



CRYSTAL HALL

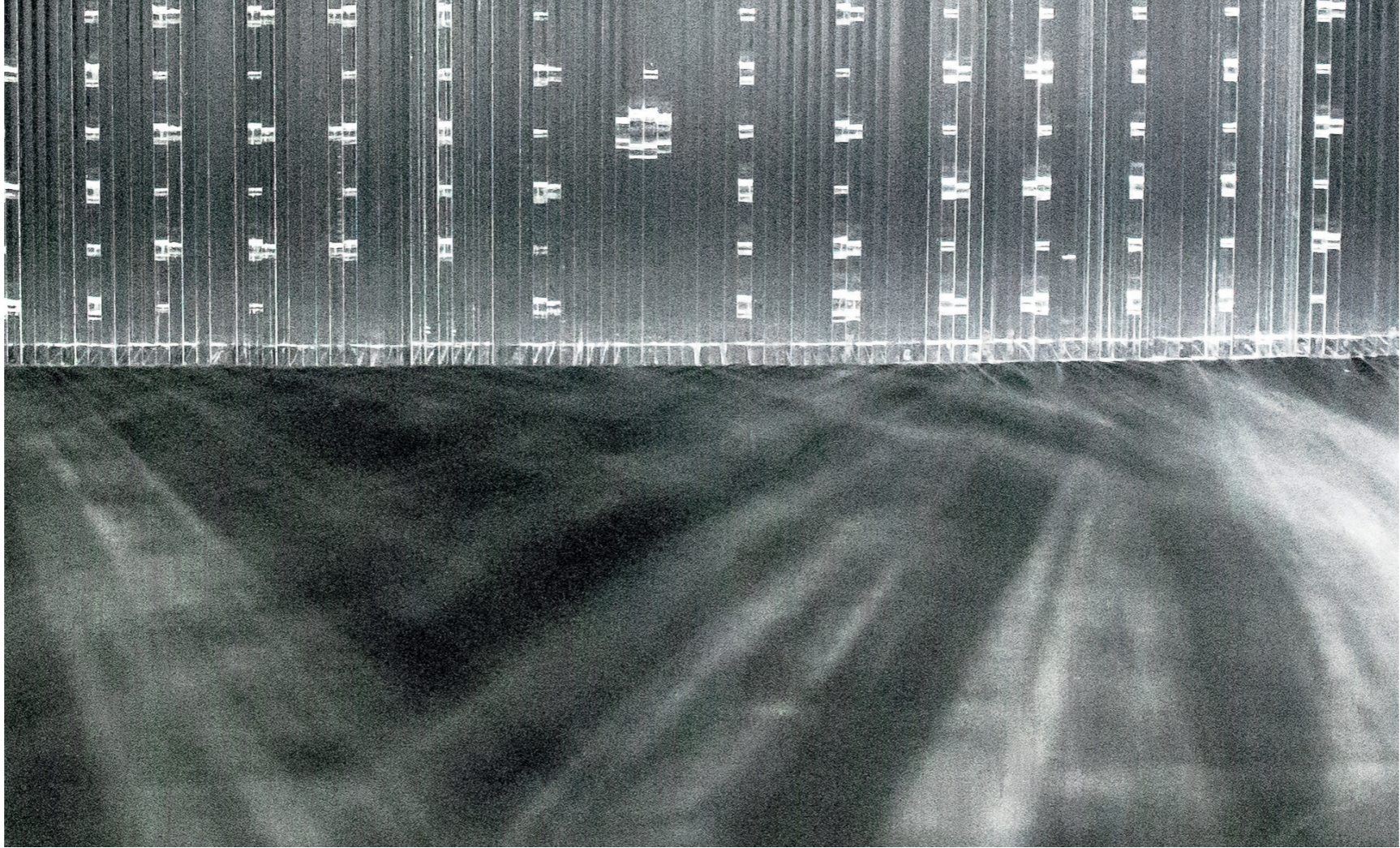
Program
ACOUSTICAL VENUE

Focus
ACOUSTICS AND PRODUCTION

Reflektion

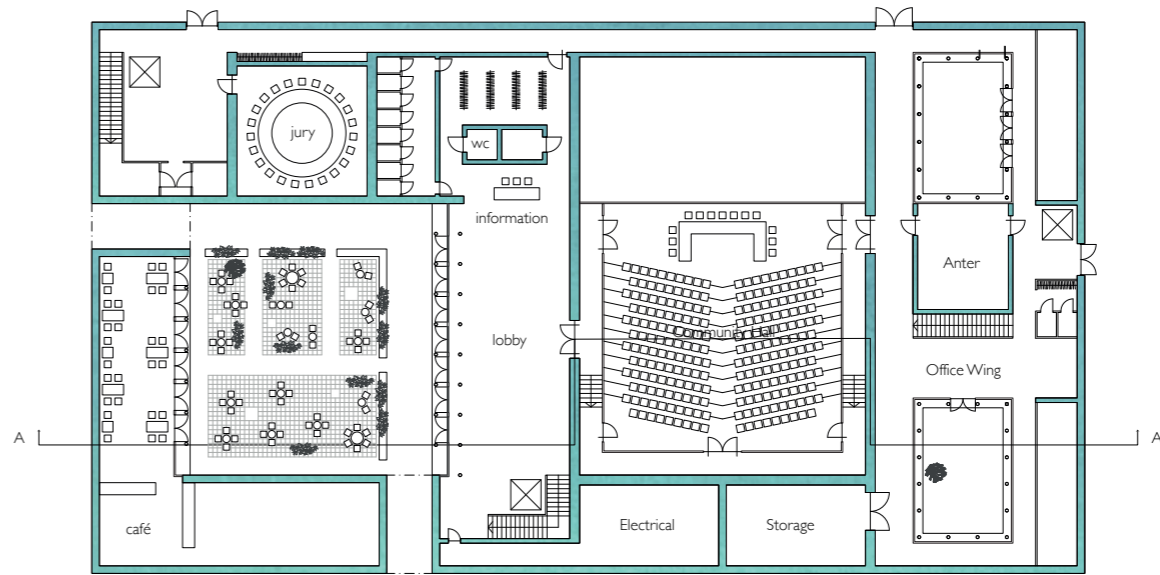
Arbetsprocessen i det här projektet är något att belysa. En stor öppenhet i skisstadiet för att utforska, testa och diskutera har varit avgörande för slutresultatet. I vårt samarbete har vi tillåtit oss att lägga mycket tid på att hitta inspiration, i biblioteket, i teckning och i snabba modeller. De tidiga veckorna sammanställdes på fredagen på väggen för att samla och diskutera kring upptäckter och i dessa samtal har koncept och prioriteringar uppkommit. Under projektet har vi varit tydliga med vad vår riktning är och med den har vi varit kompromisslösa. Valet av presentation i en längdsektion med tre försvinningspunkter fungerade starktast i sitt sätt att hjälpa inläsningen av projektet.



