SKOVLUND KIRKE

Church in Gl. Rye – Skanderborg

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Architecture and Design
May 2023, Aalborg University

Thesis title: **Skovlund Kirke**
Department: Architecture, Design & Mediatechnology
Semester: MSc04 Architecture
Project period: 01.02.2023 – 26.05.2023

Main supervisor: Michael Lauring
Technical supervisor: Kai Kanafani
Group: 14
Number of reports printed: 6
Number of pages: 175
Number of appendix: 6

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A special thanks to...

This thesis has been developed through assistance and valuable guidance. Therefore, we would like to express our gratitude to our supervisor, Michael, for his insights and guidance in the field of church architecture and tectonics. Additionally, we extend our appreciation to our technical advisor, Kai Kanafani, for providing guidance in Life Cycle Assessment (LCA). Furthermore, we would like to thank Iben Thomsen for dedicating her time to share her perspectives on the church and Gl. Rye parish.

We would also like to express our thanks to the various church personnel for their hospitality and their valuable insights into the everyday life at a church. A special acknowledgment goes to Mads Brath for his expertise in acoustics and to Thomas Lindberg for his guidance in construction.

(Lu)cis sedes est hec sacre (lu)cis edes

The seat of light is this sacred building
(Rasmussen, 2015)

Abstract

This thesis presents the design of a biogenic church, Skovlund Kirke, located in Gl. Rye, Denmark. The motivation behind the development of this thesis, was to form a proposal of church architecture, which challenges the traditional way of erecting church architecture, replacing traditional building materials, with biogenic building materials, which are low carbon emitters. Thereby, supporting a green transition in the building sector, erecting architecture, which is considerate of the environment. Furthermore, the Thesis investigates the development of the role of the church throughout history, to take a stance in what the role of the church is today and what the church must offer to enforce a diverse and rich church life in a secularized society. Today a church is a complex building, which must embrace a lot of different functions and serve as a centre for the community, however, still preserve the mysterious and fantastic atmosphere of a church. The design of Skovlund Kirke strives to both maintain the spiritual atmosphere of a church, while simultaneously having great flexibility in the layout of the church, to accommodate a broader use.

Reading guide

This thesis is divided into eight chapters, prologue, Gl. Rye parish, theoretical and thematic studies, site studies, programme delimination, presentation, design development and epilogue. The theoretical studies sets the foundation for the project. The presentation communicates the project through architectural drawings and visualizations. All architectural drawings in the right scale are collected in a separate drawing folder. The development of the design is an iterative and complex process; however, the chapter seek to communicate design propositions and choices based on qualitative and quantitative investigations in a somewhat chronological order.

All references in this thesis are presented using the Harvard reference method. All illustrations are indicated with an illustration number.

Ill. 1 / Øksendrup Kirke (Photographer: Unknown, Ørbæk Lokalhistoriske Arkiv)

CHAPTER 01 / PROLOGUE

Introduction

The history of the Danish Church dates back many years, and over time, both the appearance and role of the church in society have undergone almost constant development. Going back to the 8th century, churches were simple wooden constructions without benches and lights, which were used to worship the Nordic gods. In comparison, today we see large complex buildings that contain much more and embrace much broader functions than we have seen before.

The term “church” is ambiguous and is therefore used to describe various things. The word describes the church as a cultural institution that promotes a particular faith, such as Danish Christianity (Raun Iversen, 2017). The word also describes the church as a spiritual entity and, conversely, as the physical building in which church ceremonies take place. It is also important to note that in modern church buildings, the term “church” often describes a collection of building components that have different functions. In a traditional sense, the description of the church as a building would only cover the space where the actual church service takes place (Grey Schuster, n.d).

The historical development of the Danish population’s perception of the church means that today, we question what the church should be able to do for the local community and how the church building can be designed in the future. Having a common meeting place in smaller communities is not new. We see this in common houses that are often centrally located in the village and within reasonable walking distance of the old medieval church. The community centre can accommodate many different activities, both for private and community life. Today, there is a trend towards people wanting to live in smaller spaces, which increases the need for meeting places for larger events. Furthermore, there are many local communities where enthusiasts work hard to keep social life going with events, which also require the need for meeting places.

This is also true for the village of Gl. Rye, located between Silkeborg and Skanderborg. Here, there are several associations and clubs that wish for a common house that can accommodate a wide range of functions and thus serve as a kind of multi-purpose house. As Gl. Rye expands, and with additional land subdivisions planned, a new church building with an associated open parish hall can benefit the village.

Ill. 2 / Sankt Sørens Kirke in Gl. Rye

The aim of this thesis is to investigate how a new church can be designed to meet the need for a communal gathering space for the village, while also providing space for religious ceremonies and a sacred atmosphere. The focus of this thesis is to explore how this can be achieved using biogenic materials, which are materials composed of biological matter that must be harvested rather than extracted and processed. Biogenic building materials are already a topic of much positive debate, and there are currently numerous research experiments and performance tests taking place around the world. The goal of this thesis is to examine the potential of biogenic materials and challenge the perception of these as durable building materials. The choice of building materials is often based on experience and approved solutions, but if we desire a more sustainable approach in the building industry, we must be willing to experiment and make bold choices.

Skovlund Kirke, Gl. Rye

Methodologies

The development of this thesis is based on the integrated design process, which is an iterative process, that is built around five phases: *problem formulation, analyses, sketching, synthesis, and presentation* (Hansen and Knudstrup, 2005). In the first phase, problem formulation, the specific problem to the project is defined. Second phase, analyses, is where all necessary knowledge is gathered. Knowledge is gathered through extensive research and different methodologies, which aim to form a theoretical foundation for the project.

Analyses

Literature studies

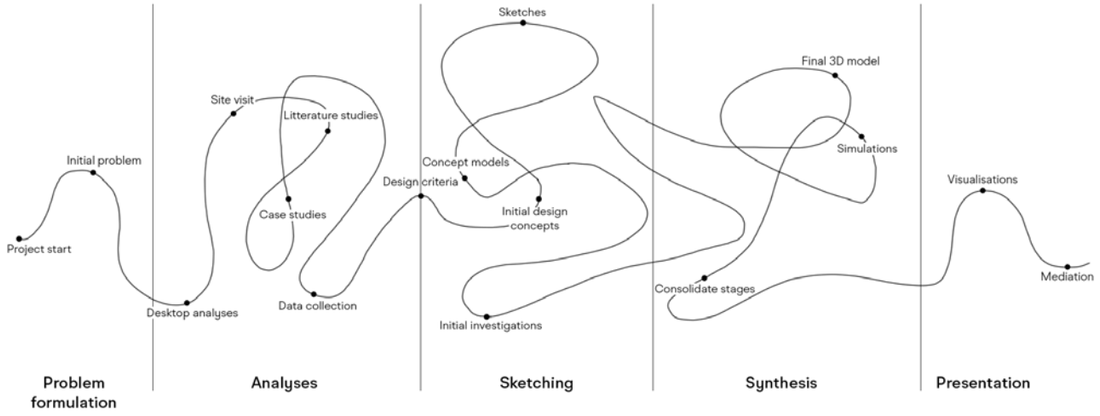
Knowledge has been gathered through literature studies. Theories, such as Peter Zumthor's theory on atmosphere, have been studied to form a foundational framework for the project.
Tools: research articles, books

Case studies

Relevant case studies, in relation to the theories, as an example of how theories are applied in works, have been studied, to find inspiration and explore solutions for the later design and sketching process.
Tools: research articles

Study trips

Visits to several different churches has provided knowledge about the atmosphere, the use of materials, the layout etc. Visits included old medieval churches, plenty of the well-known churches from the 60s to the 90s and the newest church from 2022 situated in Silkeborg. An important benefit from this method is meeting the personnel in the churches and hear their stories about the everyday life, challenges and qualities in the concerned building.
Tools: Excursions



III. 3 / The integrated design process

On- and off-site analyses

Site analyses have been completed to gather necessary knowledge about the site, to develop a design which adapts to its surroundings.

Mapping

Mappings present data of infrastructure, area use, etc. which provides a better understanding of the context where the project is built.
Tools: Qgis, photoshop, illustrator

Data collecting

Microclimatic information about wind and sun is helpful and can unfold conditions, which should be considered when designing.
Tools: databases, weather files

User analyses

The user is the focal point of the project, why it is crucial to gather information about the user in order to make a design, which will comply with needs and wishes to a design.

Interviews

Interviews are used as a tool to gather information about needs and wishes to the design and get an insight into the daily life of the user. The interviews have been semi-structured with prepared questions to gather the needed information but with room for loose conversation, whereby it is possible to gain a broader knowledge.
Tools: Excursion, online meeting

Based on the collected knowledge, the third phase, sketching, is initiated. Different idea generating methodologies are used to find a common direction for the design and structure the sketching phase.

Sketching

Collages
Collages are a great tool to inspiration and communicating ideas between group members, thereby reaching a common position regarding what aesthetic, atmosphere, and ambiances the project strives to achieve.
Tools: Pinterest, photographs, InDesign, drawings

Sketching
Sketching is done to quickly generate and communicate ideas to a design based on earlier analytical work and established criteria. Sketching can be done both by hand and software.
Tools: Hand drawings, Rhino, Revit, ArchiCAD

During the process, when new knowledge is gained, the design is revised and adapted.

Fourth phase, synthesis, is where the final form of the design is detailed. The design is based on thorough considerations.

Synthesis

Technical methodology
Specific for this thesis the technical approach aims to generate results regarding CO_2 emission in applied materials and the acoustic experience and ensure that the design accommodates the demands.

Simulations and calculations
By making simulations of the acoustics in the design process it is possible to ensure that the final design will meet the determined demands.
LCA calculations are completed to ensure that the building complies with demands of the design to have a minimal negative climate impact.
Tools: LCAbyg, Treble, Excel, SketchUp

Finally, is the last phase, the presentation of the final design. To present and communicate the design to a third-party person, different methodologies are used.

Presentation

Illustrations
Illustrations such as diagrams, sections, plan drawings, elevations etc. communicate large amounts of information regarding the project effectively and quickly.
Tools: Illustrator, Photoshop, InDesign, Rhino, ArchiCAD

Renders
With photorealistic 3D visualizations of the final design it is possible to create a precise depiction of what to expect the building to look like, when build. Photorealistic visualizations are easy to interpret by a third party, why they are a great tool to present the project.
Tools: Illustrator, Photoshop, Rhino, ArchiCAD, Twinmotion

Report
All work is concluded in a report which aim to communicate the project and all its phases, from beginning to end, through illustrations, renders and supplementing text.
Tools: InDesign, Word

The integrated design process covers the course of actions from beginning to end and combines both architectural and engineering knowledge. By combining both architectural and engineering knowledge the aim is to reach a final design, which has a clear connection between the aesthetic, functional and technical aspects, whereby, according to the Vitruvian triangle, the framework for great architecture is ensured.

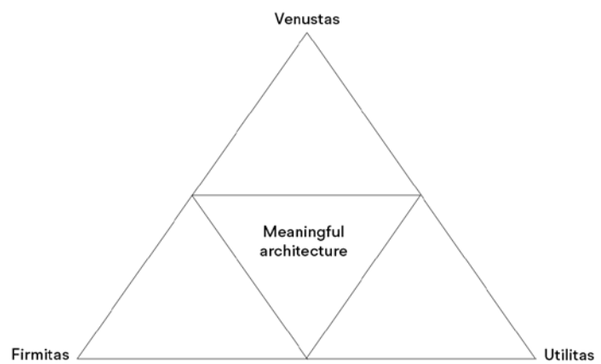
Architect and engineer Marcus Vitrivius Polio believed that architecture of great quality should contain elements of utilitas, firmitas and venustas, which can be translated to, that a design must have a clear interaction between function, technic, and aesthetics in order to create meaningful architecture.

Utilitas concerns the usability of the design and the designs capability to comply with the requirements imposed by the user.

Firmitas is the technical aspect, which concerns the strength of the design, this includes construction, energy requirements and indoor climate.

Lastly, Venustas concerns the aesthetical aspect of the design, which among other things concerns choice and processing of materials, details, and the building's capability to fit into its context (Gwilt, 1826).

The combination of the three elements is different for each project, as it is unique for every project, which elements are prioritized above others.

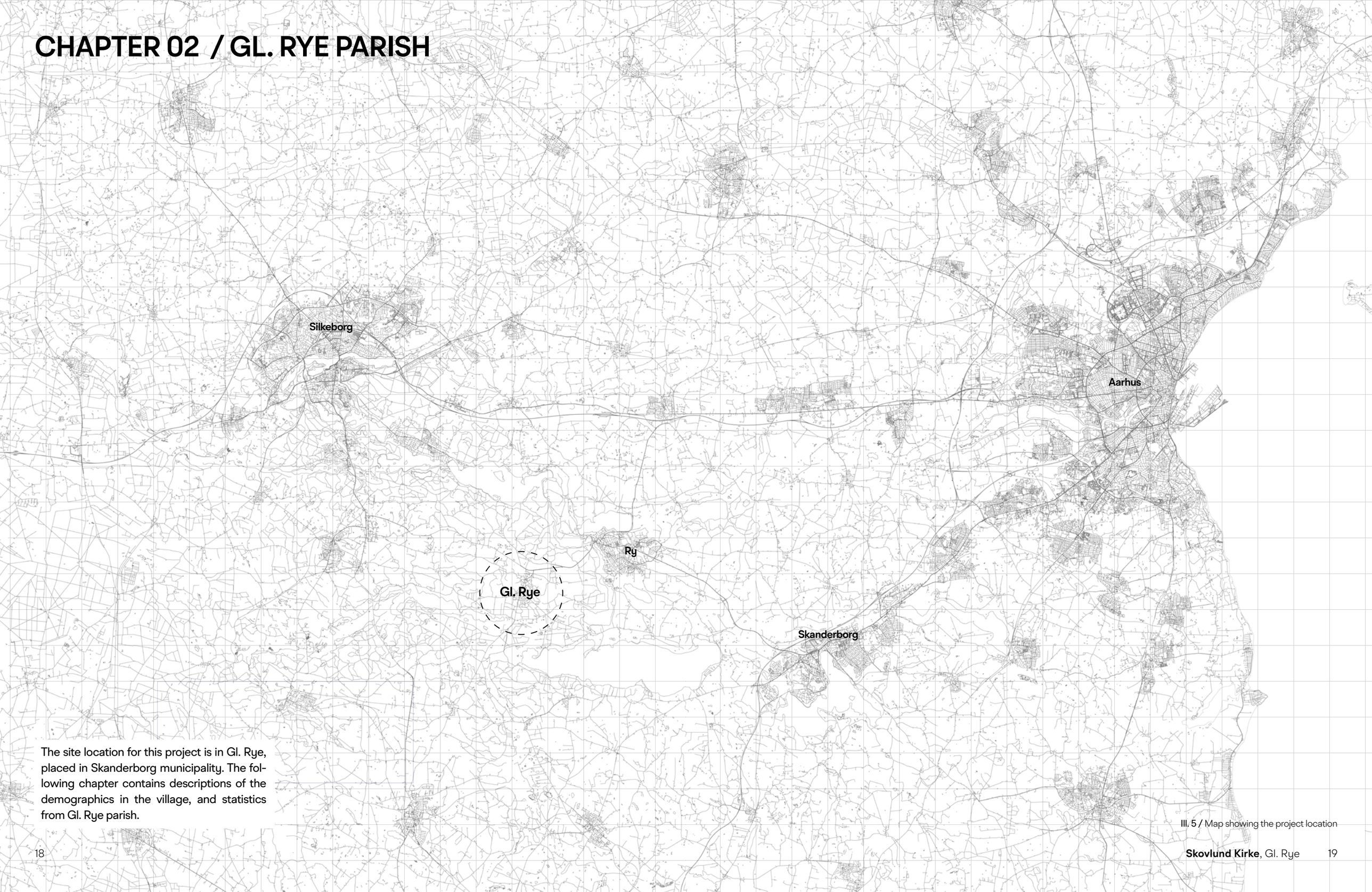


III. 4 / The vitruvian traingle

"Architecture is a science arising out of many other sciences, and adorned with much and varied learning; by the help of which a judgment is formed of those works which are the result of other arts."

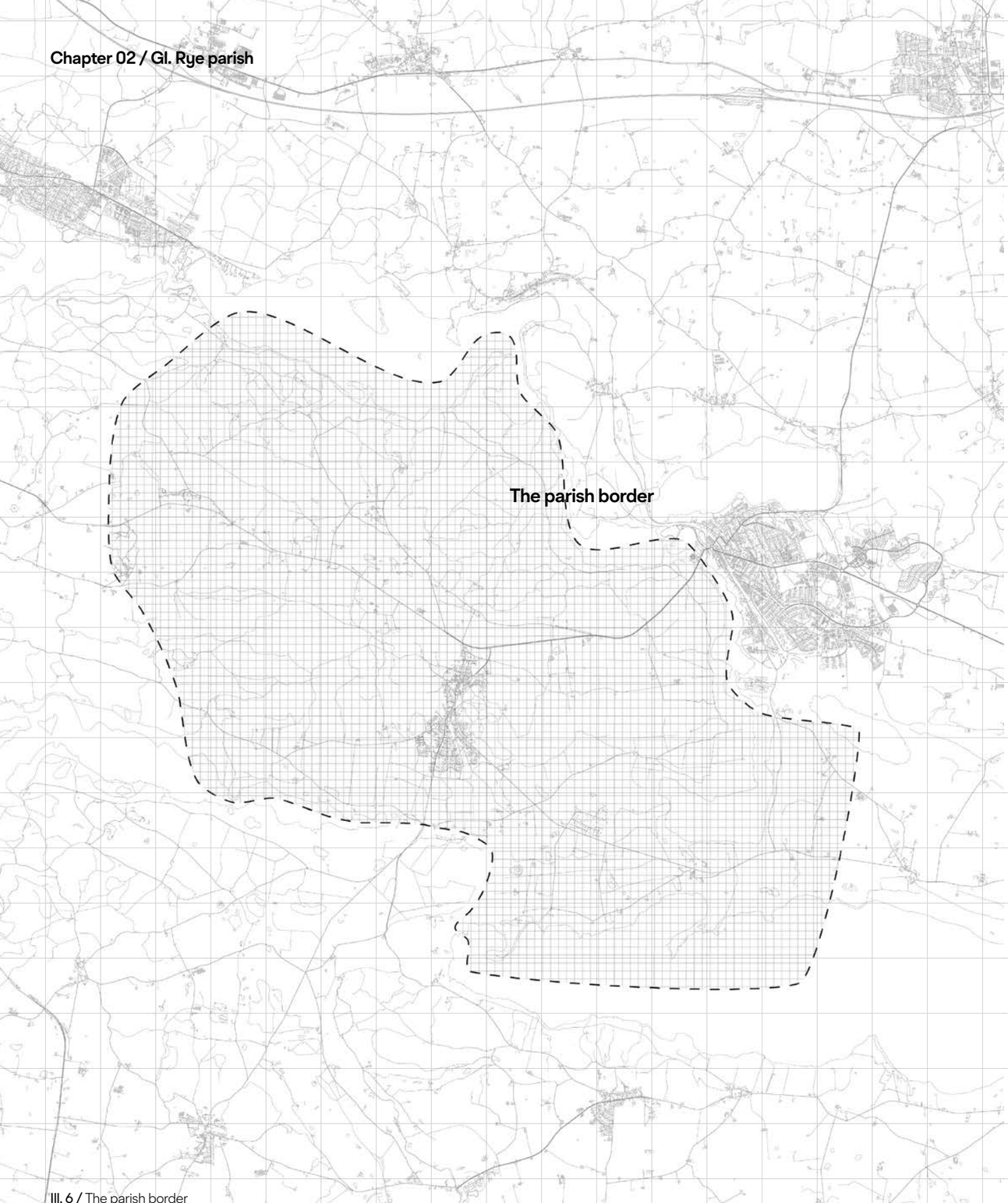
– Marcus Vitruvius Polio (Gwilt, 1826)

CHAPTER 02 / GL. RYE PARISH



The site location for this project is in Gl. Rye, placed in Skanderborg municipality. The following chapter contains descriptions of the demographics in the village, and statistics from Gl. Rye parish.

Ill. 5 / Map showing the project location



Ill. 6 / The parish border

Gl. Rye parish

Gl. Rye is a small village with approximately 1600 citizens, which is especially known for its beautiful landscape graced with hills, forest, and heather. The village is placed in East Jutland 5 km west from Ry and 40 km west from Aarhus and is an attractive village to newcomers with a still increasing population.

Gl. Rye is a great place for families with day-care facilities and a school up to 6th grade with 221 pupils, which corresponds to around 10% of the population. Furthermore, Gl. Rye has a well-educated population dominated by many resourceful people, where the average disposable income of the families is well above the national average. This is reflected in the rich associational life with more than 30 associations, which indicates a big interest in the local community of Gl. Rye. The parish church is Sankt Sørens Kirke, situated in the northern part of village (glrye.dk, n.d.).

Sankt Sørens Kirke

Sankt Sørens Kirke has an interesting history, as Gl. Rye and Sankt Sørens Kirke was the frame for the royal election on July 4th, 1534, when Christian the 3rd was elected as king of Denmark. The election of the king led to the reformation and the fall of the Catholic Church in Denmark (Kongernessamling.dk, n.d.).

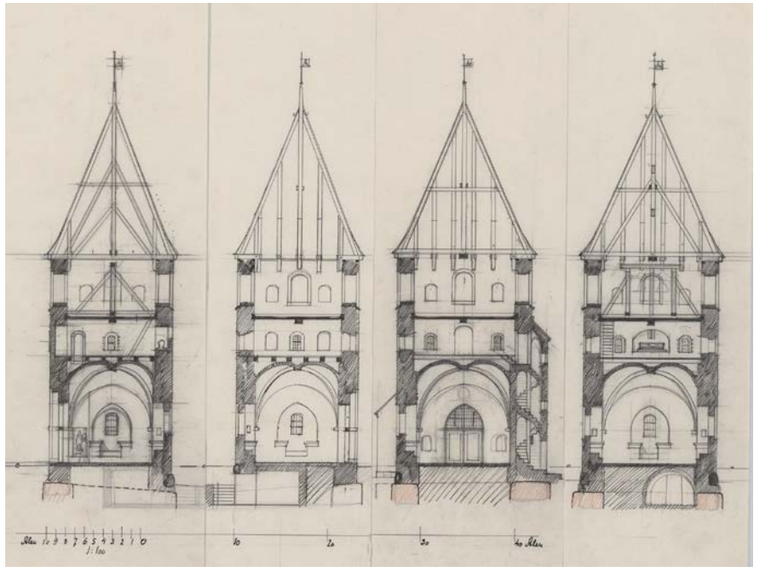
The church was once one of the biggest catholic churches in Jutland, but after the reformation, the pilgrimage and the money to the church stopped, why the church decayed, which resulted in part of the church being torn down, separating the west tower and nave. Later the west tower burnt down but was rebuilt again upon the same spot (Nationalmuseet, 1992-1996) .

Church statistic and activities
The following numbers concern 2022:
Gl. Rye parish have 2,226 citizens whereof 1,666 of them are members of the church, which is equivalent to a membership percentage of 75% (sogn.dk, 2023).

Gl. Rye parish has a rather active church life where the church in a year, besides Sunday services, is used for:
Baptism: 19
Confirmation: 1 (21 confirmands)
Marriages: 8
Funerals: 4

The church is also used for concerts, community singing events, baby hymn singing, gospel choir, New Year's and Christmas' service, etc.

The need thereby ranges from small intimate gatherings with few participants to larger events with hundred people or more. However, the church today is in short supply of facilities, which accommodate larger events. Furthermore, the church has difficulty accommodating the city's many associations and institutions, as the parish hall geared to the church, has a limitation around 60 people. Therefore, the new church must accommodate premises for local events and activities. The new church should be flexible and adapt to use (Thomsen, 2023).



III. 7 / Drafts for the west steeple by Hack Kampmann in 1911

2,226 citizens in the parish
1,666 are members of the Church
(equivalent to a membership percentage of 75%, which is the average of Denmark)

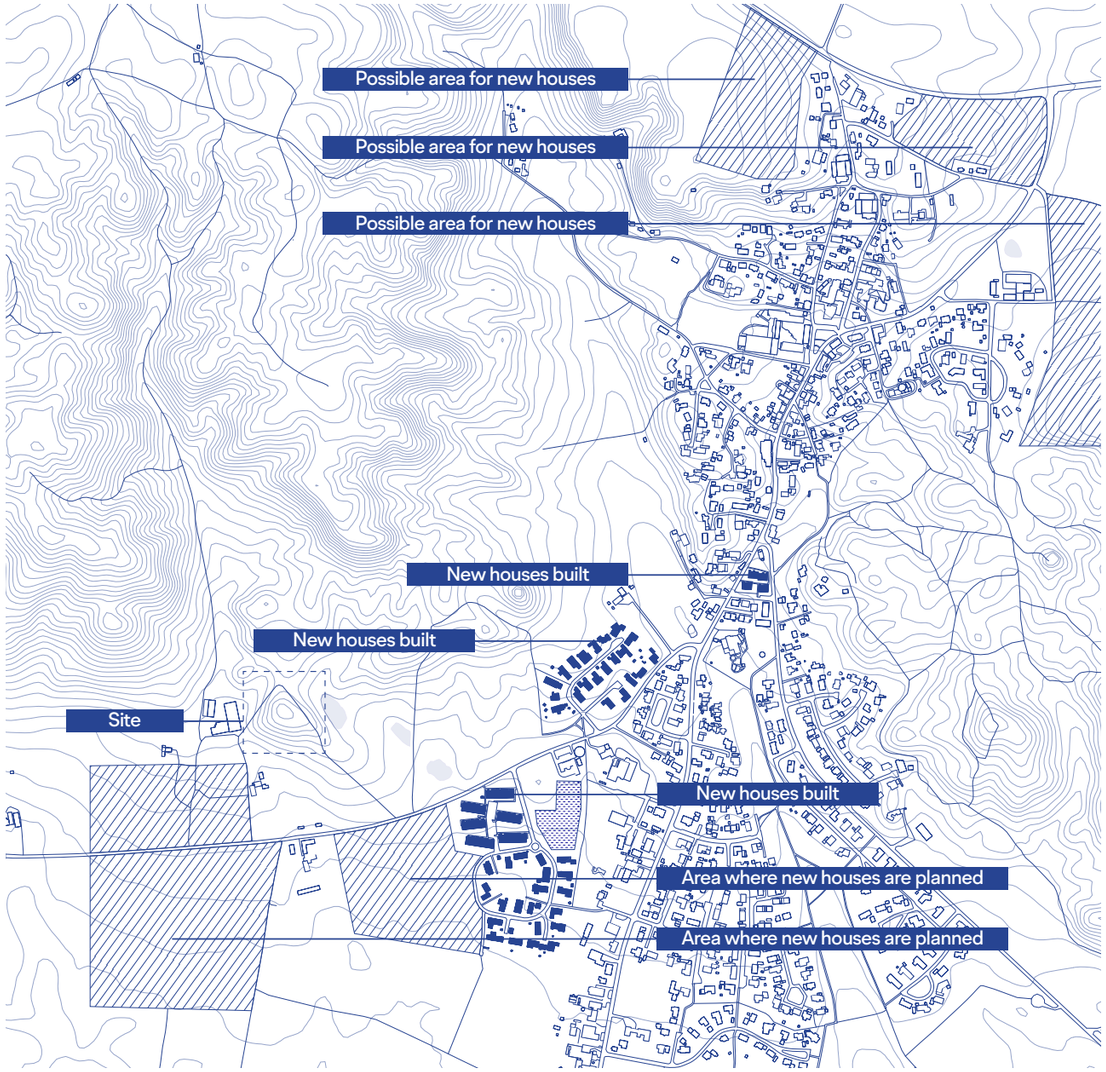
Chruch activites in a year, besides Sunday services:

19 baptisms
1 confirmation (with 21 confirmands)
8 weddings
4 funerals

III. 8 / Sankt Sørens Kirke (Photographer: Unknown, Ry Lokalarkiv)

The associational life in Gl. Rye and the need for a new common house

The community express a need for a common house for different activities. In 2016 the former common house in Gl. Rye, which was used for more than 70 different activities in a year, closed, even though the community fought hard to keep it. The former common house was funded by the residents of Gl. Rye (glrye.dk, n.d.). Today the municipality are searching for a new place, which they can use as a new common house, but so far with no luck. Local representatives have been looking at local associations club houses to see if it was possible to make use of those in other correlation. In September 2021 after 6 months search, they gave up on finding a new place. They documented and evaluated different opportunities in the town, but none of them were a possible contender. One of them was the local parish hall, but the restrictions and size made it an unattractive location.



III. 9 / Expansion of Gl. Rye in the future

Future expansion

Back in 2016 Gl. Rye expanded with 33 new dwellings, as well as there are plans of an expansion of the town towards west, where an area of 170,000 sq m. is to be divided into 90 new house plots. The expansion of the town has been slowed down by the lack of space in the kindergarten, but by the end of 2023, a bigger kindergarten replaces the old, thereby enabling more newcomers to the town (Uge-Bladet Skanderborg, 2021) (Skanderborg kommune, 2021).

Chapter 03 / theoretical and thematic studies

The position of the church and development in typology from year 800 and until today

Through time the church as institution and building typology has changed due to the general development in Denmark. This is both the architectural development and the church's role and impact on the society that has changed and thereby also the view on the church (Bjerre Dalsgaard, 2021, p. 140). In the following section this will be explained based on the Ph.D. written by Maj Bjerre Dalsgaard called *Den Middelalderlige Landsbykirke*.

Ansgar is trying to Christianize Denmark

In the middle of the 9th century the friar Ansgar came to Denmark (Nørhøj, 2011), and he succeeded to introduce Catholicism that slowly began to substitute the belief in the Norse gods. In his lifetime he is the person behind the building of two wooden churches in Denmark, one in Ribe and one in Hedeby (Christiansen, 1965). At that time the churches were only consisting of the nave and chancel and probably an outside construction of wood for the church bells. The churches were built from oak wood with beaten earth floor, and the roof were most likely covered with shingles, planks or thatched with reed (Johannsen and Smidt, 1981). When the parish went for service, they were either sitting on the floor or on the small chairs they brought for their family, and likewise it was normal to bring a fire pit bowl to stay warm. Today we often see one altar placed in the chancel, but in the Catholicism, it was normal to have many small altars around the church meaning that there was no clearly defined direction in the church (Kjær et al., 1988).

Denmark becomes Catholic

Around year 960 it is said that Denmark is finally Christianized by Harald Blåtand, and the status of the church is being increased. In the beginning the services were still taking place in the simple wooden churches, but around year 1030 the first stone church was built at the same spot as Roskilde Cathedral is placed today. The stone churches were built in roman style with round window lintels and thick ashlar walls. Often the choice of stone material for the church were defined by the surrounding resources and many similarities were seen between the small local churches since it was the same workers using the same techniques. The new stone churches were sturdier than the previous and represented power and authority, that to a higher degree underlined the position of the church during this period. This was also the time where most of the west towers were built, also with the purpose to symbolize what the church were able to construct (Christiansen, 1965).

From approximately 1104 to 1250 there was a significant increase in the amount of new Romanesque churches built in Denmark. The floors were covered with beaten earth or round stones and the walls were plastered with lime, often decorated with large murals. In this period, it was becoming common to bake bricks, which was also seen in some new churches where the large brick "munkesten" was used (Kjær et al., 1988). A lot of the churches were owned by private families, and a system called "tiendebetaling" was introduced to support

III. 10 / Reconstruction of Danish stave church (Photographer: Olav Sejerøe)

III. 11 / Vinding Kirke (Photographer: Unknown, Egnsarkivet f. tidl. Them Kommune)

Ill. 12 / Lunde Kirke (Photographer: Unknown, Blaabjerg lokalhistorisk Arkiv)

Ill. 13 / Aarhus Cathedral

the operation costs, that turned out to be the main part of the economic foundation in the future (Langberg and Egevang, 1979). The churches were still furnished without the possibility for seating, but it was important that men and woman were separated. The woman was placed in the northern part and men in the southern part (Kjær et al., 1988).

The understanding of the religion meant that the pastor and his special room, the chancel, was more important than the nave and the parish. Therefore, a clear separation of the two parts is often seen, both regarding the floor level and room height, but it was also common to have a physical barrier separating them from each other (Kjær et al., 1988).

Around 1250 the gothic style is starting to impact the design of the Danish churches. At that time there was no need for new churches, so it was primarily the extensions and alterations of the existing buildings that was affected. As an example, many new gothic west towers, sacristies, chapels, and porches were built (Grinder-Hansen, 1999). Some of the major differences between the Romanesque and Gothic style was the view on light and the construction of the ceiling. In many churches the ceilings were changed to vaulted ceilings with the purpose of stretching further into the sky, and thereby closer to God. The windows were made bigger, and the round lintels were made into a pointed arch (Kjær et al., 1988).

The reformation that replaced Catholicism with the Lutheran Protestantism

During the years from 1400 the population were not satisfied with the church anymore because they found it greedy and grasping. This led to the reformation in 1536 where Christian 3rd ruled and introduced the Lutheran Protestantism, which led to changes in the society that renewed the view on the church as institution and as physical building (Kjær et al., 1989).

Overall, one can say that in the Catholicism the church itself was a sacred building. This meant that the pastor was above the parish and thereby closer to God. In the Lutheran Protestantism the church were no longer sacred, and the focus was now on the actions in the church. The pastor was also equal to the parish and was primarily in the church because it was convenient to have a person leading the service (Bjerre Dalsgaard, 2021, p. 84).

The changes that Christian 3rd made means that the power was removed from the church and moved to the king himself. The church thereby became the overall religious leader, but the king was now the overall leader of the Danish country (Kjær et al., 1989). The changed view from the society on the church also meant that the small churches on the countryside were teared down if no one used them (Mackenprang, 1994, p. 150).

Another important difference between the two religious persuasions was that it was now important that the congregation understood everything at the service (Skriver et al., 2022, p. 43), and that everyone could see what was happening. Many pulpits are therefore built in this period to make sure that everyone could see the pastor and were able to listen to his sermons. During this period, it was therefore also common to install benches orientated in same direction to the altar, opposite to the Catholicism were there was no clear direction in the layout (Kjær et al., 1989).

As a result of the new religious beliefs the churches were as mentioned no longer seen as sacred buildings. They were to a higher extend seen as practical resources that could be used as observation posts for the local fire-fighting service, storage of the fishermen's sails and twines, and the farmer's hay, straws, and corn. Likewise, it was not unusual that the churchyard was used as marketplaces, where different salesmen could be found (Kjær et al., 1989).

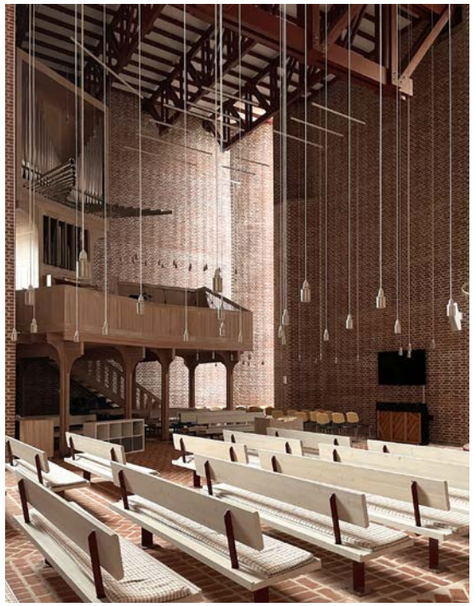
From year 1600 people realized that the room height in the churches could be used more efficiently. Many different lofts were built, for example seating for the noblemen with their own entrance, but also lofts for the organ and singers. The organ lofts are the most preserved ones, and many of the old lofts are removed today (Kjær et al., 1989).

