TUNED BY ARCHITECTURE

- An Investigation of the Link between Sound and Building Design

PETRA MARGARETHA SANDBERG

Chalmers University of Technology
Department of Architecture and Civil Engineering
Design for Sustainable Development

Tutor: Emílio Brandão
Examiner: Krystyna Pietrzyk

A SPECIAL THANK YOU TO...

Sebastian Christensson
For making my dream of a master thesis project that merges the fields of architecture and acoustics possible. The collaboration has been invaluable to my understanding of the link between sound and building design.

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For their constant support throughout the process of this master thesis, as well as helping out in my workshop and during many visits to Kulturtemplet.

My immediate Family
For their unconditional love and support during this master thesis process as well as in many other projects.

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Spring 2017

CHALMERS

SWEDISH SUMMARY

I vår vardag är vi konstant utsatta för olika ljud både i inomhus- och utomhus miljöer. Hur vi upplever dessa varierar mycket men oönskat ljud kan leda till kommunikationssvårigheter, ökad puls och i värsta fall till olika stressrelaterade sjukdomar. Olyckligtvis spenderar arkitekter en dag av fem år på akustik under sin utbildning. Till följd av bristande kunskap inom ämnet riskerar de därför att designa dysfunktionella och ohälsosamma rum och miljöer. För att bryta denna trend fokuserar detta examensarbete helt på ljud. Det har dessutom utförts i samarbete med en student från masterprogrammet 'Sound and Vibration' på Chalmers Tekniska Högskola, för att ytterligare stärka kunskapen inom ämnet. Följande frågor behandlas i projektet:

1. Hur kan design användas för att uppnå en viss ljudmiljö?
2. Hur kan den gamla vattenreservoaren, Kulturtemplet, utvecklas så att konserter kan hållas för fler personer än vad som är möjligt idag och samtidigt behålla den existerande och uppskattade efterklangstiden*?
3. Hur kan en akustiker och en arkitekt sammarbeta i ett designprojekt för att uppnå specifika ljud miljöer?

För att skala ned projektet till en hanterbar storlek valdes en byggnad med ett redan stort ljudfokus ut som fallstudie för den akustiska undersökningen. Byggnaden, också känd som 'Kulturtemplet' är en gammal vattenreservoar färdigställd år 1901. Den idag tömda vattencisternen är helt byggd i betong med valv i två riktningar vilket vid en akustisk mätning med en källa och en mottagare, visade sig ge en extremt lång efterklangstid* på ca 16 sekunder. Pga, den uppskattade ljudmiljön, används byggnaden idag av konstnärer, musiker och besökare av olika evenemang.

Människor absorberar ljud därför ändras efterklangstiden* med antalet personer som vistas i byggnaden. En konsert för 1 person vs. 40 personer låter därför olika. Designmålet för examensarbetet blev därför att finna ett koncept där efterklangstiden* kan kontrolleras och kompensera för ljudet som besökarna absorberar. Byggnadens befintliga utseende modellerades i 'Sketchup'. Olika designlösningar testades sedan genom ljudsimuleringar i 'CATT Acoustics'. En ökad volym av rummet resulterade i en längre efterklangstid.* I designförslaget sänks därför golvnivån med 11m för att möjliggöra en konsertsituation med 40 personer och en bibehållen efterklangstid* på 16 sekunder.

Om efterklangstiden* sedan önskas sänkas, kan volymen därifrån minskas genom att fylla byggnaden med vatten, vilket återkopplar till vattencisternens ursprungliga funktion. I fall när detta är otillräckligt kan fukttåliga ljudabsorbenter av mossa agera som komplement.

Examensarbetets mål är att belysa länken mellan ljud och byggnadsdesign. Den hoppas kunna uppmuntra arkitekter att överväga akustik mer i designprocessen. Med ett ökat intresse och kunskap inom området skulle färre rum och platser designas med oönskade och skadliga ljudmiljöer.

* Efterklangstid = Begrepp inom rumsakustiken som beskriver den tid det tar för ljudet att minska 60 dB (Absoflex, 2017).

ABSTRACT

All throughout our lives we are constantly exposed to sound, both outdoors and indoors. Even though human reactions vary, unwanted sound environments can lead to communication difficulties, stress and sometimes even severe illness.

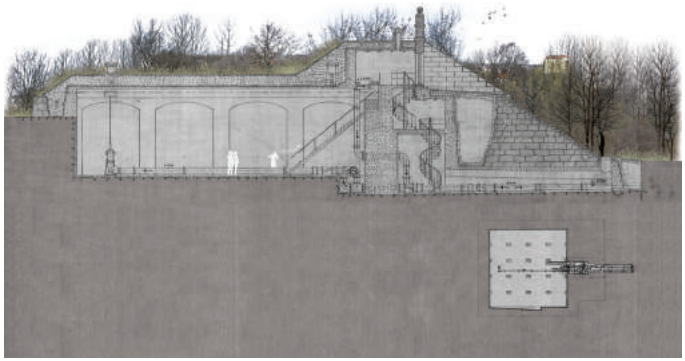
There is a strong link between how a space sounds and how it has been designed. Unfortunately, most architects lack knowledge within this field. Therefore, this master thesis has investigated three acoustic principles that can be used to guide the design process.

An underground water reservoir was used as a case study for the investigation. Due to its extremely long Reverberation Time, RT_{60} (RT_{60} = a measure of the acoustic properties of a room, equal to the time taken for a sound to fall in intensity by 60 decibels (British Dictionary, 2017)), of more than 16 seconds (at 500Hz) with two people present in the room, the building is currently used by artists and musicians as a space for performance.

The Reverberation Time automatically decreases when the number of people within the building increases. Therefore, a design concept where the sound environment could be controlled was necessary for the master thesis project. A 'Research by Design' method was carried out to investigate the effects on the Reverberation Time due to changes in space volume. The investigation was concluded with a new design proposal for Kulturtemplet where the current floor level is lowered by 11meters, making it possible to keep the existing and appreciated Reverberation Time of 16 seconds even with 40 people present in the room.

This master thesis aims to raise awareness of the link between sound and building design. It strives to encourage architects to consider acoustics more in the design process. If architects better comprehend this complicated issue and consciously work with the aspect in all projects, we can improve people's health through sound integrated design.

BEFORE



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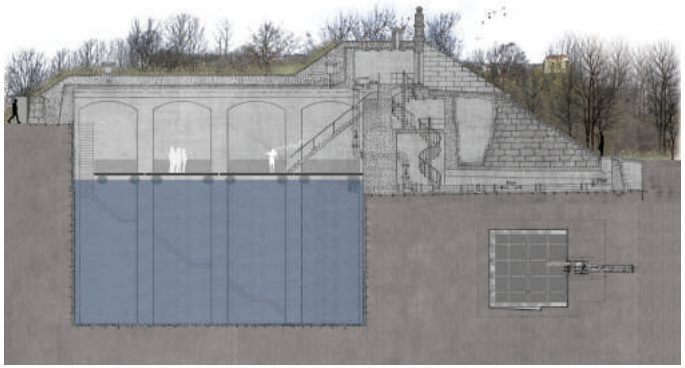

Keywords: Sound, Acoustics, Architecture, Reverberation Time, Water Reservoir, Sound Integrated Design

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Quick facts...

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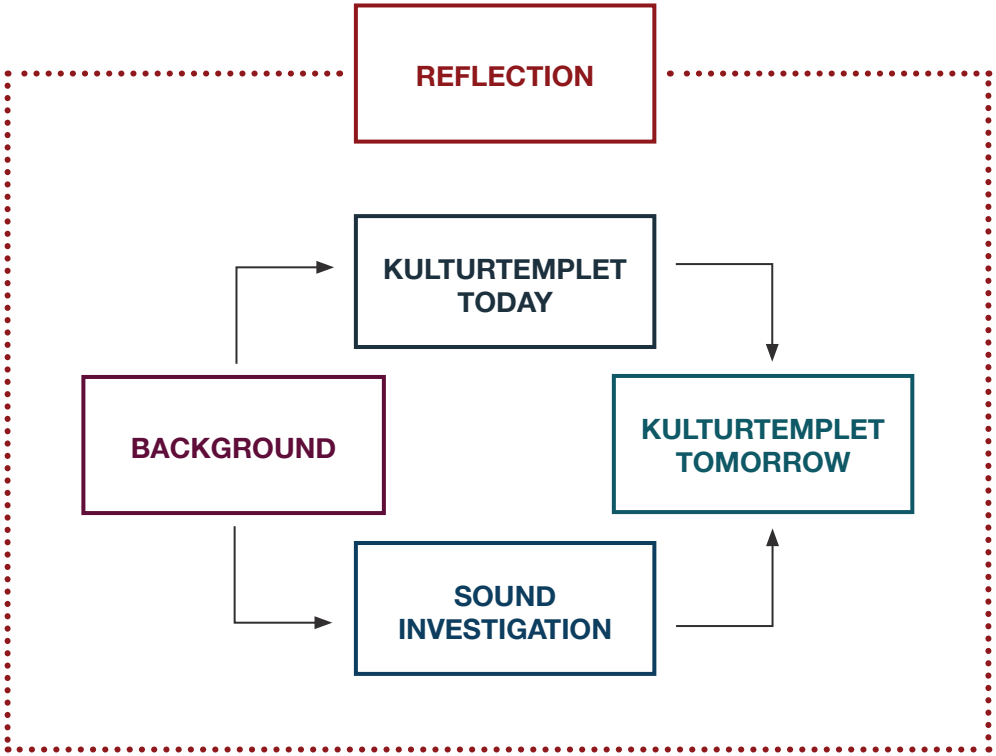
Long before I began my architecture studies I had strong interest for the link between sound and our experience of space. I expected the aspect to be frequently discussed during the degree but unfortunately that was not the case. Instead, we learnt almost nothing about sound during my bachelor in Scotland. When starting the master program 'Design for Sustainable Development' at Chalmers University of Technology, I felt that I still lacked essential knowledge about the subject. Therefore, for my master thesis project I decided to try to learn more about the link between sound and building design.

Love Letter to Kulturtemplet

How can a place so cold give you a feeling so warm?

I'm not a musician, not even an acoustician. Still you touch me like no other building ever has before. My feelings for you are hard to describe. Was it love at first sight? Or was it rather a reaction to the unavoidable audible attraction? The coolest thing of it all, is how you touched my soul, which resulted in a design goal. Did I really change you to the better is a question I ask myself while writing this letter. Nothing about you really had to change but that would have left me with a master thesis quite strange. So I wanted to investigate, how we could make you even more great. Sharing you with more, was naturally what I asked for. This was impossible at your current state, therefore we needed to add another gate. But that wasn't enough, so at the start it felt quite tough. How could your acoustic qualities remain, even with a bigger audience gain? The volume had to increase, which we tested piece by piece. The investigation was concluded, yet with a lot of aspects excluded. Anyways, the project should be seen as a case study, where you almost acted like my buddy. Through you I got to learn about sound, in a mysterious place underground. I am extremely thankful for this thing and believe that our love story is not just a temporary fling. It's time for me to move on in life and leave you behind, but you will always stay on my mind!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KULTURTEMPLET TODAY
BACKGROUND
KULTURTEMPLET TOMORROW
SOUND INVESTIGATION

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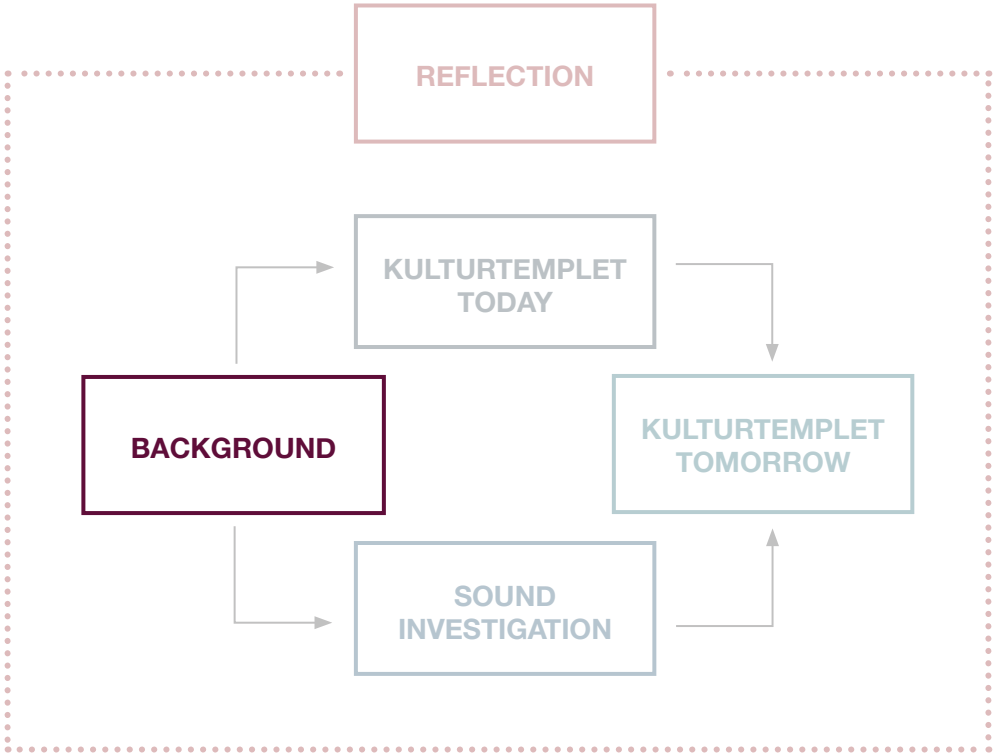
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SOUND INVESTIGATION

1. BACKGROUND

“The Modern Architect is designing for the deaf”

- Raymond Murray Schafer

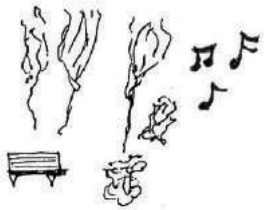
DISCOURSE

Human lives are filled with sound. In contrary to our eyes that we can close, our ears are constantly awake, even during our sleep (Christensson, 2013). The sounds that we hear vary a lot, from bird song, to traffic noise, to words coming from two colleagues having a conversation right next to our desk. Even though, human reactions to sound sometime are different it is important that we try to avoid 'sound accidents' and take sound into consideration in the design of buildings and outdoor spaces (Treasure, 2014).

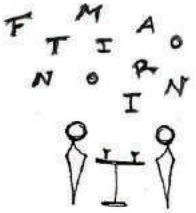
EXPOSURE TO SOUND...

At home

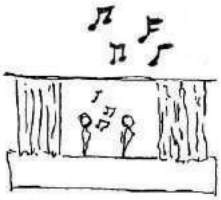
At the Office



In the Park



In Restaurants



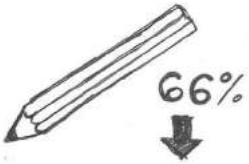
At Concerts

At the gym

Depending on the function of the space, the aspired sound environments are different. In an opera hall a bit of echo is needed whereas in a conference room it is important with good speech intelligibility, hence a low Reverberation Time (Trufelman, 2016). Research shows that productivity in an office can be reduced by 66% from hearing people talking (Treasure, 2009). Therefore, we may prefer a bit of background noise over good speech intelligibility while working. Moreover, if the sound environment is insufficient for the function of the space it may lead to discomfort, communication difficulties or even severe illness (Christensson, 2013). Therefore, even though sound is a complex matter, it should always be considered in relation to the function of each space. By consciously working with this aspect during the design process, a lot of 'sound accidents' could be avoided which hopefully would result in healthier spaces for people (Treasure, 2014).

SOUND RELATED PROBLEMS

Communication Difficulties

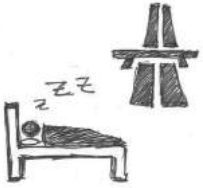


Reduced Productivity

Heart Diseases

Discomfort

Stress



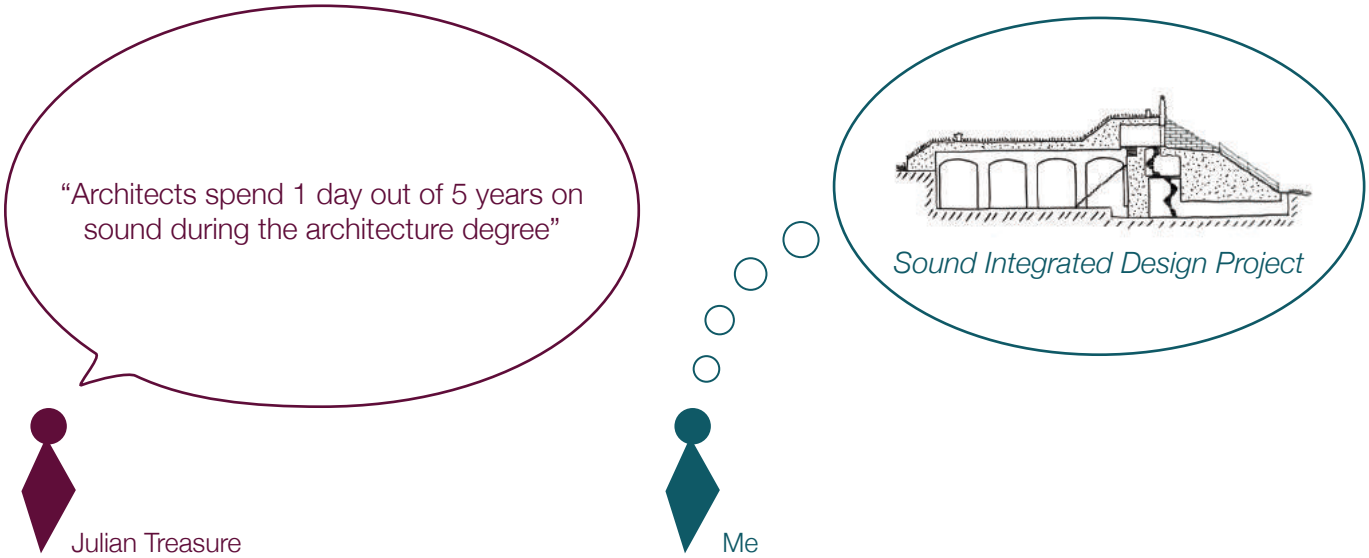
Sleeping Problems

PURPOSE

During a conference in Gothenburg in 2014, sound expert Julian Treasure pointed out that architects spend less than 1 day out of 5 years on sound during their studies (Treasure, 2014). Therefore, most architecture students lack knowledge about how their design affects the sound environment when they enter the professional world. With a desire to learn more about the subject this master thesis investigates the link between sound and building design.

In order to scale down the project to a manageable size, a space with an already existing sound focus was chosen as a case study for the investigation. The investigated building, also known as Kulturtemplet is an old water reservoir constructed in 1901. Due to its shape, volume and materials, it has an extremely long Reverberation Time, RT_{60} (RT_{60}, explained on page no. 19). The unique acoustic character of the former water cistern is appreciated by artists and musicians that use the space for different types of performances; however, one issue with the sound environment of the building was identified early the master thesis process. The Reverberation Time decreases when the number of people within the room increases which makes it impossible for a large audience to have the same audible experience as a small audience will have. Therefore, the main purpose of this master thesis project was to investigate how design could be used to control a sound environment.

In real life building projects, the aspect of sound is often brought up late in the design process. In contrary, this master thesis focuses on the current acoustics of Kulturtemplet from the onset. It uses sound as the leading concept throughout the whole design process with the aim of being a sound integrated design project.



SUSTAINABILITY

A lot of research have been done on the connection between sound and human health and comfort. However, these impacts are complex and often very subjective, which is why they have not been given a large role within this short project. Nonetheless, by learning about how sound can be controlled, architects are likely to design sound environments that are less harmful to people. Moreover, hopefully less buildings will have to be redesigned due to insufficient acoustics for the function of the space.

More specifically, there is a direct sustainability aspect to this project in reusing an existing structure and at the same time preserving its unique character and identity. It aims at improving the building's capability of serving an increased number of people, as well as, allowing for various different functions without ruining the existing, much appreciated sound environment.

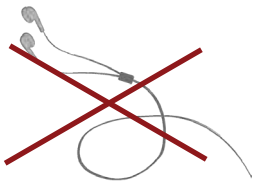
MASTER THESIS QUESTIONS

1. How can design be used to achieve a certain sound environment?

2. How can the old water reservoir, Kulturtemplet, be developed to host more people at music events without ruining the existing, much appreciated sound environment?

3. How can architects and acousticians collaborate in a design project to achieve specific sound environments?

LISTENING INSTRUCTIONS



This master thesis contains sound tracks. To listen to the recordings, use this website:

https://soundcloud.com/tunedbyarchitecture

Use covering headphones, not earbuds, for the best audible experience.

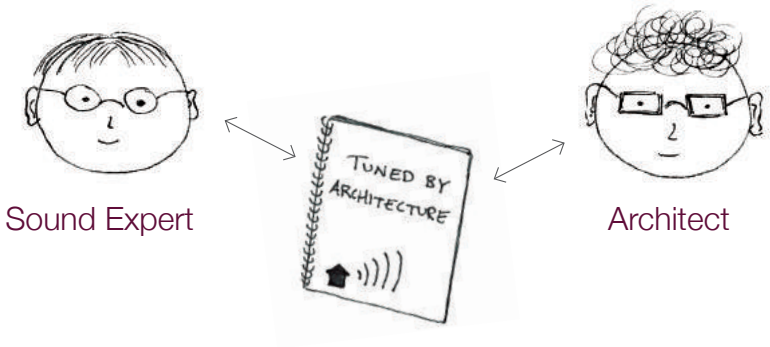
METHOD & REFERENCES

To thoroughly explore the link between architecture and acoustics in such a short time, the master thesis was carried out in collaboration with a student from the master program 'Sound and Vibration' at Chalmers University of Technology. More specifically, Sebastian Christensson agreed to work as a consultant on the project as part of his current course in room acoustics.

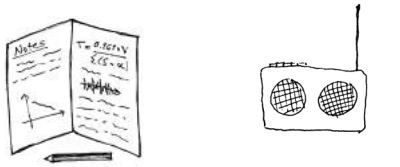
The daily conversations about acoustics and architecture worked as the base for the understanding of the link between sound and building design. All information in this report regarding acoustics refers to informal conversations with Sebastian if no other source is stated.

Further knowledge was gained through the use of mixed media such as literature studies, TED-talks, documentaries, informal interviews both with other sound experts and with users of Kulturtemplet etc. Moreover, many different types of overlapping methods where used along the process of developing this master thesis project (see diagram to the right on page no. 17).

