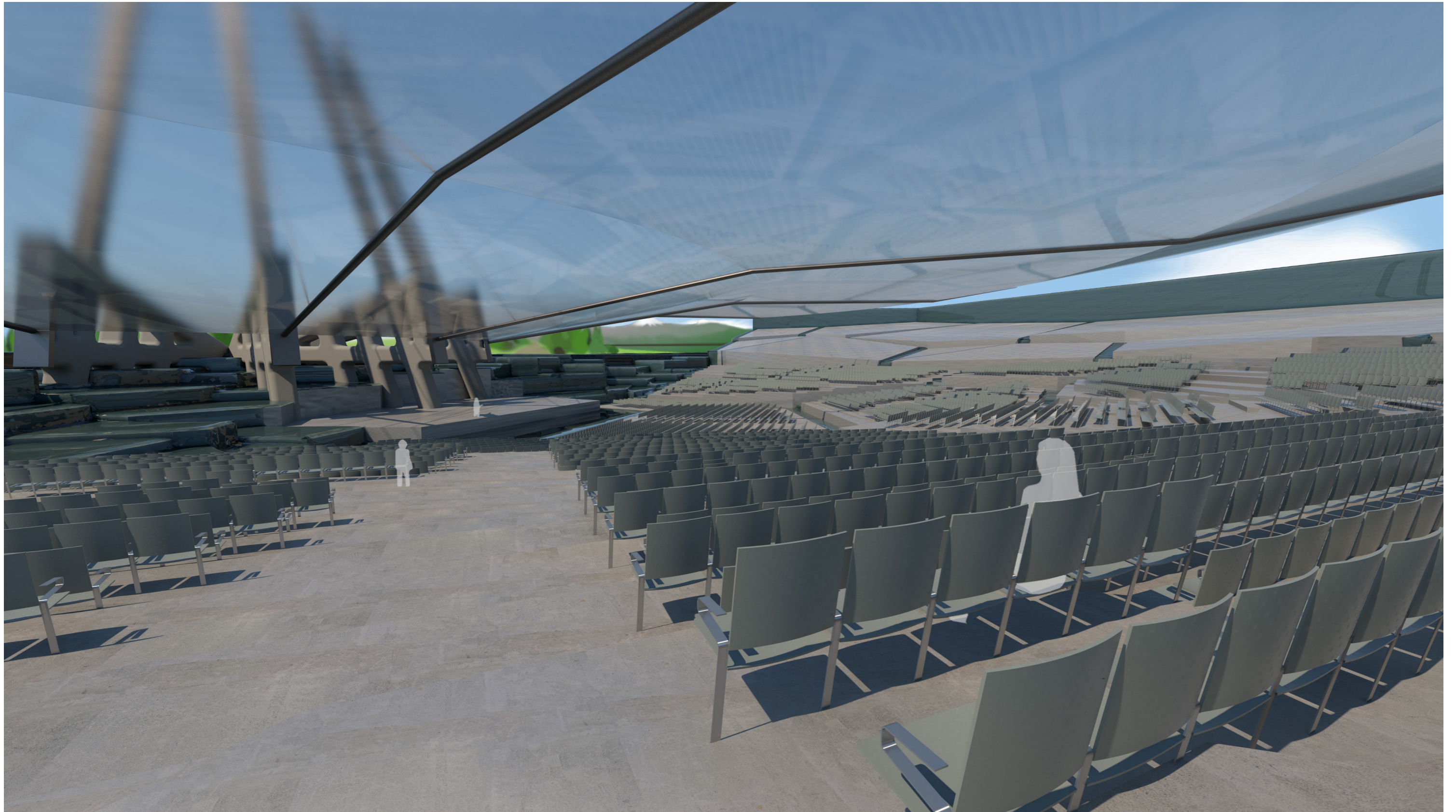
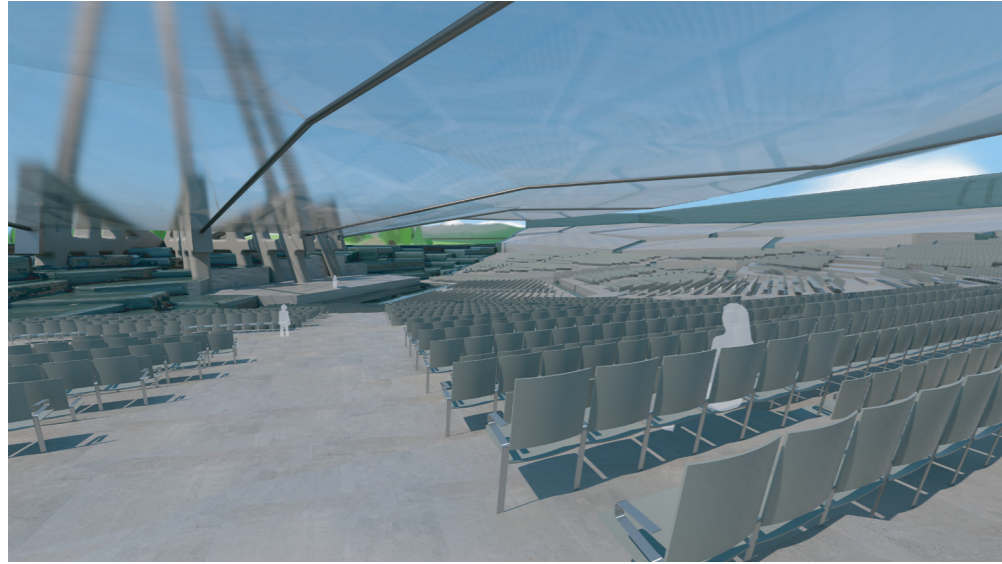


BÄCKDALEN



PRESENTATION BOARDS



BÄCKDALEN

Bäckdalen, or Stream Valley, consists of a terraced landscape where the presence of water and a transparent, movable roof allow extraordinary acoustic experiences to occur. The landscape is divided into 25 irregular plates. A waterfall stretches the back of the valley, creating an ambience of magnificence. From the waterfall, two water side streams separate the plates all the way down to the orchestra pit. From here the water returns to where it came from, the rear right outside. The nine plates closest to the stage are separated into even smaller terraces to create a diverse slope. This allows seating with a commonly good view of the stage. These plates are covered by the roof.

