# TROLLSLÄNDAN

## En konsert under vingarna

Kandidatarbete i Arkitektur och Teknik
ACEX16
Ilinca Dan
VT 2026

Program: Rhinocerous, Grasshoper, AutoCAD, Photoshop, Illustrator, InDesign & TwinMotion.

Målet med projektet var att rita en musikpaviljong som rymmer 13 000 åskådare. En del av besökarna ska få sitta under tak och en del stå på en öppen gräsmatta.

Fokus för oss under projektet var att inte bara skapa en magisk konsertupplevelse, men också en unik resa till paviljongen genom parken. Akustik och bullerhantering var också av stor vikt, och arkitekturen och landskapet utformades för att skapa de bästa akustiska förutsättningarna.

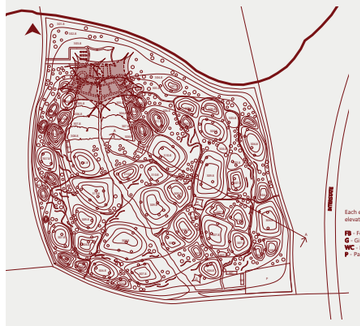
Projektet utvecklades genom en iterativ designprocess, där vi hela tiden ifrågasatte varje del och provade nya lösningar för att få de resultaten vi ville ha.

# Planscher


## THE METAMORPHOSIS
### THE CONCEPT

The Dragonfly is an outdoor music pavilion, integrated into a hilly landscape that leads the visitors under its wings. When the visitors walk in the venue, the glimmering being appears to be soaring over the audience. The entire venue and surrounding area are not only as elegant as a dragonfly, but are also acoustically engineered to provide a good soundscape.

## SITE OVERVIEW
### A PAVILION IN A PLAYFUL LANDSCAPE




## NOISE BARRIER



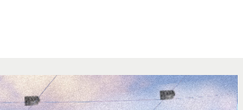

The noise barriers are asymmetric porous, one side being porous the other being highly reflective to work as an absorber down to 215 Hz. The angle of incidence is facing through the porous side.

## NOISE AND ITS REDUCTION
### TRAFFIC NOISE

Due to site limitations, noise barriers could not be placed in proximity to the interstate highway. This restriction was turned into an opportunity for creative acoustic landscaping.
A reasonable A-weighted goal for outdoor sound pressure is presented in the graph. The distance between the highway and the concert area is approximately 450 m. This distance was then used for the length attenuation from the road. The mix of vegetation noise barriers as well as the steep hills encapsulating the audience will effectively reduce the road traffic noise.




Needed noise reduction from the traffic noise.

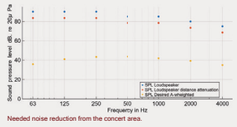


**SECTION A-A** Ground reduction of the traffic noise.

## AUDITORIUM, LAWN & LANDSCAPE


## NOISE AND ITS REDUCTION
### THE RESIDENTIAL AREA

There are also noise problems coming from the concert area. There is a residential area very close to the venue. The closest point between the residential area and the concert is 281 m. The much louder sounds coming from the concert area as well as the shorter distance to the residential area will prove more of a challenge. Noise barriers can be placed closer to the source and thus are much more effective in combatting the noise coming from the concert. The hills between the audience area will also help in reducing this noise. There will most likely still be a noticeable amount of music in the residential area, as the loudspeakers will be driven to a sufficiently loud level for the audience.



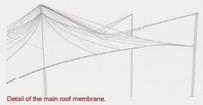

Needed noise reduction from the concert area.

## ELECTRO-ACOUSTICS
### THE SINGING DRAGONFLY

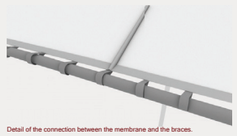
Three line arrays are used on either side and in the center of the stage. The stage is 30 m wide with a line of subwoofers below it. The frequency range of the subwoofers is between 20 Hz to 100 Hz. To ensure good directivity, the subwoofers are placed with a distance of a half wavelength from each other. The delay speakers will be hung on a net with a distance of 18x18 m between the speakers. The net will be elevated to a height of 6 m. The delay loudspeakers will be delayed to give a nice soundscape for the audience.

## ROOF STRUCTURE
### DETAILS

The membranes are held up by steel rods between the main and surrounding pillars. There are also braces both through the membranes and along the edges.



Detail of the main roof membrane.



Detail of the connection between the membrane and the braces.

Detail of the connection between the main pillar and the steel rods.

## ROOF AUDITORIUM
### UNDER THE WINGS

The roof auditorium, consisting of seven sections of rows, holds a total of 3000 spectators. The rows' curvature mimics the playfullness of the landscape. The additional paths between the sections guide the audience through the pavilion effortlessly. The seats, made of oak, have an organic nature and rise from the granite ground of the auditorium.

