THE DIAMOND COURT

Kandidatprojekt 15 Hp Arkitektur och Teknik
Process portfolio

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INLEDNING

THE DIAMOND COURT

The vision of the project is a welcoming, modern town hall that promotes dialogue with the citizens and at the same time is a functional workplace and a meeting place for townsmen, officials and politicians. The design of the municipal building makes two volumes connected by a glass roofed outside courtyard. The building will reflect the municipality’s desire for openness and daylight, inviting the public inside via the public square connected to the streetscapes.
LOCATION

The site is in a Minneapolis suburb. To fit in to a small town grid of streets the building is reachable from two streets, is low leveled and makes the footprint of a square. The building need to handle weather challenges as heavy sunlight on warm summer days and low temperatures in the winter. Thick walls of concrete with wood and copper façade are used.

URBAN SPACE

For the building to be welcoming, focus has been on how to make it accessible and attractive for people to visit and walk by. Therefore, a varied urban space with a park setting for people to hang out in is considered. The vegetation with the ground of soil and grass has positive effects on noise control.
FLOOR PLANNING

Through walking up the stairs or the ramp the circular park is reached. Both the varied heights and the park setting is used to create an open space for the people. The glass-covered courtyard will serve as the new meeting place where public services and programs are located.

The park leads on to the lobby of the building which is connected to the Community hall, the Court room and offices. Natural daylight is used in the lobby through roofed windows and a glass façade shaded by vegetation of the court yard.

The western wing holds the community hall with connections to an anteroom under the audience plane. The eastern wing will, together with the northern part of the building, house the court room and provided offices. Here meeting and conference facilities are also placed while encouraging sharing and cross-disciplinary problem solving - hallmarks of a modern work environment.

To communicate an intimate community hall and a major court room, the shape of the rooms are circular respectively sharp edged. In the facade materials wood is used on the exterior walls. Where the community hall and the court room are taking place in the facade, copper plate is used to show that these both halls are of greater weight.

Entrance to the cells is made from floor one. The cells are connected to the office part of the building with a room for meetings reached from both parts. The walk from the cells to the court room is made through a seperately set of stairs.

Mechanical and electrical equipment rooms are placed in the basement to be central in the building but kept away from direct contact with the halls.

NOISE CONTROL

To ensure that the vibrations from the heavy traffic and trams are not reaching the building the concrete slab is isolated from vibrations by a soft material. The material coupled with the building has a low resonance frequency which ensures that vibrations above the resonance frequency have poor transmission into the building.

The most common noise sources within buildings, other than the inhabitants, are related to heating, ventilation and air conditioning. Therefore transmission of noise from the HVAC system is prevented through placement of the source and using of mufflers at the beginning of the air duct system.

To prevent airborne noise entering the building and causing disturbance, the external walls are constructed with a thickness of 200 mm/7.84 inch concrete, providing a minimum reduction of 45 dB in the frequency range of 1 kHz to 4 kHz.

Indoor to indoor sound transmission control is considered by using the same thickness on the walls around the halls as the exterior walls.
COMMUNITY HALL

To create a uniform sound field, critical areas are treated using the panels which can rotate around their own axis to adjust the acoustics and improve diffusion throughout the dome. At the back wall the panels are more rotated and open up to a sound absorbing textile behind.

The panels have convex faces with the wood's natural irregularities and organic structure preserved. At the stage the wooden panels are aligned in such a way that they provide good stage support and direct the sound from the stage to the audience. The wooden parallelogram panels are in essence used to counter the detrimental effects that arise using a dome shape.

ACOUSTICAL CONCEPT

<table>
<thead>
<tr>
<th>Quantity of Seats</th>
<th>226</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total floor area</td>
<td>2400 ft$^2$</td>
</tr>
<tr>
<td>Space per seat</td>
<td>10.6 ft$^2$</td>
</tr>
<tr>
<td>Total volume</td>
<td>49,000 ft$^3$</td>
</tr>
<tr>
<td>Volume per seat</td>
<td>216.8 ft$^3$</td>
</tr>
<tr>
<td>Most distant seat</td>
<td>38 ft</td>
</tr>
<tr>
<td>Floor design</td>
<td>12 inch</td>
</tr>
</tbody>
</table>

BASS RATIO

\[
\frac{RT_{1.25\, \text{Hz}}}{RT_{500\, \text{Hz}}} + \frac{RT_{2.5\, \text{Hz}}}{RT_{1000\, \text{Hz}}} = 1.1
\]

A bass ratio of 1.1 indicates a good balance between brilliance and warmth in the Community hall. The value 1.1 lies within the recommended range for halls with lower reverberation times.

REVERBERATION TIME

The mean value of the reverberation time is about 1.2 seconds. This value is appropriate for drama performances, speech and modern music.

CLARITY

The clarity is on average around 7 dB which is high in relation to a concert hall for classical music, but since the community hall is designed for gatherings with a feeling of community and intimacy, a higher clarity will help provide just that.

INITIAL TIME DELAY GAP

The initial time delay shows that it takes the sound no more than 30 ms to reach the back row. This is a value that is incorporated into the design of the dimensions of the dome so that the seats have reflections that arrive with in about 50 ms - at all seats.