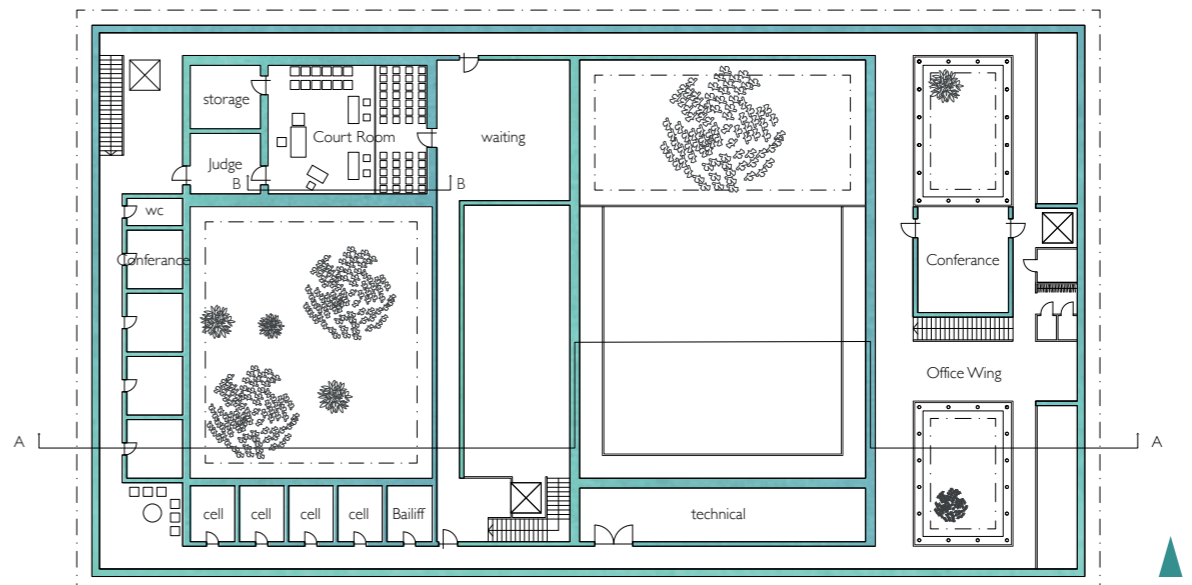




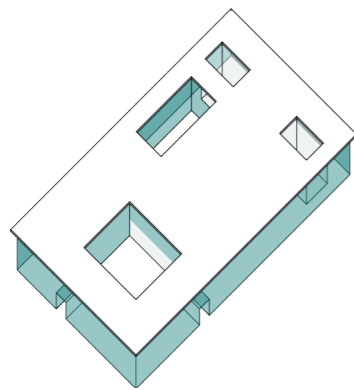
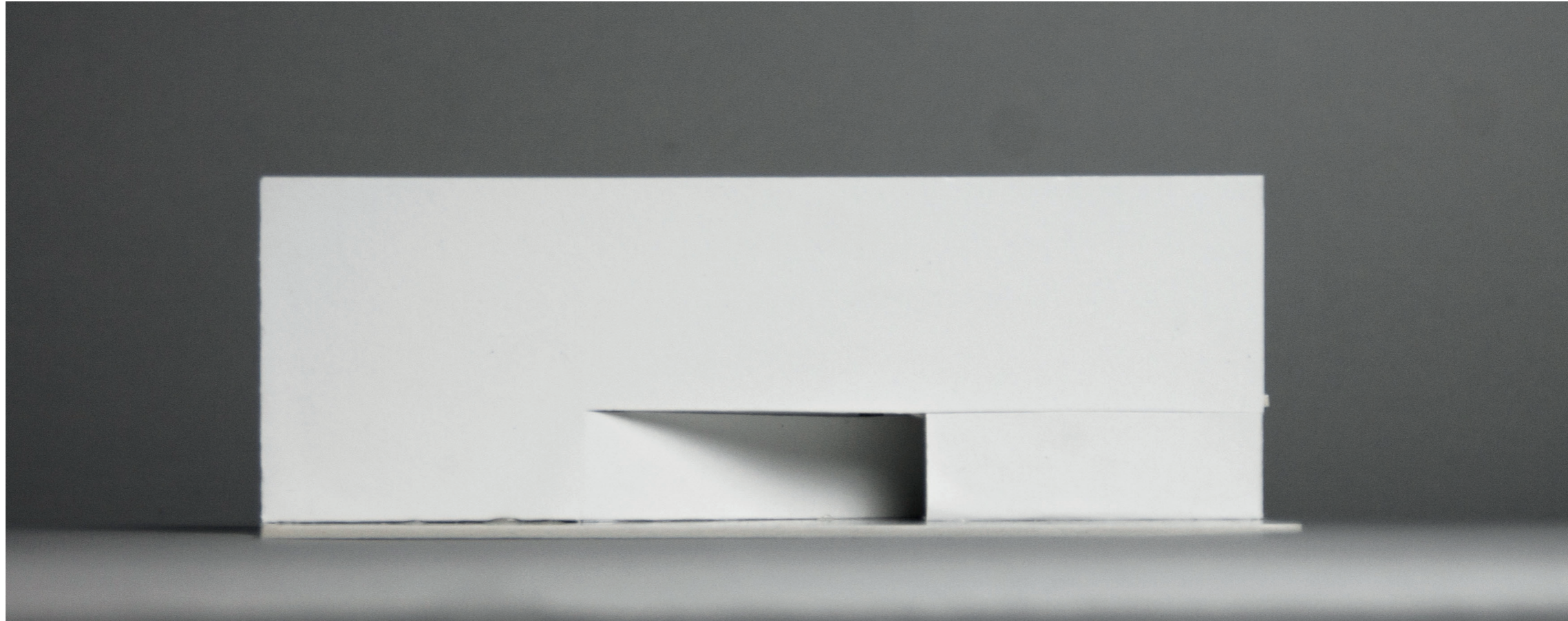
Plan 1:500