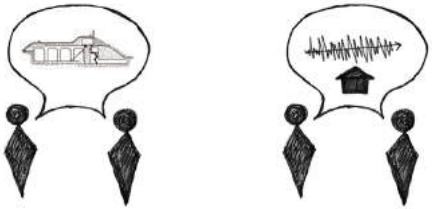
COLLABORATIVE PROCESS

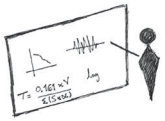


MIXED MEDIA



INFORMAL INTERVIEWS





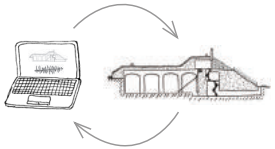
LECTURES ACOUSTICS

LITERATURE STUDIES

DOCUMENTATION OF THE EXISTING

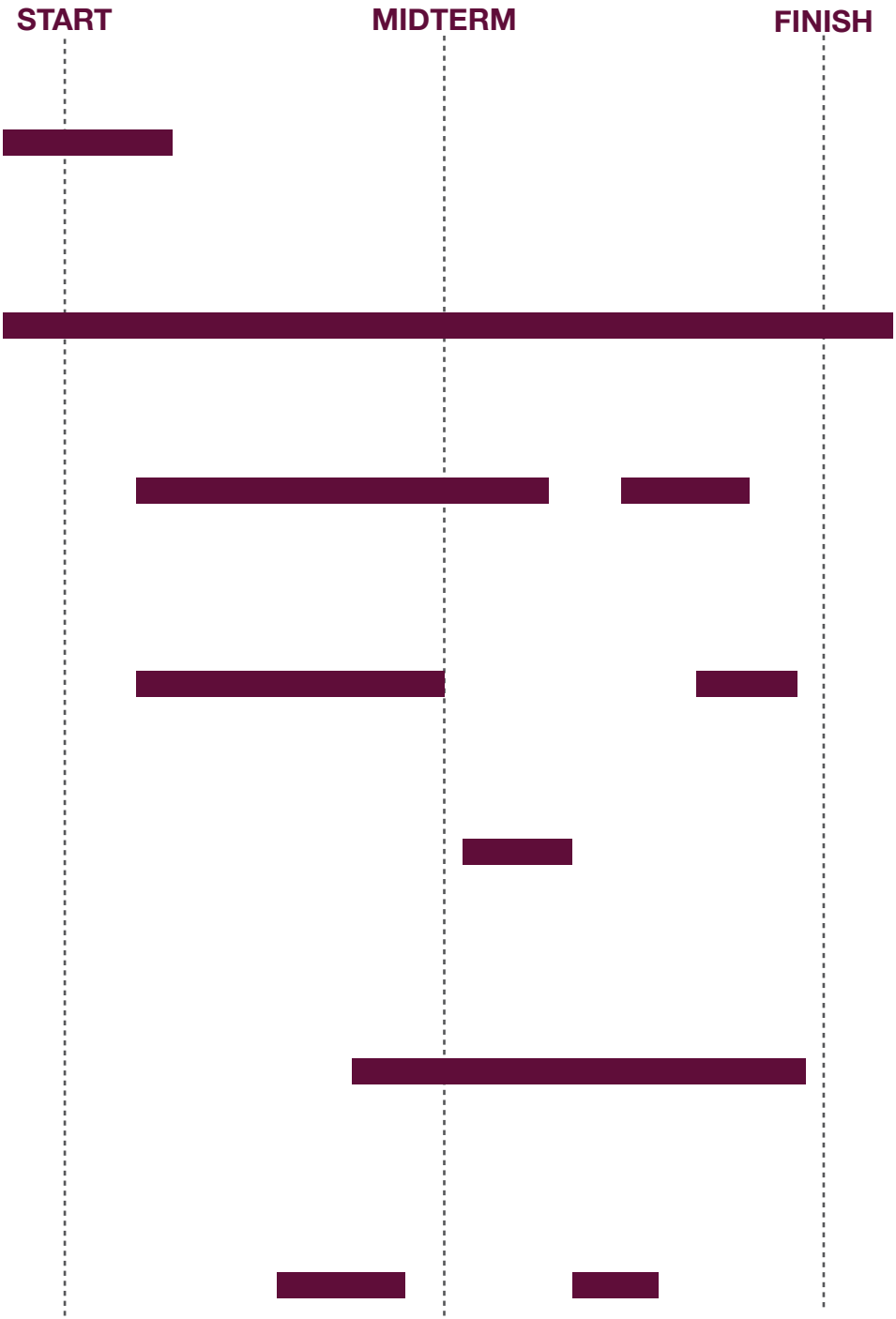
PHYSICAL MODELING

WORKSHOP WITH USERS



RESEARCH BY DESIGN

ACOUSTIC TESTS

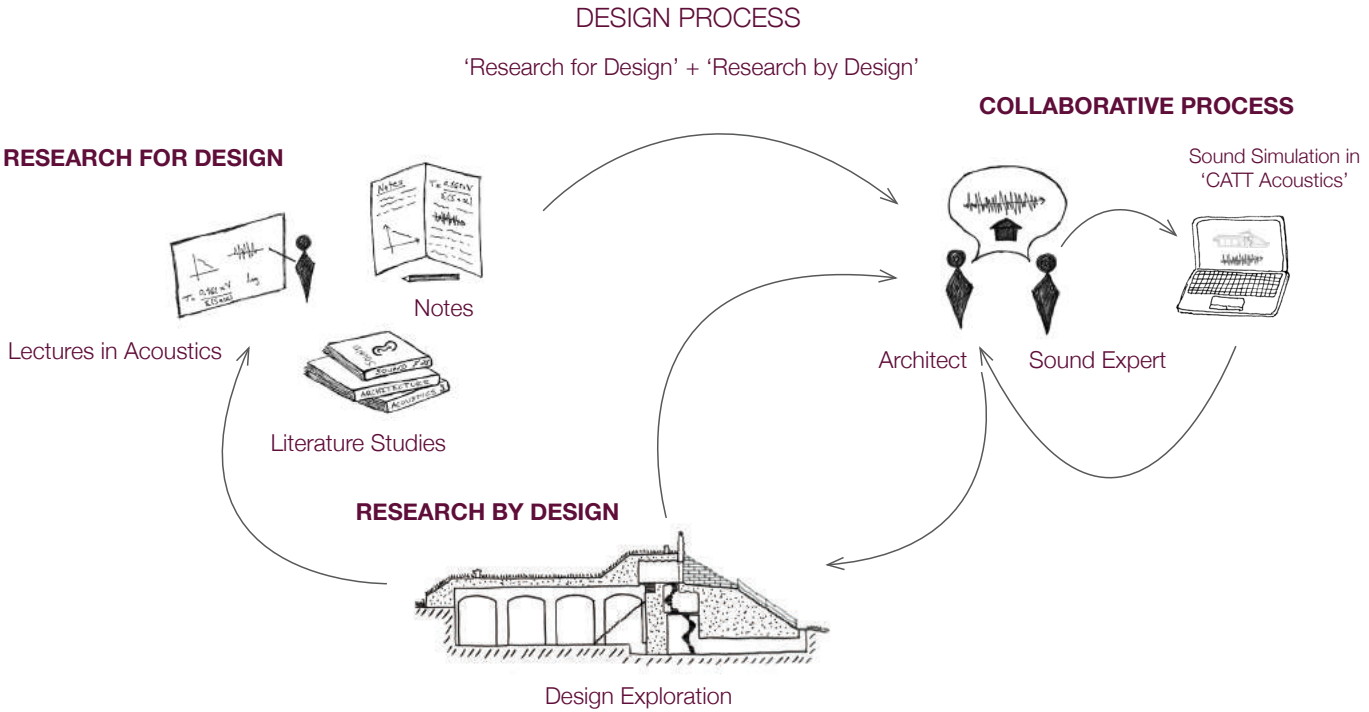


Overlapping methods used throughout this master thesis

DESIGN PROCESS

The project was developed through a combination of the two research methods 'Research for Design' and 'Research by Design'. At the start of the master thesis, knowledge about acoustics was gained through an introduction course with lectures given by Wolfgang Kropp at the master program 'Sound and Vibration'. The notes and additional reading on the subject became an essential source of information that was later used in the design phase.

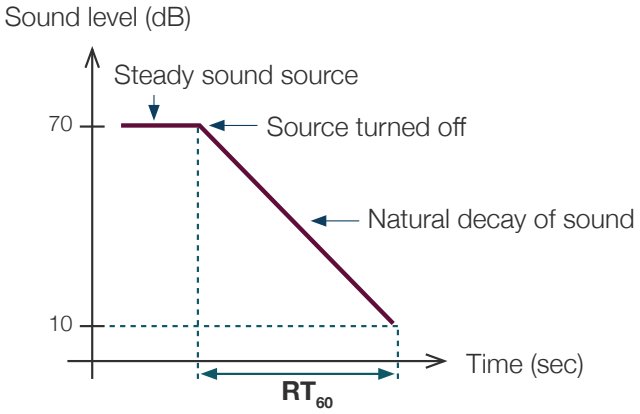
The existing building was measured and modelled in the 3D-modelling program 'Sketch-up'. Acoustic tests were carried out in the building and the digital model was aligned with the real results, in the sound simulation program 'CATT Acoustics'. The design approach naturally evolved into a non-linear process. The architect made changes in the 3D-model that was then imported into 'CATT Acoustics' by the acoustician. Sound simulation tests were carried out and a new design proposal was suggested, based on the previous results. Furthermore, it became necessary to frequently return to the notes from the lectures on acoustics and literature studies during the master thesis design process.



ACOUSTICS IN MASTER THESIS

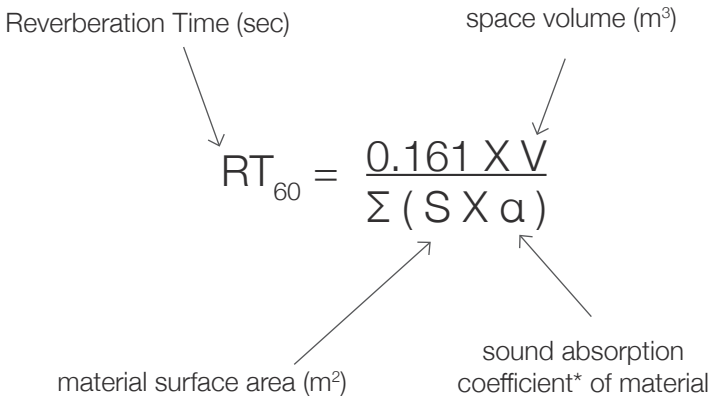
This master thesis has mainly considered Reverberation Time (RT_{60}) in the investigation of the link between sound and building design. Reverberation Time is a measure of the acoustic properties of a room. It can be explained by a sound source that it is suddenly turned off (for example a gun shot) and the time it takes for the sound to fall in intensity by 60 decibels (British Dictionary, 2017). This can be calculated both mathematically with different versions of 'Sabine's formula', as well as by rays generated by a computer in for example the sound simulation program 'CATT Acoustics', which was the digital software used in the Sound Investigation of this master thesis. Other sound concepts such as Speech Intelligibility Index (STI), Clarity (C80) and Lateral Fraction (LF) were looked at during the acoustic tests. However, all of these concepts are connected to the Reverberation Time of the room. They are also more relevant when the acoustic tests consider the specific position of the sound source and receiver, which was not the main focus during the sound investigation in this project (see 'Sound Investigation Method' on page no. 44).

DEFINITION - REVERBERATION TIME (RT_{60})



SABINE'S FORMULA (SIMPLIFIED)

Ony applicable in room temperature of approx. 20°C, Relative Humidity of approx. 50% and no people present in the room



* Sound Absorption Coefficient: the fraction of Sound Energy absorbed by a material. It is expressed as a value between 1.0, perfect absorption (no reflection) and 0, zero absorption (total reflection) (Acoustic Glossary, 2017).

Most sounds that we hear consist of many different wave lengths, hence many different frequencies. Frequencies are measured in Hertz (Hz) and what we hear as high pitch sounds, such as the consonants 'e' and 'i' are of higher frequencies than low pitch sounds such as the vowels 'a' and 'o' (Christensson, 2013).

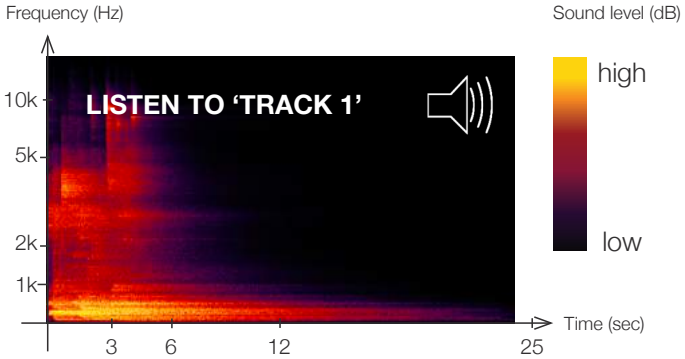
Reverberation Times varies according to frequency, partly due to that materials absorb them differently (see sound absorption coefficients for water and concrete used in the Sound Investigation in this master thesis). Low frequent sounds are normally more difficult to absorb than high frequent sounds, which is why they often stay in the room the longest. See the two spectrograms below. 'Spoken words' were simulated in a model of the existing building 'Kulturtemplet', and in a 'normal room'. Compare the two graphs and listen to 'Track 1' and to 'Track 2'. The long Reverberation Times, especially the at low frequencies, are very apparent in the example from Kulturtemplet.

Since this master thesis of Architecture investigated mainly what type of effect different design have on acoustics it was simplified by looking at only the Reverberation Time at 500Hz. Furthermore, in order to make the results accessible to people with no previous knowledge about the subject, the findings were not just communicated in numbers but also through auralisations making it possible to listen to the results.

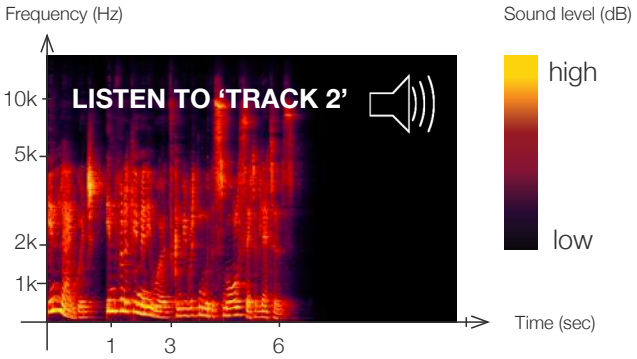
ABSORBING COEFFICIENTS

	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
CONCRETE	0.008	0.009	0.012	0.013	0.014	0.003
WATER	0.01	0.01	0.01	0.01	0.02	0.02

SPOKEN WORDS *in Kulturtemplet*

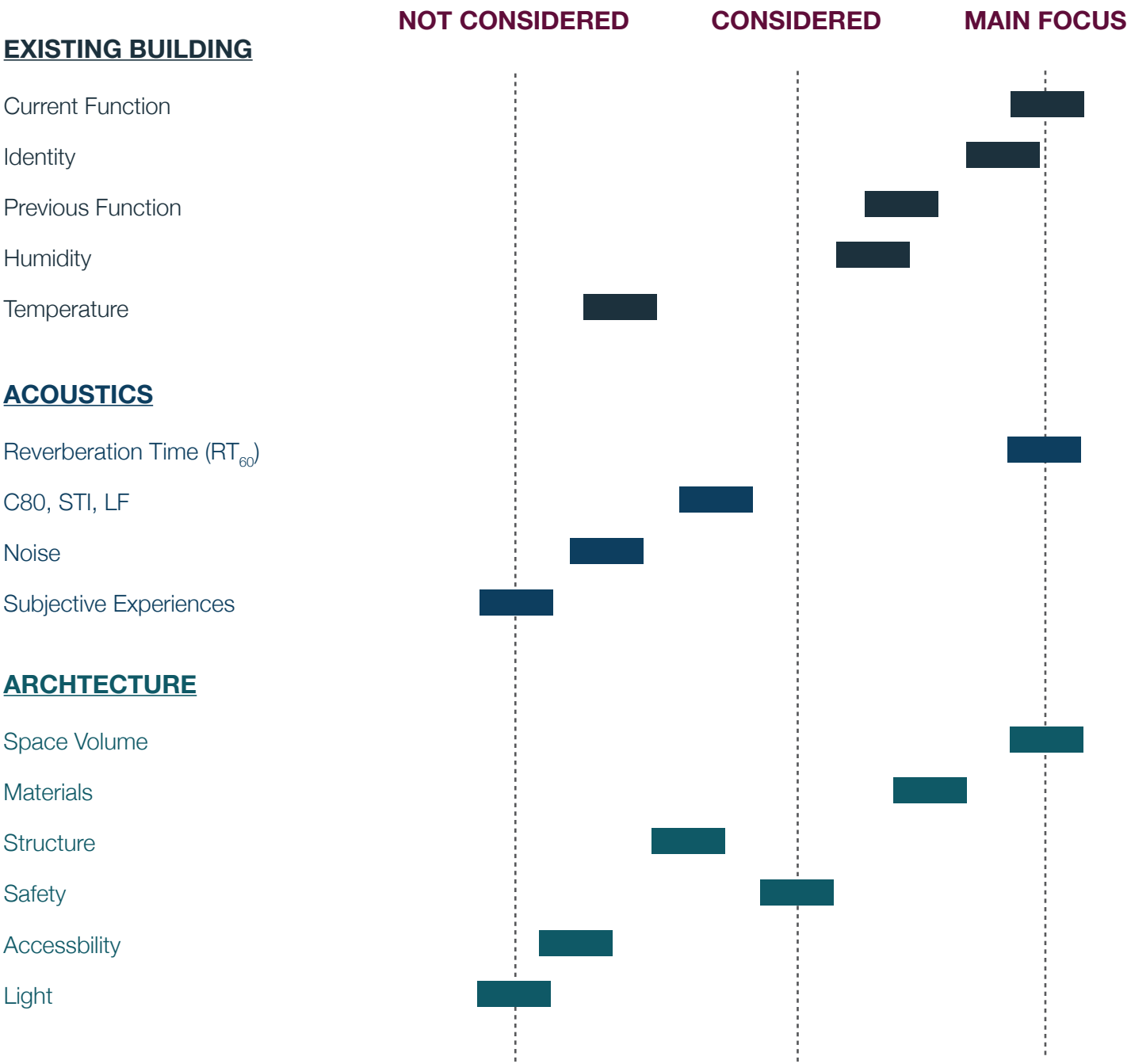


SPOKEN WORDS *in a 'normal room'*

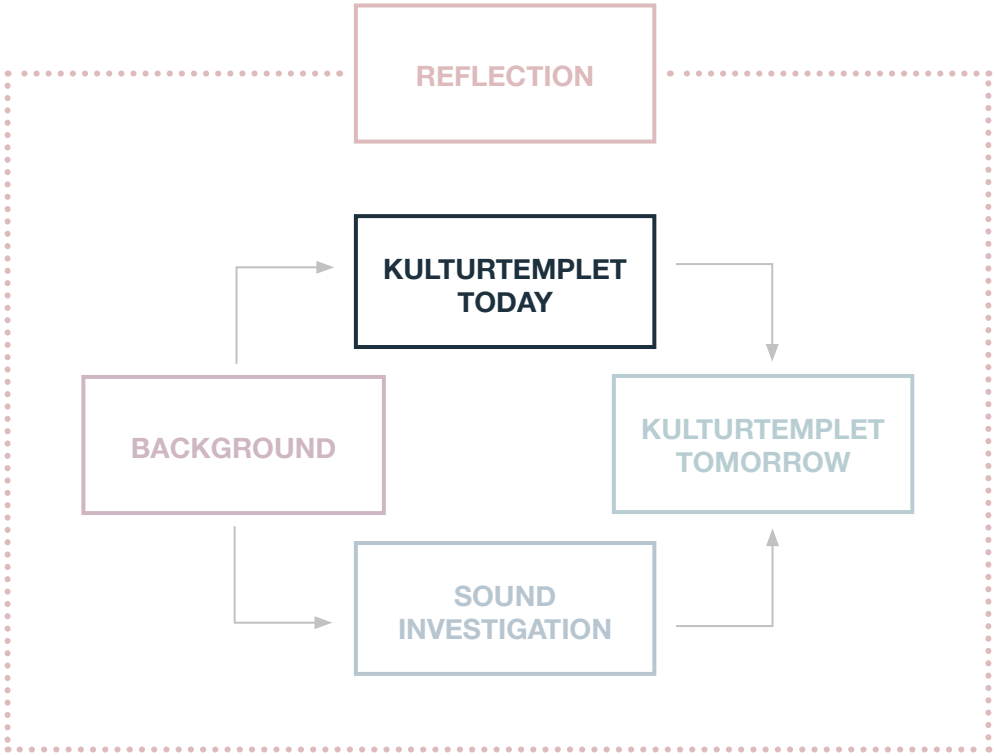


(Sound tracks at https://soundcloud.com/tunedbyarchitecture)

DELIMITATIONS



Delimitations within master thesis - Topics according to different focus levels.


REFLECTION
KULTURTEMPLET TODAY
BACKGROUND
KULTURTEMPLET TOMORROW
SOUND INVESTIGATION

2. KULTURTEMPLET TODAY

“The Day has Eyes, the Night has Ears”

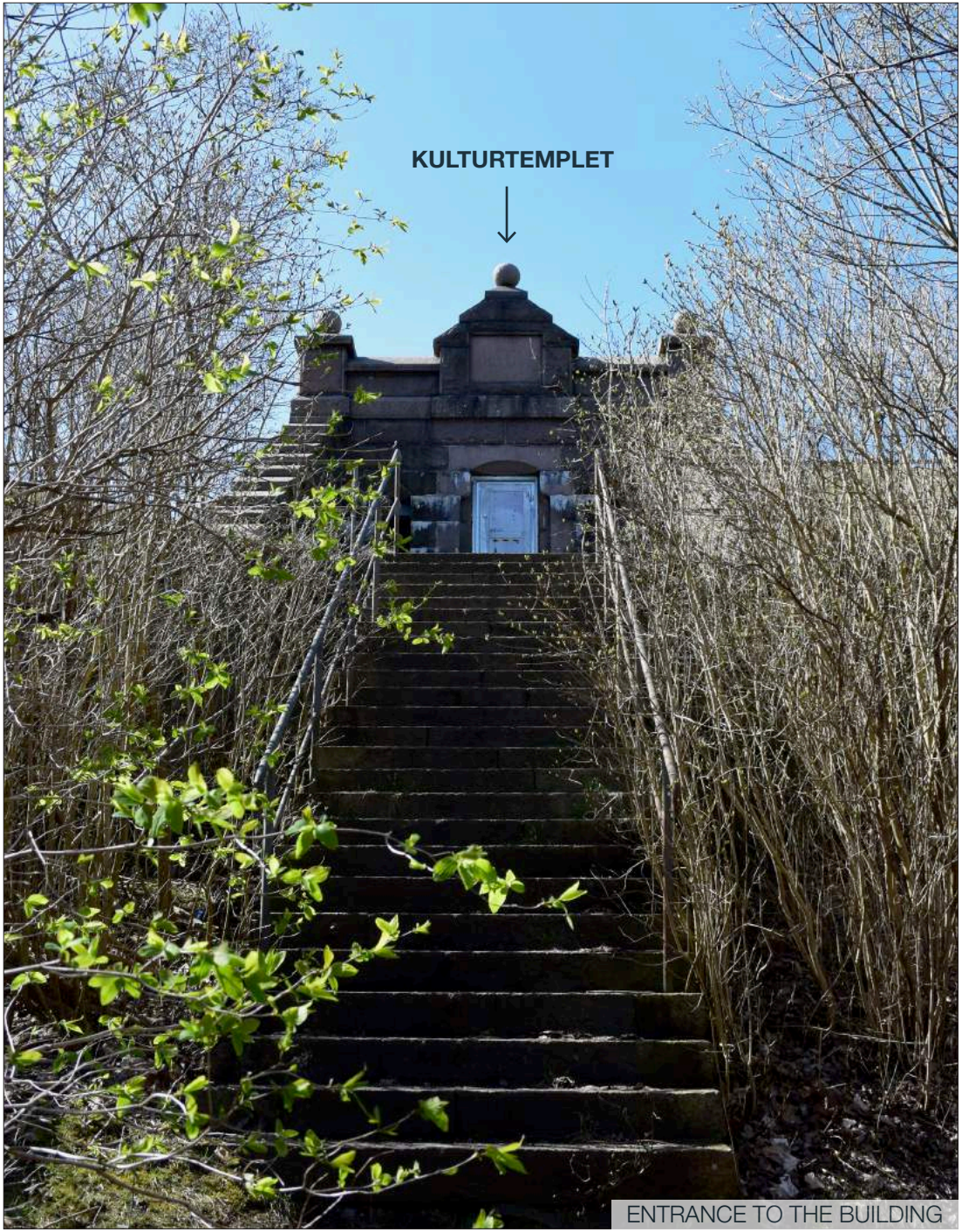
- Scottish Proverb

LOCATION


MAJORNA
ÄLVSBORGSBRON
SLOTTSKOGEN
Kulturtemplet
New water reservoir

VIEW FROM KABELGATAN

ENTRANCE TO THE SITE



ENTRANCE TO THE BUILDING

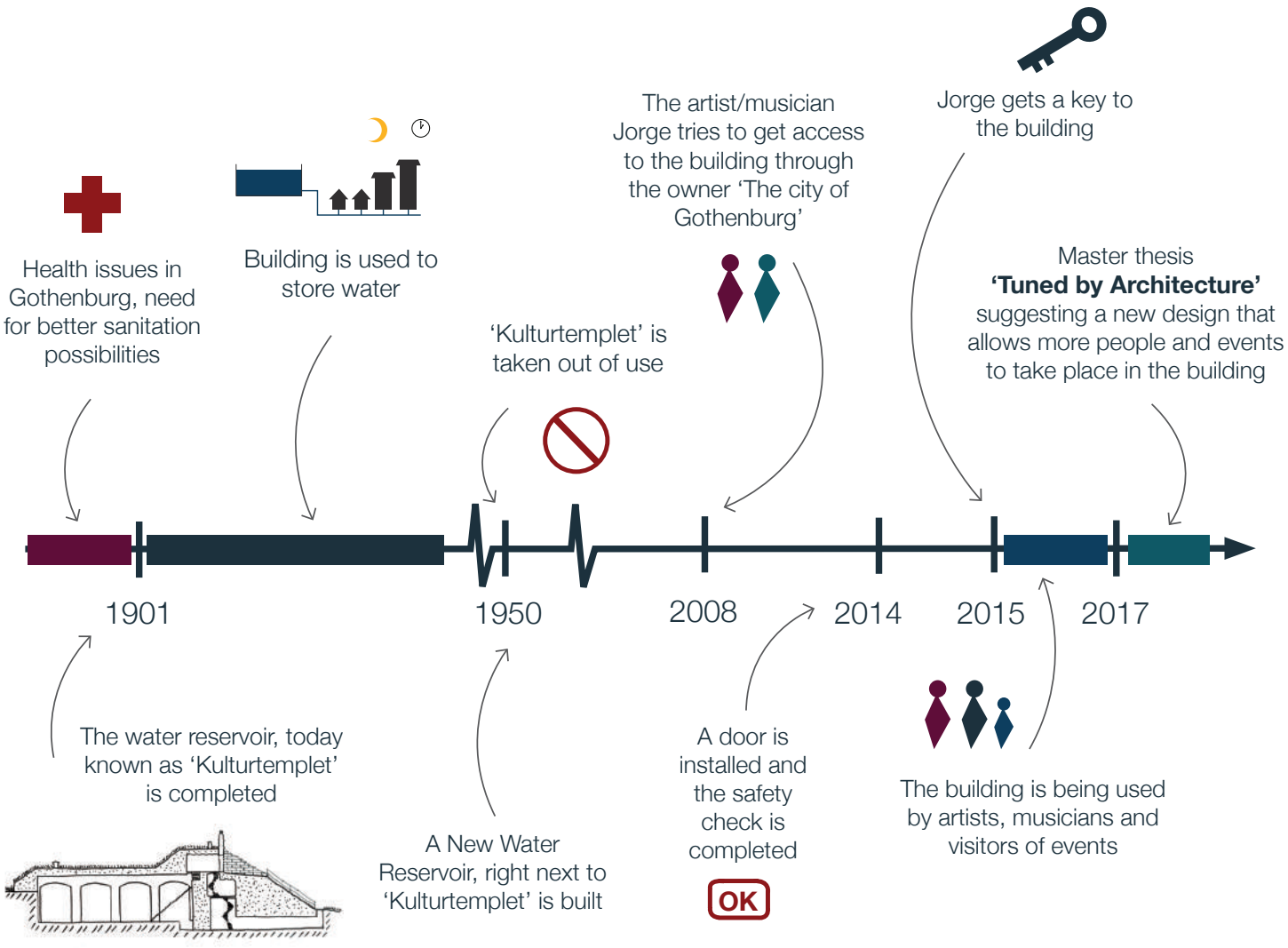

VIEW FROM THE BUILDING
TOWARDS EAST


VIEW FROM THE BUILDING
TOWARDS NORTH


VIEW FROM THE BUILDING
TOWARDS WEST

SHORT HISTORY

The timeline illustrates assumed events, based upon informal interviews with the multi-instrumental musician Jorge Alcaide and Filip Danielssson at the municipality of Gothenburg (department 'Kretslopp och Vatten Göteborgs Stad').