The Danish national church

Following Grundloven in 1849 the Danish national church was introduced. All members from the previous church were transferred, and it was now a possibility to establish parochial church councils and buy out the previous private owners. Through legislations it has been secured that many of the old churches have been preserved and maintained, and that is why the Danish churches appears in such a good condition today (Kjær et al., 1989).

Ill. 14 / Arnborg Kirke (Photographer: Ole Blume, Lokalhistorisk Arkiv i Herning)

Ill. 15 / Vinding Kirke (Photographer: Asger Laursen, Egnsarkivet f. tidl. Them Kommune)



III. 16 / Nørre Uttrup Kirke (Inger and Johannes Exner)

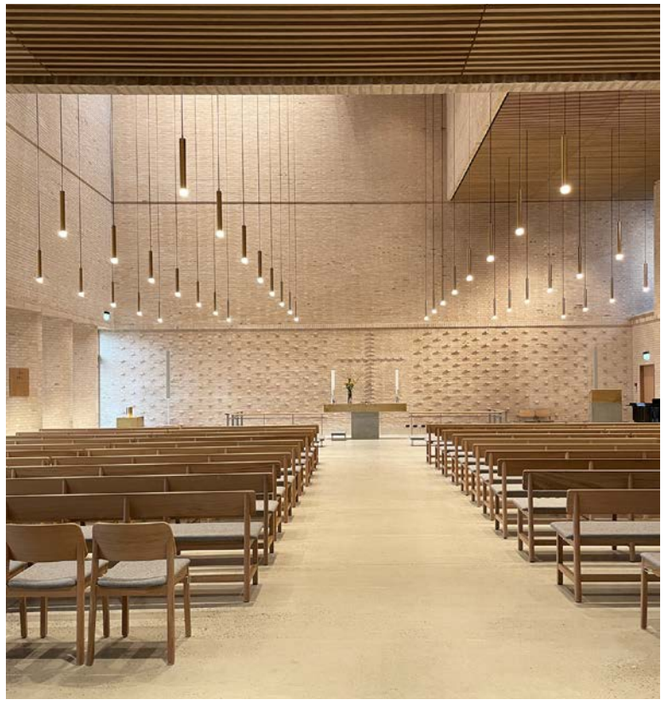
From 1960s until today

At the transition from the 1950s to the 1960s, there was a significant increase in the number of new church buildings in Denmark. In the period from 1960-69, 45 new churches were built, and even more were constructed in the 70s. Most of the new churches were designed by architect Holger Jensen, who has designed around 32 Danish churches. Inger and Johannes Exner are also unavoidable to mention in this context, who together have designed 14 Danish churches (Grey Schuster, n.d.).

Characteristics of modern churches include, among other things, that they rarely stand alone. They often are part of a detailed urban planning that ensures a well-considered connection with the surrounding buildings (Grey Schuster, n.d.). This connection is seen both in the architectural design, especially in the choice of materials, but also to a great extent in the church's offerings to the local community. Regarding the form and expression of the newer churches, Kerstin Wittman-Englert says that for the medieval churches, they are carriers of significance, while for the newer ones, they are merely carriers of associations (Witmann-Englert, 2006).

Generally, the newer churches vary more in their forms, functions, materials, and locations than we have seen before. Some of the churches solely provide the setting for worship and, for example, do not contain any of the adjacent assembly rooms found elsewhere. On the other hand, other churches can resemble modern assembly houses, where there is a wide range of rooms with assembly options (Grey Schuster, n.d.).

In 2014, a law was introduced that now allows the use of church spaces for non-church events. This has been done based on a new strategy report that aimed to examine how to secure the future of the village churches (Bjerre Dalsgaard, 2021, p. 90). Therefore, several different types of events are seen today in the Danish national church, including baby hymn singing, knitting events, study groups and much more. In this way, it can be said that the church is once again taking a position we have seen in the past, as a practical resource for the parish, rather than just the religious role.



III. 17 / Hvinningdal Kirke (Friis & Moltke Architects)

Regarding the form and expression of the newer churches, Kerstin Wittman-Englert says that for the medieval churches, they are carriers of significance, while for the newer ones, they are merely carriers of associations.

(Witmann-Englert, 2006).

Gothic style

Romanesque style

Year 826
The friar Ansgar
is trying to
Christianize DK

Year 1849
Grundloven was adopted

year

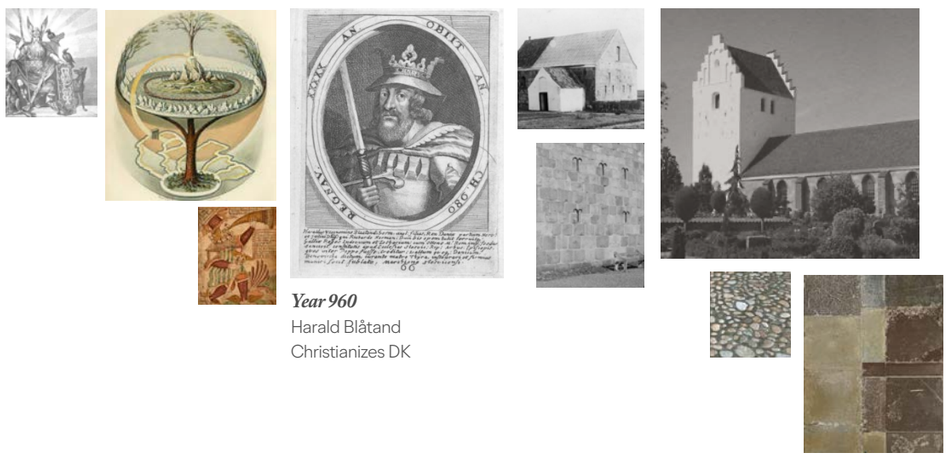
700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000

Belief in the Norse gods

Catholicism

Lutheran Protestantism

Freedom of religion



Year 960
Harald Blåtand
Christianizes DK

Year 1536
The reformation
Christian 3rd introduces the
Lutheran Protestantism

Inger and Johannes Exner
Holger Johannes Jensen

III. 18 / Timeline

III. 19 / A church in the landscape (Photographer: Johs. Rønvig, Vejle Stadsarkiv)

How is the view on the church today ?

In her PhD thesis from 2021, Maj Bjerre Dalsgaard has described five perspectives on the church today, which are based on her analyses of written sources, interviews, and conversations. As stated in her text, these perspectives should not be seen as definitive answers, but they should illustrate how many different attitudes there are towards the church today, and that these can be difficult to separate completely (Bjerre Dalsgaard, 2021, p. 90). These will be described in the following text:

The church as a public symbol
The church is experienced as a symbol, monument, or sculpture in the landscape. It is a landmark you can look for but is basically focusing on the visual experience of the church's silhouette. The church is experienced as the symbol of a common, national storytelling and cultural heritage, and can give a sense of belonging to a community (Bjerre Dalsgaard, 2021, p. 157).

The church as a place of care/care for place
This perspective on the church is built on the individual's subjective and personal experiences. This often means that an emotional attachment to a particular church can be created, e.g., through family traditions taking place in the same church (Bjerre Dalsgaard, 2021, p. 158).

The church as a sacred space
The church can be experienced as a place that can be transgressive and where you feel a connection to something otherworldly. The church can therefore feel like a safe place, and a place where you are embraced, but also as a place where you suddenly become very aware of what you can and should do, and say (Bjerre Dalsgaard, 2021, p. 160).

The church as a practice room
One can also look at the church as a practice space, and here it is especially people who have the church and its associated buildings as a workplace. The focus lies in the fact that the church has the physical framework and opportunities to hold christenings, weddings, and funerals (Bjerre Dalsgaard, 2021, p. 161).

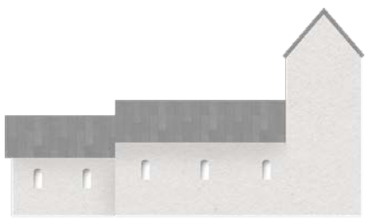
The church as a museum object
The church can also be considered a historic building that contains the story of our past, and which can therefore be given the status of something worthy of preservation that must not be changed. With this view, it can be difficult to accept that the church and its architecture are under constant development, as one feels a great desire to keep the church unchanged (Bjerre Dalsgaard, 2021, p. 162).

year 700

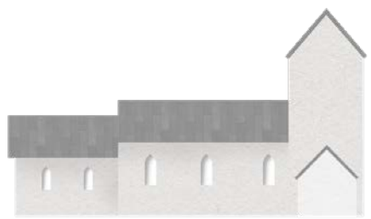
year 850

year 950

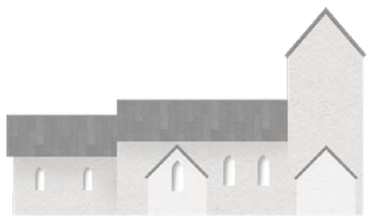
year 1100



year 1200



year 1400



year 1600

... today

III. 20 / The development in the danish church architecture

Conclusion

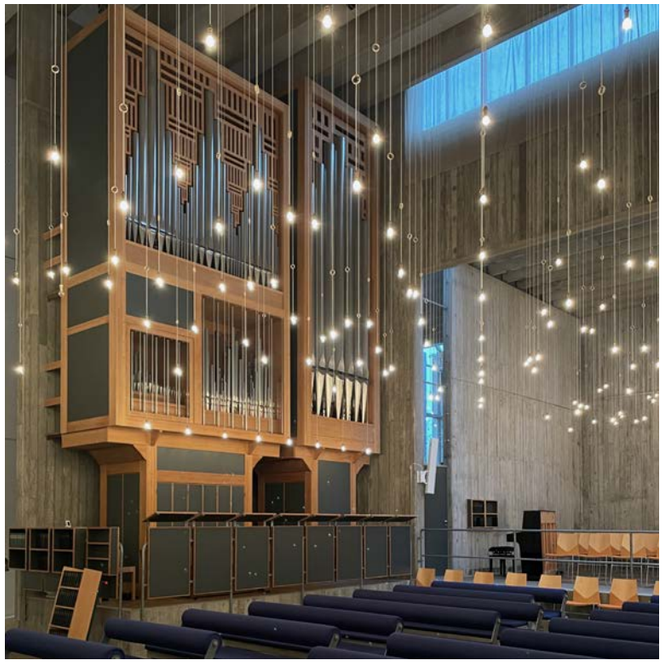
Based on the review of the development of the churches over time, it can be concluded that there has generally been openness to the church being able to adapt to the time and needs that existed. Elements of the décor have been added and removed and parts have been built and demolished if needed. Over time, the church has had both the status of authority and great social power, but after the Reformation and the introduction of Lutheran Protestantism, the church's role is now completely different. Where the church building, and everything around it used to be sacred, the focus changed to be on the actions that took place inside the church. In a questionnaire survey from 2015, the current relationship between religion and culture is highlighted, where it is emphasized that the focus moves much more towards the cultural focus than towards the religious:

"[It] can become a cultural marker devoid of all religious significance (in the above example, now that Denmark is one of the most 'secularized' societies in Europe, to define the Danes as 'Lutherans' no longer makes sense from a religious perspective). The ethnic and cultural identity is more deep-rooted than the religious identity."

(Warburg and Heise Rasmussen 2016, p. 43)

The generally great openness to change, combined with the above quote, should provide good opportunities for the Danish national church in the future, if only the church can be allowed to continue to develop with society, and offer the things that are demanded by the population.

Inger and Johannes Exner — their impact on the church architecture in Denmark



III. 21 / Gug Kirke (Inger and Johannes Exner)

An important couple in history of Danish church architecture, of recent times, is Inger and Johannes Exner, who have built 14 churches as well as completed several church restorations from 1958-1997. Based on their own studies and travels around Europe, Johannes and Inger gather a lot of inspiration from other churches, which they use in their own works. They questioned the tendency of repeating history when it comes to church architecture, where the demand for a new church, was that it had to 'look like a church' with great focus on the exterior (Bo Jensen, 2012).

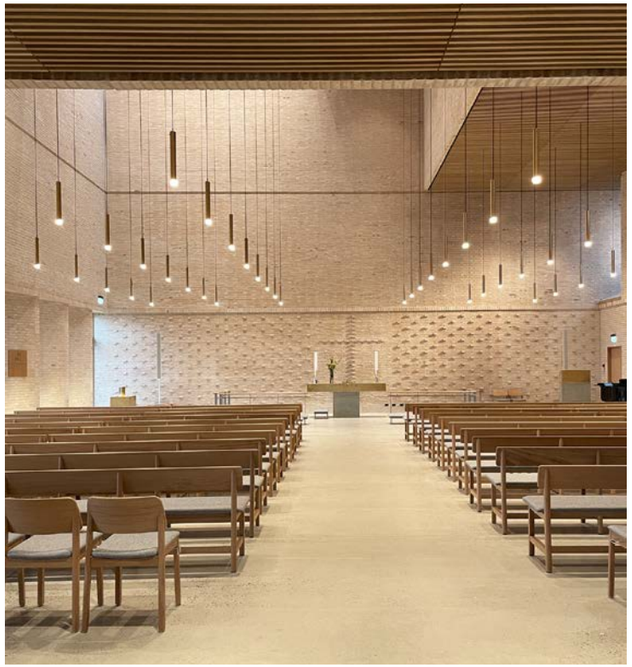
In 1993 Johannes writes this about the tendency of repeating the traditional long church: ***"It is sad, because it is due to lack of knowledge about the church, its history and development (...) It portrays someone who is a stranger to the church and who rarely go to church, but only use the church as a scene to their own events. The church has become an element in the townscape, where it with its exterior shall garnish and mark a real city"*** (Exner, 1993).

Instead, their work focused on the interior. Inger and Johannes Exner investigated possibilities in the organization of the church room and challenged the traditional long, processional church, experimenting with the central room church (centralrumskirken). The central room church worked with a cubic plan layout, where the congregation are placed around the altar, baptismal font, and pulpit. This follows the 'circumstance-principle', which focuses on actions of the church and the liturgy on which the Danish church rely.

The exterior of their churches became cubic and simplified with references to an industrial building, contradictory to – and without any references to the well-known architecture typology of a church. All Exner's churches, except their first church, Sct. Clements, emphasizes on the interior and leaves a rougher exterior.

What is also reflected in the development of Exner's churches throughout the years, is the function of the church today. The church has developed into a more communal and multifunctional institution, which sets for a lot of demands to the church, which become more of a "church centre", that must accommodate many functions (Bo Jensen, 2012).

However, despite all the studies completed by the Exner's, a tendency, which is seen today in new churches is, that the church room is organized as a traditional processional church. An explanation to this could be, that we are living in a multireligious society, where there is a need for churches to unequivocally look like churches. (Kreiner-Møller, 2022)



Ill. 22 / The church room in Hvinningdal Kirke

... a case study

Ill. 23 / The exterior of Hvinningdal Kirke

Hvinningdal Kirke

Friis & Moltke Architects A/S
Silkeborg, Denmark
2022

Ill. 24 / The foyer with a lounge area

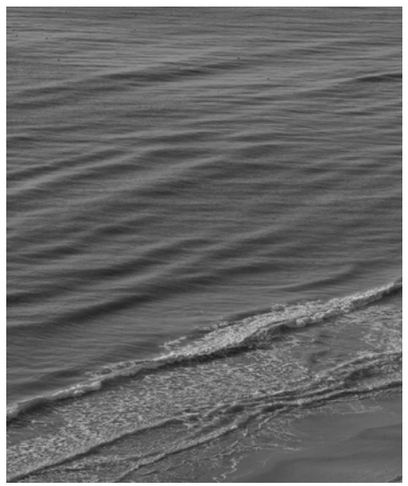
Hvinningdal Kirke is the most recent church built in Denmark. The church is designed by Friis & Moltke Architects and was inaugurated in October 2022. The church is an L-shaped building situated on top of a hill as a landmark in the green surroundings.

The church is erected in light yellow brick - a traditional building material often used for church architecture in Denmark. However, modernized by its distinctive, tapering, cubic volume.

The church is one plan, and the flow of the building is organized around two corridors which lead from the foyer and main entrance to the church room, administration, and assembly rooms. The foyer thereby functions as a link, which ties all the functions of the church together. The foyer is also where users of the church mix, as the foyer is furnished as a lounge, where associations who use the church weekly reside, as well as where the children who has confirmation preparation hang out in recesses. Thereby the church mix people of all ages. Furthermore, the foyer functions as a multiuse room, as it can be added as an extension to the church room due to the use of folding walls, whereby the church can accommodate both small and big events.

Great inspiration can be found in the organization of Hvinningdal Kirke, when sketching a plan and organizing the placement of functions, as the organization of Hvinningdal is logic and with great consideration of how to ensure a lively and diverse church life.

III. 25 / Clouds



III. 26 / Waves

Atmosphere and spirituality

A church is a place associated with solemnity and devotion (Dalsgaard, 2021), as well as it is a spiritual space which must accommodate big emotions as grief, joy, and love in connection with funerals, baptism, and weddings. A church must offer a space and time for contemplation and reflection, which makes demands to the design of the church room. So how do you design a church room of high quality? In accordance with the Swiss architect Peter Zumthor, this is done through atmosphere (Zumthor, 2006).

"Quality architecture to me is when a building manages to move me (...) things with such a beautiful, natural presence, things that moves me every single time. One word for it is atmosphere." (Zumthor, 2006).

In the book "Peter Zumthor Atmospheres" from 2006, Zumthor elaborates on architecture and atmosphere. Zumthor mentions 9 things which can help evoke an emotional response and which he considers important when trying to generate a certain atmosphere, these are: *the body of architecture, material compatibility, the sound of a space, the temperature of a space, surrounding objects, between composure and seduction, tension between interior and exterior, levels of intimacy and the light on things.*

Zumthor elaborates on the endless potential of materials: how one material can be processed in different ways and how the combination of different materials, will contribute to a different atmosphere in a space.

Furthermore, how forms and applied materials result in the acoustics of a space. Zumthor also expands on the significance of how light fall, and how shadows are cast, in relation to set the atmosphere (Zumthor, 2006).

The atmosphere in a space is perceived through our emotional sensibility (Zumthor, 2006). This is consistent with Pallassma's theory described in his book "The eyes of the skin – Architecture and the senses" from 2012, where he explains the importance of designing for all sensory realms in order to enhance the experience of architecture. When architecture activates all senses: see, touch, taste, hear - architecture can be healing and meaningful (Pallasmaa, 2012).

When we inhabit a space, the space interacts with us and tell us how we should engage with the space. How a space is narrated can be through many channels, including the history attached to a space (Birch, Sinclair, 2013).

"The sacredness of a place derives from the significance attached to it through history" (Birch, Sinclair, 2013).

But the most important narrative is generating the wished for atmosphere of a space, by connecting the person to their surroundings through tactility, focusing on senses, as a necessity to create meaningful architecture and enhance a spiritual experience.

Light

Especially the work with light is considered important when designing a spiritual place, as light has a considerate impact on the sensory perception in humans, awakening emotions and supporting a specific atmosphere (Matracchi, Habibabad, 2021).

"Changes in light affect human perception, and this effect changes the human mood more or less unconsciously. Despite its immaterial and spiritual nature, light is inseparable from the purpose of architecture. Because architecture, despite its physical and functional characteristics, can be an indicator of the perception of aesthetics, and by using light as a key element, it can create an atmosphere and evoke emotions." (Matracchi, Habibabad, 2021).

But light is also of great importance when wishing to increase the spiritual quality of a space because of lights meaning according to Christianity, where light among other things symbolize God's glory, the source of blessing, thereby drawing on religious symbols to succeed in designing a religious space (Matracchi, Habibabad, 2021).

"Architectural spaces of religious places are united by the artistic use of light combined. Indeed, light sanctifies the architectural space and manifests a sense of spirituality." (Matracchi, Habibabad, 2021).

Ill. 27 / Light

Bruder Klaus Field Chapel

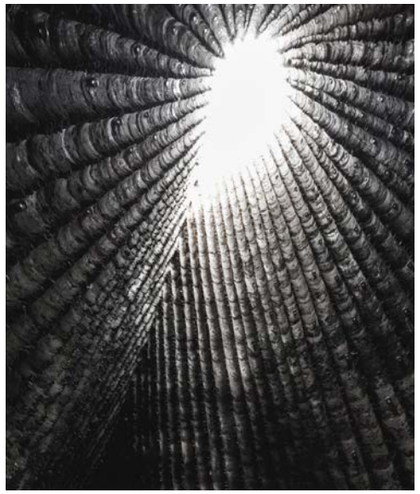
Peter Zumthor
Mechernich, Germany
2007

Bruder Klaus Chapel is a small concrete chapel build on the edge of a field in Mechernich. The Chapel is constructed of 120 tree trunks, where concrete have been poured in a formwork and cast around. The trunks have then been burned and have left a unique raw structure, charred and with traces of the original logs inside the chapel. A skylight opens to the sky and leads the eye upward. On a sunny day the opening resembles the eruption of a star. The contrast between dark and light makes the chapel a remarkable religious piece of architecture - where everyone who has an encounter with the chapel will experience inevitable reflective feelings (wikiarquitectura, 2019).

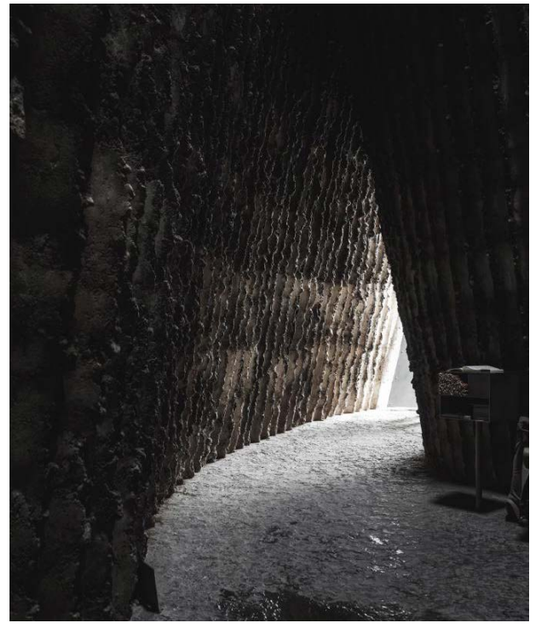
By working with light as the key element and utilising the contrast between light and shadow within a space, Zumthor succeed in reinforcing a specific atmosphere and feeling. The way Zumthor utilises light, is relevant for the future design process, where it is wished to advantageously use light as a source to set the mood.

Conclusion
In the design of the church, it is wished to use and accentuate light as an aesthetical and key design element in order to generate and support an expressive atmosphere, both drawing on symbolism to Christianity and evoke emotions in order to enhance a spiritual experience.

The contrast between light and shadow and the light on things can advantageously be used as a light source to stage different actions, thereby making the light intake choregraphed to the church activities.



III. 28 / Bruder Klaus Field Chapel
(Photographer: Rasmus Hjortshøj)



III. 29 / Bruder Klaus Field Chapel (Photographer: Rasmus Hjortshøj)

"To me, buildings can have a beautiful silence that I associate with attributes such as composure, self-evidence, durability, presence, and integrity, and with warmth and sensuousness as well; a building that is being itself, being a building, not representing anything, just being."

(Zumthor, 2006).

Acoustics

As mentioned earlier, another important part of how the church and the atmosphere inside the church room is perceived, are acoustics. Sound in a room reflect off surface, and these reflections are the phenomenon known as reverberation. Reverberation can be reduced when surfaces absorb sound instead of reflecting the sound. The acoustics of a space can thereby differ greatly depending on applied materials, geometry, and objects in a room.

Most Danish churches are built of hard surfaces, which results in the acoustic of the room having a long reverberation time, which enhance the experience of the organ play and the church choir singing (Ampel, 2017).

The many hard surfaces inside a church create an acoustic atmosphere which can be quite overwhelming and makes even small sounds become loud, which makes the people who inhabit the space very aware of the sounds they make themselves and makes them go quiet, when entering a church room. The resounding silence which dominates the room, is one of the mysterious attributes of the sanctuary in churches (Dalsgaard, 2021).

“Listen! Interiors are like large instruments, collecting sound, amplifying it, transmitting it elsewhere. That has to do with the shape peculiar to each room and with the surfaces of the materials they contain and the way those materials have been applied.”

(Zumthor, 2006)

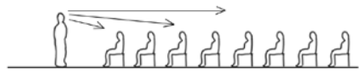
... a case study

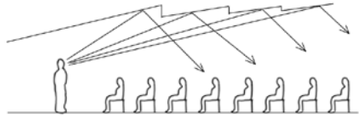
III. 31 / Aussegnungshalle Waldfriedhof
(kaestle & ocker architects)

III. 30 / Aussegnungshalle Waldfriedhof (kaestle & ocker architects)

Aussegnungshalle Waldfriedhof

kaestle&ocker
Heidenheim, Germany
2016





III. 32 / Acoustic concept

By working with materials and the geometry of a room it is possible to affect the acoustics of a room and manipulate the sound to behave in a certain way, reflecting the sound off surfaces. In the Funeral Hall, Waldfriedhof the ceiling is broken into segments to better reflect and spread the sound, so that even the people who sit in the back of the room can hear the pastor's sermon (kaestle&ocker.de, n.d). Just as it is done in the case study, it is wished to work with the geometry of the church room, in order to enhance the acoustic experience, furthermore, working with the possibility of changing the layout or interior of the room, adapting the acoustics to the use of the church, whether it being for musical arrangements or assemblies.

Conclusion

In the church a longer reverberation time are great for organ play and musical performances, while shorter reverberations are preferred for speech, why it in some churches can be difficult to hear the pastor's sermon, as there in most old churches, are a long reverberation time.

In the design of the church, it is wished to accommodate different needs to the acoustics depending on the activity, whether it'd be services or musical arrangements, thereby striving to have a church room with multiple reverberation times, by working with the layout, geometry, materials, or furnishing of the church room.

Building sustainable

The world is facing climate changes and to reduce further damages we must change our ways to take care of our planet.

The climate change issues we are facing today, especially concerns the building sector, as the building industry is a huge contributor to carbon emission, where 40% of carbon emissions are related to the industry (joint-research-centre.ec.europa.eu, n.d.). Therefore, it is a necessity we find new strategies and solutions in the construction, as we still build more, as the global population is increasing, while we must simultaneously reduce CO_2 emissions.

To respond to the climate changes, we must reduce the levels of CO_2 emission in the building industry, which can be done by using renewable energies and minimizing the need for energy by implementing passive and active strategies in the design. Furthermore, there is a great potential in reducing CO_2 emissions by using materials in the construction, which have less of a negative effect on the climate, such as biogenic building materials, which are low carbon emitters, as a mean to build more sustainable (Altomonte, 2009).

"The more organic materials we can use in our buildings, the more CO_2 we can prevent from being released back out into nature – for as long as the buildings stand. In Denmark alone, we would potentially be able to store up towards 100 million tons of CO_2 in buildings over the next 50-75 years if we improved our ability to use biogenic building materials." (Valdbjørn Rasmussen, 2022).

Biogenic building materials

Biogenic building materials sequest and store CO_2 during their lifetime, thereby reducing CO_2 emission to the atmosphere. Therefore, it is a wish to challenge the conventional approach to construction and move towards utilising biogenic building materials for construction, supporting a shift towards a more sustainable building sector, whereby it is possible to minimize the overall CO_2 print.

Today biogenic building materials are used for load-bearing structures such as beams, columns, washers, and prefabricated elements, as well as for building elements such as cladding, surfaces, roofing, insulation materials for heat, sound, and fire; as capillary-breaking materials, reinforcement in plaster and slabs (Valdbjørn Rasmussen et al., 2022).

Nowadays wood is the most used and well-known biogenic building material, however new materials are starting to get more attention (Renata Guimarães de Campos, 2022). The new building materials, which start to get more attention are often of residual products of biogenic resources, meaning the resources are already harvested and ready to be utilised for useful building materials (Valdbjørn Rasmussen et al., 2022).

Following describes available biogenic resources, which can be found in Denmark:

Wood
Wood is as mentioned a common material in the building industry in contrary to most of the other biogenic materials. Its status as a primary building material as well as being used excessively for heating, meant a decrease in woodlands in Denmark, which meant regulations and rules creating the foundation for sustainable harvesting (Karup Jensen, n.d.).

Wood has often been used as a structural material or cladding, but new building materials also make use of its insulation and acoustic qualities (Valdbjørn Rasmussen et al., 2022).

Agricultural resources
Most of the agricultural materials are made from biproducts when harvesting for the original intended resource. New building materials of residue resources are getting developed as well as older methods as a thatched roof, which once was one of the most common uses of agricultural resources in the building industry in Denmark, and it is getting popular again. The newer products made from agricultural resources are mostly used for insulation, but also acoustic panels as it often has great acoustic properties (Valdbjørn Rasmussen et al., 2022).

Marine Biomasses
Several marine resources can also be used in the building industry, most of them share the same attributes as the agricultural resources. The major difference is how the resources are harvested (Valdbjørn Rasmussen et al., 2022).

Mycelium
Mycelium products are made by combining a fungus with residual resources. The fungus is binding the materials together, afterwards the material gets burned to kill the fungus, preserving the form. The final material inherits the positive attributes from the different materials making it an ideal process. Mycelium products are great as they are fire-resistant, strong, light, and have great acoustics and thermal properties (Sonne, 2022)

The reason why new biogenic building materials aren't widely used, despite all its good attributes, are because of uncertainty about the materials properties as building materials, as many of the materials are still being experimented with. New buildings must follow the building regulations and ensure that the buildings keep up with modern standards when it comes to safety and health. Which, despite the importance hereof, restricts the use of new materials as it is tough and costly for the supplier/inventor to do all the necessary tests and collect the right data to get the material approved. The regulations are slowing down the process of building more sustainable as it is favourable for conventional building materials (Valdbjørn Rasmussen et al., 2022).

Furthermore, economy and time are usually the two parameters when choosing materials for a large-scale building. Entrepreneurs usually work within a tight schedule and cost frame, which means that conventional materials are chosen. Workers are more effective when working with materials they know, as well as the materials are mass produced making them cheaper. This is usually the hurdle new materials must overcome, which usually acquire an opportunity and open mind (Valdbjørn Rasmussen et al., 2022).

wood

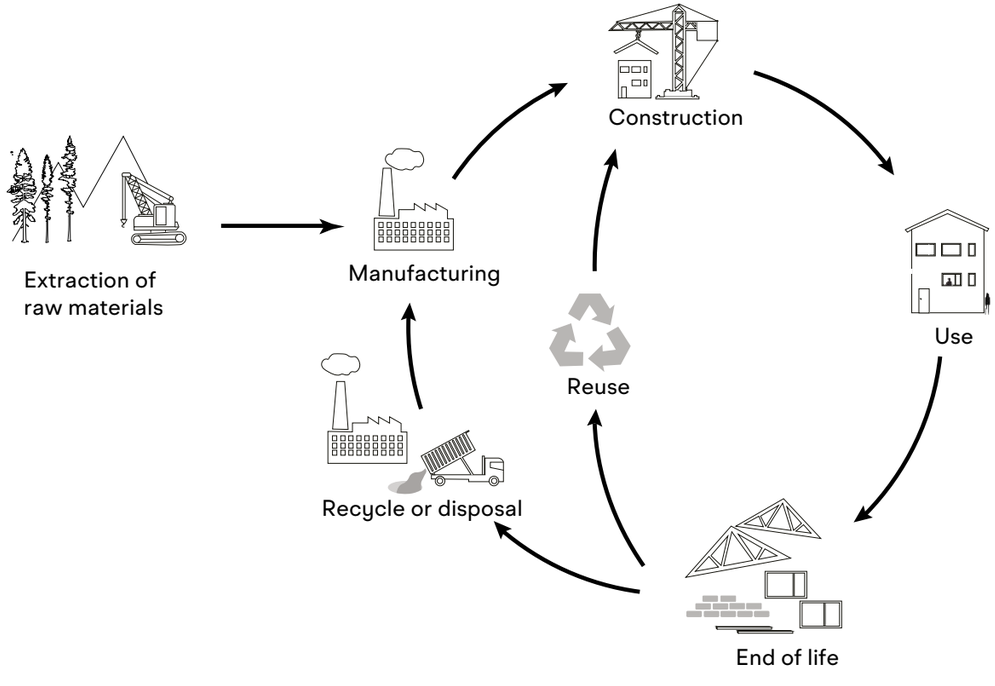
eelgrass

mycelium

straw

III. 33 / Wood
III. 34 / Eelgrass
III. 35/ Mycelium
III. 36/ Straw

LIFE CYCLE ASSESSMENT



III. 37 / The different phases of LCA

To assess the environmental impact of the construction a LCA will be conducted for 1m² of the wall structure, where different compositions of the wall structure will be compared regarding the total GWP, but also parameters as properties and aesthetics. Based on researches of the application of different biogenic materials, and considering which materials can be found in Denmark, following biogenic materials will be evaluated in different applications in the LCA in this thesis:

— ***Eelgrass, as insulation, acoustic panels and roofing***

— ***Straw, as roofing, facade and insulation***

— ***Wood, as a structural element, roofing and cladding***

— ***Hemp, as insulation***

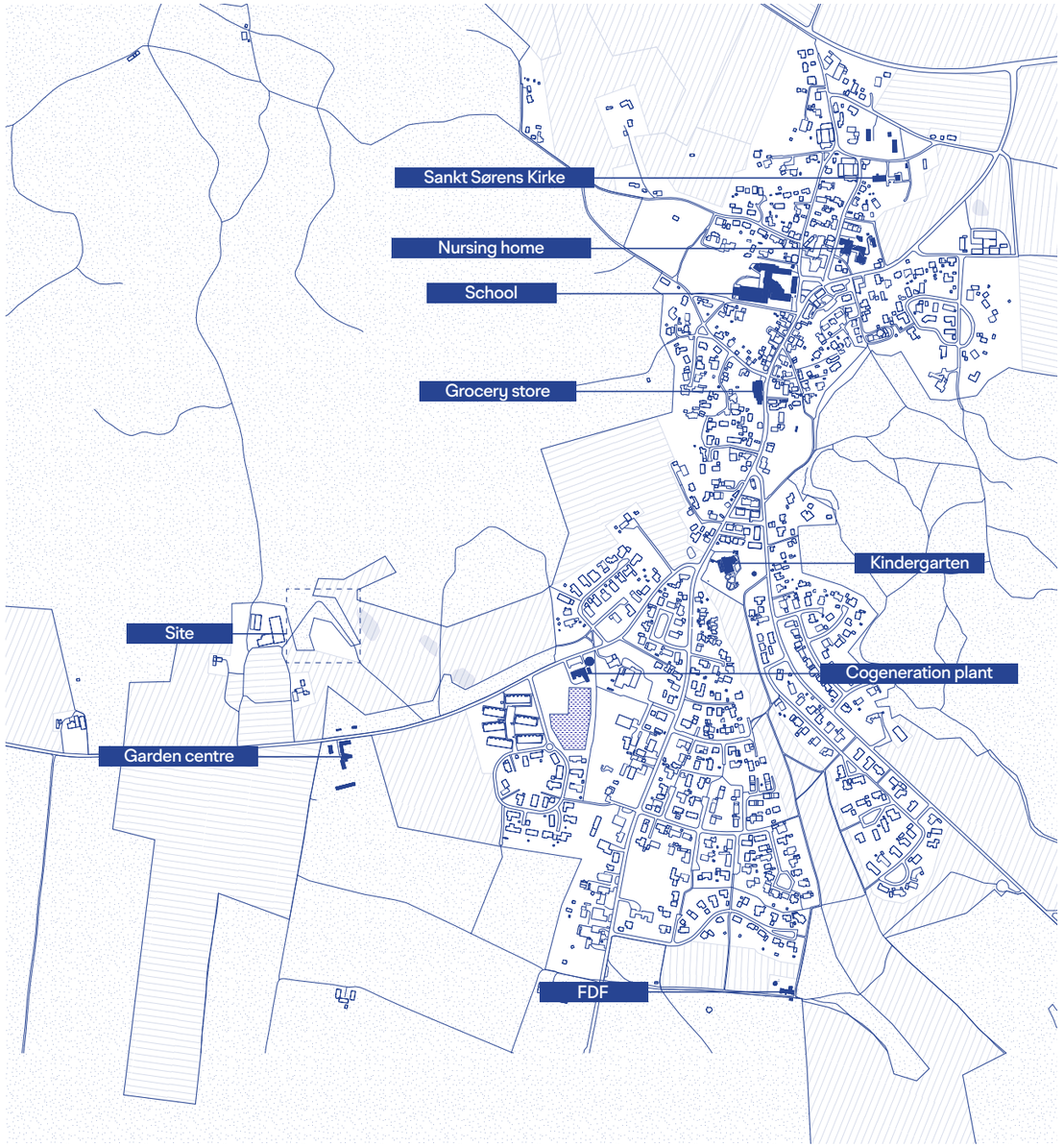
— ***Mycelium, as cladding***

Life Cycle Assesment (LCA) is a technique, which can help predict environmental impacts of a project. By performing a LCA, assesing a product and its environmental loads durings all of its lifetime from raw material extraction to production, transport, construction, operation, maintenance and disposal - it is possible to compare products, optimize and improve a project regarding its environmental impact. Futhermore, a LCA can assess materials on different potentials and pressures on the environment:

GWP = *Global warming potential*
ODP = *Ozone depletion potential*
ADPe = *Depletion of abiotic resources - elements*
ADPf = *Depletion of abiotic resources - fossil fuels*
AP = *Acidifi cation Potential*
EP = *Nutrient load*
POCP = *Photochemical ozone formation*

However, this project will as mentioned focus on materials global warming potential (GWP).