A light, tensile roof stretches over the auditorium and the stage. It is made of four layered PTFE membranes, held between poles and ropes with a larger one streching over the whole auditorium.

The PTFE fabric is highly sound absorbing, preventing reflections from the roof, creating a suitable environment for electro-acoustics. It also offers durability, flexibility and strength while having a good light and water resistance, protecting the audience from the weather.

## OPEN LAWN
### THE LANDING OF THE DRAGONFLY

An additional 10 000 spectators are spread out on the terraced lawn. The terraces take inspiration from the hilly surrounding landscape. As to limit both the reflecting sound and to decrease the sound travelling to the residential area, the sides of the walls of the terraces are made of absorbing materials. The construction of these walls are similar to that of the noise barriers.

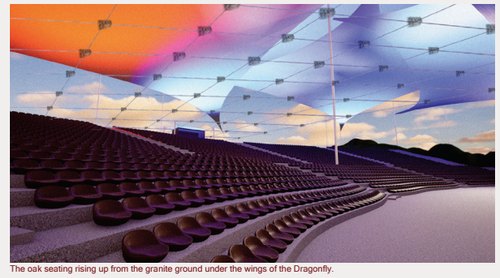
A path is bisecting the terraced lawns in two equal parts. This provides an accessible path leading to the auditorium, and creating a beautiful sight line to the stage when first entering the concert area. Along the terrace closest to the auditorium there is an accessible viewing point for wheelchair users.

## A LIGHT SHOW
### THE AWAKENING OF THE DRAGONFLY

The airy roof can be illuminated in different colors and movement patterns that follow the music and add a visual element to the concerts, awaking the dragonfly.

The roof over the auditorium is visible for the lawn audience and enhances the experience, especially for those far away from the stage.

The dragonfly in action.



The oak seating rising up from the granite ground under the wings of the Dragonfly.

## BACK OF HOUSE
### A CONTINUATION OF THE WINGS

The Dressing Rooms/Rehearsal Rooms, and Offices are as far away from the stage as possible to minimize the effect of the sound propagating from the stage. Facing the river, they have a beautiful and peaceful view. The Dressing Rooms are placed on the first floor, with easy access to the stage and the offices are on the second floor. The large Loading Dock which has two loading bays makes it possible to load and unload cargo simultaniously. It also has easy access to the Storage Room which has easy access to the stage. The Storage Room fits a piano. There is also an additional Outdoor Storage on the east side of the building. Restrooms, a Locker Room accommodating up to 100 orchestra members and store instrument cases, and a Backstage are also placed on the first floor. On the second floor, aside from the Offices, there are more Restrooms and a Green Room with access to the Roof Top with a view over the river. The Mechanical Equipment Room is underground.
In order to achieve a good sound reduction value all walls in BOH are double leaf with absorbers.

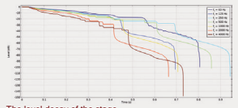
## SUN ANALYSIS OF THE STAGE

A sun analysis of the stage from 2 PM to 10 PM shows that the musicians and the instruments will be protected from the sun during concerts.

## STAGE
### THE NEST

The convex design of the stage, while both being a continuation of the roof also works very well in spreading sound power across the stage. The surfaces of the stage are clad with oak panels. Providing good acoustics on stage when one wall is open to the outside is challenging. The design of the stage has to keep as much energy on the stage as possible, this is what the wedge shape of the ceiling is designed to do. For rock and pop concerts room acoustics are not as important as the performers are using in-ears or monitors, and thus the stage will be dampened using movable absorbing panels.

The stage is 15 m deep and has an area of 458 m², being able to accommodate 250 orchestra and choir members. No podiums are built so that the stage set up can be as flexible as possible. Instead, there are portable podiums in the Storage Room.

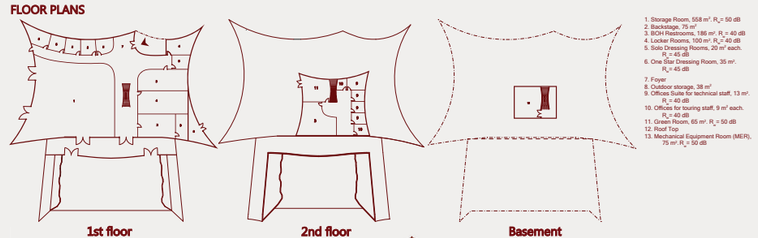


The level decay of the stage.

