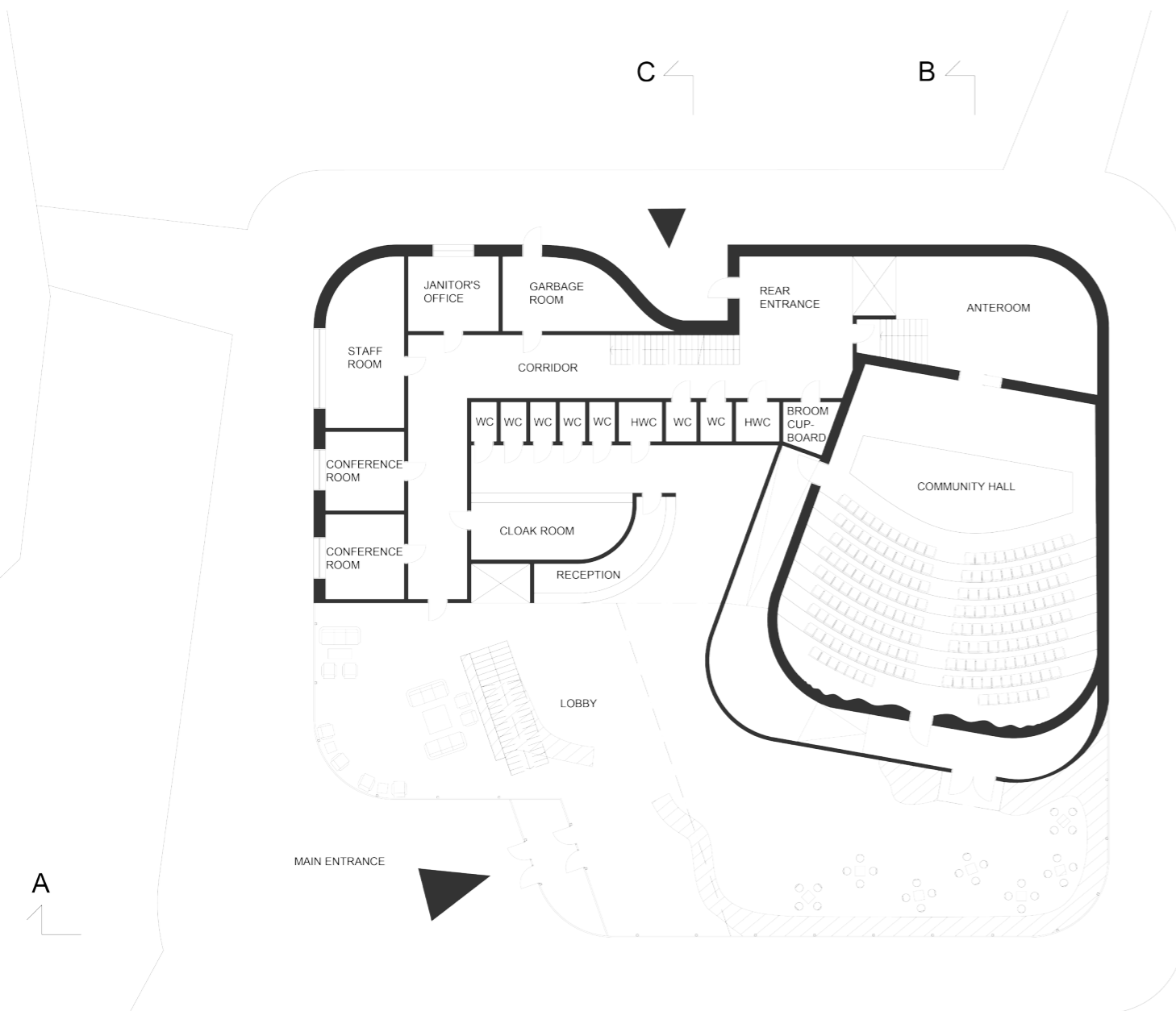
SECTION C-C



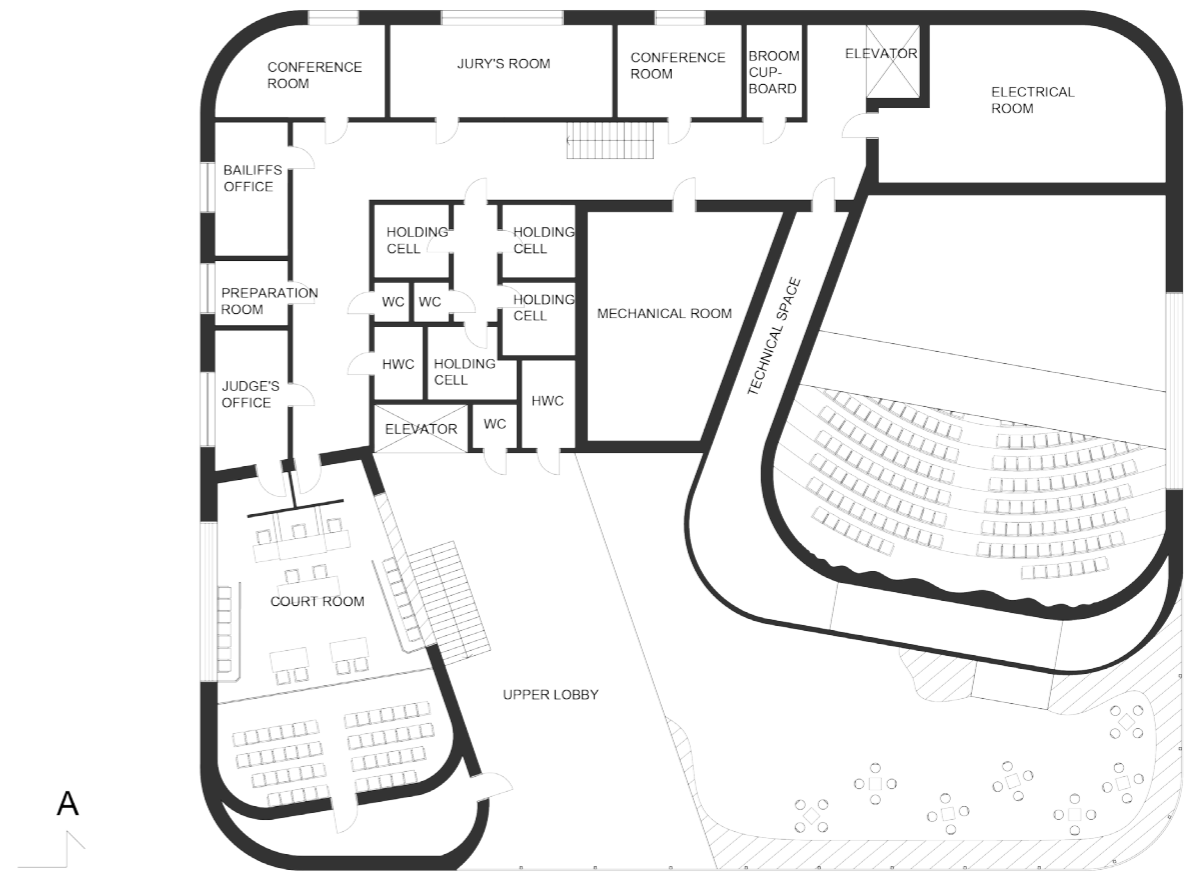
Byggnaden är placerad i Charles River i Boston för att klara av de många översvämningar som förekommer där, samt för dämpning av markvibrationer från spårvagn och biltrafik.

I lobbyn finns ett vattenfall som fungerar som en ljudmaskerare för buller. Istället för att totalt förhindra att något ljud utifrån byggnaden kommer in i byggnaden så använder vi oss av en ljudkälla i lobbyn som maskerar bullret istället. Porlande vatten fungerar psykoakustiskt och ger en lugnande inverkan samt ett behagligt ljud.



