

BACHELOR PORTFOLIO  
TRI ANGLE OPERA

LINNEA BROSE

SPRING 2024

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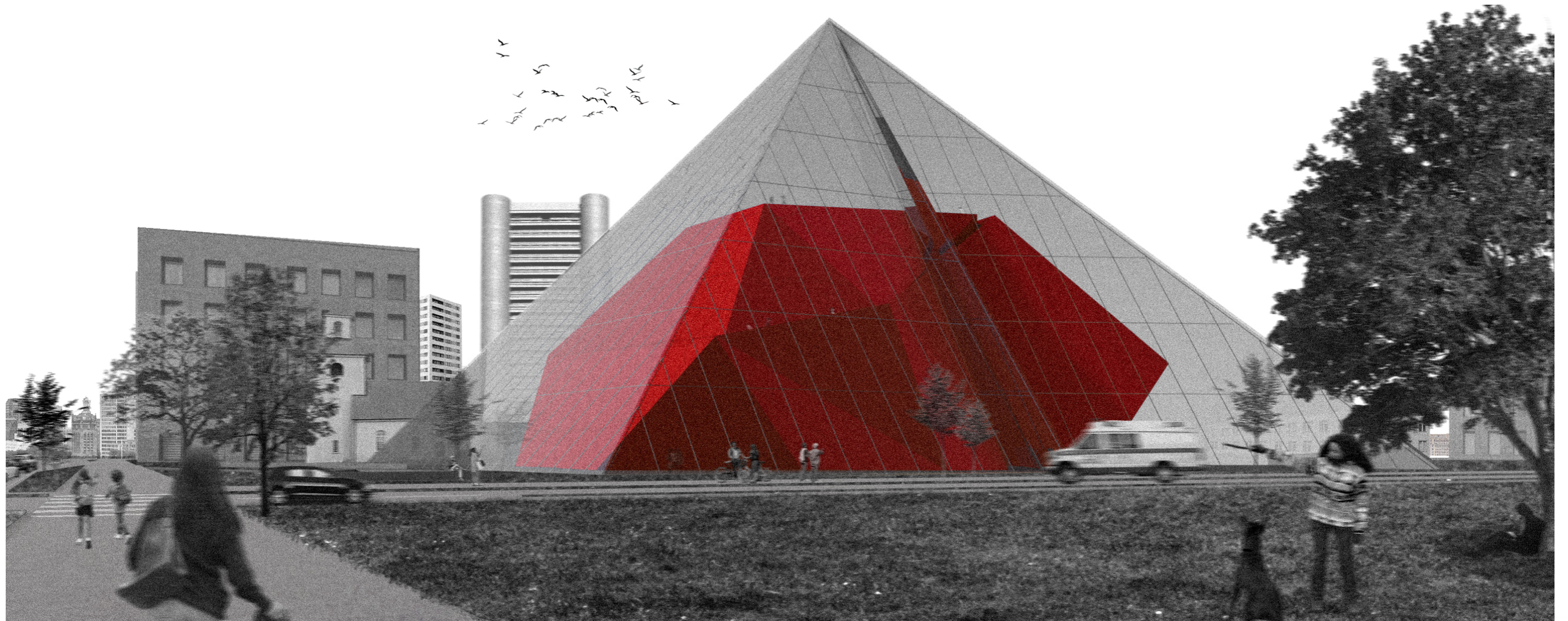
09 FUTURE

## #02 DESIGN SCENARIO

### GENERAL COMPETITION DESCRIPTION

*THE AIM OF THE STUDENT DESIGN COMPETITION WAS TO PRESENT A PROPOSAL FOR A NEW 1,200-SEAT PERFORMANCE HALL, PRIMARILY DESIGNED FOR OPERA, AT A COLLEGE WITH VERY STRONG MUSIC AND VOCAL PROGRAM. THE MAIN FUNCTION OF THE HALL IS TO SUPPORT THE OPERA PROGRAM, BUT SHOULD ALSO HOST SPEAKING EVENTS FEATURING THE SCHOOL'S PRESIDENT AND OTHER INVITED SPEAKERS. SUBMISSIONS MUST ADDRESS ROOM ACOUSTICS, SOUND ISOLATION, AND NOISE CONTROL TO MEET THE NEEDS OF THE OPERA HOUSE.*

*THE TASK WAS EXECUTED BY TWO ARCHITECTURAL- AND ENGINEERING STUDENTS AND ONE MASTER STUDENT FROM THE MSC SOUND AND VIBRATION PROGRAM.*



# #03 PROGRAM DETAILS

## ARCHITECTURAL PROGRAM

*IN THIS CHAPTER HOUSES THE ARCHITECTURAL PROGRAM STATEMENT FOR THE OPERA PERFORMANCE FACILITY, OUTLINING THE BUILDING SPECIFICATIONS DESIRED BY THE COLLEGE FOR THIS DESIGN COMPETITION. THE DESIGNATED SITE MEASURES 110 BY 90 METERS AND SHOULD BE SITUATED IN THE DOWNTOWN AREA OF A CHOSEN CITY, SURROUNDED BY BUSY ROADS AND SUBJECT TO NOISE FROM EMERGENCY TRAFFIC.*

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## FLOOR AND SECTION PROGRAM

FIRST AND SECOND FLOOR SHOULD HOUSE LOBBY, OPERA HOUSE, REHEARSAL HALL, SCENESHOP, LOADING DOCK, BACK OF HOUSE(DRESSING ROOMS, RESTROOMS, GREENROOM, STORAGE), FRONT OF HOUSE(OFFICES, RESTROOMS, STORAGE). THIRD FLOOR SHOULD HOUSE UPPER PART OF LOBBY AND OPERA HALL, BUT ALSO MECHANICAL EQUIPMENT ROOM(MER & MEPFIT: PLUMBING, ELECTRICAL, IT, FIRE PROTECTION, AMP ROOM).

THE MOST IMPORTANT REQUIREMENTS WERE TO HAVE THE OPERA CENTERED IN THE BUILDING BODY AND IT SHOULD BE SHARING A WALL WITH THE REHEARSAL ROOM. THE MECHANICAL EQUIPMENT ROOM SHOULD BE PLACED OVER REHEARSAL HALL AND ALSO SHARE A WALL WITH THE OPERA HOUSE.

## OPERA THEATRE

VARIABLE ACOUSTICS, SINCE THE HALL IS TO BE USED OCCASIONALLY FOR ORCHESTRA AND CHORAL STAGE PERFORMANCES, A PORTABLE STAGE ENCLOSURE (ORCHESTRA SHELL) IS REQUIRED. ALSO, CONSIDERATION SHALL BE GIVEN TO PROVIDING VARIABLE SOUND ABSORPTION FOR THE HALL AND FOR THE ORCHESTRA PIT. THERE MUST BE A STAGE CROSSOVER CORRIDOR FOR MUSICIANS AND TECHNICAL STAFF DURING THE PERFORMANCE, ESPECIALLY FOR USE BY STAFF AND PERFORMERS WITH MOBILITY ASSISTANCE REQUIREMENTS.

## STAGE

STAGE, EASY ACCESS TO TRUCK DOCK FOR SCENERY AND OTHER MATERIAL LOAD IN AND OUT.

560 M<sup>2</sup>, DEPTH 18 M

STAGE PROSCENIUM

15X9 M

STAGE HOUSE

HIGHT 27M

ORCHESTRA PIT

25 TO 80 MEMBERS

## AUDIENCE

SEATS

1,200

40% OF THE SEATING IS TO BE DISTRIBUTED IN TWO LEVELS OF SIDE AND REAR BALCONIES.

ORCHESTRA SEATING

TRADITIONAL

## OPERA AUDIO

OPERA, CLASSIC REPERTOIRE

NON AMPLIFIED

MODERN OPERA

LIGHTLY AMPLIFIED

SPEAKING EVENTS

AMPLIFIED

LIGHTING, STAGE MANAGER CONTROL ROOM AND FOLLOW SPOT BOTH.

50 M<sup>2</sup>

IN-HOUSE AUDIO MIX POSITION

3X9 M, IN PARQUET

## REHEARSAL ROOM

OPERA/ORCHESTRA REHEARSAL

80 MEMBERS

## DRESSING ROOMS

TWO CHORUS DRESSING ROOMS

Á 56 M<sup>2</sup>

EIGHT SOLO DRESSING ROOMS

Á 6,5 M<sup>2</sup>

## GREEN ROOM

ONE MULTIPURPOSE GREEN ROOM, THIS ROOM MAY BE USED OCCASIONALLY FOR MEETINGS AND PERHAPS AS A MUSIC REHEARSAL ROOM.

46,5 M<sup>2</sup>

## OFFICE SPACE

THREE OFFICES FOR THE FACILITY'S TECHNICAL STAFF

Á 2 M<sup>2</sup>

TWO OFFICES FOR THE RESIDENT COMPANY'S STAFF

Á 10 M<sup>2</sup>

## MEPFIT & MER

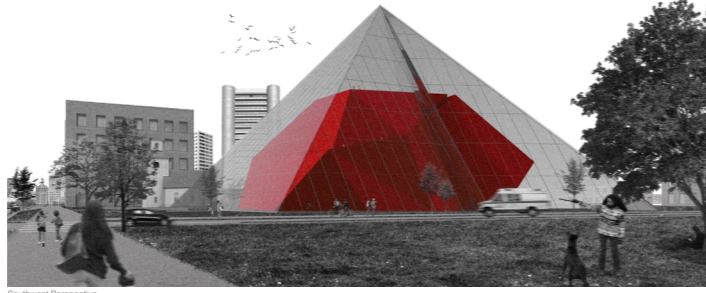
WILL PRIMARILY HOUSE TWO AIR HANDLERS AND A SCROLL TYPE CHILLER TO SERVE THE BACKSTAGE SUPPORT AND REHEARSAL SPACES.

