

# THE SOUND RIBBON

<b>Course</b>	ACEX15 Bachelor's Thesis in Architecture and Engineering
<b>Period</b>	Spring 2020 (Year 3)
<b>Examiner</b>	Morten Lund
<b>Tutors</b>	Morten Lund, Peter Christensson, Wolfgang Kropp
<b>Tools</b>	AutoCAD, Rhino, Illustrator, Photoshop, CATT-Acoustic
<b>Project group</b>	Linda Xiao, Lisa Kollberg, Spencer Mason

# PRESENTATION

**VIEW OF THE DESIGN**

**SAFELY DANGEROUS**

In order to create the illusion of a smooth structure, the ribbon is made of many thin, slightly curved panels. These are connected together in a way that can be seen through the gaps, but not enough to see the people in the cave. The panels are made of a material that is both safe and sound, as well as the ribbon is designed to be seen from above the ground.

To protect the structure from wind and prevent people from seeing the people in the cave, the ribbon is designed to be seen from above the ground. The panels are made of a material that is both safe and sound, as well as the ribbon is designed to be seen from above the ground.

**ZONES**

**THE CAVE**  
For a cave and provide a sheltered area for the audience. The cave is designed to be seen from above the ground. The panels are made of a material that is both safe and sound, as well as the ribbon is designed to be seen from above the ground.

**THE LAWN**  
The lawn is the main area for the audience. It is designed to be seen from above the ground. The panels are made of a material that is both safe and sound, as well as the ribbon is designed to be seen from above the ground.

**ACOUSTICAL PROPERTIES**

Reflector  
Absorbent

**SPEAKER SETTING**

One of the main purposes of the ribbon is to function as a giant speaker. The ribbon is designed to be seen from above the ground. The panels are made of a material that is both safe and sound, as well as the ribbon is designed to be seen from above the ground.

**THE FEARLESS ZONE**

The fearless zone is the area where the audience can see the stage. It is designed to be seen from above the ground. The panels are made of a material that is both safe and sound, as well as the ribbon is designed to be seen from above the ground.

**THE MIDDLE ZONE**

The middle zone is the area where the audience can see the stage. It is designed to be seen from above the ground. The panels are made of a material that is both safe and sound, as well as the ribbon is designed to be seen from above the ground.

**ACOUSTICS**

**CAVE FEATURES**

The cave features a large opening at the front, which allows the audience to see the stage. The cave is designed to be seen from above the ground. The panels are made of a material that is both safe and sound, as well as the ribbon is designed to be seen from above the ground.

**STAGE AREA**

**FLEXIBLE ACOUSTICS**

The stage area is designed to be seen from above the ground. The panels are made of a material that is both safe and sound, as well as the ribbon is designed to be seen from above the ground.

**ACOUSTICS**

Sound pressure level (SPL) Back position with speakers  
Sound pressure level (SPL) Back position without speakers

Sound pressure level (SPL) Forward position  
Sound pressure level (SPL) Forward position

Sound pressure level (SPL) Lower ribbon and stage area

Scale 1:1000

**THE SOUND RIBBON**

Like sound waves the ribbon spreads across the site, providing a physical acoustic environment for everyone. The ribbon flows up and down, interacting with functions on the site and creating natural paths to walk along, beneath and above. As the way from arriving at the site to the stage area where the performance will be enjoyed. Along the way, the ribbon provides several different functions to create a unique experience for the visitors interacting with it.

Uroko Kaiti  
Lisa Kulewaga  
Suzanne Mason

Wall  
Floor  
Roof  
Shelter  
Structure for Speakers  
Lights  
Acoustical Reflector  
Absorbent  
Navigation  
Sound barrier

**SITE ENTRANCE**

Rehearsal room  
Cave  
Stage  
Lawn  
Ribbon

Scale 1:1000

**STAGE AREA**

Scale 1:100

**LAWN AREA**

Scale 1:100

**ENTRANCE AREA**

ARRIVE TOGETHER

Scale 1:1000

**REHEARSAL BUILDING**

**BETWEEN ROCKS**

Scale 1:1000

**ACOUSTICS**

Scale 1:1000

Rehearsal room and stage

Scale 1:1000

Presentation boards as shown on the final critique, May 7th 2020.

