

År 3  
Projekt Kandidatarbete, grupparbete  
med Kajsa Holmquist  
Verktyg CAD, Illustrator, Photoshop,  
Rhino, Enscape  
Datum 2024-02-13 - 2024-04-25

# OPERA GLAS

SVÄVANDE OPERA AV GLAS

ACEX15  
Alma Johansson

Uppgiften var att rita en opera som skulle vara en del av ett campus. Vårt förslag är en upphängd svävande opera i glasbetong. För att låta campuskänslan fortsätta in i operahuset har en rymlig lobby utformats under den upplyfta operahallen, för att möjliggöra en mötesplats för studenter, som även kan användas till föreläsningar, tal och som fikarum.

*Perspektiv lobby*



# PLANSCHER

Nedan visas planscherna som skickades in till tävlingen. Följande två uppslag visas all text samt några bilder från planchererna. Även här har vi valt att följa konceptet genom att utgå från en uppdelning av sidorna i fyrkantiga block. Genom detta val samt val av färger hoppas vi väcka en nyfikenhet hos läsaren.

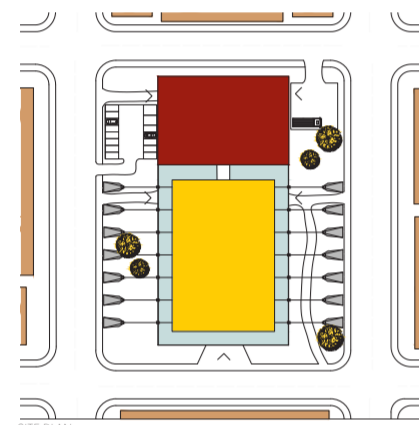
## DON'T SHAKE - SUSPENDED OPERA

Opera Glas presents a unique suspended construction made of glass blocks. The opera hall is entirely detached from both the ground and the surrounding building, effectively isolating it from vibrations. The volume is suspended by wires attached to steel frames beneath the hall. These delicate wires are anchored outside the opera house, lending a sense of weightlessness and creating the illusion of the cube floating above the ground.

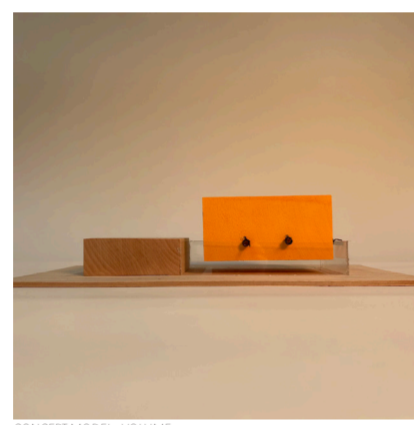
The opera hall is adorned with illuminated glass blocks whose colors can be altered to reflect the season, occasion, or the opera being performed. This elevated volume resembles a hanging lamp, casting its light over the city's streets at night.



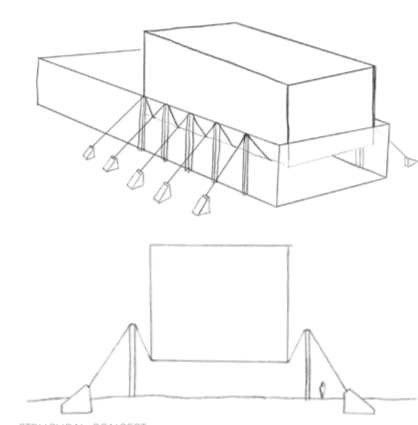
OUTDOOR PERSPECTIVE - URBAN LAMP



SITE PLAN



CONCEPT MODEL - VOLUME



STRUCTURAL CONCEPT

## THE RHYTHM OF THE OPERA

The plan reflects the modular nature of the glass cube, comprising three distinct volumes: the cube itself, the lobby, and a solid volume for additional opera house functions. Visitor flow centers around the lobby and stairs leading to the opera hall along transparent walls. On special occasions, guests can dine at the opera restaurant above the hall.

Other functions are positioned to minimize disruptions to the opera hall. The MEPFIT room is divided into two areas, with the larger one located away from the hall's influence. An airlock separates the MEPFIT area above the hall, insulating it from equipment noise and vibrations. The rehearsal hall is similarly isolated from the scene shop.