75 M<sup>2</sup>


# #04 COMPETITION POSTERS

POSTERS FOR CRITIQUE

## TRI ANGLE



Southwest Perspective



▲ Yale University, 1300m  
 ■ Residential Area, 500m  
 ▲ Central Station, 500m  
 SITE PLAN 1:3000

### OPEN FOR ALL

Students can explore room acoustics on their performances through adaptable acoustic settings tailored to various activities. Accessible to the public, the venue offers space for all to immerse in music, architecture, and the view from the Red Plateau, overlooking New Haven. The building features two distinct components: a glass enclosure shields against external noise and weather, while a red volume houses the opera's functions. This bold red hue defines both the interior and exterior, blending classical tradition with contemporary design.

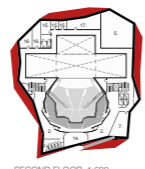
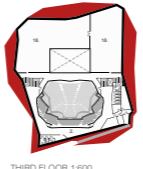
### OPERA OF YALE

The TriAngle Opera at Yale University is not just a training ground for opera students; it is a purpose-built facility that enhances the acoustic experience for performers and audiences.

Situated on the outskirts of Yale in New Haven, follow the city's main flow from the station to the university, it bridges social divides, engaging students and residents alike in music and architecture. By filling a void in a city without its own opera house, it becomes a cultural hub, fostering unity among diverse audiences and visitors.

### FUNCTIONS & NOISE CRITERIA

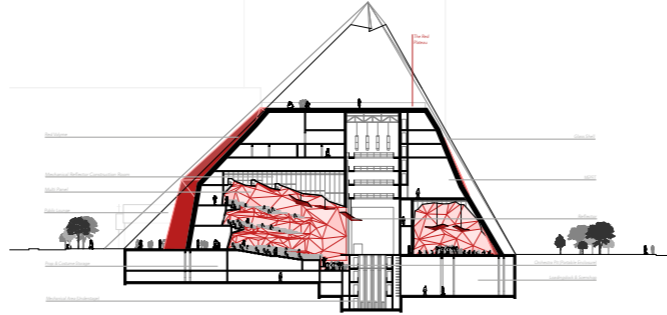
- ▲ 1. Public Lounge
- ▲ 2. Inner Lobby
- ▲ 3. Stairs to Red Plateau
- ▲ 4. Opera Hall
- ▲ 5. Rehearsal Hall
- ▲ 6. Wardrobe
- ▲ 7. Storage
- ▲ 8. Solo Dressingroom
- ▲ 9. Choral Dressingroom
- ▲ 10. Green Room
- ▲ 11. Scene Shop
- ▲ 12. Loading Dock entrance
- ▲ 13. Audio Mix Position
- ▲ 14. Follow Spot Booth, Light & Stage Manager Control Room
- ▲ 15. Tech Office
- ▲ 16. Resident Office
- ▲ 17. MER
- ▲ 18. MEPFIT

▲ NC 40 ▲ NC 30 ▲ NC 25 ▲ NC 15

FIRST FLOOR 1:600

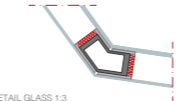
### SECTION A-A 1:300



#### SOUND ISOLATION

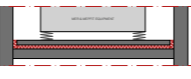
The shell features double glazing with varying glass thicknesses spaced 7cm apart, lined with absorbents to prevent sound and vibration transmission through the frames. Suction cups secure the glass panels to a steel frame.

The red volume's wall is a 1m wide double-layered structure clad with sound-absorbing material and perforated slots for a tranquil lobby/lounge. This heavy design counters structure-borne vibration transmission effectively.



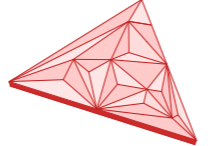
DETAIL GLASS 1:3

Sound and vibrations from MER/MEPFIT are eliminated from penetrating the opera and rehearsal room by steel spring isolators beneath each technical unit and a floating absorption floor.



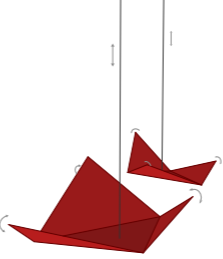
#### MULTI PANELS

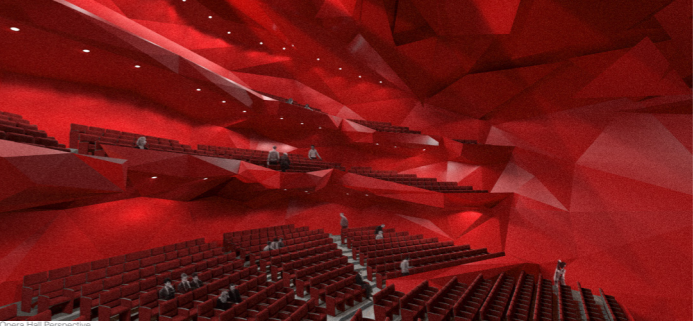
The auditorium will feature wooden diffuse panels on the ceiling and walls, designed in triangular modules and therefore easily angled to direct the sound evenly to every seat. The various-sized surfaces and angles diffuse the sound to ensure consistent acoustics. The students can replace certain panel surfaces with absorbers or resonators as needed to adjust for desired acoustic effects. This adaptability is further enhanced by the use of recycled materials, harmonizing sustainability with exceptional auditory performance.



#### REFLECTORS

The triangular reflectors, installed in the ceiling, can fold and adjust vertically. This allows for controlling sound reflection: lowering and unfolding more reflective surfaces increases reflection, while folding them in reduces it. As these reflectors form the inner ceiling, adjusting the room volume affects the desired reverberation time.





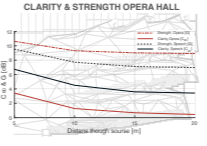
Opera Hall Perspective

### GREAT SOUND FOR ALL

In the opera hall, with capacity of 1200 seats and 80 musicians, the triangular theme design extends. The asymmetrical orientation of the walls prevent flutter echo and the straight surfaces avert sound focusing. The balconies and parquet, following the triangular theme and with traditional seating, are designed to optimize sightlines and acoustics in all areas. The walls and roof can both serve as diffusers and reflectors for early reflections. This design aligns with our concept while facilitating the angles necessary for precise sound imaging, including clarity, ITDG, dynamic range, direct sound, and well distributed first lateral and vertical reflections.

### ABSORBING

Fabric-covered chairs and absorbing materials behind the multi panels enable a  $RT_{60}$  of 1.6 s for opera performances.



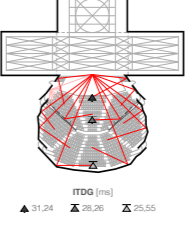
CLARITY & STRENGTH OPERA HALL

### VARIABLE ACOUSTICS

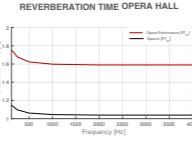
The adjustable ceiling enables optimization of reverberation time and room acoustics for different occasions or to be used for educational exploration by students. By lowering or rising the roof it creates a  $RT_{60}$  spectrum of 1.1 up to 1.7 s, including optimized values for opera 1.6 s and speech 1.1 s.

### REHEARSAL HALL

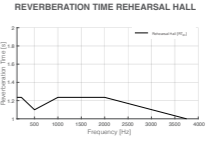
With a volume of approximately 1800 m<sup>3</sup> and capacity up to 80 musicians, the rehearsal room incorporates the same panels and reflectors as the opera hall. These features, combined with the smaller volume, enable lower reverberation time, enhanced clarity, and reduced gain, ensuring ideal acoustic conditions for rehearsals. We attain an average  $RT_{60}$  of 1.1 s, a gain (G) ranging from 14 to 13 decibels, and clarity ( $C_{80}$ ) between 3 to 2 decibels.