First Floor

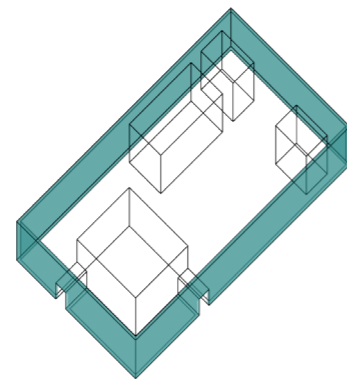


Second Floor



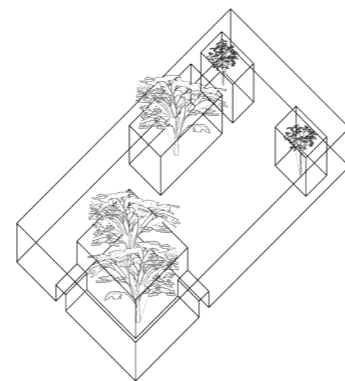
Glowing night time

A city hall in stacked soda lime glass, translucent but not transparent lighting up in the night. The activity inside only seen as moving shadows from the streets in Tucson Arizona.



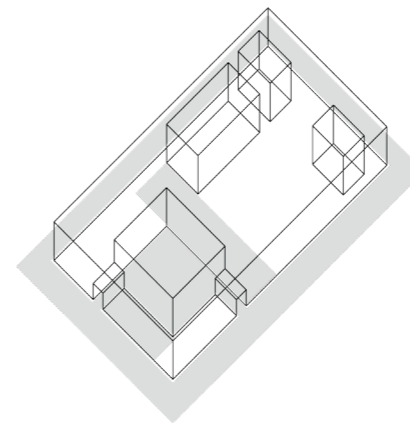
Focus inside

The translucent stacked glass panels allows diffused light to get into the rooms without allowing a precise view of what is happening inside. The glass makes sure that one cannot see through the walls in the court, jury and conference rooms to keep focus inside.



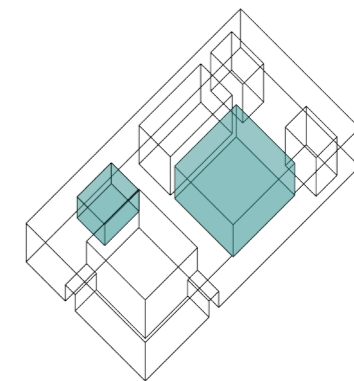
Garden courtyards

The view out are all directed inwards to the four garden atriums for a relaxed and calming atmosphere. The garden court provides an oasis to the city.



Public city plaza

The traditional city hall plaza is inverted and placed in the main atrium to invite people inside. The public square becomes an extension of the lobby and is connected to a cafe and restaurant.