GLASS BLOCK

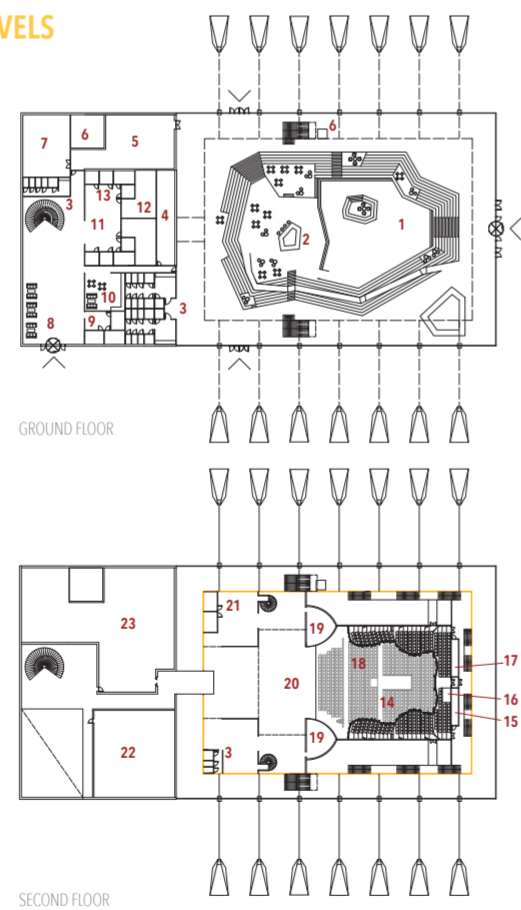
1.3

## PLAN DRAWINGS & NOISE LEVELS

- NC-15
- NC-20
- NC-25
- NC-30
- NC-35
- NC-40

- 1- Lobby
- 2- Café
- 3- Toilets
- 4- Wardrobe
- 5- Kitchen
- 6- Elevator
- 7- Loading Dock
- 8- Staff Entrance
- 9- Tech Offices, 11.6 m<sup>2</sup> each
- 10- Lounge
- 11- Green Room, 105 m<sup>2</sup>
- 12- Chorus Dressing Rooms, 54.5 m<sup>2</sup> each
- 13- Solo Dressing Rooms, 7.8 m<sup>2</sup> each
- 14- Auditorium
- 15- Follow Spot Booth, 28 m<sup>2</sup>
- 16- In-House Audio Mix, 5.7 m<sup>2</sup>
- 17- Control Room for RH, 28 m<sup>2</sup>
- 18- Conductor Podium
- 19- Orchestra Pits, 73 m<sup>2</sup>
- 20- Stage, 388 m<sup>2</sup>
- 21- MER Offices, 24.7 m<sup>2</sup> tot
- 22- Rehearsal Hall, 318 m<sup>2</sup>
- 23- Scene Shop, 570 m<sup>2</sup>

Restaurant (third floor), 1952 m<sup>2</sup>  
MEPFIT with MER (third floor), 1952 m<sup>2</sup>



GROUND FLOOR

SECOND FLOOR

## GLASS - DESIGN MEETS ACOUSTICS

Opera Glas takes on its distinctive character from glass concrete, which serves as a consistent theme throughout the entire building, from the façade to the opera's seating. The glass blocks used vary in size, with dimensions of 450x450x160 mm for the façade and 190x190x80 mm for finer details. With the semi-transparent characteristics of the glass, the aim is to awaken curiosity as the silhouettes of visitors are glimpsed from the lobby and by passersby on the street.

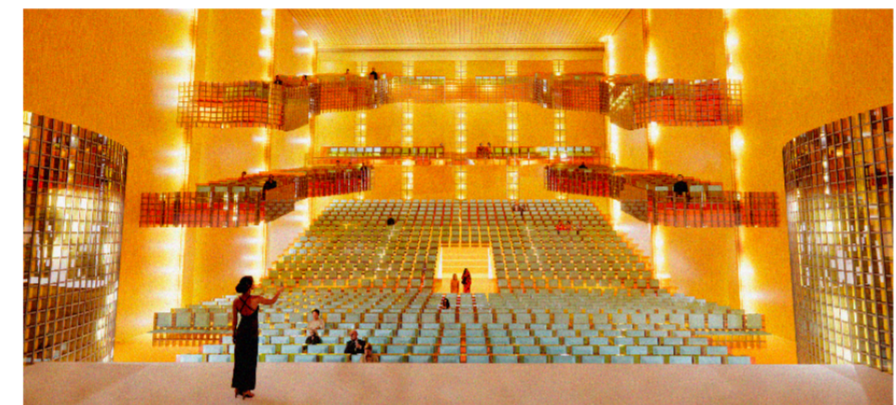
Constructing an opera house with glass concrete presents both acoustic challenges and benefits. Further details on the acoustic considerations are provided on the next page along with the acoustic prototypes.



ALMA JOHANSSON KAJSA HOLMQUIST RICHARD HEIKKILÄ



GLASS BLOCK 1:3

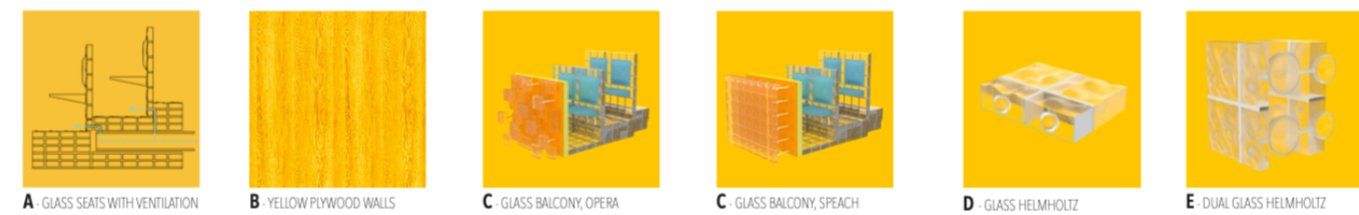


OPERA HALL

## A NIGHT AT THE OPERA

The opera hall accommodates 1295 seats, with 60 percent distributed across the ground floor with a tiered balcony, and 40 percent across two levels of balconies. The orchestra is divided into two sections elevated on balconies, with the conductor positioned centrally and visible to all.

The glass concept defines the interior of the opera hall. Walls and balconies are adorned with glass blocks, and chairbacks made of glass emerge from the glass floor. The opera is designed to stand out, to be a space that transports the visitor from everyday events and the hectic life outside, to a place where nothing is impossible, where all stories are real. With the use of color and lighting, a joyful, inspiring, and anticipatory atmosphere is created.