ITDG [ms]  
 ▲ 31.24 ▲ 28.26 ▲ 25.55



REVERBERATION TIME OPERA HALL



REVERBERATION TIME REHEARSAL HALL

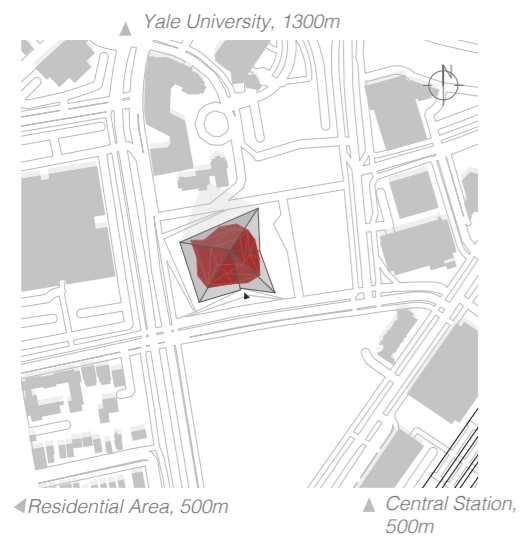
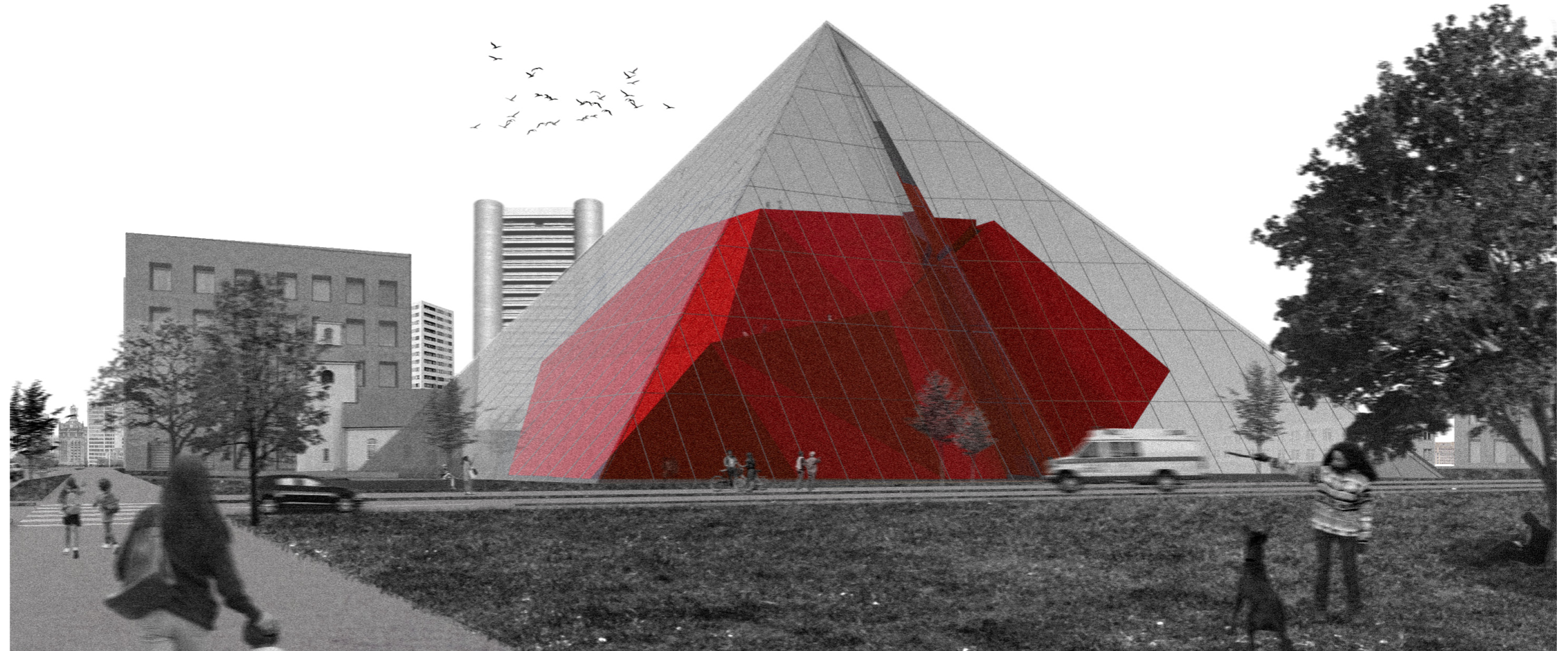
# #05 MATERIAL FROM POSTERS

PROPOSAL, TEXT AND MATERIAL FROM POSTERS : CREATED BY LINNEA BROSE AND EBBA GREGEFALK

THE TRIANGLE OPERA AT YALE UNIVERSITY IS NOT JUST A TRAINING GROUND FOR OPERA STUDENTS; IT IS A PURPOSE-BUILT FACILITY THAT ENHANCES THE ACOUSTIC EXPERIENCE FOR PERFORMERS AND AUDIENCES. SITUATED ON THE OUTSKIRTS OF YALE IN NEW HAVEN, FOLLOW THE CITY'S MAIN FLOW FROM THE STATION TO THE UNIVERSITY, IT BRIDGES SOCIAL DIVIDES, ENGAGING STUDENTS AND RESIDENTS ALIKE IN MUSIC AND ARCHITECTURE. BY FILLING A VOID IN A CITY WITHOUT ITS OWN OPERA HOUSE, IT BECOMES A CULTURAL HUB, FOSTERING UNITY AMONG DIVERSE AUDIENCES AND VISITORS.

## OPEN FOR ALL

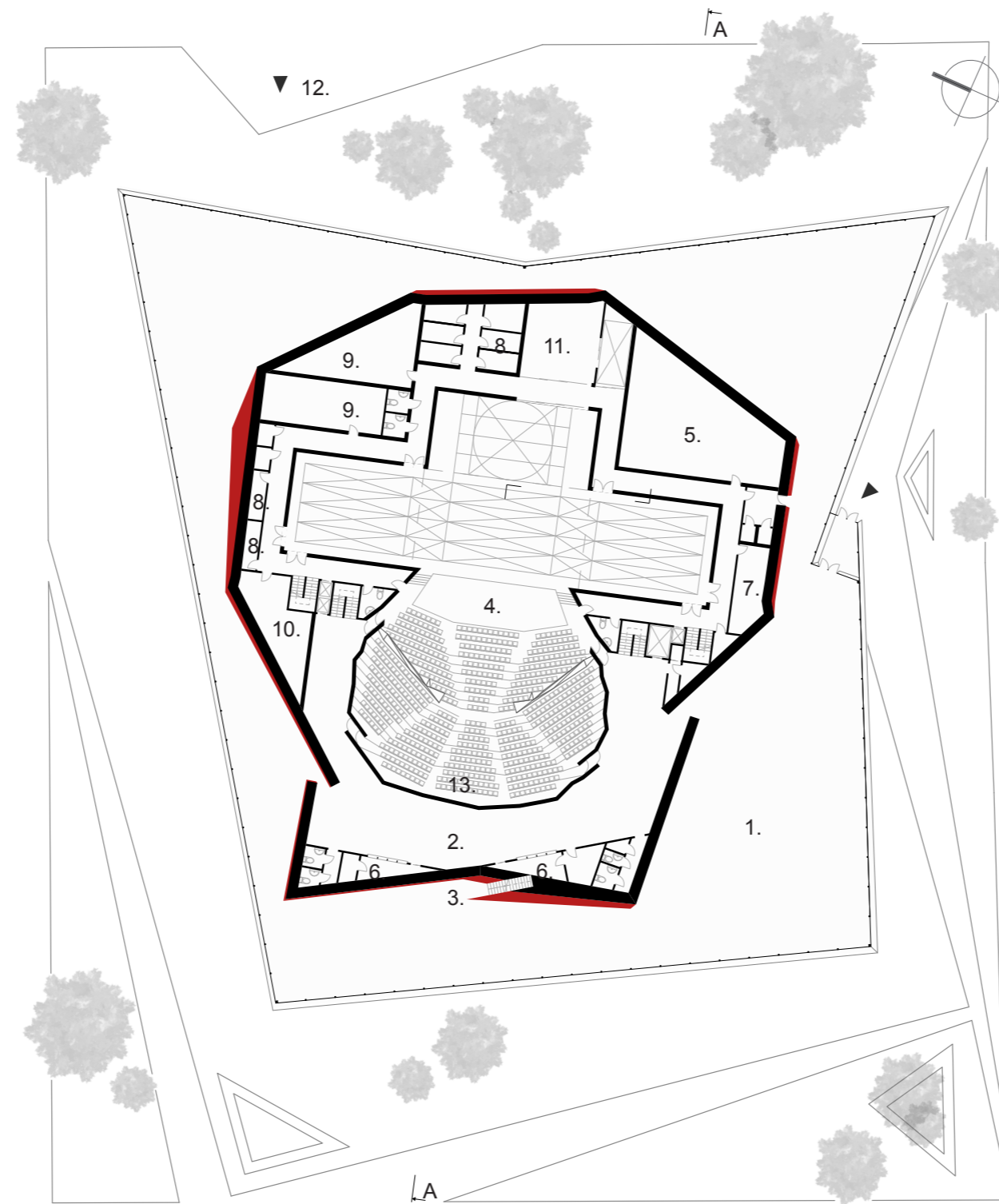
STUDENTS CAN EXPLORE ROOM ACOUSTICS ON THEIR PERFORMANCES THROUGH ADAPTABLE ACOUSTIC SETTINGS TAILORED TO VARIOUS ACTIVITIES. ACCESSIBLE TO THE PUBLIC, THE VENUE OFFERS SPACE FOR ALL TO IMMERSE IN MUSIC, ARCHITECTURE, AND THE VIEW FROM THE RED PLATEAU, OVERLOOKING NEW HAVEN. THE BUILDING FEATURES TWO DISTINCT COMPONENTS: A GLASS ENCLOSURE SHIELDS AGAINST EXTERNAL NOISE AND WEATHER, WHILE A RED VOLUME HOUSES THE OPERA'S FUNCTIONS. THIS BOLD RED HUE DEFINES BOTH THE INTERIOR AND EXTERIOR, BLENDING CLASSICAL TRADITION WITH CONTEMPORARY DESIGN.