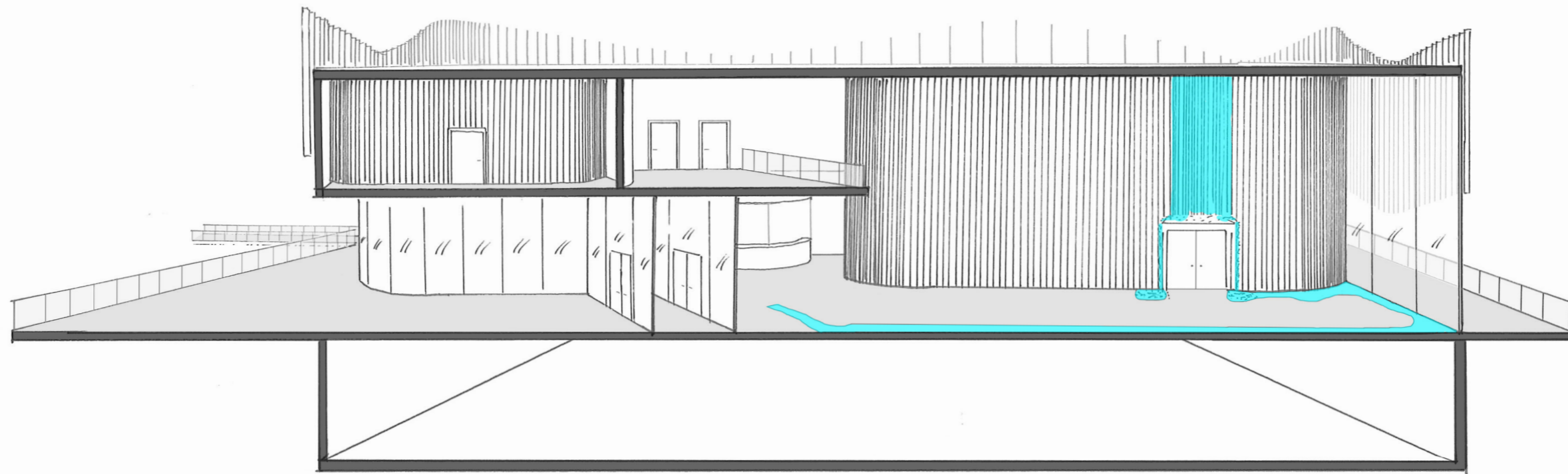


Plan 1



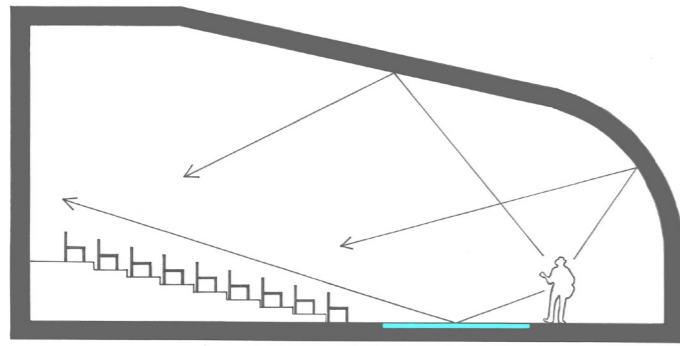
Plan 2

Planlösningen har en tydlig och enkel yttre form. De två viktigaste rummen, domstolen och kommunfullmäktige, sticker ut i lobbyn med sina volymer och skapar ett fint avbrott i den enkla yttre formen. Tydliga sektioner mellan offentligt och privat, samt klimat- och akustik-avsärmning. Domare, jurister och åtalade skiljs åt m.a.p. sekretess.