A GLASS SEATS WITH VENTILATION

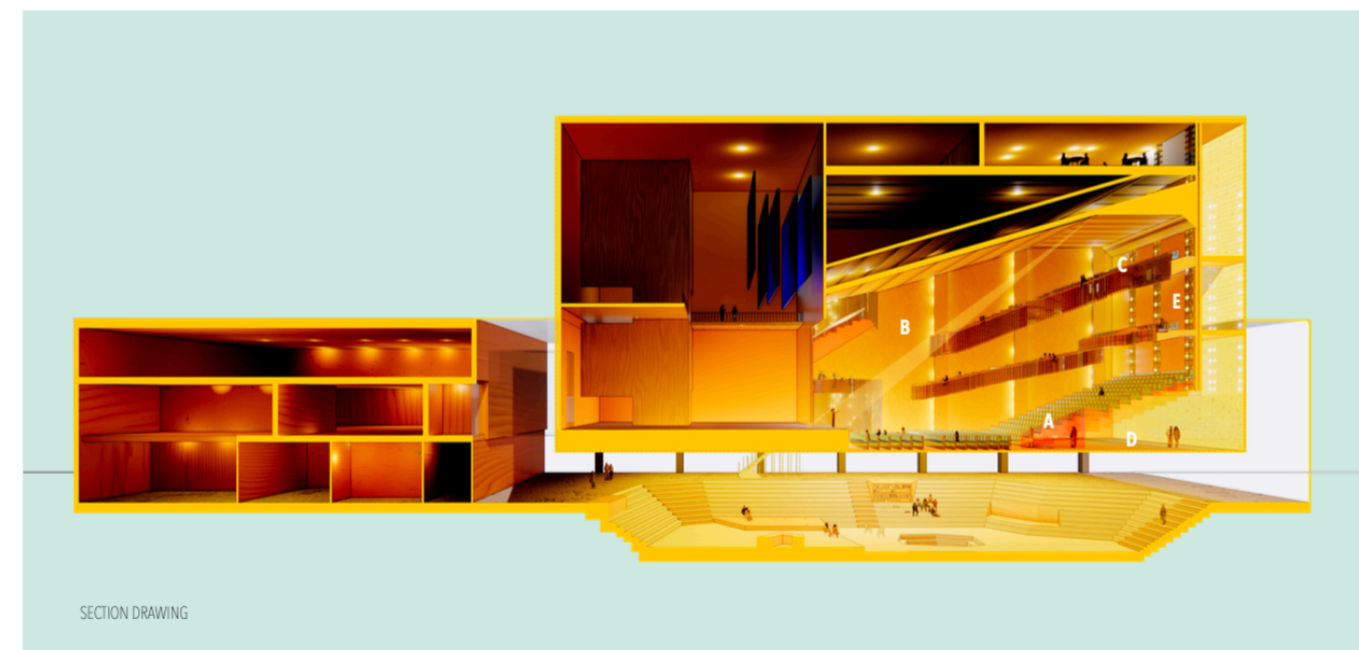
B YELLOW PLYWOOD WALLS

C GLASS BALCONY OPERA

C GLASS BALCONY SPEECH

D GLASS HELMHOLTZ

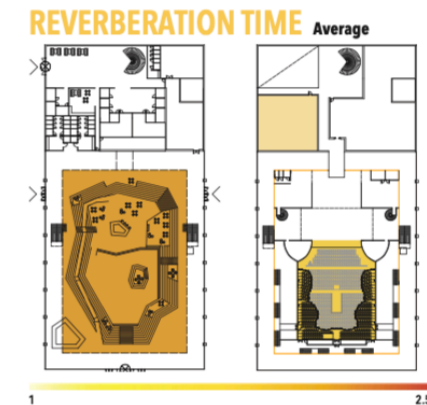
E DUAL GLASS HELMHOLTZ



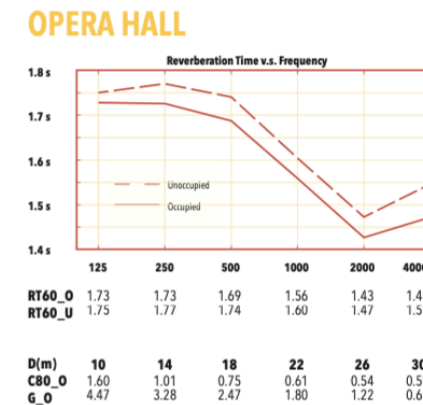
SECTION DRAWING



LOBBY - CREATIVE, MULTIPURPOSE SPACE



REVERBERATION TIME Average

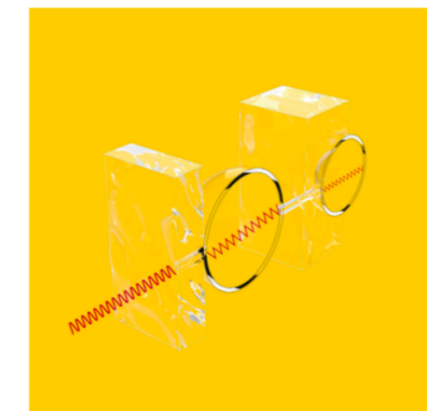


OPERA HALL

## A LOBBY THAT TAKES SPACE

The space beneath the elevated opera expands by excavating steps into the ground, inspired by the chaotic pit created when a meteorite strikes the earth. It is a dynamic and playful environment for schoolwork, speeches and lectures, and also a social meeting place for students. Designed with creativity and functionality in mind, bold colors and wood elements enhance the vibrant atmosphere. Here, you can enjoy a coffee while observing opera guests through the luminous glass floor above.

The glass ceiling blocks reduce airborne sound levels by up to 40 dB, like the double glass facade, made of laminated panes and a PVB layer. Thus, these barriers are sufficient to meet the noise criteria stated in the plan drawings.