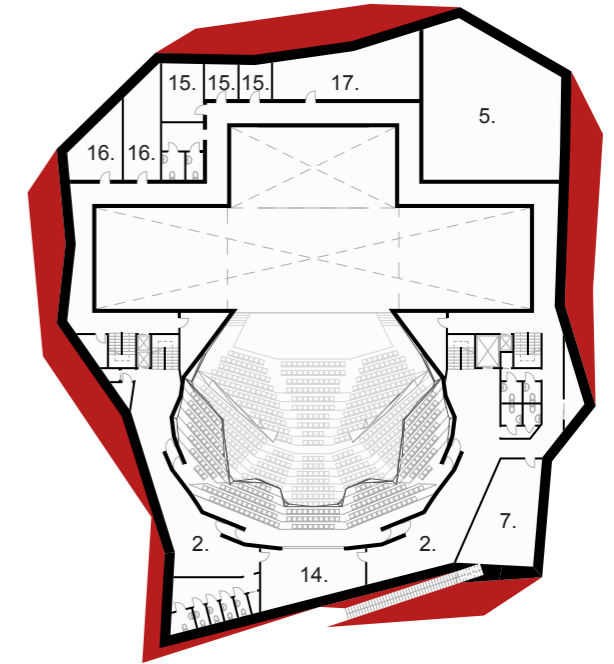
**FUNCTIONS & NOISECRITERIA**

- ▲ 1. PUBLIC LOUNGE
- △ 2. INNER LOBBY
- 3. STAIRS TO RED PLATAU
- △ 4. OPERA HALL
- △ 5. REHEARSAL HALL
- 6. WARDROBE
- 7. STORAGE
- 8. SOLO DRESSINGROOM
- 9. CHORAL DRESSINGROOM
- 10. GREEN ROOM
- 11. SCENE SHOP
- 12. LOADING DOCK ENTRANCÉ
- 13. AUDIO MIX POSITION
- 14. FOLLOW SPOT BOTH, LIGHT & STAGE MANAGER CONTROL ROOM
- ▲ 15. TECH OFFICE
- ▲ 16. RESIDENT OFFICE
- 17. MER
- 18. MEPFIT

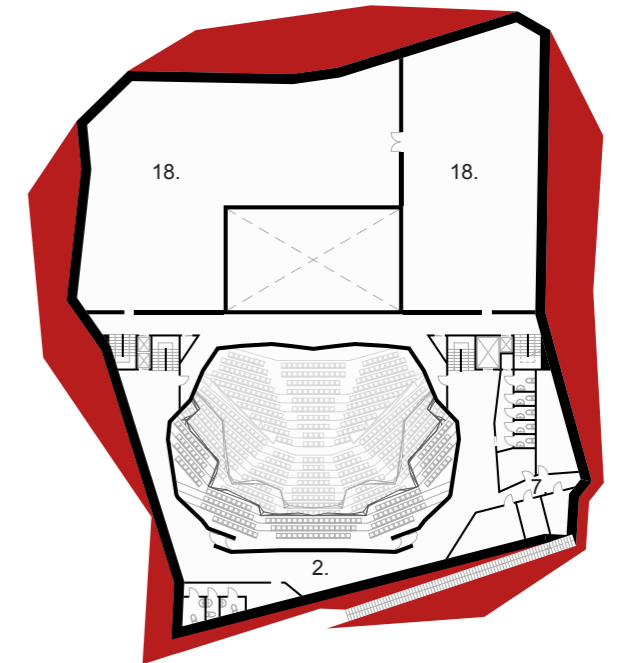
- ▲ NC 40
- ▲ NC 30
- △ NC 25
- △ NC 15



FIRST FLOOR



SECOND FLOOR

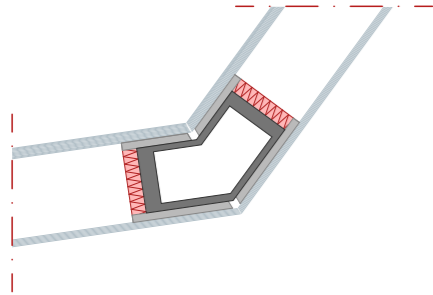


THIRD FLOOR

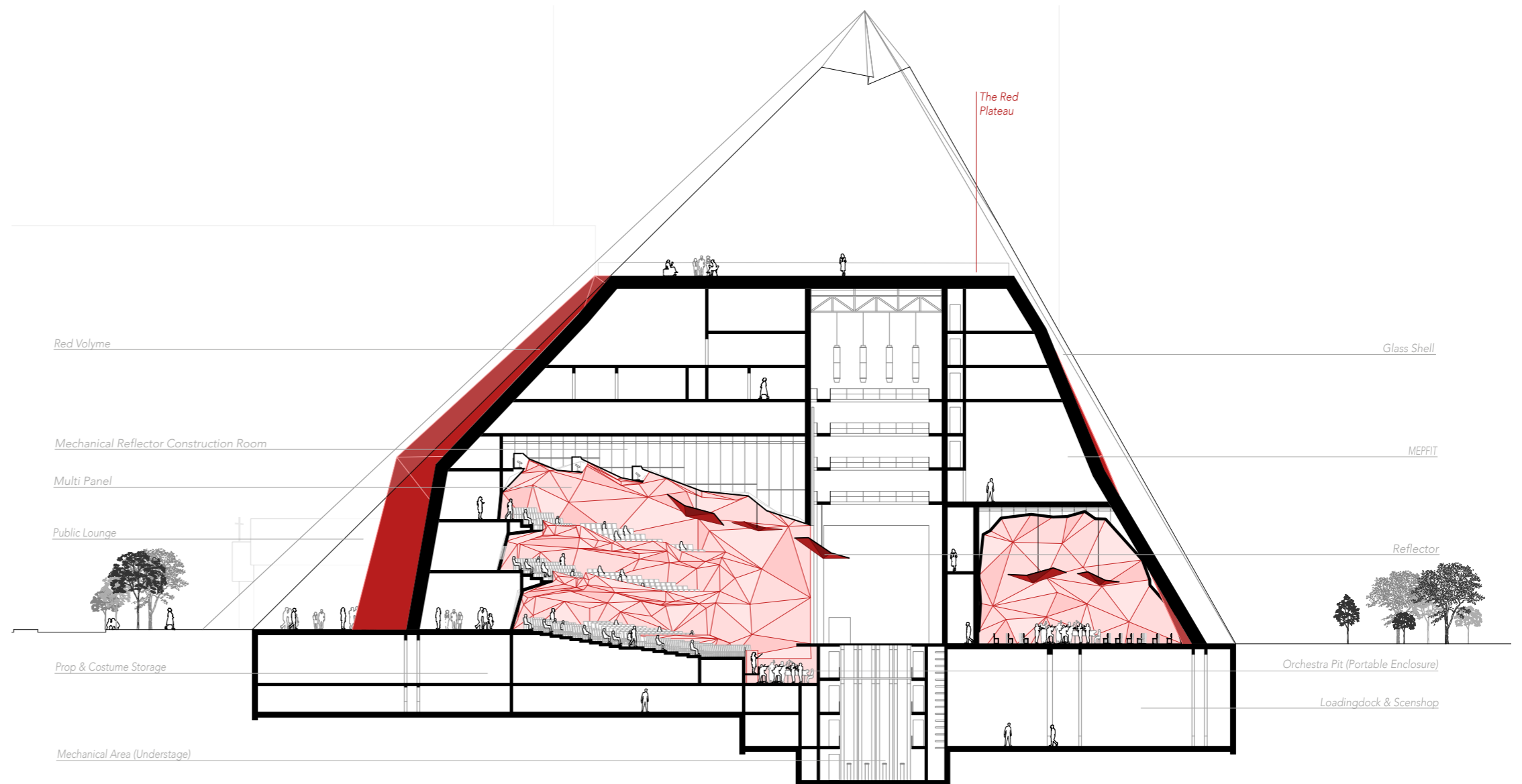
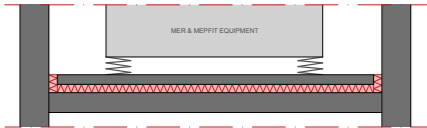
## SECTION AND DETAILS

### SOUND ISOLATION

THE SHELL FEATURES DOUBLE GLAZING WITH VARYING GLASS THICKNESSES SPACED 7CM APART, LINED WITH ABSORBENTS TO PREVENT SOUND AND VIBRATION TRANSMISSION THROUGH THE FRAMES. SUCTION CUPS SECURE THE GLASS PANELS TO A STEEL FRAME. THE RED VOLUME'S WALL IS A 1M WIDE DOUBLE-LAYERED STRUCTURE CLAD WITH SOUND-ABSORBING MATERIAL AND PERFORATED SLOTS FOR A TRANQUIL LOBBY/ LOUNGE. THIS HEAVY DESIGN COUNTERS STRUCTURE BORNE VIBRATION TRANSMISSION EFFECTIVELY.



SOUND AND VIBRATIONS FROM MER/MEPFIT ARE ELIMINATED FROM PENETRATING THE OPERA AND REHEARSAL ROOM BY STEEL SPRING ISOLATORS BENEATH EACH TECHNICAL UNIT AND A FLOATING ABSORPTION FLOOR.