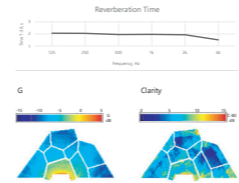
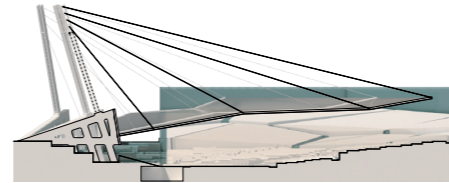
ROOF
Suspended on a symmetrical network of wires, the roof structure can move to envelope different acoustic environments, depending on the type of event. The structural supports of the roof also act as mounting for the electroacoustic reinforcement system.

TERRACES
The covered terraces are inclined towards the stage, improving both the view and the acoustic conditions. Reflective walls between each terrace help reflect the direct sound with early reflections, improving acoustic clarity.

BACKSTAGE
A stepped incline surrounds the rear of the stage, improving both the view and the acoustic conditions. Reflective walls between each terrace help reflect the direct sound with early reflections, improving acoustic clarity.

ORCHESTRA PIT
An orchestra pit lies between the stage and the front of the auditorium. During opera and ballet performances, the pit houses the orchestra. During orchestral performances, theatre, spoken word and larger concerts, the pit is filled with water to reinforce the direct sound from the performers to the audience.

ENVIRONMENT
The stream valley is isolated from surrounding highways by a dense green belt of trees and foliage. The width of the green belt, coupled with the 4m waterfall walls surrounding the stream valley, will result in 35dB of interior traffic noise. Any noise will not distract or disturb the patrons from an ongoing performance, but add to the surrounding ambience.

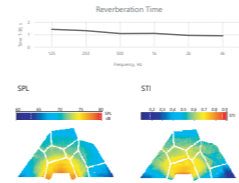
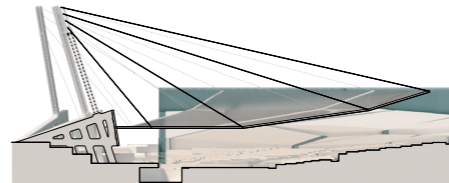


SYMPHONIC ORCHESTRA

The sound is reflected towards the audience by the upward sloping roof and the banked stage. Early reflections are reinforced by the water surface on orchestra pit right before the stage.

The shape of the semi-enclosed acoustic chamber beneath the roof allows a suitable reverberation to develop.

Early reflections are supported by the walls of the terraces and the waterfalls behind the stage, which generates preferable sound clarity.

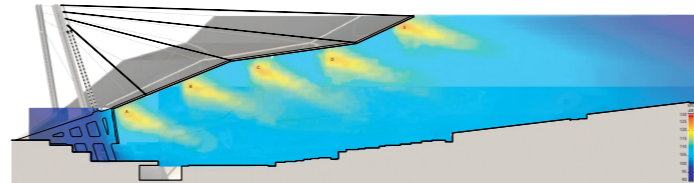


THEATRE

An optimal roof height was chosen to house backdrops whilst keeping the roof volume and therefore reverberation time to a minimum.

The waterfalls behind the stage are turned off to reveal acoustic panels with low frequency resonators. This improves STI by reducing reflections from these surfaces.

Loudspeaker arrays above the stage provide since STI to achieve suitable sound pressure across the audience.



POPULAR ACTS

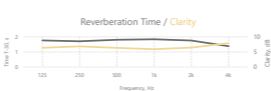
The roof is raised to its maximum height, creating a reverberation time of 2s (1000Hz and 1s (500Hz). The result is strong warmth and envelopment.

A loudspeaker array system supported by the roof provides a sound pressure between 110 and 120dB(A) at all areas. The array have delayed timing to achieve a good sound image towards the stage.

- A - aligned with the stage
- B, C, D - delayed to 20ms after array A
- E - delayed 60ms to generate a good sound image further towards the back.