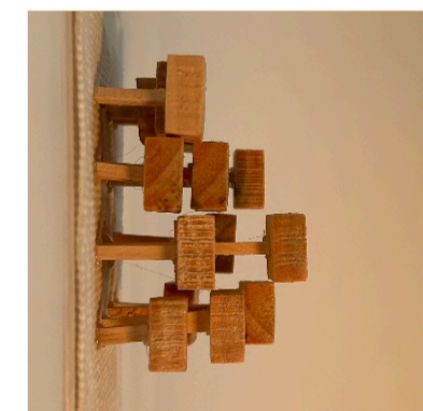
SPHERICAL DUAL HELMHOLTZ RESONATORS IN GLASS

## DUAL HELMHOLTZ RESONATORS

Crafted from spherical glass volumes, these serially connected Helmholtz resonators have been designed to target frequencies in both the 125 Hz and 250 Hz bands.

Functioning akin to mass-spring systems with two degrees of freedom, these dual resonators exhibit two natural frequencies. This enables each resonator opening to effectively absorb two frequencies. Thus, the desired target frequencies can be chosen by small changes of the parameters.

Installed within the glass block walls, this design suggests a solution to successful sound absorption despite using hard and reflective materials.

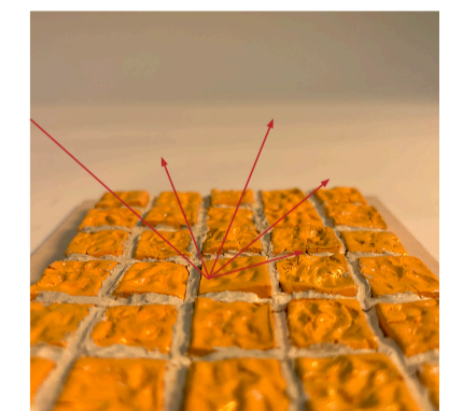


CONCEPT MODEL - ADJUSTABLE BALCONY RAILINGS

## THE GLASS SLIT BALCONIES

Balcony railings will be adorned with separate glass elements. With this prototype, the acoustic and architectural design work together, as the railings act as high frequency absorbers or diffusers.

These multi-functioning elements are comprised of small glass blocks, intermediate air gaps, and an absorbent cloth behind, extend the glass-based theme within the auditorium down to the smallest detail. The spacing between each piece and the rear absorption layer can be adjusted. This design renders them versatile in acoustic terms, as they can function as slit absorbers, diffusers, or diffractors, depending on the chosen configuration.



CONCEPT MODEL - UNEVEN GLASS FLOOR

## HEELS OVERHEAD - UNEVEN BLOCKS

The semi-transparent floor is completely constructed of glass blocks. Since this glass floor also functions as the ceiling in the lobby, visitors can catch a sparkling glimpse of the auditorium when it is filled with the audience before performances.

The uneven surfaces enable dispersion of high-frequency sound waves in the hall. This characteristic endows the hall with a vibrant acoustic environment, while simultaneously tackling optimal reflections and thus reduces the effects of acoustical glare. Single Glass-Helmholtz resonators are mounted inside the blocks, facing both towards the opera hall and the lobby, tackling challenging reverberation times in the 250 Hz band.

## DON'T SHAKE- SUSPENDED OPERA

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## THE RHYTHM OF THE OPERA

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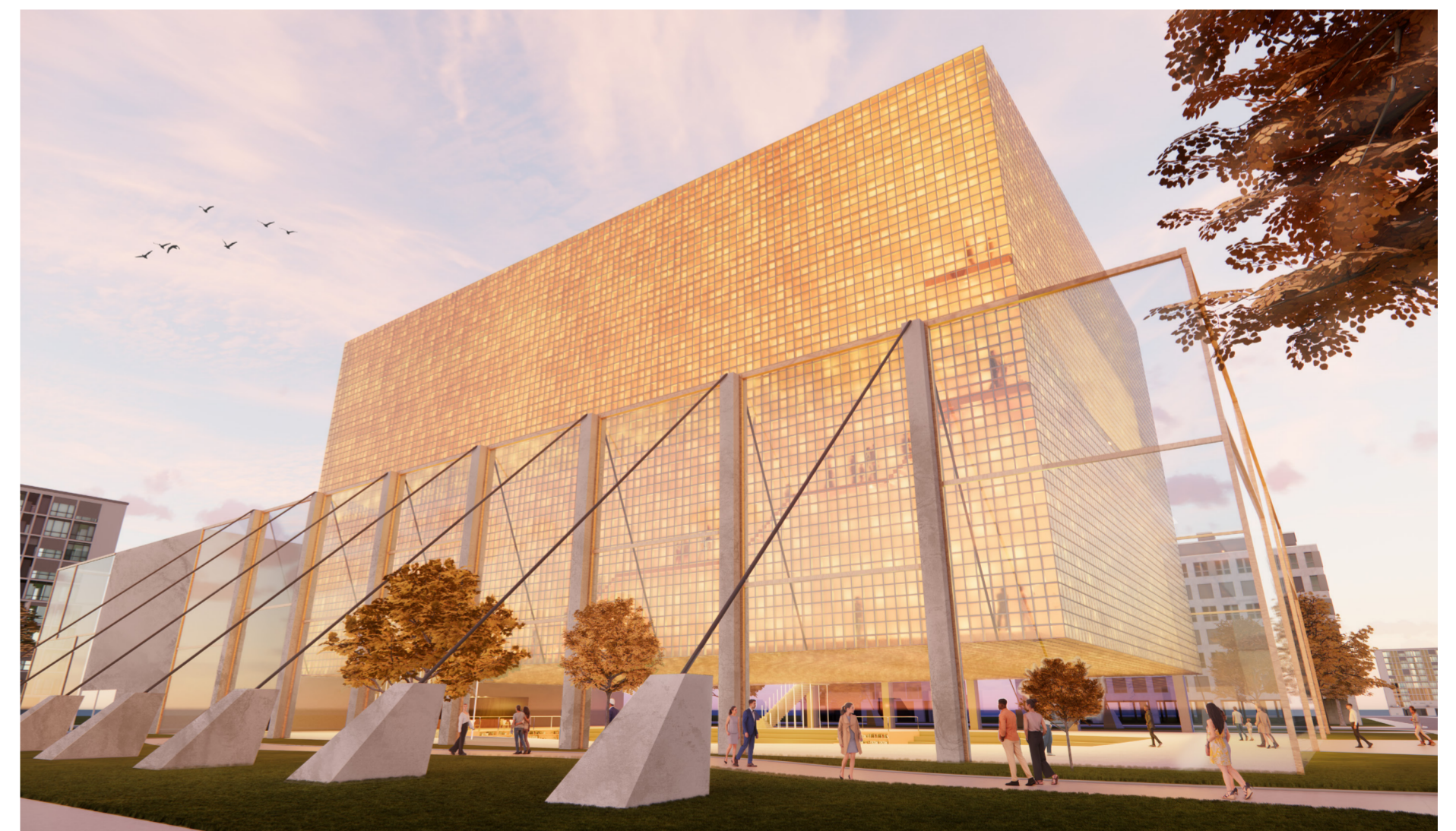
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## REHEARSAL ROOM