SPEECH TRANSMISSION INDEX

The STI is fair to good at all seats. For the best speech intelligibility, one should try to get a seat at the front row.
INTIMACY

The community hall has been designed with intimacy in mind referring to the feeling of being close to the sound source. Utilizing the classical Greek/Roman fan shape for the seating, the effects of this can be seen in the objective measure of the Initial Time Delay Gap (ITDG). ITDG is the time difference between the arrival of the direct sound and the first significant reflection for each seating position. Low values will translate into a more intimate setting and high values gives for low intimacy. The community hall has an ITDG of about 5 to 10 ms for all seats which is considered on the intimate side.

LIGHT

In the community hall, natural daylight is considered by using windows in the roof structure. The position gives the windows a high security level and prevent sound leaking out and viewers looking in.

SHAPE

The round shape of both the main section and the floor plan makes for acoustical challenges. The main focal point of the sphere is moved above the audience. This is done by placing the floor of the room at a distance from the center that corresponds to the height needed for the audience plane. Furthermore the radius of the dome is dimensioned in such a way that the total volume minus the volume of the sphere cap beneath the floor equals a volume of at least 5 $m^3$ per seat.

To account for creeping waves along the sides and a focal point at the back of the seating area, the wooden panels are rotated up at the back and to the sides to introduce irregularities in the geometry the sound sees. The dimensions of the dome also ensures that all the first reflections arrive within 50 ms at all seats, with the only exception at the seats in the front row furthest from the back. But since the panels at the back are exposing the absorptive textile these reflections are not perceived as echoes due to the attenuation relative the direct sound and the first reflections.
The mean clarity maintained in the room is 5.32 dB which is good for speech. The clarity in the court room is maintained by increasing the direct sound and early reflections. Walls made of wood would serve the purpose. In order to reduce the late reflections absorbers made of acoustic plaster are placed at the end of the room towards the audience.

The sound strength in the court room has a mean value of 13.48 db. The sound strength is equally spread over the audience plane providing equal loudness. The strength is calculated with the reference source of 94 dB.

The speech transmissibility index of the room is 0.66 which is good for the room describing the quality of speech transfer from the speaker to the listeners. In order to prevent low STI in the room direct speech is increased when compared to the reflected ones. Sufficient absorption made of acoustic plaster is added to reduce the reflected sound.

The mean reverberation time maintained in the court room is 0.77 s which makes the speech and discussions audible among listeners and the jury. The room is made unsymmetrical to prevent the effect of flutter echoes. Walls are covered with wooden panels to maintain the distributed reverberation time required for speech.

High leveled windows are used in the court room, letting light in over the peaks of the wooden panels. This gives a shaded light and holds a security standard even though the room is by the street.

<table>
<thead>
<tr>
<th>Quantity of Seats</th>
<th>50 + 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total floor area</td>
<td>1600 ft²</td>
</tr>
<tr>
<td>Space per seat</td>
<td>22.2 ft²</td>
</tr>
<tr>
<td>Total volume</td>
<td>26100 ft³</td>
</tr>
<tr>
<td>Volume per seat</td>
<td>362.5 ft³</td>
</tr>
<tr>
<td>Most distant seat</td>
<td>40 ft</td>
</tr>
<tr>
<td>Floor design</td>
<td>-</td>
</tr>
</tbody>
</table>

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SHAPE

The shape of the court room is inspired from the shape of a parallelogram. To get a better acoustical room, the walls are slightly rotated to not be parallel. The development of the shape is shown below. Although the sharpest corners are cut out, the roof seen from outside strikes out in as a continuation of the angle.
PROCESS

Charcoal sketch of self-shading facade
Notes of Architectural concept

AT3 Bachelor Project 2018

Ext. Criteria

- Vegetation and park life
- Social sustainability: urban spaces
- Smart tech. solutions
- Liquid balance
- Integrate in city

Int. Criteria

- Acoustical solutions
- Light openness
- Floor planning - movement

Mal-arbetssätt

- Sketching
- Physical models
- Charcoal
- Virtual tools

Notes of Acoustical concept

Acoustics

- Parallelogram... material on different sides? What materials?
- Curtains behind pattern?
- Box behind pattern wall?

- Room and roof shapes...
  - Identify pros and cons...
  - What other forms are good?

- City noise...
  - Solutions for noise control
  - Shape + materials

- Define acoustics criteria for different rooms
  - Reverberation time RT
  - Clarity C (C80, STI)
  - Sound strength G
  - Signal-to-noise ratio SN
General Design for Rooms for Speech

Size - Shape - Surface orientation - Materials - Background Noise

- Adequate loudness
- Sound level - relatively uniform
- Appropriate reverberation characteristics
- High Signal-to-noise ratio
- Low background noise levels to not interfere with the listening environment
- Free from acoustical defects: long delayed reflections, flutter echoes, focusing, resonance.

Sketches of Acoustical roof solutions
Sketches of Urban space and volumes
Sketches of building volumes

Sketches of floor planning
Sketch of floor planning

Conceptual sketch of dome

Representation of acoustical optimization of Community hall and Court room
REFLEKTION

Arkitektur


Projektets gång

Ett av målen med kandidatprojektet var att öva olika designverktyg. Dels att skissa för hand men också att öva modellerad i Rhino och Grasshopper samt att förbättra bildmaterial i Photoshop. Detta mål är uppnått. Det jag hade gjort annorlunda idag är att skissa mer för hand, längre in i processen, och lita på att digitaliseringen av projektet hinnit med i slutet.