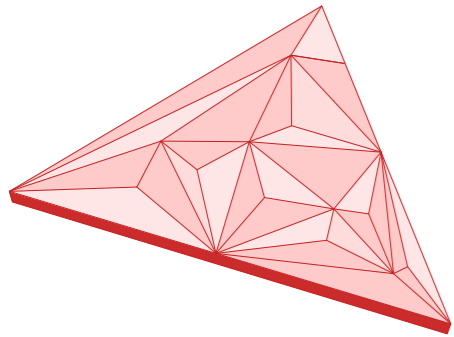
## ACOUSTICAL PROTOTYPES

### MULTIPANELS

THE AUDITORIUM WILL FEATURE WOODEN DIFFUSE PANELS ON THE CEILING AND WALLS, DESIGNED IN TRIANGULAR MODULES AND THEREFORE EASILY ANGLED TO DIRECT THE SOUND EVENLY TO EVERY SEAT. THE VARIOUS-SIZED SURFACES AND ANGLES DIFFUSE THE SOUND TO ENSURE CONSISTENT ACOUSTICS. THE STUDENTS CAN REPLACE CERTAIN PANEL SURFACES WITH ABSORBERS OR RESONATORS AS NEEDED TO ADJUST FOR DESIRED ACOUSTIC EFFECTS. THIS ADAPTABILITY IS FURTHER ENHANCED BY THE USE OF RECYCLED MATERIALS, HARMONIZING SUSTAINABILITY WITH EXCEPTIONAL AUDITORY PERFORMANCE.

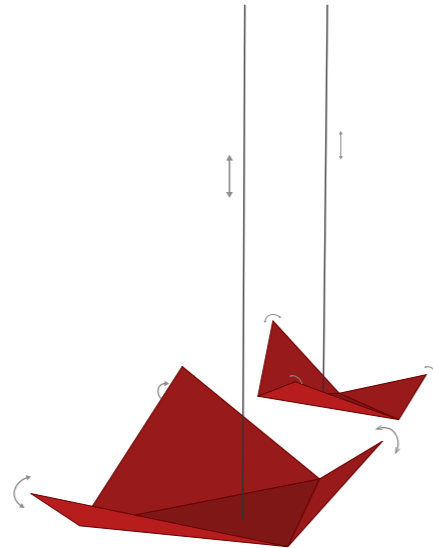
### ABSORPTION

THE ABSORBING SURFACES BEHIND THE SURFACE MATERIAL AND FABRIC-COVERED CHAIRS ENABLE A  $RT_{60}$  OF 1.6 S FOR OPERA PERFORMANCES.



### REFLECTORS

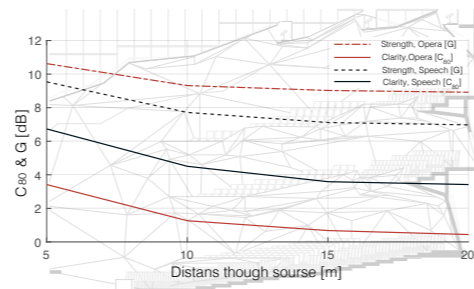
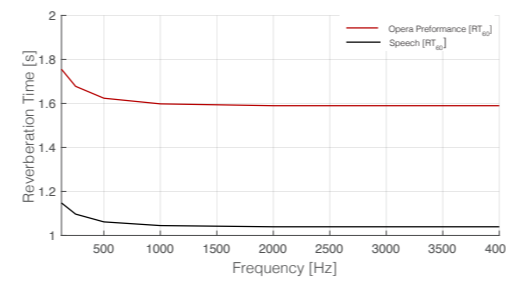
THE TRIANGULAR REFLECTORS, INSTALLED IN THE CEILING, CAN FOLD AND ADJUST VERTICALLY. THIS ALLOWS FOR CONTROLLING SOUND REFLECTION: LOWERING AND UNFOLDING MORE REFLECTIVE SURFACES INCREASES REFLECTION, WHILE FOLDING THEM IN REDUCES IT. AS THESE REFLECTORS FORM THE INNER CEILING, ADJUSTING THE ROOM VOLUME AFFECTS THE DESIRED REVERBERATION TIME.



### VARIABLE ACOUSTICS

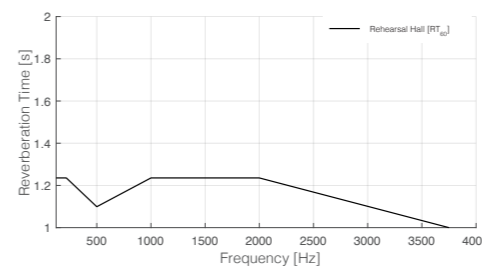
THE ADJUSTABLE CEILING ENABLES OPTIMIZATION OF REVERBERATION TIME AND ROOM ACOUSTICS FOR DIFFERENT OCCASIONS OR TO BE USED FOR EDUCATIONAL EXPLORATION BY STUDENTS. BY LOWERING OR RISING THE ROOF IT CREATES A  $RT_{60}$  SPECTRUM OF 1.1 UP TO 1.7 S, INCLUDING OPTIMIZED VALUES FOR OPERA 1.6 S AND SPEECH 1.1 S.

THE GRAPH BELOW SHOWS THE REVERBERATION TIME, CLARITY AND STRENGTH IN THE OPERA HOUSE FOR AN OPERA PERFORMANCE AND FOR THE SPEECH SCENARIO.



### REHEARSAL ROOM

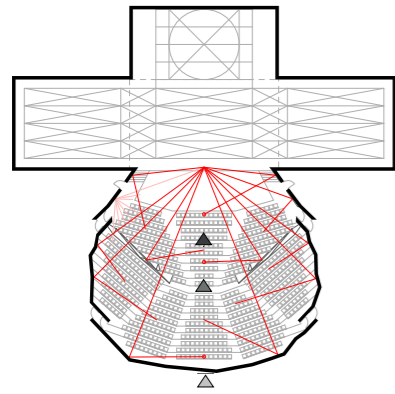
WITH A VOLUME OF APPROXIMATELY 1800 M<sup>3</sup> AND CAPACITY UP TO 80 MUSICIANS, THE REHEARSAL ROOM INCORPORATES THE SAME PANELS AND REFLECTORS AS THE OPERA HALL. THESE FEATURES, COMBINED WITH THE SMALLER VOLUME, ENABLE LOWER REVERBERATION TIME, ENHANCED CLARITY, AND REDUCED GAIN, ENSURING IDEAL ACOUSTIC CONDITIONS FOR REHEARSALS. WE ATTAIN AN AVERAGE  $RT_{60}$  OF 1.1 S, A GAIN (G) RANGING FROM 14 TO 13 DECIBELS, AND CLARITY ( $C_{80}$ ) BETWEEN 3 TO 2 DECIBELS.



## INSIDE PERSPECTIVE AND EARLY REFLECTIONS

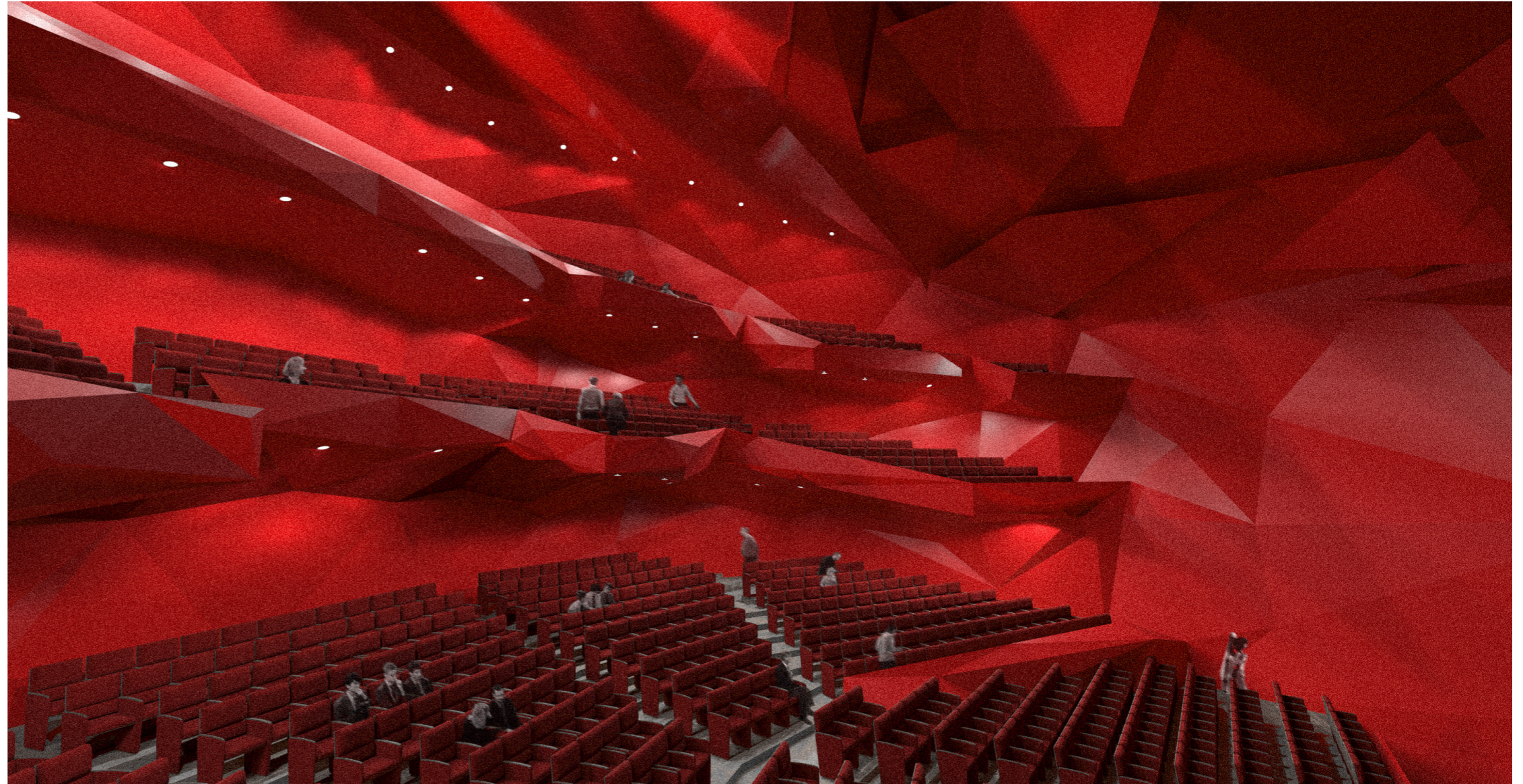
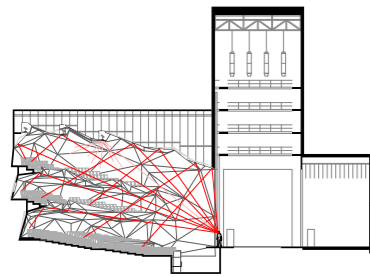
### GREAT SOUND FOR ALL