| fc (Hz) | D (%) | C80 (dB) | T20 (s) |
|---|---|---|---|
| 63 | 60.38 | 2.97 | 1.38 |
| 125 | 58.18 | 2.74 | 1.42 |
| 250 | 56.60 | 2.51 | 1.32 |
| 500 | 54.54 | 2.85 | 1.31 |
| 1000 | 55.76 | 2.79 | 1.20 |
| 2000 | 65.19 | 5.04 | 0.90 |
| 4000 | 75.98 | 8.12 | 0.73 |

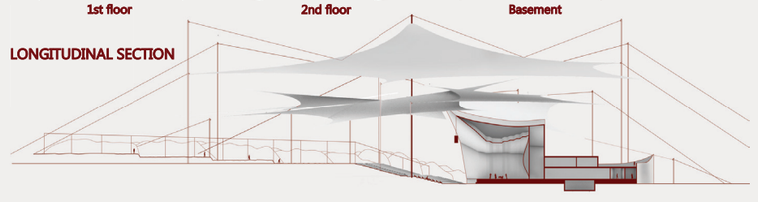
Acoustic parameters of the stage.

## FLOOR PLANS




1. Storage Room, 558 m². $R_w$= 50 dB
2. Backstage, 75 m²
3. BOH Restrooms, 186 m². $R_w$ = 40 dB
4. Locker Rooms, 100 m². $R_w$= 40 dB
5. Solo Dressing Rooms, 20 m² each. $R_w$ = 45 dB
6. One Star Dressing Room, 35 m². $R_w$= 45 dB
7. Foyer
8. Outdoor storage, 38 m²
9. Offices Suite for technical staff, 13 m². $R_w$ = 40 dB
10. Offices for touring staff, 9 m² each. $R_w$= 40 dB
11. Green Room, 65 m². $R_w$ = 50 dB
12. Roof Top
13. Mechanical Equipment Room (MER), 75 m². $R_w$ = 50 dB

## LONGITUDINAL SECTION



# Text från planscherna

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## SUN ANLYSIS
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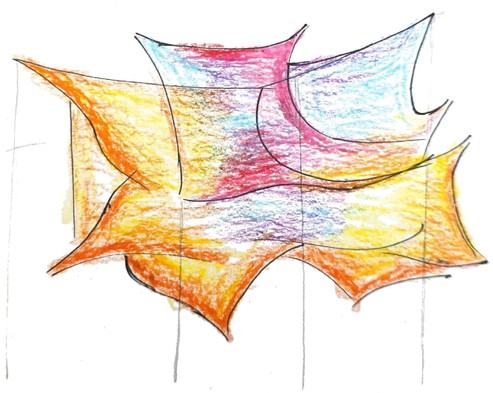
# Processen

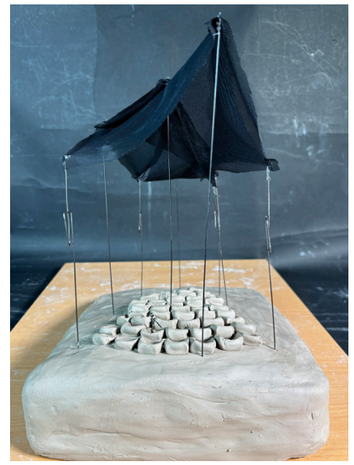
I samarbete med Alicia Bergsten och Nils Steijer. I början av projektet ritade vi tre koncept: The Dragonfly, The Cocoon & The Shell. Vi skissade longitudinella sektioner och byggde modeller av dem, för att sedan tillsammans med vår akustiker välja att gå vidare med The Dragonfly, eller Trollsländan som den hette i början.

Vi tog mycket hjälp av lera i våra skisser. Det är ett mycket enkelt och förlåtande material, och det kom att bli ett väsentligt verktyg under vår iterativa process.

Prototyper av bullerskydden, av sittplatserna och en tidig skiss av situationsplanen i lera styrde vårt process oerhört mycket. Vi skapade ett lekfullt, kulligt landskap i leran, där kullarna och klätterväggarna inte bara agerade som bullerskydd, men de bidrog också till den magiska känslan vi ville uppnå i vårt projekt.

Under utformningen av både landskapet och paviljongområdet låg vårt fokus inte bara på estetiken, men också på vilken design som gav det bästa ljudlandskapet. Vår akustiker var med under varje steg av processen för att säkerställa att de bästa besluten fattades.





# Platsen

Vi valde att rita paviljongen i ett bergigt och lugnt landskap. Det kulliga, lekfulla parklandskapet ska inte sticka ut, utan snarare framhäva de bästa delarna av det redan existerande landskapet.