OPERA & BALLET

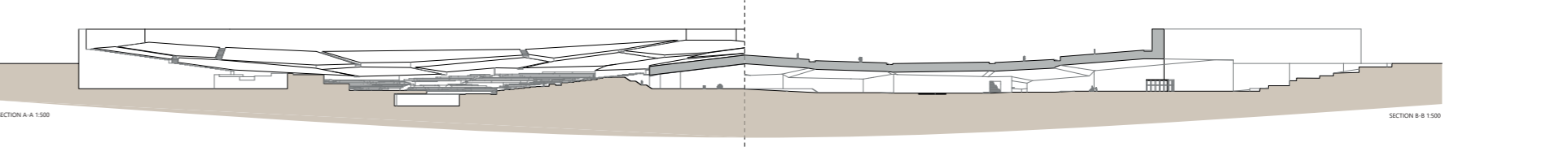
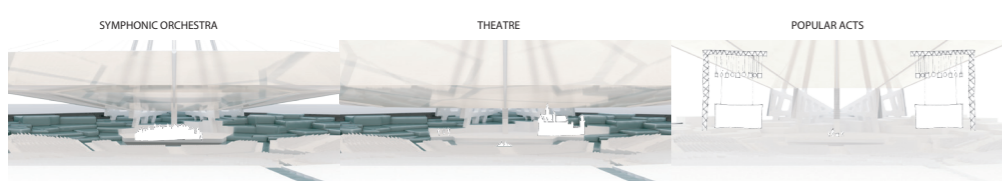
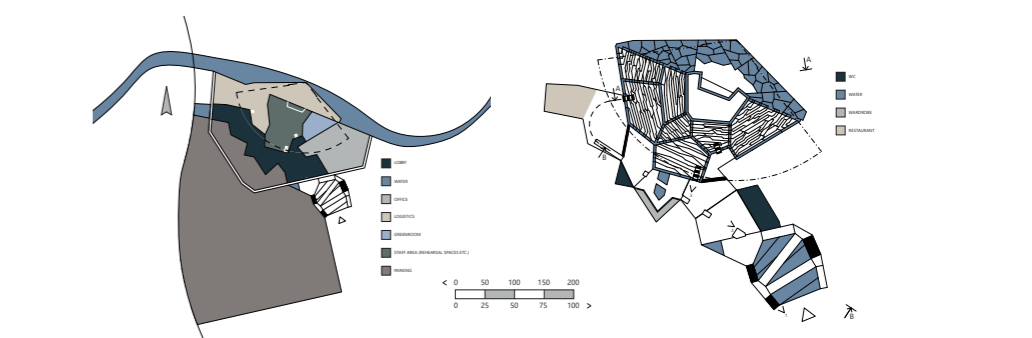
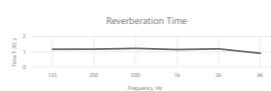
The orchestra are positioned in the pit before the stage. A roof height was chosen both to house the backdrops and provide a supportive reflector position directly above the orchestra pit. This results in a strong early reflection to the audience, improving musical clarity.



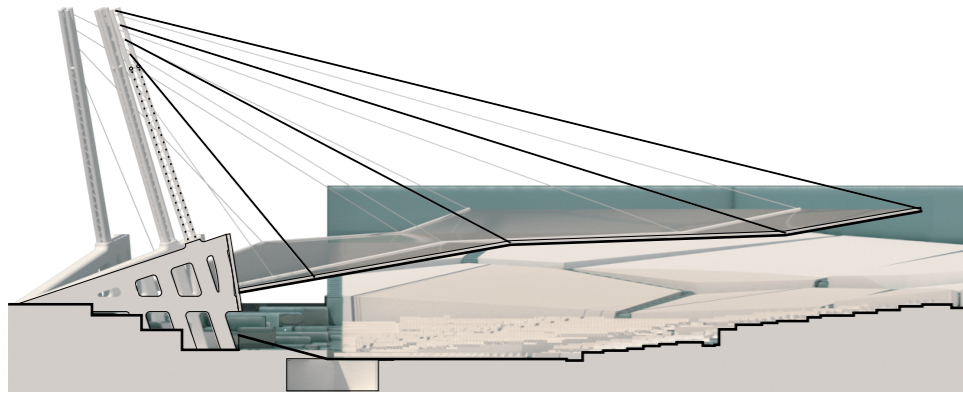
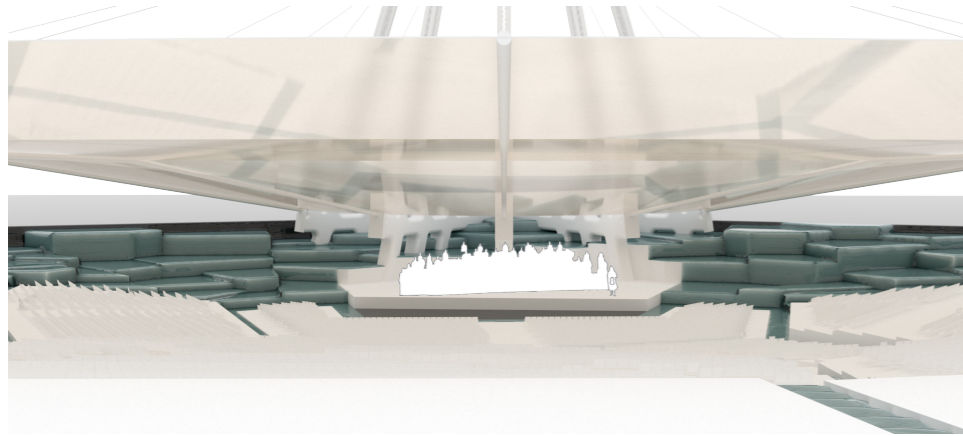
SPOKEN WORD

Similar to the theatre configuration, with the roof height minimized to reduce reverberation time and improve speech intelligibility.