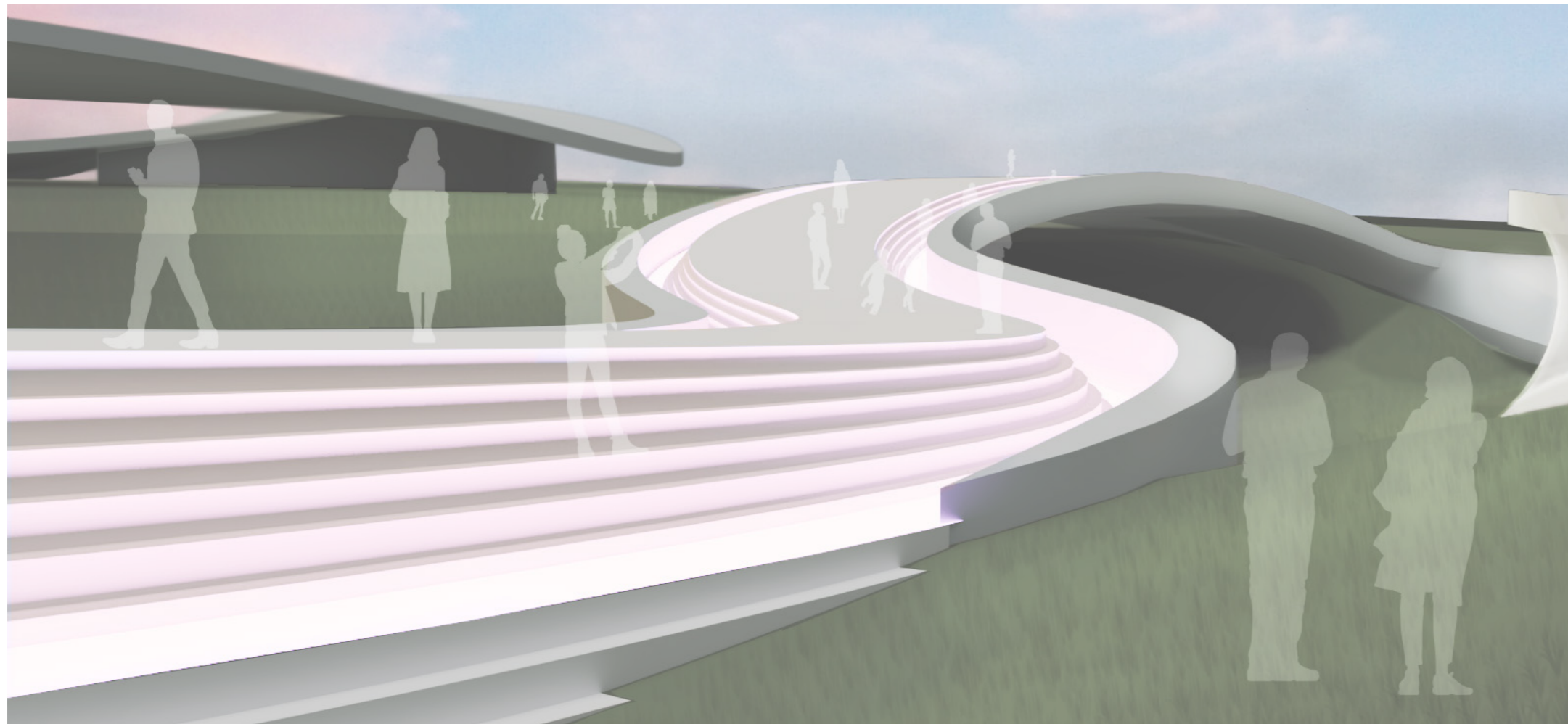
# THE PROJECT

## Interactive structure

Like sound waves the ribbon spreads across the site, providing a pleasant acoustical environment for everyone. The ribbon flows up and down, intertwining every function on the site and creating natural paths to walk along, beneath and upon, all the way from arriving at the site to the stage area where the performance will be enjoyed. Along the way, the ribbon provides several different functions to create a unique experience for the visitors interacting with it.

## Customisable experience

The site has the capability to accommodate different types of performances and is able to adapt depending on the acoustical demands for each performance. There are several different ways to experience the variety of performances that takes place at the site in different audience zones, ranging from a peaceful and classic theatre experience inside a cave to a hectic and social experience in the lawn or mingle zone or an adrenaline rush in the fearless zone on top of the ribbon. The experience can be customised for all preferences.



Perspective of people walking on top of the ribbon.