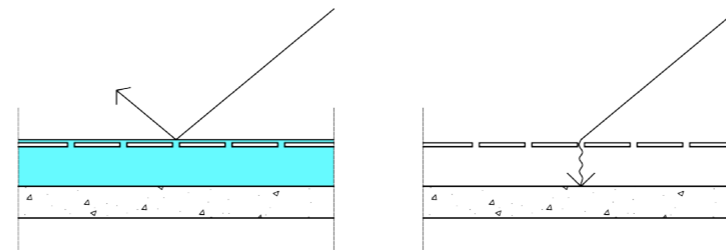


Sektion A-A

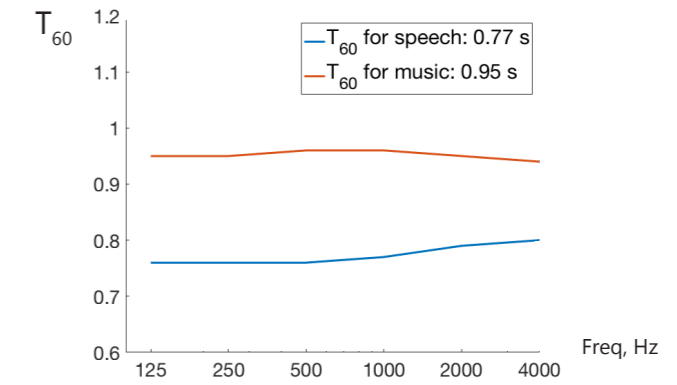
KOMMUNFULLMÄKTIGE



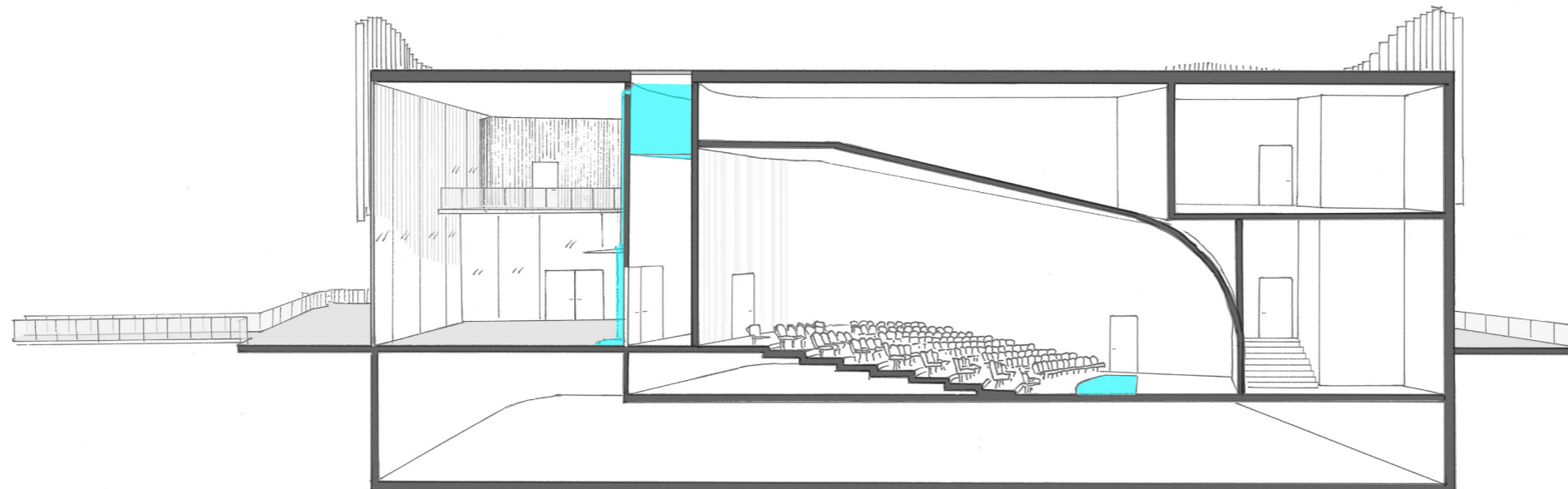
Ljudutbredning i salen med reflekterande ytor som optimerar akustiken.



För att öka efterklangstiden i kommunfullmäktige fylls vattenspegeln till bredden och ljudet reflekteras i ytan. Vid tal töms vattnet ut och vattenspegeln fungerar som en Helmholtz resonator och absorberar ljudet.



En jämn efterklangstid för alla frekvenser. Både för tal och för musik.