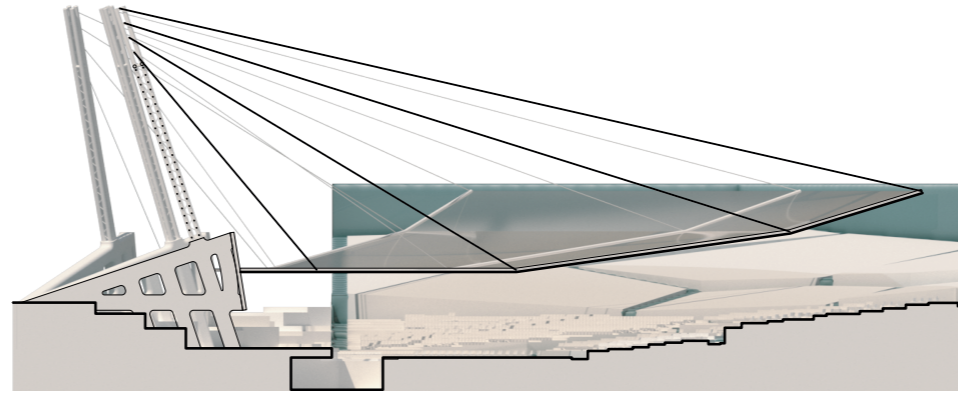
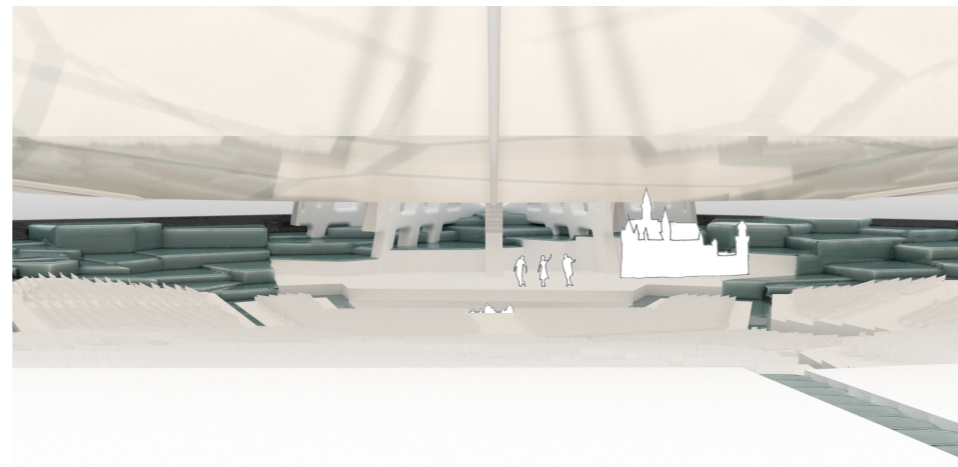
The backstage panels are uncovered, improving STI and reducing reverberation.



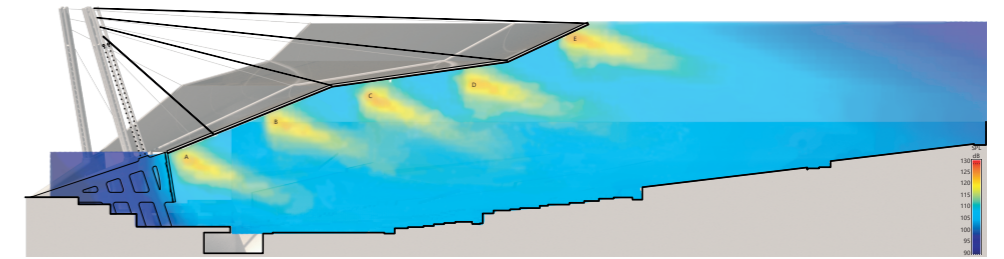
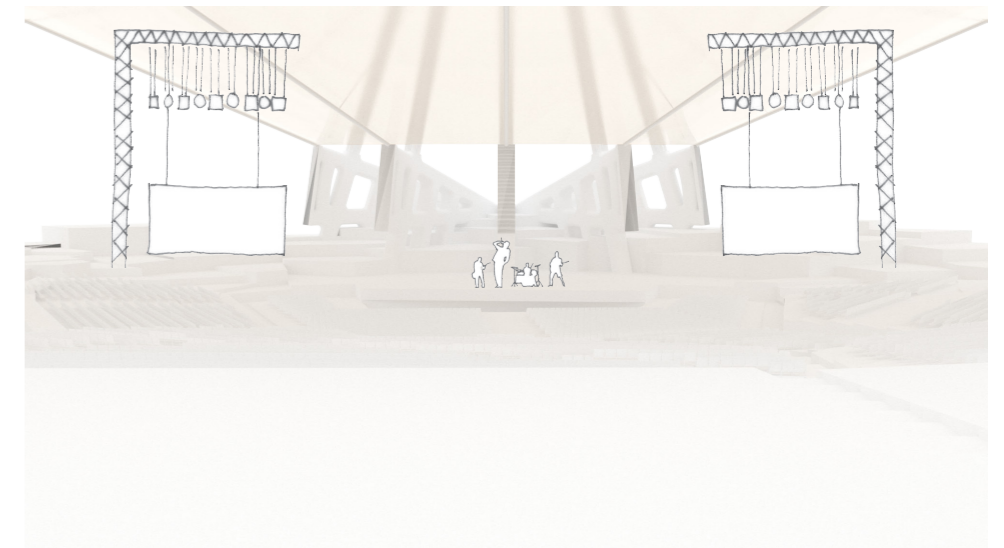
SYMPHONY ORCHESTRA



THEATRE



POPULAR ACTS



ROOF

Suspended on a symmetrical network of wires, the roof sections can move to envelop different acoustic environments, depending on the type of event. The structural supports of the roof also act as mounting for the electroacoustic reinforcement system.

TERRACES

The covered terraces are inclined towards the stage, improving both patron's line of sight and sound direct from the source. Reflective walls between each terrace step reinforce the direct sound with early reflections, improving acoustic clarity.

BACKSTAGE

A stepped incline surrounds the rear of the stage. Surfaces are acoustically treated to absorb unwanted reflections which would reduce acoustic clarity. When higher reverberation is required, water is channelled to fall, almost silently, over the edge of each step. The remaining water sound will be masked by the main sound source, while add a calm ambience during quiet and silent intervals.