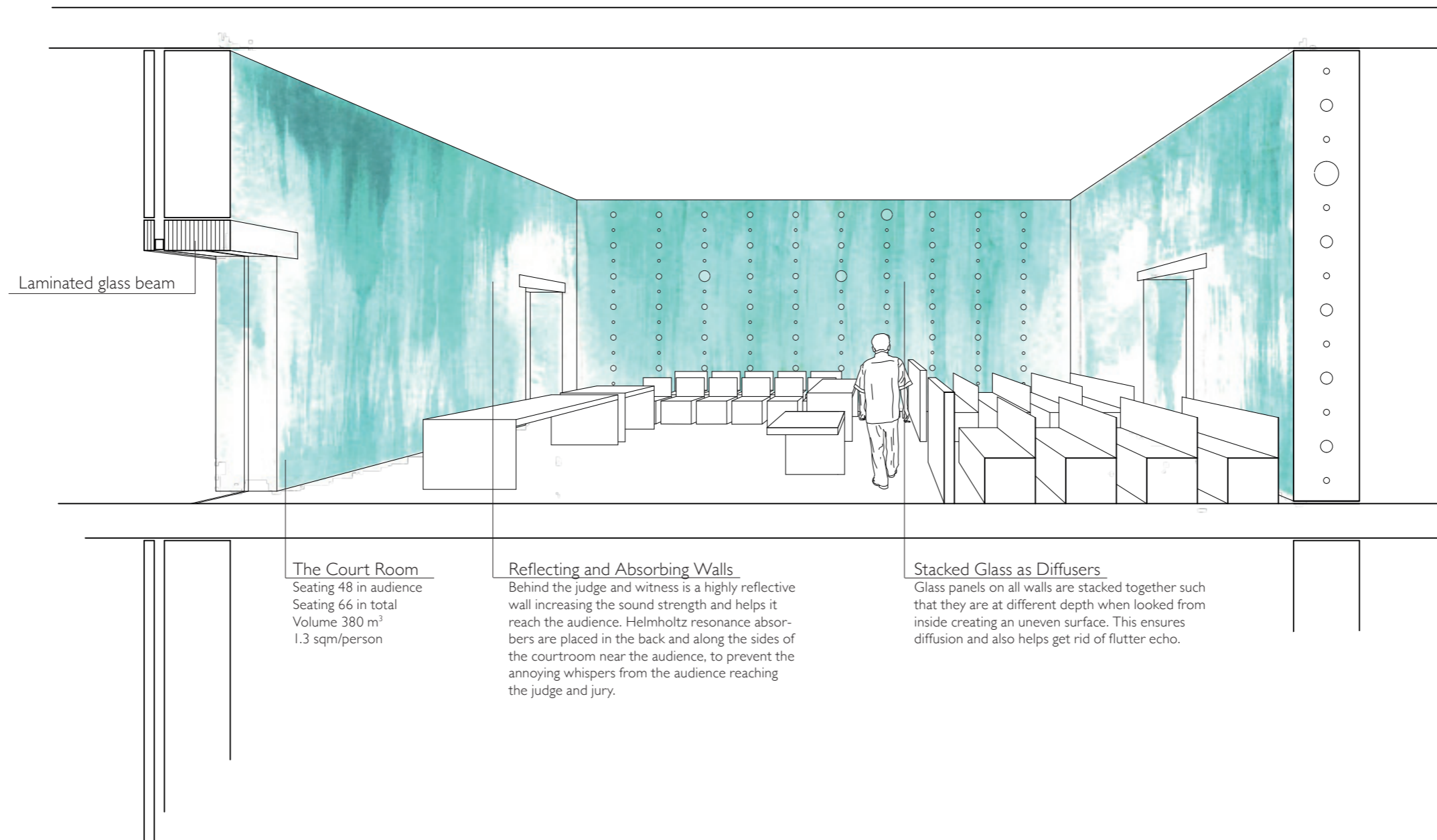


Room for democracy

The community hall is easily reached from the lobby and Garden Court which creates a floating, open space, connecting the politicians to the civilians. With ceremonial respect for the walk to a trial, a stair and glass corridor slows one down and prepares before entering the Court room.

The Court Room

Section B-B 1:50





Fine demands in spoken word requires a fine instrument

The Crystal Hall is a multipurpose city hall located in Tucson, Arizona. A new venue for political meetings, small events, trials, weddings and home for many city offices. The garden plaza provides a green living room for the citizens of Tucson connecting to intimate spaces. The rooms are small and the sound precise to create good conditions for speech and music.

Studio environment

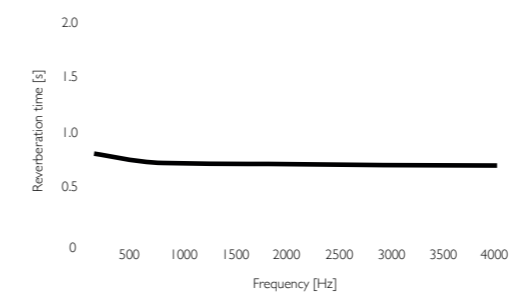
In a building hosting the democratic institution of justice and politics, it is important that people speak the truth. To hear all nuances of speech, the integrated Helmholtz resonators can absorb even the lowest of frequencies from 20 Hz, resulting in a studio environment.

Small volumes

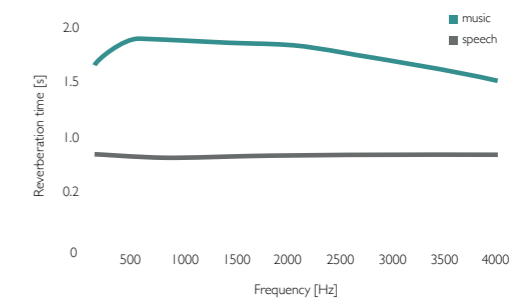
Both the community hall and the court room have approximately one square meter per person to create a sense of intimacy both spatially and acoustically. Small volumes have naturally a low reverberation time, so only a little absorption is needed. The low reverberation time helps achieve a good STI.