To imitate the acoustic environment of the opera hall, the rehearsal room is clad in the same combination of materials. Like in the opera, Dual Helmholtz resonators are integrated in the rear wall of sparkling glass blocks. To dampen the perceived loudness of the sound strength and to create an ergonomic environment for rehearsals, additional sound absorption- and sound scattering panels have been installed on the walls.

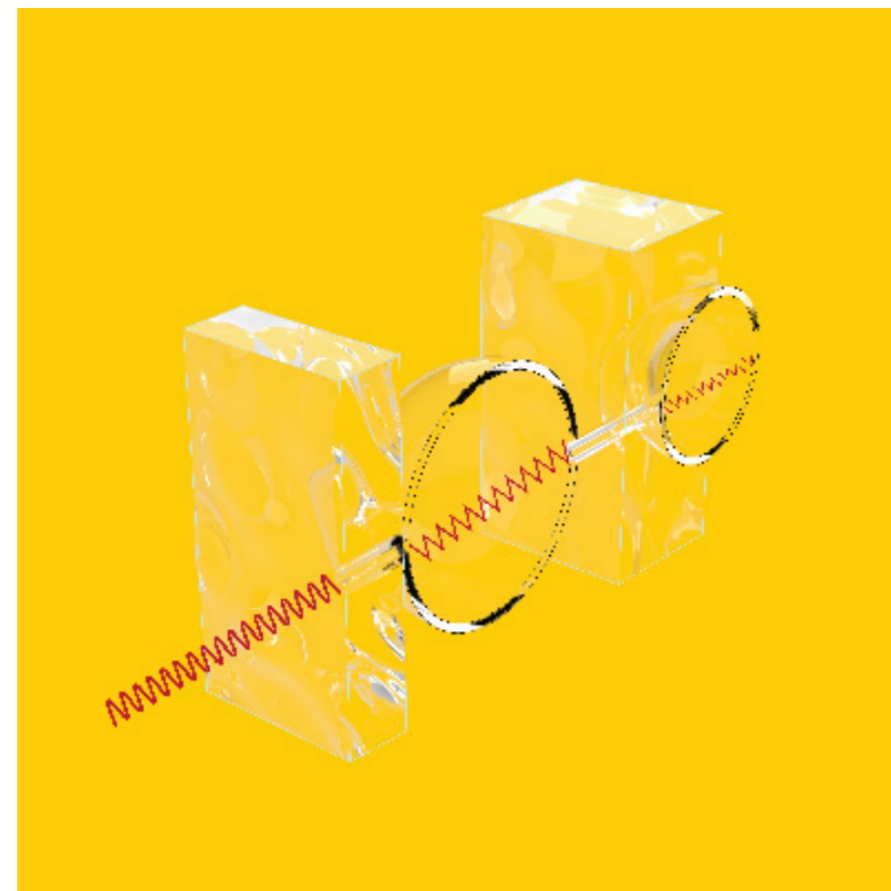


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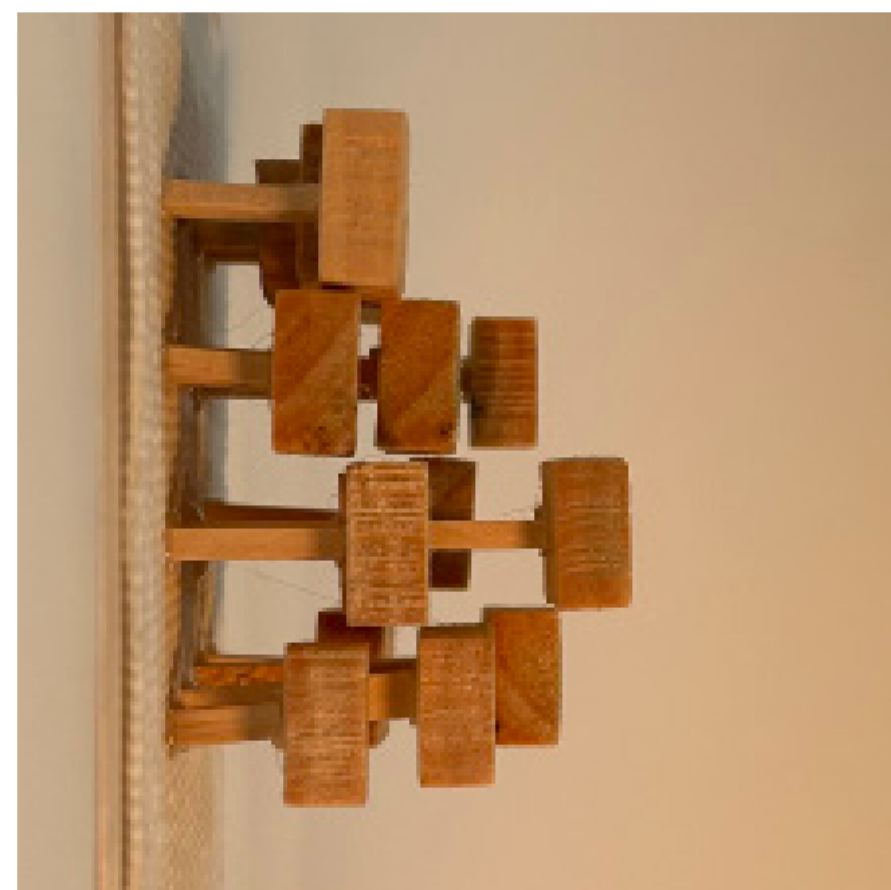