ORCHESTRA PIT

An orchestra pit lies between the stage and the front of the audience. During opera and ballet performances, this pit houses the orchestra. During orchestral performances, theatre spoken word and larger concerts, the pit is filled with water to reinforce the direct sound from the performer(s) to the audience.

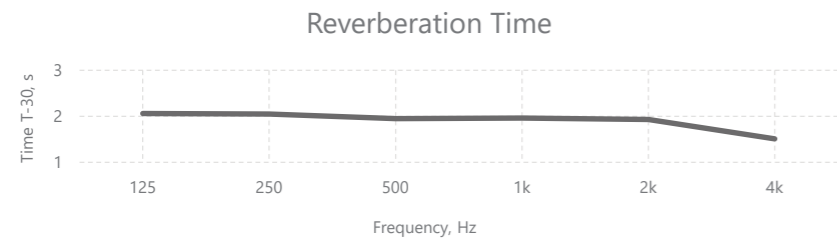
ENVIRONMENT

The Stream Valley is isolated from surrounding highways by a dense green belt of trees and foliage. The width of the green belt, coupled with the 4 m waterfall (wall) surrounding the Stream Valley, will result in 30 dB of interstate traffic noise disturbing the venue's patrons. This residual noise will be masked by the ongoing performance.

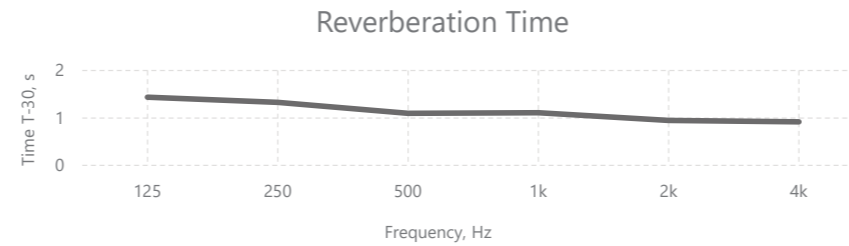
The audience directly face the riverway, via the stage. River traffic noise and natural sounds are typically of a calming, low intensity nature when compared to traffic noise. Any noise will not distract or disturb the patrons from an ongoing performance, but add to the surrounding ambience.

ACOUSTIC PROPERTIES

SYMPHONY ORCHESTRA

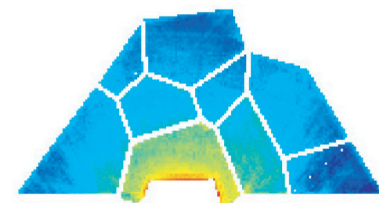
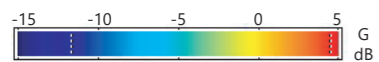


THEATRE

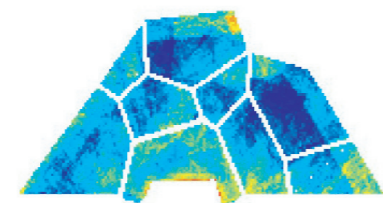


POPULAR ACTS

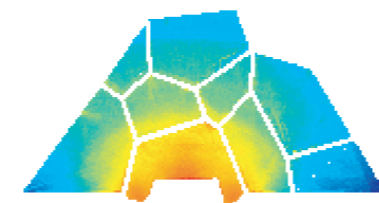
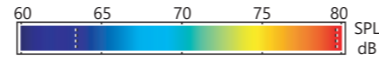
G



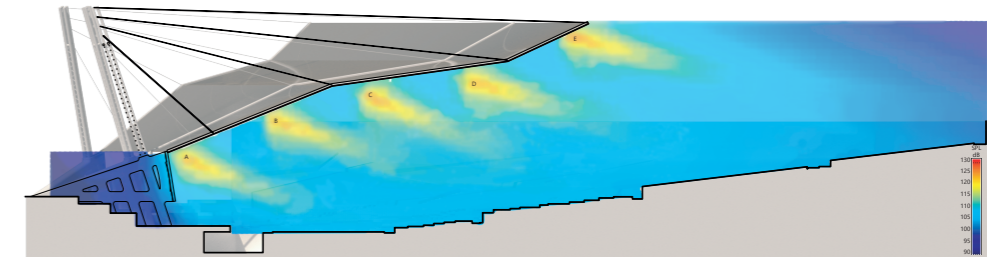
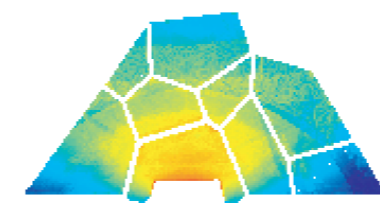
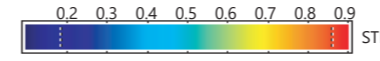
Clarity



SPL



STI



The sound is reflected towards the audience by the upwards sloping roof and the banked stage. Early reflections are reinforced by the water surface in the orchestra pit, right before the stage.

The shape of the semi enclosed acoustic chamber beneath the roof allows a suitable reverberation to develop.

Early reflections are supported by the walls of the terraces and the waterfalls behind the stage, which generated preferable sound clarity.