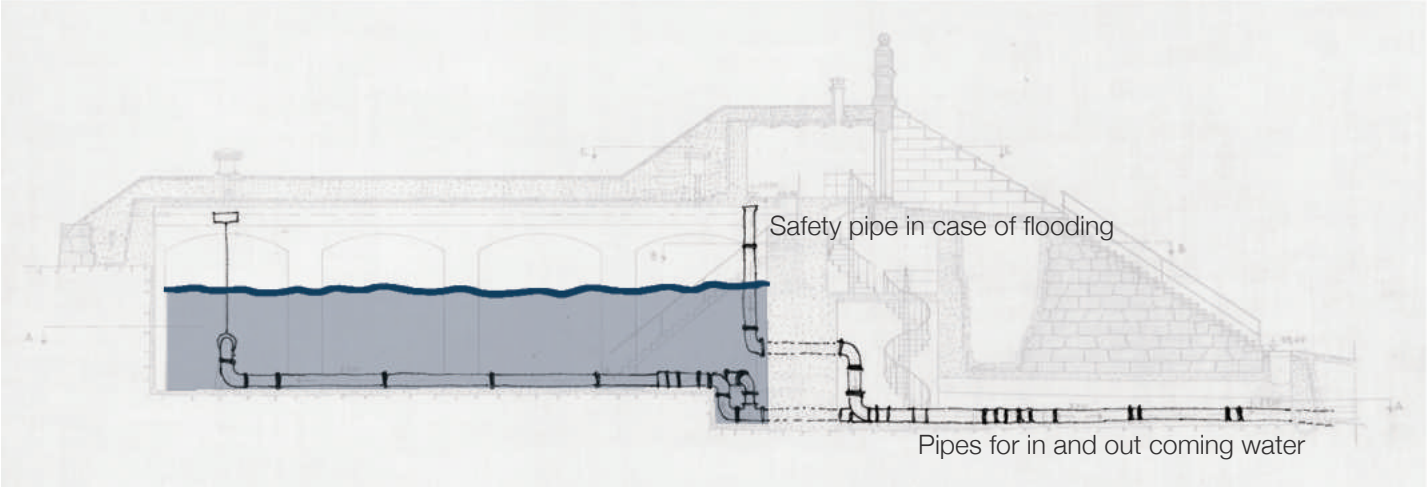


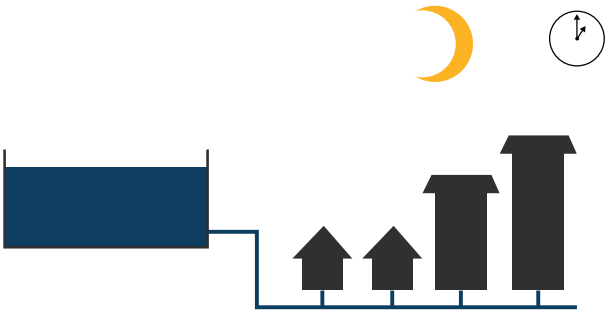
ORIGINAL FUNCTION OF THE BUILDING

After the construction in 1901, 'Kulturtemplet' is believed to have been used to store water until a new water reservoir was built in the 1950s (Danielsson, 2017).

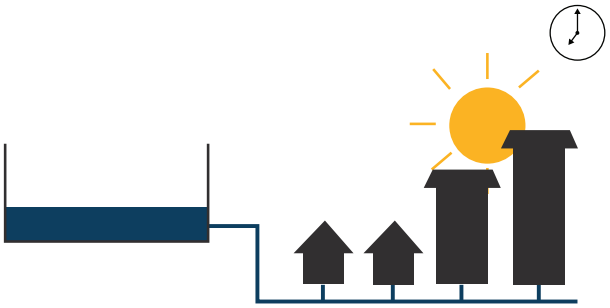
During hours of low demand, clean water was pumped into the building taking approx. one day to fill up the entire room. When a lot of water was needed in the city at the same time, mainly at public baths, it could be taken directly from the water reservoir (Danielsson, 2017).

The concept of changing water levels as part of the original function of the building was explored further in the investigation phase of the master thesis (see chapters 'Sound Investigation' and 'Kulturtemplet Tomorrow').





Low demand - used for storing water



High demand - water supplier

CURRENT FUNCTIONS

Music Performances

Dance Performances

Art Exhibitions

~ 85%

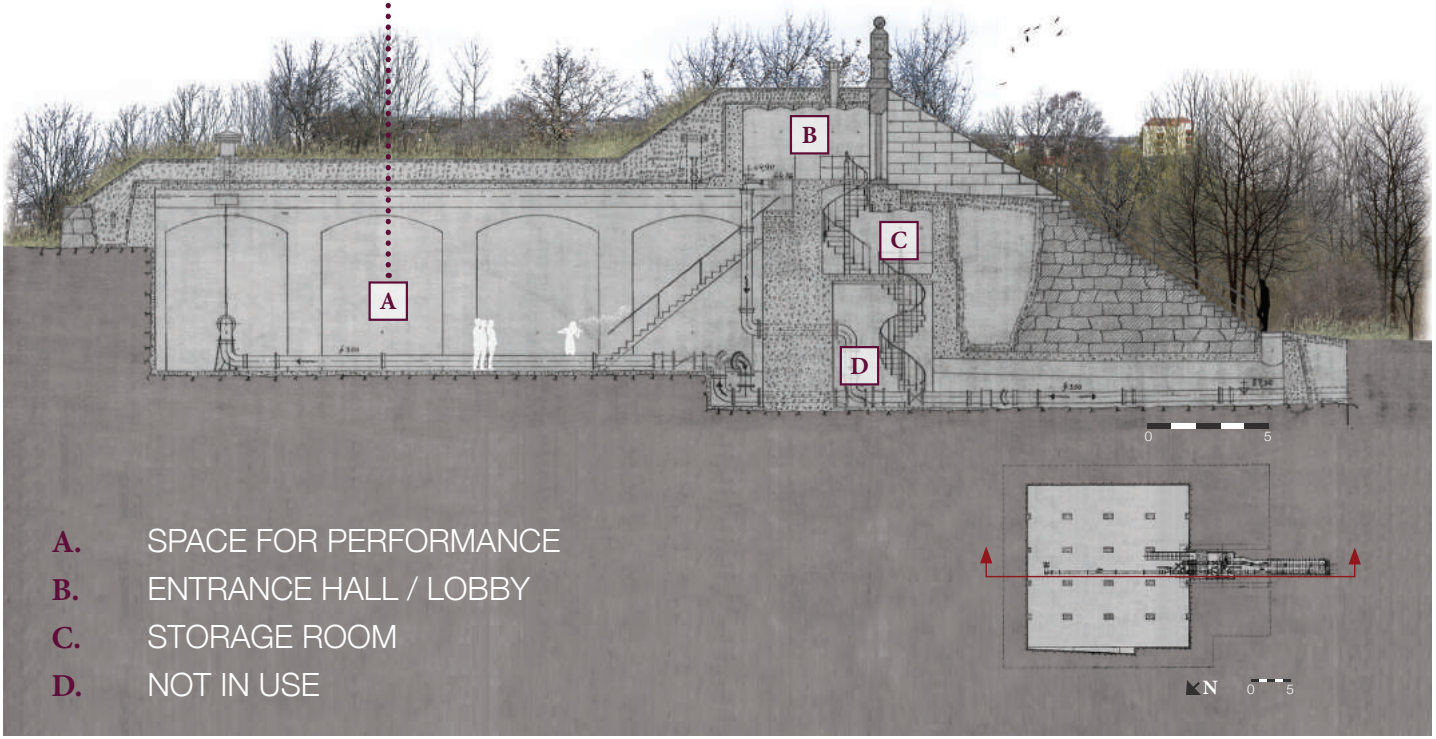
Average Relative Humidity

≤ 20

Number of People Allowed

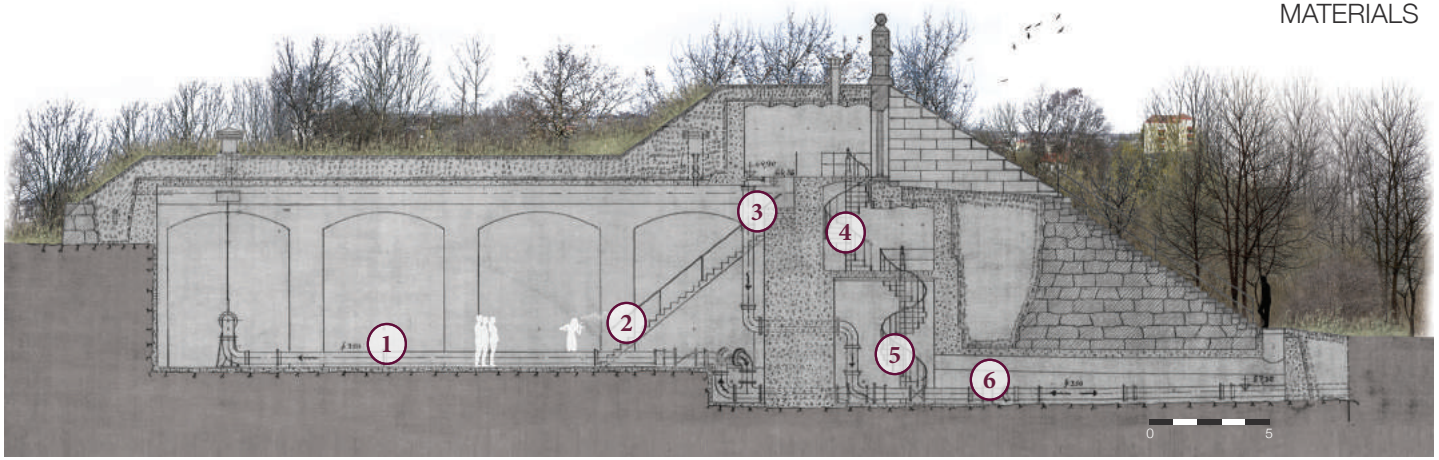
~ 8°C

Temperature



A. SPACE FOR PERFORMANCE
B. ENTRANCE HALL / LOBBY
C. STORAGE ROOM
D. NOT IN USE

MATERIALS



WORKSHOP WITH USERS

In order to get a better understanding for the existing building a group of people with different competences and with varying experiences of Kulturtemplet were invited to a workshop (see participants). The original idea was to find out more about different events that take place within the building today, where a physical model of scale 1:25 of the former water cistern was used to let the participants elaborate on their ideas 3-dimensionally. However, the workshop turned out to not just give information about the physical arrangements for cultural events. Instead, it resulted in many insights about the unique characters and identity of the building, which can be defined as 'soft values'.

PARTICIPANTS IN THE WORKSHOP

Jorge Alcaide
Artist, Musician

Leonor Palazzo
Cellist

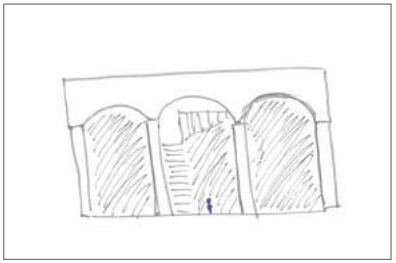
Moises Rodriguez
Cultural event manager student

Ida Röstlund
Architecture Student

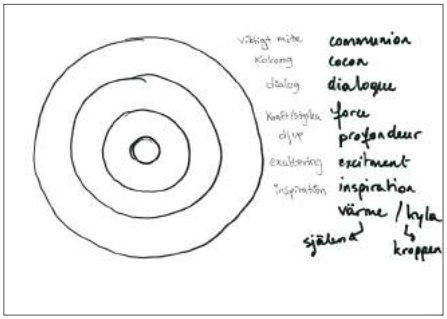
Sebastian Christensson
'Sound and Vibration' Student

Petra Sandberg
Architecture Student

DESCRIBE YOUR FIRST VISIT TO KULTURTEMPLET...

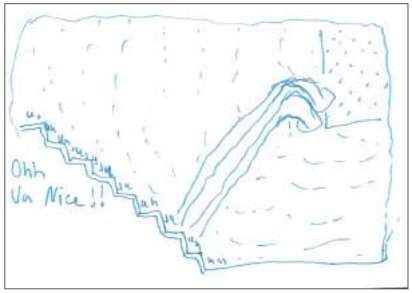


Petra



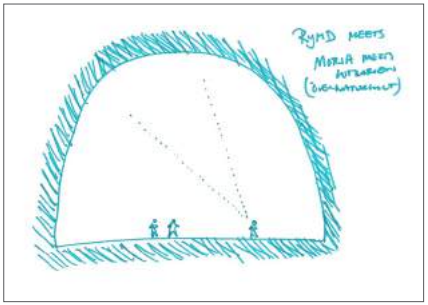
Jorge

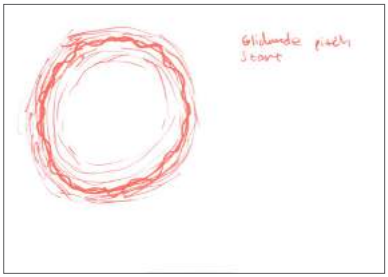
Leonor



Moises

Ida

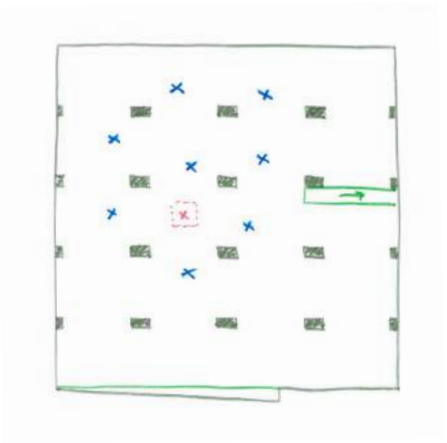




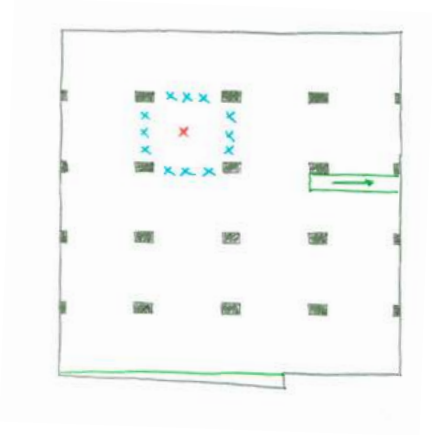
Sebastian

DESCRIBE PAST OR DESIRED PERFORMANCES IN KULTURTEMPLET...

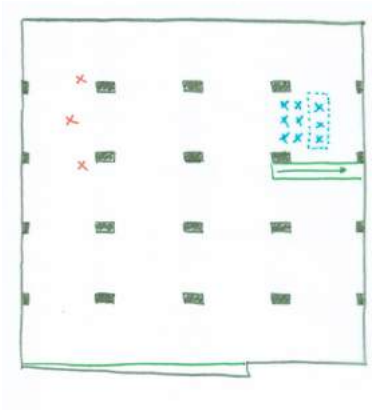
SOME PREFORMANCES ILLUSTRATED IN THE WORKSHOP



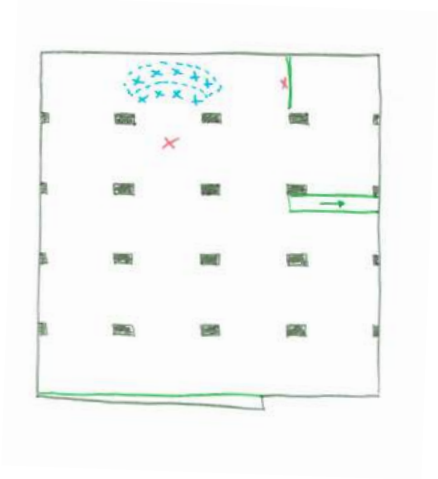
The audience is spread out in the space around the musician during the performance.



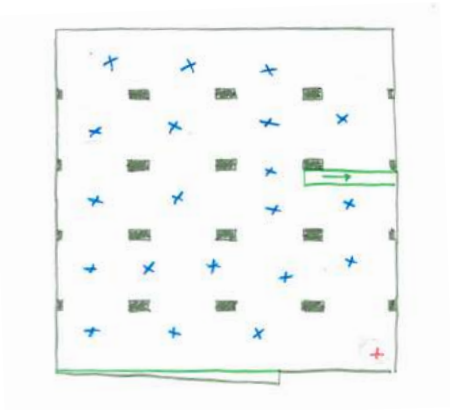
The audience sits around the musician during the performance.



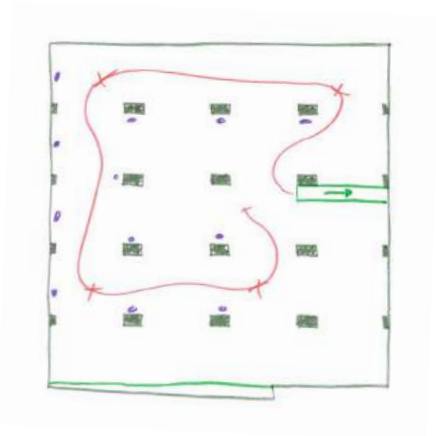
The audience sits and watches dancers from a distance during the performance.



The audience sits close to the musician during the performance.



The audience is spread out in the entire space, the musician plays from a corner of the room during the performance.



The audience and actors move around during a cultural event with some performance.

SOME QUOTES FROM WORKSHOP...

"There are no clear boundaries of the room acoustically"
- Sebastian

"The building is in focus, I play the building"
- Leonor

"Talking in Kulturtemplet is hard but why would anyone have to speak in there? There are so many other buildings good for talking."
- Leonor

"If the reverberation time could be controlled, the building could be used for more types of events"
- Jorge

"It would be interesting if people could move around during events"
- Jorge

"No place in the world, not even the greatest of churches sounds as big as Kulturtemplet."
- Leonor

"The building is like an instrument"
- Leonor

CONCLUSION WORKSHOP

The workshop clarified the user and client perspective of the building. It provided information about the 'soft values' of the space that you normally cannot read about in literature. During the workshop it became clear that the unique acoustics were the most appealing aspects of the building. Leonor expressed: "The building is like an instrument" and explained that she adapts her way of playing to the unique sound environment of the space. This quote was later used to guide the conceptual design (see chapter 'Kulturtemplet Tomorrow').

Furthermore, the results from the workshop (see page no. 35) showed that the building is used for many different types of events where the audience and performers are either standing, sitting or walking around during events. This indicated a need for flexibility, which was also taken into account during the design phase of the project.

SOUND RECORDING *in Kulturtemplet*

In order to grasp and communicate the unique acoustics of the space the professional musicians Jorge Alcaide and Leonor Palazzo, where recorded while singing and playing inside Kulturtemplet. See spectrograms on page no. 39 and listen to 'Track 3' for a mixed tune, 'Track 5' for Leonor playing the Cello and 'Track 6' for Jorge playing the flute.

Things and people kept dry and warm before the sound recording

'Dummy head' used for the binaural recording

Sound recording of Leonor playing the cello

Acoustic measuring during sound recording

SOUND RECORDING *in the anechoic chamber*

It is very difficult to have a conversation in Kulturtemplet today due to the very long Reverberation Times. By using the sound simulation program 'CATT acoustics' it was possible to simulate sound of a person talking within the existing building. However, since this is not a very common scenario it was decided to instead use song and instruments for the sound investigation. The musicians Jorge Alcaide and Leonor Palazzo were invited to the anechoic chamber at the Acoustic Department at Chalmers University of Technology. There they played the same tune as had been recorded in Kulturtemplet earlier. (Listen to 'Track 4' to hear the version recorded in the anechoic chamber. Listen to 'Track 3' to hear the real recording from Kulturtemplet). The recording from the anechoic chamber was later used in the sound investigation where the tune was simulated in digital models to test the effects on sound due to changes in the design (see pages 70-77).

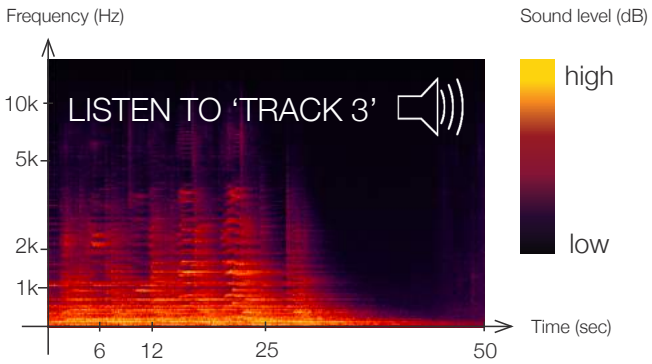
Jorge and Leonor playing the same tune in the anechoic chamber as in Kulturtemplet

Sebastian listening to the sound recording

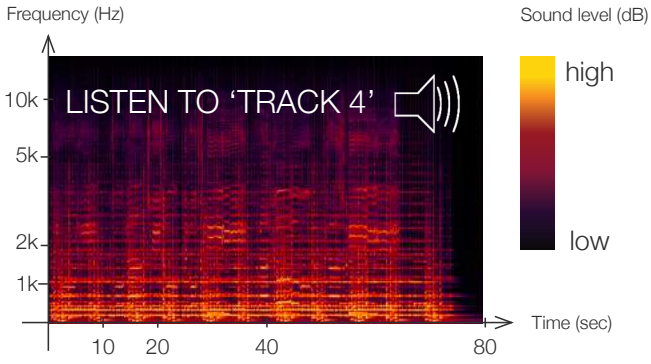
Jorge closing the door for playing alone in the anechoic chamber

(Sound tracks at https://soundcloud.com/tunedbyarchitecture)

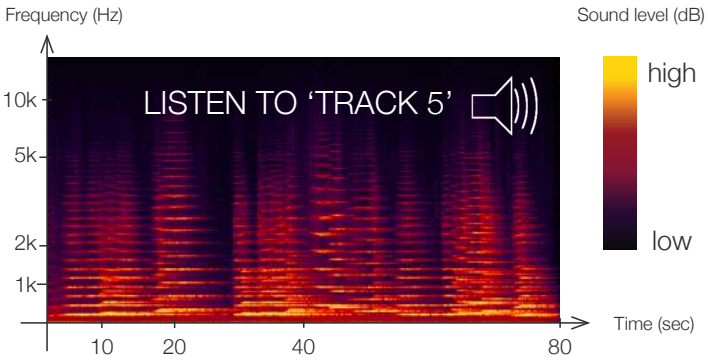
TUNE *in Kulturtemplet*



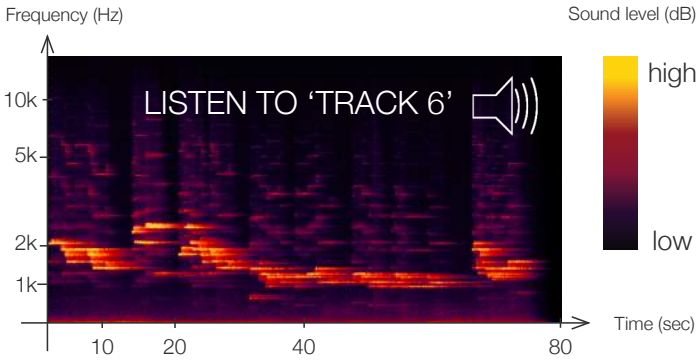
TUNE *in the anechoic chamber*

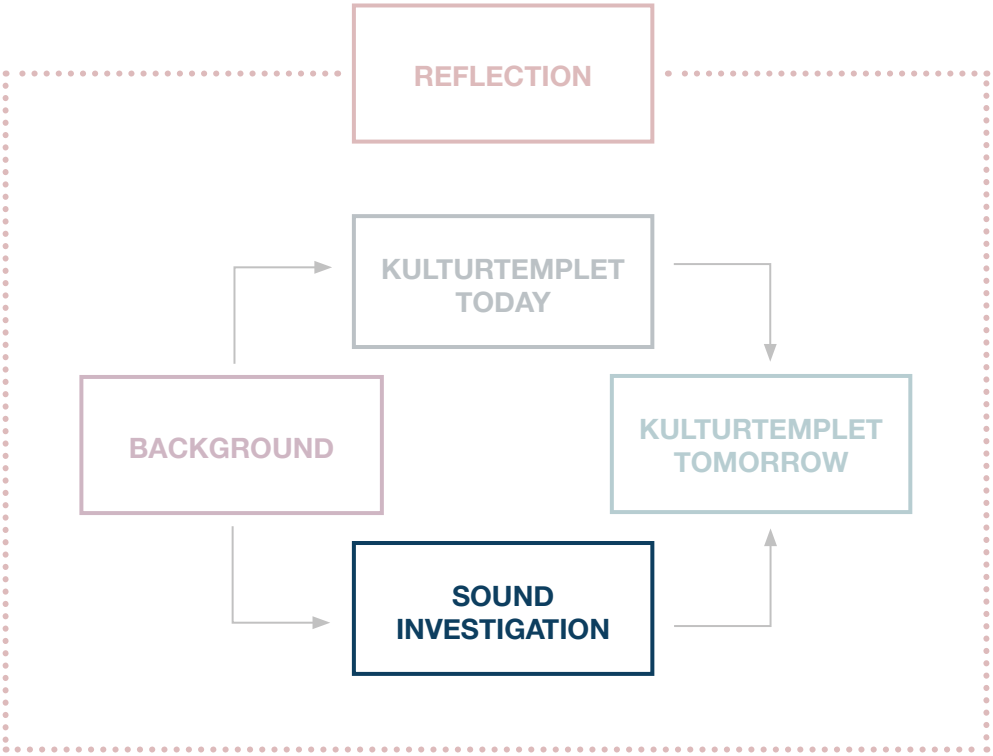


CELLO *in Kulturtemplet*



FLUTE *in Kulturtemplet*




REFLECTION
KULTURTEMPLET TODAY
BACKGROUND
KULTURTEMPLET TOMORROW
SOUND INVESTIGATION

3. SOUND INVESTIGATION

“It’s time to start designing for our ears”

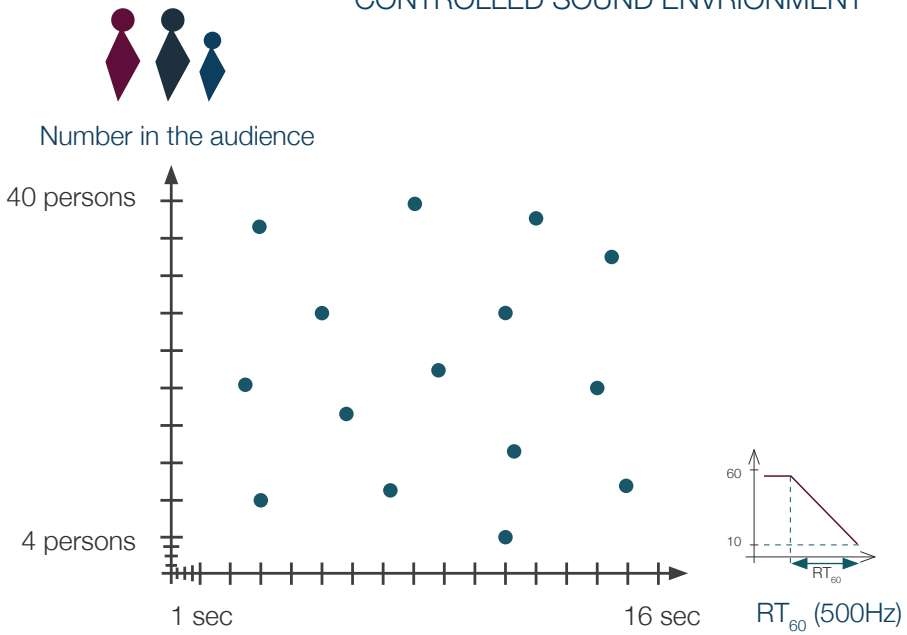
- Julian Treasure

DESIGN GOAL

The design goal for the project is based upon the 'soft values' that were identified during the workshop in combination with more scientific data including Reverberation Times expressed in numbers (see table of aspired Reverberation Times for different activities on page no. 43). While speaking to users of Kulturtemplet it was clear that the long Reverberation Time (at 500Hz) of more than 16 seconds was much appreciated. However, this sound environment is currently only possible with very few people present in the room. Moreover, the users of Kulturtemplet expressed a wish for the possibility to temporary reduce the Reverberation Time making the building suitable for more types of events. In order for the building to be accessible for an increased number of people as well as varying activities, a controlled sound environment was introduced as the goal for a conceptual design (see illustration below). The design concept should make it possible to 'tune the building' to any Reverberation Time up to 16 seconds regardless of a big or small audience present in the room.