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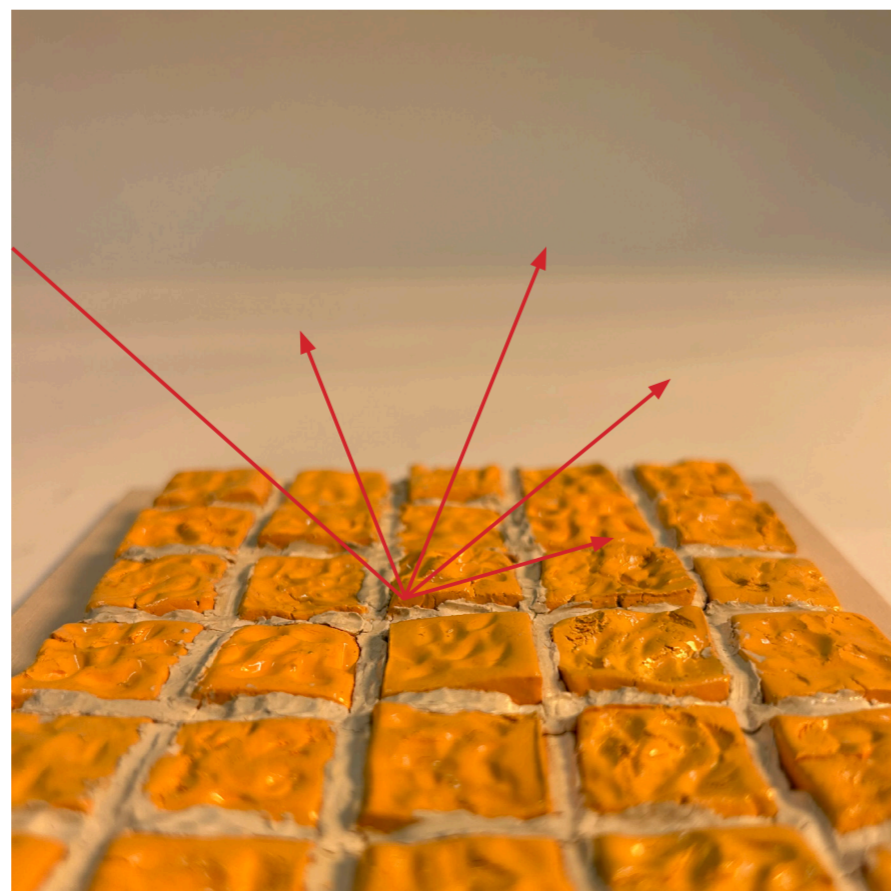