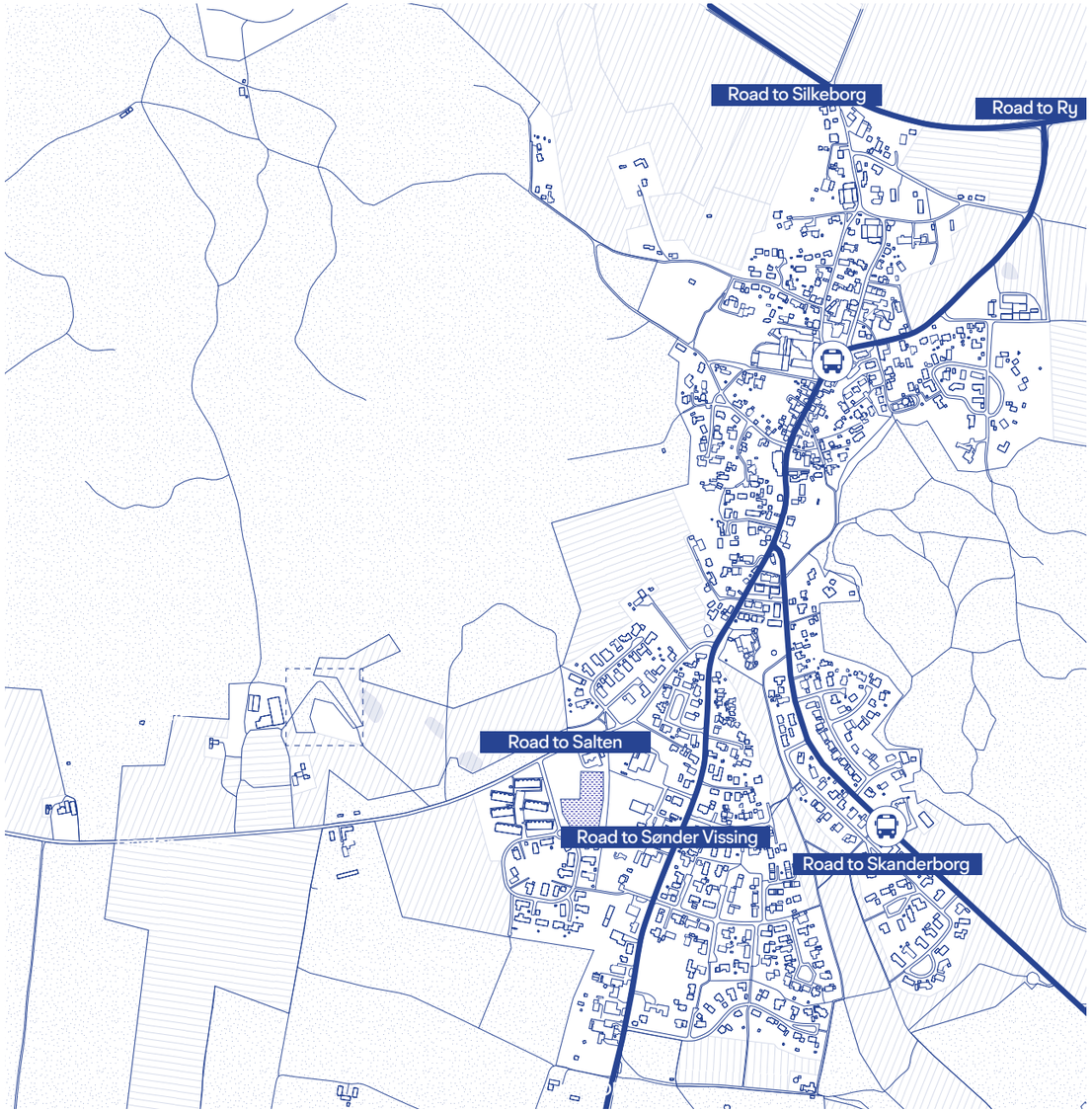
CHAPTER 04 / SITE STUDIES



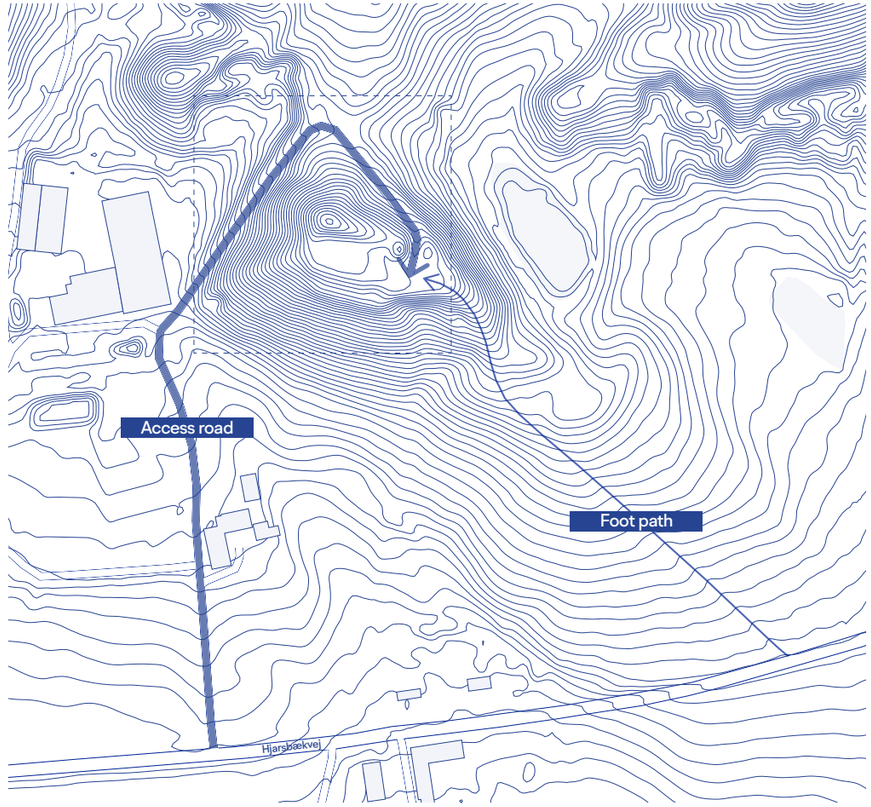
III. 38 / Map showing the functions in Gl. Rye

Mapping the functions

Gl. Rye is a small town with all the necessary functions to operate on its own. The town has its own school, kindergarten and supermarket, which make it an ideal place for young adults to start a family. The town has evolved towards the south as the number of citizens have increased. The map illustrates how the functions are distributed following the main roads.



III. 39 / Map showing the infrastructure in Gl. Rye

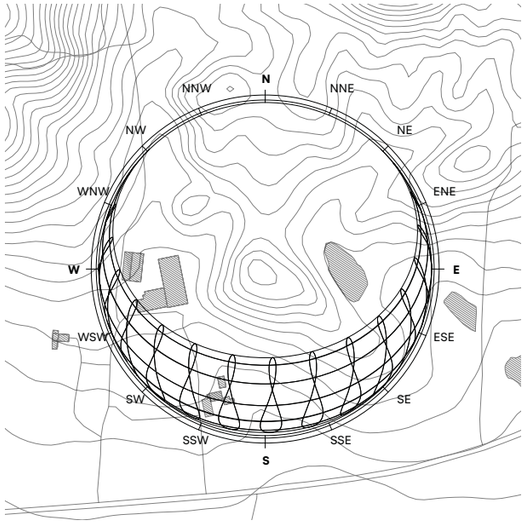


III. 40 / Map showing the access ways to the site

Infrastructure

The main road through the town is connecting Gl. Rye to Ry as the nearest town, with more opportunities when it comes to shopping and a railway station. Silkeborg and Skanderborg are the nearest big towns and are both 16 km away. There are two types of busses who connect Gl. Rye to the region: a school bus and a flex bus. These busses rarely run, meaning it is difficult to live in Gl. Rye without a car (Midttrafik.dk, n.d.).

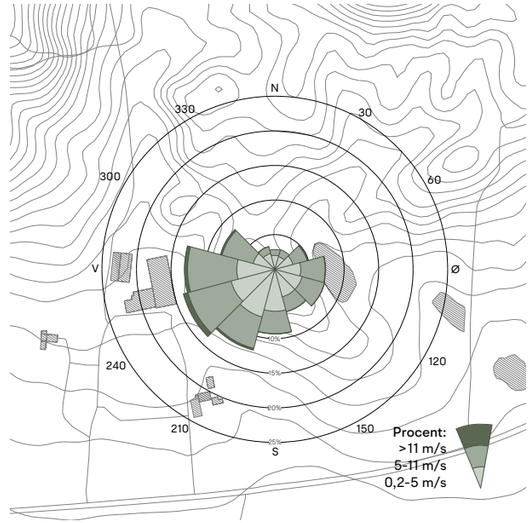
Microclimatic conditions



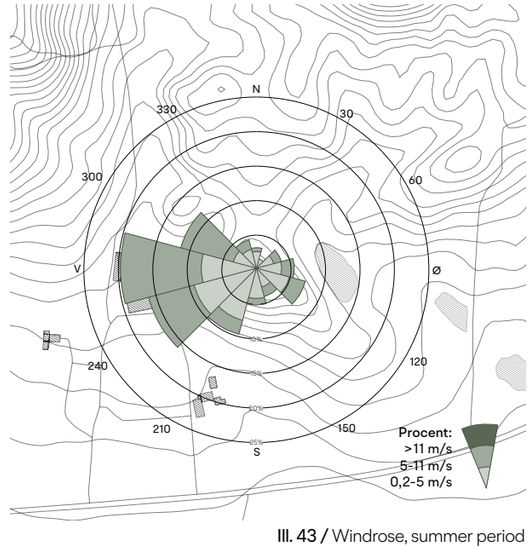
III. 41 / Sun diagram

Sun

The suns position relative to the site is an important factor when placing the church, organizing functions inside the church, and placing openings in the façade. Knowledge of the course of the sun through different seasons is important to ensure an adequate daylight inside the church, while still maintaining a good indoor environment and prevent overheating. Furthermore, light intake is of great importance when wishing to create certain atmospheres. Sunlight has a direction and can be used to emphasize an atmosphere, whereas skylight has no direction and offers diffuse light intake.



III. 42/ Windrose, average during a year

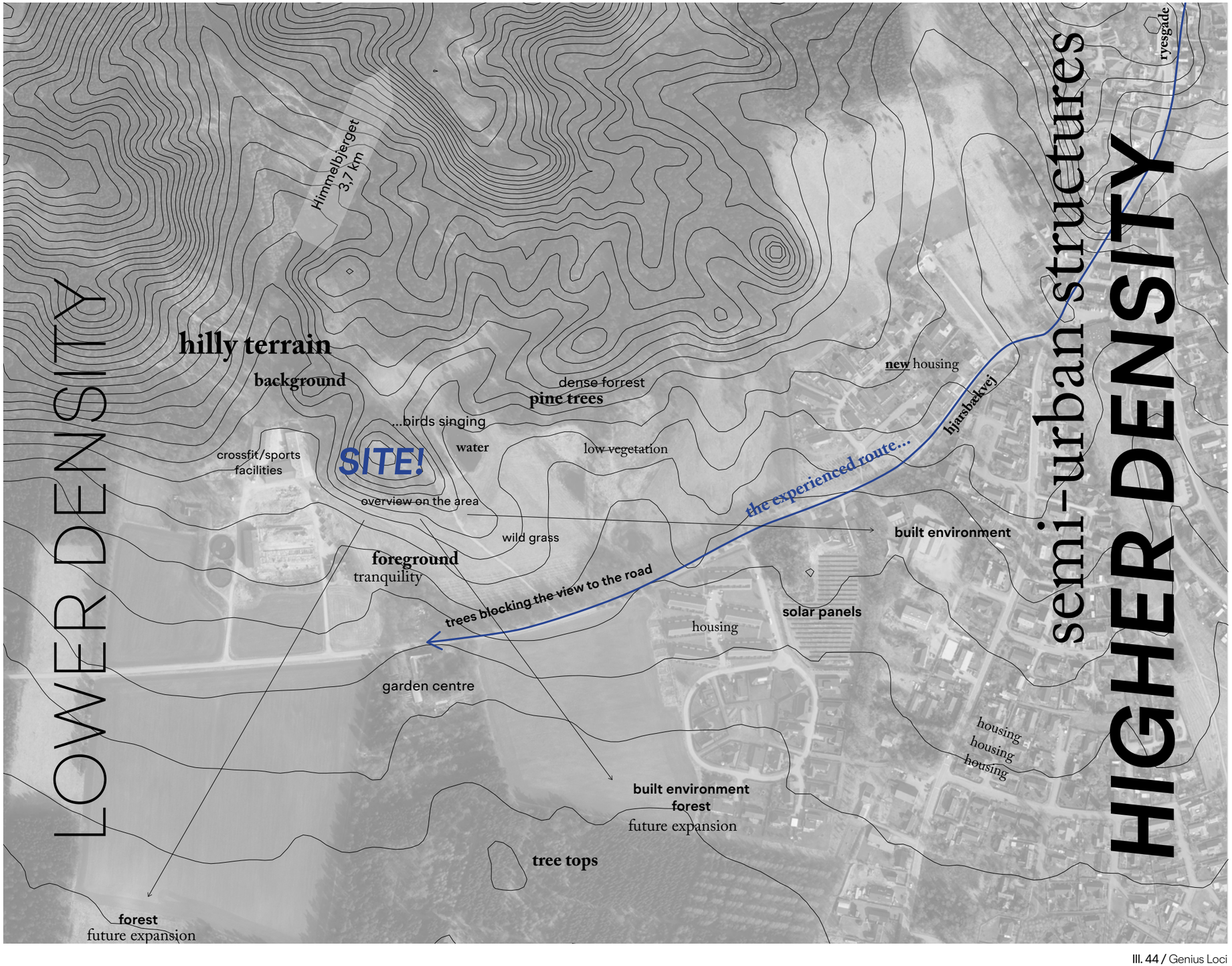


III. 43 / Windrose, summer period

Wind

The wind roses show the direction and speed of the wind for the analysed periods. The general wind rose is created of data from an annual period, which shows that the wind is coming mostly from the south and west. The second wind rose is from July as a representative for the warm months it shows that the wind is coming mostly from the west. This is great knowledge when it comes to the placement of the church and the surrounding outdoor areas. Denmark is known to be quite windy all year around, so it is of great importance to shield outdoor areas from the wind.

First hand expressions of the site



III. 44 / Genius Loci

Genius Loci
The spirit of place

It is often very difficult and becomes subjective when trying to describe the atmosphere and spirit of a place. It is what distinguishes the place from others and contributes to creating the identity of the area. The following description is an attempt to describe the characteristics of the site and give an impression of how the place around the site and through Gl. Rye is experienced.

The arrival to the area is by car, along the long narrow road. The road is following the slightly hilly terrain. The car has just passed the school, grocery store and kindergarten. The houses of the town vary from half-timbered houses to modern type houses, creating a varied and complex expression. On the sidewalks, children are walking with their school bags, and a school bus has just dropped them off at the kerb. On the opposite side of the road, a younger couple are out for a walk in the good weather, with their pram.

Ryesgade splits in two, and at the start of Hjarsbækvej, the area changes character. The houses are placed a little further away from the road, leaving more room for vegetation and openness. A little higher than the road, on the right, several new type houses are situated, with low hedges and sparse vegetation. On the left hand is the red combined heat and power plant, which at first sight seems large, empty, and unstaffed. After passing the city sign that now points out that you have left Gl. Rye, the landscape is experienced much more openly.

Many different couples are walking their dogs along the road, and several of them turn off the road and follow the shelter belts that lead into the nearby forest area. Nothing drowns out the birds' singing, except the wind soughing through the tall conifers.

Photo catalogue

III. 45/ The view towards the foot path leading to the site

III. 46 / The view from the site towards the forrests and new building areas

III. 47 / The road leading to the plateau on the site

III. 48 / The view to the small lake

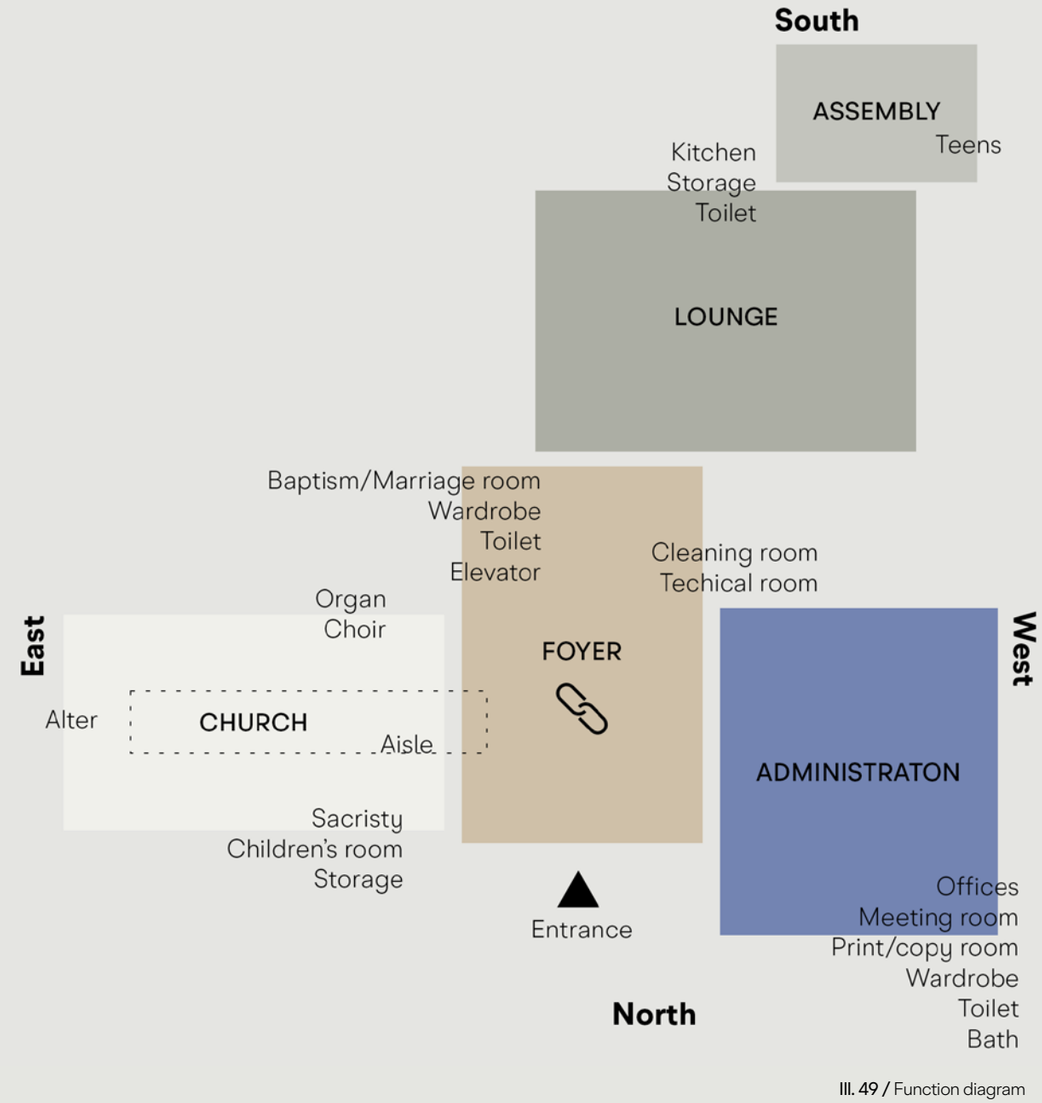
CHAPTER 05 / PROGRAMME DELIMINATION

Room programme

Room	Amount	Sqm.	Light	Atmosphere	Characteristica
Church					
Church room	1	300	Diffuse and effect light	Sacral and peaceful	Reveberation time of 0,6-2 fitted for both speech and music
Sacristy	1	10	Natural/artificial		Space for church silver
Baptism and marriage room	1	20	Natural/artificial	Comfortable and relaxed	Preparation and meeting room with table, chairs and sofa
Childrens room	1	15	Natural/artificial		Space kids and parents to avoid disturbing services, still with an auditive and visual connection to the church room
Foyer	1	70	Natural/artificial	Open and inviting	Functioning as a link between church, administration and lounge
Wardrobe	1	10	Artificial		
Toilet	2	2	Artificial		
HC toilet	1	5	Artificial		
Elevator	1	1,5	Artificial		
Lounge	1	150	Natural/artificial	Relaxed and attractive	Area where users of the church mix, reverberation time of 1
Serving kitchen	1	20	Natural/Artificial		Open and in direct connection with the lounge
Kitchen	1	20	Artificial		
Assembly room	1	70	Natural/artificial	Inspiring and calm	Reveberation time of 1, possibility of different table arrangements
Teen room	1	70	Natural/artificial		A hang out place for teens with computers and games
Administration					
Office	3	15	Natural/artificial	Comfortable and positive	Offices for the priest, verger and church musician
Toilet	1	2	Artificial		
Bath	1	5	Artificial		
Wardrobe	1	5	Artificial		
Print and copy room	1	10	Artificial		
Cleaning room	1	10	Artificial		Space for washing machine, dryer, cleaning cart
Other					
Technical room	4	Total of 80	Artificial		AV room, ventilation
Storage	2	Total of 80	Artificial		Storage of extra furnitures; chairs, tables and other remedies
Waste seperation room	1	10	Artificial		Easy access from inside and outside
Unheated					
Church tower	1	30	Artificial		

Distribution of functions

The function diagram illustrates which rooms should be in close connection to each other and functions as a tool and guide for the further design process. The function diagram is helpful in ensuring an optimal and logic organization of the church.



III. 49 / Function diagram

Design criteria

The entirety

What	How	Why
Create a church that accommodates social, musical and ecclesiastical arrangements.	By creating a church with great flexibility and the possibility of refurbishment.	To ensure a diverse and active church life.
The church should be built of primarily biogenic materials with longevity in mind.	Choosing biogenic building materials when possible, and applying preservation techniques to prolong durabilty.	In order to minimize the buildings negative climate impact and erect environmentally safe architecture.
The landscape must dictate the placement and design of the building.	By utilising the natural terrain and letting the slope determine the levels inside the building.	To have the church become one with nature.
The church must have general openness towards the outdoor areas with a strong connection between inside and outside.	By having large window sections as a general design choice.	To ensure a healthy indoor environment with natural daylight and a great view to the outdoors.
The outdoor areas must be designed accordingly to the microclimatic conditions.	By utulizing knowledge of the orbit of the sun and the wind direction when placing outdoor areas.	To ensure comfortable outdoor spaces.
The foyer must act as a nerve of the church.	By placing the foyer centrally and use it as a link which ties all of the functions of the Church together.	To mix users of the church and ensure a logic organization of the church

The church

What	How	Why
Use historical references in the layout of the church.	By having the alter oriented towards east, and design the church as a traditional processional church.	To respect the liturgical aspects and traditions and draw on what is characteristic and well-known for a church
The church acoustics must accommodate both speech and music.	By designing an acoustic loft and thereby achieving a varying reverberation time inside the church.	To enhance the acoustic experience of the church - ensuring clear speech and lively music.
The use of light must support a spiritual atmosphere, as well as the light intake should be choreographed to the church activities.	By utilising light intake from 10-14, where most church activities are held to create effect light.	To evoke emotions and draw on symbolism to Christianity, enhancing the sacral atmosphere during church activities.

Vision

The vision for this thesis is to design a church which challenges the traditional way of constructing a church in relation to use of materials. The wish is to design a church, where materials are cautiously chosen for the building to have a less negative effect on the environment, why the church primarily will be built of biogenic materials. Furthermore, the church must accommodate different use and should have a flexible layout. Light and acoustic play a huge role in setting the atmosphere and are important design elements, where light intake draws on symbolism and strategically should be choregraphed to church activities. The acoustic of the church should support different use, where the reverberation time of the room must accommodate both speech and music.

PROBLEM.

How to design a church that accommodate the active social life in Gl. Rye inviting for broad use, and which exploits the possibilities of biogenic materials, with a great connection to nature and the focus on creating a spiritual atmosphere with the use of elements such as light and acoustics?

CHAPTER 06 / **PRESENTATION**

Ill. 50 / Visualisation, lounge area

CONCEPT.

1. Placing a one story building on top of the hill on the plateau.

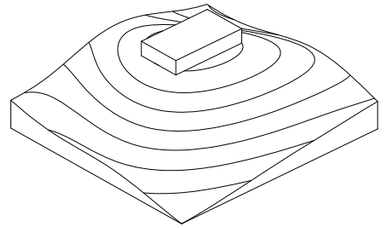
2. Moving the building towards the edge to create an arrival area and utilise the slope by making the building two stories.

3. Off-setting the volumes and rotating them slightly to follow the terrain.

4. Two distinctive roofs indicates the placement of the functions from outside.

5. The final concept situated upon the hill surrounded by nature.

1.



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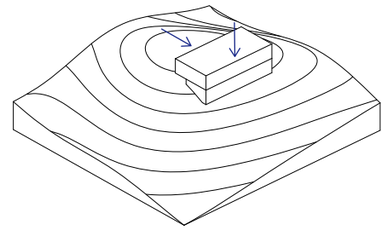

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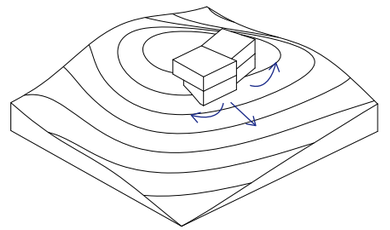

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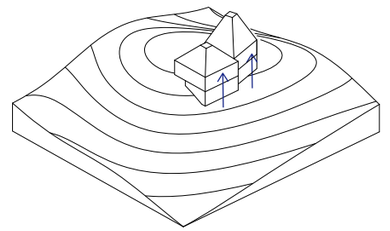

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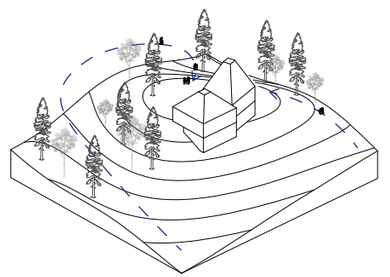
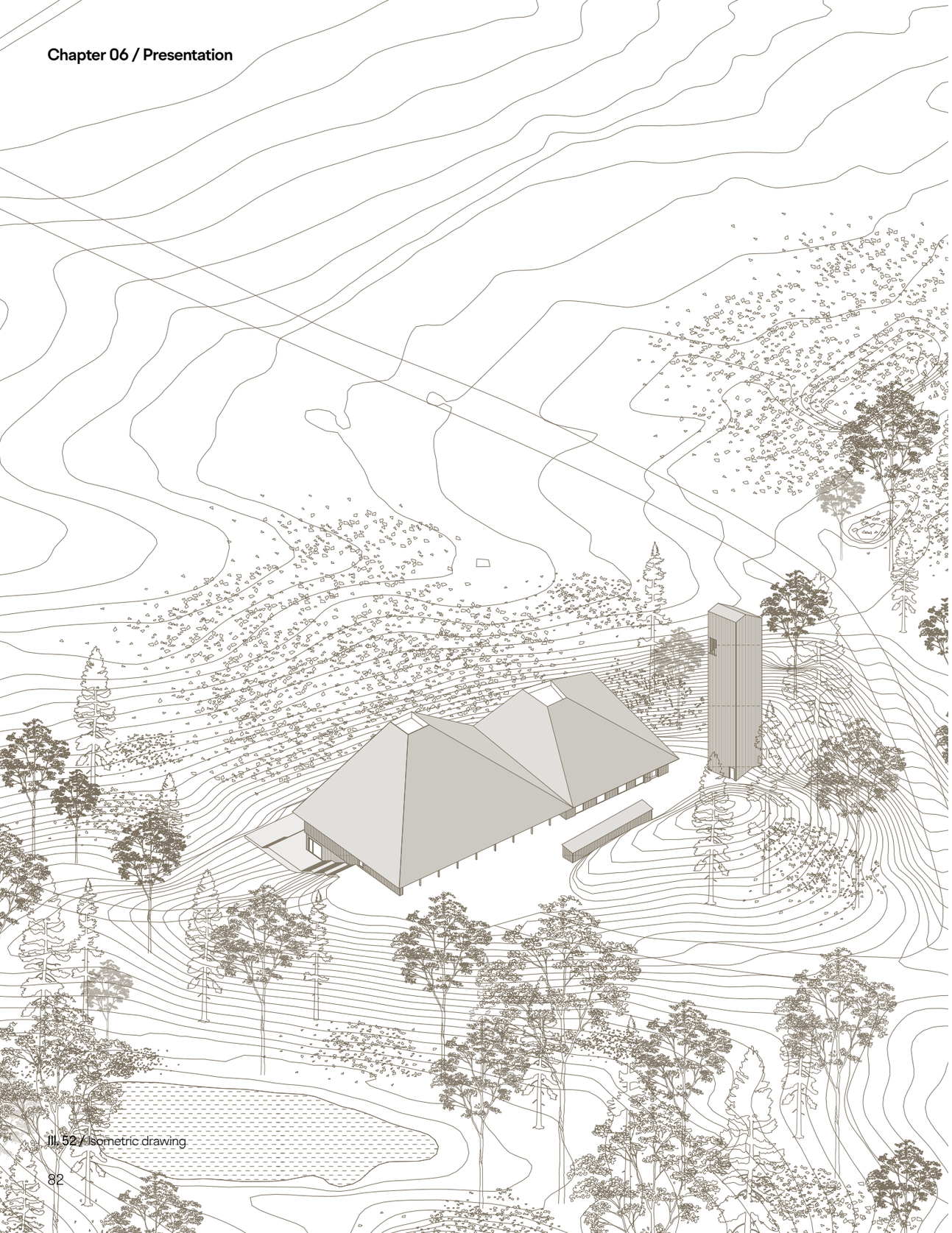


III. 51 / Concept diagram



Ill. 52 / Isometric drawing

Skovlund Kirke

Skovlund Kirke is situated in scenic surroundings build into a hill, with pine forest as background and overlooking the to be build new district of Gl. Rye.

To get to the church you drive up a small hill. A parking lot is situated in close perimeter to the church, with the possibility of drop off by the church, so that people with walking difficulties do not have to walk the last stretch from the parking lot to the church. A bicycle parking shed is placed in close connection to the church.

Ill. 53 / Masterplan

Ill. 54 / North facade

North facade

The vertically installed wooden facade cladding fits into the surroundings and contributes to a modern and visually elongated exterior. The eelgrass roof contributes to a raw and ecological exterior. To minimize the building's negative climate impact, and emphasise the design narrative, the building is constructed primarily of, and cladded with locally sourced materials with low CO_2 emission. The chosen materials draw on and pays homage to traditional craftmanship and regional materials.

The shift in material on the north facade frames and makes the entrance stand out as it is sheathed with thatched reed, continuing the construction material of the roof into the facade.

The distinctive tall roof above the church, as well as the change in the dimension of windows on the south facade, makes it easy to understand the organization of functions from outside.

South facade

Ill. 55 / South facade

East facade

Ill. 56 / East facade

Ill. 57 / West facade

The church tower is separated from the building, and visible from all angles as well as from far distance. It distinguishes itself by being the tallest construction.