Sektion B-B

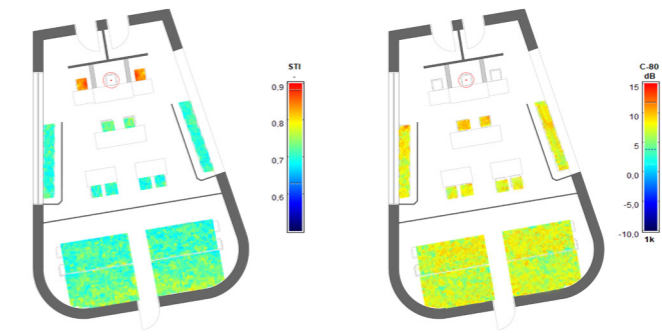
DOMSTOL



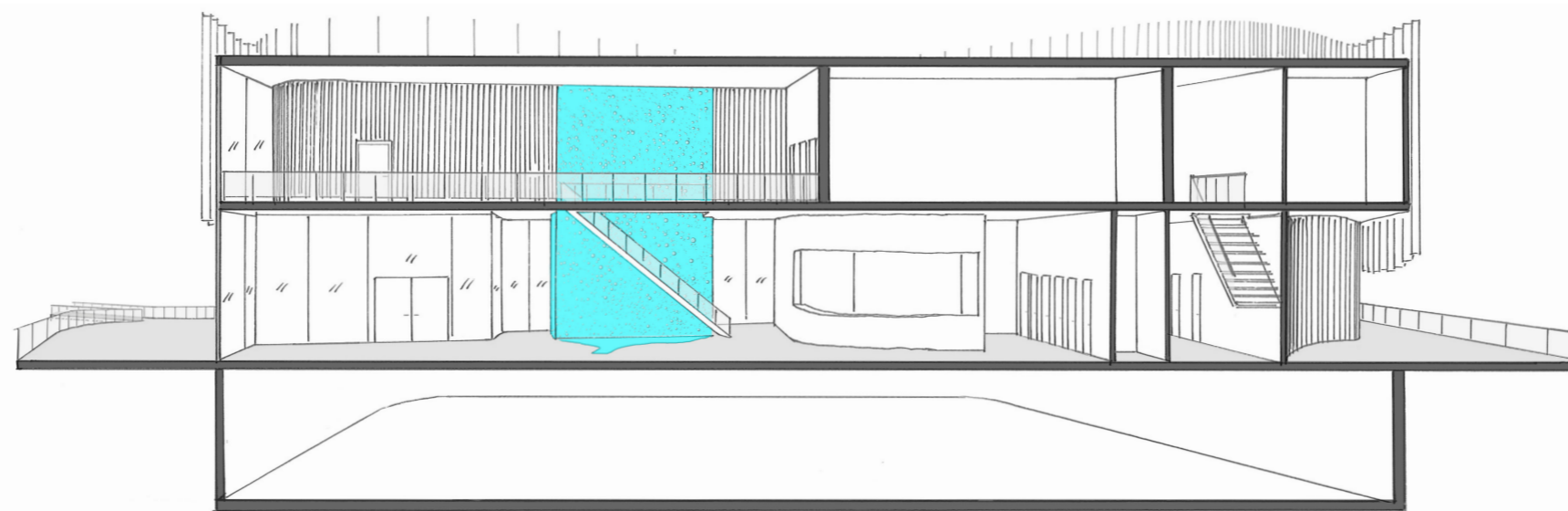
Domstolen befinner sig på andra våningen för att skapa avskiljdhet från övrig verksamhet. Stort ljusinsläpp genom fönster på fasadsidan.



Bubbelväggen sträcker sig upp i två våningar och används som insynskydd under rättegångar med hjälp av mängder av luftbubblor. Utanför kontorstid stängs bubblorna av och det går att se in i domstolen.



Domstolen är liten till ytan, vilket ger goda akustiska resultat.



Sektion C-C

LJUSSTUDIER

10 minuters modeller



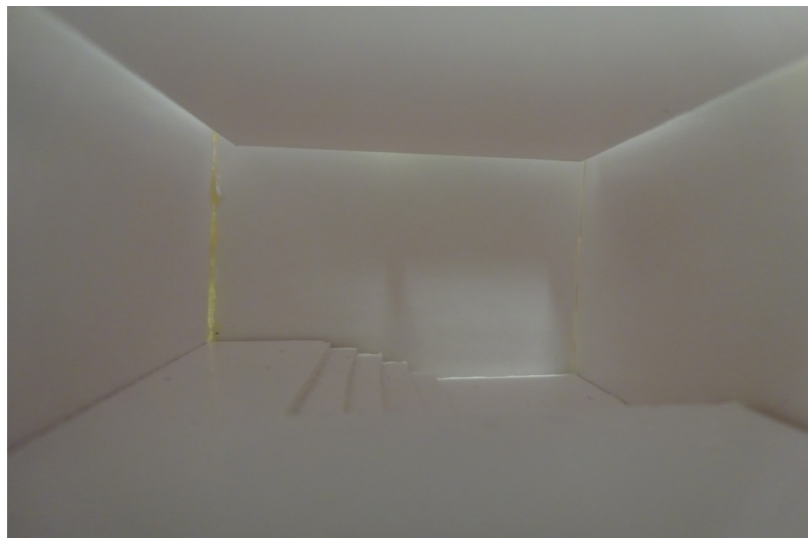
Modell på ljusinsläpp genom taket.
Inspiration av Sverre Fehns Nordic Pavilion.