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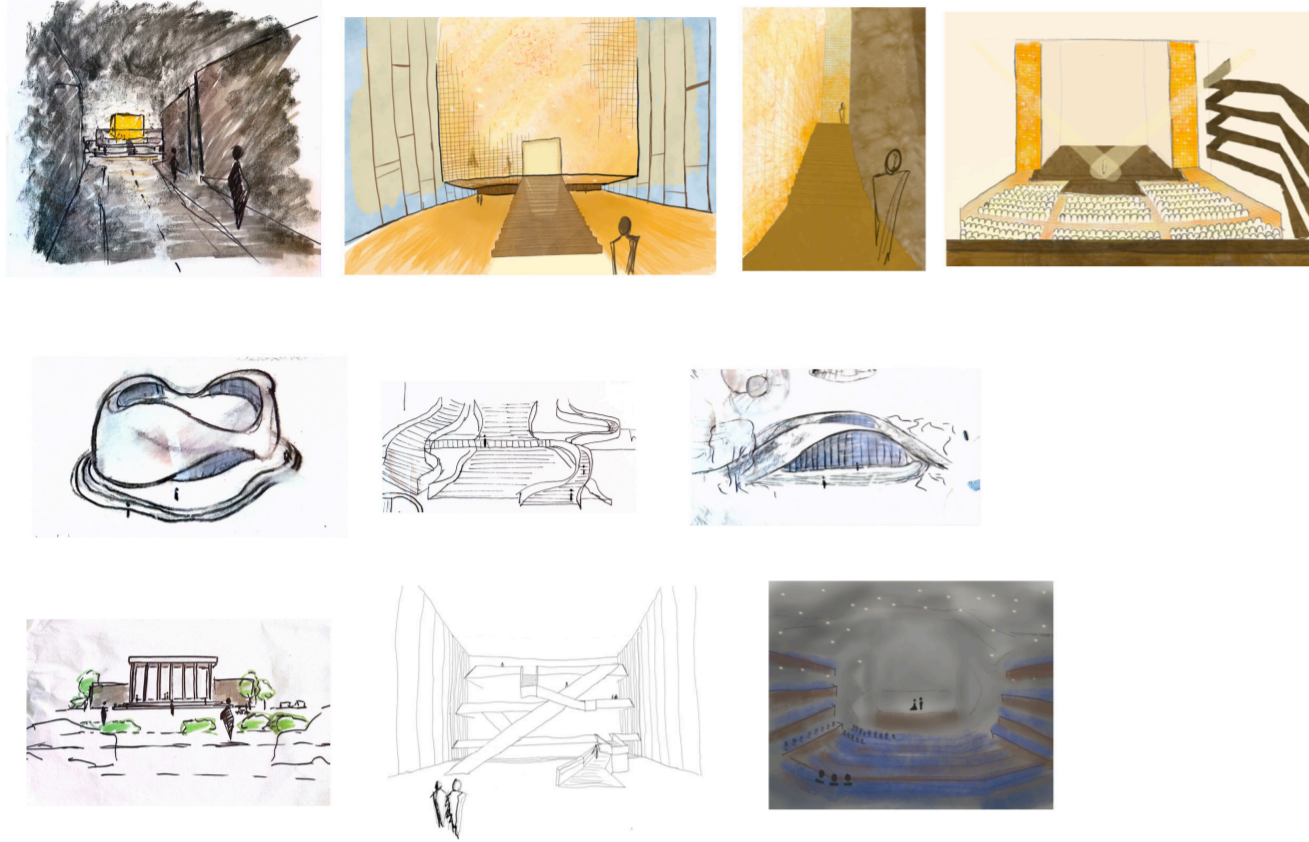
INTERIÖRPERSPEKTIV OPERASAL



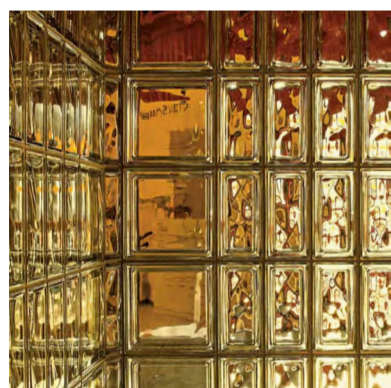
SEKTION

# PROCESSEN

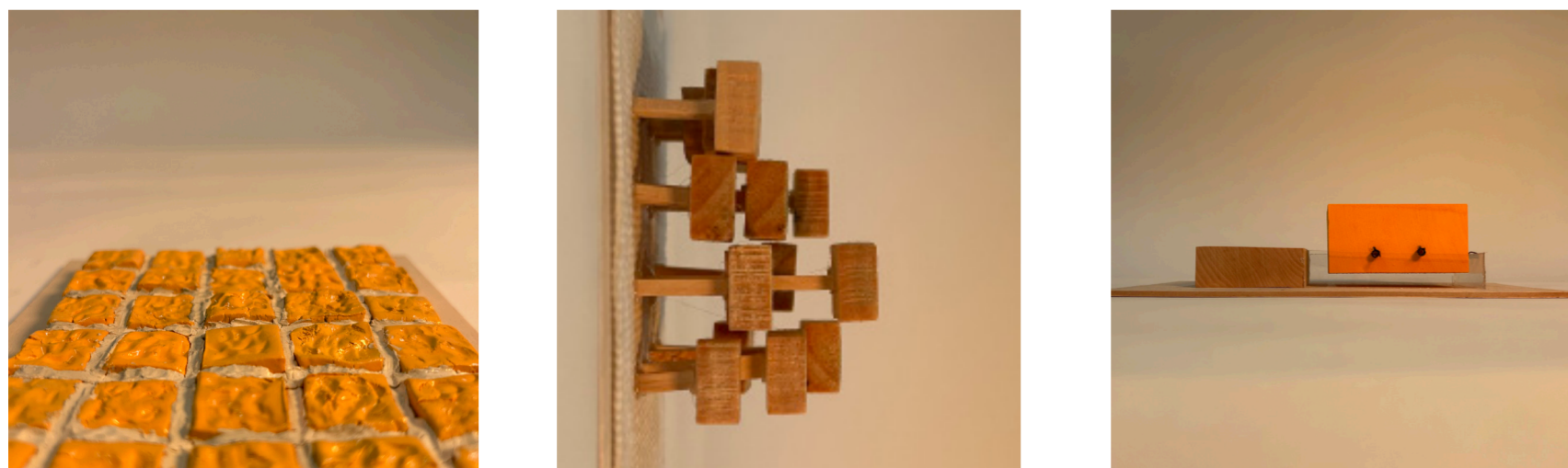
1. Vi letade inspiration, producerade många skisser, tog fram tre olika förslag