Reverberation Time

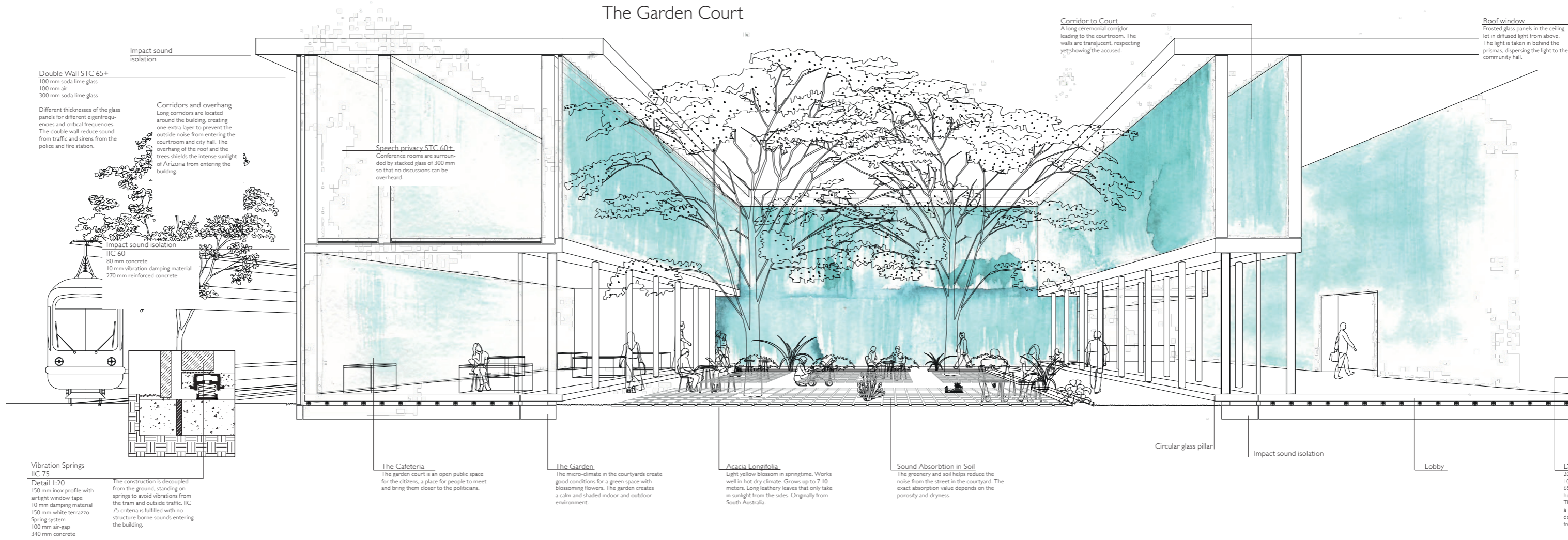
Reverberation time Court room
380 m³



Reverberation time Community hall
1750 m³



The Garden Court



Double Wall STC 65+
 100 mm soda lime glass
 100 mm air
 300 mm soda lime glass

Different thicknesses of the glass panels for different eigenfrequencies and critical frequencies. The double wall reduce sound from traffic and sirens from the police and fire station.

Impact sound isolation

Corridors and overhang
 Long corridors are located around the building, creating one extra layer to prevent the outside noise from entering the courtroom and city hall. The overhang of the roof and the trees shields the intense sunlight of Arizona from entering the building.

Impact sound isolation
 IIC 60
 80 mm concrete
 10 mm vibration damping material
 270 mm reinforced concrete

Speech privacy STC 60+
 Conference rooms are surrounded by stacked glass of 300 mm so that no discussions can be overheard.

Corridor to Court
 A long ceremonial corridor leading to the courtroom. The walls are translucent, respecting yet showing the accused.

Roof window
 Frosted glass panels in the ceiling let in diffused light from above. The light is taken in behind the prisms, dispersing the light to the community hall.

Vibration Springs
 IIC 75
 Detail 1:20
 150 mm inox profile with airtight window tape
 10 mm damping material
 150 mm white terrazzo
 Spring system
 100 mm air-gap
 340 mm concrete

The construction is decoupled from the ground, standing on springs to avoid vibrations from the tram and outside traffic. IIC 75 criteria is fulfilled with no structure borne sounds entering the building.

The Cafeteria
 The garden court is an open public space for the citizens, a place for people to meet and bring them closer to the politicians.

The Garden
 The micro-climate in the courtyards create good conditions for a green space with blossoming flowers. The garden creates a calm and shaded indoor and outdoor environment.

Acacia Longifolia
 Light yellow blossom in springtime. Works well in hot dry climate. Grows up to 7-10 meters. Long leathery leaves that only take in sunlight from the sides. Originally from South Australia.

Sound Absorption in Soil
 The greenery and soil helps reduce the noise from the street in the courtyard. The exact absorption value depends on the porosity and dryness.

Circular glass pillar

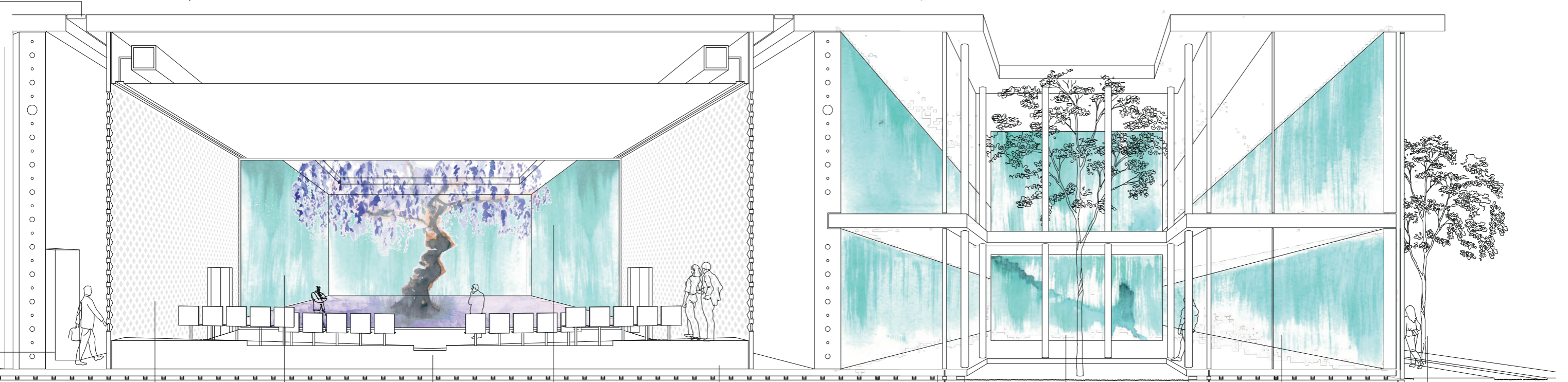
Impact sound isolation

Lobby

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The Crystal Hall

City Offices



Double wall STC 70+
 100 mm soda lime glass
 100 mm air
 50 mm soda lime glass with Helmholtz resonators
 The community hall is surrounded by double wall, with a windbreak and double doors, avoiding the sound from the courtyard and lobby.