Branta kullar som reser sig från marken oregelbundet, formar ett landskap som inte tillåter besökaren ana vad som kommer härnäst. Tanken är att besökarna då och då ska få en liten glimt av Trollsländans vingar, och låtas ledas fram av nyfikenheten. Ån bakom scenen ska vara en del av konsertupplevelsen, och ska inte gömmas. Vi ansåg inte att ån skapade några problem bullermässigt, utan snarare bidrog till utomhusupplevelsen.

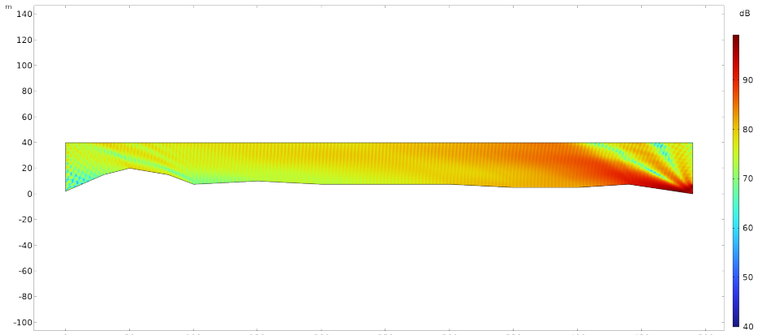

Each elevation curve resembles 1 meter difference in elevation.

**FB** - Food & Beverage
**G** - Gift shop
**WC** - Restrooms
**P** - Parking lot with additional underground parking

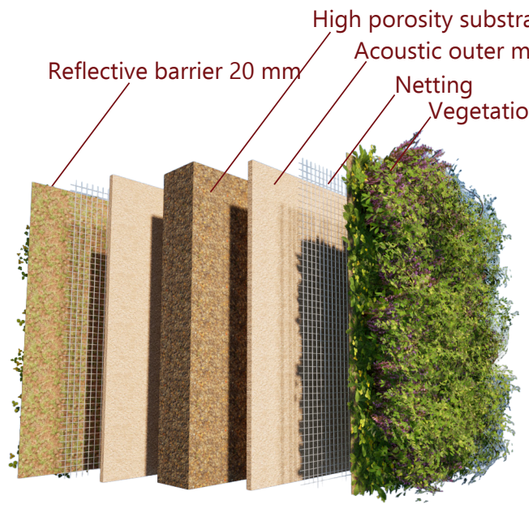
# Ljudbarriärer

På grund av tomtgränserna kunde bullerskydd inte placeras i närheten av motorvägen. Vi tog vara på denna begränsningen och valde istället att utforska med landskapsarkitekturen.

Det kulliga landskapet som omsluter publiken tillsammans med vågiga gröna väggar agerar som ljudbarriär mot trafikbullret. Väggarna är slumpvist placerade i parken och bidrar även visuellt.




Sektion A-A: Reducering av trafikbuller med hjälp av landskapet.