# THE RIBBON

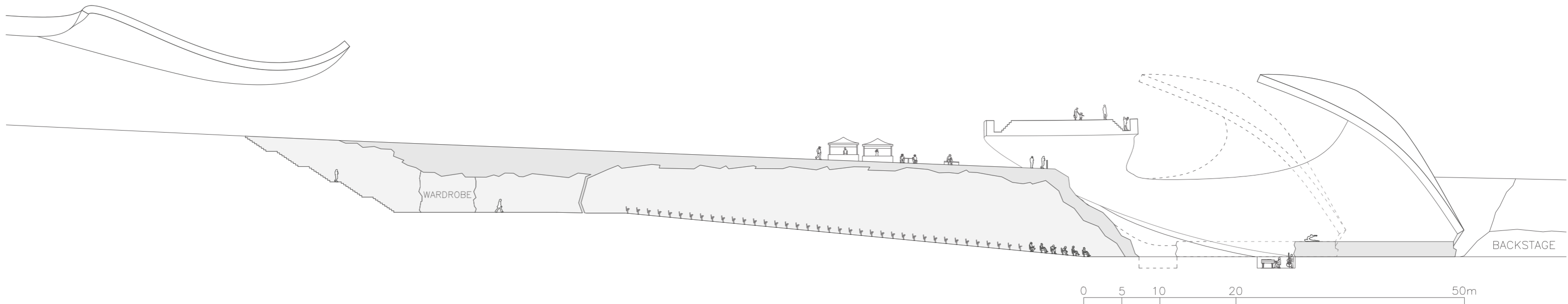
## Multifunctional structure

The ribbon provides several different functions across the site, ranging from creating spatiality and forming roofs, walls and floors, to acting as grid-iron for speakers and spotlights and creating a pleasant acoustical environment with varying surface materials depending on the acoustical demands.

In the stage area, the ribbon and stage are flexible and can be moved backwards and forwards depending on the acoustical demands of the performance. For a smaller concert requiring natural acoustics, the stage can be moved closer to the cave to create a more intimate and enclosed experience for the audience. For a larger concert with a much larger anticipated crowd, the stage can be pushed back to provide a good sight for more people and for the acoustics to spread further across the site.