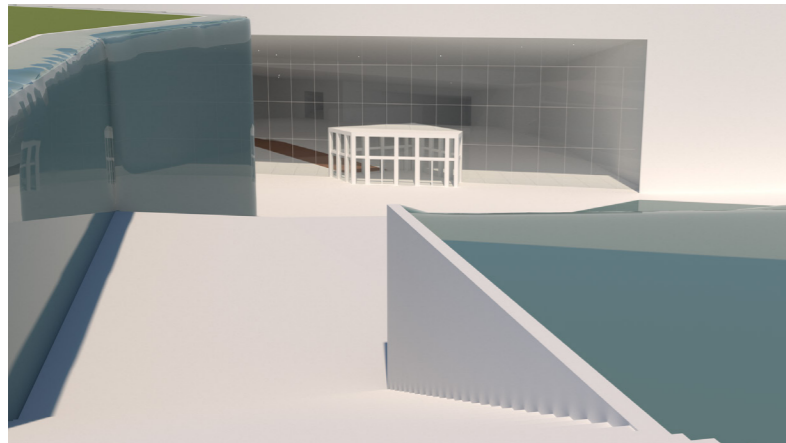
An optimal roof height was chosen to house backdrops whilst keeping the roof volume and therefore reverberation time to a minimum.

The waterfalls behind the stage are turned off to reveal acoustic panels with low frequency resonators. This improves STI by reducing reflections from these surfaces. Loudspeaker arrays above the stage provide voice lift to achieve suitable sound pressure across the audience.

The roof is raised to its maximum height, creating a reverberation time of 2 s < 500 Hz and 1 s > 500 Hz. This results in strong warmth and envelopment.

A loudspeaker array system supported by the roof provides a sound-pressure between 100 and 105 dB(A) to all areas. The arrays have delayed timing to achieve a good sound image towards the stage.

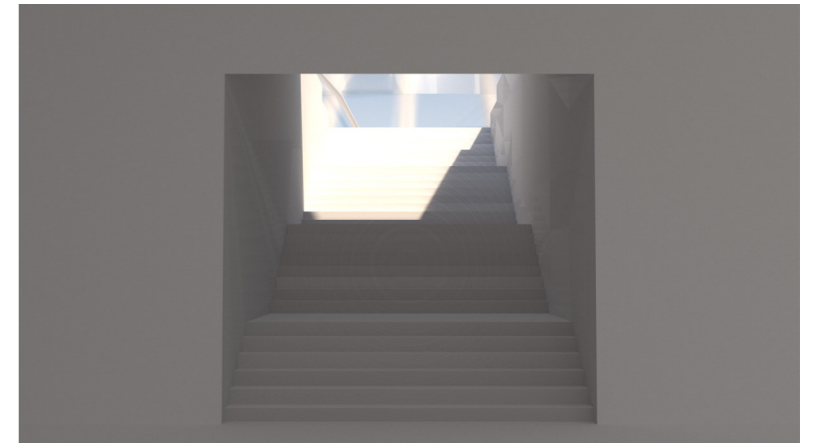
A - aligned with the stage
 B, C, D - delayed to 20 ms after array A
 E - delayed 60 ms to generate a good sound image further towards the back.



Since the facility is dug into the ground, you reach the entrance by stairs, elevators or ramps. The area in front of the entrance is spacious. You are introduced to the presence of the water, as it flows down the walls and edges surrounding the paths that brings you down.