2. Vi valde vi konceptet GLAS i enighet med vår akustiker



3. Konceptmodell & akustiska prototyper



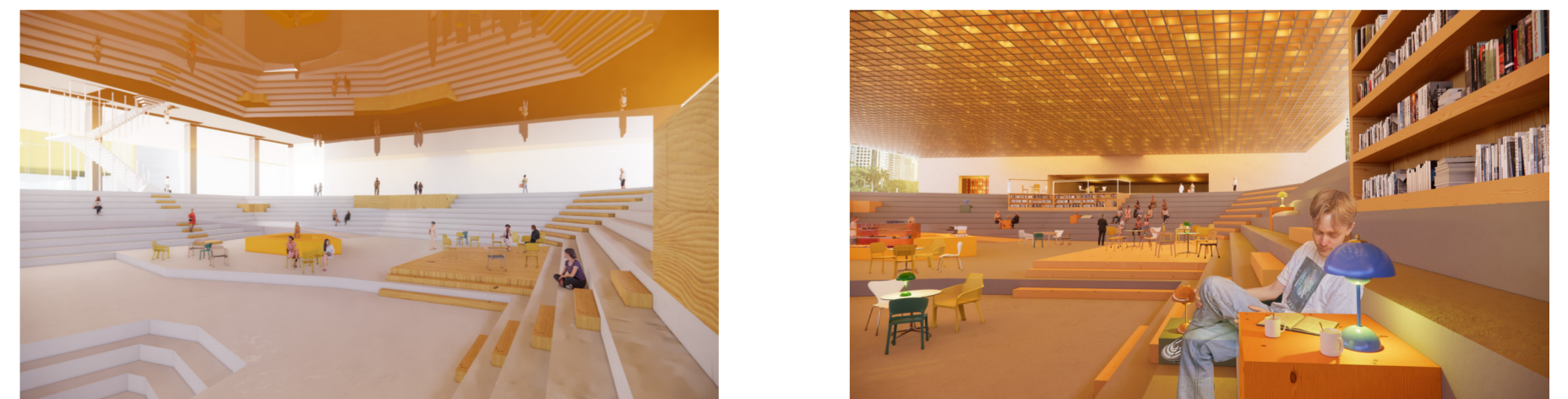
4. Besök på glasblocks-företag och eget besök på operan



5. Få allt att passa ihop, framför allt operhall och lobby. Pussel, fokus på lobby, planritning.



6. 3Dmodell i Rhino och renderingar i Enscape



## REFLEKTION DESIGNPROCESSEN

Genom kursens gång hade vi flera delmål och uppgifter som skulle genomföras på kort tid. Detta främjade enligt mig designprocessen på ett positivt sätt, då det bidrog till ett effektivt arbetssätt och en mer jämn arbetsbelastning över hela kursen.

Första veckan skulle ett koncept tas fram, något som vi nog inte då riktigt förstod skulle ligga till grund för hela projektet. Dock tror jag att det var en av anledningarna till att vi kom igång snabbt och sedan kunde använda all tid till att utveckla vårt koncept.

I vår grupp upplevdes detta arbetssätt som något som tog oss framåt, med konkreta inlämningar längs vägen. Inom gruppen har vi varit noga med principerna, det vill säga att jobba under vanlig arbetstid och sedan släppa projektet på helger och kvällar. Jag tror starkt på detta sättet att jobba, då det för min egen del är superviktigt för att kunna njuta av processen och ha en glädje i skapandet. Hade vi grottat ner oss i detaljer som inte var viktiga för helheten, eller velat för länge med beslut tror jag inte att vi hade uppnått samma resultat eller kunnat jobba lika effektivt när vi väl jobbade. Jag tänker också att det är som en prövning inför arbetslivet att hinna med det man ska på den tiden som är given.

Under arbetet använde vi oss av flera olika designprocesser, exempelvis fysiska modeller och prototyper, skisser för hand, filmer samt 3D-modellering. Jag upplever att en variation i metoder ofta leder till ett mer nyanserat och informerat resultat. Vissa kanske upplever det som flummigt att gå ut och skrika i skogen, men den bakomliggande tanken att skapa förståelse för ljud i olika miljöer är ju superviktig. Att börja ett projekt i den änden, att på ett lekfullt och kravlöst sätt samla kunskap genom olika kreativa metoder är något jag verkligen uppskattar. Jag upplever att det får tankarna att sättas igång samtidigt som man kliver in i projektet med förståelse för de viktiga delarna.

## REFLEKTION RESULTAT

Det slutgiltiga resultatet är jag mycket nöjd med. Det blev ett färgstarkt och utstickande projekt, med en svävande kub i glas, precis som vi ville. Att kolla på planscherna och känna att man är nöjd och gjort allt man kunnat är en så härlig känsla. Och det är ännu roligare när man också känner att vi har haft kul under processen.

Designmässigt är jag supernöjd. Den gula, glittrande operasalen i glas är min favorit i hela projektet och jag tror att det hade varit magiskt att sitta där inne. Som kritik fick vi bland annat att det kan vara ett svårt val att välja endast en färg i operasalen, eftersom den ska kunna anpassas efter vilken opera som spelas. Däremot tror jag att det går att lösa med hjälp av ljussättning och kanske tyg eller paneler som kan dras fram. Exempelvis är ju stolarna i Göteborgsoperan röda, men när jag var och såg musikalen Wicked där för ett tag sedan lyste grönt ljus över rummet när vi skulle gå in, och alla stolar och människor såg gröna ut.

Det som vårt projekt kanske faller mest på är konstruktionen. Vi visste med oss att det skulle bli svårt att utforma och presentera en lösning som faktiskt funkar i praktiken, men det var ett medvetet val att ändå fortsätta på vårt koncept med den svävande glaskuben.

## INFÖR FRAMTIDA ARBETEN

Detta projektet inspirerade mig på många sätt. Jag tyckte designprocessen var kul och tack vare att vi var en likasinnad grupp med liknande vision av att testa något som kändes kul och utvecklande för oss var det väldigt trevligt att arbeta med detta projektet. Jag tar i fortsättningen med mig den positiva stämningen och strävan efter att göra något riktigt bra med den tiden vi fick. Dessutom tar jag med mig koncept-tänket till framtida projekt. Jag har förstått fördelarna med att ha ett starkt koncept och att kunna utgå från det.