## Section of the cave and stage area

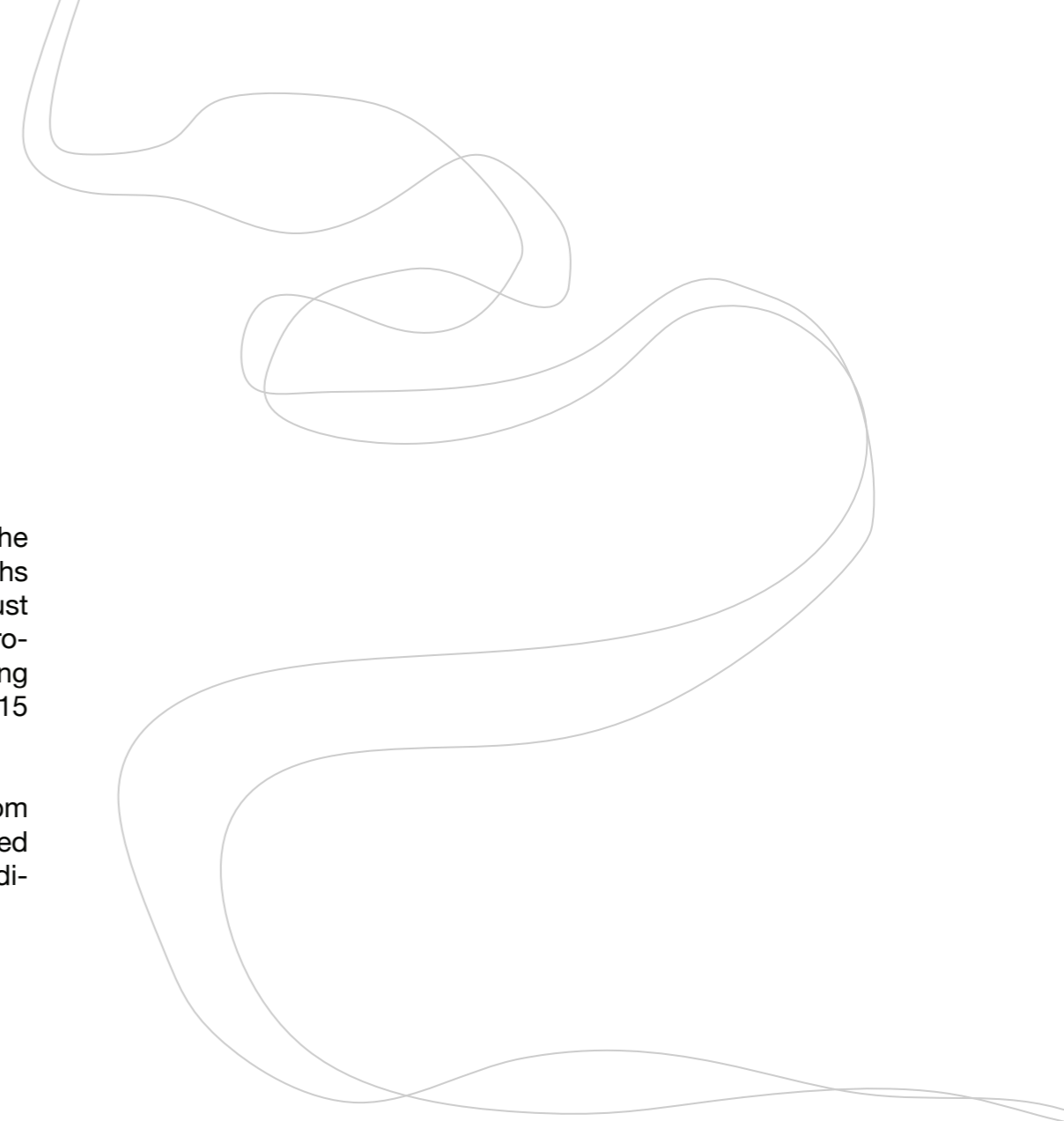
Scale 1:500



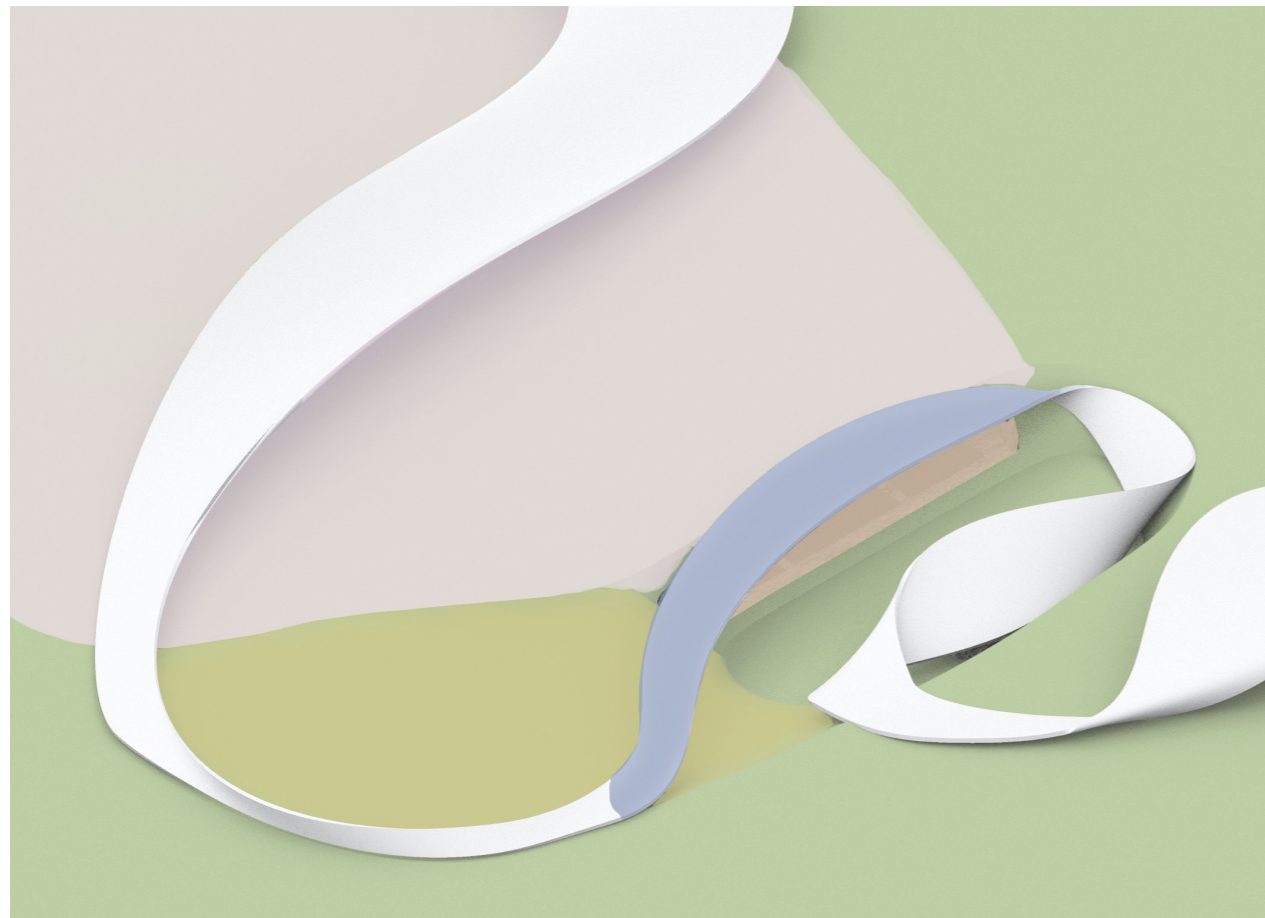
## Safely dangerous

In order to create the illusion of a smooth silhouette, the edges of the ribbon are lowered, creating narrow paths along the sides, that are accessible through stairs, with just enough width for one person to stand. The paths both provide a sense of safety and good sight for the people walking on the ribbon, as well as the illusion of a fenceless ribbon 15 meters above the ground.

To maintain the fenceless ribbon and prevent people from walking where they are not supposed to, the path is blocked by the ribbon itself twisting and becoming vertical to indicate that the standing area ends.



# THE ZONES



## The cave

For a luxurious and peaceful experience, the seated audience is placed inside a cave in front of the stage. With a capacity of 5,000 people, the cave provides the best sight and natural acoustics for the seated patron.

## The fearless zone

The most unique experience is only for the fearless patrons. The zone is accessed by walking onto the ribbon and provides a good sight of the whole site and an adrenaline rush. On top of the ribbon, the concert can be enjoyed coming from beneath the feet while feeling the breeze 15 meters up in the air.