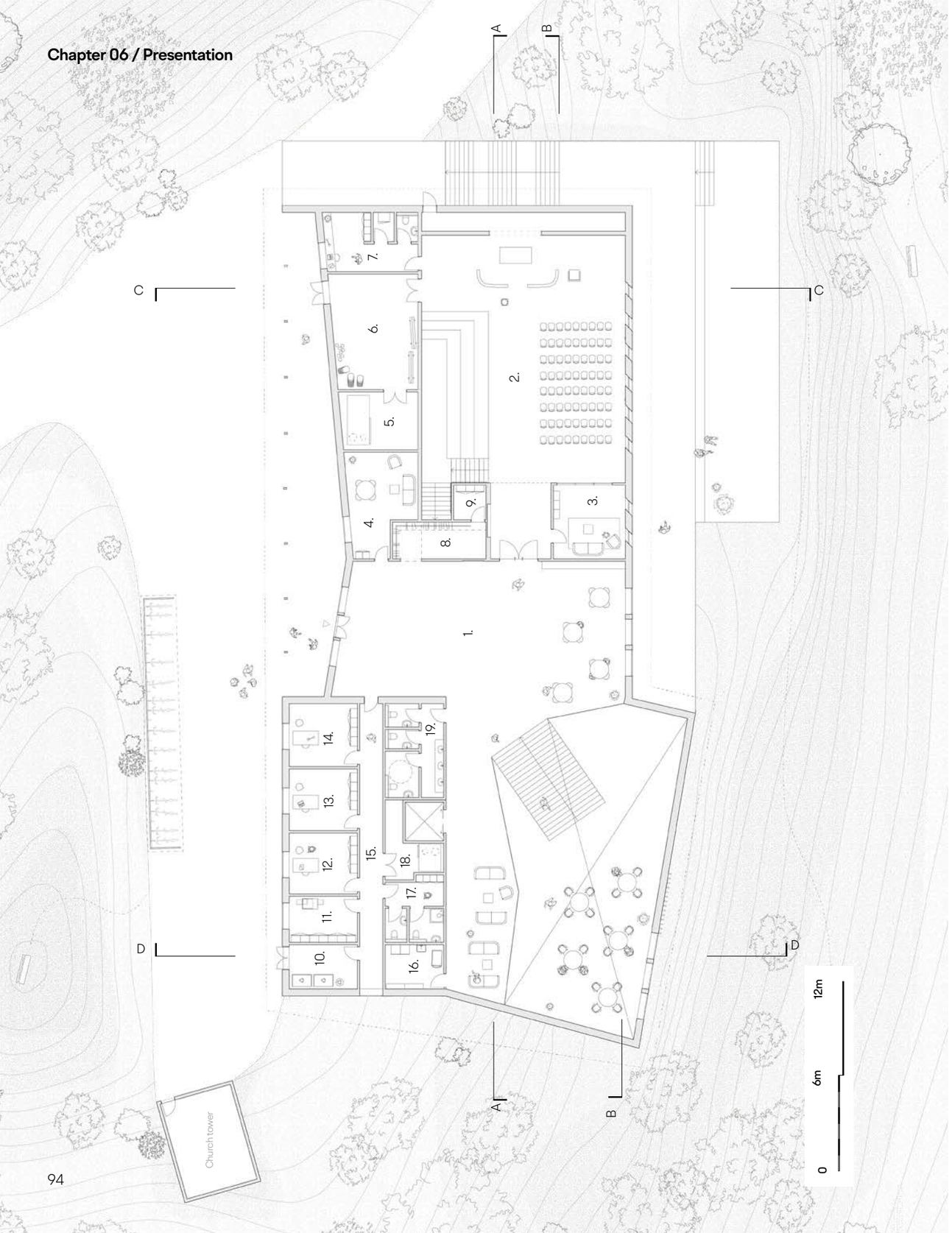
Exterior

A slight angle to the facade leads you to the entrance upon arrival at the church. An overhang provides a sheltered outdoor space.

Ill. 58 / View from main intrance

Ill. 59 / The foyer

The entrance to the church and foyer is open and inviting, with high ceilings and kept in warm colors of the plywood, which is a continuous material in the church.



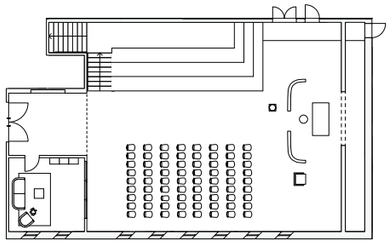
GROUND FLOOR

1. Foyer	249.8 m²
2. Church room	256.3 m²
3. Children's room	22.3 m²
4. Baptism and marrige room	26.6 m²
5. Technical room	18.7 m²
6. Storage room	41.3 m²
7. Sacristy	23.2 m²
8. Wardrobe	14.5 m²
9. AV room	4.7 m²
10. Waste seperation toom	12.7 m²
11. Print and copy room	13.2 m²
12. Office	17.7 m²
13. Office	17.7 m²
14. Office	17.7 m²
15. Corridor	27.8 m²
16. Cleaning room	10.9 m²
17. Staff wardrobe	15.7 m²
18. Technical room	18.8 m²
19. Toilets	23.2 m²
	(net areas)

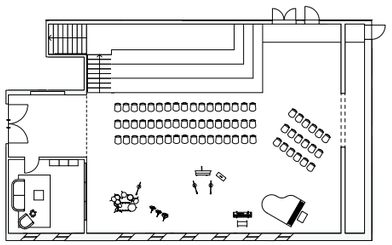
The foyer functions as a link between all functions of the church. The foyer offers different seating options, is double height and offers both a visual and auditive connection to the Lounge.

The church is furnished as a traditional procession church, with an aisle leading towards the altar. A big depot is in direct connection to the church, ensuring easy refurbishment of the church, depending on the church activity.

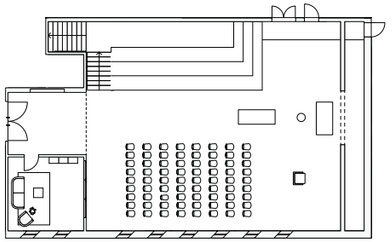
Ill. 60 / Ground floor



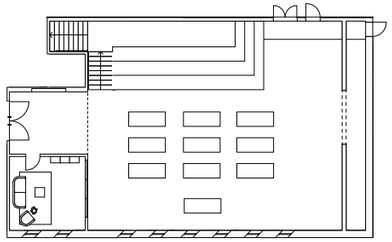
Church service and baptism
Church services are about listening, praying, singing and feeling a connection to God. The church is furnished as a traditional procession church with the conregation oriented towards the alter.



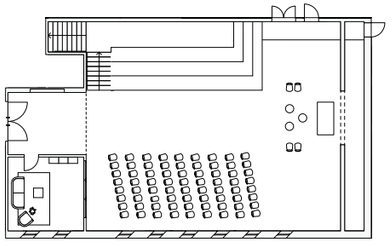
Concert
When the church is used for musical arrangements the chairs can be placed in elongiation of the tribune and the floor can be used as a stage.



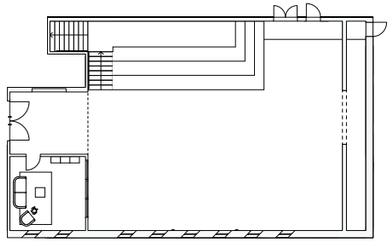
Funeral
A funeral is the relatives' final consolation and goodbye to the deceased. The coffin is placed centrally in front of the alter. The set-up makes it easy and natural to carry out the coffin.



Everyday
In everyday life the church can be used by associations forexample for yoga or pilates.



Wedding
A church wedding is build around traditions, why the church is furnished as a procession church with the aisle free. The chairs are angled towards the bride and groom.

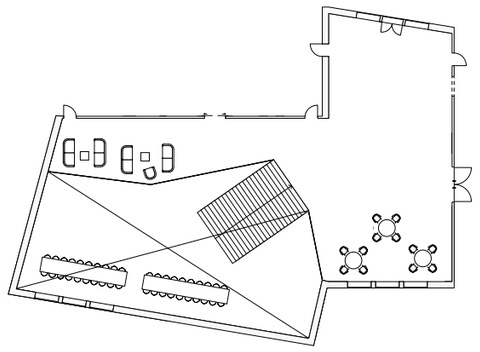


A quiet moment

III. 61 / Different layouts in the church
III. 62 / Different layouts in the lounge

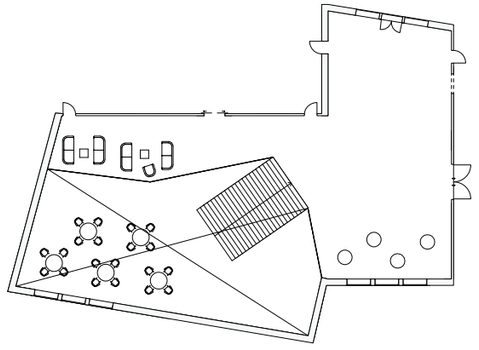
Different layouts

The church, foyer and lounge can be furnished differently depending on the activity. The multifunctionality gives the opportunity for a broad variety of use of the church.



Everyday
In an everyday situation the foyer offers great possibilty to socialize with the other churchgoers. It offers different seating options for associations who use the church, such as knitters, who can sit and relax at a coffee table and chat while knitting.

In the lounge tables are arranged for co-dining. The long tables are great for spaghetti services and other dining events which are held at the church.



Events
Before events as weddings or concerts people can conversate and gather around high tables in the foyer.

After a concert the lounge offers seating at coffee tables where people can sit and chat while enjoying a refreshment from the bar.

Ill. 63 / The church seen from the entrance

As you enter the church you instantly sense the height of the room. The ceiling opens towards a skylight, which both offers diffuse light and a look to the sky. The acoustic panels, which are installed in the ceiling, ensures great acoustic inside the church. The panels manipulate sound and ensures that the reverberation time of the room is oriented and adapted to the furnishment of the church. The acoustic panels are angled towards east, thus music from the organ play is reflected into the ceiling.

The church is kept in light and warm colors of the plywood, enhancing a sacral and tranquil atmosphere.

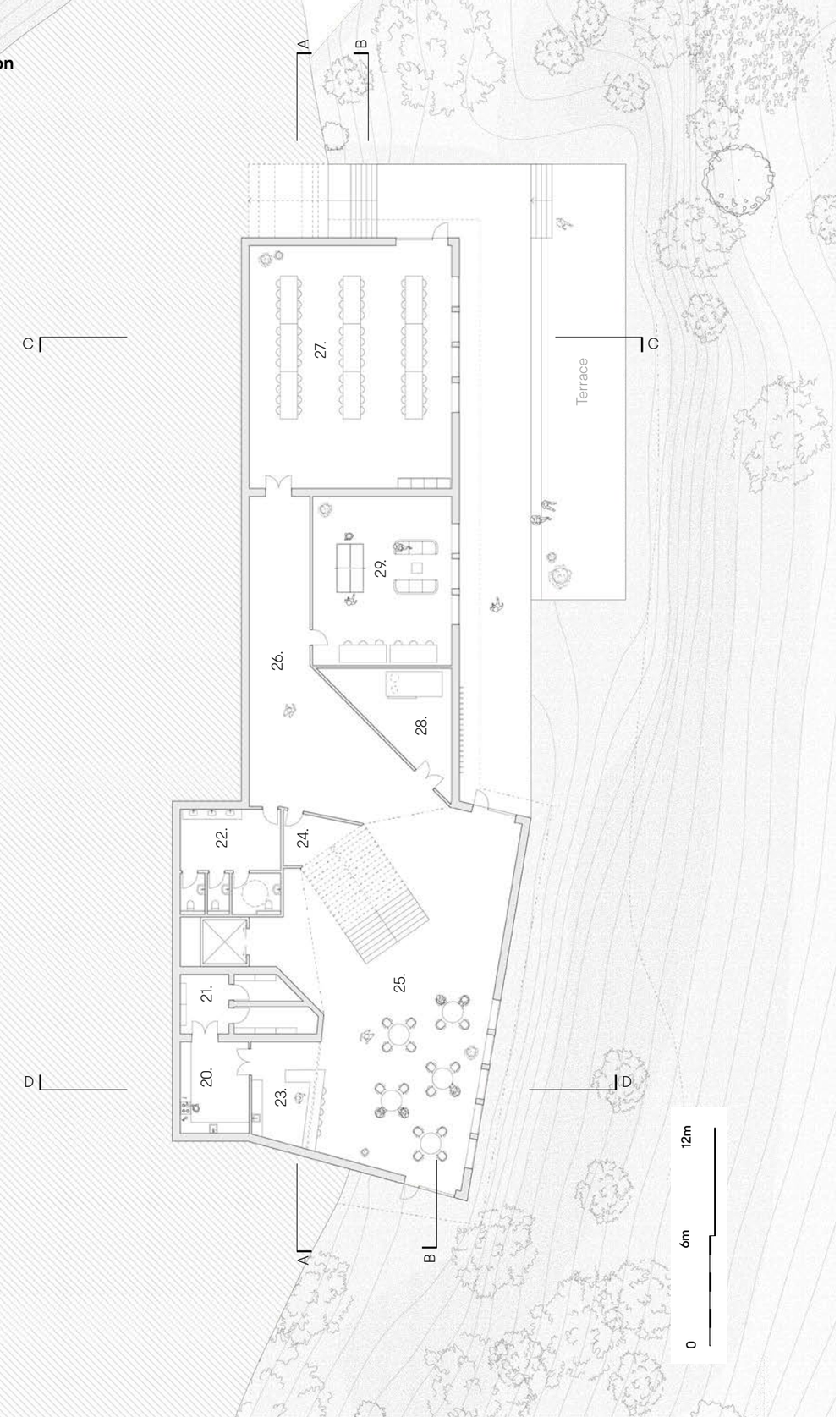
The church is oriented towards the altar, where a panel of mycelium creates an altar wall, which appears as a work of art in itself. The light intake above the altar draws on symbolism of God, the divine and the beyond. The continuation of the lines from the plywood panels used for wall cladding, creates a cross behind the altar, further drawing on symbolism of Christianity.

From the alter the expression of the ceiling changes, as the angle of the panels create a more closed off ceiling. The acoustic panels absorb unwanted nuisance, ensuring clear speech, which is reflected and spread, so people better can hear the pastor's sermon.

When entering the church, the loft above you is lowered, enhancing the contrast of the high ceiling inside the church. When you take a few steps forward the room opens above you.

A built-in tribune, which gives access to the organ and choir, is the only permanent inventory inside the church and offers seating.

III. 64 / The church seen from the alter



BASEMENT

20. Kitchen	23 m²
21. Cold rooms and storage	23.7 m²
22. Toilets	34.5 m²
23. Bar	17.7 m²
24. Storage	20.3 m²
25. Lounge	216.4 m²
26. Corridor	98.3 m²
27. Assembly room	160.1 m²
28. Technical room	30.2 m²
29. Youth assembly room	76.6 m²
	(net areas)
Church tower	34.7 m²
Terrace	299.2 m²
Total net area	**1533.6 m²**
Total gross area	**1708 m²**

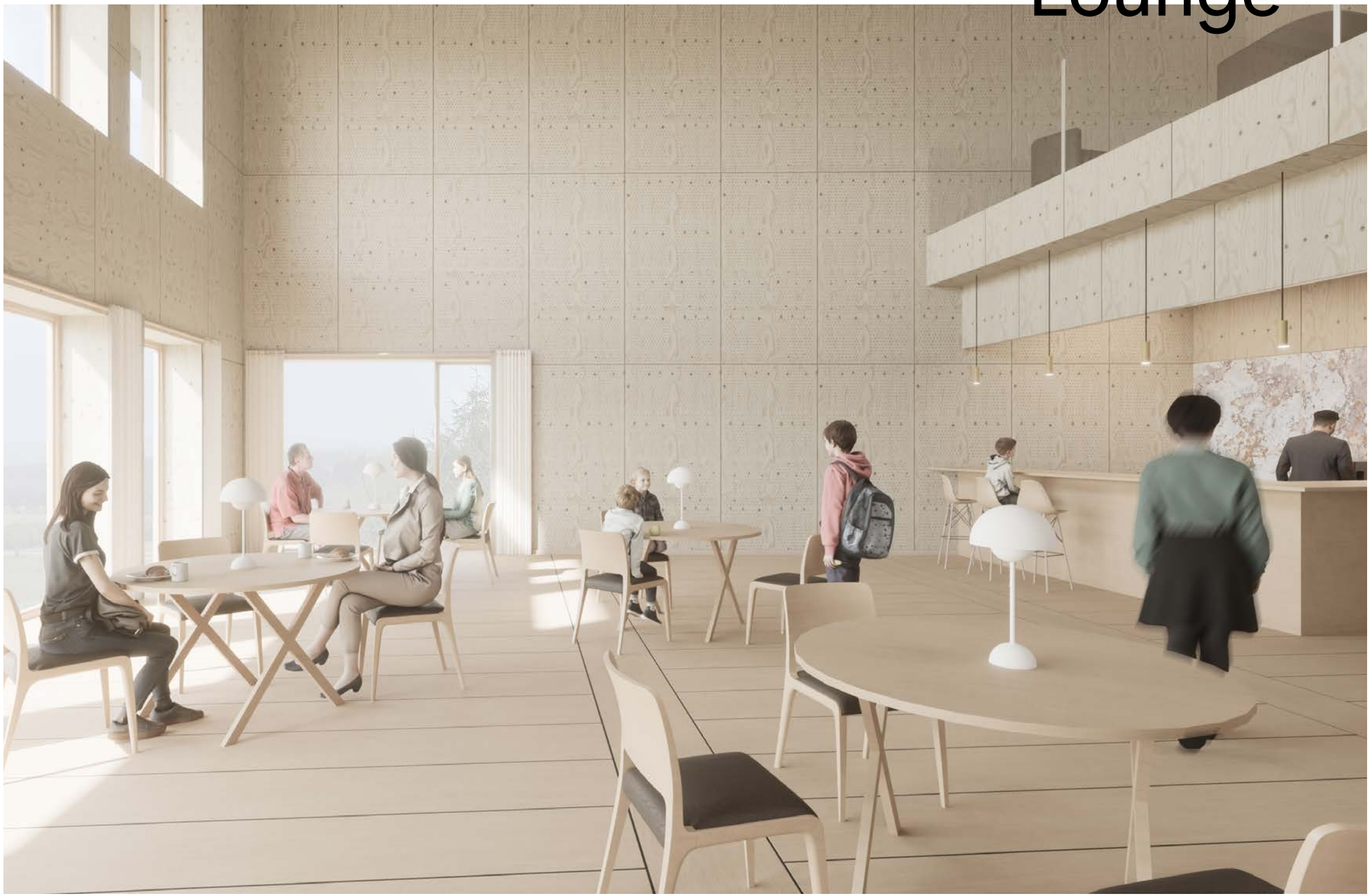
In the basement is a double height, open lounge, and bar area, which is fit for pasta services, bigger gatherings and use by associations, who use the church on weekly basis. From the lounge an outdoor terrace can be accessed. The assembly room can be used for confirmation preparation, parish council meetings or lectures.

Ill. 65 / Basement

Lounge

The lounge is where users of the church mix. Here the confirmands can do group work or hang out during recess, simultainously with associations as the knitting association uses the lounge for their weekly meet up – thereby mixing people of all ages.

The lounge is also great for assemblies after services or lectures where people can meet and chat and get refreshments.



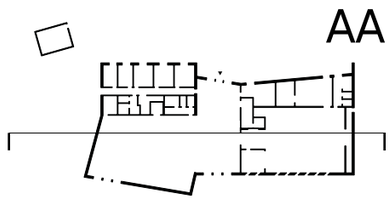
Ill. 66 / The lounge and bar area

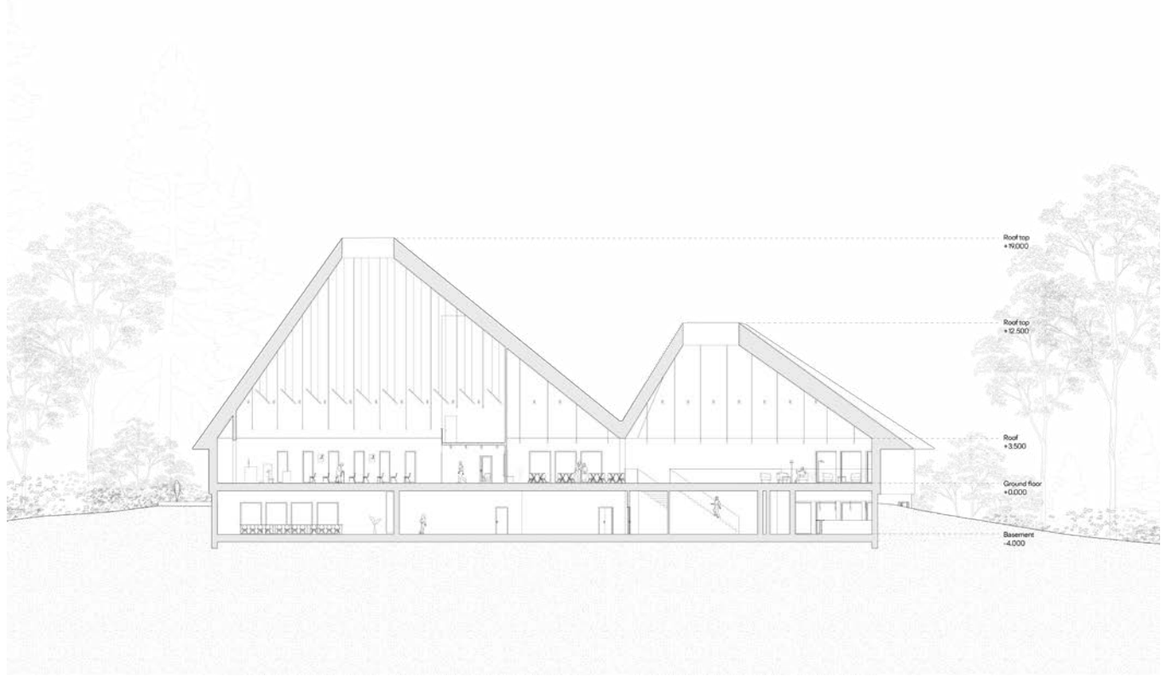
III. 67 / The assembly room

The assembly room is cladded with plywood, however, the load bearing walls of concrete in the basement are exposed, thereby using the materials to tell the story of the construction - which walls are light, and which are heavy. The use of concrete is limited and only used where necessary, as concrete is a heavy carbon emitter.

Sections

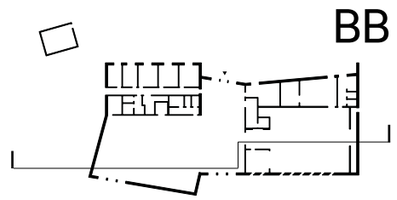
The sections illustrate the spatiality inside the building and the rooms relation to each other.

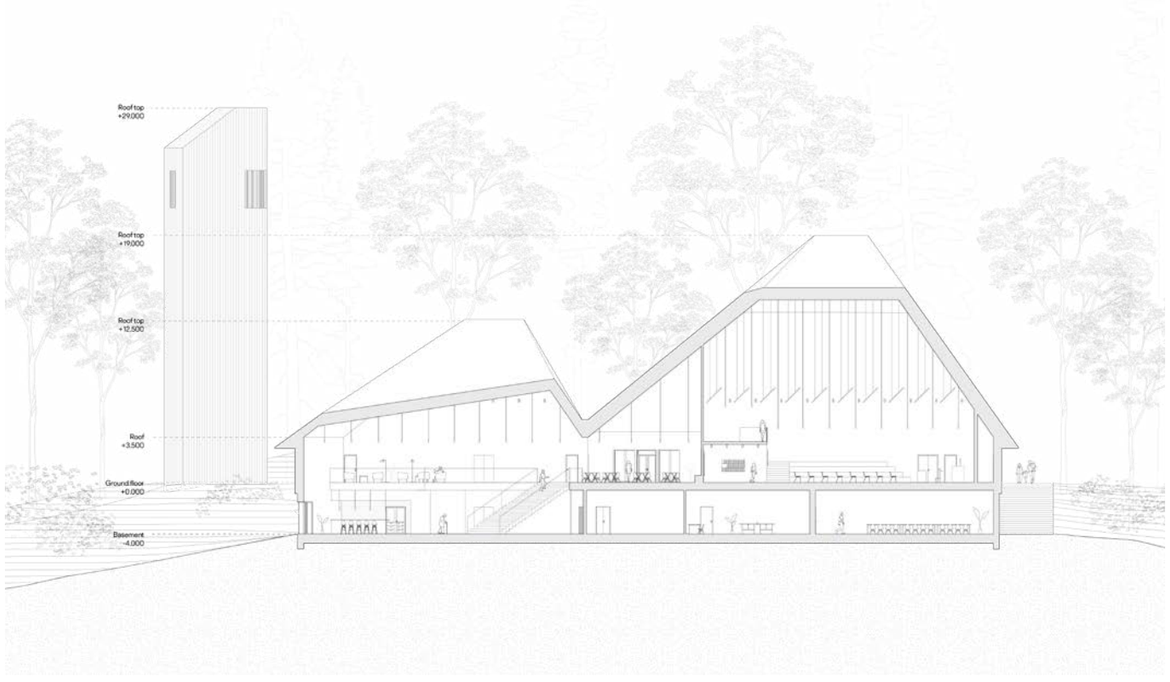




0 6m 12m

Ill. 68 / Section AA





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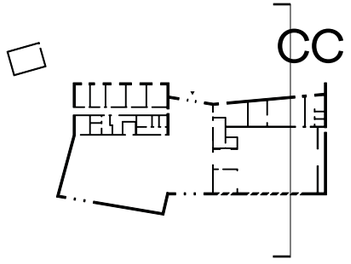

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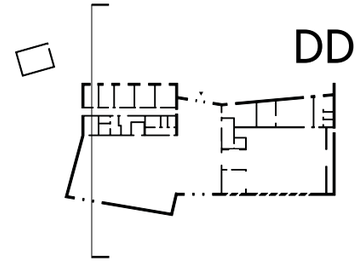
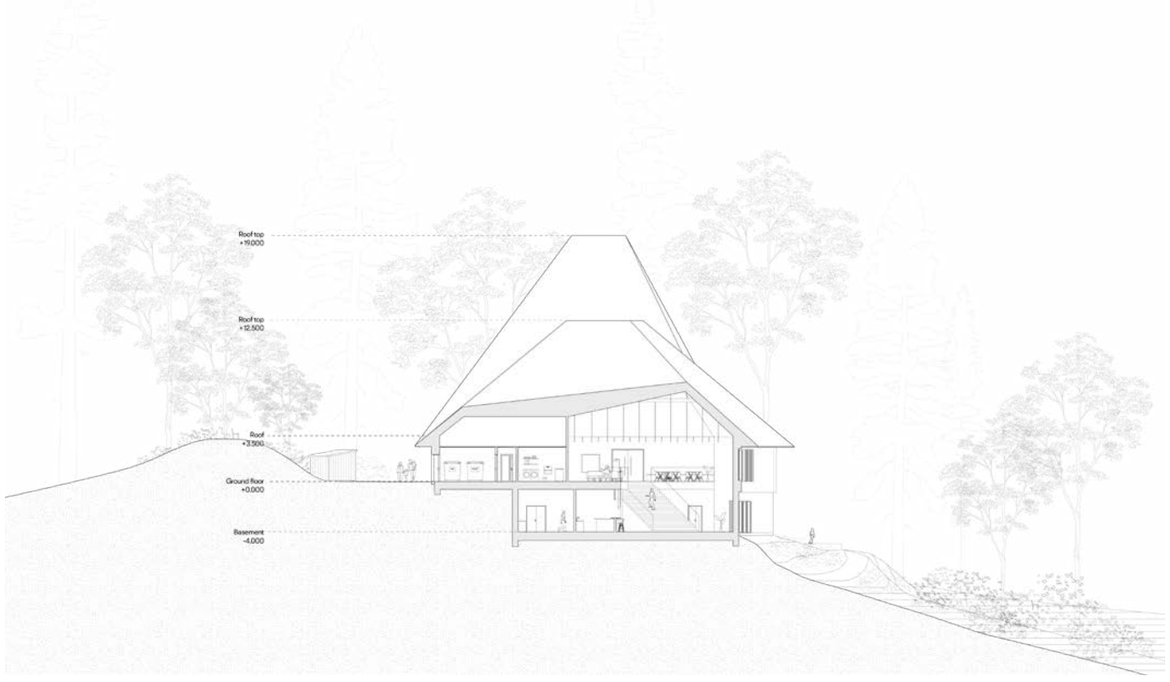
Ill. 70 / Section CC





0 6m 12m

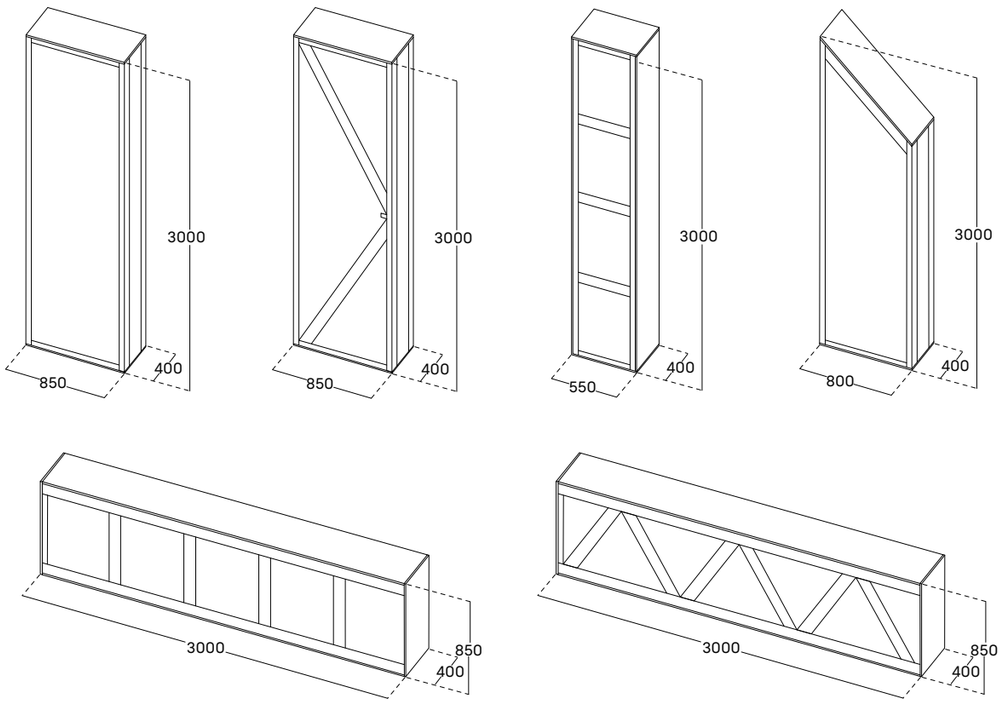
Ill. 71 / Section DD

In the landscape

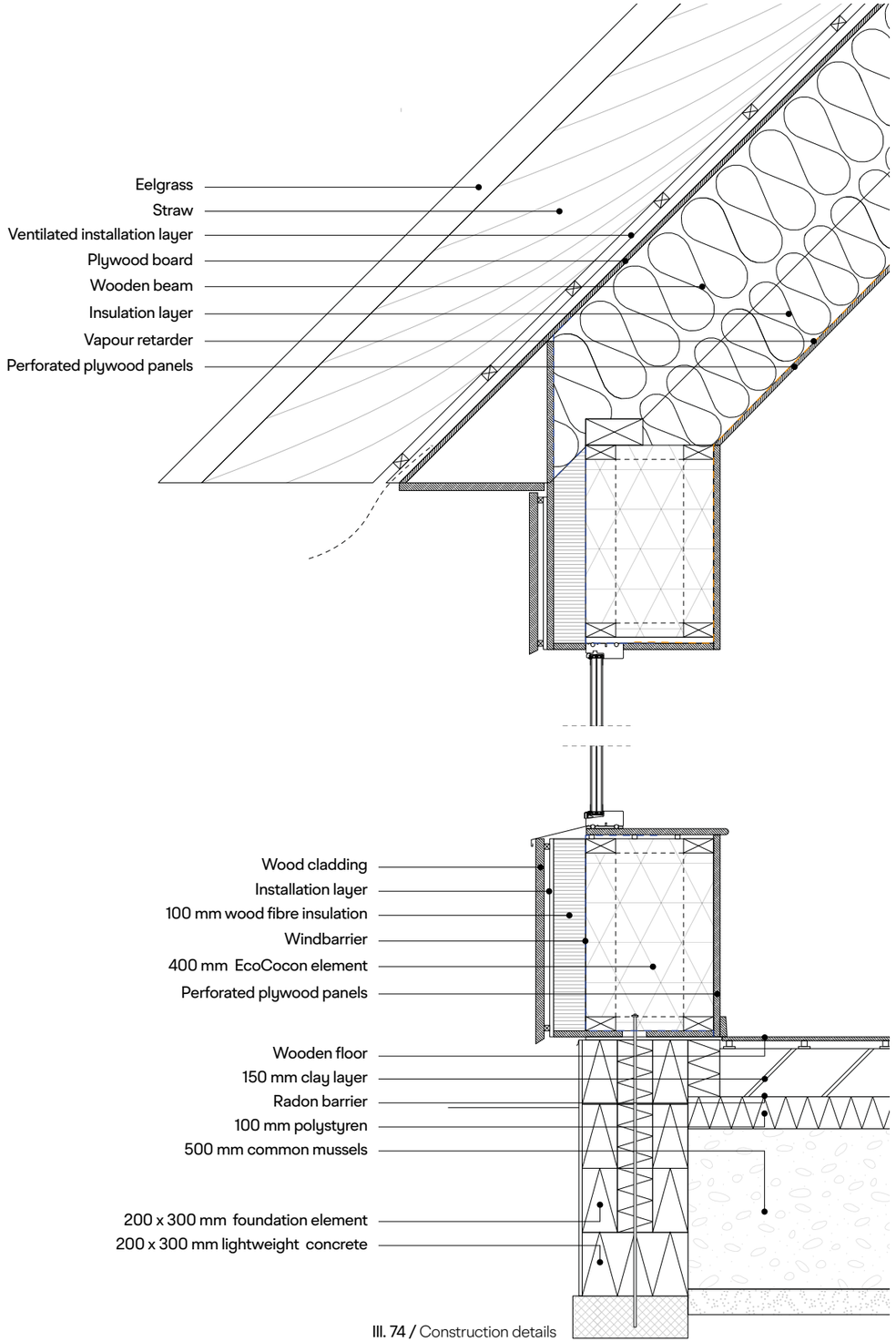
Ill. 72 / Skovlund Kirke seen from the main road

Wall construction with EcoCocon elements

The church is constructed of EcoCocon straw-timber elements, whereby biogenic materials make up the building envelope. Characteristic for biogenic materials is that they sequester and store large amounts of CO^2 during their lifetime. The straw-timber elements are easy to install and can be customized to each project. The double wooden frame of the elements ensures structural capacity, and supports ceilings, roof, and facades. Because the straw-timber elements are of non-processed renewable materials, the construction has less of a negative impact on the climate and make it possible to erect architecture, with great conscious of the environment and which saves tons of CO^2 (EcoCocon s.r.o., nd.).