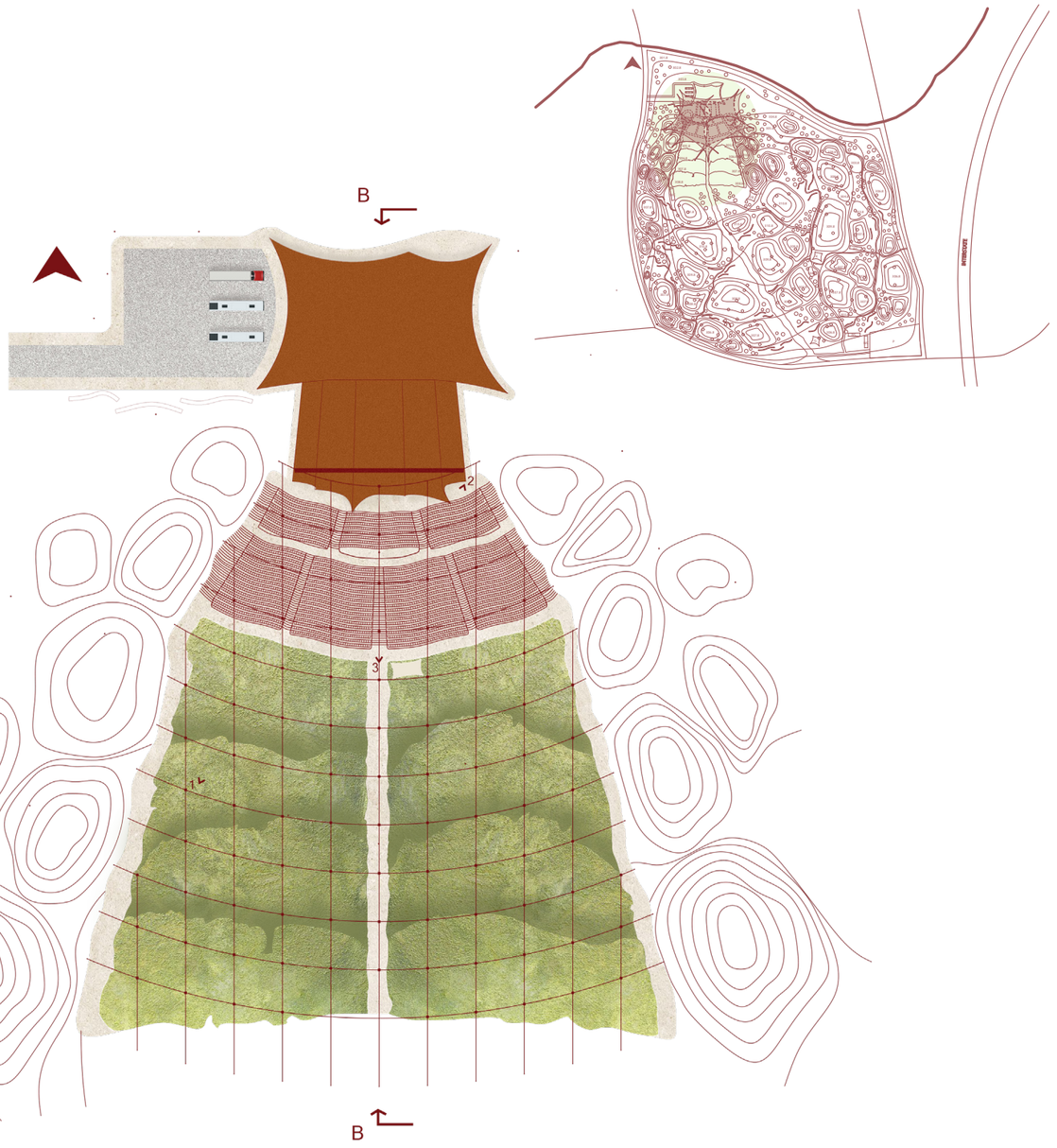

# Amfiteatern & Ståplatserna

Sittplatserna med tak rymmer totalt 3 000 åskådare. Amfiteaterns krökta rader efterliknar landskapets organiska form och lekfullhet. Sätena, gjorda av ek, reser sig från auditoriets mark med sin mjuka form.

Auditoriet täcks av ett lätt membrantak som spänns mellan stolpar och rep. Membranerna är av PTFE och är mycket ljudabsorberande, vilket förhindrar reflektioner från taket och skapar en lämplig miljö för elektroakustik.

Ytterligare 10 000 åskådare är utspridda på den terrasserade gräsmattan, inspirerad av det omgivande landskapet. En stig delar terrasserna i två lika stora delar. Detta skapar en tillgänglig väg som leder till auditoriet och skapar en vacker siktlinje till scenen när man först kommer till konsertområdet.

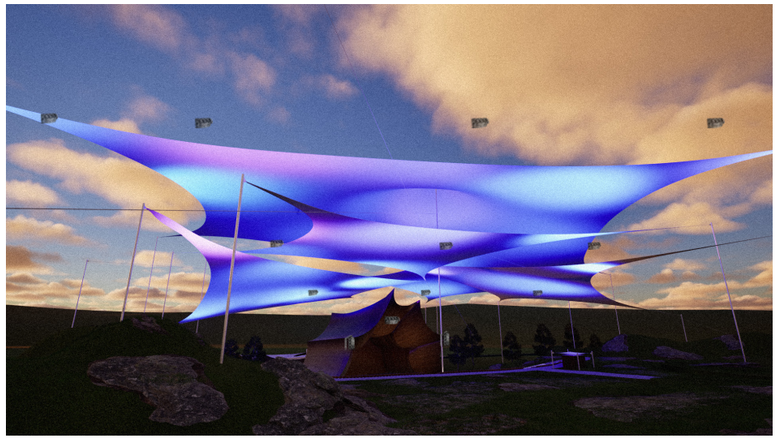
Vi förlitar oss på elektroakustik över hela publikområdet med hjälp av högtalare som hänger i ett nät.