## The lawn

The lawn in the slope to the left of the stage provides a large area for the patron desiring both a good sight and acoustics as well as a good atmosphere. The slope is divided into plateaus to create comfortable areas for people to sit, stand or dance on while enjoying the performance.

## The mingle zone

For a more relaxed experience, the mingle zone provides a large area for the visitors who wish to enjoy live music while having the freedom to move around, dance and have a chat with people.

# THE ACOUSTICS

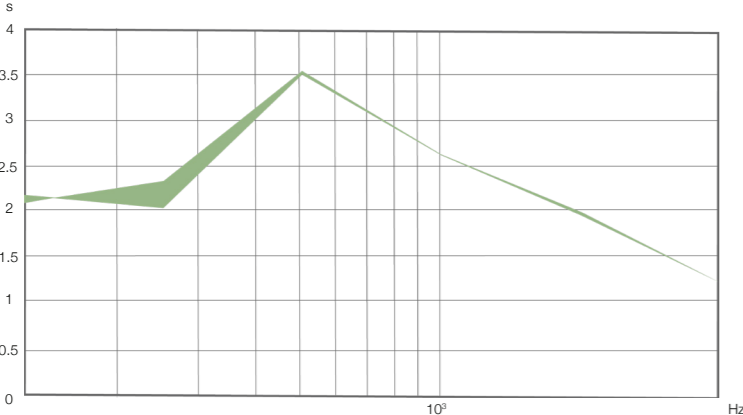
## Cave features

When the stage is in the forward position, the natural acoustics fill the entire cave that holds the seated audience. The interior is covered with a porous stone material which absorbs some sound to reduce the reverberation time. For the lower frequencies, the inside of the walls are constructed with Helmholtz absorbers. This contributes to a reverberation time of 2.3 seconds, and the acoustics resemble that found inside a natural cave.

With the reflective and rough stone walls inside the cave, the sound pressure level and clarity are quite even throughout the space, with only about a 5 dB difference in sound pressure level between the front and the back. By increasing the absorption on the stage wall, the stage roof and the underside of the ribbon, late reflections are reduced, improving the clarity within a range of 0 to 5 dB which is ideal for concert halls.