Community Hall
 Seating 238 people
 Volume: 1750 m³
 1.05 sqm/person

Double Glass Window STC 65+
 20 mm insulation glass
 66 mm helium
 16 mm insulation glass
 A highly reflective wall behind the stage helps the sound to reach the audience.

Wedding Aisle
 A large centered aisle for special occasions and weddings.

Blue Jacaranda Tree
 Purple blossom for more than 8 weeks in spring. Prefers bright sunny conditions, enriched sand and moisture but tolerates drought. Grows up to 20-30 meter. Originally from Central America.

HVAC System
 Behind the community hall is a plenum silencer, on the first floor. It allows a slow airflow of fresh air that siphers up underneath the seats and is collected through air-curtains along the sides of the ceiling.

Rear Entrance 2.5 m
 A corridor large enough to transfer a grand piano and other large objects.

Sun Chimneys
 5 mm black steel
 300 mm air-chimney
 20 mm glass

Natural airborne cooling system. Dark panels directed towards south heat up the air in the chimneys and creates a natural airflow in the building. The chimenes goes down into the ground cooling the air. All channels are decoupled acoustically from the structural system.

Elevators and technical rooms
 Elevators are acoustically decoupled from the load-bearing system with an air-gap between the doc and the floor. Technical rooms have thick double walls and vibration springs so that no noise is transmitted through the structure.

Working Environment
 Large windows towards the atrium creates an open and pleasant working environment in the office.



Variable Acoustic Crystal Wall

The crystal wall allows variable acoustics and natural lighting in the community hall. Fully opened they expose the hall to high and low frequency absorbers behind, and when closed they reflect the incident sound resulting in higher reverberation time. The crystals also scatter and diffuse the sound in different directions depending on their orientation and help to get rid of flutter echo between parallel walls. Opening up to low and high frequency absorbers, a flat reverberation time for music and speech is achieved. The crystal walls are located in the back and along the sides of the room letting light through while the focus of the audience is directed towards the stage. The big Jacaranda tree in the atrium behind create a calm and centered view.

Music

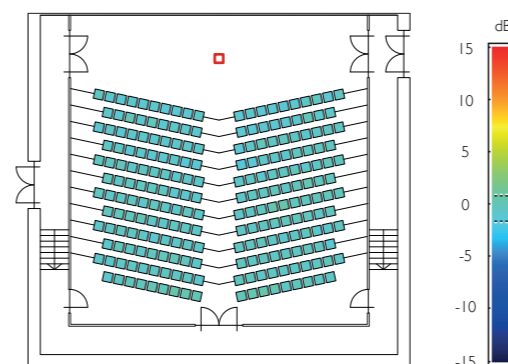
Most of the crystals are closed to reflect sound and elongate the reverberation time and to get the required clarity for music between -2 and +2 dB.

Speech

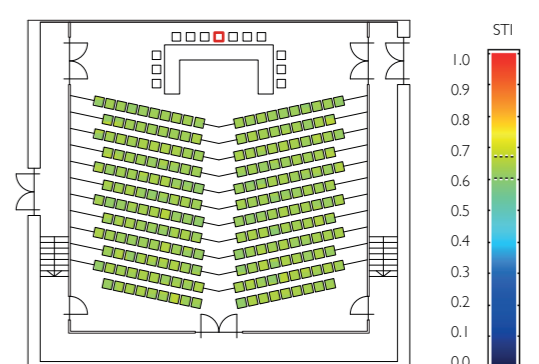
Most crystals are open to the absorbing corridor that creates a flat reverberation and good STI value. The rise in reverberation time due to slight increase of volume is dealt with by having sufficient absorption so that the net reduction in reverberation time meets the requirements for speech.