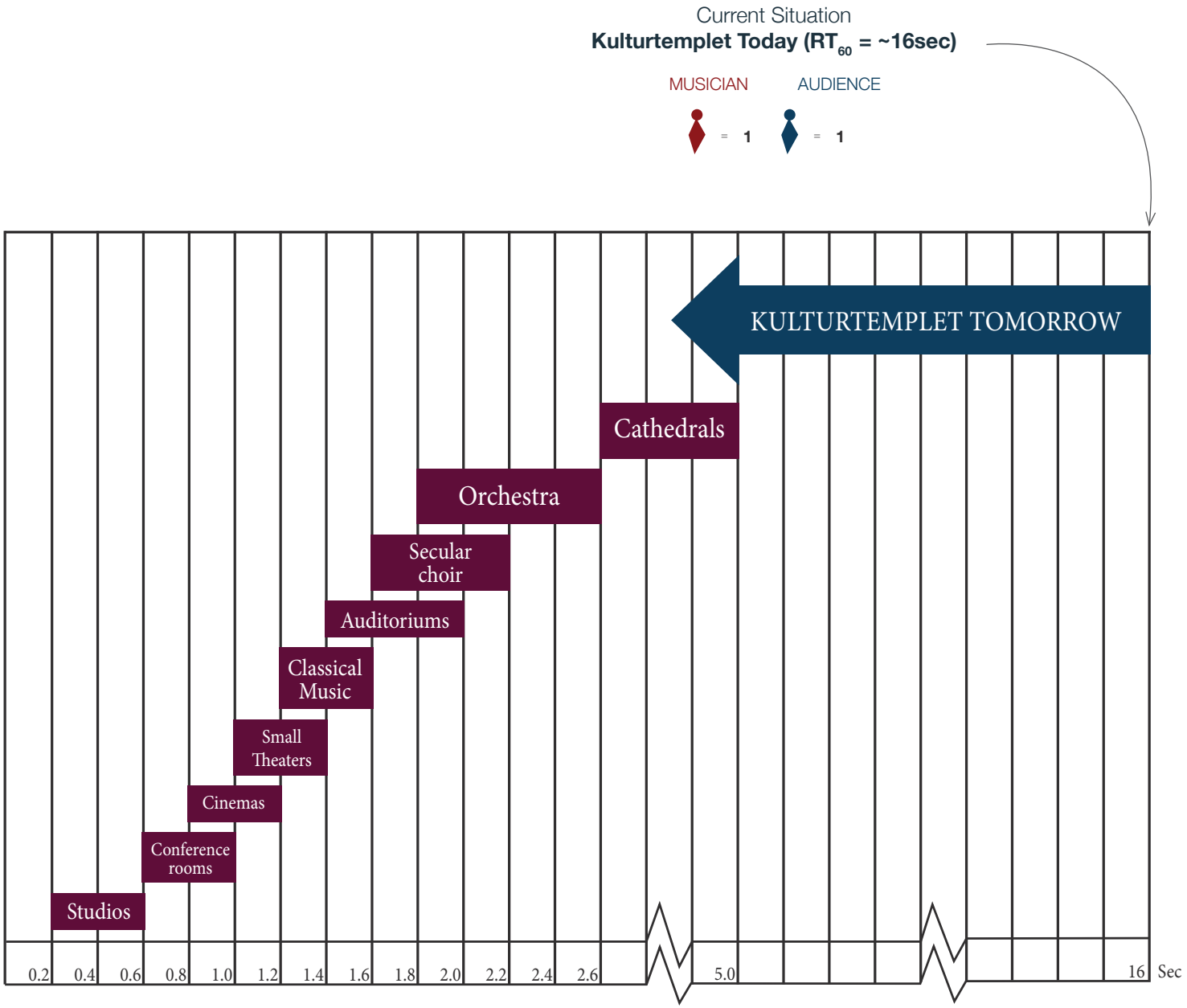
CURRENT FUNCTIONS OF KULTURTEMPLET...

CONTROLLED SOUND ENVRIONMENT



The final design proposal should enable a controlled sound environment within the old water reservoir, Kulturtemplet. The graph shows a sample of possible scenarios.

ASPIRED REVERBERATION TIMES



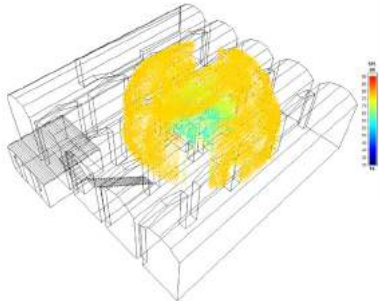
Standard Reverberation times for different activities (irrespective of people present in the room)

Aspired Reverberation Times for Kulturtemplet Tomorrow

SOUND INVESTIGATION METHOD

For the sound investigation in this master thesis project, the collaborative possibilities between architects and acoustician appeared very clear. After measuring the existing space the architect built a digital model in the 3D-modelling program 'Sketch up'. This model was imported by the acoustician into 'CATT Acoustics' and aligned with the results from the real acoustic measurements inside Kulturtemplet, which worked as a base for the sound simulation tests. The Relative Humidity of approx. 85% and the temperature of approx. 8 degrees were also taken into account for the settings.

Four goals specific to the sound investigation were set, relating to the extreme scenarios of the design goal of the project (see page no. 42). In each test rays were generated from one sound source (acting as the musician). The audience was then varied between blocks of 1 person and 40 persons, where one of these acted as a receiver of the sound. From the workshop with users of Kulturtemplet it was clear that many different types of events take place, hence the arrangement of people will vary. To simplify the investigation, it was decided to not focus on the different scenarios of performances but to always place the audience around the musician. Since the positions of the sound source and the receiver were not taken into account during the tests, it may give misleading results in terms of how the sound environment would actually be experienced if the design was implemented. Nevertheless, the sound investigation in this master thesis aims at giving architects an indication of how different factors in their designs affect the sound environment. Therefore, it should work conceptually.



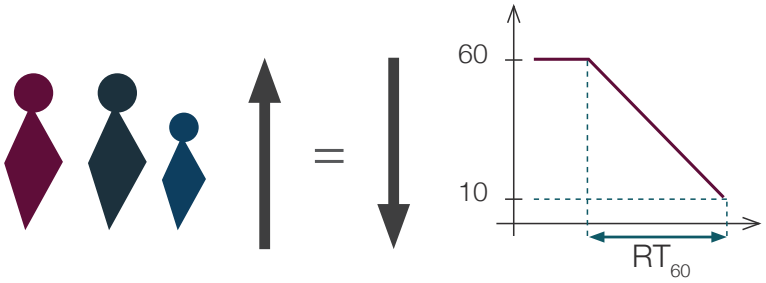
Sound Simulation with Rays in 'Catt Acoustics'

SOUND SIMULATION GOALS

GOAL 1	Audience = 1	RT_{60} =	**>16sec**
GOAL 2	Audience = 40	RT_{60} =	**>16sec**
GOAL 3	Audience = 40	RT_{60} =	**<5sec**
GOAL 4	Audience = 1	RT_{60} =	**<5sec**

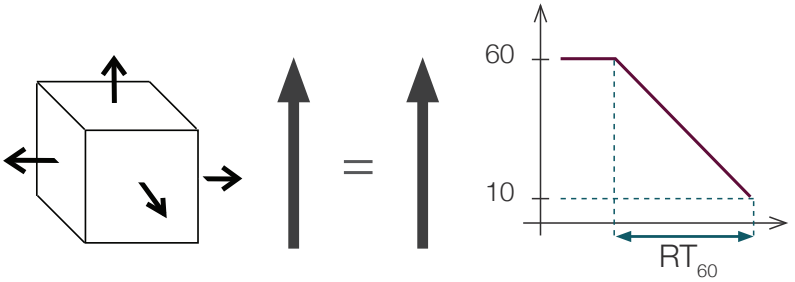
Current Situation in Kulturtemplet Today

ACOUSTIC PRINCIPLES USED IN THE SOUND INVESTIGATION



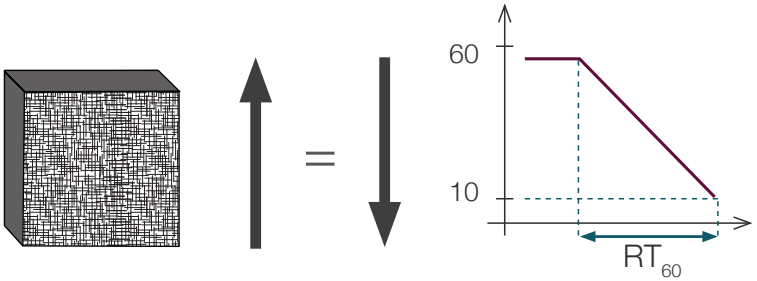
INCREASED
NUMBER OF PEOPLE

REDUCED
REVERBERATION TIME



INCREASED
BUILDING VOLUME

INCREASED
REVERBERATION TIME

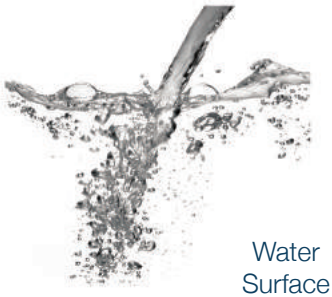


INCREASED AMOUNT OF
ABSORBING MATERIALS

REDUCED
REVERBERATION TIME

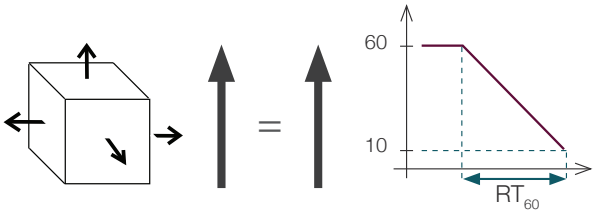
MATERIAL CHOICE

VOLUME CHANGING ELEMENT



Water
Surface

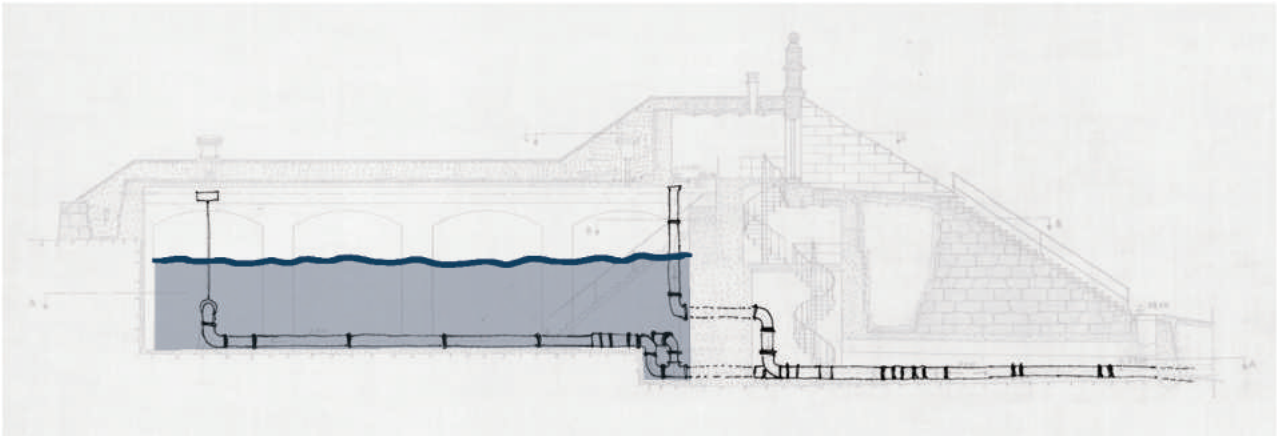
ACOUSTIC PRINCIPLE



INCREASED
BUILDING VOLUME

INCREASED
REVERBERATION TIME

CHARACTERISTICS



CONNECTS TO ORIGINAL FUNCTION OF THE BUILDING

DISASSEMBLABLE

HUMIDITY RESISTANT

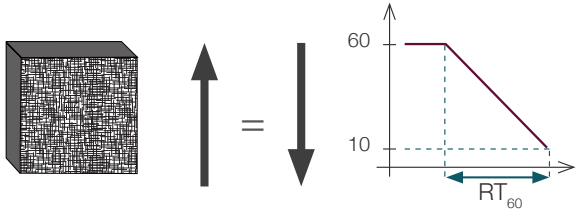
VERTICALLY FLEXIBLE

MATERIAL CHOICE

SOUND ABSORBING ELEMENT

Nordgröna's Moss Absorbing Panel

ACOUSTIC PRINCIPLE

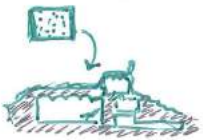


INCREASED AMOUNT OF ABSORBING MATERIALS

REDUCED REVERBERATION TIME

CHARACTERISTICS

HORISONTALLY FLEXIBLE



CONNECTS TO EXISTING

PATTERN FLEXIBILITY

COLOUR VARIATION

FORMABLE

DISASSEMBLABLE

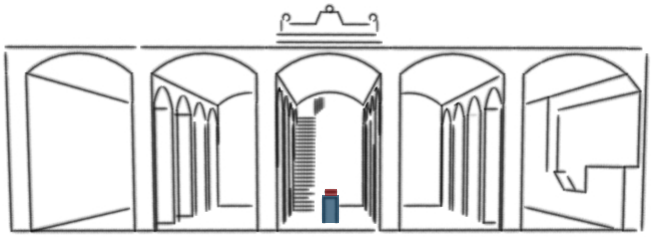
HUMIDITY RESISTANT

VERTICALLY FLEXIBLE

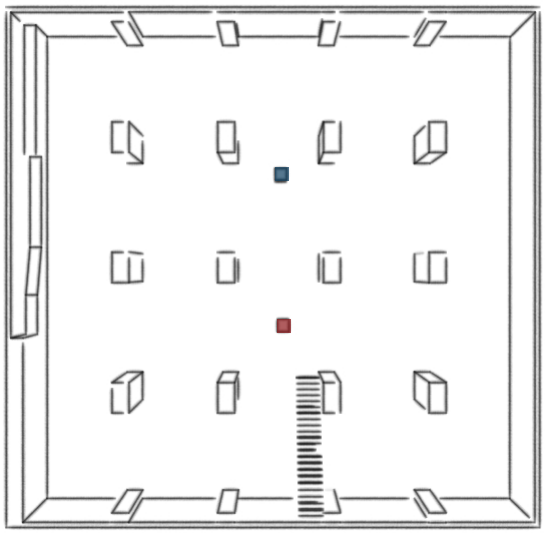
ACOUSTIC TEST 1

GOAL 1 Audience = 1 RT_{60} = **>16sec**

SMALL AUDIENCE, CURRENT SITUATION



Perspective section



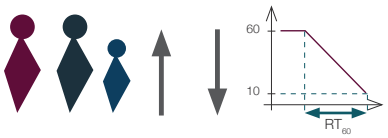
Perspective plan

Goal 1 fullfilled

NUMBER IN AUDIENCE

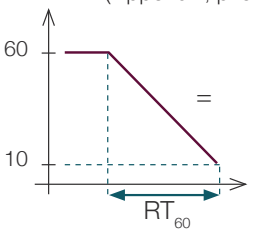
= **1**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

(Appendix, p. 90)

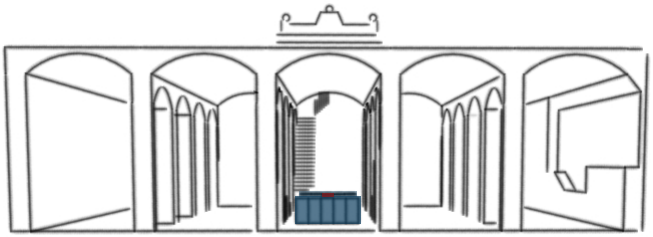


= **~16.5sec**

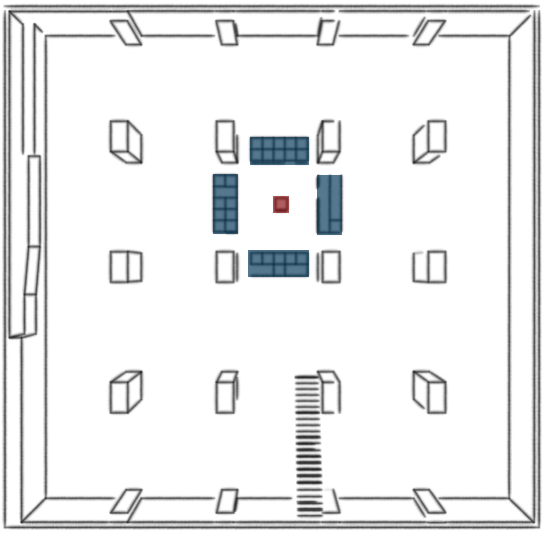
ACOUSTIC TEST 2

GOAL 2 Audience = 40 RT_{60} = **>16sec**

BIG AUDIENCE, CURRENT SITUATION



Perspective section



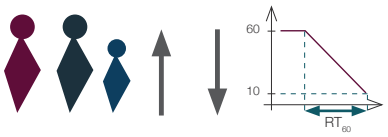
Perspective plan

Goal 2 not fullfilled

NUMBER IN AUDIENCE

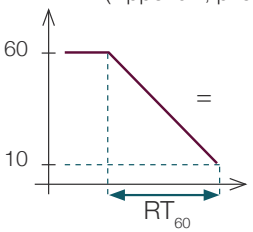
= **40**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

(Appendix, p. 90)

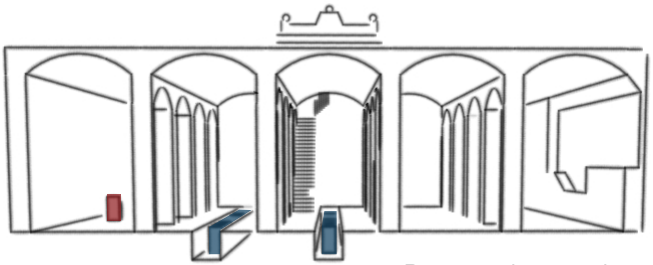


= **~10.5sec**

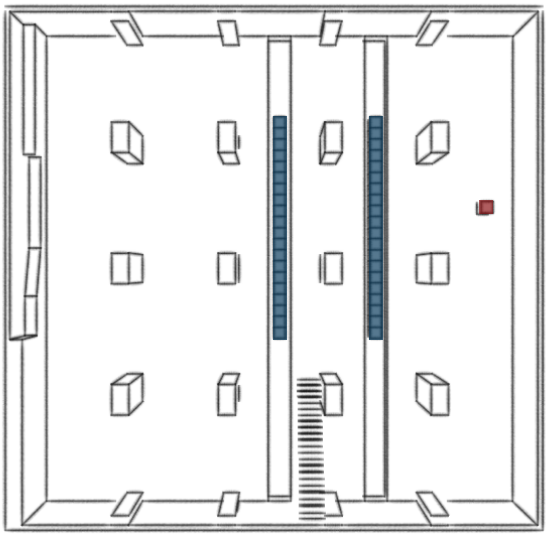
ACOUSTIC TEST 3

GOAL 2 Audience = 40 RT_{60} = **>16sec**

BIG AUDIENCE, PLACED IN POCKETS



Perspective section



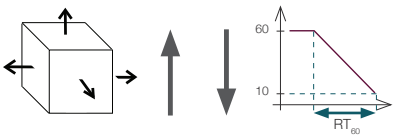
Perspective plan

Goal 2 not fullfilled

NUMBER IN AUDIENCE

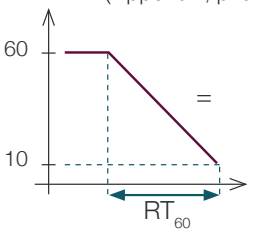
= **40**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

(Appendix, p. 90)

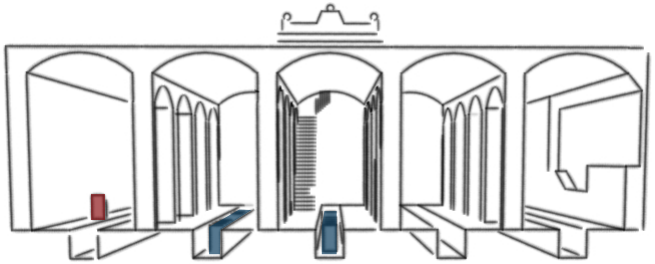


= **~11sec**

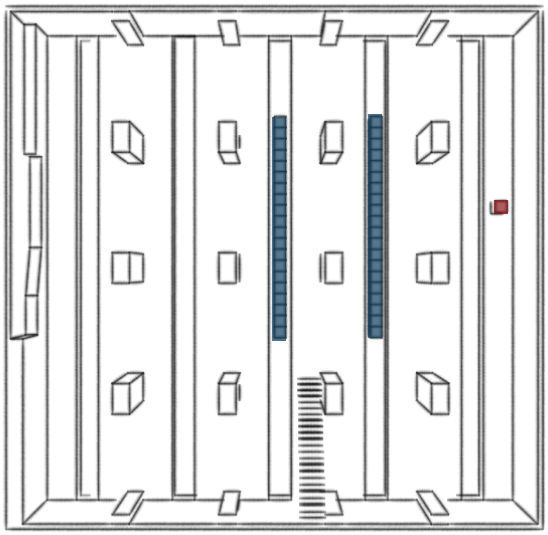
ACOUSTIC TEST 4

GOAL 2 Audience = 40 RT_{60} = **>16sec**

BIG AUDIENCE, PLACED IN POCKETS, 3 ADDED POCKETS



Perspective section



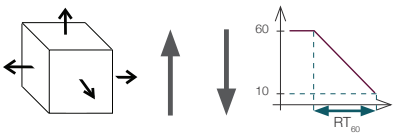
Perspective plan

Goal 2 not fullfilled

NUMBER IN AUDIENCE

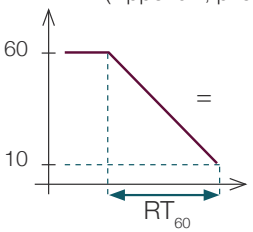
= **40**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

(Appendix, p. 90)

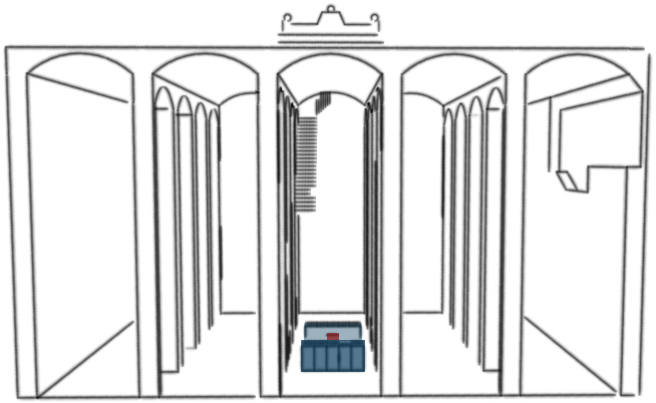


= **~12sec**

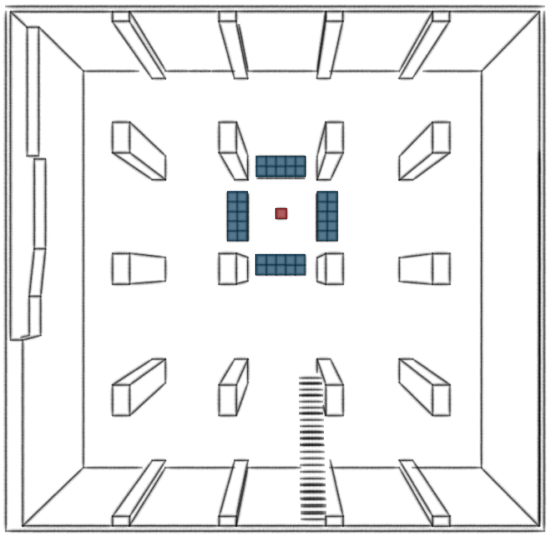
ACOUSTIC TEST 5

GOAL 2 Audience = 40 RT_{60} = **>16sec**

BIG AUDIENCE, FLOOR LEVEL LOWERED BY 6m (~double the volume)



Perspective section



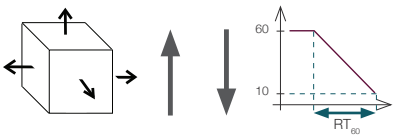
Perspective plan

Goal 2 not fullfilled

NUMBER IN AUDIENCE

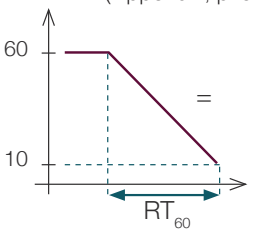
= **40**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

(Appendix, p. 90)