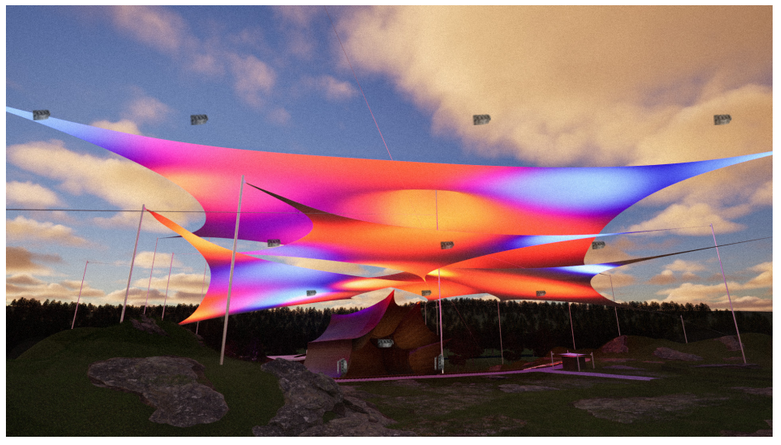


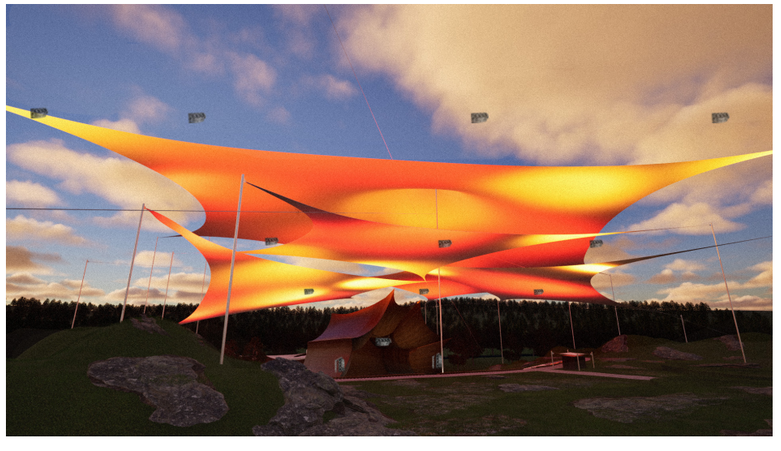
# Trollsländans magi

Det lätta taket kan belysas i olika färger och rörelsemönster som följer musiken och tillför konserterna ett visuellt element, vilket gör Trollsländan levande.

Taket över auditoriet är synligt för den stående publiken på gräsmattan och förhöjer upplevelsen, särskilt för de som befinner sig långt från scenen.