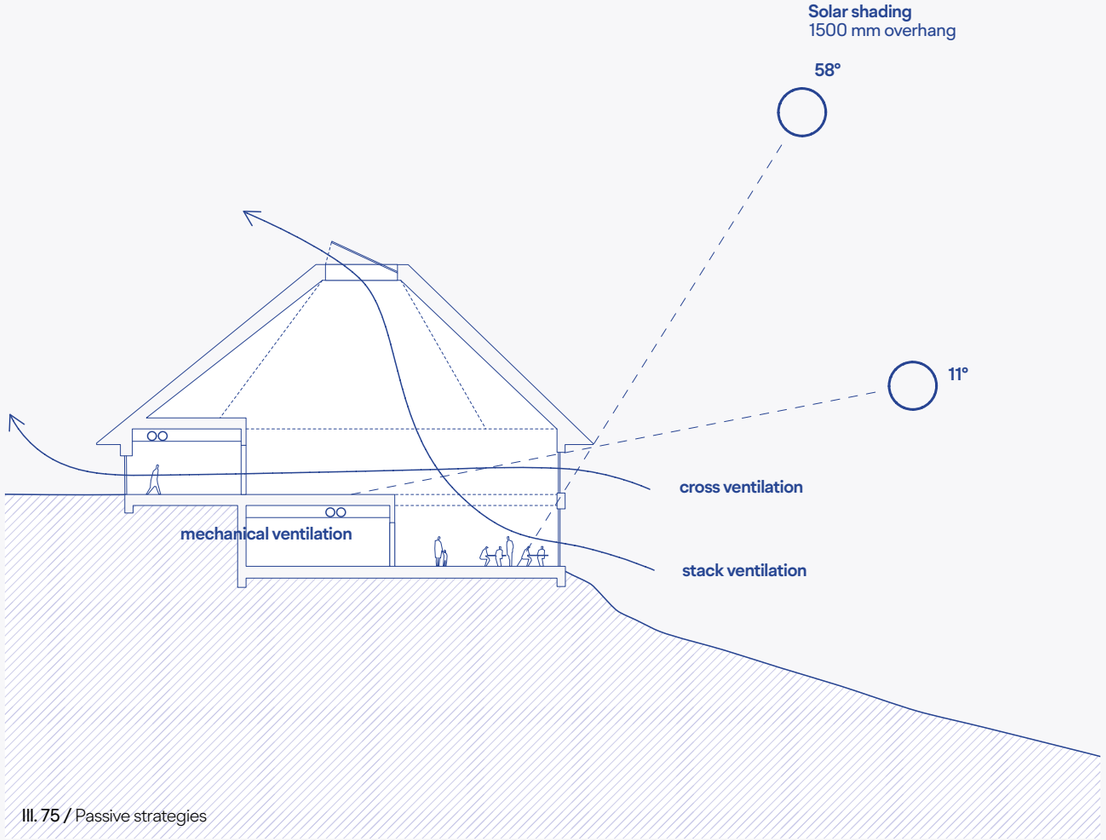
III. 73 / The different EcoCocon elements



III. 74 / Construction details

Designing with passive strategies

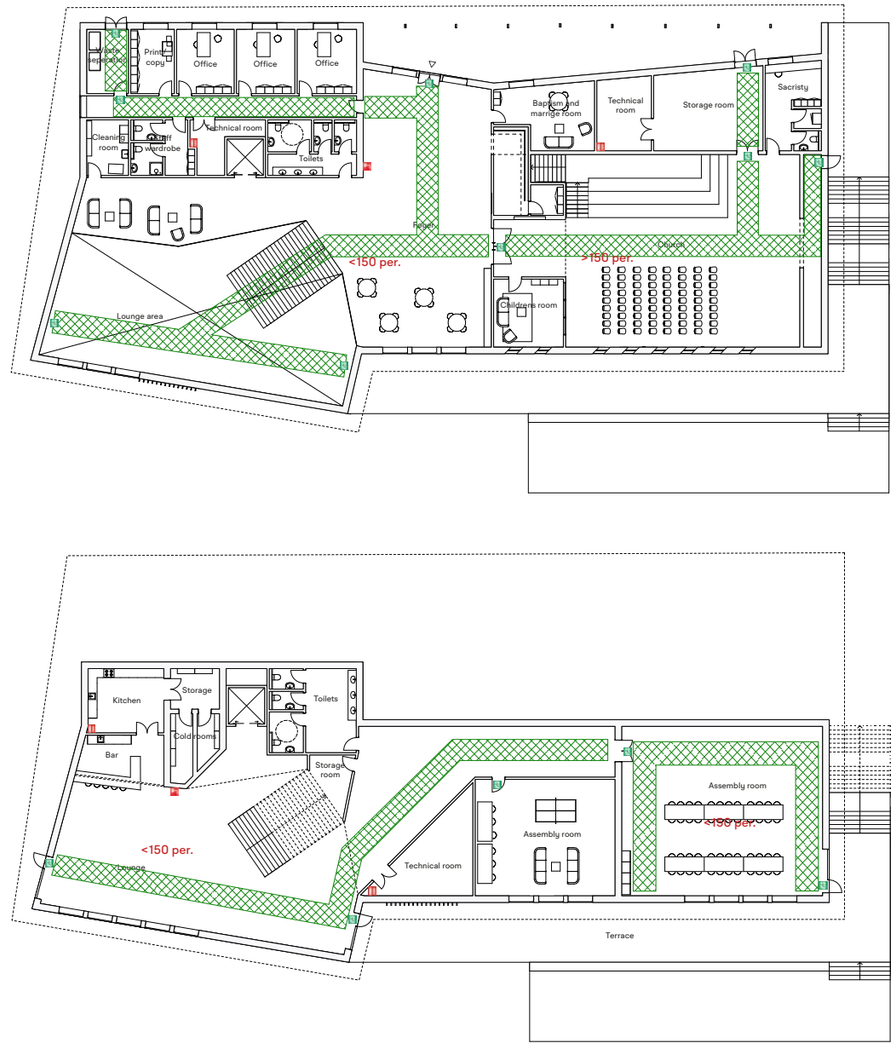
The church uses a combination of mechanical and natural ventilation to ensure a good indoor environment. In the big rooms with high ceilings thermal buoyancy is utilised, where mechanical ventilation is used in smaller rooms with lowered ceilings.



III. 75 / Passive strategies

Fire emergency plans

Considerations about fire safety and an escape strategy with emergency exits are drawn and illustrated on the fire plan. In the considerations the number of exits are aligned with the expected number of people.

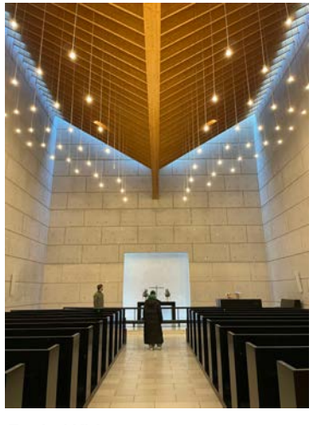


III. 76 / Fire emergency plans

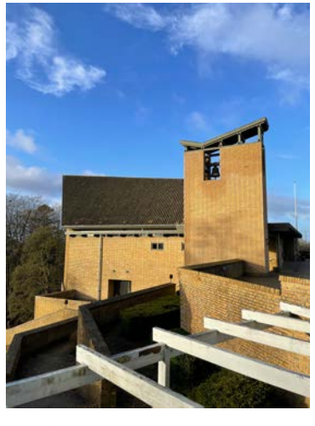
CHAPTER 07 /
DESIGN DEVELOPMENT

Study trips

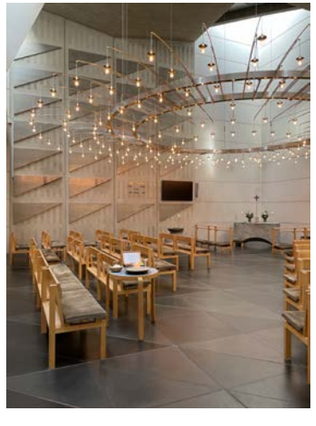
III. 77 / Collage showing the churches visited on study trips



Enghøj Kirke
Randers
Henning Larsen
1995

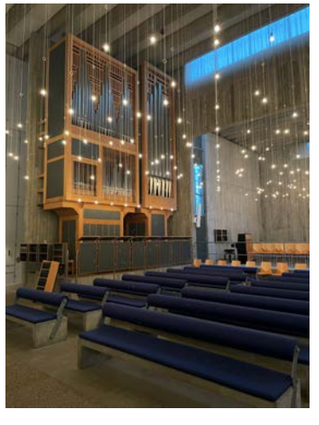


Sct. Clemens Kirke
Randers
Inger and Johannes Exner
1963

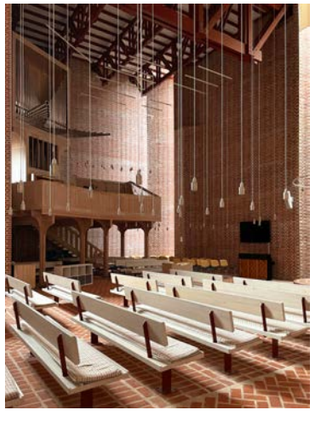


Skæring Kirke
Aarhus
Inger and Johannes Exner
1994

Ravnsbjergkirken
Aarhus
C.F. Møller
1976



Gug Kirke
Aalborg
Inger and Johannes Exner
1972



Nørre Uttrup Kirke
Nørresundby
Inger and Johannes Exner
1977

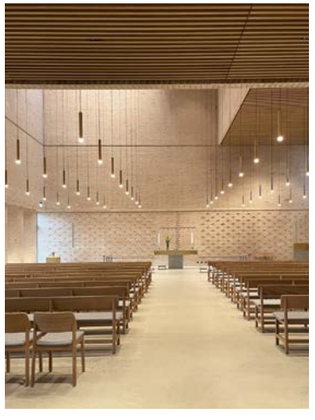
Vor Frelsers Kirke
Aalborg
Ole Peter Momme and Ludvig Frederik Olesen
1902

Sct. Mariæ Kirke
Aalborg
1926

Ansgars Kirke
Aalborg
Hother Paludan
1929

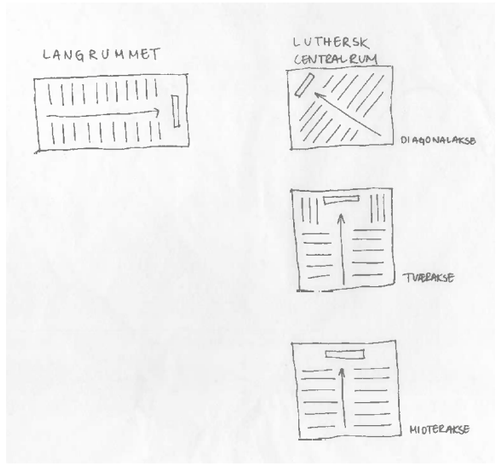
Budolfi Kirke
Aalborg
Approx. 1300

Sankt Sørens Kirke
Gl. Rye
Approx. 1400



Hvinningdal Kirke
Silkeborg
Friis & Moltke Architects
2022

Ill. 78



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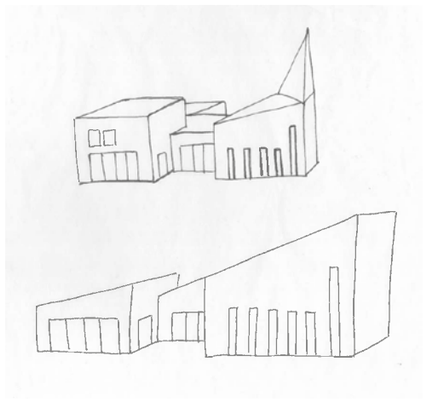
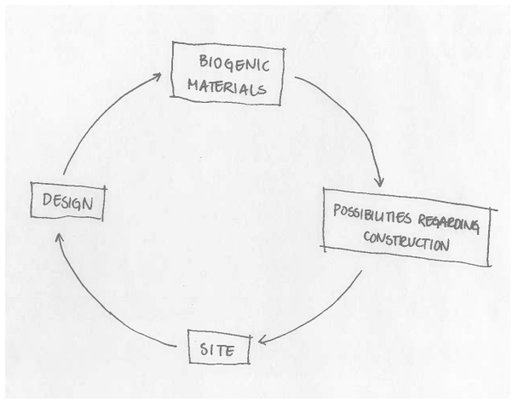
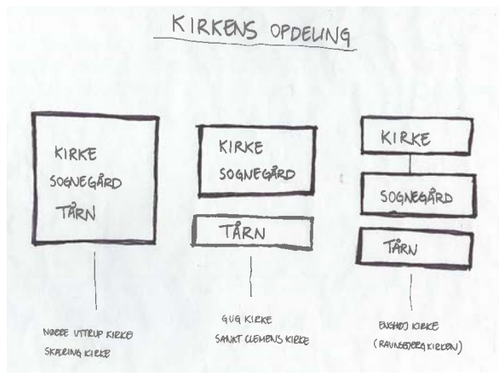
Ill. 79







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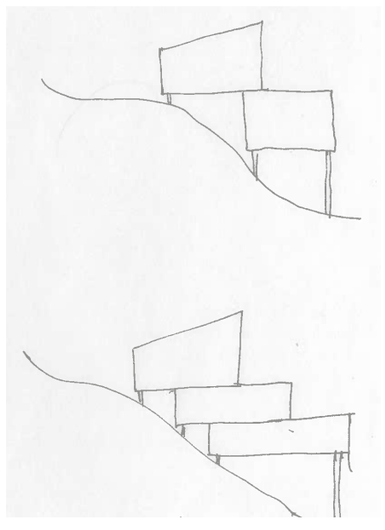
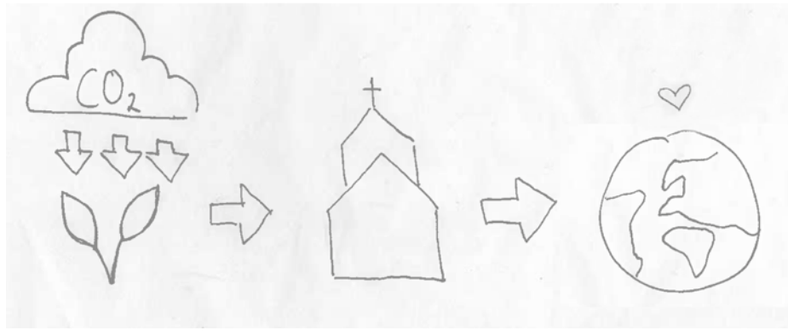
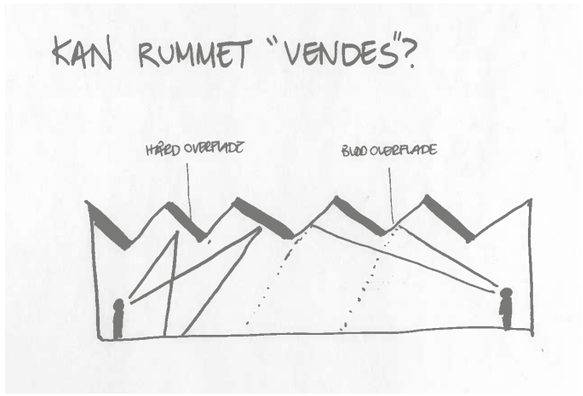


Ill. 82

Ill. 83





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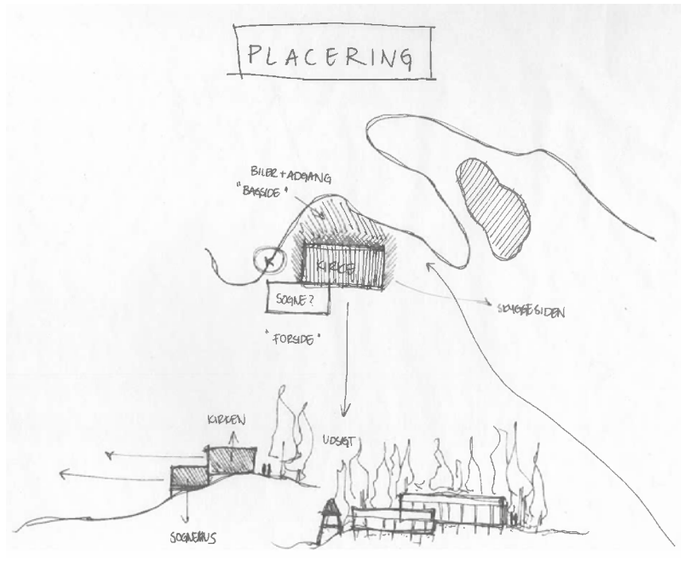
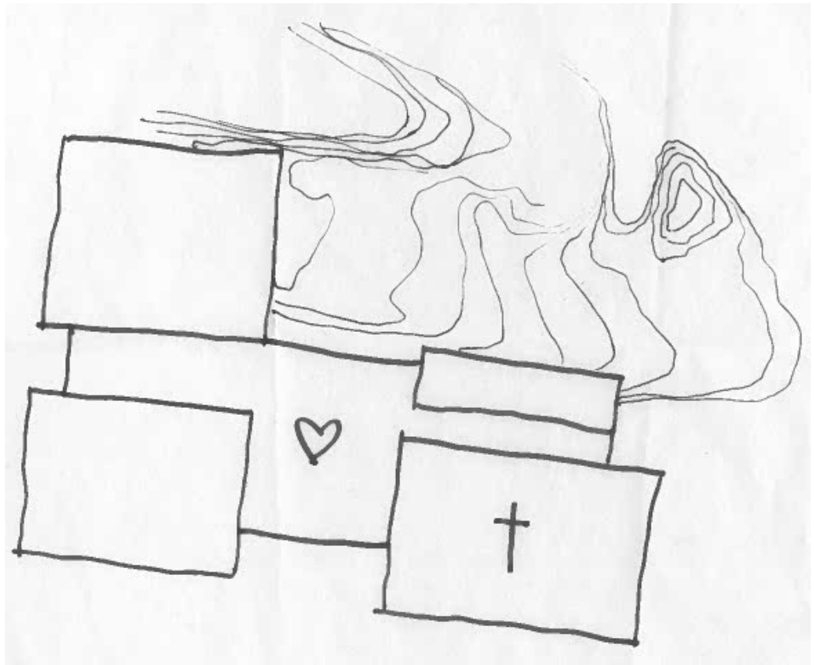


Ill. 85

Initial sketches

From the prelimary analytical work several criteria and wishes to the design was established, which initiated the design process. The following is a somewhat chronological presentation of the design process, however the design process is much more complex as the process is iterative and many decisions are made simultaneously. The design process communicates the investigations which have been completed to end up with the final design solution.

From the function diagram it was established that the church should consist of three main functions; the church, the parish, administration and the foyer as a link between the three.



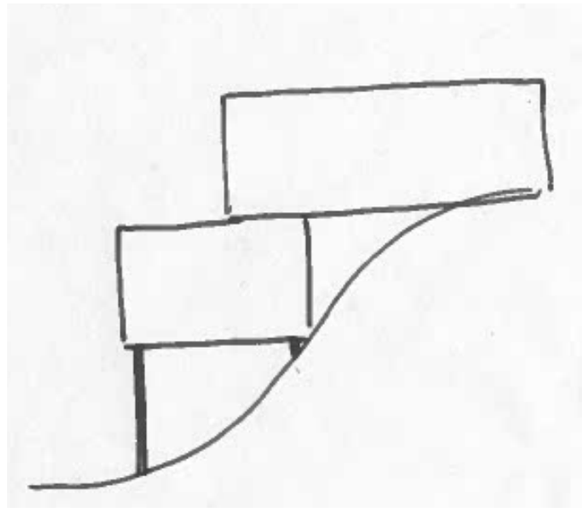
Ill. 86

Placement in terrain

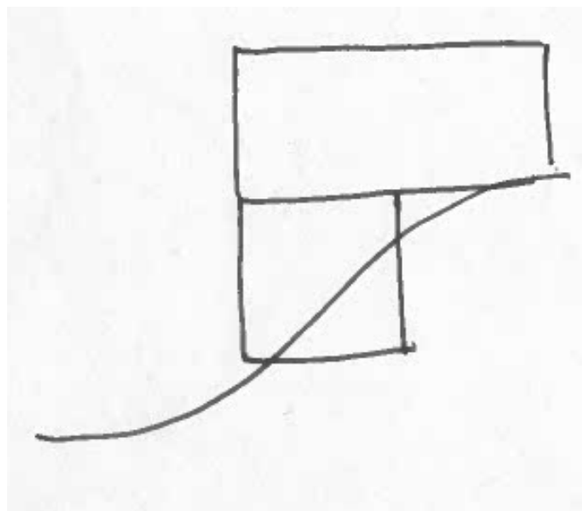
An investigation of how to place the building in the terrain was completed. Two principles was discussed, as the building could either be rasied above ground on screw columns, making it possible to construct the entire building in biogenic materials. As well as making minimal changes to the existing terrain. However because of the steep slope, the columns would become very tall and leave a lot of dead space underneath if the church should be in more than one level. Thereby, if screw columns were to be used, the church should be placed on an even area.

The other principle was to utilise the slope and build into the hill. This would accomodate a church in two levels, but demand for changes to the terrain. As biogenic building materials are not suitable for building into the terrain, it would demand for use of concrete, however the use of concrete would be limited, used only where necessary.

Ill. 87

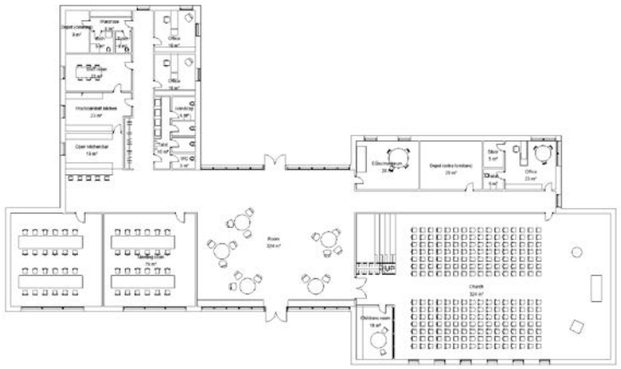


Ill. 88



Organisation of functions

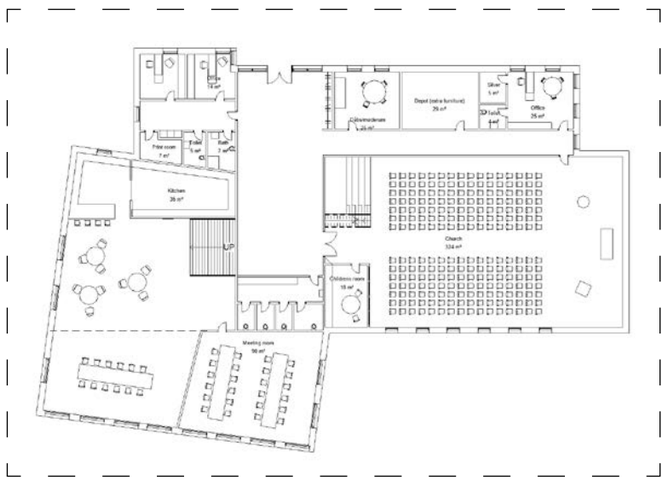
The initial drawings focused on a logic organisation of functions and several iterations of a plan were drawn, which of two concepts was further developed.



III. 89

First concept was a church in one plan with a centrally placed foyer functioning as a link between the church, administration and meeting rooms. The walls to the meeting rooms are sliding walls, thus the foyer and meeting room could be merged to one big room for big events. The foyer would function as the heart of the church where all churchgoers would mix.

Chosen for further developement



III. 90

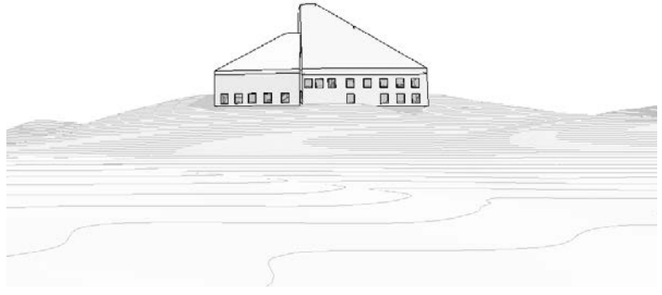
The second concept was a church in two levels to utilise and build into the terrain. The church and administration is in connection to the foyer on the ground floor, where the rooms related to the parish hall is located on the lower level. The two floors are connected by a big landscape stair.
The slight rotating of the parish hall is a small gesture, following the curves of the landscape.

VOLUME STUDIES
Design of the roof

The use of biogenic materials means that there are limitations to the design of the roof, as the roof can't be flat. This quickly resulted in sketching a frustum roof.

III. 91

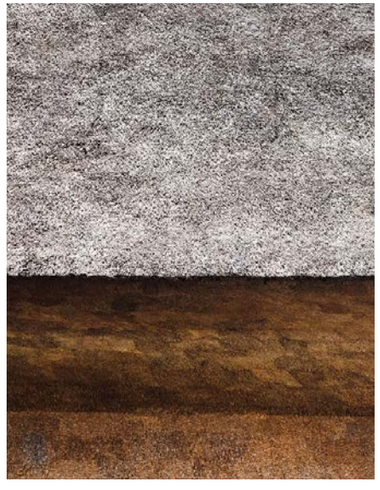
The first iteration of the roof focused on emphasizing the importance of the church, making the frustum roof above the church stand out in its dimension, being taller and bigger than the frustums above the parish hall and administration. The frustum roof have an advantage according the possibility of skylights, which provide diffuse light. The wish was to have the skylight above the alter. Illuminatng the alter and creating a divine light.



III. 92

The second iteration of the roof was an attempt to limit scotches, where water would gather, making the construction vulnerable. Instead of three frustums, the second iteraton of the roof has two frustums, with a vertical slope where the two roofs meet.
The biggest frustum are still above the church emphasizing its function. However, even though scotches are limited, the skylights are positioned incorrectly in relation to the rooms and functions inside the building.

Wood cladding



Thatched reed

Eelgrass

Mycelium

III. 93

LIFE CYCLE ASSESMENT

Product catalogue

Exterior cladding	Pinewood	Reed	Eelgrass	Mycelium
Thermal conductivity W/mK	0.2	0.06	0.037	0.05
Lifetime years	50	50	x	x
Sum of GWP of 1 m^2 $kgCO_2$-eq	5.048	49.580	x	x
Transportation km	80	38	56	No market
Apperance and characteristics	Natural, warm, fits in with the surroundings, easy to maintain and repair	Ecological, historical, local product, low cost	Raw and natural, rot resistant, fire resistant, easily harvested	Decorative, biodegradable

Note: Because of the lack of data on new biogenic materials it wasn't possible to calculate the sum of GWP for eelgrass and mycelium. The sum of GWP for eelgrass depend on the processing of the material. If used for cladding in its raw state with no processing the total sum of GWP would be very low. Mycelium as cladding is still in its early experimental stages, with a lot of uncertainty of how to make the material suited for external cladding.

Plywood boards

Eelgrass (søuld) panels

Clay plaster

Mycelium panel

Ill. 94

LIFE CYCLE ASSESMENT

Product catalogue

Interior cladding	Plywood	Eelgrass	Clay Plaster	Mycelium
Thermal conductivity W/mK	0.16	0.037	0.8	0.05
Lifetime years	100	40	60	30
Sum of GWP of 1 m^2 $kgCO_2$-eq	1.728	5.078	0.287	x
Transportation km	45	283	190	1319
Atmosphere and characteristics	Warm atmosphere, inexpensive, easy to install, sound absorbing properties, fire resistant	Raw and ecological atmosphere, acoustic absorbent, fire resistant, easy to install	Textured finish, variety of colours, great properties regulating relative humidity, absorbs acoustics and toxins	Decorative, variety of shapes, unique natural patterns, easy to install, sound absorbing qualities, fire-resistant properties

Note: It is possible to manufacture mycelium panels yourself and save energy on transport

Eelgrass

Straw

Wood fiber

Hemp

III. 95

LIFE CYCLE ASSESMENT

Product catalogue

Insulation	Eelgrass	Straw	Wood fiber	Hemp
Thermal conductivity W/ mK	0.037	0.049	0.038	0.04
Lifetime years	50+	50+	50+	50+
Sum of GWP of 1 m^2 $kgCO_2$-eq	x	2.800	5.434	x
Transportation km	56	67	103	500
Characteristics	High insulation value, absorb and release moisture, mold -, fire- and decay resistance, non-toxic, light-weight and easy to install	Good thermal insulation proper-ties, fire-resistant, vapour-perme-able, lightweight and easy to install, cost effective	Great insulation properties, fire-re-sistant, hygros-copic, lightweight and easy to install	Good insulation value, fire-resistant, diffusion open, moisture regula-ting, VUC free, lightweight and easy to install

Note: because of lack of data on new biogenic materials it wasn't possible to calculate the sum of GWP for eelgrass and hemp. How-ever considering eelgrass stores CO_2 and the eelgrass is harvested from the water, washed, dried and fitted into the walls, the sum of GWP would be very low as there are no processing of the matieral. Hemp is very effective in storing CO_2 why hemp would also have a low GWP. Opposite eelgrass, hemp has to be processed into batts before it is suitable for building material.

CONSTRUCTION PRINCIPLES

Hempcrete blocks

Ill. 96

Hemp blocks
Hemp blocks provide insulation and aren't load bearing, why they are typically paired with a timber frame construction. Hemp blocks compensate for the lightweight constructions low thermal inertia as they ensure a vapor permeable construction, storing and redistributing heat during temperature variations, controlling humidity. Furthermore, hemp blocks are fire resistant, and provide acoustic and thermal insulation. Another advantage is that hemp blocks can be used directly as backing for plasters (IsoHemp S.A., nd.).

Chosen construction - interior walls

Timber frame construction

Ill. 97

Timber frame construction
Timber frames are well-known and well-used in projects as they are easy, light, and fast to erect. Insulation is fitted between the structural studs and allow for a free choice of insulation (Edmondson, 2023).

Wood casettes

Ill. 98

Cassettes
The wooden cassettes are made from a sustainable wooden plate material such as plywood, which are cut into sub elements, and then assembled into cassettes with mechanical assembly principles as bolts and screws. Upon assembly of the construction insulation can be blown into the cassettes, ensuring that the cassettes are light during construction making the system easy to work with as it demands for no heavy construction elements, as well as the assembly technique demands for no use of cranes and heavy equipment. The assembly of the construction reminds a lot of building with LEGO. Another advantage to the system is that it is possible to disassemble thereby making it reusable and fit for a circular economy (Agdrup et al., 2016) .

Chosen construction - external walls

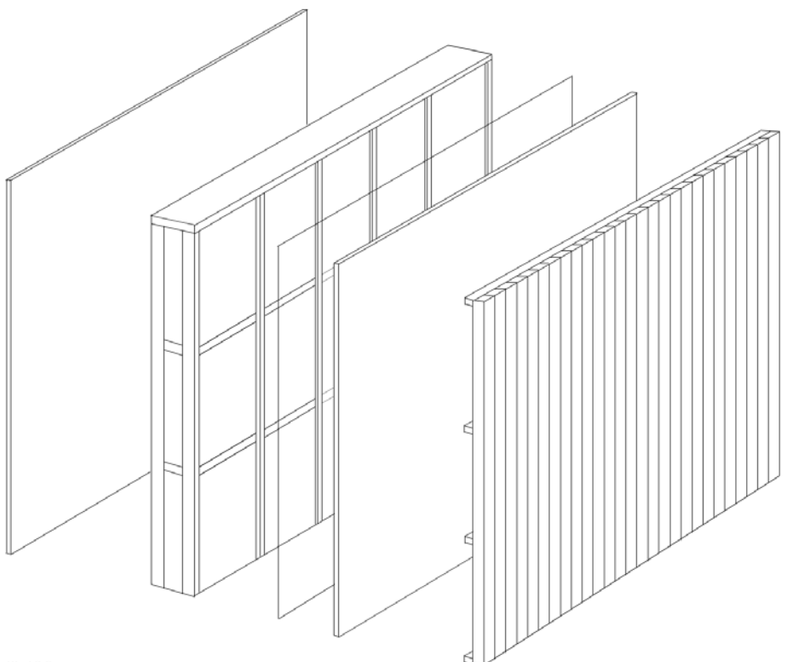
EcoCocon timber-straw elements

Ill. 99

Timber-straw elements
The system is a modular system of 98% natural and renewable elements, consisting of 10% timber and 89% straw which both sequester and store large amounts of CO2 during their lifetime. Thereby, the construction has a positive climate impact. The system provides acoustic comfort and are vapor permeable allowing excess humidity to escape.

Straw has an unique cell structure making it great for insulation, which is why it has been used in construction for thousands of years. With modern technology EcoCocon has managed to improve straws already great properties to achieve outstanding insulation properties in their timber-straw elements. Furthermore, the system is designed to use as little wood as possible - just enough to ensure it is loadbearing. A great advantage is that the system provides simple and rapid installation on site. (EcoCocon s.r.o., nd.)

WALL CONSTRUCTION



Ill. 100

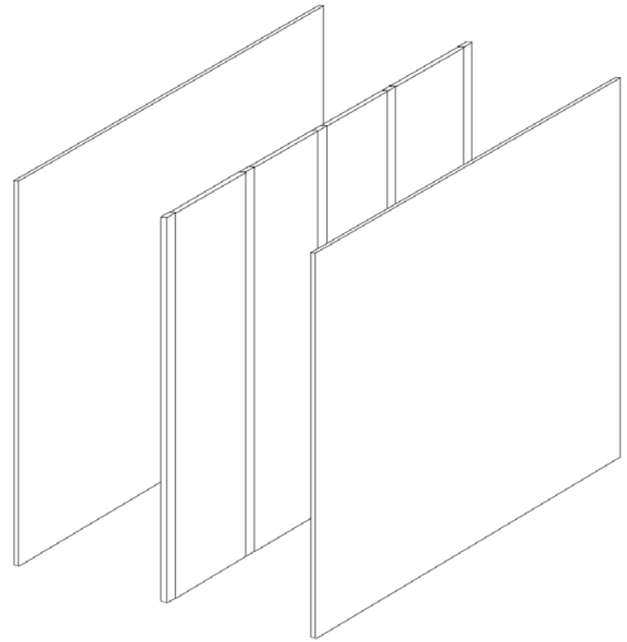
The external wall construction consists of
A ventilated wooden facade cladding, where a gap between the perimeter wall and exterior cladding offers many advantages in improving the buildings durability, energy savings and acoustic insulation.

A wood fiber board of 60 mm to offer extra layer of insulation, which also ensures against any potential damages to the facade won't impact the load-bearing structure of straw panels.

An airtight breathable membrane with a sd value less than 0,2 m, which is water resistant but vapour permeable, thereby allowing excess humnidity to escape, ensuring the construction against condensation and mold formation.

An Ecococon timber straw panel.

Interior cladding.



Ill. 101

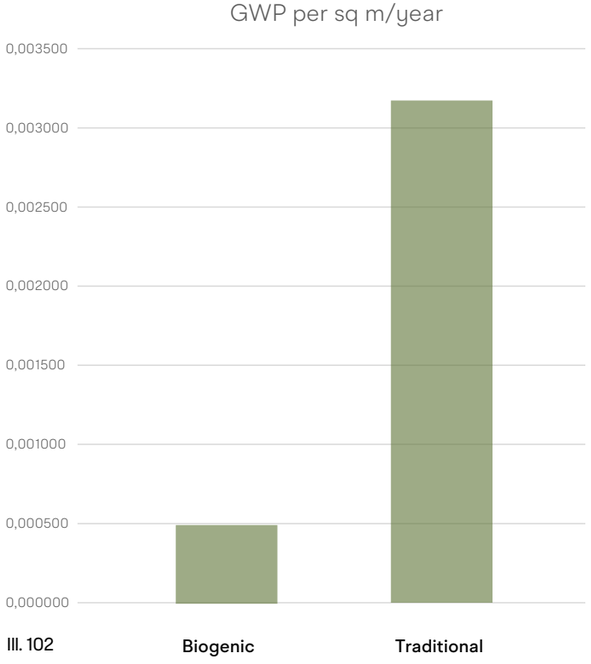
The inner walls consists of
Plywood panels as cladding.

Timber studs.

Eelgrass as insulation.

LIFE CYCLE ASSESMENT

of 1m^2 wall structure



III. 102

The external wall construction of biogenic building materials is compared to a wall construction of traditional building materials, which are often used for church archicture, to compare the total GWP of each wall construction.