IN THE OPERA HALL, WITH CAPACITY OF 1200 SEATS AND 80 MUSICIANS, THE TRIANGULAR THEME DESIGN EXTENDS. THE ASYMMETRICAL ORIENTATION OF THE WALLS PREVENT FLUTTER ECHO AND THE STRAIGHT FACES AVERT SOUND FOCUSING. THE BALCONIES AND PARQUET, FOLLOWING THE TRIANGULAR THEME AND WITH TRADITIONAL SEATING, ARE DESIGNED TO OPTIMIZE SIGHTLINES AND ACOUSTICS IN ALL AREAS. THE WALLS AND ROOF CAN BOTH SERVE AS DIFFUSERS AND REFLECTORS FOR EARLY REFLECTIONS. THIS DESIGN ALIGNS WITH OUR CONCEPT WHILE FACILITATING THE ANGLES NECESSARY FOR PRECISE SOUND IMAGING, INCLUDING CLARITY, ITDG, DYNAMIC RANGE, DIRECT SOUND, AND WELL DISTRIBUTED FIRST LATERAL AND VERTICAL REFLECTIONS.



ITDG [ms]

▲ 31,24   ▲ 28,26   ▲ 25,55



# #06 DESIGN PROCESS

## PROCESS THOUGHTOUT PROJECT

THIS CHAPTER PRESENTS THE DESIGN PROCESS, HIGHLIGHTING SEVERAL CRUCIAL DECISIONS. THE ALTERNATIVE DESIGN PROPOSALS WE CONSIDERED ARE ALSO DESCRIBED AND DISCUSSED, EXPLAINING THE REASONS BEHIND OUR FINAL CHOICES.

THE FIRST STEP OF THE PROJECT WAS TO CREATE ARCHITECTURAL CONCEPTS. WE DEVELOPED SEVERAL PROPOSALS, SOME OF WHICH ARE SHOWN TO THE LEFT. AT THIS STAGE, WE DREW SPONTANEOUSLY, INSPIRED BY VARIOUS IMAGES WITH SHAPES AND SHADOW PLAY. ONE OF THE PROPOSALS, WHICH WAS PARTICULARLY SIGNIFICANT, HAD A CONNECTION TO A HAIKU POEM FROM A PREVIOUS COURSE WHERE WE FOLDED PAPER TO MATCH THE POEM.

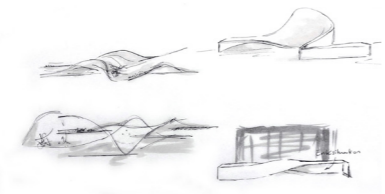
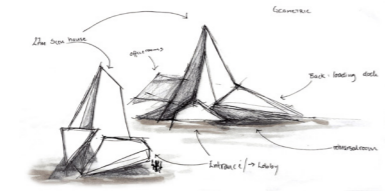
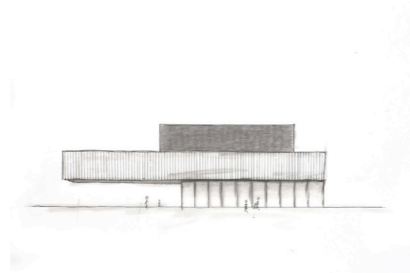
### FIRST THREE CONCEPTS

THE THREE CONCEPTS WERE NAMED FLOWING FORMS, BALANCE, AND HAIKU. WHEN IT WAS TIME TO CHOOSE WHICH CONCEPT TO DEVELOP FURTHER, WE REALIZED THAT WE HAD NEVER DESIGNED ANYTHING THAT DEVIATED FROM TRADITIONAL ARCHITECTURE. WE WANTED TO CHALLENGE OURSELVES AND THEREFORE CHOSE THE HAIKU CONCEPT. THROUGHOUT THE PROJECT, WE REMINDED OURSELVES TO HAVE FUN AND PUSH OUR DESIGN BOUNDARIES.

### BASE CONCEPT AND THE SHELL

EARLY ON, WE DECIDED TO USE TRIANGLES AS BASE ELEMENTS, INSPIRED BY THE HAIKU MODEL'S FORM. WE TESTED VARIOUS SHAPES BY FOLDING PAPER AND WORKING IN RHINO WITH TRIANGULAR SURFACES. IT WAS CHALLENGING TO FIND A FORM THAT FELT NATURAL AND SUITABLE FOR A LARGE SCALE, BUT EVENTUALLY, WE FOUND THREE VOLUMES THAT WERE APPEALING AND PLEASING TO THE EYE.

THE MODELS HAD A PYRAMID SHAPE WITH A BASE OF FIVE CORNERS, FEATURING BOTH OBTUSE AND ACUTE ANGLES. AFTER DISCUSSIONS WITH THE REFERENCE



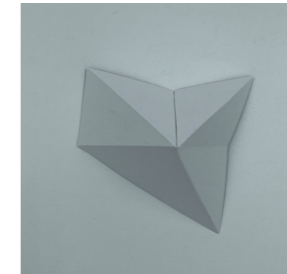
GROUP, WE CHOSE THE MODEL THAT BEST FIT OUR SITE IN NEW HAVEN AND THE COMPETITION PROGRAM. WE HAD DETERMINED OUR EXTERNAL FORM AND ALSO HAD A REFERENCE BUILDING, THE CUBE IN BERLIN, A GRAND CUBE WITH TRIANGULAR SURFACES WHOSE OUTER CURTAIN WALL REFLECTS THE SURROUNDINGS.

### INTERIOR

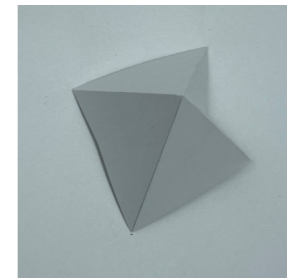
NEXT, WE NEEDED TO DEFINE THE INTERIOR AND THE OPERA ROOM. WE DECIDED THAT THERE SHOULD BE A DISTINCT DIFFERENCE BETWEEN THE OUTER SHELL AND THE INNER VOLUME TO MATCH BOTH VISUALLY AND ACOUSTICALLY. WE USED TRIANGLES AS OUR STRONG CONCEPT FOR THE INNER VOLUME AS WELL. WITH RHINO, WE CREATED A RED TRIANGULAR VOLUME, DRESSED IN TRADITIONAL OPERA COLORS, WHICH ENCLOSED AN OPERA HALL. THE DESIGN OF THE HALL WAS OPTIMIZED WITH TRIANGULAR MODULES ACTING AS DIFFUSIVE PANELS, ONE OF OUR THREE ACOUSTIC CONCEPTS.

### VISION OF FINAL PRODUCT

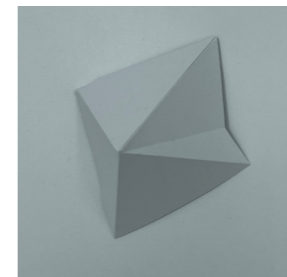
WE NOW SAW OUR GOAL: A BUILDING WHOSE LIGHT GLASS SHELL WOULD INVITE THE PUBLIC TO EXPERIENCE BOTH THE EXTERIOR AND THE DISTINCT RED INTERIOR VOLUME. THIS VOLUME WOULD HOUSE THE OPERA AND ALL ITS FUNCTIONS, FREEING THE SPACE BETWEEN THE GLASS AND THE RED VOLUME TO CREATE A PUBLIC AREA. THE SIGNIFICANT DIFFERENCE IN THEIR DESIGN ALLOWED US TO CREATE AN OBSERVATION DECK ON THE RED VOLUME, WHICH ENDED WELL BELOW THE POINTED GLASS SHELL TOP. THIS DECK WOULD BE ACCESSIBLE TO ALL THE CITY'S RESIDENTS AND VISITORS.