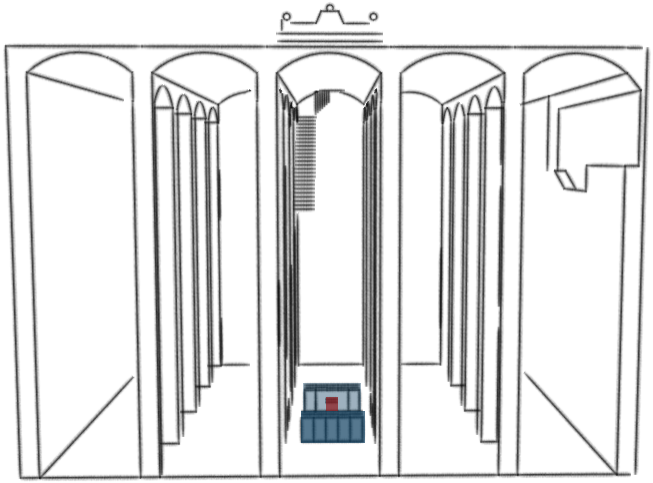


= **~14sec**

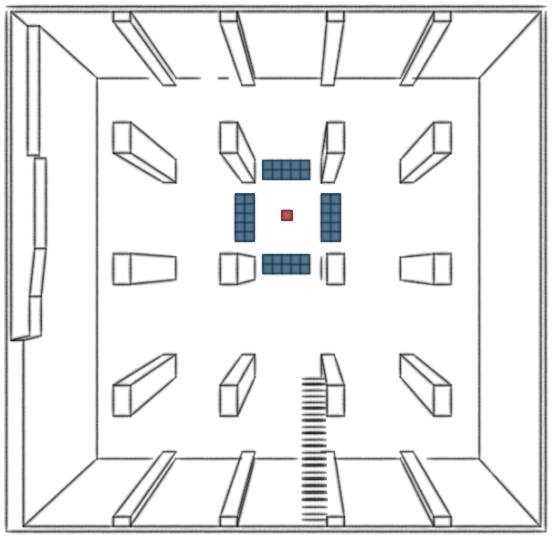
ACOUSTIC TEST 6

GOAL 2 Audience = 40 RT_{60} = **>16sec**

BIG AUDIENCE, FLOOR LEVEL LOWERED BY 9m



Perspective section



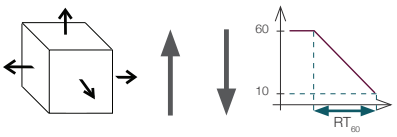
Perspective plan

Goal 2 not fullfilled

NUMBER IN AUDIENCE

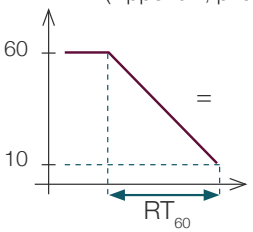
= **40**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

(Appendix, p. 90)

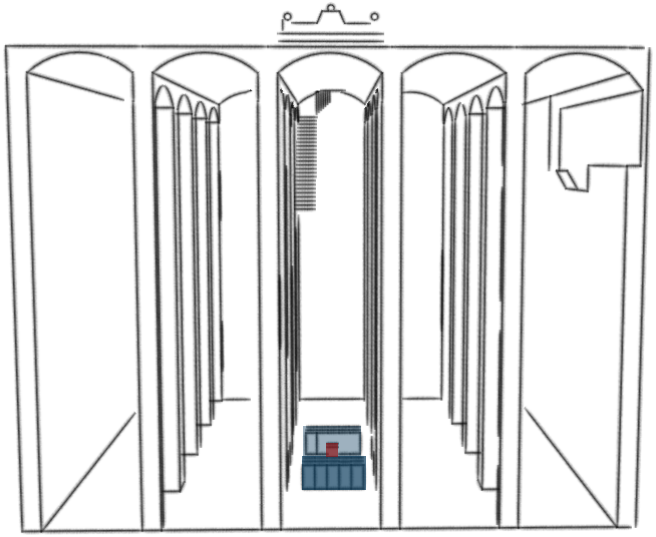


= **~16sec**

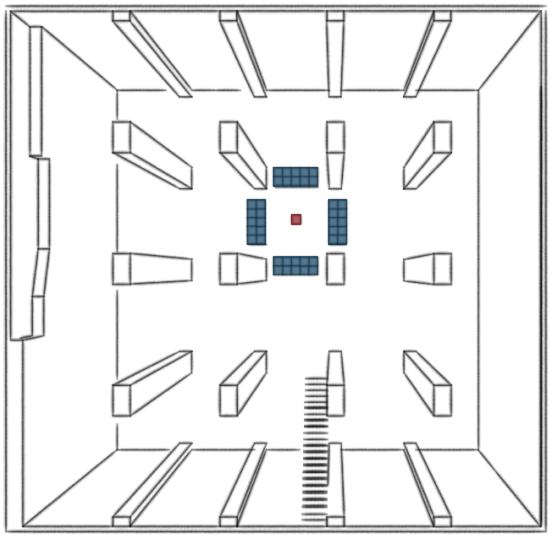
ACOUSTIC TEST 7

GOAL 2 Audience = 40 RT_{60} = **>16sec**

BIG AUDIENCE, FLOOR LEVEL LOWERED BY 11m



Perspective section



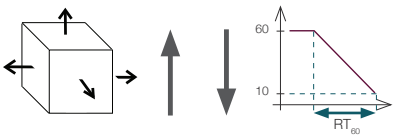
Perspective plan

Goal 2 fullfilled

NUMBER IN AUDIENCE

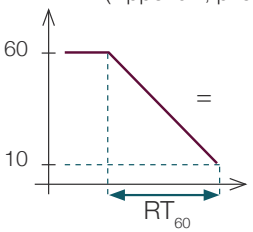
= **40**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

(Appendix, p. 91)

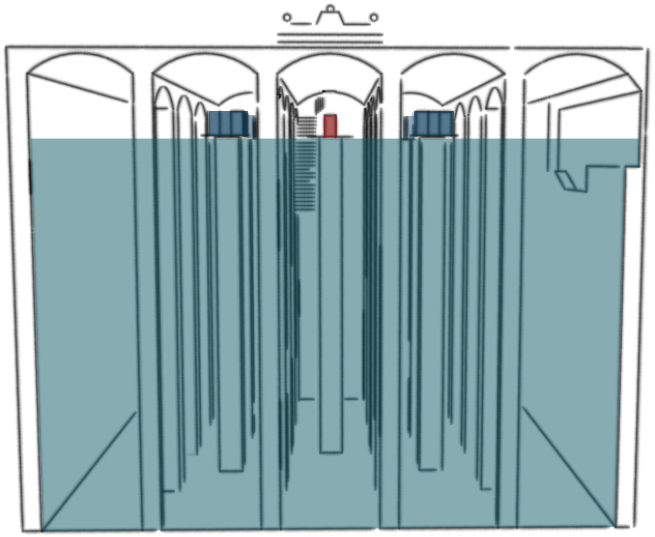


= **~16.5sec**

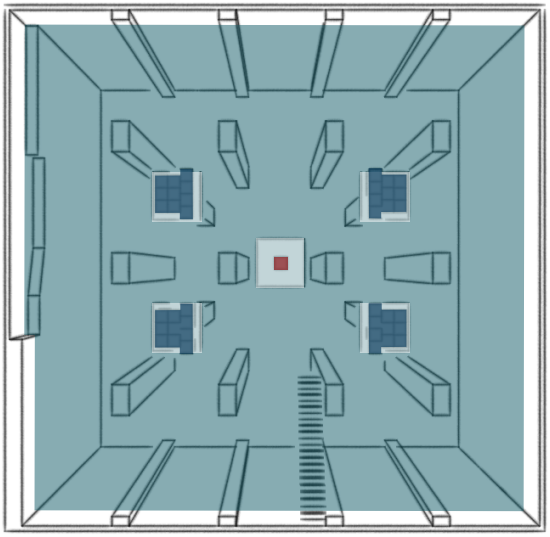
ACOUSTIC TEST 8

GOAL 3 Audience = 40 RT_{60} = **<5sec**

BIG AUDIENCE, RAISED WATER LEVEL BY 14.5m



Perspective section



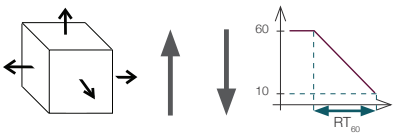
Perspective plan

Goal 3 fullfilled

NUMBER IN AUDIENCE

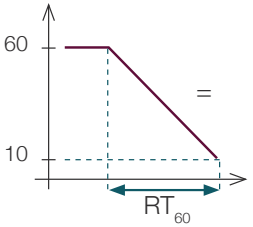
= **40**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

(Appendix, p. 91)

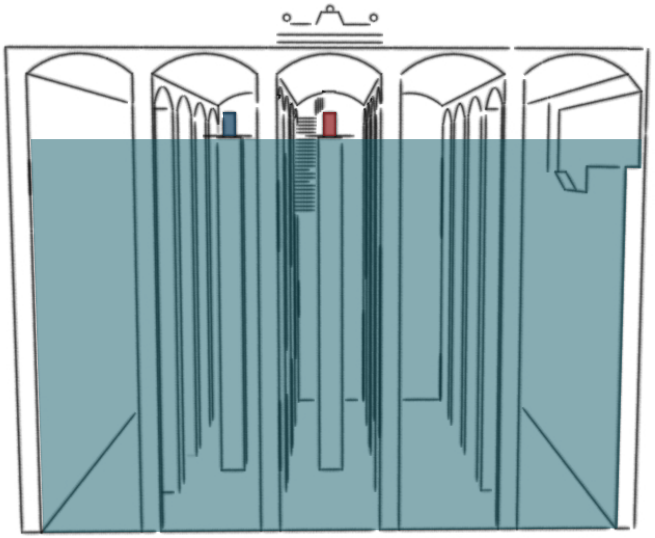


= **~3.1sec**

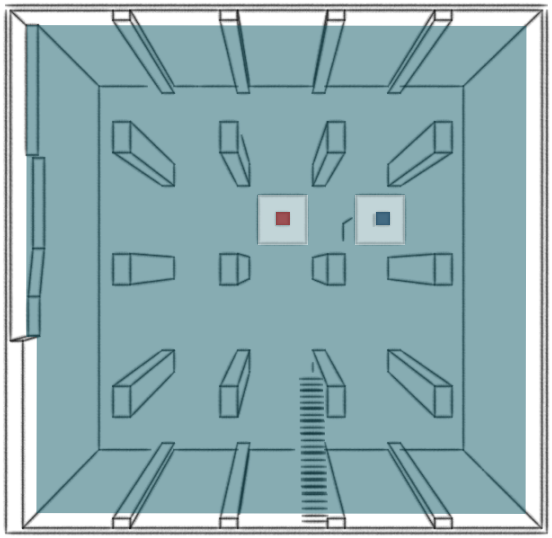
ACOUSTIC TEST 9

GOAL 4 Audience = 1 RT_{60} = **<5sec**

SMALL AUDIENCE, RAISED WATER LEVEL BY 14.5m



Perspective section



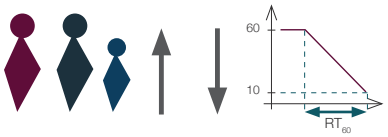
Perspective plan

Goal 4 not fullfilled

NUMBER IN AUDIENCE

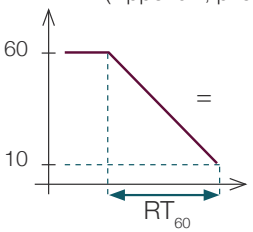
= **1**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

(Appendix, p. 91)

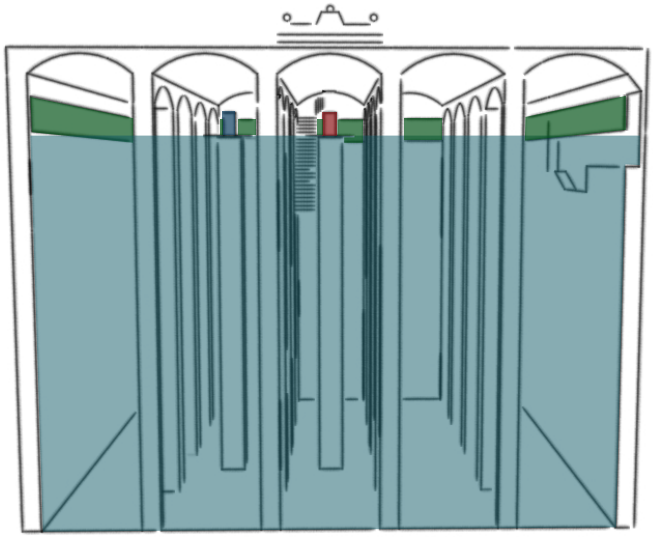


= **~10.5sec**

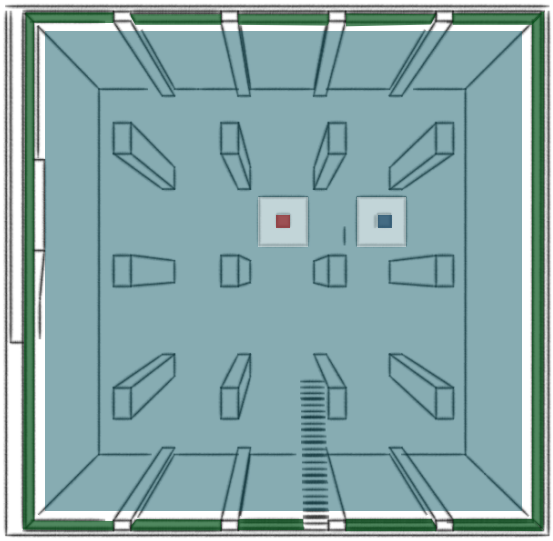
ACOUSTIC TEST 10

GOAL 4 Audience = 1 RT_{60} = **<5sec**

SMALL AUDIENCE, RAISED WATER LEVEL BY 14.5m, ADDED MOSS ABSORBENTS



Perspective section



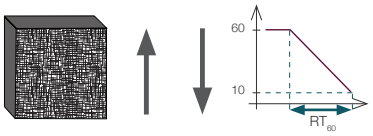
Perspective plan

Goal 4 fullfilled

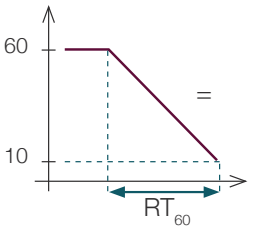
NUMBER IN AUDIENCE

= **1**

ACOUSTIC PRINCIPLE TESTED



RESULT - RT_{60} (500Hz)

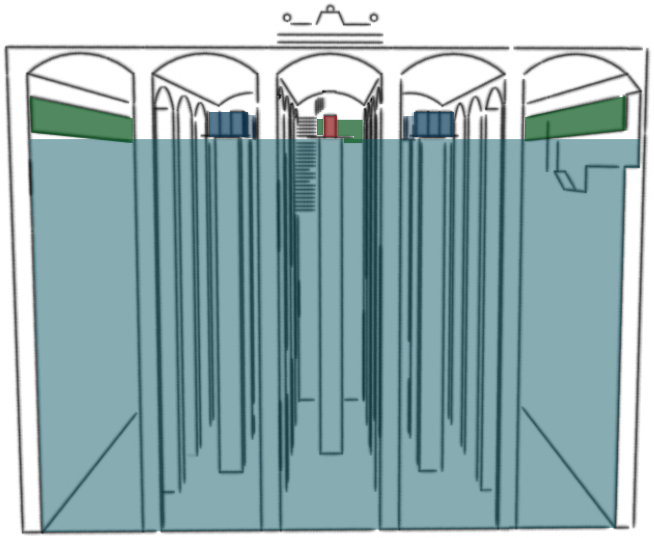


= **~5sec**

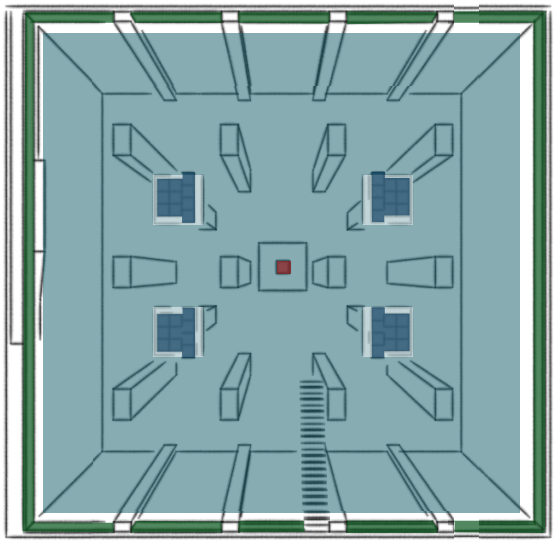
ACOUSTIC TEST 11

ADDITIONAL TEST

BIG AUDIENCE, RAISED WATER LEVEL BY 14.5m, ADDED MOSS ABSORBENTS



Perspective section

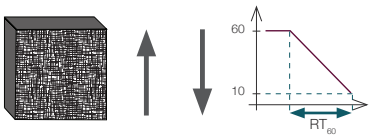


Perspective plan

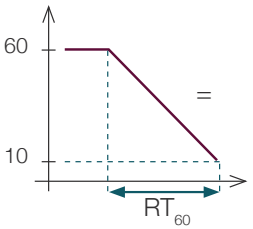
NUMBER IN AUDIENCE

= **40**

ACOUSTIC PRINCIPLE TESTED



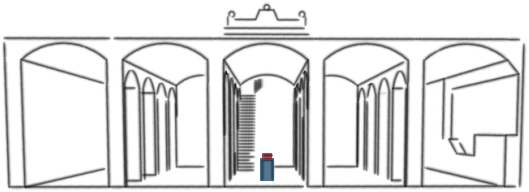
RESULT - RT_{60} (500Hz)



= **~2.8sec**

CONCLUSION - SUCCESSFUL MODELS

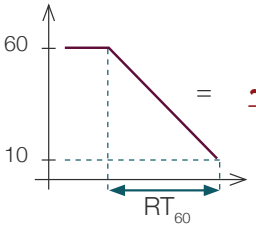
SMALL AUDIENCE, CURRENT SITUATION



NUMBER IN AUDIENCE

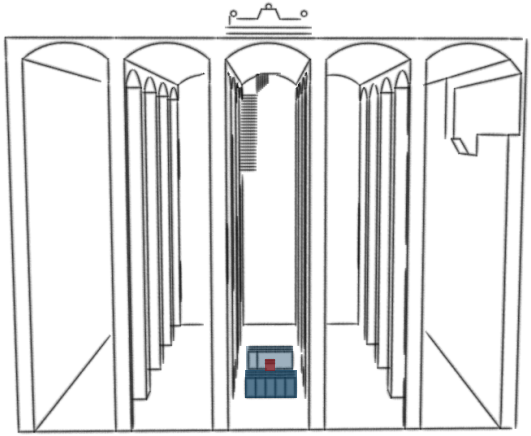
= **1**

REVERBERATION TIME (500Hz)



= **~16.5sec**

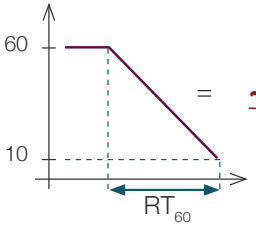
BIG AUDIENCE, FLOOR LEVEL BY LOWERED 11m



NUMBER IN AUDIENCE

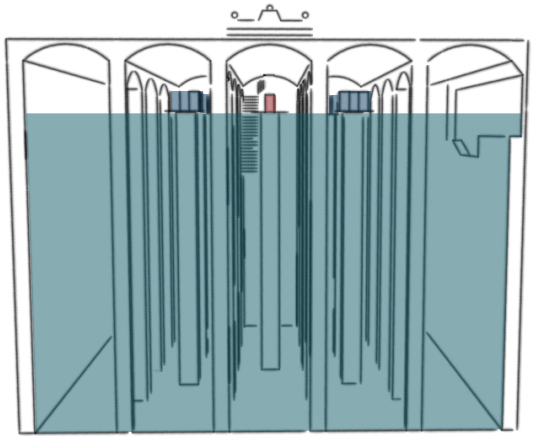
= **40**

REVERBERATION TIME (500Hz)



= **~16.5sec**

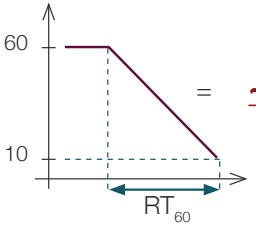
BIG AUDIENCE, RAISED WATER LEVEL BY 14.5m



NUMBER IN AUDIENCE

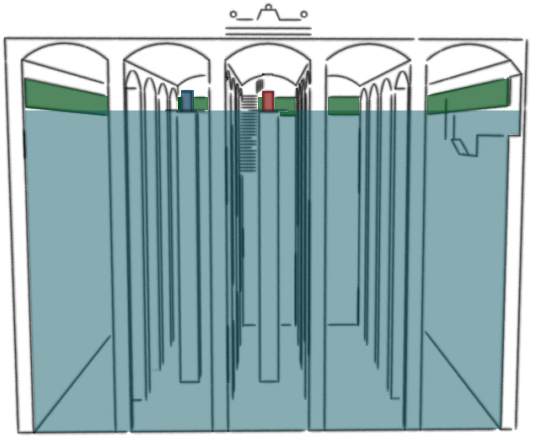
= **40**

REVERBERATION TIME (500Hz)



= **~3.1sec**

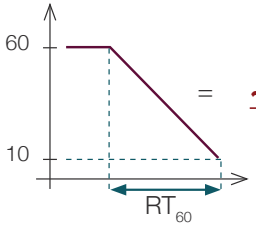
SMALL AUDIENCE, RAISED WATER LEVELBY 14.5m, ADDED MOSS ABSORBENTS



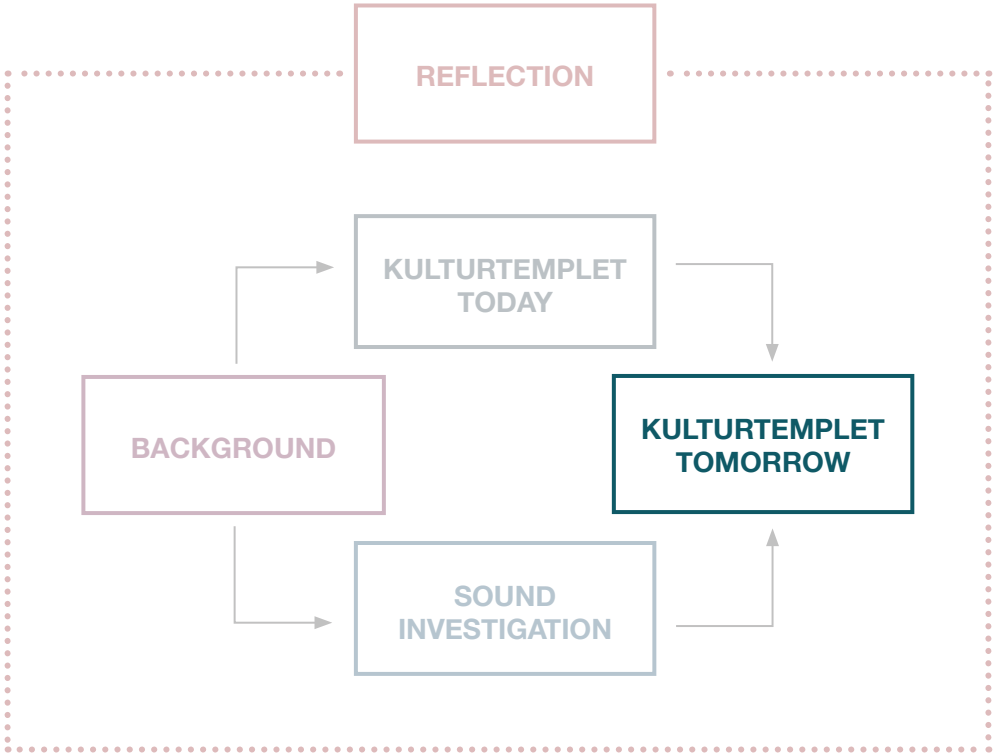
NUMBER IN AUDIENCE

= **1**

REVERBERATION TIME (500Hz)



= **~5sec**


REFLECTION
KULTURTEMPLET TODAY
BACKGROUND
KULTURTEMPLET TOMORROW
SOUND INVESTIGATION

4. KULTURTEMPLET TOMORROW

“The building is like an instrument”

- Leonor Palazzo (Cellist at Kulturtemplet)

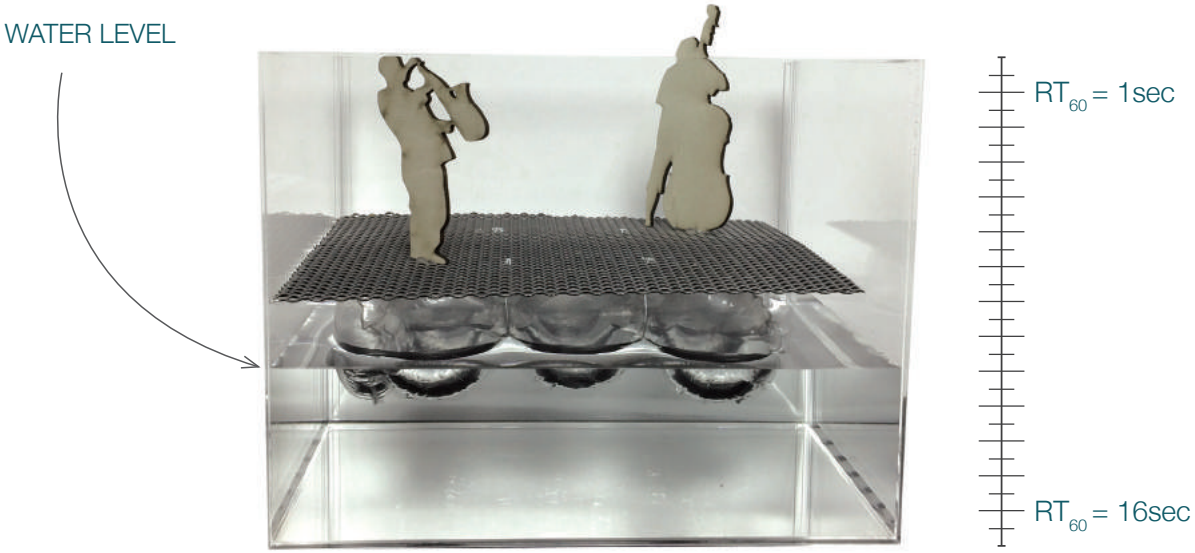
FINAL DESIGN CONCEPT

The final design proposal for Kulturtemplet is a concept that aims at embracing the current characteristics and unique acoustic identity of the building. The results from the sound investigation showed that the Reverberation Time of 16 seconds could be experienced by 40 people present in the room if the floor level is lowered by 11 meters. Moreover, the space volume, hence the Reverberation Time could then be reduced by filling up the room with water which connects to the original function of the building as a water reservoir.