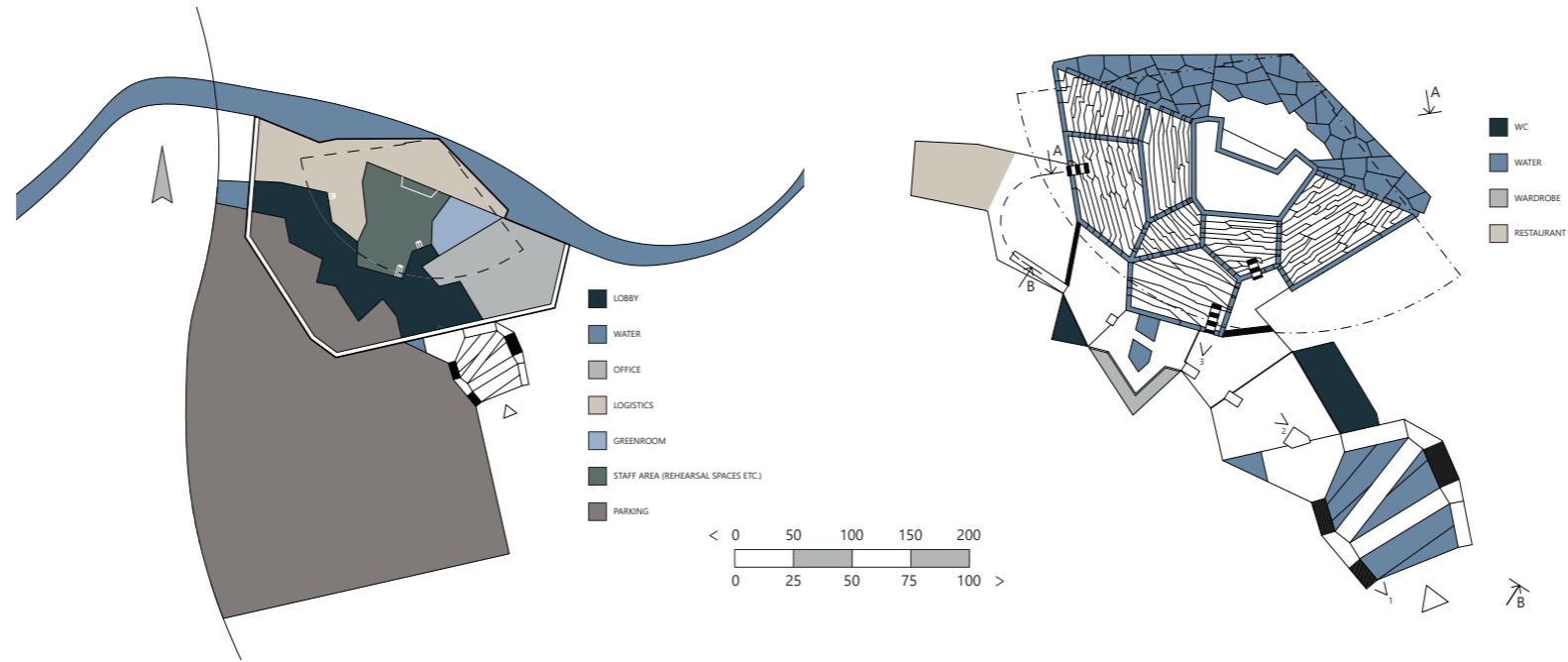


You enter the lobby through the glass facade and are greeted by the wooden path that guides you through the cave-like space closing in around you. The daylight is replaced by overhead lightning, and the sound of water is still present due to the lonely waterfall which marks the wardrobe.

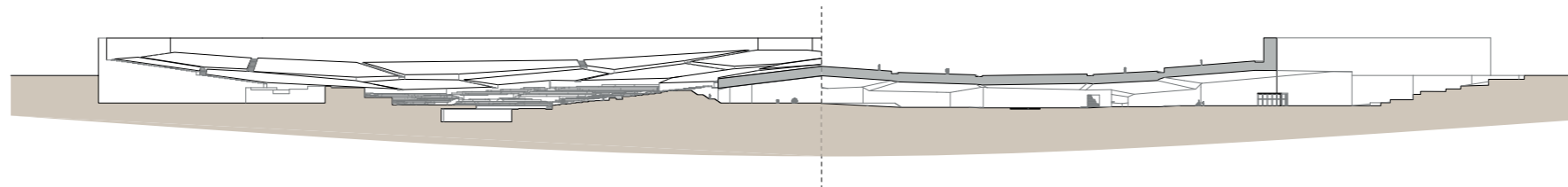


When you have passed through the dark cave, and found the entrance to your section, the light and sound from the landscape above guides you up the stairs.