Chosen volume model



Not chosen volume



Not chosen volume

# #07 DESIGN METHODOLOGY

## METHOD USED

*THE METHOD USED THROUGHOUT THE PROJECT WAS BASED ON THE STRUCTURE OF THE ACEX15 COURSE. THIS CONSISTED OF FIVE DIFFERENT ITERATIONS.*

### 1 ACUSTIC INTERACTION

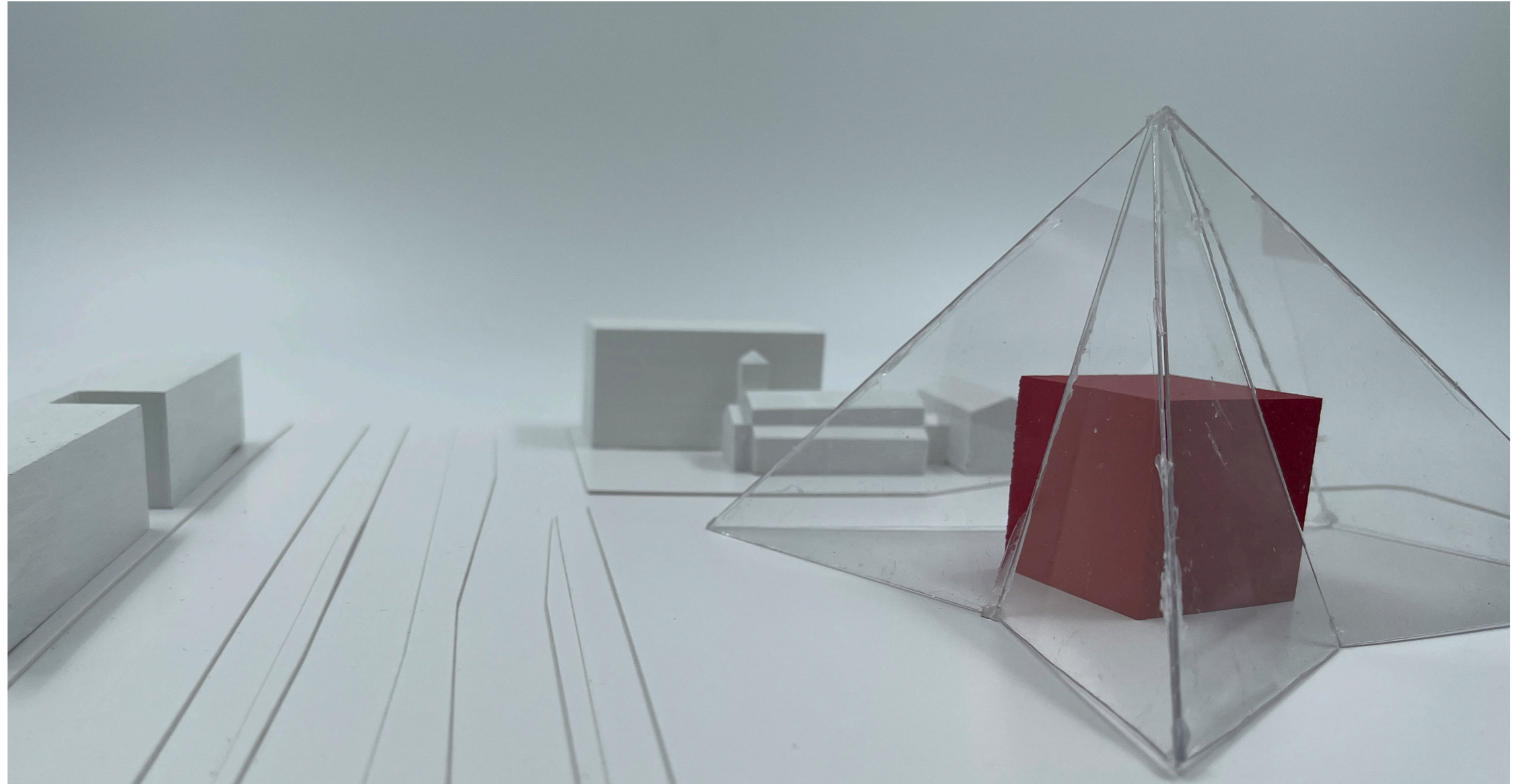
DURING THE FIRST ITERATION, WE VISITED THREE DIFFERENT LOCATIONS WHERE THREE DIFFERENT TYPES OF TEXTS AND SONGS WERE TO BE PERFORMED AND FILMED FROM VARIOUS DISTANCES. THE SPACES CONTRASTED WITH EACH OTHER, CREATING DIFFERENT SOUNDSCAPES. THIS TASK AIMED TO GIVE US AN UNDERSTANDING OF ACOUSTICS IN DIFFERENT ENVIRONMENTS AND WAS CARRIED OUT IN SMALLER REFERENCE GROUPS.

### 2 THREE ARCHITECTURAL CONCEPT

IN THE SECOND ITERATION, THE SKETCH PHASE BEGAN. THREE CONCEPTS WERE TO BE PRESENTED ALONG WITH ACOUSTIC BENCHMARKS FOR EACH CONCEPT. WE DEVELOPED SEVERAL ARCHITECTURAL CONCEPTS BASED ON VARIOUS SOURCES OF INSPIRATION, ALLOWING CREATIVITY TO FLOW. THE FINAL PRESENTATION WAS TO BE PRESENTED TO FIRST-YEAR MASTER'S STUDENTS IN THE MSC SOUND AND VIBRATION PROGRAM. AN ACOUSTICS STUDENT WAS ASSIGNED TO EACH PROJECT GROUP AS AN "ACOUSTICS CONSULTANT" THROUGHOUT THE PROJECT, SINCE ACOUSTICS IN THE OPERA HALL WERE THE MAIN FOCUS OF THE COMPETITION.

### 3 SPATIAL ACOUSTIC PROTOTYPES

IN THE THIRD ITERATION, WE WORKED WITH THE ACOUSTICIAN TO DEVELOP AT LEAST THREE ACOUSTIC CONCEPT MODELS. THE GOAL WAS TO MEET THE FLEXIBLE NEEDS PRESENTED IN THE COMPETITION PROGRAM, ALLOWING FOR VARIATIONS IN REVERBERATION TIME, CLARITY, AND STRENGTH. DURING THIS PHASE, WE CREATED MECHANICAL REFLECTORS, A TRIANGULAR DIFFUSING WALL PANEL TO COVER THE INSIDE OF THE OPERA HALL AND REHEARSAL ROOM, AND THE BASIC IDEA OF TWO VOLUMES OR SHELLS.



#### 4 FIRST MOCKUP

IN THE FOURTH ITERATION, IT WAS TIME TO PRESENT THE FIRST MOCKUP, WHICH WE DISPLAYED ON THREE BOARDS FOR THE COMPETITION. HERE, WE DEFINED THE KEY VISUALS AND SKETCHES, WROTE THE INITIAL EXPLANATORY TEXTS, AND PRESENTED A LAYOUT TO BE CRITIQUED BY STUDENTS AND TEACHERS THROUGH A GALLERY CRITIQUE.



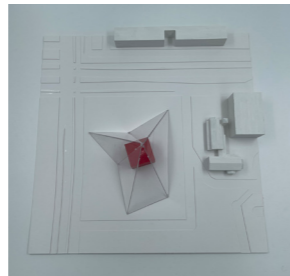
#### 5 FINAL PROJECT DESIGN

AFTER RECEIVING FEEDBACK ON OUR MOCKUP, WE BEGAN THE FINAL PRODUCTION PHASE OF THE PROJECT'S DRAWINGS AND LAYOUT IN THE FIFTH ITERATION. THE FINAL PRODUCT OF THIS PHASE WAS A COMPLETE COMPETITION ENTRY ON THREE BOARDS ACCORDING TO SPECIFIED DIMENSIONS. THE PROPOSAL WAS PRESENTED IN A CRITIQUE SESSION WITH REVIEWERS FROM FOSTER + PARTNERS AND WOLFGANG KROPP.



#### 6 PROJECT PORTFOLIO

AFTER THE CRITIQUE SESSIONS, WE CREATED A BACHELOR PORTFOLIO SUMMARIZING THE PROJECT IN ITS ENTIRETY, INCLUDING DESCRIPTIONS AND REFLECTIONS ON THE RESULTS, PROCESS, AND COLLABORATION. THIS IS THE DOCUMENT YOU ARE READING RIGHT NOW.



# #08 PROJECT REFLECTION

## PERSONAL PROJECT REFLECTION

*BELOW IS A REFLECTION ON THE PROCESS AND THE COLLABORATION WITH BOTH THE OTHER ARCHITECTURE STUDENT AND THE ACOUSTICS STUDENT. THOUGHTS ON WHAT WENT WELL, WHAT WENT LESS WELL, AND WHAT COULD HAVE BEEN DONE DIFFERENTLY OR NOT AT ALL ARE MENTIONED IN THIS SECTION.*

### PROCESS

THE PROCESS DESCRIBED IN THE PREVIOUS CHAPTER WORKED VERY WELL AND WAS DESIGNED TO REDUCE STRESS AND AVOID RUSHED DECISIONS. WE WERE ABLE TO IMPLEMENT A CLEAR CONCEPT AND RECEIVE VALUABLE FEEDBACK ON THE LAYOUT AND HOW TO PRESENT A PROPOSAL SO THAT THE BOARDS SPOKE FOR THEMSELVES WITHOUT LEAVING QUESTIONS FOR THE VIEWER. THE GALLERY CRITIQUES AND WORK WITH REFERENCE GROUPS MADE IT EASY TO BOTH SEEK HELP FROM AND ASSIST DIFFERENT GROUPS, WHICH PREVENTED US FROM GETTING STUCK IN OUR OWN HEADS.