Snedställda raster för att skapa ett intressant ljusspel på
väggarna.



Raster med utforskning av ljus- kontra solljusinsläpp.
Relationen mellan rastrets täthet och ribbornas dimensioner.



Ett litet glapp mellan väggar och tak för att skapa ett
ljusinsläpp längs med väggarna.

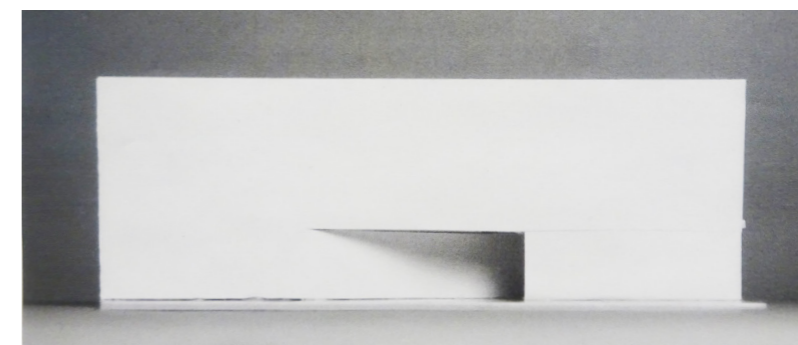
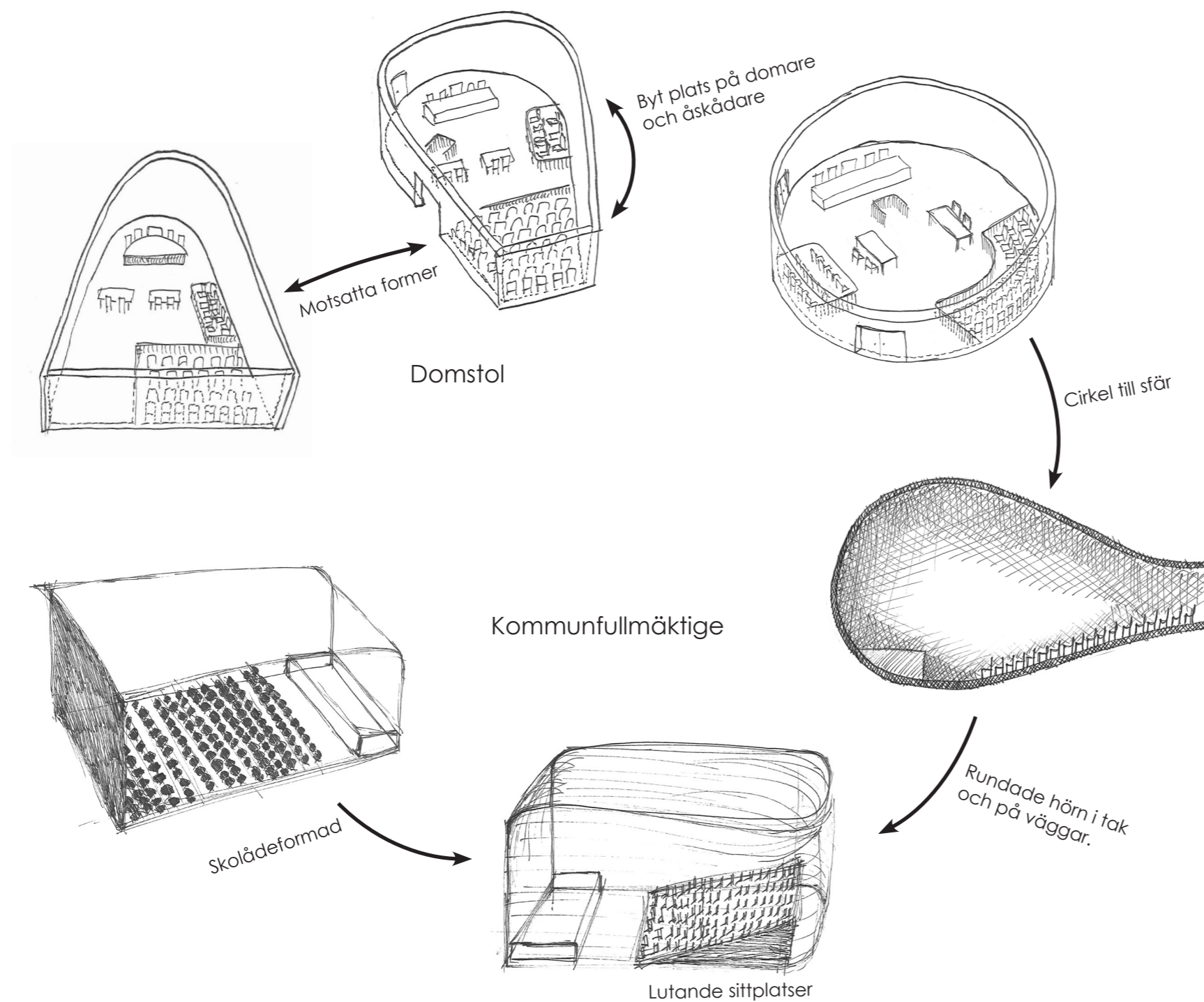