## Reverberation time (T-30)

Inside the cave



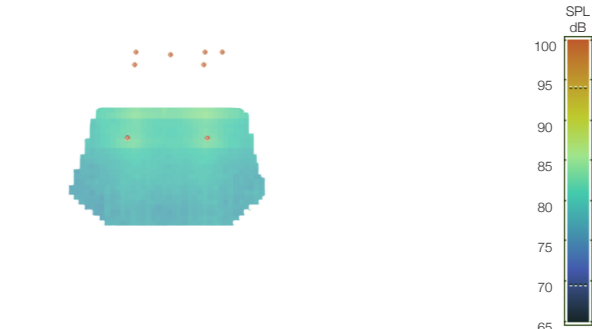
## Sound pressure level (SPL)

Back position without speakers

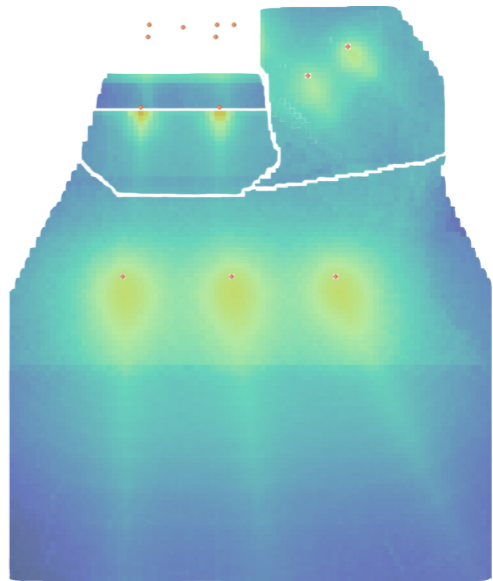
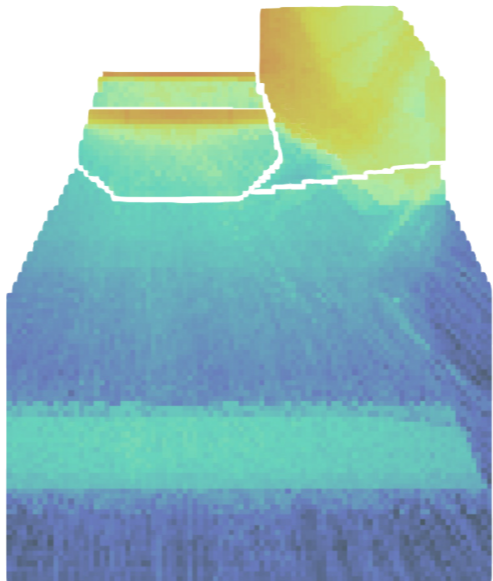
Inside the cave



Back position with speakers



Lawn, ribbon and mingle zone



# DESIGN PROCESS

## Concept origin

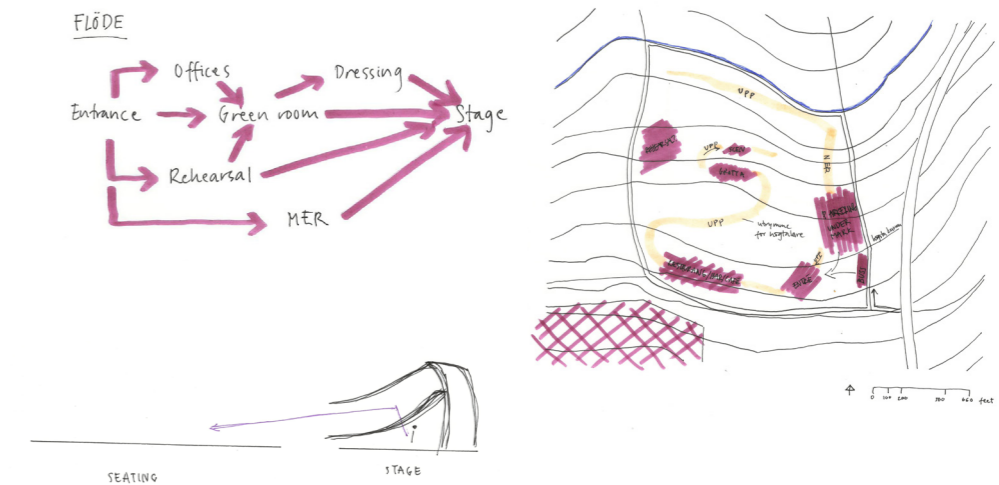
Early in the process, we acknowledged the significance of the size of the site and we wanted to create a concept that connects every function in order for the size to not feel so overwhelming. Thus, the concept of a ribbon stretching across the site was born.