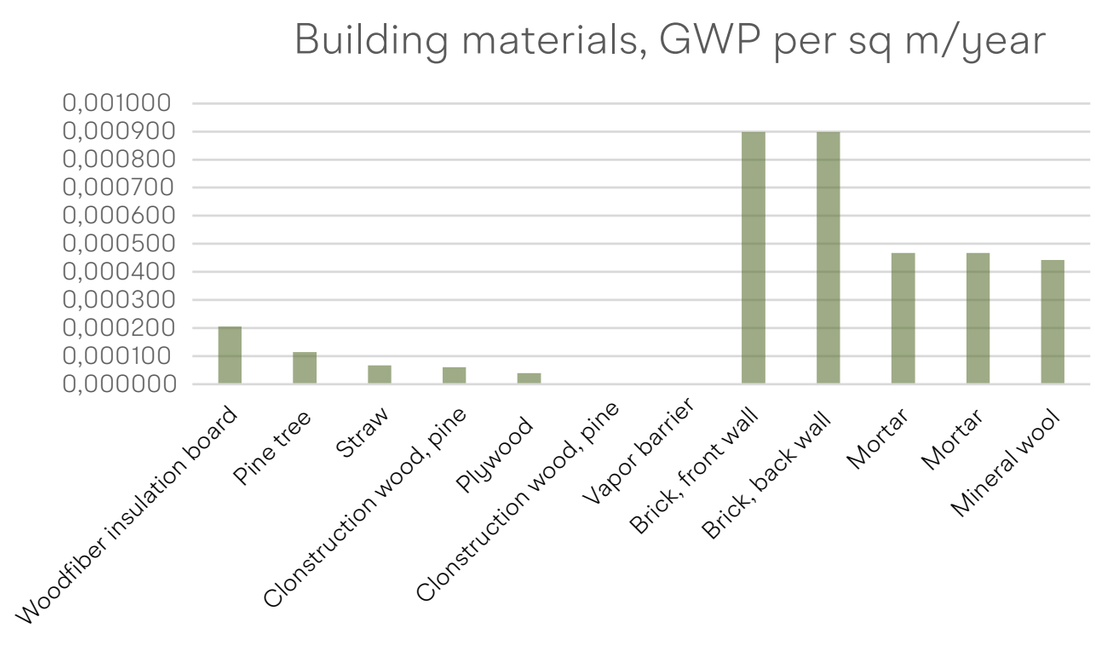
The traditional wall construction consists of an internal and external layer of bricks, mortar and a layer of mineral wool for insulation.

The graph shows the total GWP pr sq m/year for each of the wall constructions

Total GWP for the biogenic wall construction
0.00049 kg CO_2-eq/sq m/year

Total GWP for the wall of traditional building materials
0.00317 kg CO_2-eq/sq m/year

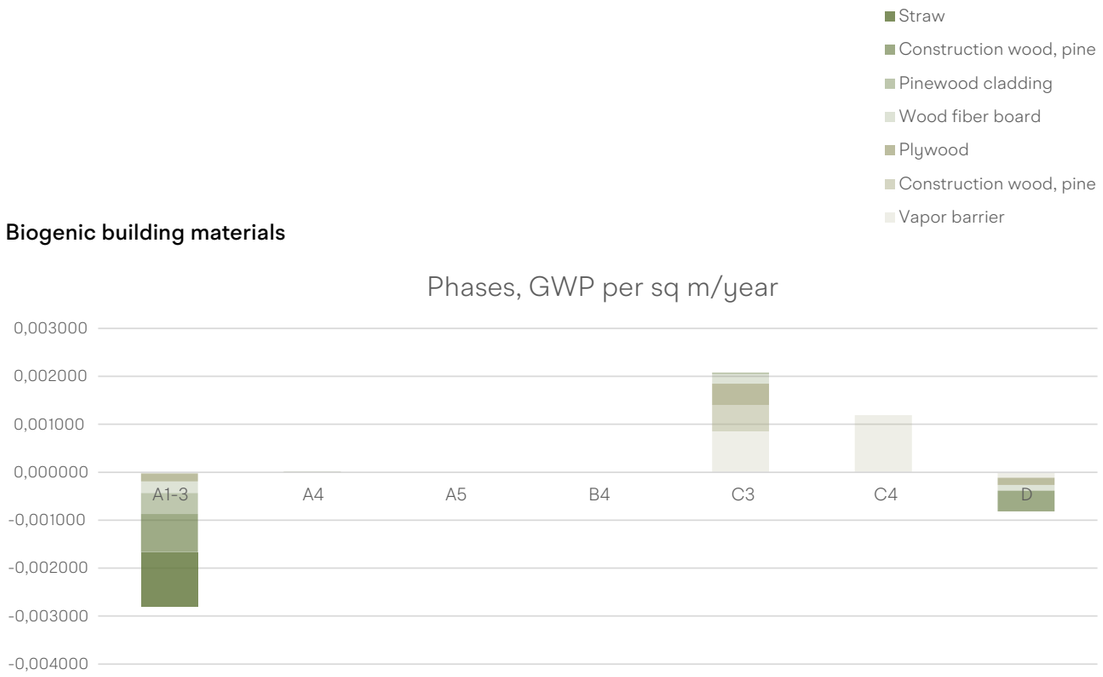
The graph depitcs the building materials used for each construction and the GWP embedded in each building material. From the graph it becomes clear that the building materials used for the traditional wall construction have a greater emmision than the biogenic building materials, and by choosing biogenic building materials instead of traditional building materials it is possible to erect buildings which are more considerate of the climate.



III. 103

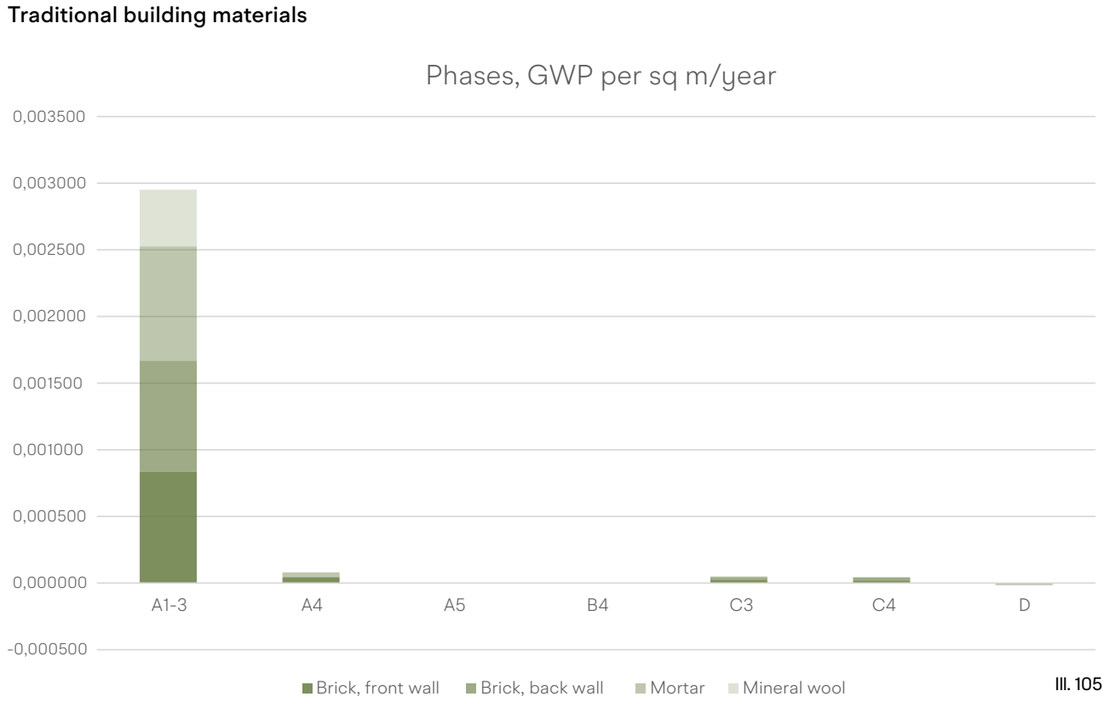
LIFE CYCLE ASSESMENT

of 1m^2 wall structure



III. 104

The graph shows all life cycle phases for the building materials from manufacturing of the materials to disposal. The graph shows in which phases each material have an impact on the total GWP. Phase A1-A3, which is the manufactoring of the materials are negative, as biogenic materials store CO_2. In phase C3 and C4, which is disposal, the possibilty for recycling isn't considered. All materials used in the biogenic wall construction are cradle to cradle certified - the materials are either compostable, recycable or reuseable. Phase D - which is the potential outside the project, it is shown that there is potential for earnings.



III. 105

The graph shows that the phase with the highest impact on the total GWP for the traditonal building materials is the manufactoring of the materials, as a lot of energy is used to burn the clay in order to make bricks. Furthermore, it shows that there are little to no potential of recycling the materials.

Exterior expression

Facade study

Different facade expressions have been tested through collages to achieve a greater understanding of the aesthetical outcome of different cladding materials and combinations hereof.

Wooden cladding

Wooden cladding and roofing gives an uniform facade expression and makes the building seem as one element. The vertical installation of the boards adds to the illusion of height and visually elongate the building. Furthermore, vertically installed cladding has great properties regarding protection against wind and rainwater.

Ill. 106

Wooden cladding and thatched reed roof

Thatched reed roof and wooden cladding on the facades results in a facade expression, where facade and roof are seperated by not only the material and texture hereof, but also the volume which follows with a thatched roof. The combination hereof results in a ecological architecural expression fitting to the scenic surroundings.

Ill. 107

Thatched reed

Thatched reed facade and roof is another way to achieve the uniform look. Thatch gives an unique and textured look to the building. Thatch draws on old building techniques and practice, however with the uniform look with both thatched roof and facade it results in a ecological yet modern architectural expression. Thatch uses low cost vegetation and can be found locally. The layering of the vegetation protects and shed away water from the inner roof. Futhermore it has great potential to reduce CO_2 emisson, but the use hereof has been decreased because of the fear of fire hazards. However new experiments show that coating the thatched reed with clay effectively protects from the spread of fire.

Ill. 108

Eelgrass

Eelgrass facade and roofing provides an uniform and raw ecological expression. Eelgrass roofing draws on old traditions, but with new techniques it is possible to apply the material as roofing and cladding in new ways, for example as soft pillow cladding. Eelgrass has many great benefits such as it is rot and fire resistant.

Ill. 109

Chosen combination

Wooden cladding and eelgrass roof

Wooden cladding and eelgrass roof much like the combination of reed and wood seperates the facade from the roof in both texture and volume.

Ill. 110

Mycelium and wooden roofing

Mycelium panels and wooden roofing creates a dynamic facade expression, where the patterns and shift in colours of the mycelium cladding adds an interesting and playful element to the facade. Mycelium as an outdoor cladding material regarding durability is still in its experimental stages.

Ill. 111

FACADES - South facade

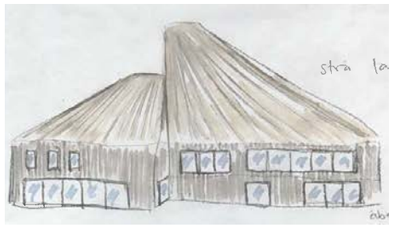
Windows and coherence

Ill. 112

Tall narrow windows distinguishes the church from the rest of the building making it easy to decode the building and the placement of its functions from outside.

Ill. 113

With less of the narrow windows in the church a greater coherence with the rythm of the windows in the rest of the building is achieved. However less daylight will be allowed to enter.

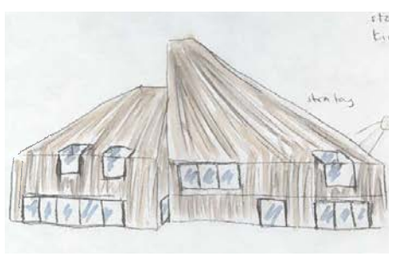


Ill. 114

Big windows connect the church to nature and allows view to the sceneric outside. A great coherence in the facade is achieved as all windows are of same dimension.

Ill. 115

Another way to make the church distingiush itself from outside, is with no windows, having a closed off facade and instead have skylights.



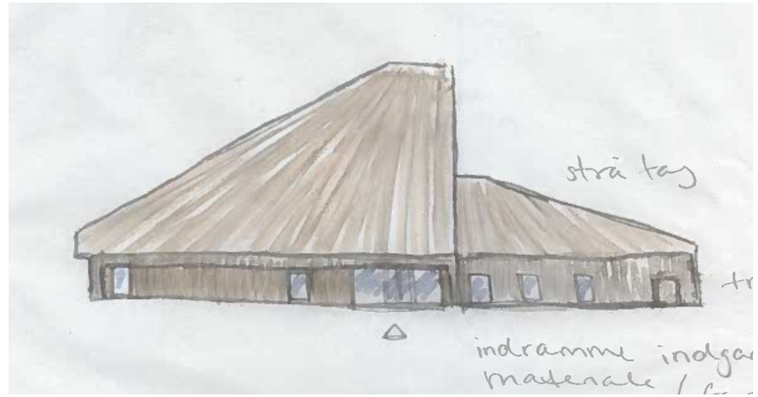
Ill. 116

To create a smooth transition from facade to roof windows in the facade can continue into a skylight. This demands for the facade cladding and roof to align.

The choice of windows will be determined from daylight simulations along with considerations of the aesthetic of the facade.

North facade

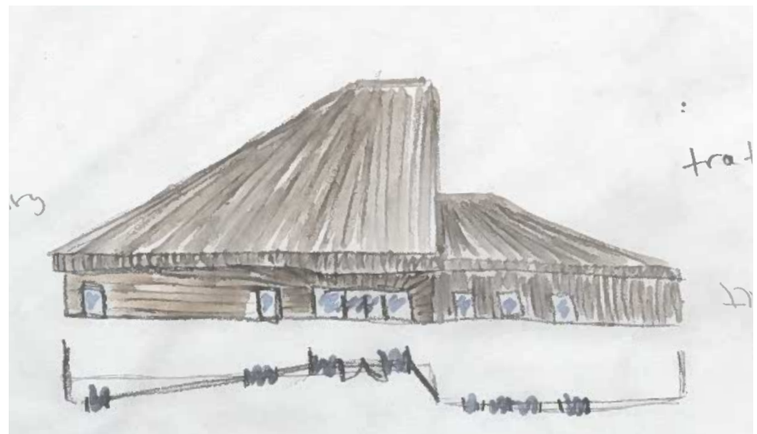
An inviting entrance



Ill. 117

A change in material can help frame and accentuate the entrance, differenting it from the rest of the facade.

Chosen entrance



Ill. 118

A soft angled displacement leads you to the entrance. As well as a change in material or shift in orientation of cladding frame the entrance.

Details

To break up the tall facade different iterations of how to do so was tested.

First iteration was a horizontal board which marked the floor seperation.

Ill. 119

Second iteration was to offset the lower level - accentuating the floor seperation by pushing the lower level in.

Ill. 120

Chosen detail

The third iteration was not only to push the lower floor in but also differentiate and accentuate he floor seperation in the choice of cladding. The baords are wider on the lower level, whereas the boards are slim on the upper level.

Ill. 121

DURABILITY

Ill. 122 / Mock-up model of roof construction (Photographer: Lise Hornehøj, KADK).

Measures to extend lifetime of biogenic materials

To prolong the lifetime of the chosen biogenic materials several actions have been applied. Kebony, which is a high quality wooden cladding has been chosen for the facades because of its hardwood properties, thanks to a modification process with biogenic fluid that permanently changes the wood cell walls.

An overhang protects the facade from sun, rain, wind and weather. Furthermore, to protect the wooden cladding against rainwater and reduce the risk of it wetting the cladding is terminated 200 mm above the ground.

The roof construction consists of a base of reed and an outer layer of eelgrass, as eelgrass as a roofmaterial would have great weaknesses as it doesnt have constructive properties. By combining reed and eelgrass the two materials compensate each others weaknesses, as reed is fire-resistant and rot resistant where reed is easy to set fire and vulnerable to algaes.

However reed has great constructive properties and are water repellent, which are qualities eelgrass lack. By combining the two materials it is possible to prolong the lifetime of the roof greatly. Normally a thatched reed roof would have a lifetime of 50 years but by applying a layer of eelgrass the lifetime of the roof could be 2-300 years (Hornehøj, 2017).

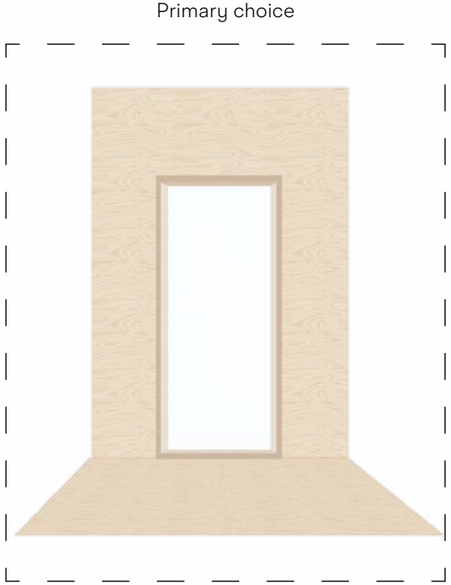
The angle of the roof is also an important factor in prolonging the lifetime of the roof construction. The steeper the angle, the longer the lifetime. The angle should always be above 45 degrees. Therefore it is aimed to have an angle of the roof of 45 degrees or above at all places, however the design of the roof doesn't meet these wishes at all places.

Interior materiality

Material composition

The materials which are applied to the interior contributes to how a room is experienced, therefore the composition of different materials have been studied through collages to investigate what atmosphere they provide.

Primary choice



Plywood

Plywood panels provide a warm, colorful and welcoming atmosphere. With perforated acoustic plywood panels, a good acoustic can be obtained as well as it is possible to create an interesting pattern with the panels. Furthermore, plywood is easy to work with, repair, is inexpensive and reusable. If plywood is applied to both walls, ceilings, and floor the impression of a room can become a bit monotonous.

Ill. 123

Clay plaster

Clay plaster provides a textured raw wall finish. Clay plaster can be colored in several different colors and nuances, where white and light colors can help reflect light inside a room. With clay plaster it is possible to create unique effects and apply patterns to a wall. Furthermore, clay plaster has many great properties, as it is capable of absorbing toxins, odors and sound, as well as it has properties in regulating the relative humidity, thereby ensuring a healthy indoor climate (SURFACED AS, n.d.).

Ill. 124

Eelgrass

Eelgrass panels creates an ecological and raw atmosphere and imbue the interior with warmth. It is rich in tactility, and stimulates the senses. Furthermore, eelgrass panels has great properties providing acoustic comfort, effective humidity regulation and fire-resistance. Eelgrass is CO_2-storing and recycable (Søuld, n.d.).

Ill. 125

Mycelium

Mycelium panels can vary in colours and patterns, creating an intriguing and decorative wall element. One of myceliums great advantages is its great sound-absorbing properties, futhermore mycelium are fast growing, cheap to produce and sequester carbon. Mycelium has a delicate surface and should be handled with great care in order to ensure long lasting durabilty. Furthermore mycelium should only be applied in living environments as mycelium is subject to change from excessive moisture (Mogu S.r.l., n.d.).

Ill. 126

ACOUSTICS

The acoustics of a room is measured by different approaches, in this project the EDT, T30/T20 and D50 are being used.

EDT is a shortage for Early Decay Time, which is the time it takes for the sound to drop by 10 decibel x 6. The EDT is usually associated with how the reverberation in a room is perceived, which is an important acoustic parameter regarding the perception of the church room, as described earlier.

T30 is used to measure the reverberation time by calculating the time it takes the sound to drop 30 decibel x 2 after the drop of the first 5 decibel.

D50 is also called clarity, as it is the ratio of the early received sound energy (in the first 50 ms) to the total received energy. The early sound energy is good for the clarity, while the later sound energies are making the sound muddier.

Different spaces have varying conditions and uses, which means that simulations are done for an office, the lounge/foyer area, the church, and the big assembly.

The acoustic program that is used for the calculations also have audiolizer, which makes it possible to listen to the acoustic instead of only looking through charts. This feature is also used when selecting materials and/or geometry of the rooms but isn't presented in the rapport.

The acoustics are mostly changed by the materials in these simulations, as the tool is used later in the design process, but in some rooms, it also have an impact on the geometry.

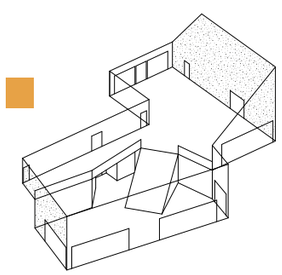
Lounge/foyer

The Lounge/foyer needs a reberveration time that is comfortable for both conversation and music, as it is a multi-functional room.

The floor, window, door and inventory is the same at the different simulations.

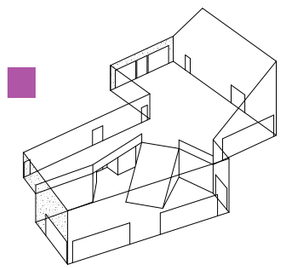
The ceiling is perforated, and the perforated walls are illustrated.

Ill. 127



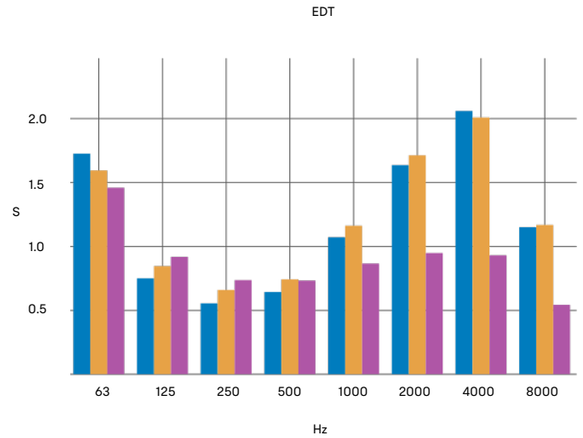
The ceiling is perforated, and the perforated walls are illustrated.

Ill. 128

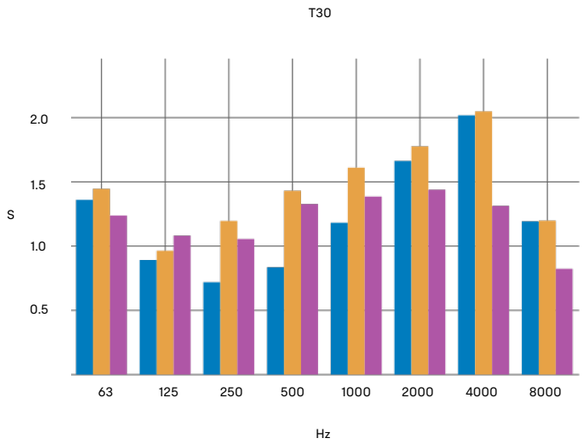


The ceiling is with another perforation pattern and the perforated walls are illustrated.

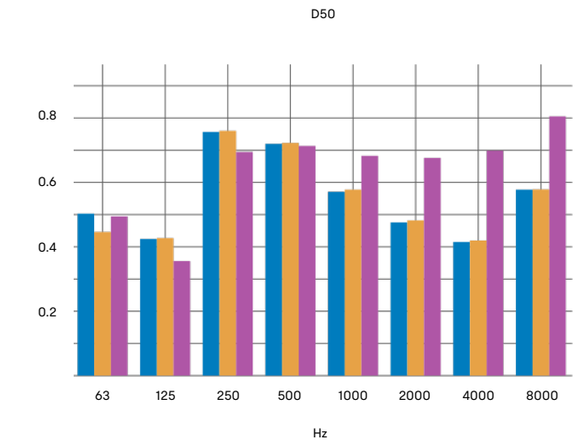
Ill. 129



Ill. 130



Ill. 131



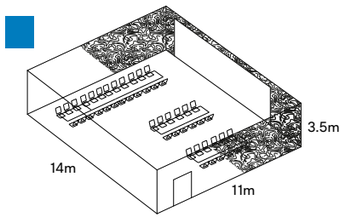
Ill. 132

The D50 results isn't good at any of the rooms, and the EDT results is alright, but also quite similar between the rooms. Both the yellow and purple room is quite good at lower frequencies. The purple is chosen as it have more consistent reberveration time across the spectre. A reberveration time of 1.2 is usually quite good in multipurpose rooms.

Assembly

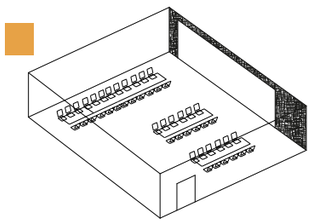
The assembly needs a reberveration time that is mostly good for conversation, but which also acommondate smaller musical performances.

The floor, window, door and inventory is the same at the different simulations.



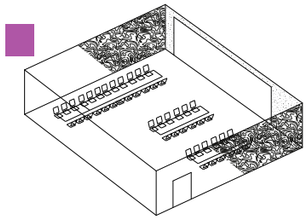
The ceiling is made of eelgrass absorbant and the north and part of the east and west wall are a thinlayer of plywood, while the rest of the walls are smooth concrete.

III. 133



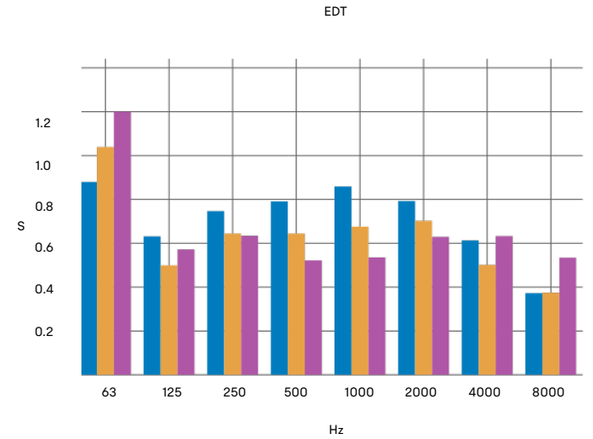
The ceiling remain the same as in the blue model, while the northen wall is covered by ealgrass absorbant, the rest of the wall is made by smooth concrete.

III. 134

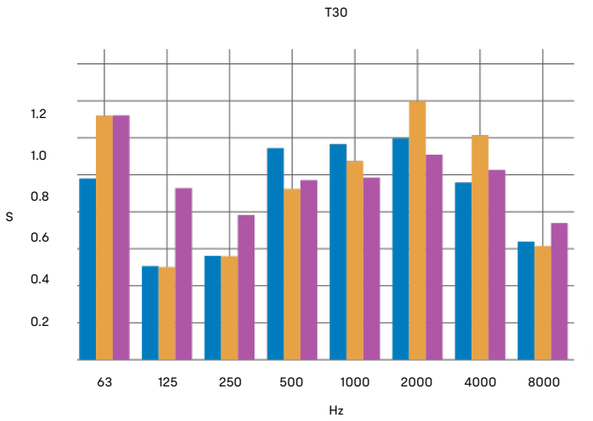


The ceiling material is changed in thickness, as well as the northern wall that is covered in perforated plywood.

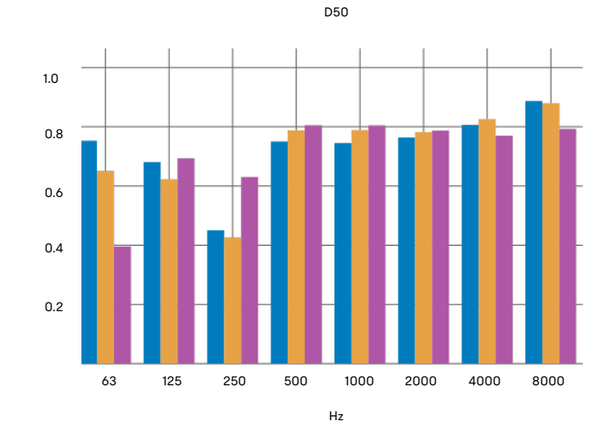
III. 135



III. 136



III. 137



III. 138

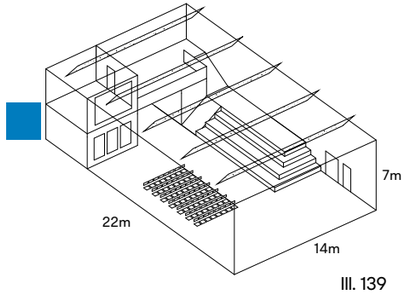
The purple room have the overall best reverberation time and D50 results. The difference in the northern wall between the blue and purple room, is making a major difference, as the plywood absorbs low frequencies better than the perforated material, while the perforated material is better at absorbing the high frequencies. The purple room is chosen for the final design.

Church

The concept is to have two reverberation times, one that provides clear speech and one that supports music.

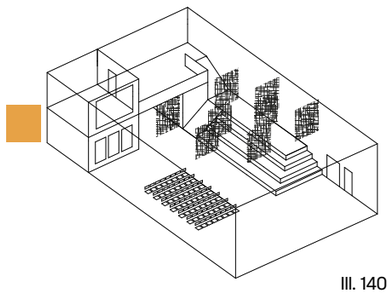
To accommodate two different acoustic qualities, three different acoustic principles for a ceiling have been compared.

In this simulation two sources of sound is placed in the church. One simulates the sermon of the priest, and one simulates the music from the opposite direction.



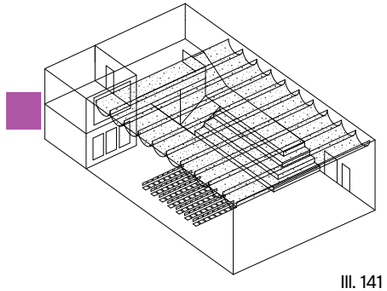
Ill. 139

The first principle is a ceiling that is directed towards east aborbing the low frequences coming from the altar, while reflecting sound from the organ towards the ceiling.



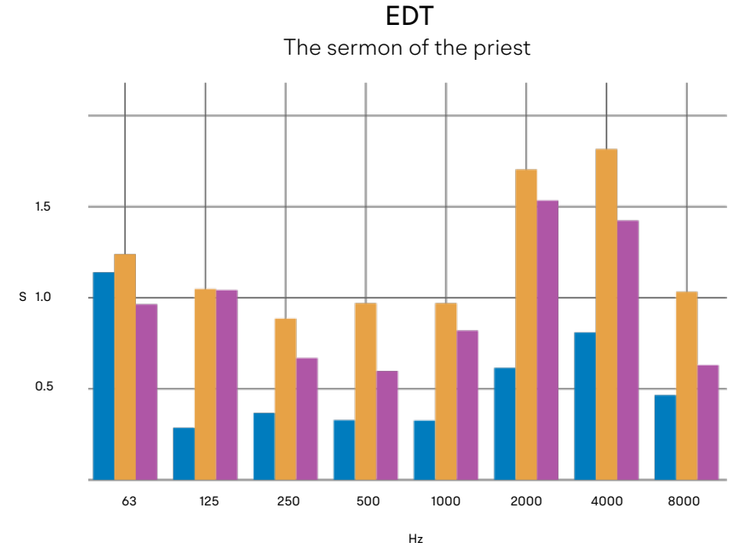
Ill. 140

The second principle are big curtains hanging from the ceiling absorbing sound from both directions, but making use of the different angles the sound is coming from.

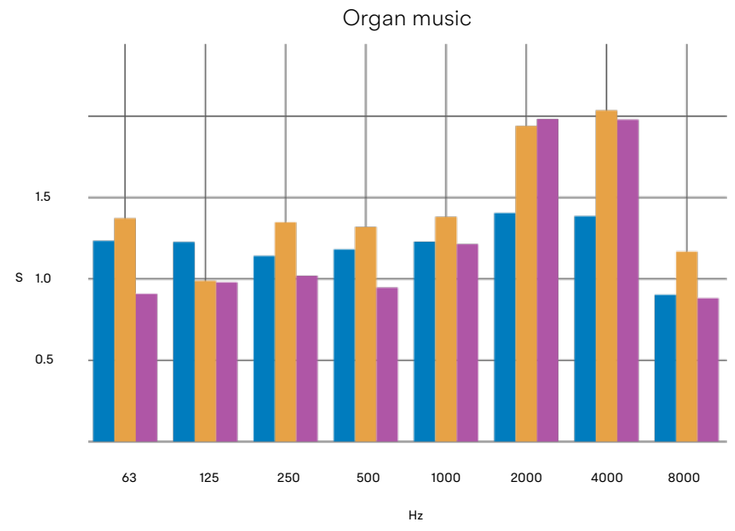


Ill. 141

The third principle is a curvy ceiling that reflect the sound in different directions. The difference in sound is made as the angle of the sources differences.

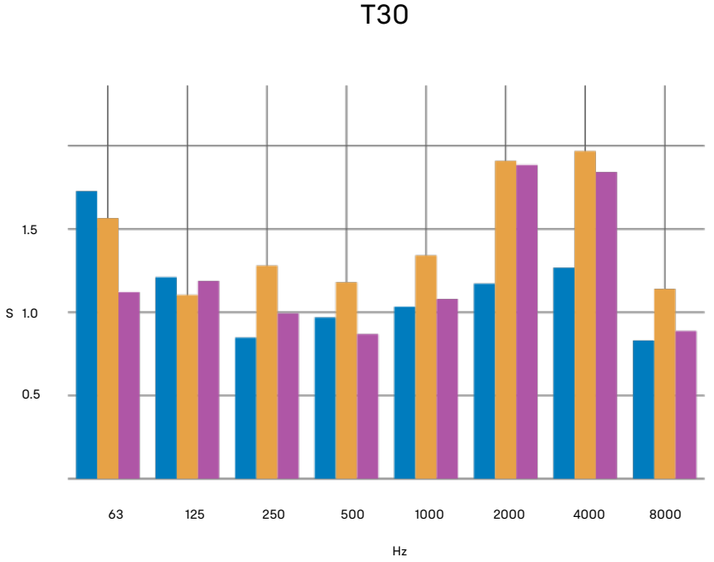


Ill. 142

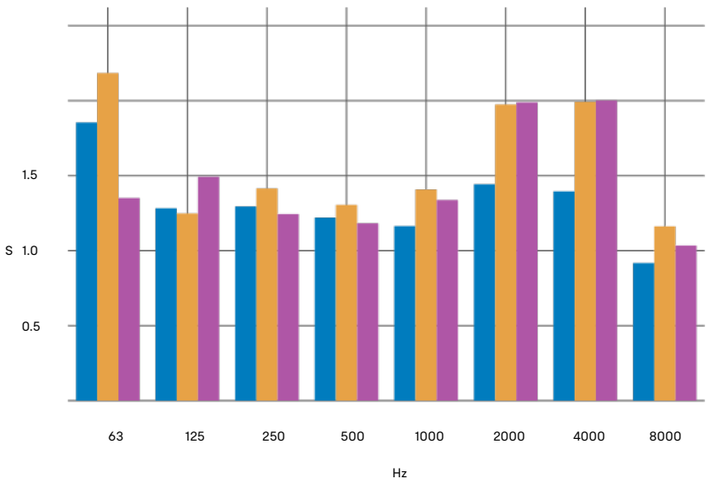


Ill. 143

The early decay time in situation 1 and 2 varies much in the blue room, while it is much more consistent in the two other solutions. The EDT is very important in how the church is perceived, while it doesn't reach the same reverberation times as old churches, the difference is noteable.