FROM THE BEGINNING, WE WANTED THIS PROJECT TO BE ONE WE WOULD REMEMBER WITH JOY. THEREFORE, THROUGHOUT THE PROCESS, WE FOCUSED ON HAVING FUN AND MAINTAINING A BALANCED WORKLOAD. WE ESTABLISHED A RULE THAT WHENEVER WE NEEDED A BREAK OR FELT TIRED, WE WOULD STOP FOR THE DAY. THIS APPROACH GREATLY ENHANCED OUR EFFICIENCY AND THE QUALITY TIME WE INVESTED IN THE PROJECT, A LESSON I WILL CARRY INTO FUTURE PROJECTS. OVERALL, IT WAS A FUN, EFFICIENT, AND EDUCATIONAL PROCESS.

### COLLABORATION

THE COLLABORATION WITH EBBA GREGEFALK WAS EXEMPLARY. WE MAINTAINED GOOD COMMUNICATION, CLEAR GOALS, AND MUTUAL RESPECT, MAKING THE WORK ENJOYABLE, RELAXED, AND FREE FROM PERFORMANCE PRESSURE. WE TRULY DID EVERY PART OF THE PROJECT TOGETHER, CONSTANTLY SITTING TOGETHER AND ENGAGING IN DIALOGUE AS WE

WORKED. THE FINAL RESULT IS A PRODUCT OF CLOSE COLLABORATION WHERE WE BOTH CONTRIBUTED TO EVERYTHING, WHICH IS SATISFYING BECAUSE WE BOTH LEARNED A LOT AND THE MATERIAL TRULY FEELS LIKE A JOINT EFFORT.

THE COLLABORATION WITH THE ACOUSTICS STUDENT WAS LESS SUCCESSFUL. I OFTEN FELT THAT WE DID NOT RECEIVE THE SUPPORT, COMMUNICATION, OR FEEDBACK WE NEEDED, EVEN WHEN REQUESTED, AND OVERALL, THERE WAS A LACK OF ENGAGEMENT.

### LESSONS LEARNED

AT THE START OF THE PROJECT, WE DISCUSSED OUR DESIRE TO COLLABORATE ON THE FINAL MATERIALS, AS WE BOTH WANTED TO LEARN MORE ABOUT RENDERING AND 3D MODELING, AS WELL AS ADOBE PROGRAMS FOR PROCESSING DRAWINGS.

I CAN SAY THAT I HAVE EXPANDED MY KNOWLEDGE IN RHINO, AUTOCAD, INDESIGN, PHOTOSHOP, ILLUSTRATOR, V-RAY, AND ENSCAPE. SOME OF THESE PROGRAMS I HAD USED VERY LITTLE BEFORE, BUT NOW, AFTER THIS PROJECT, I FEEL VERY CONFIDENT USING THEM. I HAVE LEARNED A LOT DURING THIS PROJECT, THANKS TO THE COLLABORATION WITH EBBA, WHICH GAVE US BOTH THE SPACE AND TIME TO LEARN THINGS WE HADN'T PRIORITIZED IN PREVIOUS PROJECTS.

DUE TO THE LOW ENGAGEMENT FROM OUR ACOUSTICIAN, I ENDED UP LEARNING A LOT MORE ABOUT ACOUSTICS. I TOOK THE TIME TO UNDERSTAND ACOUSTIC PRINCIPLES AND THE DESIRABLE CHARACTERISTICS NEEDED TO CREATE A GOOD OPERA

HOUSE. THE COLLABORATION WITH THE ACOUSTICIAN ALSO TAUGHT ME THE IMPORTANCE OF SITTING DOWN TOGETHER WITH PEN AND PAPER AND ALLOWING EVERYONE TO DESCRIBE, DRAW, AND SHOW THEIR VISION OF THE PROJECT. THIS HELPS ENSURE THAT EACH PERSON FULLY UNDERSTANDS THE VISIONS, CONCEPTS, AND ACTUAL DRAWINGS. IT IS A PROCESS THAT TAKES TIME AND SHOULD BE GIVEN AMPLE TIME TO ACHIEVE GOOD RESULTS.

FOR EXAMPLE, I LEARNED THAT SITTING CLOSE TOGETHER WITH EBBA THROUGHOUT THE WHOLE PROJECT AND DISCUSSING QUESTIONS AS THEY AROSE MADE THE PROCESS ENJOYABLE, MEASURABLE, AND EASY TO FOLLOW WHEN IT CAME TO THE POINT IF EVERYONE SHARED THE SAME VISION AND THINKING. THIS WAS IN CONTRAST TO THE ACOUSTICIAN, WHO UNDERSTOOD LITTLE AND SPENT LITTLE TIME WITH US.

### RESULTS

I AM VERY IMPRESSED WITH HOW WELL WE MANAGED TO PRESENT OUR PROJECT IN A CLEAR AND STRAIGHTFORWARD MANNER DESPITE THE CHALLENGING DESIGN. WE CREATED A BUILDING THAT INCLUDES PUBLIC, SEMI-PRIVATE, AND PRIVATE ROOMS FOR THE OPERA, WHICH LOWERS THE THRESHOLD FOR ALL TYPES OF PEOPLE TO ENGAGE WITH THE ARCHITECTURE AND THE MUSIC. BOTH THE GLASS SHELL AND THE INTENSELY RED VOLUME ARE ESSENTIAL TO ELEVATE AND FULFILL OUR CONCEPT OF A MODERN OPERA THAT PROVIDES ADDED VALUE FOR ALL THE CITY'S RESIDENTS. THIS IS PROBABLY WHAT I AM MOST PROUD OF: THE RESULT IS A LIGHT AND TRANSPARENT CLIMATE SHELL THAT INVITES PEOPLE IN, AND A RED

VOLUME THAT VISITORS CAN INTERACT WITH VIA THE STAIRCASE, TAKING THEM UP TO THE PLATFORM. AND THE TRIANGULAR CONCEPT WHICH FOLLOWS INTO THE OPERA HALL CREATES A FANTASTIC OPERA EXPERIENCE.

THE PROJECT TRULY MET MY EXPECTATIONS AS A PROJECT THAT CHALLENGED OUR ABILITIES. I AM VERY SATISFIED WITH THE RESULT, ESPECIALLY CONSIDERING THAT WE CAN GENUINELY SAY IT IS OUR JOINT PROJECT, WITH ALL ELEMENTS THOROUGHLY WORKED ON BY BOTH OF US WITHOUT A CLEAR DIVISION OF WHO DID WHAT.

WHAT WAS LESS SUCCESSFUL WAS THE ACOUSTICS ASPECT. I WOULD HAVE LIKED MORE FEEDBACK AND ENGAGEMENT FROM OUR ACOUSTICIAN TO ADDRESS THE ACOUSTIC SOUND AND VIBRATION ISSUES AND TO OPTIMIZE MATERIAL AND CONSTRUCTION CHOICES.

IF WE HAD MORE TIME, I WOULD HAVE WANTED TO SPECIFY AND DEVELOP DETAILS ON THE GLASS SHELL AND THE RED VOLUME THROUGH MORE CONSTRUCTIVE DETAIL DRAWINGS. THIS MEANS NOT ONLY CREATING DETAILED DRAWINGS BUT ALSO SOLVING THE STRUCTURAL AND CLIMATE-RELATED ISSUES THAT SUCH A LARGE GLASS SURFACE CAN CREATE AND TURNING THOSE CHALLENGES INTO ADVANTAGES. PERHAPS WE COULD HAVE ALSO INTEGRATED A CLEARER FOCUS ON SUSTAINABILITY IN OUR WORK, SUCH AS UTILIZING THE BUILDING'S HEAT DURING THE SUMMER.

# #09 FUTURE

## THOUGHTS OF FUTURE

*THE MOST IMPORTANT LEARNED LESSONS FROM THIS PROJECT IS THE KNOWLEDGE AND CONFIDENCE I'VE GAINED BY DESIGNING A PROPOSAL THAT TRULY CHALLENGED MY SENSE OF FORM AND CREATING DRAWINGS FOR A PROJECT WITH UNCONVENTIONAL AND COMPLEX SHAPES. THIS WAS MADE POSSIBLE THROUGH THE DEEPENED KNOWLEDGE AND SKILLS IN VARIOUS SOFTWARE PROGRAMS, ENABLING US TO ACHIEVE A VISUALLY CLEAR AND READABLE RESULT.*

*I AM PARTICULARLY PROUD OF THE EXCELLENT COLLABORATION BETWEEN EBBA AND ME, WHICH HAS GIVEN US A CHERISHED MEMORY TO LOOK BACK ON. THIS PROJECT HAS TRULY DEMONSTRATED THE IMPORTANCE OF GOOD TEAMWORK AND COMMUNICATION IN ACHIEVING GREAT RESULTS. CONVERSELY, IT HAS ALSO HIGHLIGHTED THE NECESSITY OF ENSURING THAT EVERYONE IN THE PROJECT UNDERSTANDS THE EXACT GOALS WE ARE COLLECTIVELY STRIVING FOR, AND THE IMPORTANCE OF ADDRESSING COMMUNICATION ISSUES BEFORE THEY BECOME PROBLEMS THAT COULD COMPROMISE THE PROJECT'S QUALITY.*

*I EAGERLY ANTICIPATE IMPLEMENTING A MORE COMPREHENSIVE AND EASILY COMPREHENSIBLE APPROACH TO ENVIRONMENTAL, ECONOMIC, AND SOCIAL SUSTAINABILITY IN MY FUTURE PROJECTS.*



*Haiku model that inspired the whole project*