We began investigating different shapes with modelling clay and were inspired by a Möbius strip and its ambiguity regarding above and beneath. Based on this concept, the idea of an interactive structure with people walking both on top and beneath was born.

In the meantime, we investigated different possibilities for the seated audience demanding roof and natural acoustics. Our idea of the cave originates from the idea of wanting a natural and organic pavilion meanwhile making use of the terrain to provide sight for a larger audience. In order to achieve this, we did several analyses by drawing sightlines to obtain the most optimal inclination of the cave and depth of the excavation where the stage is located.

As we developed the concept of the ribbon and cave further, we also worked with flow charts to facilitate the movement for everyone using the site and we decided to separate the entrance for the performers and visitors to create an undisturbed visit for both parts.

## Exploratory sketches

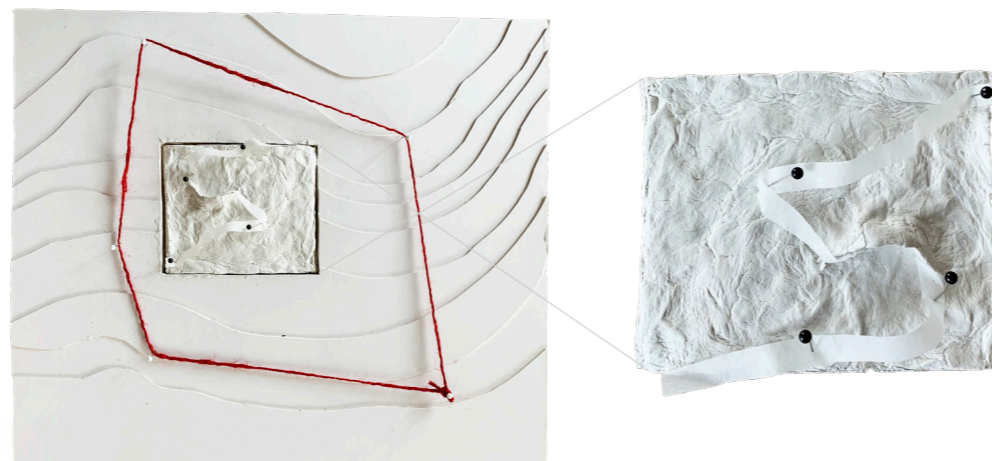


## Concept models



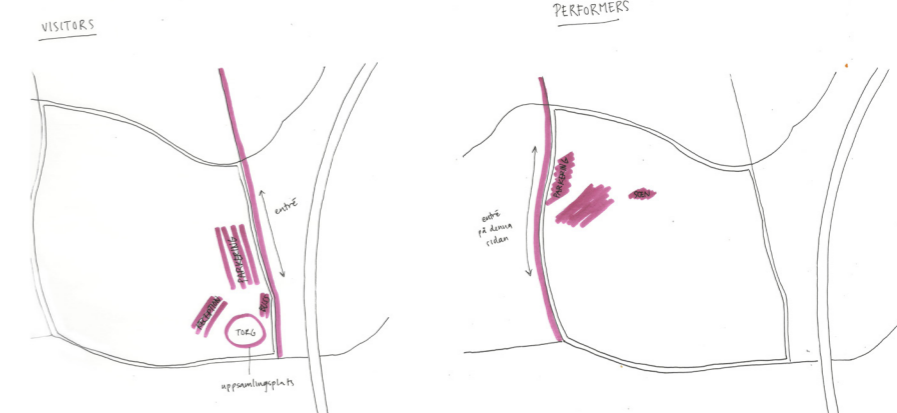
Material: modelling clay

Concept model of the ribbon around the stage area.



Material: foam board, modelling clay

Landscape model with a model of the cave and the surrounding ribbon.