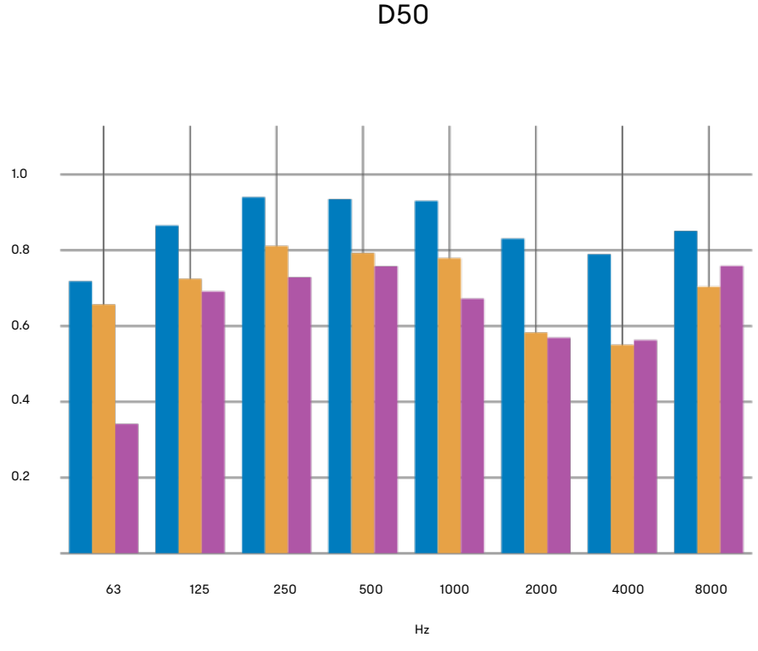
Ill. 144



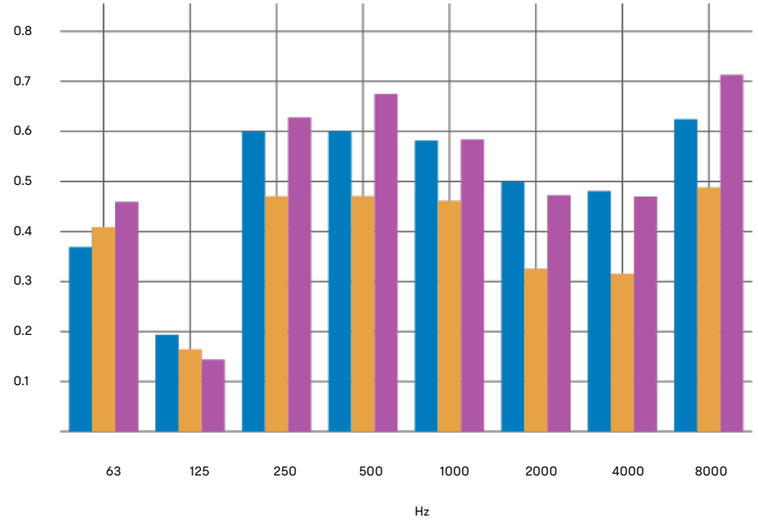
Ill. 145

The T30 decay time shows that the yellow solution doesn't vary much between the two orientations, which could be expected as the solution works in both direction, it's is purely the height difference from the sound sources that makes the difference.

The purple and blue solution are quite similar, where the purple solution is probably a tiny bit better, even through it may miss a bit of bass.



Ill. 146



Ill. 147

The blue room is clearly better from the first source, while yellow is better from the second source. The clarity chart shows that spech is clear when talking from the altar towards the entrance in all cases, as 0.7 should be quite good.

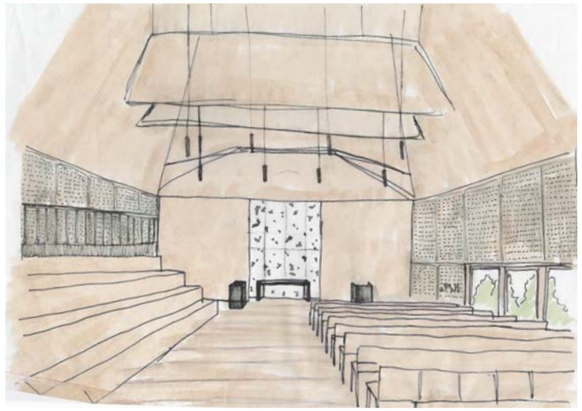
The blue solution is the one chosen from it's acoustics attributes.

CONCLUSION ON ACOUSTICS

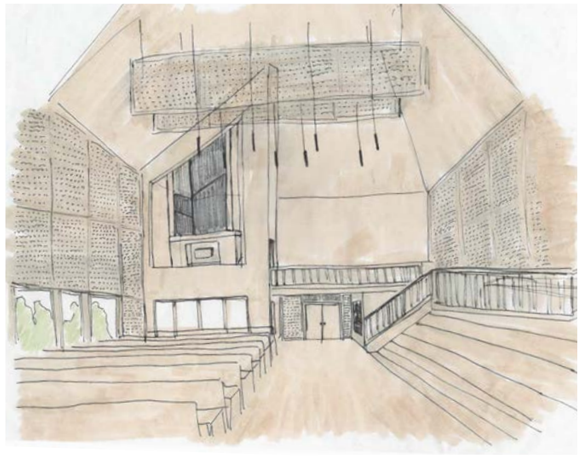
The simulations just showcased isn't a hundred percent accurate representation of the final design, as other things also need to be considered when designing a room. The simulations work as guidelines and the overall idea is that the final designs reverberations times should be close to the one found in the simulations.

The simulations were made while other part of the design process was researched like the construction. This means that the models that were used to run models upon may have changed slightly.

The simulations shown in the design process is only a fraction of all the simulations that have been made. The church room has had a lot of simulations to determine the materials and not just the form, but that process is already showcased in the other simulations that have been made.



Perforated walls and loft panels
Ill. 148



Ill. 149

DETAILING - ACOUSTIC CEILING AND WALLS

Conclusions from the acoustic simulations concluded that the acoustic loft inside the church would function best after the intention with panels which are angled towards east, absorbing the low frequences coming from the alter with a perofo-rated surface, while reflecting sound from the organ towards the ceiling. Thereby making the church perform great in two reverberation times, accomodating both speech and music. Futhermore, it was concluded that several walls should be perforated.

To detail the acoustic loft further, different iterations of the placement of the acoustic panels was tested, to see how it would affect the impression of the church.

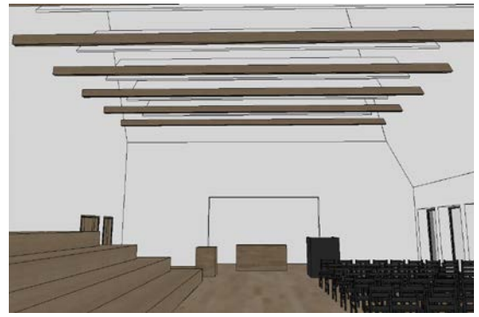
Ill. 150

Ill. 151

If the acoustic panels are flushed with the bottom of the beams the acoustic loft becomes a 'heavy' element which is percieved oppressive.

Chosen placement

Ill. 152



Ill. 153

By raising the panels slightly above the beams a rythm of alternating beams and plates are achieved. As well as the panels aren't percieved as, as heavy an element.

DAYLIGHT

Choregraphed light

A wish to use light and stage it to different church activities initiated an investigation of how light intake could support church activities such as a funeral. Often funerals are held around 13 - 14 o'clock pm. The coffin are placed in the middle og the aisle in front of the alter. With the light intake it was wished to create a light collumn which would frame and illuminate the coffin, creating a peaceful and elysian vision when the relatives are saying their final goodbye to the deceased.

However with simulations of the light intake it quickly became clear that the choregraphed light only would be possible to achieve in a specific time a year.

March 13 pm

Ill. 154

June 13 pm

Ill. 155

Effect light

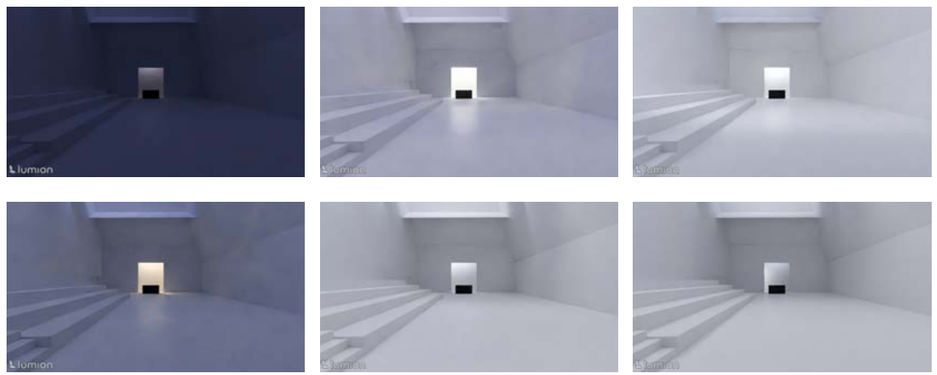
2x1,5 window area

Month December March June

Clock

10 am

12 pm



Ill. 156

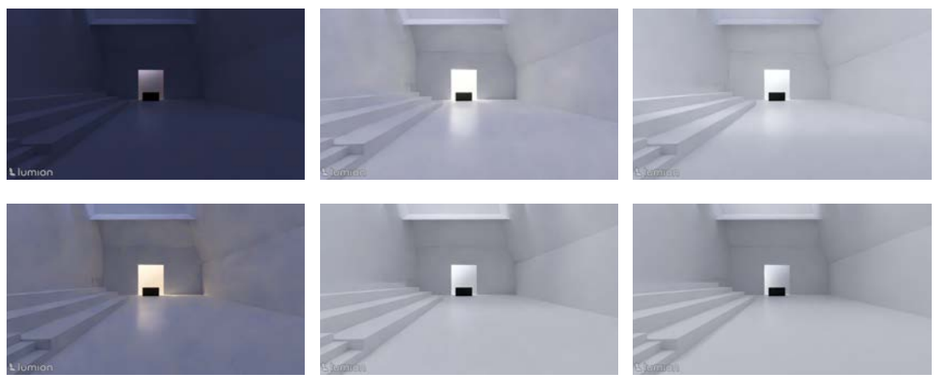
2x1,5x2 window area

Month December March June

Clock

10 am

12 pm



Ill. 157

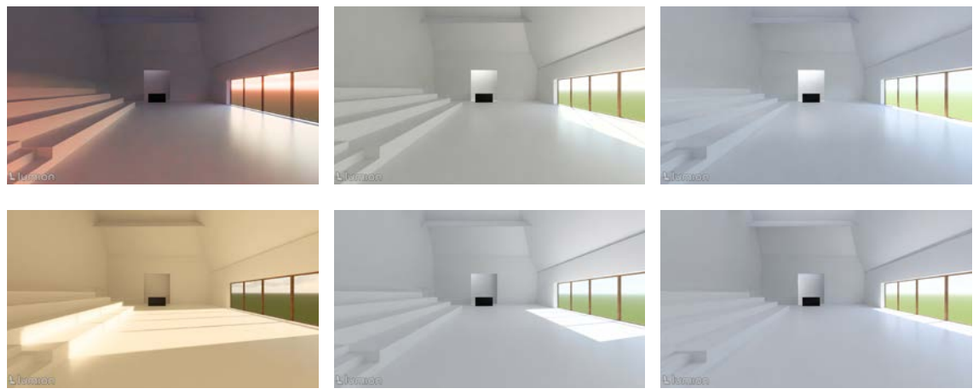
To enhance a spiritual experience and draw on symbolism to Christianity it was wished to accentuate and put focus on the alter. This was done by creating contrast between light and shadow, inserting a partition wall, which cuts of the back wall from the rest of the room, so that it would not get the same daylight as the rest of the room. By inserting a sky-light the backwall behind the alter is illuminated and draw on the symbolism of the divine. The daylight simulations are completed at 10 am and 13 pm as this is where services and church actvities as weddings and funerals are held, and therefore the time slots where the effect of a lit up alter is especially wished for.

Big windows with view to the outside with an overhang of 0,7m

December March June

10 am

12 pm



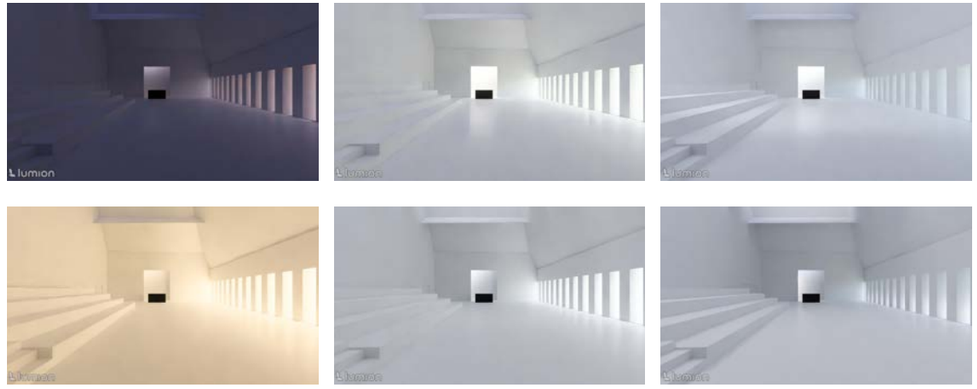
Ill. 158

Window row with 45° angle

December March June

10 am

12 pm



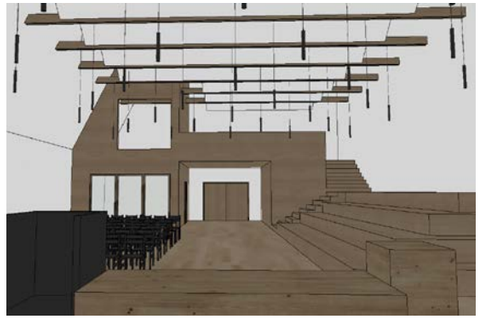
Ill. 159

Different iterations of the windows in the south facade was tested to see what effect it would have on the room. The first iteration had big windows which allowed for a great view to the outside connecting the church to the surrounding nature. However the big windows can result in causing issues with glare as well as it takes away from the effect of the lit up back wall, as too much light are let in to have a big contrast in shadow and light.

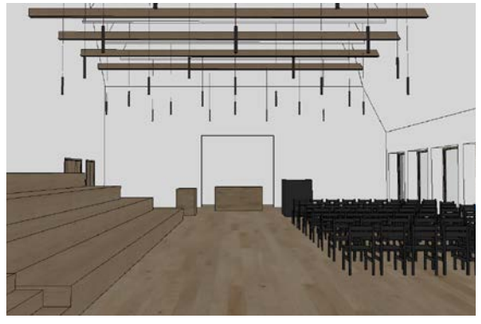
The second iteration are tall more narrow windows which are rotated 45°. The windows let in an adeqaute amount of daylight but doesn't steal focus from the alter, as well as there are no risk of glare.

DETAILING - LIGHTING

Small pendants create a sky of lights, supporting the heavenly aspect of the church.
Different iterations of the pendants was tested to see what expression they would add to the church.



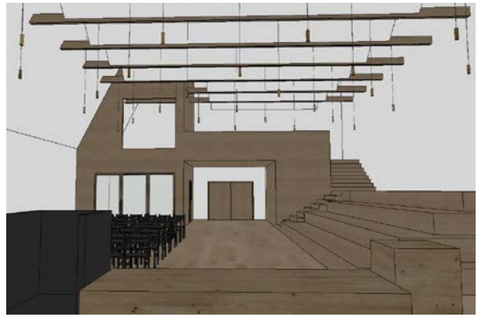
Ill. 160



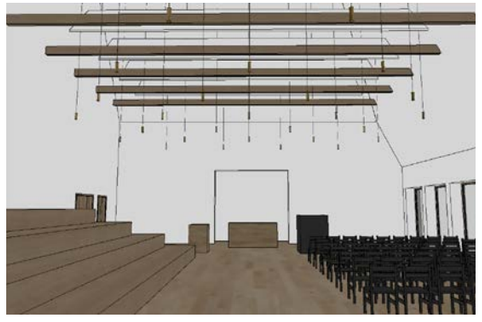
Ill. 161

As a lot is already happening in the loft, the long narrow pendants take a lot of focus and add a disrupting element.

Chosen lighting



Ill. 162



Ill. 163

The smaller pendants are more sensitive to the already busy loft and gives an illusion of a starry sky.

CHAPTER 08 / EPILOGUE

CONCLUSION

The role of the church in society has changed significantly over the past 1000 years, where it has served as a symbol of power, a sacred space, a practical resource for storage and latest a space to perform religious activities.

In today's Denmark, new churches are still being built as the population grows, which raises the question once again: What role does the church have in todays society - and how do the church take part in relevant discussions of today?

This project has examined how the church can become an example of how to erect environmentally friendly architecture, challenging the traditional building materials that are used for church architecture, and instead using biogenic building materials, while still ensuring great durability. As well as how the church can become a greater part of society, accommodating several functions and different use. Thereby the church become a much more complex building, with character of a community centre.

The church has a lot of history and meaning attached to it, why the church should support and strengthen the spiritual narrative and be a space beyond the ordinary. At the same time, a modern church should be able to be used for activities other than religious ones. Skovlund Kirke creates the framework for a space, where religious, musical, and other everyday activities function in harmony. Skovlund Kirke offers great flexibility in its furnishment whereby it accommodates a broad use and take role as a centre for the local community. This is done with great care, to ensure the spiritual character of a church is not compromised.

To preserve the unique atmosphere of a church, the church room in Skovlund Kirke draw on symbolism, utilising light to enhance a specific atmosphere. Another important aspect has been the acoustics of the church room. The church room has an acoustic loft, which creates different reverberation times in opposite directions, accommodating both clear speech and vibrant organ play.

Great conscious of materials is an important topic in the construction industry, as it accounts for 40% of the total CO_2 emissions in Denmark.

Skovlund Kirke is a project that focuses on the use of biogenic materials and thereby looking at solutions to mitigate and reduce CO_2 emissions in the building industry. Biogenic materials have untapped potential, but the uncertainty surrounding their lifespan compared to concrete and other conventional materials, as well as the cost, often result in them being overlooked. This project has demonstrated some of the great potential in these materials through its constructive solutions that do not compromise aesthetics. Skovlund Kirke positions itself in the Danish landscape as a platform for innovative church architecture using biogenic materials and as an example of an inclusive modern church.

... *AND REFLECTION.*

This thesis has focused on two main topics regarding the design of a new church. Firstly, it has considered the role of the church in society and secondly, the choice of materials for construction.

The numerous study trips during the project period have been a great source of inspiration in interpreting the modern church, with Hvinningdal Kirke being a particular good example, as this is the newest built church in Denmark. Additionally, the church room and the design of this was examined to determine if it required a major revision, as the church room hasn't changed or evolved significantly in many centuries.

The form and expression of the church room have ended up being quite traditional. The church is furnished as a processional church, however with the possibility of emptying the room completely and use it for other activities. A tribune is the only element, which is fixed in the interior of the church, as well as it is the only 'foreign' element compared to the layout of a traditional processional church. The tribune offers seating as well as it allows access to the organ and choir, which platform is integrated in the design of the tribune.

The loose furniture is a modern way of furnishing the church, which creates possibility for multiuse. The free arrangement leaves the church an empty canvas, which the church can fill as they desire. This responsibility is relinquished by the architect. We have thus not taken a significant stance on whether church activities should be renewed, and these can still be carried out in the traditional matter, as many church activities are also tradition bound. The question also arises whether it is the architect's job to change the way we attend church?

The technical aspects of acoustics and light has played the most significant role in the design of the church room. Acoustics are corrected not only by choice of material for internal cladding but also through changing the geometry of the room slightly by inserting an acoustic loft. Several churches in the country struggle with long reverberation times, which are great for organ play, however which makes speech unclear due to a lot of echoes, why the use of speakers is necessary to be able to hear the priest's sermon. Therefore, a wish was to create a space that could accommodate both music and speech.

The acoustic loft makes it possible to achieve two different reverberation times in opposite directions. However, a greater distinction between the two was desired, to still have the high reverberation time, which is great for organ play and which also enhances the unique atmosphere of a church, which make people go quiet. Instead, the reverberation time only varies slightly and accommodate a broader spectrum of use, not necessarily enhancing the unique acoustics found in many old churches.

Maybe if, had the investigations with acoustics been completed earlier in the design process, it would have been possible to design a room with an increased difference between the two reverberation times. This would demand for bigger changes and flexibility to the geometry of the church room.

We are not acoustic engineers, so the final design would still require refinement. However, the use of acoustic tools should ensure that the design does not undergo significant changes in appearance. If architects can incorporate the use of simple acoustic simulation software into the design process, it would add a new dimension to creating spaces. The ability to physically listen to sound in a computer-animated space also provides the opportunity to communicate design strategies better to clients, as physical sound is easier to comprehend than diagrams.

Churches are often placed as landmarks in the landscape and build of durable building materials, as churches are built to last and are structures, we aim to maintain. The question of whether this characteristic for a church can be transferred to a church built primarily of biogenic materials was investigated. Skovlund Kirke is situated on top of a hill in scenic surroundings and with its distinctive high roof, it indeed appears as a landmark. The construction of Skovlund Kirke achieves a long lifespan by carefully choosing materials and applying actions to further improve their durability. The construction of the roof has not been seen before in Denmark, as it draws inspiration from Chinese construction practices combined with Danish expertise in materials and execution and should improve the lifespan of the roof with 200-300 years.

However, the roof is also the weakest point of the construction as the design of the roof results in a scotch where water can gather. The design of the roof is an example of a design choice where aesthetics takes precedence over practicality. The strong expression created by the difference in size and separation of the roofs has been prioritized over the overall narrative of a building designed to stand for many years without major repairs. Skovlund Kirke has emerged from a balance, where the possibilities of biogenic materials, the terrain, and wishes to the aesthetic have shaped the final design. The location influences certain aspects of the project, but overall, the project is an attempt to envision how future church architecture can appear, both in terms of material and thought.

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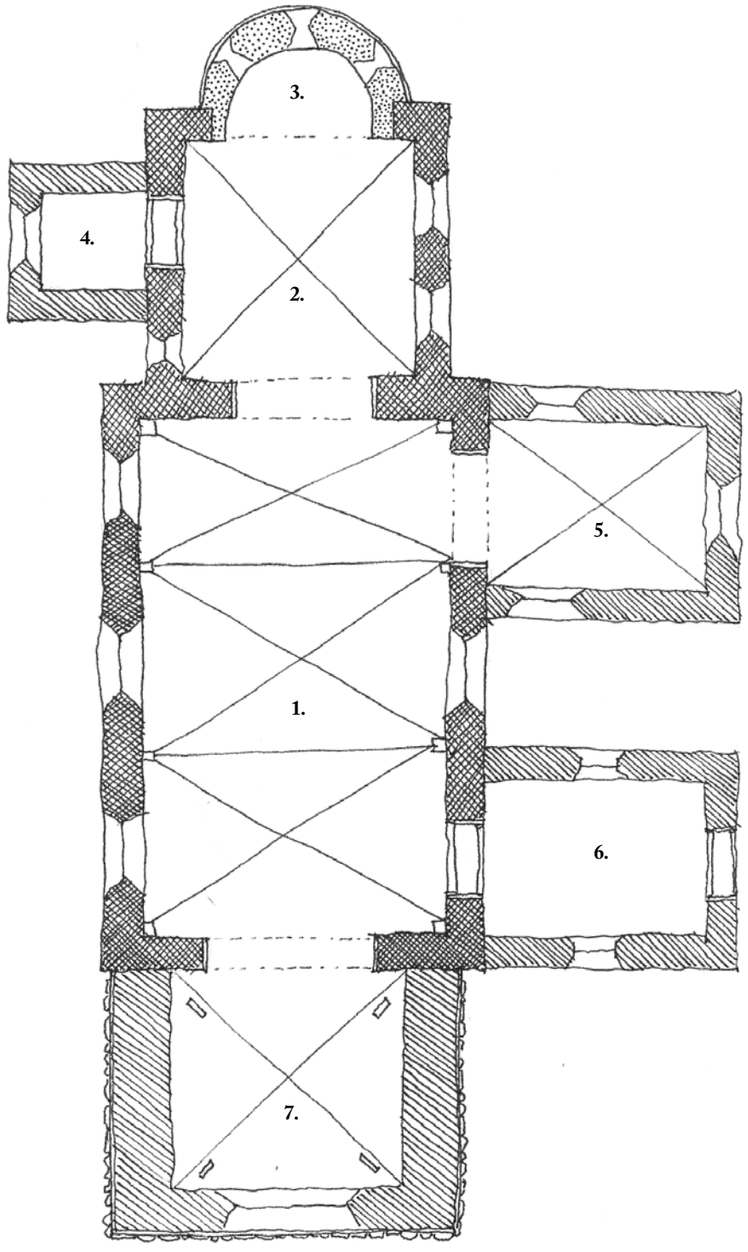
APPENDIX.



1. Nave
2. Chancel
3. Apse
4. Sacristy
5. Chapel/transept
6. Church porch
7. West tower

Terminology

Many different terms and symbols are related to the typology of the church. To create a common understanding the most relevant keywords are explained in the following text.

Zones/rooms

Nave
Is the largest part of the church and is where the congregation is staying during the service. The nave is mostly furnished with built-in benches, and the layout is symmetrical and with a clearly defines direction (most often with east-west orientation) (Bjerre Dalsgaard, 2021, p. 104).

Chancel
Is a part of the church that is connected to the eastern part of the nave. The chancel is clearly separated from the nave, with a difference in level and the access is (in old Danish churches) through a triumphal arch. The nave and the chancel are the two main parts of the church typology, and is often the oldest parts (Bjerre Dalsgaard, 2021, p. 106).

Apse
A semi-circular structure built onto the chancel (Bjerre Dalsgaard, 2021, p. 104).

Sacristy
Is an extension or room in the church where the priest can stay and liturgical elements can be stored (elements used for the service) (Kjær, 2017).

Chapel/transept
Is an extension of the nave, that is often built to create more space for seating or as small chapels to side altars (Bjerre Dalsgaard, 2021, p. 81).

Church porch
Is the main entrance of the church and it is therefore the connection between the church and the world outside. The porch is often furnished with storage, coat hooks and few seats (Bjerre Dalsgaard, 2021, p. 104).

West steeple
Is built onto the church in the west end and is often what we associate with the mediaeval Danish church. In the beginning the church bells were found outside in smaller wooden constructions, but today they are mostly placed inside the west steeple (Bjerre Dalsgaard, 2021, p. 106).

Interior

Lofts
Is a type of balcony constructed in wood with different purposes. It can be an organ loft, or a loft for the noblemen of the parish. These were efficient to make use of the high ceiling, but today it is mostly the organ lofts that has been preserved (Frederiksen, 2022).

Altar
Etymological the meaning of the word is a raised space from where sacrifices can be done. Today we recognize it as a decorated board and a table where the priest is often orientated and where the bible is placed (Smidt Hansen and Damgaard Andersen, 2013).

Pulpit
Is a raised platform often placed to east and where the priest to speak from (Frederiksen, 2022).

Kneeler
Is a low, upholstered construction from where the congregation can receive communion during the service (Frederiksen, 2020).

CASESTUDY

Sct. Clemens Kirke
Inger and Johannes Exner's first church was Sct. Clements Kirke from 1963 in Randers, Denmark, which is the only church of Exners', which doesn't challenge the traditional processional church, and which focus on a beautiful exterior instead of an interior, which accommodate the circumstance-principle. Because of this the Exners' began to question the design of the church themselves during its construction.

The church is a complete yellow-brick construction, placed on a hilltop in beautiful scenery and the external beauty of the church, which resembles a ship, is undeniable. The north-facing façade, which meet the street adapts to the scale of the neighbourhood, where the south park-facing church room raises and distinguishes itself with its prismatic form.

The interior is characterized by the continuous use of the yellow brick, where benches and the knee fall almost seems to grow up from the brick floor. The backdrop of the alter is the tall windows towards south, which offer a beautiful view to the treetops of the park. The light intake from the windows casts a dramatic play between light and shadow when sun hit from the side. However, the tall windows towards the south also cause glare issues when the sun is too bright (Bo Jensen, 2012).

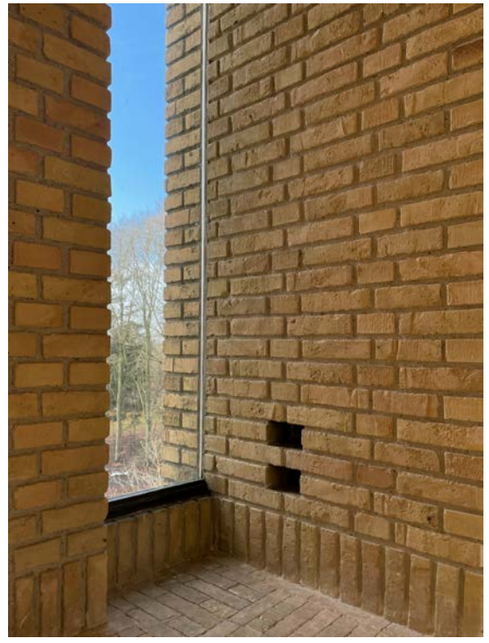
As it is done with Sct. Clements, it is wished to utilise the hilly landscape in Gl. Rye, so the church raises above and are overlooking the city - thereby also providing the residents a view to the church and its distinctive architecture.

SCT. CLEMENS KIRKE

Inger and Johannes Exner

Randers, Denmark

1958 - 1963



CASESTUDY

The Biological house is an innovative and sustainable house, which is designed with circle economy in mind as well as with great conscious of applied materials. The house is constructed of upcycled biogenic waste materials from the agricultural sector, such as straw, eelgrass, and seaweed, which would otherwise have been burned and used for energy production.

The house is constructed of straw fiber boards, which have been cut into elements and assembled into cassettes. The cassettes are assembled using carpentry joints or bolts and screws, which makes it possible to separate the cassettes, thereby ensuring that the elements can be used in other context and are suitable for circuits with closed loops. Besides the straw fiber boards being a sustainable solution, they also have great advantages in relation to creating a healthy environment, as they keep moisture out and don't emit any chemical vapors. Because the biological house is a demonstration house, two different types of biological insulation have been used: eelgrass and wood fiber – one in each wing of the house. Both eelgrass and wood fiber have been blown into the cassettes upon assembling. Eelgrass has many great qualities, which makes it suitable for construction. These include a high insulation value, mold resistance, fire resistance, and decay resistance. Just as eelgrass, wood fiber has great qualities regarding insulation, furthermore, wood fiber isn't heat-conducting and is great for moisture management.

The rest of the construction, roof, roof membrane, facade and interior cladding are also of biogenic materials. All materials which have been used are well thought out, and just as it is done in the biogenic house, it is wished to use primarily biogenic materials in the construction of the church, in order to lower CO2 emission and ensure that the building will have less of a negative impact on the environment. Therefore, great inspiration can be found in the list of materials used in the Biological House in the later design process.

DET BIOLOGISKE HUS

Een til Een, GXN, NCC

Middelfart, Denmark

2016

Det Biologiske Hus (Photographer: Svend Christensen)

APPENDIX 04

INTERVIEW WITH THE PRIEST OF SANKT SØRENS KIRKE

Interview with the female priest:
Hi

Hi, as a start we would like to tell you about the project, what it is about.

Thank you.

We are during our last semester of architecture and want to try to make a new church with focus on, materiality, the church's actuality and give the church more functions – yes and we have placed it in gl. Rye – as we like the location, and we think the place is beautiful and the history is interesting.

The matter of if the new church is needed isn't that much of a concern but we still want to know about the town, activities, are there many who use the church. That is the short intro.

Can you tell me who you are? What are your name?

My name is Catharina, I'm the one who you have written with.
My name is Jacob.
And I'm Katrine.

Have you worked together before?

This is the first time

Have you created the group yourselves?

Yes, we have created the group ourselves.

Ok, you have created the group yourselves as you are interested in the topic, church.
And do you have any background or anything for you to choose that topic?

To me it is the history of architecture that I find interesting, and it is a topic who have a lot of history.

I am a part of a family who have used the church a lot and I have been part of a catholic school. So, it has always been part of my life. I also think it is exciting with the materials and how they can influence the modern church.

For me it is something entirely different, as we now have made a lot of other projects as houses and healthcare buildings, so I just think this could be awesome.

Why have you chosen gl. Rye, I'm really curios hearing why? Do you know gl. Rye?

I have been down there a few times and actually brought my boat there. I think it is quite beautiful – the idea of making the last project in a beautiful landscape. The history we have found is also quite interesting. The reformation, the king and all of the unique things that can be read about.

Yes, it is quite interesting – I get you.
Have you watched the website and I can't remember if there are any pictures from before and after the restoration of the church? We have just renovated the church inside. I have been a part of this area for 10 years and then I arrived there were a little crack in the floor close to the altar. You must as the parish church council keep an eye on the church. We measured the crack year by year and it had expanded each time. We have a crypt underneath, and we were afraid that the crypt was sliding away pulling the floor with it, creating that crack. We have a churchwarden who is also an architect, and he is just like the one from old times who looks after the church. He had an idea that in 1929 wires had been placed underneath the floor packed into a metal pipe and that pipe had maybe rust away. He deduced that it should be the case, with the old drawings and a metal detector.

To fix it they removed everything from the church, and by doing so they discovered that under the chancel it was pure earth, no kind of flooring. The kneeler couldn't be brought back as the state was to pour. The architect who did draw the new kneeler proposed to replace some of the other older stuff, so it all looked similar. The benches have been repainted and the foot for the baptismal font was changed and so on. The church got new interior chalk. But that doesn't matter for your project.

We love to hear about that stuff – it is awesome. We have actually been down there to see the church, but it was closed so we looked at it from the outside.

You should have called me.

We are soon coming by again.

Then I shall show you around.

Something we would love to know something about is the parish church council, new Ideas for what could be exciting to do in the church, what are you doing right now and what of whose are new things, are the church being used, so what is happening in and around the church.

Primarily for us the church is used for services, as that is the main function of the church. That also influence how we think about the church. Because for us it is a liturgical utility room. Then we talk about the church's uses besides this, we as a parish church council look at the area, we are placed in to find out what we should offer. We have just used 6 months to look at our parish so that we could get an idea of the different user groups. We are a small parish, so we don't have much money therefore we made it ourselves. How many people, how many is part of the church, demographic – so a kind of description of the parish statistics and so on.

We have also described what kind of resources we have ourselves. You can say that in this parish lives around 2200 people and around 1600 people is part of the church. Approximately 75 %. Actually, it is quite low for the Skanderborg deanery. We are in an area where there some places are around 90 % members of the church. So, what kind of parish are we? Locally we differ from the nearby parishes. We have internally a parish church council with 6 chosen members. In the case of the church there are always minimum 5 members + one for every 500 members above 1000. So, six chosen and the two priest.

Two priest is actually quite much for such a small parish as we only have 75% priest employment but because I'm part of the clergy union as vice president, so I don't not work as much in Gl. Rye church. We have an organist working 20 hours each week and a church musician on a 20-hour workweek and 2 church singers where one is a temporary worker, a choir boy that we share with the other parishes and then a lot of volunteers.

Gl. Ryes population aren't big but we still have all the important organisations as, a kindergarten, a school with 6 classes (most of them continue at Mølle skolen in Ry) and a nursing home, but it has been degraded to a short stay – nursing home, as the stay there are only 3 to 12 weeks with a few who stay there all the time. Then we have a Dagli'Brugs and a lot of associations, like a really big FDF constituency that are 25 years old and Skanderborg Museum who has different locations like Gl. Rye Mølle and Øm Kloster ruin, which is placed in Emborg which is in Gl. Rye parish. Then we look at which kind of parish we are. There is not that many elderly people, because then you live in Gl. Rye you need to be able to transport yourself, as the bus only comes around four times per day. Because even though they have a Dagli'Brugs, we are still in need of other necessities.