Clarity and STI Community Hall

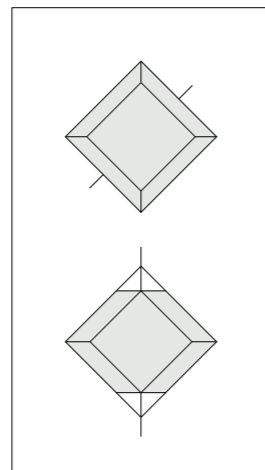
C80 Clarity for 1 kHz



STI



Crystal Wall



Rotating Crystal Panels

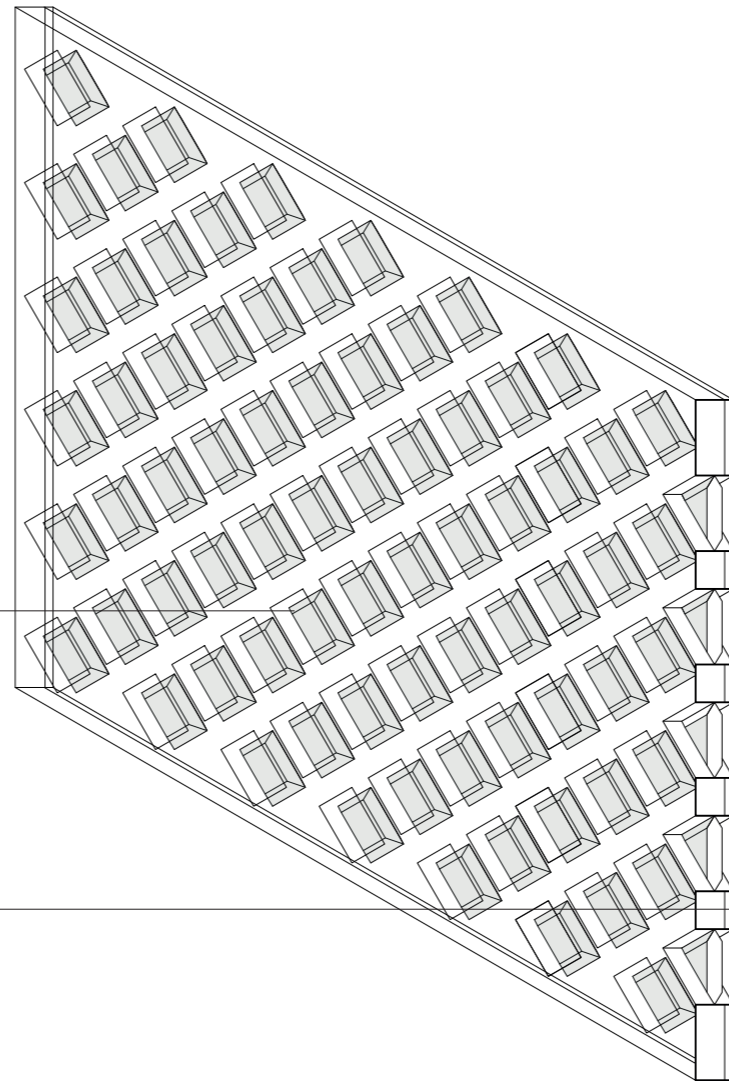
Detail 1:10

200 mm diagonal axis
Rotating around different axis.
The surface is frosted and the cut clear creating an dispersing light effect.

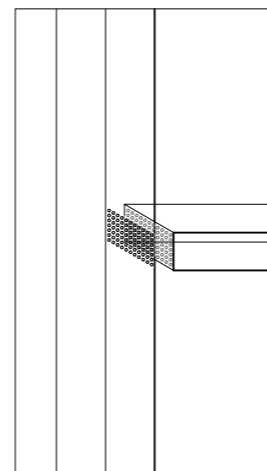
High Frequencies Absorption

Detail 1:20

100 mm concrete
high frequency absorber
Absorbing material placed at the back of the crystal wall ensures the absorption of mid to high frequencies.