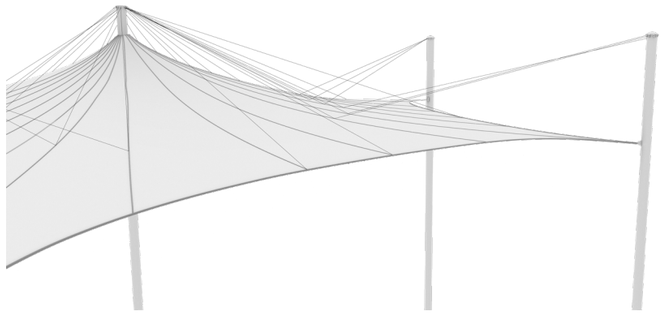


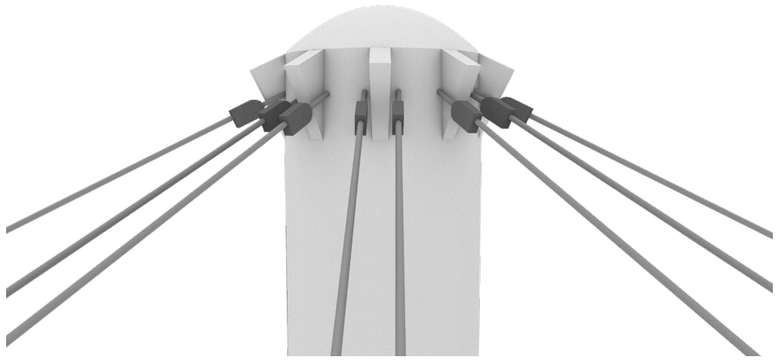


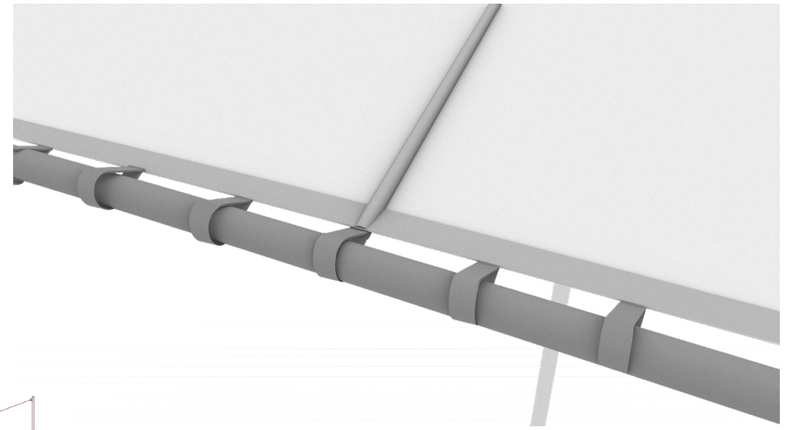
# Takkonstruktion

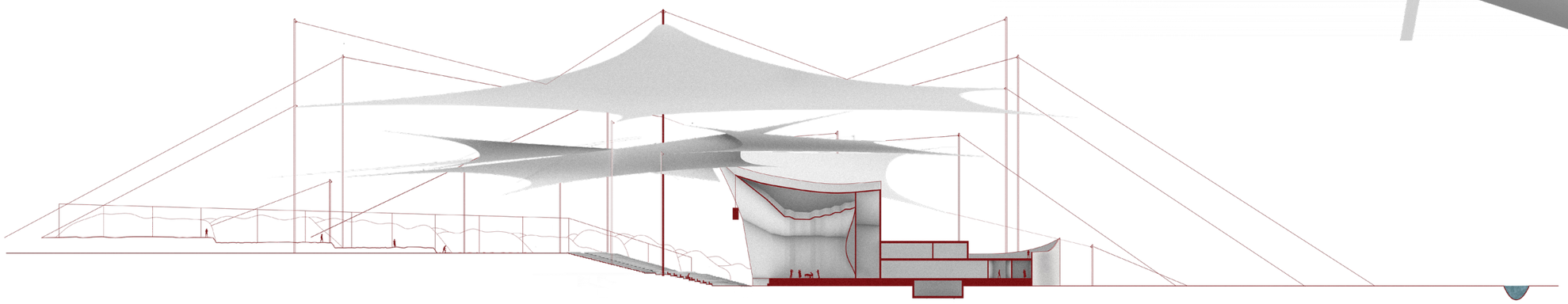
Membranen hålls uppe av stålstänger mellan den centrala huvudpelaren och de omgivande pelarna. Det finns även stag både genom membranen och längs kanterna.

Sektionen visar hur taket förhåller sig till scenen och publiken, samt lutningen på amfiteatern och gräsmattans terrassering.