The institutions we have in Gl. Rye cannot follow the amount of people who settle in the town, so a lot of the children are going in kindergarten in the nearby towns. The kindergarten which is being built doesn't make space for that many more children, so I do not know what is going to happen. A lot of new families have moved to the town as new buildings are being homes. There are 250 students at gl. Rye school, so there are a lot of children in the town which is a lot compared to the 1600 people in town and there is a lot younger and

older children than the ones in Gl. Rye school. One of the things that you as church should prioritise is the younger crowd as it is a big part of the contingent. We should of course offer something for other groups of people as well, but they shouldn't be prioritised. We have a lot of resourceful and educated people. We have gathered all that knowledge to make sure we offer something for anyone. Many of our activities are for the primary group, as Babysalmesang, where mostly women come by with their baby and a few men and we have actually added one more team because of the popularity.

We have mini confirmands which is for third grade and normal confirmand, but mini confirmands are an offer where the musicians are part of it and us the priests mostly comes as guest. There are a lot of associations so we really try to work with them and as an example, we are having two annually events with them, one is a service where the children are making the content, it's called busk service and then we have a new year eve service with torchlight procession from the church. We always try to include the young, so we have a choir for kids and sometimes we have displays for young families where we have invited a theatre or made a concert for kids.

How does the kid services vary from normal services?

We can also have the young choir with us to normal services, but it doesn't differ the act. Services for kids are completely different and we are actually having one next Thursday. It starts by having anyone standing on the floor, jumping around singing the hello song and then the kid choir is teaching the young families some songs before we all sing them together. I tell a story, this time it's about easter. We are going to hide glass pearls around the church and then the kids are going to have a treasure hunt. Under the busk service they have been stomping and a lot of other crazy things. We really want to listen to the ones who partakes and are using their ideas now and then – we are quite open.

It is quite interesting to listen to how the church room is being used. You can begin to imagine that the room needs to differ then being used for different purposes or events. It is quite funny to hear how it all is happening.

Another thing we also offer, this is for the adults, we have concerts as the reverberations and the orgel is quite good. Sometimes we have a choir visiting us and we have the room for them. They can perform both in the back or front, as it is quite wide in the front, which can differ in churches.

Other activities in the parish includes a lecture society that we collaborate with. Yesterday Peter Viggo Rasmussen visited us, maybe you know him, its him from the national defence, and he visited us because of the one-year anniversary of the war in Ukraine and analysed the conflict. And that is some of those things that happens in relation to the church, we have 4-6 lectures annually. And this is also part of the accommodation of all the well-educated people, who wants to hear this stuff and it is well visited. We have a lot of song evenings. A song café is held the first Thursday each month sometimes it is held in the church and other times in the parish house. It is an informally concept and it is between 19:30 and 21:30, where we sing, and you can come 19:30 and be part of all of it – or just come later and take part in what is happening at that hour. It is a more informally concept where we sing, drink tea and coffee.

Then we have study circles and that is not held in the church or sometimes it has been. This year it was a study circle which were about the book series that is called "Kristendommen ifølge" which is written by several writers and culture personalities who write about their relation to the church. The consensus it that we meet and discuss different books. Sometimes it had been bible study circles, every winter we have a study circle or a room of wonder.
As said, we have a lot of associations that we try to meet to some extent. In Gl. Rye we have something called "uge 30" which is a quite fun concept. We have an event manager in the town, and she is an educated experience economist and is really good. She creates an environment where everyone partakes in planning different things. She has created the idea of a Gl. Rye week where anyone have the opportunity to contribute. Some are opening up for the use of their trampoline where people can come and jump upon that and in the church, we have postal run at the graveyard and discussion forums for adults, concerts in the nave, tours where we talk about the church's history. Some have also been giving concerts – that have sometimes been in their living room or in borrowed rooms that is made for that purpose. The ones who want to, have the possibility to create a small event of their own in that week. You just announce what you are offering, the time and place. There are communal dining, stalls and flea markets – all sorts of stuff. It is really fun and Dagli' Brugsen is serving beer and sausages. We have a website where people can offer their activities, and all of this is happening at week 30. This is quite fun and of course the church does also participate.

What about your parish house is that also something you use for activities like a knitting club?

We have different associations that loan the house for different purposes, we have a knitting club where some ladies meet every second week and sits and knit hats for the children at Skejby. Sweater for people who may freeze and all sorts of knit. We have an art association that is housed in the parish house making sure the exhibitions change. They have meetings and other activities as well. We have a sew group, yesterday the gymnastic association had a meeting for the instructors, sometimes the towns nature foundation is having their meetings in the parish house. The only thing that isn't allowed is commercial use of the building. If there is a free spot in the house, then we loan it to private people or associations.

Of course we are using the building ourselves very much so it a balance. We have a gospel choir which are also using the parish house. They are here every Tuesday and also in the church and they are 35 so that is a quite big choir.

Do you have an approximate number of how many activities is held in the church annually? Do you have any statistics or number about that?

I will try to calculate that.

It is something that is written about in the parish analysis.

I don't think any numbers is written in the report, but I will try to calculate it lightning fast. Is it with or without services?

Without.

There are around 3-4 activities per month. More activities in the winter months as it is a bit quieter in the summer. Sometimes we have a week, where Tuesday, Whensday and Thursday are booked for activities.

We have been looking at the Gl. Ryes facebook site and learned that there is a need for a new common house. There have been some posts asking for which purposes it was needed for. A group of chosen people have

searched for possible places in the town to become the new common house and one of those places were the church's parish house. That building wasn't a possibility because of the lack of space and restrictions from the church. For a few moments ago you said that the church was open for private events, but that contradict the information gathered by the search team. So that is a bit confusing?

I have been here for 10 years, and I think this is the third time that there have been looked into finding a place for a common house and every time existing buildings are looked into. We have a circuit house for FDF, parish house, gymnastic clubhouse, we have a mill which is owned by Skanderborg municipality but is still used by the town for events, like the lectures that is streamed from Aarhus university and we have a school where there is a very big sports hall, a big library, school club and a SFO which you can loan for stuff. So, it is not places that we need, maybe it is seven years ago, then we had "fælleshuset" which was a really fun place, this was a place like week 30, as if someone wanted to create something they could offer it and do it in that building. "Fælleshuset" was in an antic store which were using the old dairy building. Later the building was torn down. At that time, we were talking at the founding meeting to make use of the existing places like the parish house and what made it a problem or what makes it hard is that we have confirmation, mini confirmation, babysalmesang, bible meetings, parish church council, study circles, song evenings. We have a line of activities that we make and are open for everyone if you are part of the age group, so we have a lot of things that is happening and that intervene if you want a place where you can just drop in and drink a cup of coffee. You are always welcome, but you cannot stay here while... The dream of Gl. Rye is to find a culture house which is a common ground for the whole town, where there isn't anything beforehand. Do you follow me? The parish house can of course be used but minus the activities that are already there. Besides the activities that I already mentioned other people are also using the parish house. Is is really hard to fit into that framework. It is also a workplace for our organ musician and the ones who work in administration. Right now, there is a thing called "Bageriets venner" we have had since fall, a self-established bakery but unfortunately it isn't running anymore because of the energy prices. This has opened up again for the establishment of a common place in the bakery.

We have had a common workspace called transistor whom Louise I talked about before who is an experience economist started as an office community, but it is for some reason not there anymore. Some of the reasons is the economy as it isn't free to have such place and the old common house, which was quite fun, did have so many activities that the council couldn't keep up. They couldn't gather the necessary money for it to run even through people willingly donated money. It was still hard – economy is just everything. I haven't been part of the last meetings around the bakery but they are talking about regulations and some of the people who are part of it were also part of "fælleshuset" so they take past experiences into account. The dream is to get a open place which isn't bound by anything else than being a common house. Some of the conversations we had was that we could reshape some of the activities like we do also have common dinner here at the church and the school has a large hall they could use, as it is room with space for a lot of people. So why do we need a new place? Then I remember all the artsy people wanted a place where you can hit a nail in the wall and right that isn't possible in the parish house, we wouldn't want that. So of course, it is a place for all of us, so it needs to fit into the framework, so even through you want to hit seven nails into the wall you can't even though I understand the need. There is some restrictions. Does it make sense?

We understand. We can see that Griff is having some meetings about using there clubhouse.

Griff actually has some funds and has a clubhouse, that how do you say it, it is a part of the town. It is a place that stands quite still because of the lack of activities. There are some good people at Griff who tries to make this happen, but we could also use a place that is more for young people. Where do our young people go? The young people we have that are studying at Silkeborg or Skanderborg gymnasium and the older school kids who do not know where to meet and do stuff, so they are meeting outside and some people are mad because of the sound they make, so it would really be nice if a place for them were made.

Can I ask you something in relation to your project. We were some who talked a lot then we were renovating the church in relation to the nave. It's about the architecture then renovating a church room because one thing is the activities that happens in the room and another thing is that it is a liturgical utility room. And the interior design of a liturgical room is about the pulpit, baptismal font and altar ... and kneeler even though the kneeler isn't necessary. You can consider Gellerup kirke as have they placed points in the floor, so you stand in some kind of oval. Ohh you disappeared again.
Do you think about how it perform as it is also a liturgical room?

That is what we need to find a solution to, we are thinking about making it more transformative, as it should fit the different activities but there is some framework that you cannot fiddle with as we don't want to remove the feeling of entering a church. It is a tough exercise.

What do you solve? What can you solve? Because Ben Flemming Nielsen has written about the church rooms spell. And that is what you talk about Katrine, that you get that feeling then you enter a church's room, that you are met by something else. There is something that is bigger than yourself. Even atheist acknowledge that it is a different room. We feel it at once, the ceiling height is taller than other rooms. There is something with the acoustics. There is something about the direction of the room – it is directed towards the altar – a natural centre point. Usually you have a cross, Christ. We feel the sense of direction. That is exciting... We talked a lot. We had some opportunities. We talked with the architect about the kneeler – should we have one, should it be mobile so we could move it. We chose to have a permanently installed kneeler – maybe it wasn't the right decision, but we did that because, we could have made a device so we could fasten it, you do that in some churches, to the floor. Then it is mobile if you want room to a big choir or whatever you want. We chose a permanently installed kneeler because the room shall also resist against what we want to do with it. Maybe that sounds tricky, but it is a way to keep the rooms otherness in relation to us. We cannot change it completely to our liking, we can do stuff in the room that it isn't made. In another way may a church room should be a resistance that interact with us then we enter. We chose to keep that type of room, but because the room is as big as it is we are not having any problems with space for big choirs, services for kids. I acknowledge fully that if you enter a room where those possibilities are narrowed, then maybe it is a good idea. It is just to give you some insights in some of the architecture then you are working with a liturgical room. What does it do to us being in a permanently installed room where you say that the intention with this room is services. We behave differently if we feel as visitors. We acknowledge by doing this that it is primally a service room. This is just to give you inspiration to how you can

think about the church room.

It is an exciting angle to let the room decide somethings instead of the people using it. We have looked at the history of the church where...

An example could be the reformation where the benches entered the room, that is one of those things that changed the room of the church. This changed the equality which also fits the theological thoughts at the time. Then all are sitting down, as it before only were the owner or highly decorated people who sat down, on a small box or something. Then after the reformation people weren't preoccupied with the hierarchical and suddenly everyone is getting a place to sit, but what does it do to us then we are sitting down. You can consider what it means solely liturgical, what is happening then you are standing, then we sit, what does it express? You can also play with a church room without benches if you want to challenge the body, the bodily expression. There is a lot of considerations.

We have looked nto a lot of case studies where people are beginning to look into how the chuch inventory can change or be changeable towards different services or church activities. So how much can you challenge it? Can you have communal dining in the church hall or?

Do you know that they are already doing it in relation to Maundy Thursday even though it is sterilized. I want to point at a place, the Danish church in Toronto. They have just had a renovation where they chose to replace the benches with chairs because they now are using the church for the annually Bazaar. That is a mundane activity and that have been a big discussing in their parish church council. It is just to give you some examples of possible directions, like what you have talked about.

We were in Ravnbjergskirke in Aarhus and in that church the altar was placed in the middle, which were a new thing for me and what I have experienced. We are witnessing new things that showcase different ways to set up the church room. That makes us think about how locked are the set up? Is it still possible to get the same feeling without having to place the furniture's at the exact locations? It quite interesting that you tell us about some of the alternative set ups that are already in use.

I would also tell you one more thing. Do you know invar Kronhammer created a project to Årsted kirke. It is not a project that was realised, as the parish church council wasn't interested. Where were a really big resistance to the project and the reason was that Kronhammer and the architect created a whole new church room. Their thought was to empty the whole room and then they created an art installation, but it was more than an installation because Kronhammer was quite interested in the relation between the liturgical and services. They created a very interesting project that I think you can find if you search for Kronhammer and Årsted kirke. But where were one of Kronhammers thoughts that you shall not go on a straight path towards the altar. It is just to talk to you about lines, a moment ago I mentioned that then you enter the church then you have a directness towards the altar immediately. He thought that you should showcase with the architecture that you aren't equal to god. You entered a bit from the side, he made some offset paths in the room. It was quite interesting, so you did not walk upon the axis but a bit offset, but the closer you got to the altar you would end up walking upon the axis towards the altar. He is dead now, but I have listened to him, and I have talked with him about the Årsted project and it is really interesting as it is from a theological viewpoint that god's mightiness isn't something that we are equal to. This is an example for you to remember the use of the room then you are creating your project. Niels Bjørn Poulsen have written about it, the architect that worked with Ingwar Kronhammer. I think he did write some articles about it.

We have been gathering a lot of knowledge but soon we are going to draw and write about it all, so if you should give us some wished you have for the church what would they be? Do you have some small issues that annoy you, things that could have been solved better.

On a low practicality, we are in need of storage, waiting room to baptism families. We only have a porch and the church room, but there is not a sacristy or waiting room where you can take care of your baby or where you could enter with an impossible 3-year-old. We only have the porch that we are warming up and then our verger is handing out juice to smaller children, but that is something that if I was drawing a Church room, then I would remember that it should also be able to handle things like that. I have talked a lot about the liturgical, but the practical is also important. Great conditions are also important, a toilet or a small kitchen would be nice. We are talking a lot with the personal then things are troublesome, like that we need to carry water. We have cans of water just to wash the cups. You do maybe not notice that as a member but then the verger is handling water and stuff afterwards.

As aspiring architects I want to tell you something, that one thing is the aesthetics but another thing is the practical stuff. Storage is of great importance, like where to put loose chairs that we use for the bride and gorm, right now they are placed in our stone-cold chapel, but that means they aren't made of wood as there would grow mold. Does it make sense?

We have visited some different churches where some churches have become church-centres, in your case it is dissembled making it less easy to move around.

It is quite interesting then you look at the architecture history, as in the 60'es and 70'es, people were very preoccupied with the church stopping being solemn, in that time the singularisation were quite big and people had an expectation that the time of the church were finished, it would fade more and more with time and then close. You can watch movies from the 60'ties that shows that if you turn left you arrives to Bilka or if you turn right you arrive at the church. That is an expression of the "nivellering" and then later a second wave arrived in the 90'ties where Henning Larsens Enghøj church, a procession church, just like the old churches from... where you get a very big driveway to the church and that arrival follows through the church room and that is quite different... Again the question about loose chairs or benches, what do you want to signal with the church room. The church room always mirror a theology, a sign of what kind of god you express with that room you create as those things are connected.

Thank you Iben, it was quite interesting!

It is a quite fun and interesting project.

APPENDIX 05

24 h average, church room

Description of the room

Constructions towards outdoors

Nr	Surface	A m²	U W/m²K	Bu W/K	
1	Outerwall South	414,00	0,12	49,68	
2	East	54,00	0,12	6,48	
3			0,12	0,00	
4			0,12	0,00	
5				0,00	
	Total	468,00		56,16	= Bu,con

Windows towards outdoors

Nr	Surface	Number stk	A m²	U W/m²K	Bu W/K	Orient degree	Inclination 90/45/0	g-value [-]	f(beta) [-]	f(shade) [-]	f(shadow) [-]	f(glass) [-]	Fsun [-]
1	Window N	0			0,00								0,00
2	Window S	5	5,00	1,40	35,00	180	90	0,63	0,90	1,00	0,90	0,80	0,41
3	Window E	0			0,00								0,00
4	Window W	0			0,00								0,00
5					0,00								0,00
	Total	5	5,00		35,00	= Bu,win							
Total specific heat loss towards outdoors, Bt					91,16	= Bt = Bu,con+Bu,win							

Constructions towards ground and surrounding rooms

Nr	Surface	A m²	U W/m²K	Br W/K	tr °C	Br*tr W	
1	Inner wall North	400,00	0,22	88,00		0,00	
2	West	251,00	0,22	55,22		0,00	
3				0,00		0,00	
4				0,00		0,00	
5				0,00		0,00	
	Total	651		143,22		0,00	=S Br*tr
Total specific heat loss towards ground and surrounding rooms				143,22	= Br		

Ground temperature for area chosen under destination in "internal heat gains"
7,6 °C

Ventilation

	Type	Air change h⁻¹	Room volu m³	Air flow m³/s	Density kg/m³	Heat kap. J/kgK	BL W/K
1	Ventilation	2,30	46,20	0,030	1,2	1006	35,63
2	Infiltration	0,10	46,20	0,001	1,2	1006	1,55
	Total	2,4		0,031			37,18
Total specific heat loss for ventilation, BL							37,18 = BL

Control
Total air flow
litre pr. m² floorarea
0,1

Heat accumulation

	Choose heat accumulation	Therm. cap W/K pr m²	Floor area m²	Ba W/K	Description of chosen inner structure
1	Medium heavy	11	303,00	3333,00	Several heavy structures, e.g. concrete slabs with clinker and brick or clinker concrete walls.
Samlet specifik varmeakkumulering Ba				3333,00 = Ba	

Internal heat loads

Project:
0
Internal heat loads

Time	Personbelast W	Belysning W	Andet W	Sum W	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	65	0	65	
9	150	100	100	350	
10	150	100	100	350	
11	150	100	100	350	
12	150	100	100	350	
13	150	100	100	350	
14	150	100	100	350	
15	150	100	100	350	
16	150	100	100	350	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
Sum	1200	865	800	2865	
Middelværdi	50	36	33	119	=Fi
Max. timeværdi	150	100	100	350	=Fimax
Min. timeværdi	0	0	0	0	=Fimin

Pr. m² gulvareal	Personbelast W/m²	Belysning W/m²	Andet W/m²	Sum W/m²
Middelværdi	0,17	0,12	0,11	0,39
Max. timeværdi	0,50	0,33	0,33	1,16
Min. timeværdi	0,00	0,00	0,00	0,00

External loads
Choose destination
Copenhagen

Choose month
June

Outdoor temp: 24-hour a	20	°C	= tu
variation	12	°C	= Dtu

Solar gain windows	Area m2	Orientation degree	Inclination degree	Fsun [-]	Fs W	Fsmax W
1	0,00	0	0	0,00	0	0
2	25,00	180	90	0,41	2111	7073
3	0,00	0	0	0,00	0	0
4	0,00	0	0	0,00	0	0
5	0,00	0	0	0,00	0	0
Total solar gain in room					2111	7073

Help for internal loads

Heat from persons:	Activity lev met	Total W/person	Sensible he W/person	Number of	Sensible, total W
	1,2	118	76	100	7616

Ligthing: general	Level: lux	Incandesce W/m² g.a.	fluorescent W/m² g.a.	Lowenergy W/m² g.a.	Choose pov W/m² g.a.	Ligthing i alt W
	100	26	8	4	8	2424

Results

Project:
0

Choosen month:	June	tu =	20	°C

If the ventlation air has same temperature as outdoor air			
24-hour average	ti =	17,7	°C
Temperature variation	Dti =	1,6	°C
Max. Temperature	timax =	18,5	°C

$$t_i = \frac{B_t t_u + \sum B_r t_r + B_L t_L + \Phi_i + \Phi_s}{B_t + \sum B_r + B_L}$$

$$\Delta t_i = t_{imax} - t_{imin} = \frac{\Delta \Phi_K}{B_t + \sum B_r + B_L + B_{akk}}$$

$$\Delta \Phi_k = \Delta \Phi_{k1} + \Delta \Phi_{k2}$$

$$\Delta \Phi_{k1} = \frac{2}{3}[(\Phi_i + \Phi_s)_{max} - \Phi_{i,min}]$$

$$\Delta \Phi_{k2} = \Delta t_u (B_{u,vin} + B_L)$$

Additional calculations

If the ventilation air has the same temperature as the outdoor 24-hour average temperature			
24-hour average	ti =	17,7	°C
Temperature variation	Dti =	1,5	°C
Max. Temperature	timax =	18,4	°C

Calculation where the ventilation air has a constant inlet temperature which is Dt =			2 °C lower than the outdoor 24-hour average temperature
If the ventilation air has a constant temperature of		18 °C	
24-hour average	ti =	17,4 °C	
Temperature variation	Dti =	1,5 °C	
Max. Temperature	timax =	18,1 °C	

APPENDIX 06

24 h average, assembly room

Description of the room

Constructions towards outdoors

Nr	Surface	A m²	U W/m²K	Bu W/K	
1	Outerwall South	135,00	0,12	16,20	
2	East	33,00	0,12	3,96	
3			0,12	0,00	
4			0,12	0,00	
5				0,00	
	Total	168,00		20,16	= Bu,con

Windows towards outdoors

Nr	Surface	Number stk	A m²	U W/m²K	Bu W/K	Orient degree	Inclination 90/45/0	g-value [-]	f(beta) [-]	f(shade) [-]	f(shadow [-]	f(glass) [-]	Fsun [-]
1	Window N	0			0,00								0,00
2	Window S	3	4,00	1,40	16,80	180	90	0,63	0,90	1,00	0,90	0,80	0,41
3	Window E	1	4,00	1,40	5,60	90	90	0,63	0,90	1,00	0,90	0,80	0,41
4	Window W	0			0,00								0,00
5					0,00								0,00
	Total	4	8,00		22,40	= Bu,win							
Total specific heat loss towards outdoors, Bt					42,56	= Bt = Bu,con+Bu,win							

Constructions towards ground and surrounding rooms

Nr	Surface	A m²	U W/m²K	Br W/K	tr °C	Br*tr W	
1	Inner wall North	135,00	0,22	29,70		0,00	
2	West	33,00	0,22	7,26		0,00	
3				0,00		0,00	
4				0,00		0,00	
5				0,00		0,00	
	Total	168		36,96		0,00	=S Br*tr
Total specific heat loss towards ground and surrounding rooms, B				36,96	= Br		

Ground temperature for area chosen under destination in "internal heat gains"
7,6 °C

Ventilation

	Type	Air change h⁻¹	Room volur m³	Air flow m³/s	Density kg/m³	Heat kap. J/kgK	BL W/K	
1	Ventilation	2,30	46,20	0,030	1,2	1006	35,63	
2	Infiltration	0,10	46,20	0,001	1,2	1006	1,55	
	Total	2,4		0,031			37,18	
Total specific heat loss for ventilation, BL							37,18	= BL

Control
Total air flow
litre pr. m² floorarea
0,1

Heat accumulation

	Choose heat accumulation	Therm. cap W/K pr m²	Floor area m²	Ba W/K
1	Medium heavy	11	303,00	3333,00
Samlet specifik varmeakkumulering Ba				3333,00 = Ba

Description of chosen inner structure
Several heavy structures, e.g. concrete slabs with clinker and brick or clinker concrete walls.

Internal heat loads

Project:
0
Internal heat loads

Time	Personbelast W	Belysning W	Andet W	Sum W	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	0	0	
8	0	65	0	65	
9	150	100	100	350	
10	150	100	100	350	
11	150	100	100	350	
12	150	100	100	350	
13	150	100	100	350	
14	150	100	100	350	
15	150	100	100	350	
16	150	100	100	350	
17	0	0	0	0	
18	0	0	0	0	
19	0	0	0	0	
20	0	0	0	0	
21	0	0	0	0	
22	0	0	0	0	
23	0	0	0	0	
24	0	0	0	0	
Sum	1200	865	800	2865	
Middelværdi	50	36	33	119	=Fi
Max. timeværdi	150	100	100	350	=Fimax
Min. timeværdi	0	0	0	0	=Fimin

Pr. m² gulvareal	Personbelast W/m²	Belysning W/m²	Andet W/m²	Sum W/m²
Middelværdi	0,17	0,12	0,11	0,39
Max. timeværdi	0,50	0,33	0,33	1,16
Min. timeværdi	0,00	0,00	0,00	0,00

External loads

Choose destination
Copenhagen

Choose month
June

Outdoor temp: 24-hour a	20	°C	= tu
variation	12	°C	= Dtu

Solar gain windows	Area m2	Orientation degree	Inclination degree	Fsun [-]	Fs W	Fsmax W
1	0,00	0	0	0,00	0	0
2	12,00	180	90	0,41	1013	3395
3	4,00	90	90	0,41	355	1424
4	0,00	0	0	0,00	0	0
5	0,00	0	0	0,00	0	0
Total solar gain in room					1368	4819

Help for internal loads

Heat from persons:	Activity lev met	Total W/person	Sensible he W/person	Number of	Sensible, total W
	1,2	118	76	50	3808

Ligthing: general	Level: lux	Incandesce W/m² g.a.	fluorescent W/m² g.a.	Lowenergy W/m² g.a.	Choose pov W/m² g.a.	Ligthing i alt W
	100	26	8	4	8	2424

Drawing folder

Skovlund Kirke

Church in Gl. Rye – Skanderborg

Architecture and Design
May 2023, Aalborg University

Group 14
Catharina Møller Mulbjerg
Jacob Maribo Hjære Hansen
Katrine Pedersen

Content

Skovlund Kirkevej

Skovlund Kirkevej

Foot path

0 15m 30m

Masterplan 1/500
Paper size A3

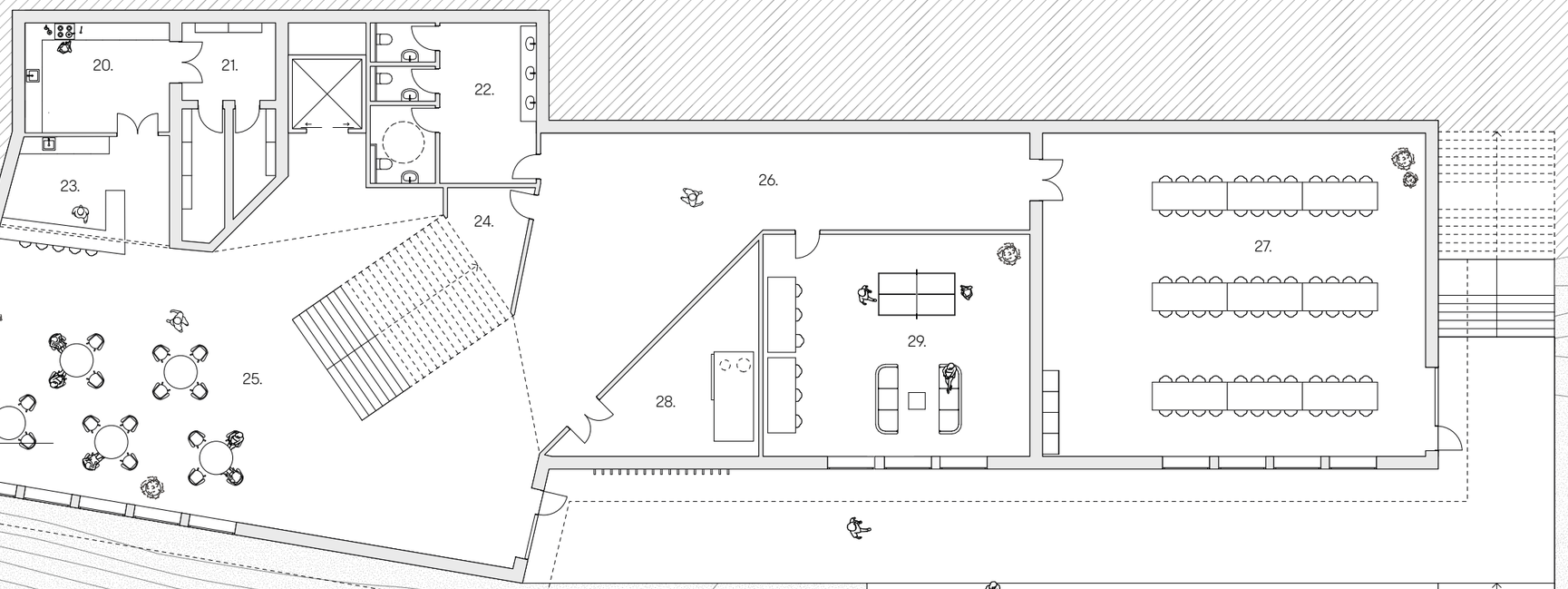
Church tower

Terrace

1. Foyer	249,8 m²
2. Church room	256,3 m²
3. Children's room	22,3 m²
4. Baptism and marrige room	26,6 m²
5. Technical room	18,7 m²
6. Storage room	41,3 m²
7. Sacristy	23,2 m²
8. Wardrobe	14,5 m²
9. AV room	4,7 m²
10. Waste seperation toom	12,7 m²
11. Print and copy room	13,2 m²
12. Office	17,7 m²
13. Office	17,7 m²
14. Office	17,7 m²
15. Corridor	27,8 m²
16. Cleaning room	10,9 m²
17. Staff wardrobe	15,7 m²
18. Technical room	18,8 m²
19. Toilets	23,2 m²
	(net areas)

0 6m 12m

Ground floor 1/200
Paper size A3



20. Kitchen	23 m²
21. Cold rooms and storage	23,7 m²
22. Toilets	34,5 m²
23. Bar	17,7 m²
24. Storage	20,3 m²
25. Lounge	216,4 m²
26. Corridor	98,3 m²
27. Assembly room	160,1 m²
28. Technical room	30,2 m²
29. Youth assembly room	76,6 m²
	(net areas)
Church tower	34,7 m²
Terrace	299,2 m²
Total net area	**1533,6 m²**
Total gross area	**1708 m²**

0 6m 12m

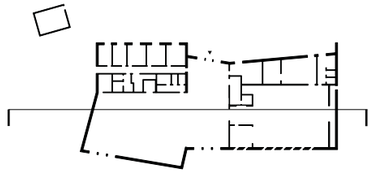
Basement 1/200
Paper size A3

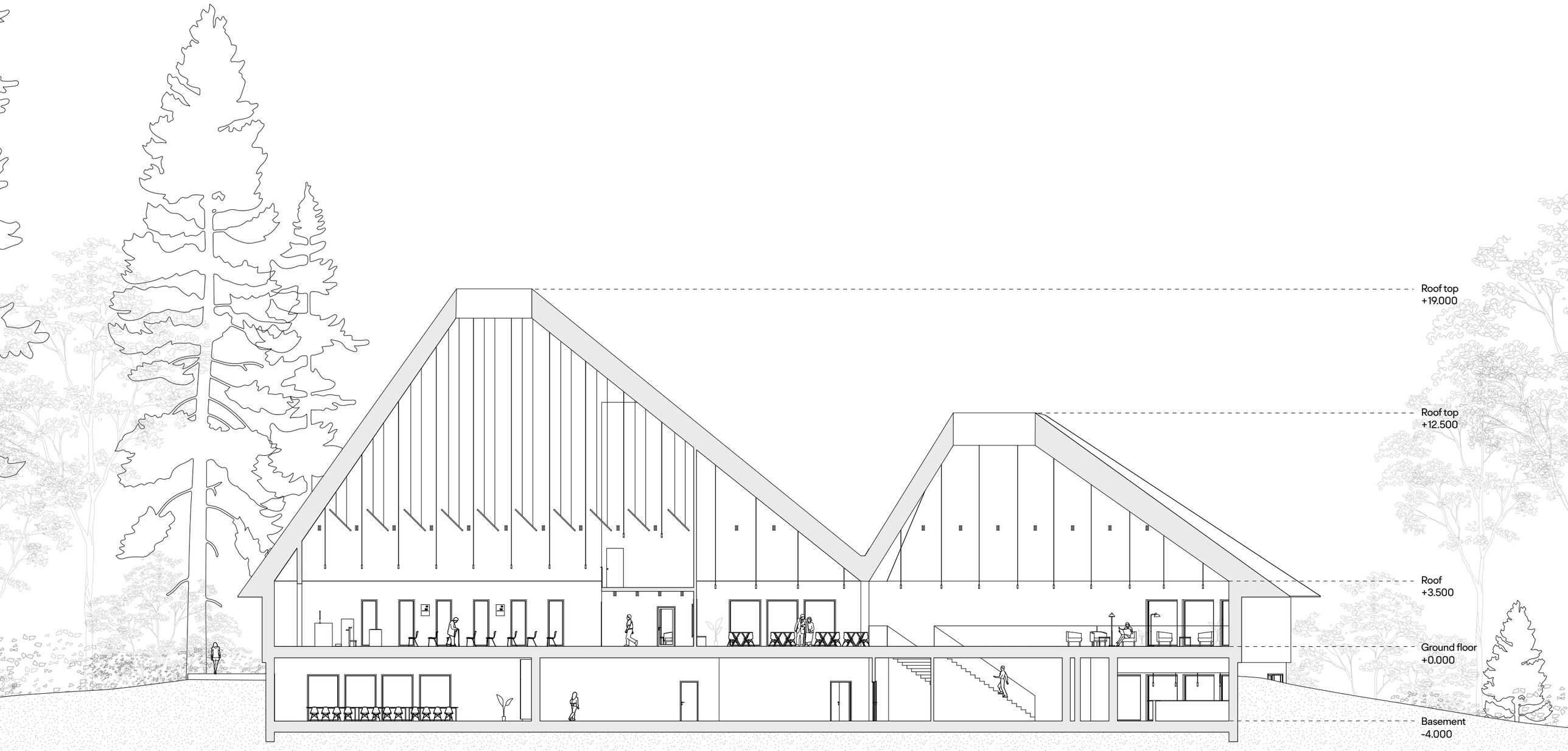
North facade 1/200
Paper size A3

South facade 1/200
Paper size A3

East facade 1/200
Paper size A3

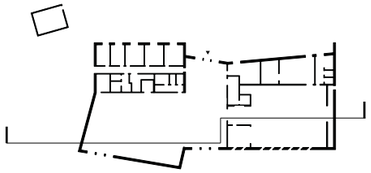
West facade 1/200
Paper size A3





0 6m 12m

Section AA 1/200
Paper size A3



Roof top
+29.000

Roof top
+19.000

Roof top
+12.500

Roof
+3.500

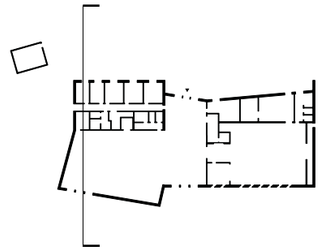
Ground floor
+0.000

Basement
-4.000

0 6m 12m

Section BB 1/200
Paper size A3

Section CC 1/200
Paper size A3



Roof top
+19.000

Roof top
+12.500

Roof
+3.500

Ground floor
+0.000

Basement
-4.000

0 6m 12m

Section DD 1/200
Paper size A3