Ett fönsterband där solljuset reflekteras i en utkragande del för
att skapa en ljusreflektion i taket och på så vis sprida ljuset.



Fasadmodell med ett ljusläpp i utkanten av fasaden.
Byggnaden lyser upp kvällstid.

TIDIGA SKISSER



Fasaden övergår mjukt till en indragen entré.



Öppningen definieras av två skarpa linjer.



En skiva står framför en entré. Ljuset inifrån reflekteras på skivan.

REFLEKTION

ARBETSGÅNG

Sara och jag hade en strukturerad arbetsmetod där vi gjorde ljus-, volym- och formstudier på fysiska modeller i lera, cellplast, kartong och plast för att sedan fotografera och analysera resultaten. Varje vecka gjorde vi "att göra listor" för att förvalta tiden på bästa sätt och för att se till så att vi höll oss till arbetsplanen. I tidigt skede gjorde vi en presentationsmockup som uppdaterades regelbundet under arbetets gång.

Vi bevarade det tidiga huvudkonceptet med vatten och utforskade det på många olika sätt. Men tillät oss också att under stunder släppa konceptet och tänka utanför konceptboxen.

KVALITÉER

Vi hittade tidigt en rumsform som fungerade bra akustiskt för domstolen och kommunfullmäktige. Denna form kunde vi sedan iterera om och om igen i dialog med akustikern för att få bättre akustiska värden.

Planerna är väl genomritade. Vi har fokuserat mycket på rörelser och kopplingar mellan de olika verksamheterna, samt att få till ljudbarriärer i form av isolering av teknikrummen.

Vi lyckades bra med att förmedla vattenkonceptet under presentationen och på planscherna. Vattenspegeln i kommunfullmäktige kunde dock ha förmedlats tydligare.

MÖJLIGHET TILL FÖRBÄTTRING

Ur synvinkeln av en arkitekttävling kunde vi ha renodlat den arkitektoniska framtoningen i domstolen och låtit bubbelväggen och fönstret följa hela väggytorna.

Istället för att använda betong i ytterväggarna hade det varit intressant att gjort dem helt i trä, så som vi först ville ha det. På vilket sätt hade de då behövts utformas?

Fågelperspektivet saknar den urbana kontexten med trafikerad bilväg och spårvagn. Bilden signalerar något annat än vad som faktiskt är. De två andra renderingsbilderna kunde istället ha gjorts till kollage med handskissade inslag, eller gjorts i fysiska modeller.