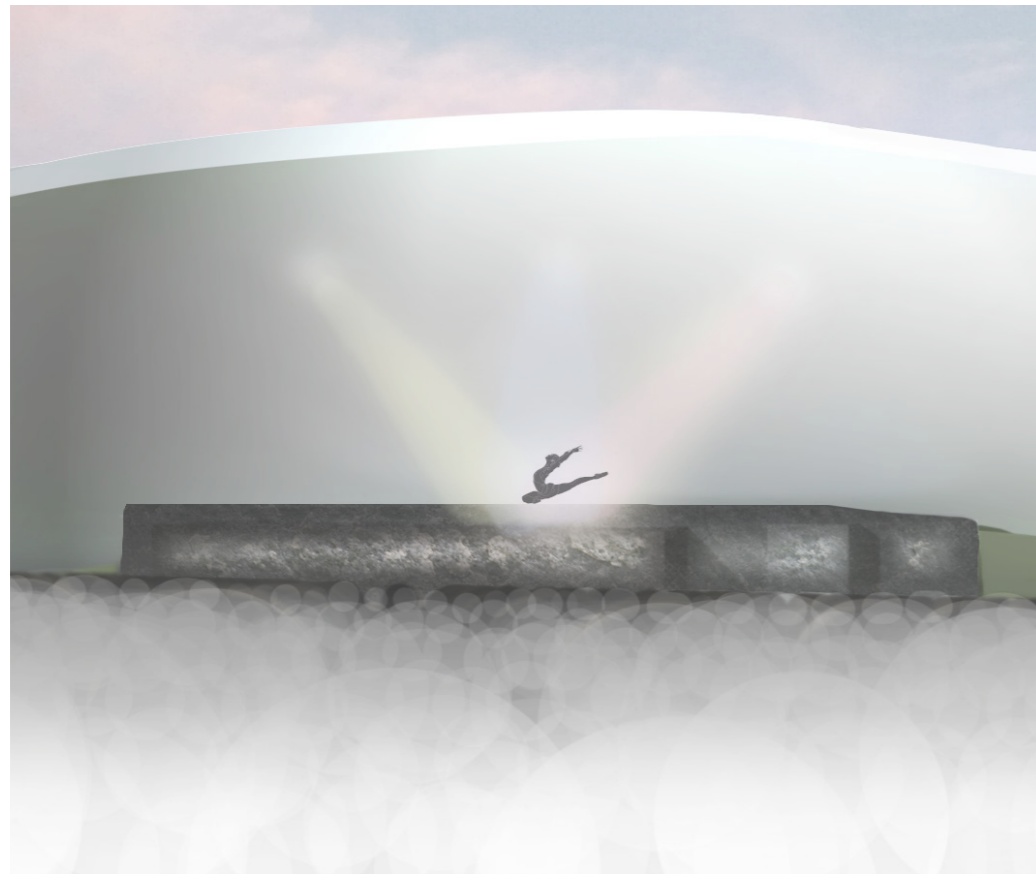


# REFLECTION

## Interdisciplinary collaboration

Due to difficulties in the beginning of the project, we were not able to collaborate with an acoustician until some time into the process. Therefore, we set the acoustical part of the project aside during quite a long time and mainly focused on the architectural part. However, when we got in contact with our acoustician later in the process, it was quite late to make drastic changes in order to improve the acoustical properties, but we managed to compromise and find solutions that was beneficial both for our concept and the acoustics.

It was very helpful to work with someone within another discipline and to get another perspective of the project, which we have never done before, and I believe that the collaboration has been interesting and educational.



Perspective of the stage from the cave.

## Applied methodology

During the conceptual stage of the project, we spent most of the time investigating different shapes using physical models. I believe that it was the most optimal way to develop a concept we liked, since it was a much more effective way for us to obtain a simple model in 3d unlike when working with digital tools, as well as a better alternative than drawing in 2d in order to being able to watch it from different angles.

Up until the first gallery critique, we produced everything by hand and we wanted to set the concept straight with physical models and drawings before we moved on to digital models. By this time, the Covid-19 pandemic began to spread in Sweden and we decided to continue to work from home to prevent the risk. In the beginning, it was quite difficult to adjust to working with a group project remotely, but we tried our best and held daily meetings via Zoom to review the plan of the day and thereafter worked individually with occasional communication during the day. It was especially difficult to have to send our unfinished products back and forth, which certainly would be more efficient if we worked together face to face, but I believe that we managed to adapt to the situation as good as possible from a distance.

## Acoustical architecture

With regards to the circumstances, I believe the project turned out as we wanted it to be and we are very satisfied with the result. I think that we managed to integrate the ribbon on the site as a structure connecting the different functions, and especially how well the acoustics are integrated in the structure, which was our intentions from the very beginning.

Furthermore, the concept of the cave is another part of the project that we worked much with. We are especially pleased with its achieved acoustical properties which is optimal for concert halls, meanwhile still resembling the properties of a natural cave which was our intention with the concept. In conclusion, we had many shattered ideas early on that we wanted to develop, but I believe that we have managed to keep many of the ideas from the early iterations and integrated them to create a coherent whole.