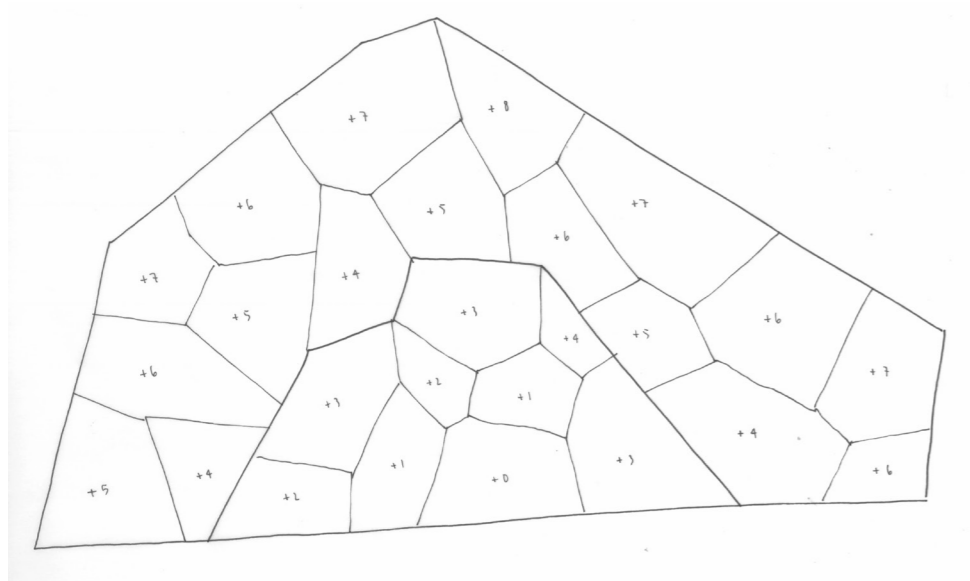
PLANS



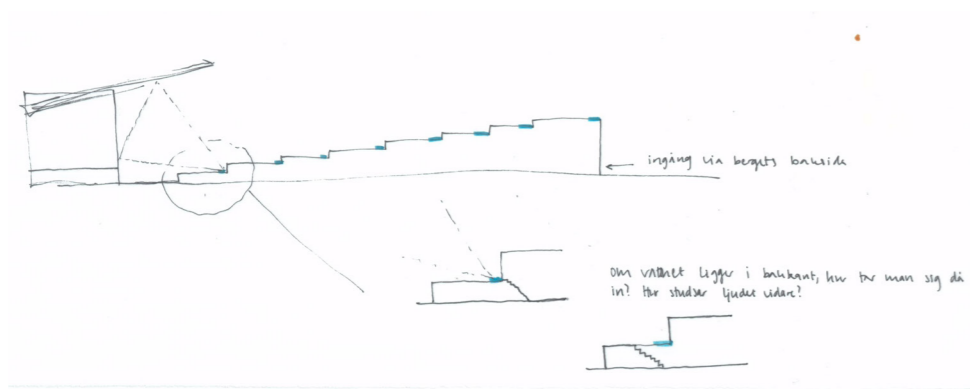
SECTION 1:500



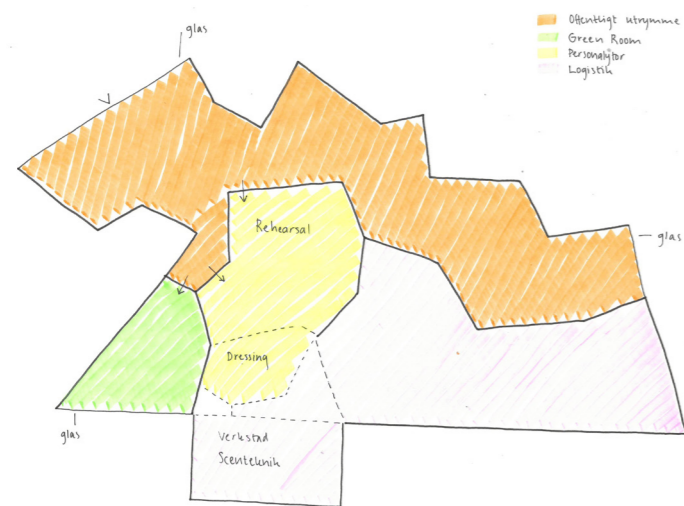
DESIGN PROCESS



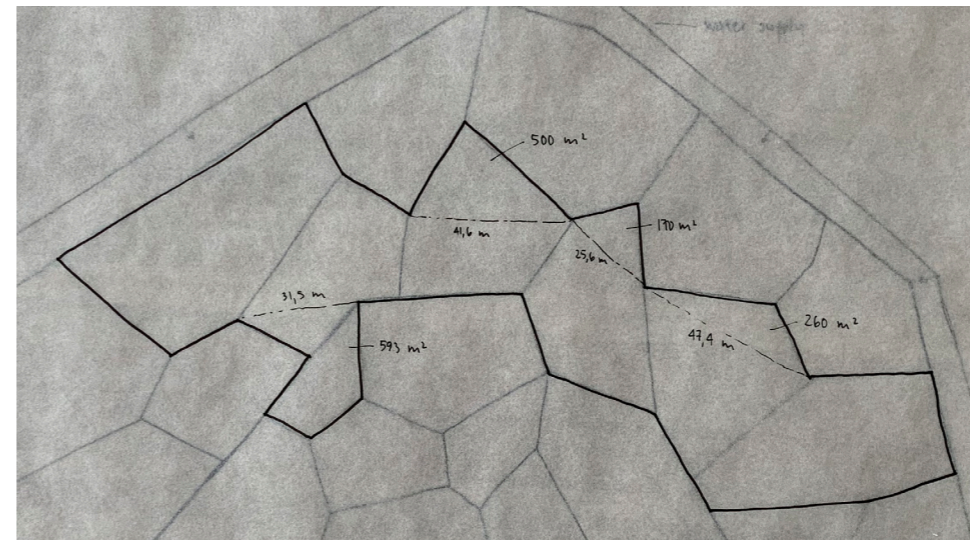
1. The shape from which we started with



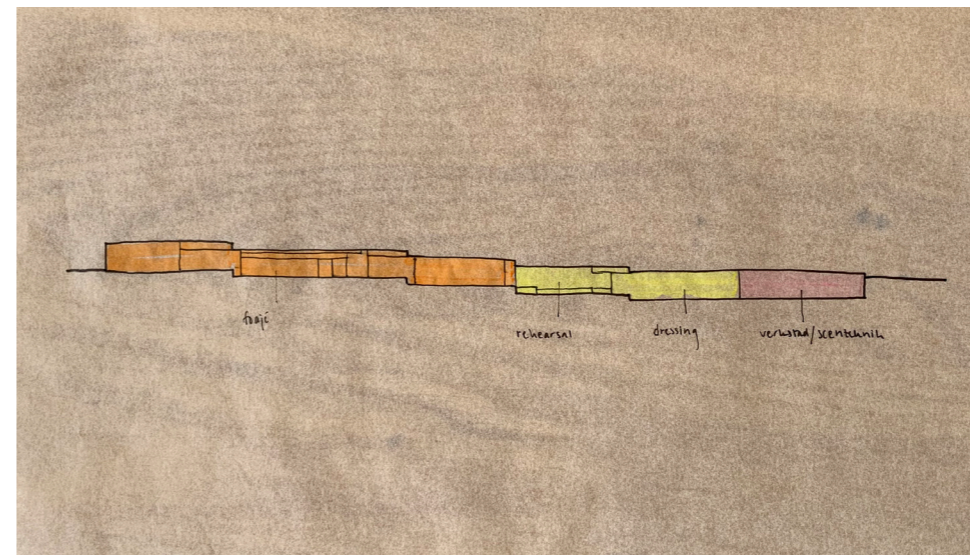
2. Early sketch and thought on how to reenforce the sound



3. Critical decision:
Deciding to put all program spaces beneath the valley.



4. Exploring what the foyer could look like



5. Early sketch of what a section could look like

REFLECTION

Interdisciplinary Collaboration

Eric and I divided the work, so he was the one who had the most contact with our acoustic student, Tom. But from what I've heard from him, the collaboration has worked very well. He was ambitious, efficient and came up with good solutions when problems occurred.

Methodology

We early realised that water was an element we wanted to work with to reinforce the sound. Due to that we wanted the sound to "bounce" on the water, we early realised that we wanted a slope on the platform. The pattern of the platform is inspired by cracking mud, where each platform is divided by streams. To offer each spectator a good view of the stage, we decided to give the platforms different height. We decided to put all program spaces underneath the valley, and since the platform now was pretty high, we also chose to dig it into the ground.

The next thing we did was to decide what the interior rooms should look like, and how to approach the building. Then the next step was to create a stage and roof which both had good acoustical qualities and were aesthetic appealing.

Architectural and Acoustical Qualities

I am pleased with both the architectural and acoustical qualities we achieved. I am especially very pleased that we together with Tom were able to get the water to contribute to the sound, because half through the project, it didn't seem to be possible.