To keep the room a flexible space, floating platforms were introduced to the design concept. Depending on the event, the height of the platforms can be adjusted by inflating or deflating the buoys. Water could also be used as part of the performance by combining the two alternatives (see page no. 66-67). Moreover, the sound investigation indicated that sound absorbing elements needs to be added to achieve a low Reverberation Time when only a few people are present in the room. Therefore, a system was introduced where Nordgröna's moss absorbents could be hung on the railings around the platforms (see page no. 68).

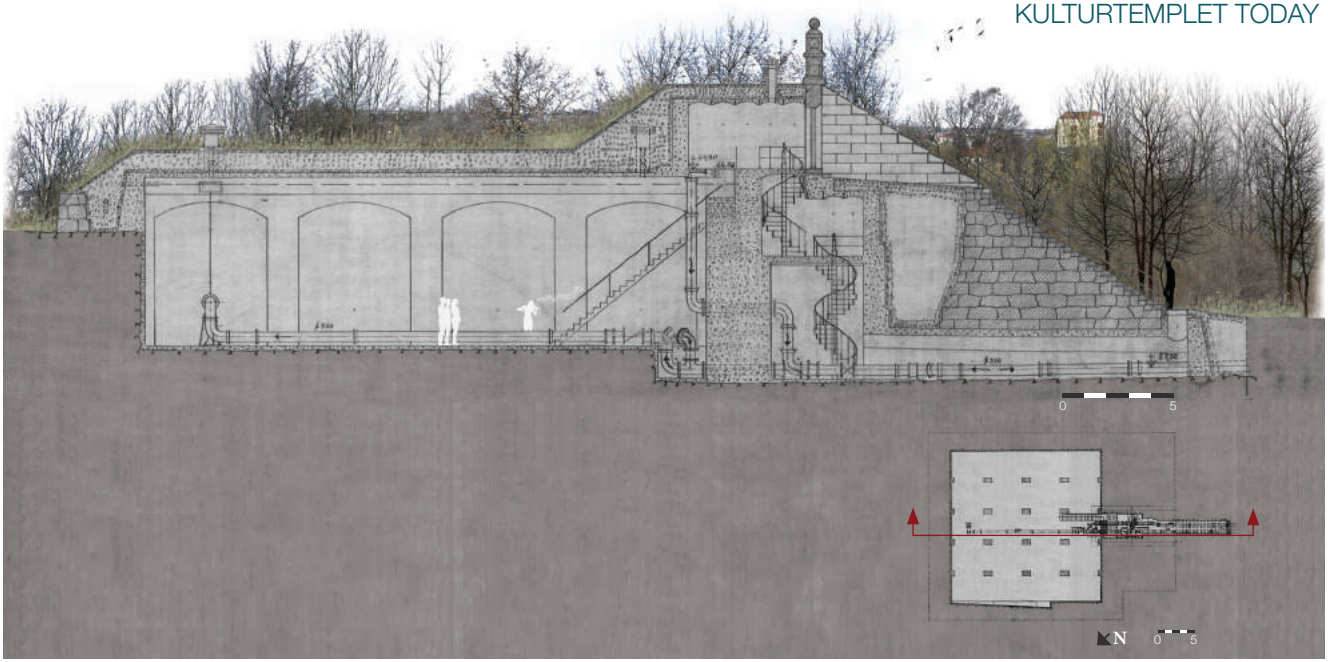
The expected Reverberation Times of the scenarios in the final design (see pages no. 70-77) are based on the tests from the Sound investigation and should be seen as indications rather than definitive results.

PRINCIPLE MODEL

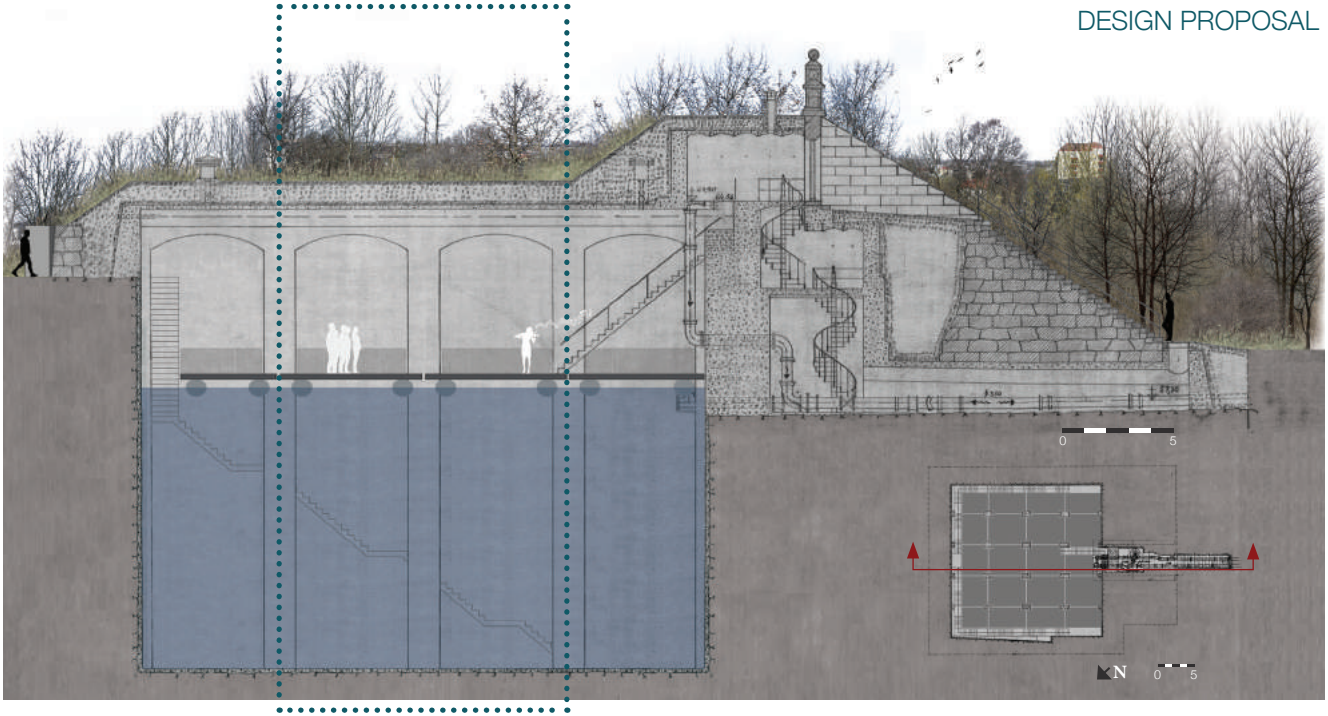


Raised water level = Reduced Reverberation Time

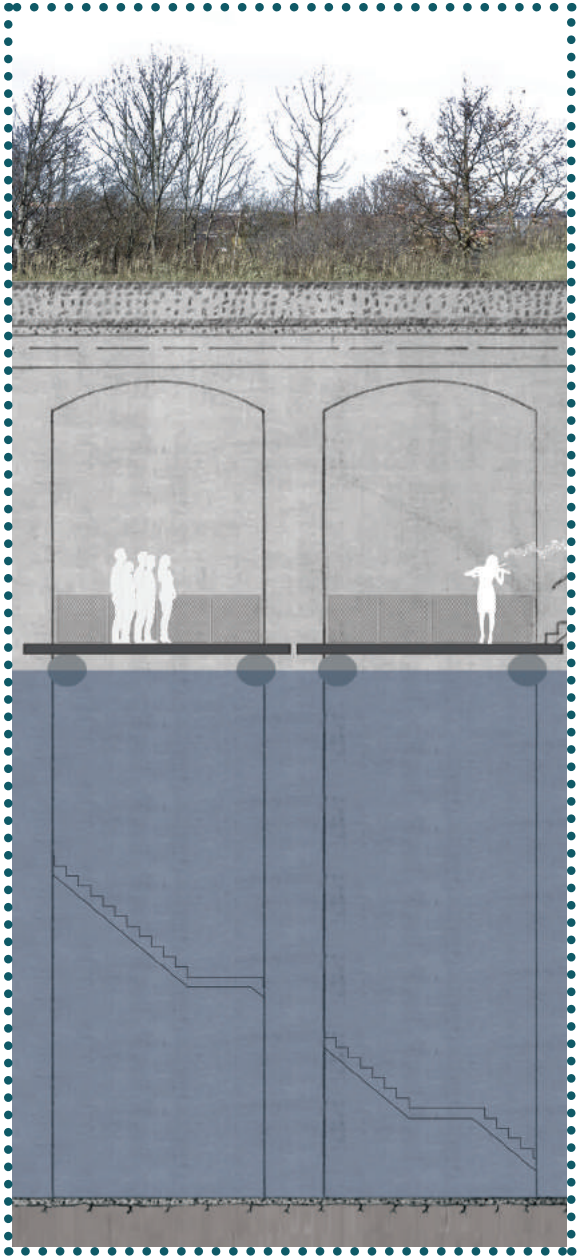
KULTURTEMPLET TODAY



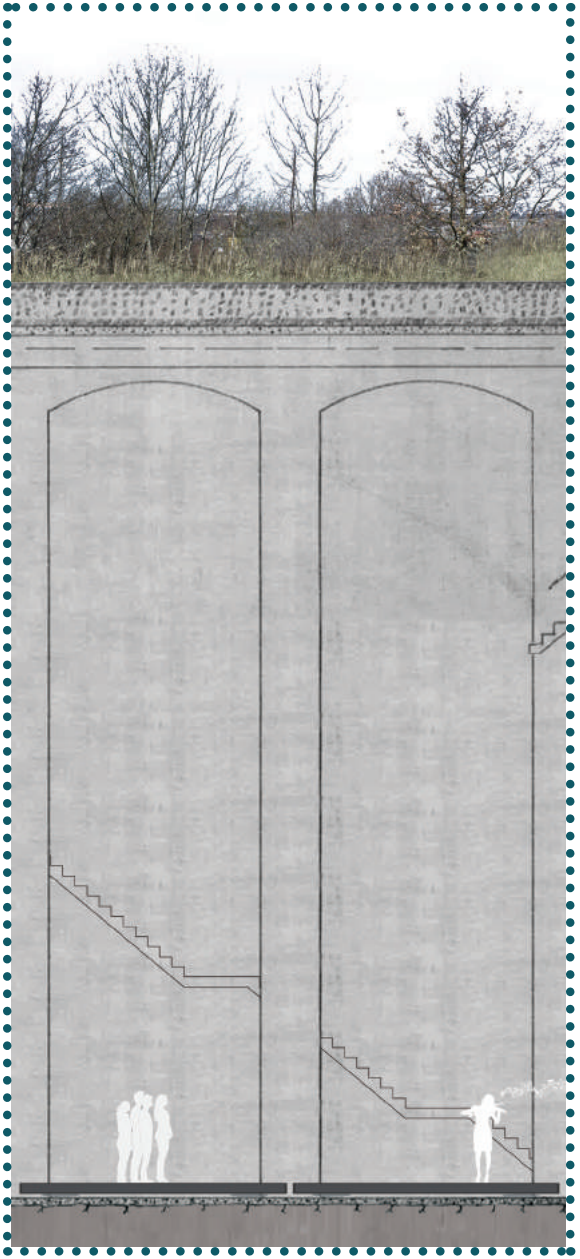
DESIGN PROPOSAL



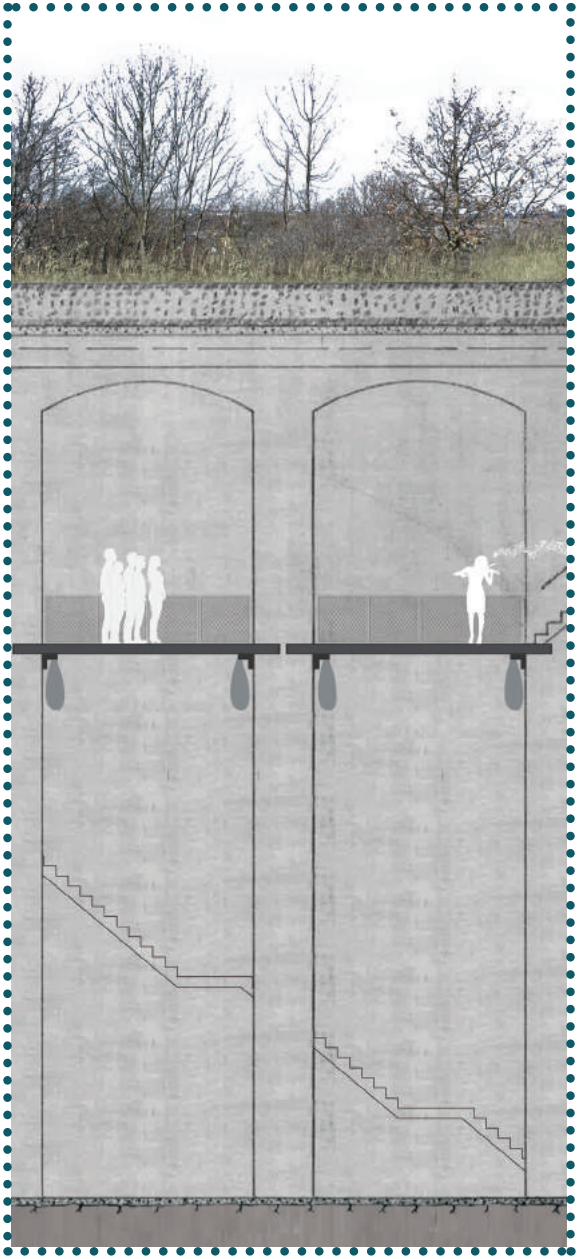
FLOATING MECHANISM



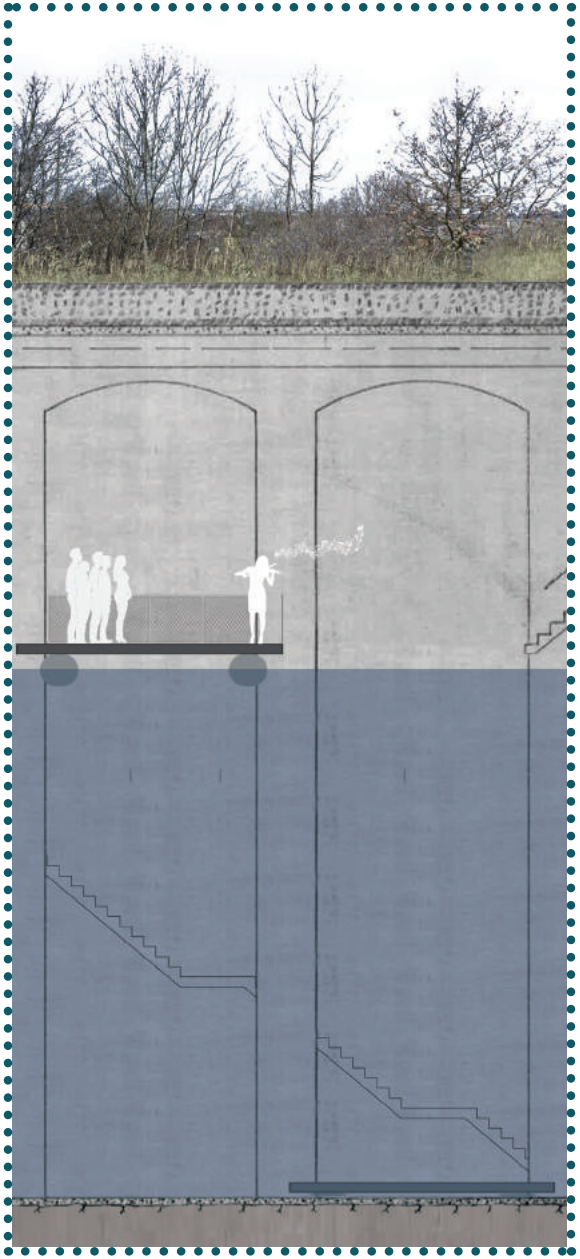
INFLATED BUOYS



DEFLATED BUOYS

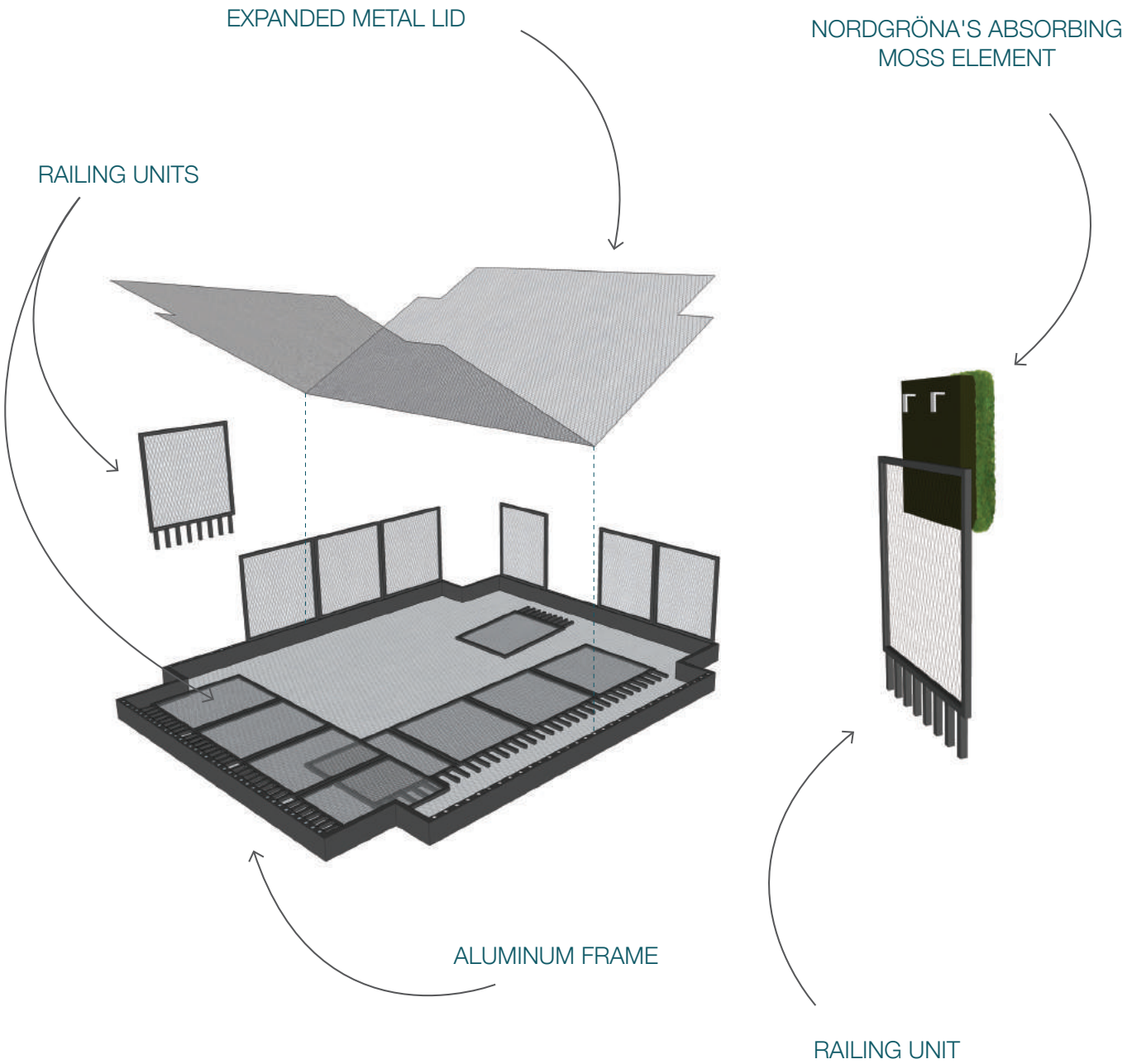


LOCKED PLATFORMS



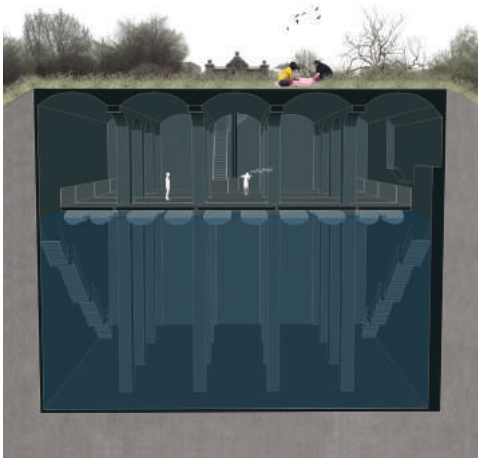
INFLATED+DEFLATED BUOYS

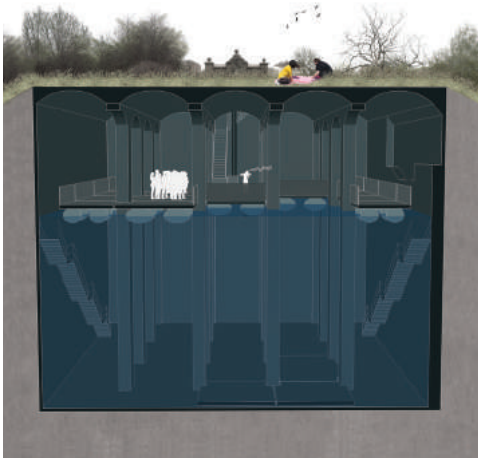
Embedded Storage System

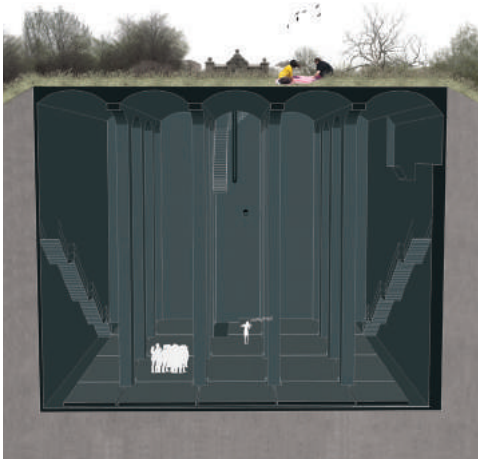


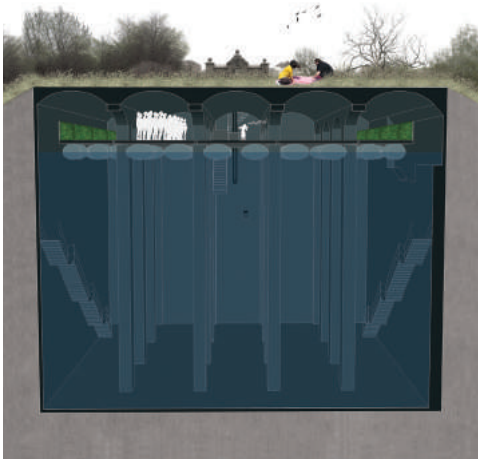
KULTURTEMPLET TOMORROW

Sample of Possible Scenarios



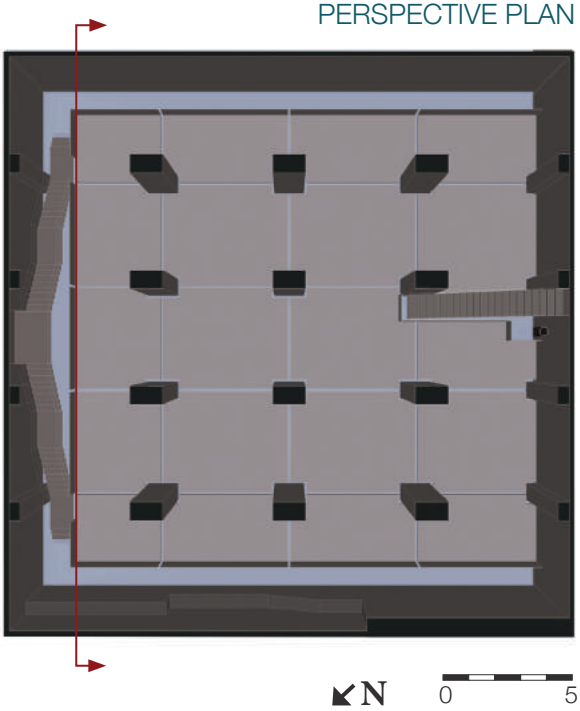






SMALL AUDIENCE, WATER LEVEL TO EXISTING FLOOR LEVEL, INFLATED BOUYS

PERSPECTIVE PLAN



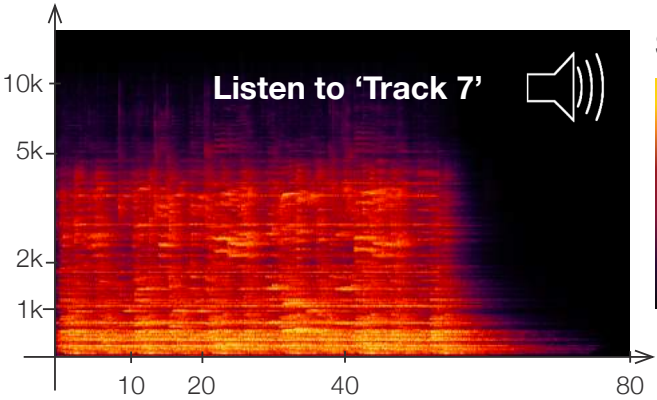
AUDIENCE

= 1

WATER

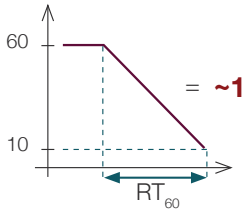
MOSS

Frequency (Hz)