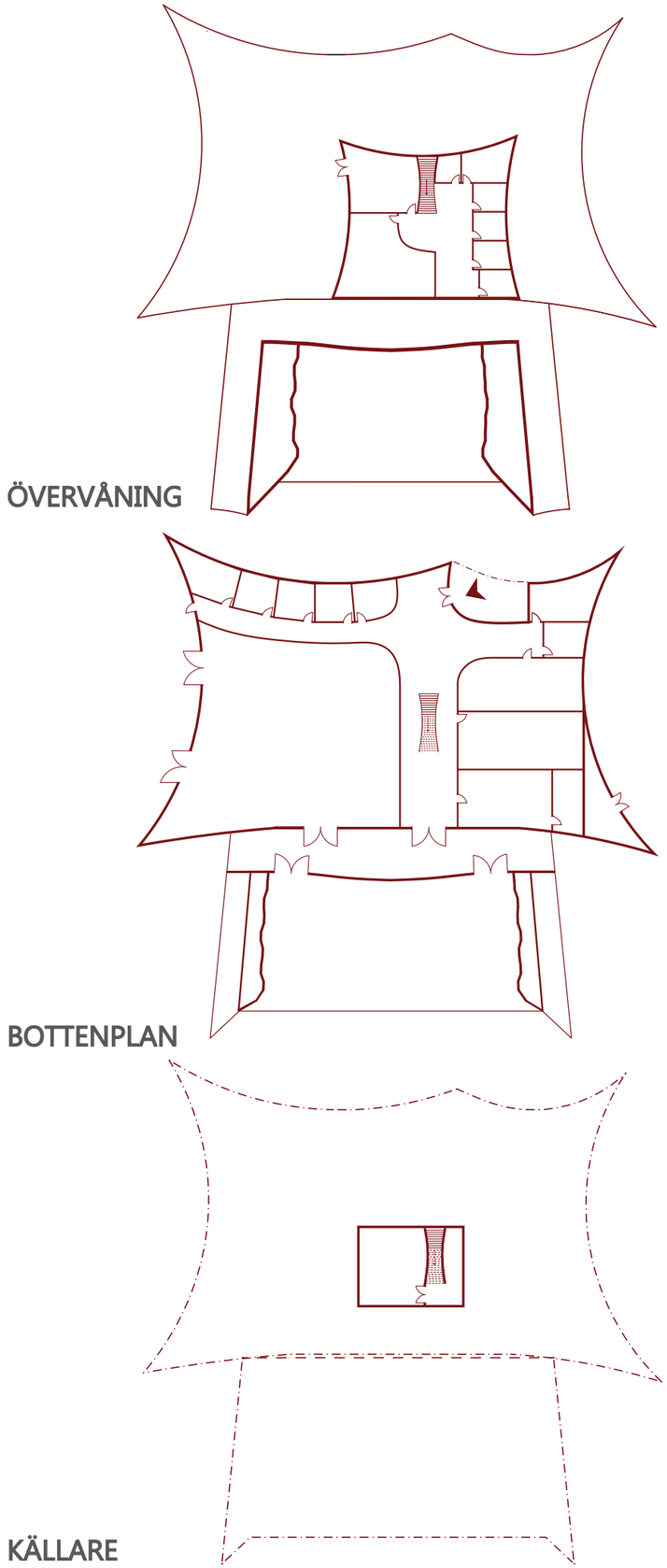
# Scen & Back of House

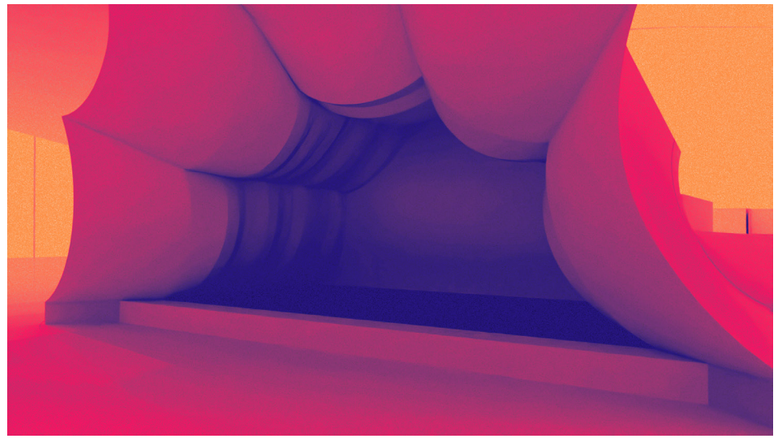
Scenens konvexa design är inte bara en förlängning av takets formspråk. Den sprider även ljud bra över scenen. Scenens ytor är klädda i ekpaneler, och vi förlitar oss helt på rumsakustik på scenen vid klassisk-musikspelningar. Den rymmer 250 orkester- och körmedlemmar.

Omklädnings- och repetitionsrummen och kontoren är placerade så långt bort från scenen som möjligt för att minimera ljudet som kommer från scenen. De vetter mot ån och har en vacker och fridfull utsikt. På andra våningen finns det ett Green Room med tillgång till takterrass med utsikt över ån.

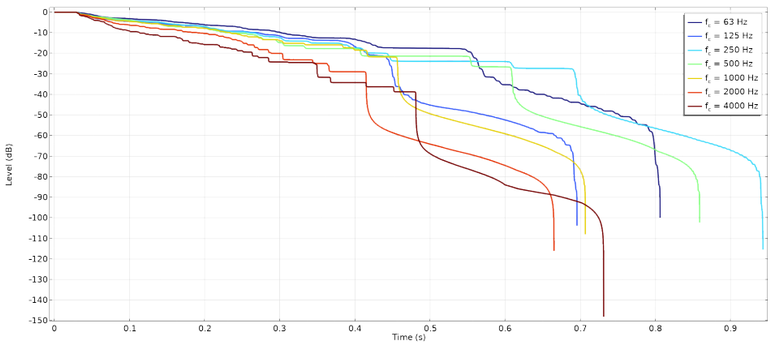
För att uppnå ett bra ljudreduceringsvärde är alla väggar i Back of House dubbelväggar med absorbenter.

En solstudie av scenen som gjordes mellan 14.00 och 22.00 sommartid visar att musikerna och instrumenten alltid kommer vara skyddade från solen under sina konserter.



Solstudie av scenen.




Bortfall av ljud på scenen.

# Reflektion

Jag känner mig mycket nöjd med vårt projekt. Det har varit mycket roligt och lärorikt. Att arbeta i grupp med en akustiker har varit en spännande erfarenhet. Jag tyckte det var roligt att vi kunde sammanfoga våra mycket olika kunskaper och skapa något fint och genomtänkt.

Att arbeta iterativt med flera inlämningar som vi gjort har varit mycket givande. Projektet blev bättre och bättre och konceptet starkare och starkare för varje inlämning.

Under projektet har jag även förstått vikten av att jobba i modell och jag tycker att lera har varit ett underbart skissverktyg som lät kreativiteten ta över.

Källor:
www.skalgubbar.se