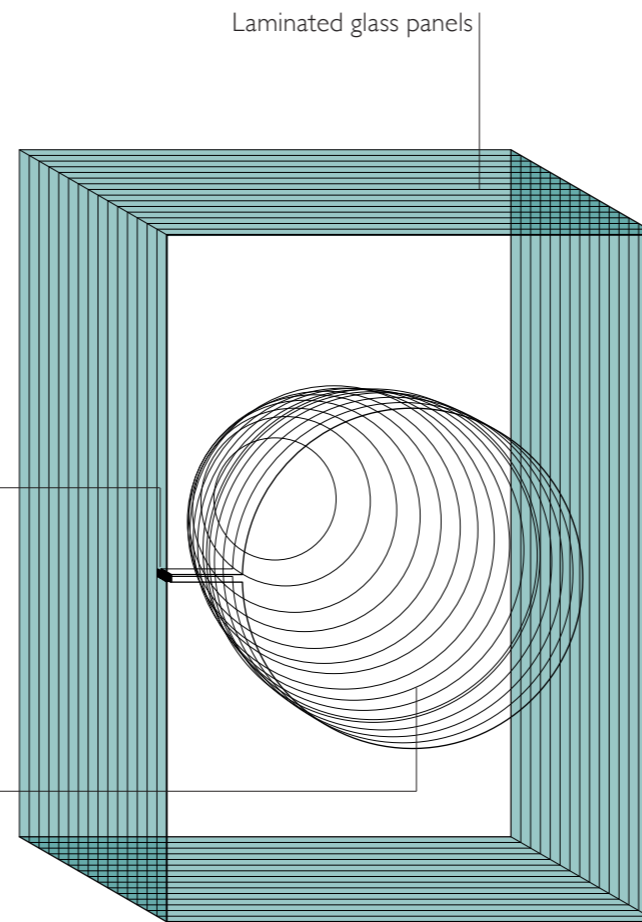


Transparent Absorber

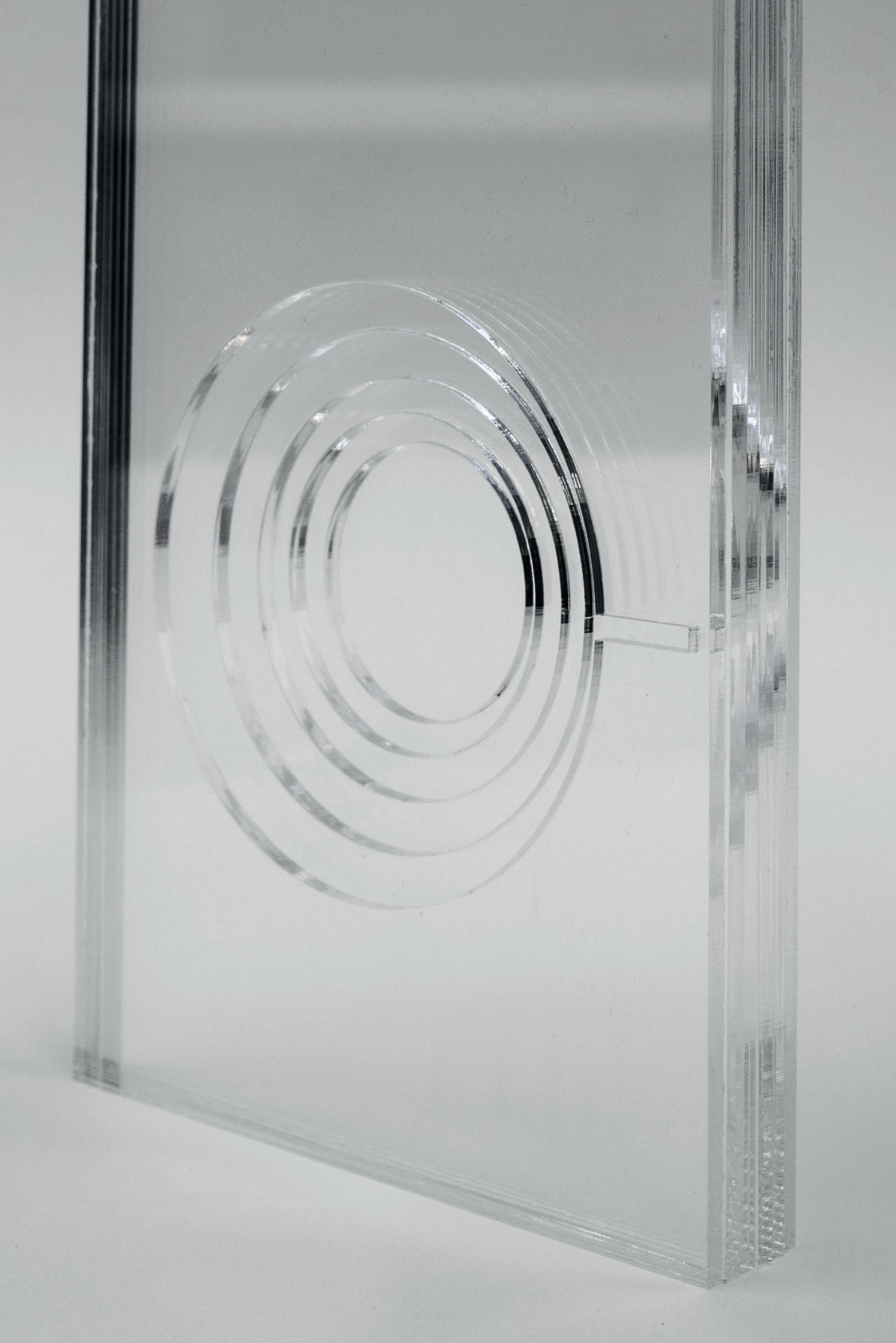


Micro Perforation
Detail 1:2
15x15 mm neck opening
Micro perforation for
viscous friction

Helmholtz Resonant
Absorber 20 Hz
Detail 1:10
2 mm micro-perforated glass
100 mm neck
450 mm diameter
650 mm glass panels



Laminated glass panels



Integrated Helmholtz Resonators

The transparent integrated Helmholtz resonators in the walls allows absorption and can be tuned to desired frequency. Micro-perforation at the end of the neck ensures absorption because of viscous friction. The Helmholtz resonant absorbers gives total control over even the lowest frequencies as low as 20 Hz. In the community hall the Helmholtz resonators are integrated in the back walls that are exposed when the crystals are open. Helmholtz resonance absorbers are placed in the back of the court room near the audience, to prevent the annoying whispers from the audience reaching the judge and jury.

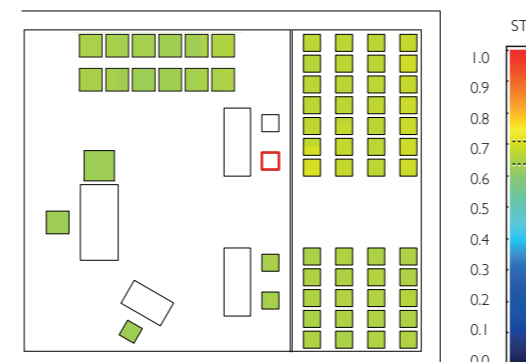
Fabrication

The walls are made of laminated glass panels of the commercial and easily recycled soda lime glass. The glass walls act in compression and bending is prevented by lamination. Thanks to the thin panels, the spherical absorbing volume integrated in the walls are created by circles cut in each glass panel. In the mid panel, also acting as the neck of the Helmholtz, a thin channel is cut almost to the edge, saving a

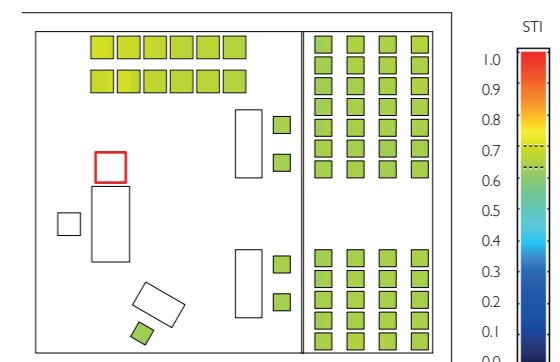
small bit for micro-perforation of holes drilled from the side. The viscous friction achieved by micro-perforation makes it possible for no other absorption material. Put together the panels create a three dimensional effect of spheres, diffusing light through the walls. The Helmholtz are visible in the lobby, in the corridor to the community hall and on the walls of the court room, having an appearance of frozen bubbles.

STI Court Room

STI Lawyer speaking



STI Witness speaking



EARLY SKETCHES