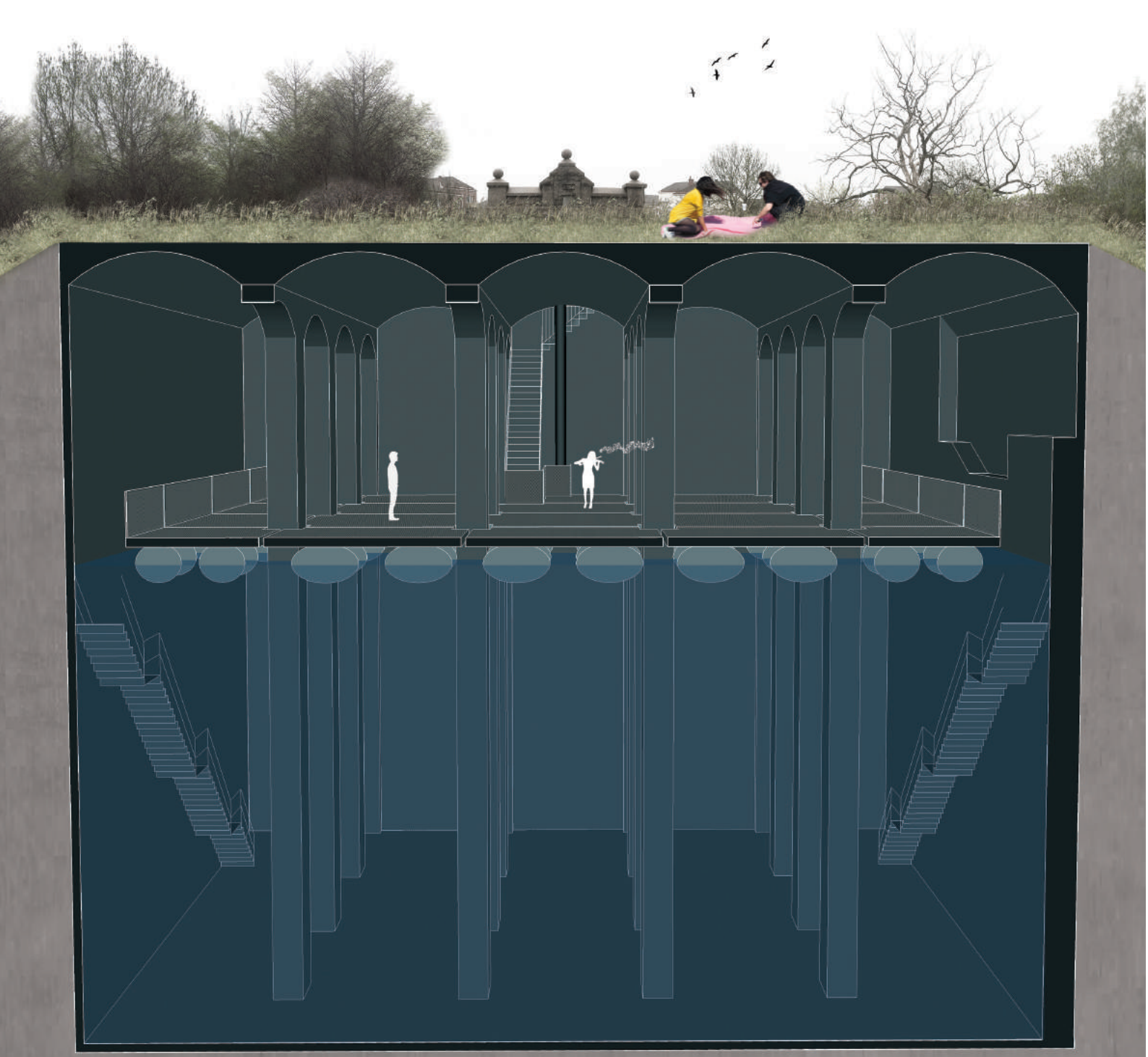


Sound level (dB)

EXPECTED RT_{60} (500Hz)



(Sound track at https://soundcloud.com/tunedbyarchitecture)

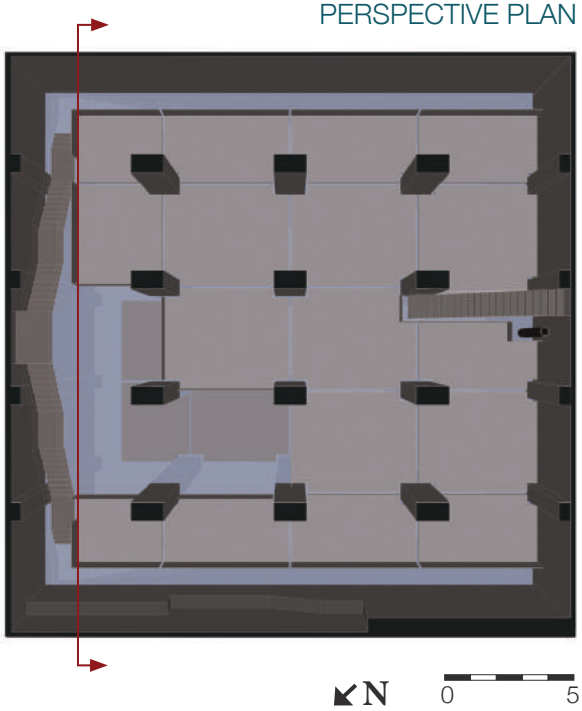


PERSPECTIVE SECTION

0 5

BIG AUDIENCE, WATER LEVEL TO EXISTING FLOOR LEVEL, SOME DEFLATED BOUYS

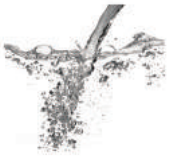
PERSPECTIVE PLAN



AUDIENCE

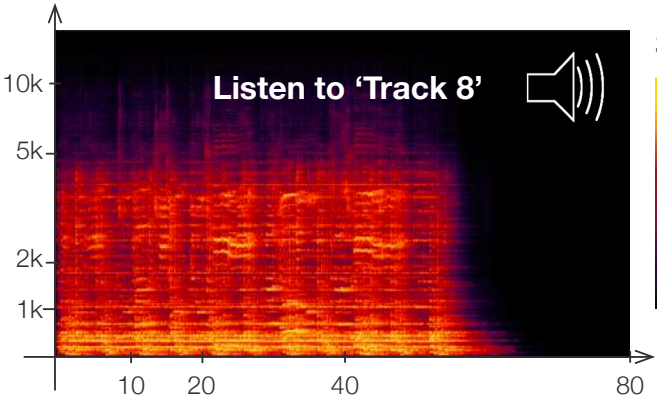
= 40

WATER



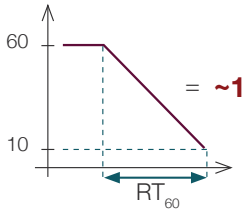
MOSS

Frequency (Hz)

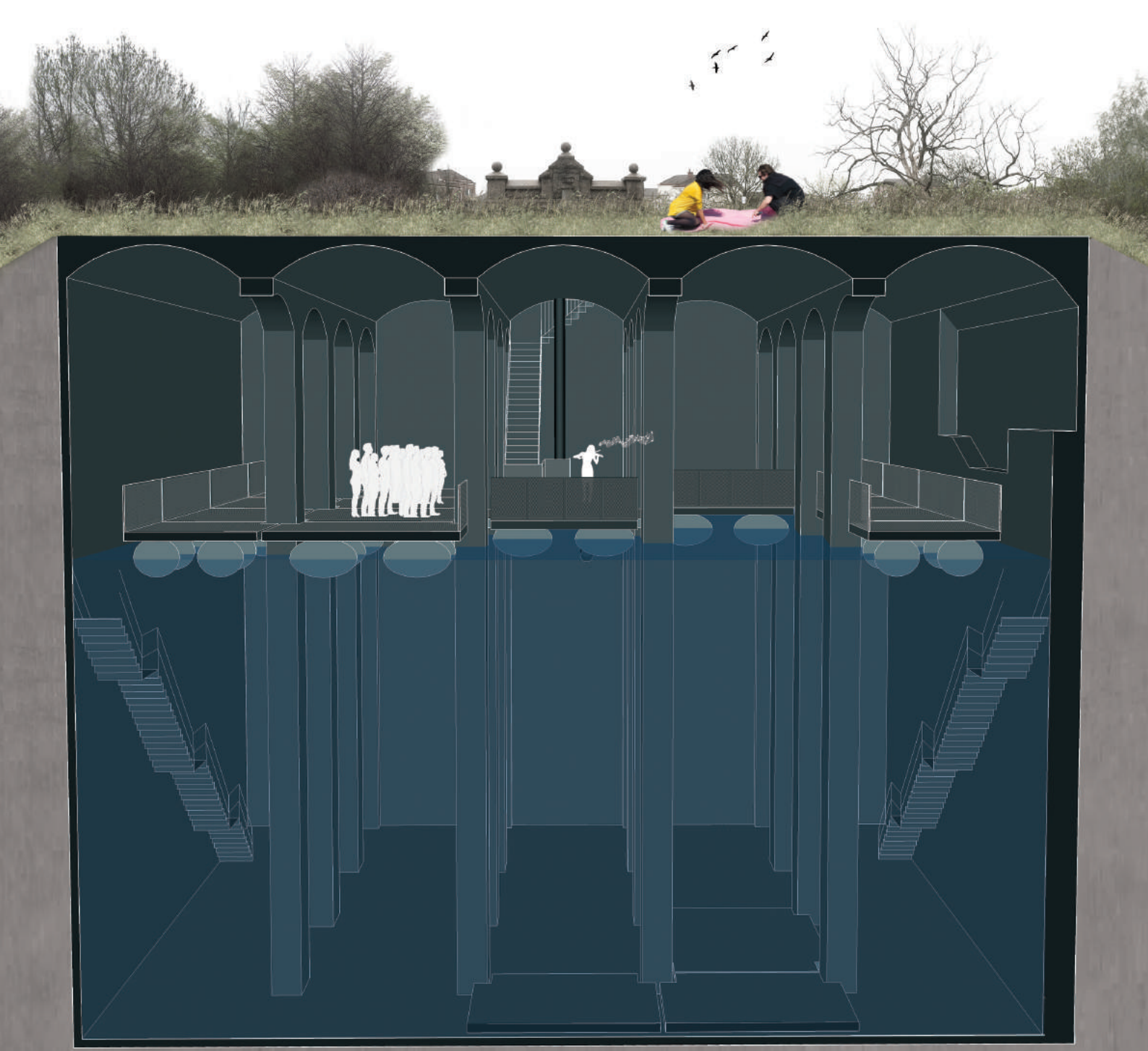


Sound level (dB)

EXPECTED RT_{60} (500Hz)



(Sound track at https://soundcloud.com/tunedbyarchitecture)

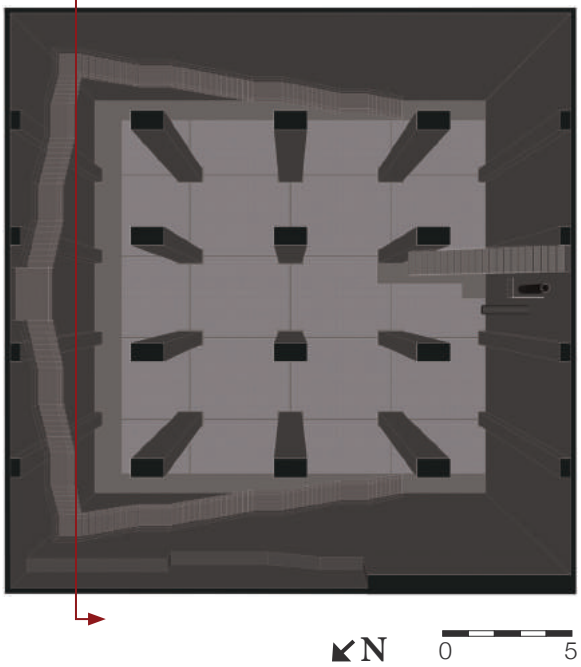


PERSPECTIVE SECTION

0 5

BIG AUDIENCE, NO WATER

PERSPECTIVE PLAN



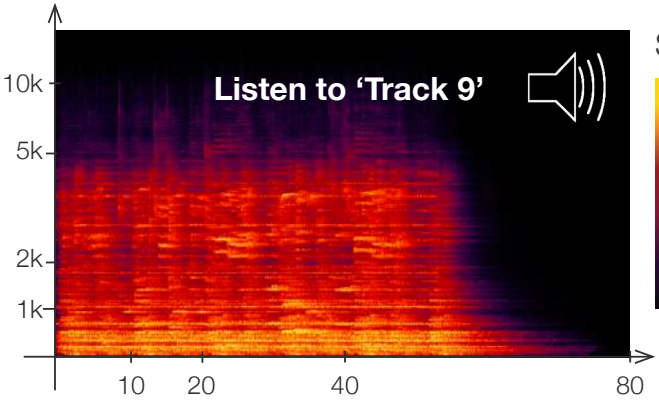
AUDIENCE

= 40

WATER

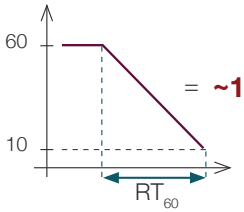
MOSS

Frequency (Hz)



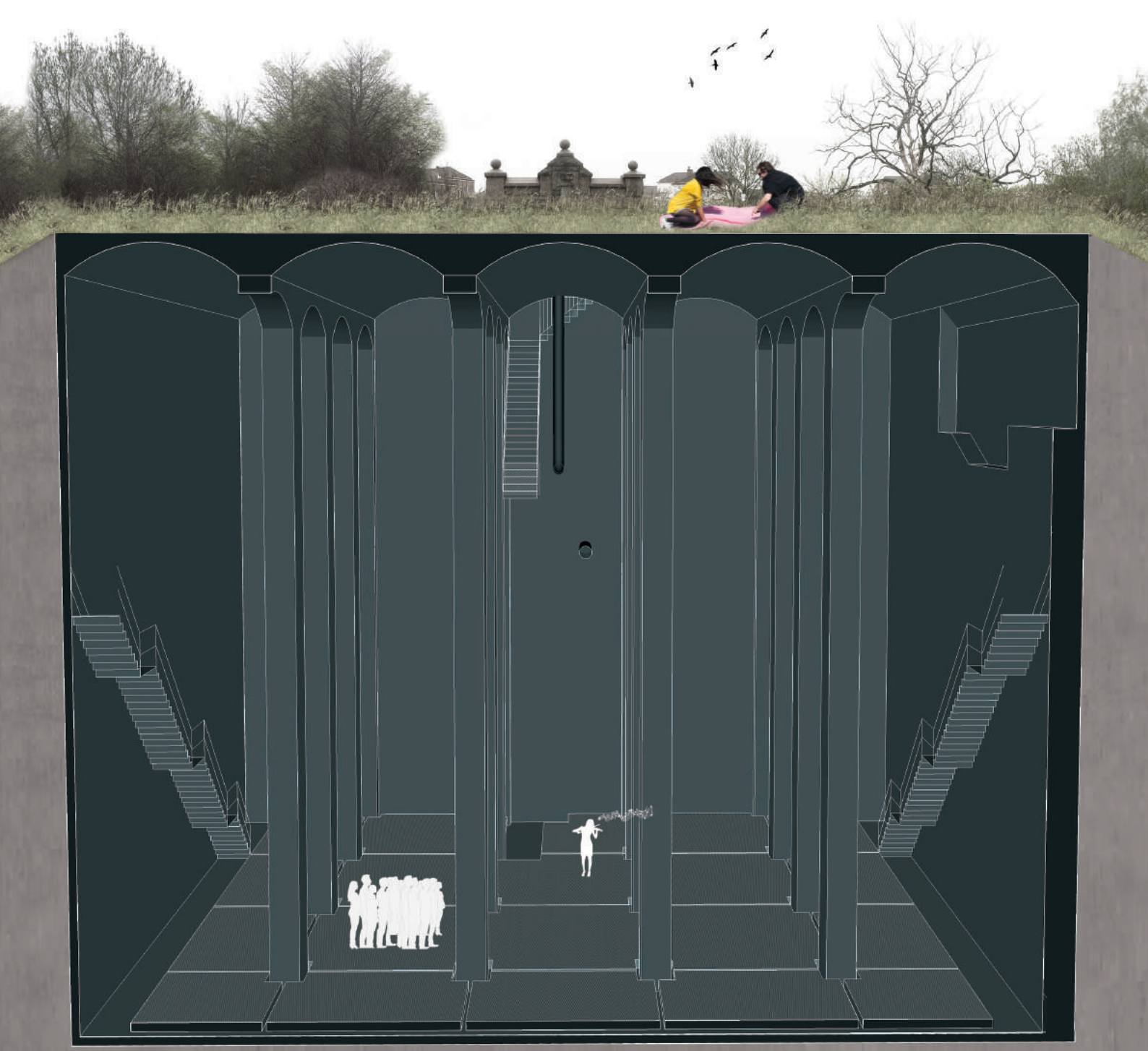
Sound level (dB)

EXPECTED RT_{60} (500Hz)



= **~16sec**

(Sound track at https://soundcloud.com/tunedbyarchitecture)

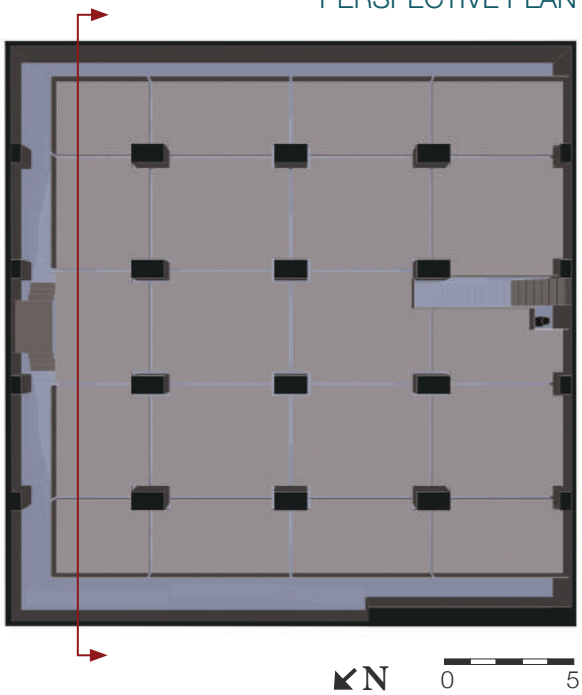


PERSPECTIVE SECTION

0 5

BIG AUDIENCE, RAISED WATER LEVEL BY 14.5m, INFLATED BOUYS, MOSS ADDED

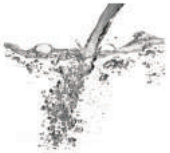
PERSPECTIVE PLAN



AUDIENCE

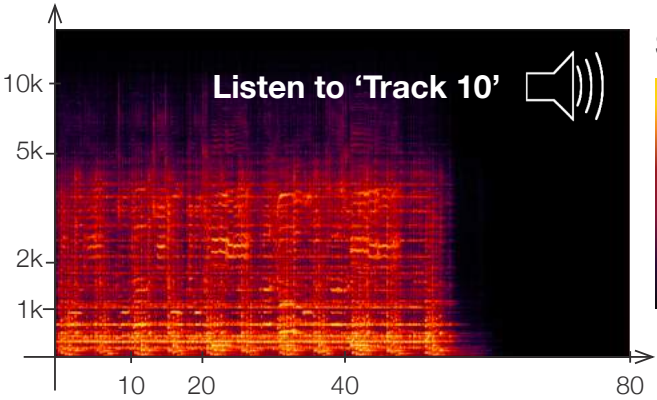
= 40

WATER



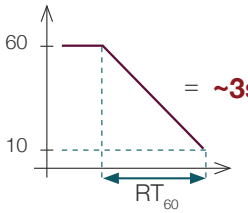
MOSS

Frequency (Hz)



Sound level (dB)

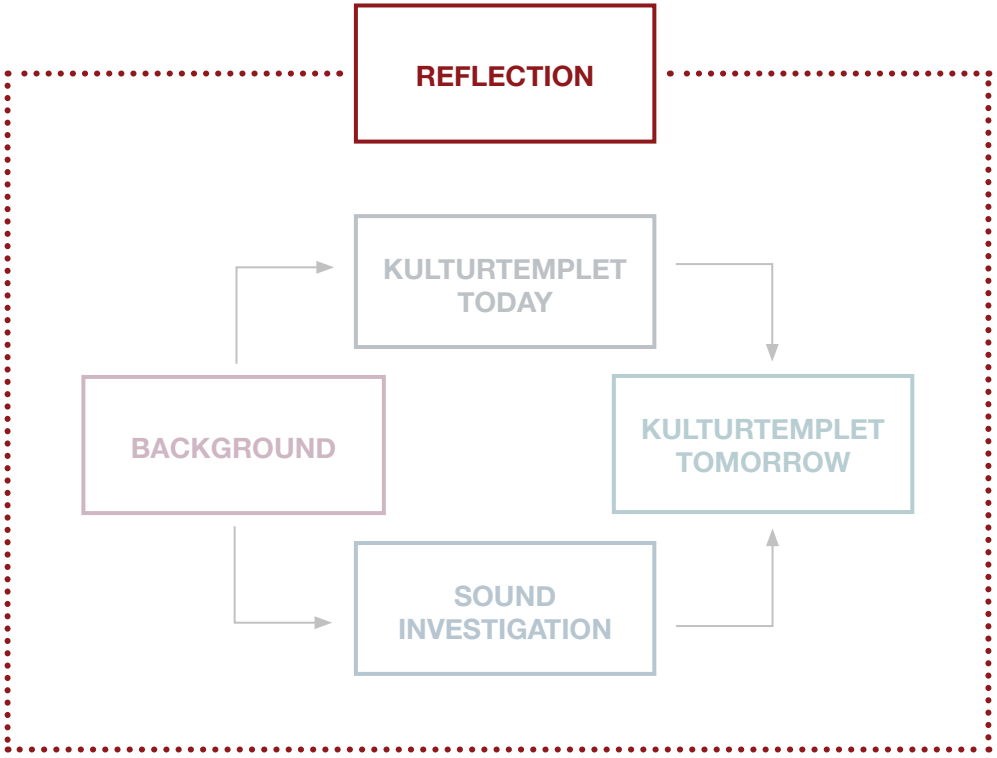
EXPECTED RT_{60} (500Hz)



(Sound track at https://soundcloud.com/tunedbyarchitecture)

PERSPECTIVE SECTION

0 5


REFLECTION
KULTURTEMPLET TODAY
BACKGROUND
KULTURTEMPLET TOMORROW
SOUND INVESTIGATION

5. REFLECTION

“It always seems impossible until it’s done”

- Nelson Mandela

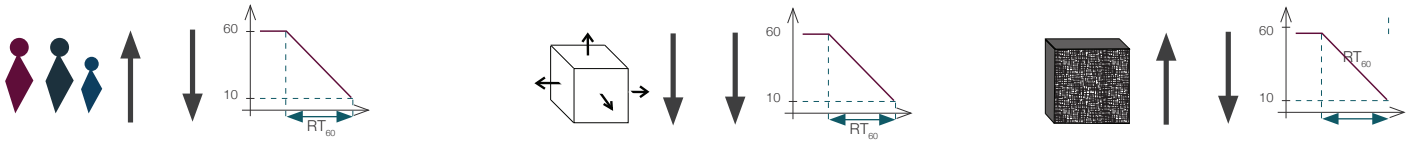
REFLECTION THESIS QUESTION NO. 1

1. How can design be used to achieve a certain sound environment?

This master thesis has investigated how design can be used to achieve a certain sound environment. Along the process of the project, three acoustic principles were identified to have a strong impact on the Reverberation Time: the number of people present in the room, the space volume, and the amount of absorbing materials of the interior. In order to design healthy spaces for people or simply avoid 'sound accidents', architects must be aware of that these three factors have a great impact on the sound environment.

More specifically, in the design proposal for Kulturtemplet, water was used as a volume changing element to control the Reverberation Time. Mainly due to its water resistance quality, moss was introduced as an absorbing material when the goal was to reduce the Reverberation Time. The expanded metal was used in the design of the floating platforms since it had almost no effect on the sound environment.

In order to understand the full potential of how design can be used to achieve a certain sound environment, further investigation on the subject is needed. However, this master thesis has shown some examples of how architecture can influence sound within a space.

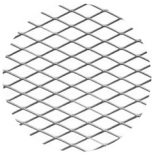


The Acoustic Principles used in this master thesis

WATER

MOSS

EXPANDED METAL



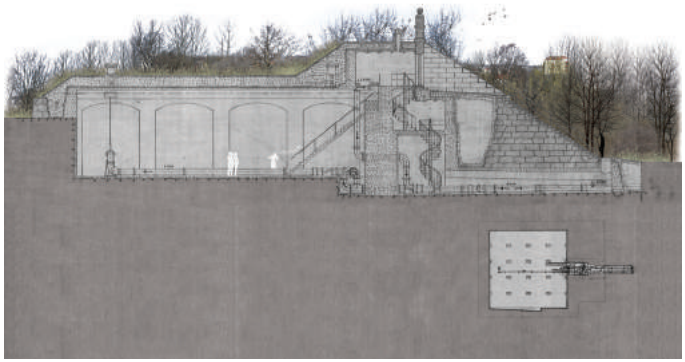
Elements used to control the sound envrionment in this master thesis project

2. How can the old water reservoir, Kulturtemplet, be developed to host more people at music events without ruining the existing, much appreciated sound environment?

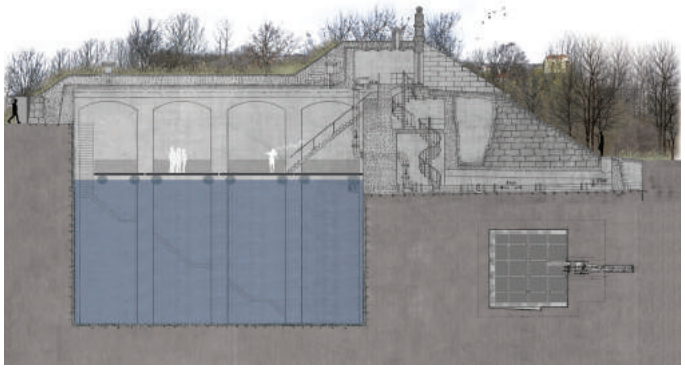
The existing sound environment in Kulturtemplet today, is much appreciated by its users. However, one issue with the building was identified early in the process of this master thesis. The sound environment, hence the Reverberation Time was affected by the number of people present in the room. Therefore, the unique acoustic quality of the space was only accessible to a small audience during performances. This factor lead to that one of the main goals of the project was to suggest a design where the building could host more people at events but without ruining the existing sound environment.

The result of the project is a design where the current floor level is lowered by 11meters and where water can be used to reduce the space volume whenever needed for achieving a lower Reverberation Time. Today, only 20 people are allowed within the building at the same time since there is only one exit. Therefore, another exit was introduced in the new design as well as a staircase providing access to the platforms that change position according to the water level (see chapter 'Kulturtemplet Tomorrow'.

BEFORE



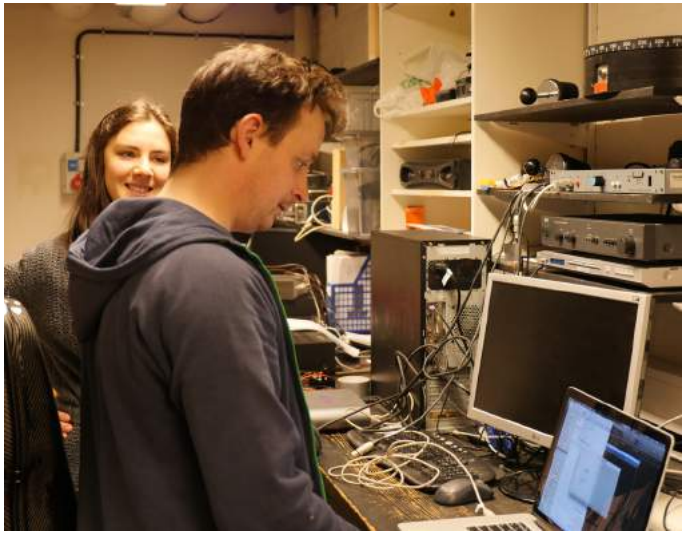
AFTER



3. How can architects and acousticians collaborate in a design project to achieve specific sound environments?

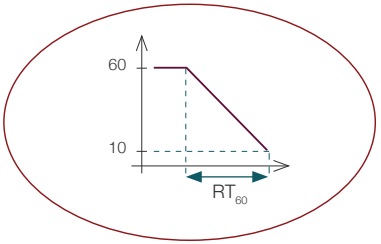
The final question investigated in this master thesis relates to the collaboration between an architect and an acoustian. It is important for architects to be able to present their ideas visually. Moreover, this project had to be communicated to people with no previous knowledge about acoustics. Therefore, complex mathematical concepts that acousticians use in their daily work were translated into drawings by the architect.

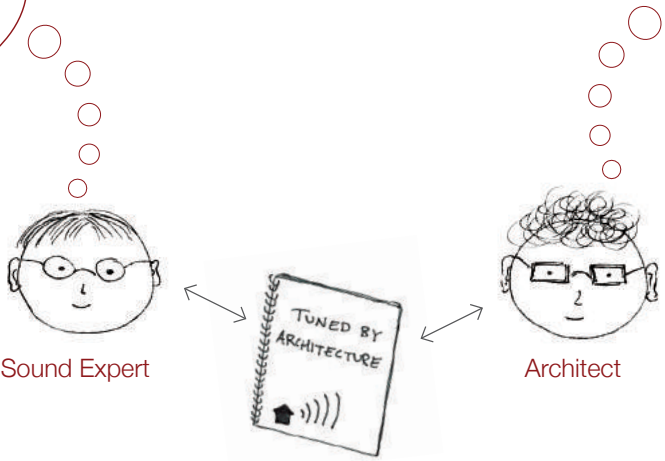
During the design process there was a natural division of tasks between the architect and the acoustican. According to some basic acoustic knowledge the architect suggested design ideas and prepared models of the proposals in the 3D-modelling program 'Sketchup'. This was imported into 'CATT Acoustics' by the acoustician where sound simulation tests were carried out. The results were analysed by the architect and acoustician together, generating interesting discussions and followed by new design proposals to be tested. All collaborative processes are unique and this way of working might not apply to all design projects. However, this master thesis is hopefully an encouraging example of how architects and acousticians can collaborate in design projects to achieves specific sound environments.



REFLECTION
COLLABORATIVE PROCESS

$$RT_{60} = \frac{0.161 \times V}{\Sigma (S \times \alpha)}$$

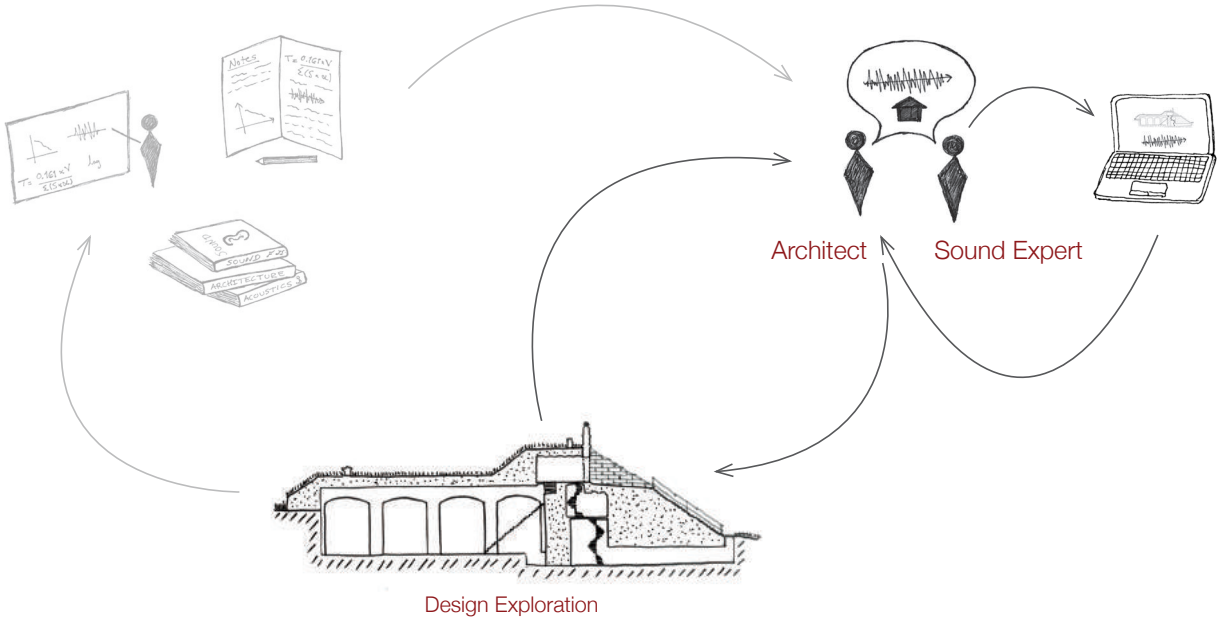




Sound Expert

Architect

REFLECTION
DESIGN PROCESS



Architect

Sound Expert

Design Exploration

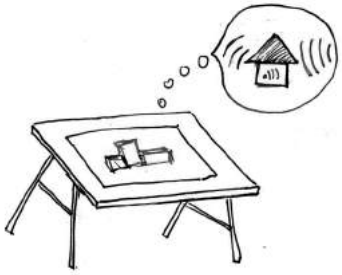
RESULT

The aim of this master thesis is to highlight the importance of sound for our experience of space. It has through a case study of an old water reservoir showed how architects can work with design to achieve aspired sound environments. The goal of the project was not to reach definitive answers but to open up for a discussion and encourage further investigation within the subject of the link between sound and building design.

The master thesis project was concluded with a new design proposal for the building. However, the project has hopefully also highlighted the problem of 'sound accidents' and inspired architects to: consider sound early in the design process, to collaborate with sound experts, and to strive for sound integrated design.

INSPIRE ARCHITECTS TO...

CONSIDER SOUND EARLY IN THE DESIGN PROCESS



COLLABORATE WITH SOUND EXPERTS

STRIVE FOR SOUND INTEGRATED DESIGN

TOPICS FOR FURTHER INVESTIGATION

Apart from that added objects during performances such as chairs have great impact on the acoustics of the space, there are also many other aspects within this master thesis that have been left undeveloped due to lack of time. Following are some of the areas within the project that would benefit from further investigation.

INTERIOR OBJECTS

The chairs and other interior objects used during performances will have great impact on the acoustics. This should be further investigated for more accurate results of the Reverberation Time and experience of the sound environment.

LIGHT

Kulturtemplet is today completely dark. There is no electricity and no windows except for in the 'lobby/waiting room' (see page no. 30). How could light be introduced in the design?

STRUCTURE AND CONSTRUCTION

The final design proposal of this master thesis is still on a conceptual level. In order to implement the design a lot more investigation is needed in terms of structure and construction, an area where an architect's knowledge often is lacking. Therefore, structural engineers need to be consulted.

ACCESSIBILITY

This master thesis has focused on making Kulturtemplet accessible for more people at music events. However, in the final design proposal functional disability has not been considered. In order for Kulturtemplet to be an inclusive space, this is an aspect that should be further explored.

SUBJECTIVE EXPERIENCES

Human reactions to sound vary, the subjective experiences of the different Reverberation Times investigated in the project should be further explored.

COST

Even if the design could be implemented in terms of structure and construction it is likely to not make sense economically. Therefore, a cost analysis is necessary.

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Chapter quotes

BACKGROUND "The Modern Architect is designing for the deaf" - Raymond Murray Schafer
Schafer, R. (1977). *The soundscape: Our sonic environment and the tuning of the world.* Rochester, VT: Destiny. p. 222.

KULTURTEMPLET TODAY "The Day has Eyes, the Night has Ears" - Scottish Proverb
Wise Old Sayings. Retrieved January 30, 2017, from http://www.wiseoldsayings.com/nature-quotes/

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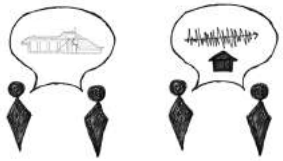

Informal Inverviews/Consultations

Informal interview with Filip Danielssson, The City of Gothenburg (department 'Kretslopp och Vatten Göteborgs Stad'), during a visit at Kulturtemplet on February 15, 2017.

Informal interviews with the manager of Kulturtemplet Jorge Alcaide on several occasions throughout the master thesis project.

'CATT Acoustics' consultation with Johan de Sousa Mestre at ÅF Consult AB on February 3, 2017.

Crash course in CATT Acoustics and Odeon with Emma Gjers at Norconsult, on January 29, 2017

IMAGES / ILLUSTRATIONS

All images, photos and illustrations are by the author unless other stated.

Image page no. 3, Chalmers' logo. n.d.). Retrieved June 7, 2017, from https://www.chalmers.se/sv/om-chalmers/profil-och-identitet/Sidor/logotyp.aspx

Photo page no. 6, Petra Sandberg, by Erika Fransson

Photo page no. 7, Kulturtemplet, by Erika Fransson

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Photo page no. 32, Jorge Alcaide, by Héctor Hernández Rubilar
Photo page no. 32, Leonor Palazzo, by Leslie Artamonow
Photo page no. 32, Moises Rodriguez, by Karol Tatiana Cardona
Photo page no. 32, Petra Sandberg, by Erika Fransson

Photos page no. 34, workshop images by Erika Fransson

Photo page no. 37, 'Dummy head' by Sebastian Christensson

Image page no. 45, 'CATT Acoustics simulation' by Sebastian Christensson

Illustration page no. 43, Aspired Reverberation Times, Illustration by author based on information Retrieved February 7 2017, from https://acousticalsolutions.com/reverberation-examples-and-explanations/ and http://www.philophony.com/sensprop/reverberation.html

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Photos page no. 47, Nordgröna Moss absorbent, (n.d.). Retrieved March 30, 2017, from http://nordgrona.com

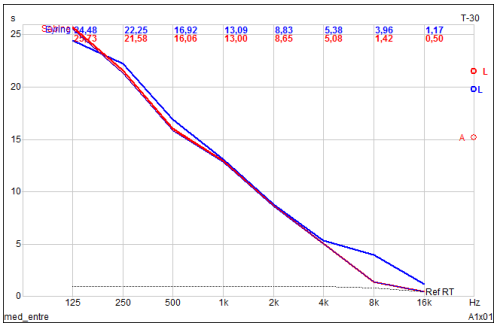
Image page no. 82, Petra Sandberg and Sebastian Christensson, by Jorge Alcaide

Images page. no. 90-91, Reverberation Time graphs by Sebastian Christensson

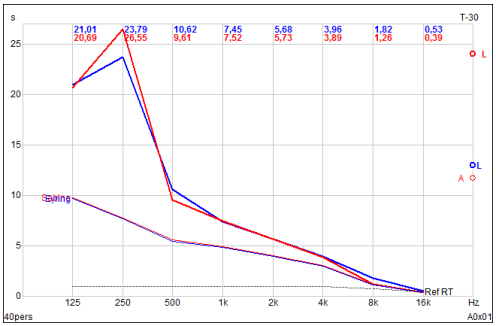
APPENDIX

REVERBERATION TIMES (RT_{60}) FULL GRAPHS

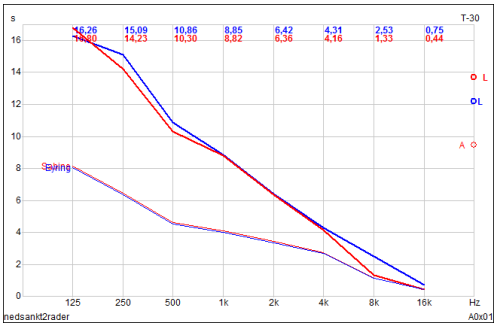
RT_{60} - ACOUSTIC TEST 1



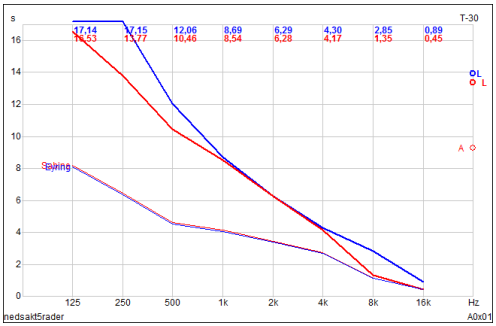
RT_{60} - ACOUSTIC TEST 2



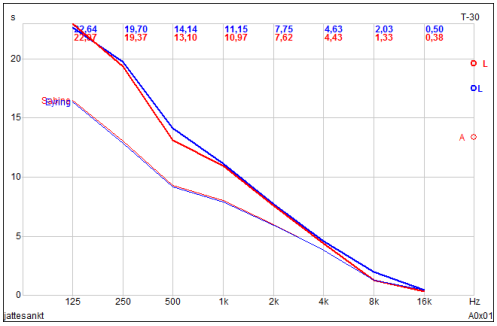
RT_{60} - ACOUSTIC TEST 3



RT_{60} - ACOUSTIC TEST 4



RT_{60} - ACOUSTIC TEST 5



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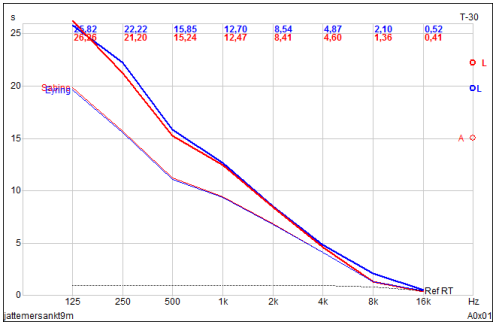
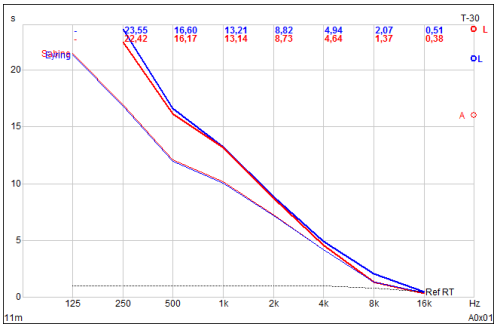
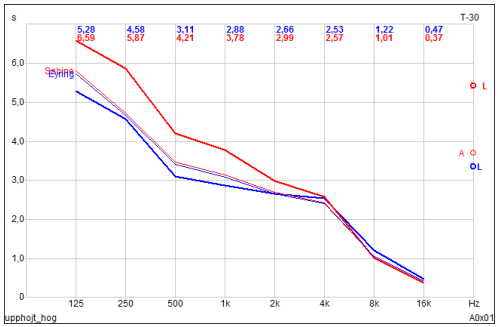


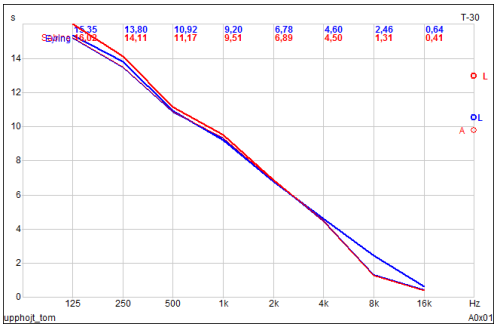
RT_{60} - ACOUSTIC TEST 7



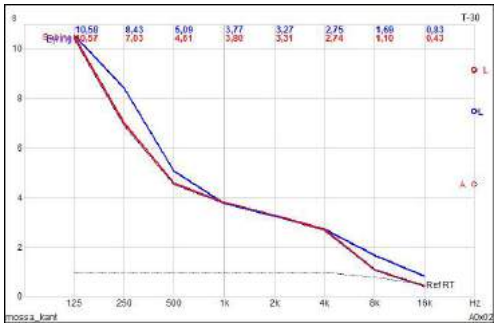
RT_{60} - ACOUSTIC TEST 8



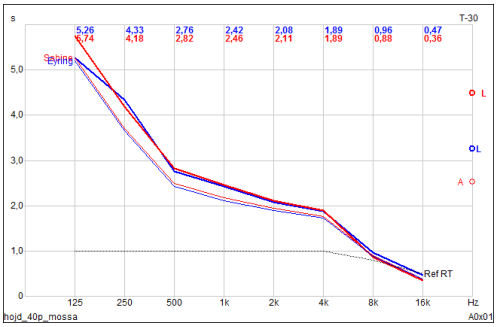
RT_{60} - ACOUSTIC TEST 9



RT_{60} - ACOUSTIC TEST 10



RT_{60} - ACOUSTIC TEST 11



Hej!
Vill du berätta lite om de kvalitéer du ser med att använda Kulturtemplet, vad ni planerar göra, hur det går till, hur det fungerar med publik etc.? Vet inte hur mycket du har lust att skriva, jag bjuder gärna på en fika eller så om det känns lättare.

Hej!
Jag känner en stor kärlek och ömhet till hela byggnationen, från anmarsch till interiör. Jag uppskattar den vildvuxna karaktären runt om. Väl inne i templet sker någonting i mig som jag tror har med mörkret, vattnet och tystnaden att göra. Jag uppskattar verkligen hur lokalen är så minimalistisk vilket gör att en kan använda olika delar/vinklar av rummet för olika effekter/känslor. Rummet är fantastiskt inbjudande till skapande med dessa möjligheter till placering. Templet är så enormt starkt i sig självt och när jag jobbade där kände jag tydligt rummets integritet. Det är som en egen individ och verken som presenteras där inne är bara kollaborationer med denna individ. Jag tror verkligen att det är en känslig miljö, likt individer. Jag har en stor respekt för kulturtemplet. Jag får en trygghetskänsla av att befinna mig där, något jag vill likna med att vara i livmodern.

Med vår performance VATTENVÄG II jobbade vi fram ljud-texturer med olika objekt genom improvisation och workshops. Dansaren, jag och min medmusiker gick igenom ljussättning; vilka delar av rummet vi ville använda, hur vi ville placera dansarens och pelarnas skuggor. Tillsammans med dansaren gick vi igenom rörelse-dynamiken genom rummet. Central stage hade vi en stor pöl med magnesium som var vår enda rekvisita utöver ljus-former. Dansaren rörde sig och samspelade med det.

Publiken ordnade vi lätt genom 4 rader av lastpallar och stolar. Vi hade 20 platser. Placeringen valde vi efter vart akustiken träffade dem effektivt, och vartifrån en bra scenyta med djup blev.

by, Alba Vera Bergeling

Hej

Tack för en fantastisk dag idag. Tack Petra framförallt för det fina arbete som du gör och alla er andra för ert deltagande.

Jag tänkte mycket nu på det märkliga som visade sig i våra teckningar. Det var väldigt skumt att vi 3 som är inne på ljud ritade alla cirkelformade eller spiralformade teckningar medans ni som är mest inne på form och kanske det visuella eller mer helhetsmässiga upplevelsen av rummet ritade teckningar som använde sig mer av rummets fysiska form som är mer kantig och formig...

Sen tänkte jag på hur tydligt det blev att ljud är något runt och inte linjärt som det ofta ritas.
Jag insåg att det som sker i kulturtemplet är att detta förtydligas fysiskt och att det är det som är det magiska.
Ljudet får form, rummet blir tid ....Ni vet i musikteori brukar man tala om vertikala- harmoniska förhållanden och melodiska-horisontella linjer.
Det som sker i kulturtemplet är en åtdragning av dessa till varandra, till en rundare form.

Flummigt?

Hoppas det, det behövs ibland i denna värld.

Jag tyckte i alla fall att det var väldigt intressant idag och är jätte tacksam för att ni alla bidrar till detta projekt som är så kärt.

Vi ses imorgon.

Moises, kan du ta med fosforecent färg?

Jorge

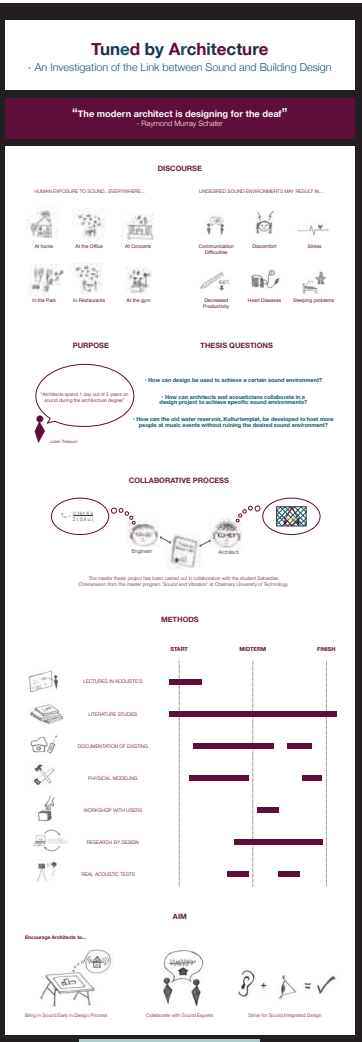
EXHIBITION POSTERS

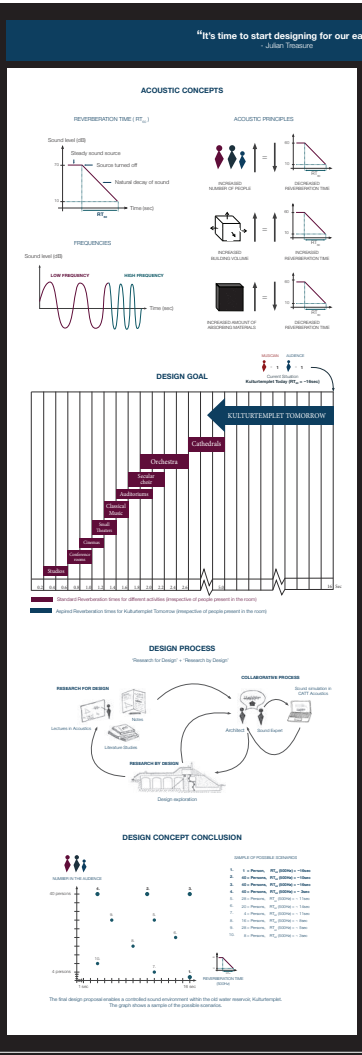
ABSTRACT PAGE

STUDENT BACKGROUND

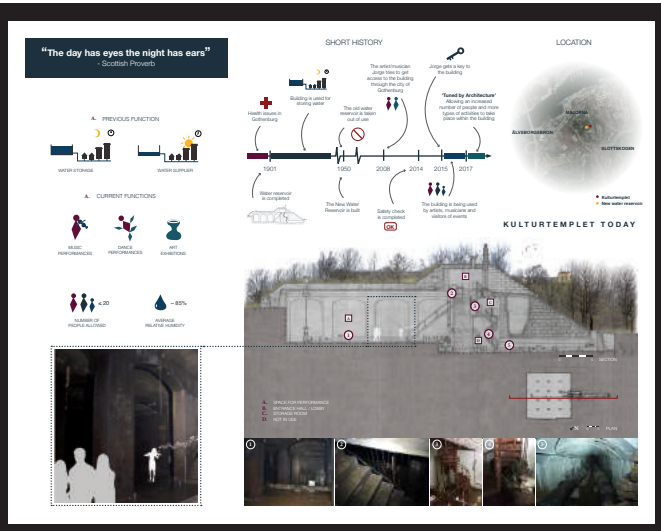
ABSTRACT HOLDER

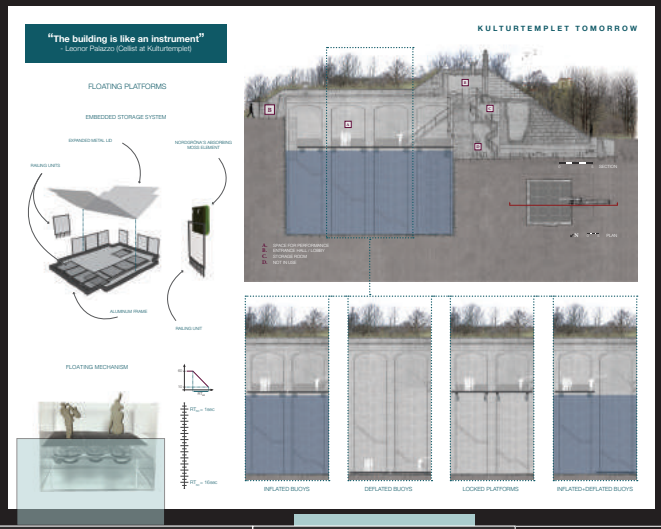
PHYSICAL MODEL
KULTURTEMPLET TODAY

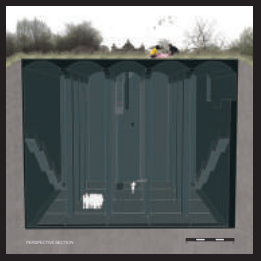


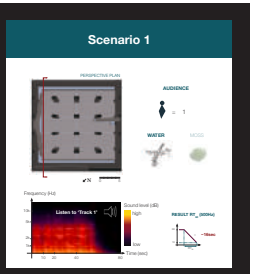


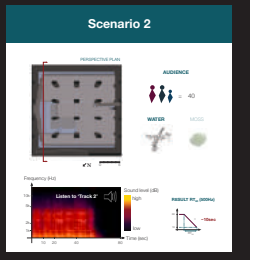
DRAFT BOOKLET

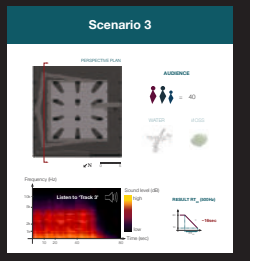


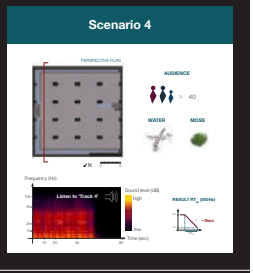












PRINCIPLE MODEL + NORDGRÖNA MOSS SAMPLES

EXPANDED METAL SAMPLE